

B51-03

***Boiler, Pressure Vessel,
and Pressure Piping Code***

Currently in preview, click buy full version

Currently in preview, click buy full version

CSA Standard

B51-03
***Boiler, Pressure Vessel, and
Pressure Piping Code***



**CANADIAN STANDARDS
ASSOCIATION**

®Registered trade-mark of Canadian Standards Association

*Published in March 2003 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*

Visit our Online Store at www.csa.ca

ISSN 155397-172-8

Technical Editor: Jeet Tulshi (Totaram)

© Canadian Standards Association — 2003

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 Boilers and Pressure Vessels x

Association of Chief Inspectors Subcommittee xiv

Subcommittee on Boilers and Related Components xv

Editorial Subcommittee xvi

Subcommittee on Parts 2 and 3 of CSA Standard B51 xvii

Preface xviii

Foreword xx

B51-03, Part 1 **Boilers, Pressure Vessels, and Pressure Piping**

1 Scope 3

2 Reference Publications 4

3 Definitions 6

4 General Requirements 9

4.1 Registration of Designs 9

4.2 Registration of Fittings 9

4.3 Canadian Registration Numbers (CRNs) 11

4.4 Registration of Welding and Brazing Procedures 12

4.5 Welding and Brazing Qualifications 12

4.6 Submission of Manufacturer's Data Report 12

4.7 In-service Repairs and Alterations 13

4.8 Fabrication Inspection 13

4.9 Quality Control Program 14

4.10 Program Implementation for Manufacturers in Canada 14

4.10.1 Holders of ASME Certificate of Authorization 14

4.10.2 Non-holders of ASME Certificate of Authorization 14

4.11 Program Implementation for Manufacturers in the USA 15

4.12 Program Implementation for Manufacturers in Other Countries 15

4.13 Non-destructive Examination 15

4.14 Water Tanks 15

4.15 Requalification of Vessels in Liquefied Petroleum Gas Service 15

4.16 High-Pressure Cylinders for Compressed Natural Gas and Compressed Natural Gas Refuelling Station Pressure Piping Systems and Containers 15

4.17 Piping 15

5 Identification 16

5.1 Nameplates 16

5.2 Additional Nameplates 16

5.3 Stamping 16

5.4 Fittings 17

6 Boilers and Related Components 17

- 6.1 General Requirements 17
- 6.2 Lap-Seam Riveted Boilers 17
- 6.3 Supplementary Construction and Installation Requirements 17
 - 6.3.1 Water Gauges 17
 - 6.3.2 Low-Water Cut-off 17
 - 6.3.3 Fusible Plugs 18
 - 6.3.4 Boiler Installation 18
 - 6.3.5 Boiler Inspection Openings 18
- 6.4 Boiler Outlet Dampers 19
- 6.5 Blowoff Vessels, Systems, and Devices 19
- 6.6 Thermal Fluid Heaters and Piping 19
- 6.7 Cast Iron Steam and Hot Water Boilers 19

7 Pressure Vessels 19

- 7.1 General Requirements 19
- 7.2 Pressure Vessel Installation 20
 - 7.2.1 General Requirements 20
 - 7.2.2 Propane Tanks 20
 - 7.2.3 Other Buried Pressure Vessels 20
- 7.3 Pressure Vessel Inspection Openings 21
- 7.4 Water Heaters and Hot Water, Hydropneumatic, and Cushion Tanks 21
 - 7.4.1 Water Heaters 21
 - 7.4.2 Hot Water Tanks 21
 - 7.4.3 Hydropneumatic Tanks 22
 - 7.4.4 Cushion Tanks 22
- 7.5 Blowoff Vessels 22
 - 7.5.1 Design Requirements 22
 - 7.5.2 Cleaning and Inspection Facilities 22
 - 7.5.3 Inlets and Outlets 22
- 7.6 Anhydrous Ammonia Service 23
- 7.7 Liquefied Petroleum Gas and Natural Gas Liquids Services 23
 - 7.7.1 Liquefied Petroleum Gas Service 23
 - 7.7.2 Natural Gas Liquids Service 24
- 7.8 Installation of Air Receivers 24

