CANADIAN STANDARDS ASSOCIATION

B51-09

Boiler, pressure vessel, and pressure piping code

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

Affranchir suffisamment

Place Stamp Here

ASSOCIATION CANADIENNE DE NORMALISATION
BUREAU CENTRAL DE L'INFORMATION
5060, SPECTRUM WAY, BUREAU 100
MISSISSAUGA ON L4W 5N6
CANADA

CANADIAN STANDARDS ASSOCIATION
CONSOLIDATED MAILING LIST
5060 SPECTRUM WAY, SUITE 100
MISSISSAUGA ON L4W 5N6
CANADA

CSA Standard

B51-09
Boiler, pressure vessel, and pressure piping code

CANADIAN STANDARDS ASSOCIATION

Published in January 2009 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

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*** *or call toll-free 1-800-463-6727 or 416-747-4044.*

ISBN 978-1-55436-733-7

Technical Editor: *Totaram (Jeet) Tulshi*

Contents

Figures

B51-09, Part 2, *High-pressure cylinders for the on-board storage of natural gas and hydrogen as fuels for automotive vehicles*

Technical Committee on Boilers and Pressure Vessels

C. Turylo	Technical Standards & Safety Authority, Toronto, Ontario	*Chair*
M. Newlands	Steel Fab, Oakville, Ontario	*Vice-Chair*
J. Adams	Sleegers Engineered Products, London, Ontario	
R. Barnes	ANRIC Enterprises Inc., Toronto, Ontario	
E. Bergshoeff	Hager Industries Inc., Burlington, Ontario	
A. Blahoianu	Canadian Nuclear Safety Commission, Ottawa, Ontario	
M. Blanchet	Gaz Métro, Montréal, Québec	*Associate*
J. Cairns	CSA America, Independence, Ohio, USA	*Associate*
R. Cavan	Human Resources and Social Development Canada, Ottawa, Ontario	
T. Clark	All-Weld Company Limited, Toronto, Ontario	
P. Dodge	Nova Scotia Department of Environment and Labour, Halifax, Nova Scotia	
S. Donovan	Government of the Northwest Territories, Yellowknife, Northwest Territories	
D. Eastman	Government of Newfoundland and Labrador, St. John's, Newfoundland and Labrador	
G. Ferrero	British Columbia Safety Authority, Nanaimo, British Columbia	
J. Graham	Babcock & Wilcox Canada Ltd., Cambridge, Ontario	
W. Grant	Canadian Nuclear Safety Commission, Ottawa, Ontario	*Associate*
R. Graves	Saskatoon Boiler Mfg. Co. Ltd., Saskatoon, Saskatchewan	

K. Greenwood	Praxair Canada Inc., Mississauga, Ontario	
A. Hantelmann	Alberta Municipal Affairs, Edmonton, Alberta	*Associate*
Y. Huang	Royal & SunAlliance Insurance Company of Canada, Toronto, Ontario	
T. Huynh	Miura Boiler Company Limited, Brantford, Ontario	*Associate*
K. Hynes	Prince Edward Island Department of Community and Cultural Affairs, Charlottetown, Prince Edward Island	
M. Jamieson	Imperial Oil Limited, Dartmouth, Nova Scotia	
S. Katz	S. Katz and Associates Inc., North Vancouver, British Columbia	
R. Kauling	General Motors of Canada Limited, Oshawa, Ontario	
M. Kotb	Régie du bâtiment du Québec, Montréal, Québec	
B. Krasiun	Saskatchewan Corrections and Public Safety, Regina, Saskatchewan	
K. Lau	ABSA, Edmonton, Alberta	
K. Le Van	Air Liquide Canada Inc., Montréal, Québec	
R. Martin	Technical Standards & Safety Authority, Toronto, Ontario	*Associate*
J. McMillan	ALSTOM Canada Inc., Gloucester, Ontario	*Associate*
B. McWhirter	ABSA, Edmonton, Alberta	*Associate*
P. Molvie	Cleaver-Brooks Incorporated, Milwaukee, Wisconsin, USA	*Associate*
A. Park	Compressed Gas Association, Ottawa, Ontario	
M. Premovic	Premovic & Associates, Toronto, Ontario	*Associate*