8 Piping and Fittings 24**9 Refrigeration Equipment 24****10 Fired-Heater Pressure Coils in Petroleum and Chemical Plant Service 25****11 Repairs and Alterations 25****Tables 26****Figures 28****Annexes**

- A** (informative) — Burial of Pressure Vessels 31
- B** (informative) — Quality Control Program for Defect Prevention and In-service Reliability 32
- C** (informative) — Guidelines for Safety Valve, Relief Valve, and Safety-Relief Valve Repair Organizations 34
- D** (informative) — Sample Forms 39
- E** (informative) — Inspection of Welds in Pressure Coils Exposed to Direct Radiant Heat 62
- F** (informative) — Quality Control Program Manufacturers of Fittings 63

G (normative) — Automotive Propane Vessel Standards 65

H (informative) — Overpressure Protection Devices 69

B51-03, Part 2

High-Pressure Cylinders for the On-board Storage of Natural Gas as a Fuel for Automotive Vehicles

0 Introduction 75

1 Scope 75

2 Reference Publications 76

3 Definitions 78

4 Service Conditions 80

4.1 General 80

4.1.1 Standard Service Conditions 80

4.1.2 Use of Cylinders 80

4.1.3 Service Life 80

4.1.4 Periodic Requalification 81

4.2 Maximum Pressures 81

4.3 Maximum Number of Filling Cycles 81

4.4 Temperature Range 81

4.4.1 Gas Temperatures 81

4.4.2 Minimum Design Cylinder Temperatures 81

4.4.3 Transient Temperatures 81

4.5 Gas Composition 82

4.6 External Surfaces 82

4.7 Gas Permeation or Leakage 82

4.8 Installation Requirements 82

5 Design Approval 83

5.1 General 83

5.2 Statement of Service 83

5.3 Design Data 83

5.3.1 Drawings 83

5.3.2 Stress Analysis Report 83

5.3.3 Material Test Data 84

5.3.4 Design Qualification Test Data 84

5.3.5 Fire Protection 84

5.3.6 Cylinder Supports 84

5.3.7 Additional Supporting Data 84

5.4 Manufacturing Data 84

5.5 Quality Control Program 84

5.6 Service Life and In-service Requalification Requirements and Rejection Criteria 84

5.6.1 Service Life 84

5.6.2 Retesting 85

5.6.3 Reconnection 85

5.7 Design Specification Sheet 85

6 Requirements Applicable to All Cylinder Types 85

6.1 General 85

6.2 Design 85

6.3 Materials 86

6.3.1 General 86

6.3.2 Steel 86

6.3.3 Aluminum	86
6.3.4 Resins	87
6.3.5 Fibres	87
6.3.6 Plastic Liners	87
6.4 Manufacture	87
6.5 Test Pressure	87
6.6 Burst Pressures and Fibre Stress Ratios	87
6.7 Stress Analysis	87
6.8 Inspection and Testing	87
6.9 Fire Protection	88
6.10 Openings	88
6.10.1 General	88
6.10.2 Tapered Threads	88
6.10.3 Straight Threads	88
6.11 Cylinder Supports	88
6.12 Exterior Protective Coatings	88
6.13 Design Qualification Tests	88
6.14 Batch Tests	89
6.15 Production Examinations and Tests	89
6.15.1 General	89
6.15.2 Maximum Defect Size	89
6.16 Design Changes	89
6.17 Failure to Meet Test Requirements	90

7 Type CNG-1 Metal Cylinders 90

7.1 General	90
7.2 Stress Analysis	90
7.3 Manufacturing and Production Test Requirements	90
7.3.1 General	90
7.3.2 Non-destructive Examinations	90
7.3.3 Hydrostatic Pressure Proof Test	90
7.4 Batch Tests	91
7.4.1 Materials Tests	91
7.4.2 Burst Test	91
7.4.3 Periodic Burst Test	91
7.4.4 Pressure-Cycling Test	91
7.4.5 Periodic Pressure-Cycling Test	91
7.5 Design Qualification Tests	92
7.5.1 General	92
7.5.2 Hydrostatic Pressure Burst Test	92
7.5.3 Ambient Temperature Pressure-Cycling Test	92
7.5.4 Bonfire Tests	92
7.5.5 Penetration Tests	92

8 Type CNG-2 Hoop-Wrapped Cylinders 92

8.1 General	92
8.2 Design Requirements	92
8.2.1 Metal Liner	92
8.2.2 Composite Overwrap	92
8.2.3 Stress Analysis	92
8.3 Manufacturing Requirements	93
8.3.1 General	93
8.3.2 Liner	93
8.3.3 Overwrap	93
8.3.4 Autofrettage	93
8.4 Production Test Requirements	93

8.4.1	Non-destructive Examinations	93
8.4.2	Hydrostatic Pressure Proof Test	94
8.5	Batch Tests	94
8.5.1	Materials Tests	94
8.5.2	Burst Tests	94
8.5.3	Pressure-Cycling Tests	94
8.6	Design Qualification Tests	94
8.6.1	General	94
8.6.2	Hydrostatic Pressure Burst Test	94
8.6.3	Ambient Temperature Pressure-Cycling Test	94
8.6.4	Extreme-Temperature Pressure-Cycling Test	95
8.6.5	Bonfire Test	95
8.6.6	Penetration Test	95
8.6.7	Flaw Tolerance Tests	95
8.6.8	High-Temperature Creep Test	95
8.6.9	Accelerated Stress Rupture Test	95
8.6.10	Environmental Test	95

9 Type CNG-3 Fully Wrapped Cylinders 95

9.1	General	95
9.2	Design Requirements	95
9.2.1	Composite Overwrap	95
9.2.2	Stress Analysis	95
9.3	Manufacturing Requirements	96
9.4	Production Test Requirements	96
9.5	Batch Tests	96
9.6	Design Qualification Tests	96
9.6.1	General	96
9.6.2	Drop Test	96

10 Type CNG-4 All-Composite Cylinders 96

10.1	General	96
10.2	Design Requirements	96
10.2.1	General	96
10.2.2	Stress Analysis	96
10.3	Materials — Metal End-Bosses	96
10.4	Manufacturing Requirements	96
10.4.1	General	96
10.4.2	Overwrap	97
10.4.3	Curing of Thermosetting Resins	97
10.5	Production Test Requirements	97
10.5.1	Hydrostatic Pressure Proof Test	97
10.5.2	Leak Test	97
10.6	Cylinder Batch Tests	97
10.6.1	Material Tests	97
10.6.2	Burst Test	97
10.6.3	Pressure-Cycling Test	97
10.7	Design Qualification Tests	97
10.7.1	General	97
10.7.2	Permeation Test	97
10.7.3	Natural Gas Cycling Test	98
10.7.4	Boss Torque Test	98

11 Marking 98

12 Preparation for Dispatch 98

13 Quality Control 99

- 13.1 General 99
- 13.2 Manufacturer's Quality Control System 99
- 13.3 Manufacturer's Quality Control System Manual 99
- 13.4 Audit of Manufacturer's Quality Control System 99
- 13.5 Certification of the Manufacturer 100
- 13.6 Maintenance of the Manufacturer's Quality Control System 100
- 13.7 Independent Inspection Agency's Quality Control System 100
- 13.8 Third-Party Inspection of Production 100