D. Price	Government of Yukon, Whitehorse, Yukon	
H. Prits	Cimco Refrigeration, Toronto, Ontario	
C. Raczynski	Ontario Power Generation Inc., Pickering, Ontario	
T. Rieger	Manitoba Department of Labour and Immigration, Winnipeg, Manitoba	
D. Ross	New Brunswick Department of Public Safety, Fredericton, New Brunswick	
V. Sage	General Motors of Canada Limited, Oshawa, Ontario	*Associate*
T. Slimmon	Slimmon Consulting Services Ltd., Calgary, Alberta	
C. Smith	Boilersmith Ltd., Seaforth, Ontario	*Associate*
L. Smith	L & S Engineering, Guelph, Ontario	*Associate*
W. Spekkens	SPEKQUALTEK Inc., Chute-à-Blondeau, Ontario	
R. Sproston	Boiler Inspection & Insurance Company of Canada, Toronto, Ontario	*Associate*
P. Sterescu	Boiler Inspection & Insurance Company of Canada, Toronto, Ontario	
H. Sturm	Charles G. Turner & Associates Limited, Toronto, Ontario	*Associate*
I. Svorinic	British Columbia Safety Authority, New Westminster, British Columbia	*Associate*
D. Tanner	National Board of Boiler and Pressure Vessel Inspectors, Columbus, Ohio, USA	
G. Walker	NATCO Canada, Calgary, Alberta	
C. Webster	Powertech Labs Inc., Surrey, British Columbia	*Associate*
J. Weiss	Acuren Group, Inc., Edmonton, Alberta	
N. White	Charonic Canada Inc., Belleville, Ontario	*Associate*

S. Wills	Foster Wheeler Limited, Niagara-on-the-Lake, Ontario	
C. Wolfe	Nunavut Department of Community and Government Services, Iqaluit, Nunavut	
R. Wolfe	West Hill, Ontario	*Associate*
P. Yeung	ABSA, Edmonton, Alberta	*Associate*
J. Zirnhelt	Acuren Group, Inc., Oakville, Ontario	
T. Tulshi	Canadian Standards Association, Mississauga, Ontario	*Project Manager*

Subcommittee on Boilers and Related Components

C. Turylo	Technical Standards & Safety Authority, Toronto, Ontario	*Chair*
G. Adgey	Clayton Sales and Service Ltd., Brampton, Ontario	
J. Graham	Babcock & Wilcox Canada Ltd., Cambridge, Ontario	
R. Graves	Saskatoon Boiler Mfg. Co. Ltd., Saskatoon, Saskatchewan	
T. Huynh	Miura Boiler Company Limited, Brantford, Ontario	
P. Molvie	Cleaver-Brooks Incorporated, Milwaukee, Wisconsin, USA	
C. Smith	Boilersmith Ltd., Seaforth, Ontario	
R. Sproston	Boiler Inspection & Insurance Company of Canada, Toronto, Ontario	
H. Sturm	Charles G. Turner & Associates Limited, Toronto, Ontario	

Subcommittee on Clauses 4, 5, 8, and 11 and Annexes D and H of Part 1 of CSA B51

B. McWhirter	ABSA, Edmonton, Alberta	*Chair*
E. Bergshoeff	Hager Industries Inc., Burlington, Ontario	
K. Greenwood	Praxair Canada Inc., Mississauga, Ontario	
H. Klaver	British Columbia Safety Authority, New Westminster, British Columbia	
K. Le Van	Air Liquide Canada Inc., Montréal, Québec	
C. Selinger	Saskatchewan Ministry of Corrections, Public Safety and Policing, Regina, Saskatchewan	
M. St-Georges	Régie du bâtiment du Québec, Montréal, Québec	
C. Turylo	Technical Standards & Safety Authority, Toronto, Ontario	

Subcommittee on Parts 2 and 3 of CSA B51

S. Katz	S. Katz and Associates Inc., North Vancouver, British Columbia	*Chair*
C. Webster	Powertech Labs Inc., Surrey, British Columbia	*Secretary*
A. Beregszazy	Natural Resources Canada, Ottawa, Ontario	
D. Davis	Transport Canada, Ottawa, Ontario	
J. Dimmick	Pressed Steel Tank Company, Inc., West Allis, Wisconsin, USA	
M. Duncan	Dynetek Industries Ltd., Calgary, Alberta	
A. Ghelesel	BC Gas International Inc., Burnaby, British Columbia	
B. McWhirter	ABSA, Edmonton, Alberta	
N. Newhouse	General Dynamics Armament and Technical Production, Lincoln, Nebraska, USA	
V. Sage	General Motors of Canada Limited, Oshawa, Ontario	
N. Sirosh	Quantum Fuel System Technologies Worldwide Inc., Irvine, California, USA	
M. Tremayne	Enbridge Consumers Gas, Mississauga, Ontario	
C. Turylo	Technical Standards & Safety Authority, Toronto, Ontario	
N. White	Charonic Canada Inc., Belleville, Ontario	

Subcommittee on Pressure Vessels

K. Lau	ABSA, Edmonton, Alberta	*Chair*
J. Adams	Sleegers Engineered Products London, Ontario	
R. Clyne	Alberta Transportation, Calgary, Alberta	
B. Lade	Syncrude Canada Ltd., Fort McMurray, Alberta	
J. Melnick	Sea Jay Engineering Services Ltd., Calgary, Alberta	
J. Seale	Seale Engineering Ltd., Edmonton, Alberta	
S. Yuen	Shell Canada, Calgary, Alberta	

Editorial Subcommittee

B. McWhirter	ABSA, Edmonton, Alberta	*Chair*
M. Kotb	Régie du bâtiment du Québec, Montréal, Québec	
W. Spekkens	SPEKQUALTEK Inc., Chute-à-Blondeau, Ontario	
J. Zirnhelt	Acuren Group, Inc., Oakville, Ontario	

Preface

This is the seventeenth edition of CSA B51, *Boiler, pressure vessel, and pressure piping code*. It supersedes the previous editions published in 2003, 1997, 1995, 1991, 1986, 1981, 1975, 1972, 1969, 1965, 1960, 1957, 1955, 1951, 1945, and 1939.

In keeping with CSA's goal of harmonizing its standards with those of other countries to the greatest extent possible, CSA's Technical Committee on Boilers and Pressure Vessels and its Subcommittees have, in the course of developing this Standard, worked closely with the National Board of Boiler and Pressure Vessel Inspectors in the USA and with The American Society of Mechanical Engineers (ASME) committees responsible for producing the *National Board Inspection Code* and ASME's *Boiler and Pressure Vessel Code.*

There are three parts to this Standard.

Part 1 contains requirements for boilers, pressure vessels, pressure piping, and fittings. It is intended mainly to fulfill two objectives: first, to promote safe design, construction, installation, operation, inspection, testing, and repair practices, and second, to facilitate adoption of uniform requirements by Canadian jurisdictions.

Part 2 contains requirements for high-pressure cylinders for the on-board storage of natural gas, blends of natural gas and hydrogen (hydrogen blends), and hydrogen as fuels for automotive vehicles. It has been harmonized with International Organization for Standardization (ISO) Standard 11439:2000, *Gas cylinders — High pressure cylinders for the on-board storage of natural gas as a fuel for automotive vehicles.* In addition, the CSA Subcommittee responsible for developing Part 2 has consulted with the American National Standards Institute (ANSI) committee responsible for developing ANSI Standard NGV2-2000, *Basic Requirements for Compressed Natural Gas Vehicle (NGV) Fuel Containers,* and the draft *American National Standard/CSA Standard for Compressed Hydrogen Gas Vehicle (HGV) Fuel Containers.* The members of these two committees are dedicated to harmonizing their Standards as far as circumstances allow.

Part 3 contains requirements for compressed natural gas and hydrogen refuelling station pressure piping systems and ground storage vessels. These requirements have been allotted a separate part of the Standard to emphasize the differences between them and the requirements in Part 1, thereby facilitating their application.

This Standard has undergone technical and editorial revisions since the previous edition. The current edition contains all of the revisions published in Update No. 1 to CSA B51-03 and in CSA B51S1-05, *Supplement No. 1 to B51-03*, Boiler, pressure vessel, and pressure piping code. Some of the more noteworthy changes to Part 1 are found in the following clauses:

(a) Clause 4.2.4 (acceptability of fittings manufactured outside Canada);
(b) Clause 4.2.6 (documentation supporting registration or reregistration);
(c) Clause 4.7.3 (new requirement for hot tapping);
(d) Clause 4.8.2(g) (small pressure vessels registered as Category H fittings are exempt from shop inspection);
(e) Clause 4.11 (audit requirements for manufacturers outside of Canada);
(f) Clause 6.3.1.3 (two means for determining the water level for high-pressure steam boilers);
(g) Clause 6.8 (new requirements for welded staybolts); and
(h) Clause 8.2 (fittings used in piping systems need to be registered).