14 Test Methods 100

- 14.1 Tensile Tests — Steel and Aluminum 100
- 14.2 Impact Test — Steel Cylinders and Steel Liners 100
- 14.3 Sulphide Stress Cracking Test — Steel 101
- 14.4 Stress Corrosion Cracking Tests — Aluminum 101
- 14.5 Sustained Load Cracking Test — Aluminum 101
- 14.6 Coating Performance Tests 101
- 14.7 Fracture Performance Tests 102
 - 14.7.1 Leak-before-Break Performance Test 102
 - 14.7.2 Determination of Non-destructive Examination Defect Size by Flawed-Cylinder Cycling 102
- 14.8 Brinell or Rockwell Hardness Test 102
- 14.9 Coating Batch Tests 102
 - 14.9.1 Coating Thickness 102
 - 14.9.2 Coating Adhesion 102
- 14.10 Leak Test 102
- 14.11 Hydrostatic Pressure Proof Test 102
- 14.12 Hydrostatic Pressure Burst Test 103
- 14.13 Ambient Temperature Pressure-Cycling Test 103
- 14.14 Extreme-Temperature Pressure-Cycling Test 103
- 14.15 Bonfire Test 104
 - 14.15.1 General 104
 - 14.15.2 Cylinder Set-up 104
 - 14.15.3 Fire Source 104
 - 14.15.4 Temperature and Pressure Measurements 104
 - 14.15.5 General Test Requirements 104
 - 14.15.6 Cylinders 1.65 m (65 in) in Length or Less 104
 - 14.15.7 Cylinders Greater than 1.65 m (65 in) in Length 104
 - 14.15.8 Acceptable Results 105
- 14.16 Penetration Tests 105
- 14.17 Flaw Tolerance Test 105
- 14.18 High-Temperature Creep Test 105
- 14.19 Accelerated Stress Rupture Test 105
- 14.20 Drop Test 105
- 14.21 Permeation Test 106
- 14.22 Environmental Test 106
 - 14.22.1 Test Cylinder 106
 - 14.22.2 Pendulum Impact Preconditioning 106
 - 14.22.3 Environmental Fluids for Exposure 106
 - 14.22.4 Pressure Cycle and Pressure Hold 107
 - 14.22.5 Acceptable Result 107
- 14.23 Natural Gas Cycling Test 107
- 14.24 Boss Torque Test 107

Tables 107

Annexes**A** (informative) — Report Forms 110**B** (informative) — Procedure for Requalifying All-Steel Natural Gas Vehicle Storage Cylinders 112**B51-03, Part 3****Compressed Natural Gas Refuelling Station Pressure Piping Systems and Ground Storage Vessels****1 Scope** 121**2 Reference Publications** 121**3 Definition** 123**4 General Requirements** 123

4.1 General 123

4.2 Gas Quality 123

4.3 Gas Pressure 123

4.4 Registration 123

4.5 Inspection 124

5 Compressed Natural Gas Refuelling Station Pressure Piping Systems 124

5.1 Design 124

5.2 Materials 125

5.3 Installation and Welding 125

5.4 Non-destructive Examination 125

5.5 Pressure Tests 126

5.6 Overpressure Protection 126

6 Compressed Natural Gas Refuelling Station Ground Storage Vessels 127

6.1 Design 127

6.2 Use of Cylinders 128

6.3 Requalification of Steel Ground Storage Containers 128

6.4 Storage Installations 128

Technical Committee on Boilers and Pressure Vessels

K.T. Lau	Alberta Boilers Safety Association, Edmonton, Alberta	<i>Chair</i>
T. Slimmon	TransCanada Pipelines Ltd., Calgary, Alberta	<i>Vice-Chair</i>
J. Adams	Sleegers Engineering, London, Ontario	
A.H. Andersen	Andersen Inspection and Consulting, Calgary, Alberta	
R. Awad	Régie du bâtiment du Québec, Montréal, Québec	<i>Associate</i>
B. Bachellier	Nunavut Department of Public Works and Services, Cambridge Bay, Nunavut	<i>Associate</i>
R.W. Barnes	Anric Enterprises, Toronto, Ontario	<i>Associate</i>
M. Beaulieu	Roth Canada, Belœil, Québec	
E. Bergshoeff	Hager Industries, Oakville, Ontario	
M. Binet	Gaz Métropolitain Inc., Montréal, Québec	
C.J. Castle	Nova Scotia Department of Labour, Halifax, Nova Scotia	
S. Donovan	Northwest Territories Department of Public Works and Services, Yellowknife, Northwest Territories	
L.J. Doran	National Board of Boiler and Pressure Vessel Inspectors, Columbus, Ohio, USA	<i>Associate</i>
D. Eastman	Newfoundland and Labrador Department of Government Services and Lands, St. John's, Newfoundland	
K. El-Mousfi	FM Global, Montréal, Québec	

H.M. Furse	Cimco Refrigeration, Toronto, Ontario	
J. Graham	Babcock & Wilcox Canada Ltd., Cambridge, Ontario	
R.A. Graves	Saskatoon Boiler Mfg. Co. Ltd., Saskatoon, Saskatchewan	
K. Greenwood	Praxair Canada Inc., Mississauga, Ontario	
V. Hera	Ontario Power Generation Inc., Toronto, Ontario	
A.F. Higgins	Inco Limited, Copper Cliff, Ontario	
Y. Huang	Royal & Sun Alliance Insurance Company of Canada, Toronto, Ontario	
T. Huynh	Miura Boiler Company Limited, Brantford, Ontario	<i>Associate</i>
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	British Columbia Ministry of Community, Aboriginal and Women's Services, New Westminster, British Columbia	
M. Kotb	Régie du bâtiment du Québec, Montréal, Québec	
S. Lajoie	Gaz Métropolitain Inc., Montréal, Québec	<i>Associate</i>
K. Le Van	Air Liquide Canada Inc., Montréal, Québec	
S. Lim	DuPont Canada Inc., Kingston, Ontario	
I.W. Mault	Manitoba Department of Labour and Immigration, Winnipeg, Manitoba	
J.A. McMillan	ASLTOM Canada Ltd., Gloucester, Ontario	
B. McWhirter	Alberta Boilers Safety Association, Edmonton, Alberta	<i>Associate</i>

R. Mile	Technical Standards and Safety Authority, Toronto, Ontario	<i>Associate</i>
M.N. Mirza	Thermogenics Incorporated, Aurora, Ontario	<i>Associate</i>
P. Molvie	Cleaver-Brooks, Milwaukee, Wisconsin, USA	<i>Associate</i>
M.V. Newlands	Steel Fabricating & Welding Company Incorporated, Oakville, Ontario	
R. Paplawski	GLM Tanks & Equipment Ltd., Nisku, Alberta	
A. Pighin	Human Resources Development Canada, Ottawa, Ontario	
M. Premovic	Premovic & Associates, Toronto, Ontario	<i>Associate</i>
D. Price	Government of Yukon, Whitehorse, Yukon	
D.E. Ross	New Brunswick Department of Public Safety, Fredericton, New Brunswick	
C. Smith	Boilersmith Ltd., Seaforth, Ontario	<i>Associate</i>
L.C. Smith	Waterloo Manufacturing Co. Ltd., Waterloo, Ontario	<i>Associate</i>
W. Spekkens	Spekqualtek Inc., Chute-à-Blondeau, Ontario	<i>Associate</i>
R. Sproston	The Boiler Inspection and Insurance Company of Canada, Toronto, Ontario	<i>Associate</i>
P. Sterescu	The Boiler Inspection and Insurance Company of Canada, Toronto, Ontario	
H. Sturm	Charles G. Turner & Associates Limited, Toronto, Ontario	<i>Associate</i>
N. Surtees	Saskatchewan Department of Corrections and Public Safety, Regina, Saskatchewan	
D. Tanner	National Board of Boiler and Pressure Vessel Inspectors, Columbus, Ohio, USA	

C. Turylo	Technical Standards and Safety Authority, Toronto, Ontario	
J. Weiss	EPCOR Utilities Inc., Edmonton, Alberta	
W. Widla	Fulton Enterprises, Inglewood, Ontario	
S.C. Wills	Foster Wheeler Limited, St. Catharines, Ontario	
S. Wilson	TWD Technologies, Oakville, Ontario	<i>Associate</i>
R. Wolfe	Insurance Bureau of Canada, West Hill, Ontario	<i>Associate</i>
J. Zirnhelt	Canspec Group Inc., Oakville, Ontario	
T. Tulshi	CSA, Mississauga, Ontario	<i>Project Manager</i>

The Technical Committee wishes to acknowledge the substantial contribution of the late A.J. Nathanielsz to the development of this Standard during his tenure as a member of the Committee.