In addition, a new definition of "design pressure" has been added to Parts 1 and 2. There have been no significant changes to Part 3.

The users of this Standard should note that it is a recommendatory document only and does not have the force of law except where it has been officially adopted by a Canadian jurisdiction. Users should also note that adoption does not necessarily mean that the Standard has been adopted unchanged. For example, a jurisdiction may decide to make an informative annex normative.

In addition, owners and users of cylinders designed to the requirements of Part 2 should note that the safe operation of such cylinders requires, first, compliance with the service conditions specified by the manufacturer, and second, use of the cylinders only during the service life specified by the manufacturer. Each cylinder is marked with an expiry date, and owners and users are responsible for ensuring that a cylinder is not used after that date.

The Technical Committee intends to meet periodically to review this Standard and, if necessary, to revise it to meet changing conditions and maintain uniformity of practice throughout Canada.

This Standard was prepared by the Technical Committee on Boilers and Pressure Vessels, under the jurisdiction of the Strategic Steering Committee on Mechanical Industrial Equipment Safety, and has been formally approved by the Technical Committee.

January 2009

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.*

CSA Standard

B51-09, Part 1
General requirements for boilers, pressure vessels, and pressure piping

Published in January 2009 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

B51-09, Part 1
General requirements for boilers, pressure vessels, and pressure piping

1 Scope

1.1
Except as indicated in Clause 1.2, Part 1 of this Standard applies to all boilers, pressure vessels, pressure piping, and fittings, as provided for by the Act (as defined in Clause 3) and identified in Part 1 of this Standard.

Notes:

(1) *It is possible that the size limitations specified in provincial or territorial statutes or regulations will differ from those specified in Part 1 of this Standard. The applicable regulatory authority should be consulted.*

(2) *The pressures specified in Part 1 of this Standard are gauge pressures above atmospheric pressure.*

(3) *This Standard applies to all boilers, pressure vessels, pressure piping, and fittings installed subsequent to its adoption.*

1.2
Requirements for compressed natural gas cylinders and refuelling station pressure piping systems and containers are covered in Parts 2 and 3 of this Standard.

1.3
This Standard does not apply to

(a) pressure-retaining components in hydraulic elevators;

(b) pressure-containment devices for gas-filled switchgear and controlgear; and

(c) pressure vessels for the transportation of dangerous goods regulated by Transport Canada.

1.4
Where a clause in Part 1 of this Standard is at variance with a Code or Standard referenced in Part 1 of this Standard, the requirements of Part 1 of this Standard govern.

1.5
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; "may" is used to express an option or that which is permissible within the limits of the standard; and "can" is used to express possibility or capability. 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.

1.6
The values given in SI (metric) units are the standard. The values given in parentheses are for information only. Nominal pipe sizes are expressed in non-dimensional terms.

2 Reference publications

Part 1 of 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)

B52-05
Mechanical refrigeration code

CAN/CSA-B149.1-05
Natural gas and propane installation code

CAN/CSA-B149.2-05
Propane storage and handling code

CAN/CSA-B149.5-05
Installation code for propane fuel systems and tanks on highway vehicles

CAN/CSA-ISO 9001-00 (R2005)
Quality management systems — Requirements

CAN/CSA-Z180.1-00 (R2005)
Compressed breathing air and systems

Z299 series of Standards

CAN3-Z299.1-85 (R2006)
Quality assurance program — Category 1

CAN3-Z299.2-85 (R2006)
Quality assurance program — Category 2

CAN3-Z299.3-85 (R2006)
Quality assurance program — Category 3

CAN3-Z299.4-85 (R2006)
Quality assurance program — Category 4

CAN/CSA-Z305.3-M87 (withdrawn)
Pressure Regulators, Gauges, af Flow-Metering Devices for Medical Gases

CAN3-Z305.4-M85 (withdrawn)
Qualification Requirements for Agencies Testing Nonflammable Medical Gas Piping Systems

Z662-07
Oil and gas pipeline systems

CAN/CSA-Z7396.1-06
Medical gas pipeline systems — Part 1: Pipelines for medical gases and vacuum

ANSI (American National Standards Institute)

K61.1-1999
Safety Requirements for the Storage and Handling of Anhydrous Ammonia