Association of Chief Inspectors Subcommittee

R. Awad	Régie du bâtiment du Québec, Montréal, Québec	<i>Chair</i>
P. Dodge	Nova Scotia Department of Environment and Labour, Halifax, Nova Scotia	
E. Hurd	British Columbia Ministry of Community, Aboriginal and Women's Services, New Westminster, British Columbia	
B. Krasium	Saskatchewan Department of Corrections and Public Safety, Regina, Saskatchewan	
B. McWhirter	Alberta Boilers Safety Association, Edmonton, Alberta	
C. Turylo	Technical Standards and Safety Authority, Toronto, Ontario	
T. Tulshi	CSA, Mississauga, Ontario	<i>Project Manager</i>

Subcommittee on Boilers and Related Components

C. Turylo	Technical Standards and Safety Authority, Toronto, Ontario	<i>Chair</i>
G. Adgey	Clayton Sales and Service Ltd., Brampton, Ontario	
K. El-Mousfi	FM Global, Montréal, Québec	
J. Graham	Babcock & Wilcox Canada Ltd., Cambridge, Ontario	
R.A. Graves	Saskatoon Boiler Mfg. Co. Ltd., Saskatoon, Saskatchewan	
T. Huynh	Miura Boiler Company Limited, Brantford, Ontario	
M.N. Mirza	Thermogenics Incorporated, Aurora, Ontario	
P. Molvie	Cleaver-Brooks, Milwaukee, Wisconsin, USA	
C. Smith	Boilersmith Ltd., Seaforth, Ontario	
R. Sproston	The Boiler Inspection and Insurance Company of Canada, Toronto, Ontario	
H. Sturm	Charles G. Turner & Associates Limited, Toronto, Ontario	
T. Tulshi	CSA, Mississauga, Ontario	<i>Project Manager</i>

Editorial Subcommittee

C.J. Castle	Nova Scotia Department of Labour, Halifax, Nova Scotia	<i>Chair</i>
B. Bachellier	Nunavut Department of Public Works and Services, Cambridge Bay, Nunavut	
V. Hera	Ontario Power Generation Inc., Toronto, Ontario	
M. Kotb	Régie du bâtiment du Québec, Montréal, Québec	
B. McWhirter	Alberta Boilers Safety Association, Edmonton, Alberta	
W. Spekkens	Spekqualtek Inc., Chute-à-Blondeau, Ontario	
J. Zirnhelt	Canspec Group Inc., Oakville, Ontario	
T. Tulshi	CSA, Mississauga, Ontario	<i>Project Manager</i>

Subcommittee on Parts 2 and 3 of CSA Standard B51

S. Katz	British Columbia Ministry of Community, Aboriginal and Women's Services, New Westminster, British Columbia	<i>Chair</i>
C. Webster	Powertech Labs Inc., Surrey, British Columbia	<i>Secretary</i>
O. Alonso	Technical Standards and Safety Authority, Toronto, Ontario	
R. Awad	Régie du bâtiment du Québec, Montréal, Québec	
A. Beregszazy	Natural Resources Canada, Ottawa, Ontario	
D. Davis	Transport Canada, Ottawa, Ontario	
J. Dimmick	Pressed Steel Tank Company, Inc., West Allis, Wisconsin, USA	
A. Ghelesel	BC Gas International Inc., Burnaby, British Columbia	
B. McWhirter	Alberta Boilers Safety Association, Edmonton, Alberta	
N. Newhouse	General Dynamics Armament and Technical Production, Lincoln, Nebraska, USA	
H. Portmann	Dynetek Industries Ltd., Calgary, Alberta	
M. Tremayne	Enbridge Consumers Gas, Mississauga, Ontario	
N. White	Charonic Canada Inc., Belleville, Ontario	
T. Tulshi	CSA, Mississauga, Ontario	<i>Project Manager</i>

Preface

This is the sixteenth edition of CSA B51, *Boiler, Pressure Vessel, and Pressure Piping Code*. It supersedes the previous editions published in 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 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 as a fuel 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*. 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 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, and thereby to facilitate their application. To ensure that the designs of new cylinders and refuelling stations are compatible, the filling limits specified in Clause 4.2 of Part 2 provide the basis for the design pressures specified in Clauses 6.1.4 and 6.1.5 of Part 3.

All three parts of this Standard have undergone technical and editorial revisions since the previous edition. Some of the more noteworthy changes are as follows:

- Designs for fittings may now be registered through a central registration process administered by a nationally recognized organization (Part 1, Clause 4.2.3).
- Manufacturers of fittings with more than one plant or facility must now submit proof of a quality control program for each plant or facility where production occurs (Part 1, Clause 4.2.4).
- Organizations wishing to repair boilers, pressure vessels, pressure piping, or fittings must now submit proof that they maintain a satisfactory quality control system (Part 1, Clauses 4.9.2 and 4.9.3).
- The informational requirements for nameplates affixed to boilers, pressure vessels, and fittings have been revised (Part 1, Clause 5).
- Part 2 contains revised requirements concerning fire protection (Clause 6.9), design changes (Clause 6.16), failure to meet test requirements (Clause 6.17), and test methods (Clause 14).
- Part 2 contains a new annex on the procedure for requalifying all-steel natural gas vehicle storage cylinders (Annex B). This annex is referenced in Part 3 as well.

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 a non-mandatory annex mandatory.

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 Public Safety, and has been formally approved by the Technical Committee.

March 2003

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.

Foreword

The Canadian Standards Association (CSA) develops standards under the name Canadian Standards Association, and provides certification and testing under the name CSA International. CSA International provides certification services for manufacturers who, under license from CSA, wish to use the appropriate registered CSA Marks on certain products of their manufacture to indicate conformity with CSA Standards.

CSA Certification for a number of products is provided in the interest of maintaining agreed-upon standards of quality, performance, interchangeability and/or safety, as appropriate. Where applicable, certification may form the basis for acceptance by inspection authorities responsible for enforcement of regulations. Where feasible, programs will be developed for additional products for which certification is desired by producers, consumers, or other interests. In performing its functions in accordance with its objectives, CSA does not assume or undertake to discharge any responsibility of the manufacturer or any other party. The opinions and findings of the Association represent its professional judgement given with due consideration to the necessary limitations of practical operation and state of the art at the time the Standard is processed.

Products in substantial accord with this Standard but which exhibit a minor difference or a new feature may be deemed to meet the Standard providing the feature or difference is found acceptable utilizing appropriate CSA International Operating Procedures. Products that comply with this Standard shall not be certified if they are found to have additional features which are inconsistent with the intent of this Standard. Products shall not be certifiable if they are discovered to contravene applicable laws or regulations.

Testing techniques, test procedures, and instrumentation frequently must be prescribed by CSA International in addition to the technical requirements contained in Standards of CSA. In addition to markings specified in the Standard, CSA International may require special cautions, markings, and instructions that are not specified by the Standard.

Some tests required by CSA Standards may be inherently hazardous. The Association neither assumes nor accepts any responsibility for any injury or damage that may occur during or as the result of tests, wherever performed, whether performed in whole or in part by the manufacturer or the Association, and whether or not any equipment, facility, or personnel for or in connection with the test is furnished by the manufacturer or the Association.

Manufacturers should note that, in the event of the failure of CSA International to resolve an issue arising from the interpretation of requirements, there is an appeal procedure: the complainant should submit the matter, in writing, to the Secretary of the Canadian Standards Association.

If this Standard is to be used in obtaining CSA Certification please remember, when making application for certification, to request all current Amendments, Bulletins, Notices, and Technical Information Letters that may be applicable and for which there may be a nominal charge. For such information or for further information concerning CSA Certification, please address your inquiry to Applications and Customer Service, CSA International, 178 Rexdale Boulevard, Toronto, Ontario, Canada M9W 1R3.

CSA Standard

B51-03, Part 1
***Boilers, Pressure Vessels, and
Pressure Piping***



**CANADIAN STANDARDS
ASSOCIATION**

® Registered trade-mark of Canadian Standards Association

*Published in March 2003 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*

Visit our Online Store at www.csa.ca

B51-03, Part 1

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)** *In certain provinces there may be variations in the size limitations specified in Part 1 of this Standard. The regulatory authority should be consulted.*
- 2)** *All pressures specified in Part 1 of this Standard are gauge pressures above atmospheric pressure.*

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 any clause of Part 1 of this Standard is at variance with the referenced codes and standards, 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; 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. Legends to equations and figures are considered requirements.

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.