

ANSI Z21.13-2010
CSA 4.9-2010

American National Standard/
CSA Standard For
**Gas-Fired Low Pressure
Steam And Hot Water
Boilers**

AMERICAN NATIONAL STANDARD
ANSI Z21.13-2010

CSA STANDARD
CSA 4.9-2010

Third Edition - 2010
This Standard is based on the Standard for
Gas-Fired Low Pressure Steam and Hot Water Boilers
ANSI Z21.13-2004 • CSA 4.9-2004
and ANSI Z21.13a-2005 • CSA 4.9a-2005,
ANSI Z21.13b-2007 • CSA 4.9b-2007

APPROVED



October 30, 2009
American National Standards Institute, Inc.

IGAC

January 4, 2010
Interprovincial Gas Advisory Council
Effective in Canada September 1, 2011

Standards Developer

CSA AMERICA INC.
8501 East Pleasant Valley Road
Cleveland, Ohio 44131

CANADIAN STANDARDS ASSOCIATION
5060 Spectrum Way, Suite 100
Mississauga, Ontario, Canada L4W 5N6

Published - January 2010

Copyright © 2010
Canadian Standards Association

Permission is granted to republish material herein in laws or ordinances, and in regulations, administrative orders, or similar documents issued by public authorities. Those desiring permission for other republication should consult Canadian Standards Association, 5060 Spectrum Way, Suite 100, Mississauga, Ontario, Canada L4W 5N6.

Copyright © 2010
CSA America, Inc.

Permission is granted to republish material herein in laws or ordinances, and in regulations, administrative orders, or similar documents issued by public authorities. Those desiring permission for other republication should consult CSA America, Inc., 8501 East Pleasant Valley Road, Cleveland, Ohio 44131.

Canadian Standards Association

The Canadian Standards Association (CSA), 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 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.

Individuals, companies, and associations across Canada indicate their support for CSA's standards development by volunteering their time and skills to CSA Committee work and supporting the Association's objectives through sustaining memberships. The more than 7000 committee volunteers and the 2000 sustaining memberships together form CSA's total membership from which its Directors are chosen. Sustaining memberships represent a major source of income for CSA's standards development activities.

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

In addition to its head office and laboratory complex in Toronto, CSA has regional branch offices in major centres across Canada and inspection and testing agencies in eight countries. Since 1919, the Association has developed the necessary expertise to meet its corporate mission: CSA 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.

L'Association canadienne de normalisation (CSA), sous les auspices de laquelle cette Norme nationale a été préparée, a reçu ses lettres patentes en 1919 et son accréditation au sein du Système de Normes nationales par le Conseil canadien des normes en 1973. Association d'affiliation libre, sans but lucratif ni pouvoir de réglementation, elle se consacre à l'élaboration de normes et à la certification.

Les normes CSA reflètent le consensus de producteurs et d'utilisateurs de partout au pays, au nombre desquels se trouvent des fabricants, des consommateurs, des détaillants et des représentants de syndicats, de corps professionnels et d'agences gouvernementales. L'utilisation des normes CSA est très répandue dans l'industrie et le commerce, et leur adoption à divers ordres de législation, tant municipal et provincial que fédéral, est chose courante, particulièrement dans les domaines de la santé, de la sécurité, du bâtiment, de la construction et de l'environnement.

Les Canadiens d'un bout à l'autre du pays témoignent de leur appui au travail de normalisation mené par la CSA en participant bénévolement aux travaux des comités de la CSA et en appuyant ses objectifs par leurs cotisations de membres de soutien. Les quelque 7000 volontaires faisant partie des comités et les 2000 membres de soutien constituent l'ensemble des membres de la CSA parmi lesquels ses administrateurs sont choisis. Les cotisations des membres de soutien représentent une source importante de revenu pour les services de soutien à la normalisation volontaire.

L'Association offre des services de certification et de mise à l'essai qui appuient et complètent ses activités dans le domaine de l'élaboration de normes. De manière à assurer l'intégrité de son processus de certification, l'Association procède de façon régulière et continue à l'examen et à l'inspection des produits portant la marque CSA.

Outre son siège social et ses laboratoires à Toronto, la CSA possède des bureaux régionaux dans des centres vitaux partout au Canada, de même que des agences d'inspection et d'essai dans huit pays. Depuis 1919, l'Association a parfait les connaissances techniques qui lui permettent de remplir sa mission d'entreprise, à savoir la CSA est un organisme de services indépendant dont la mission est d'offrir une tribune libre et efficace pour la réalisation d'activités facilitant l'échange de biens et de services par l'intermédiaire de services de normalisation, de certification et autres, pour répondre aux besoins de nos clients, tant à l'échelle nationale qu'internationale.

For further information on CSA services, write to

***Canadian Standards Association
5060 Spectrum Way, Suite 100
Mississauga, Ontario, Canada L4W 5N6***

Pour plus de renseignements sur les services de la CSA, s'adresser à

***Association canadienne de normalisation
5060, Spectrum Way, bureau 100
Mississauga, Ontario, Canada L4W 5N6***

American National Standards Institute

The American National Standards Institute (ANSI), Inc. is the nationally recognized coordinator of voluntary standards development in the United States through which voluntary organizations, representing virtually every technical discipline and every facet of trade and commerce, organized labor and consumer interests, establish and improve the some 10,000 national consensus standards currently approved as American National Standards.

ANSI provides that the interests of the public may have appropriate participation and representation in standardization activity, and cooperates with departments and agencies of U.S. Federal, state and local governments in achieving compatibility between government codes and standards and the voluntary standards of industry and commerce.

ANSI represents the interests of the United States in international nontreaty organizations such as the International Organization for Standardization (ISO) and the International Electrotechnical Commission (IEC). The Institute maintains close ties with regional organizations such as the Pacific Area Standards Congress (PASC) and the Pan American Standards Commission (COPANT). As such, ANSI coordinates the activities involved in the U.S. participation in these groups.

ANSI approval of standards is intended to verify that the principles of openness and due process have been followed in the approval procedure and that a consensus of those directly and materially affected by the standards has been achieved. ANSI coordination is intended to assist the voluntary system to ensure that national standards needs are identified and met with a set of standards that are without conflict or unnecessary duplication in their requirements.

Responsibility of approving American National Standards rests with the

***American National Standards Institute, Inc.
25 West 43rd Street, Fourth Floor
New York, NY
10036***

Preface

This publication represents a basic standard for safe operation, substantial and durable construction, and acceptable performance of gas-fired low pressure steam and hot water boilers. It is the result of years of experience in the manufacture, testing, installation, maintenance, inspection and research on gas-fired low pressure steam and hot water boilers designed for utilization of gas. There are risks of injury to persons inherent in appliances that, if completely eliminated, would defeat the utility of the appliance. The provisions in this standard are intended to help reduce such risks while retaining the normal operation of the appliance.

Nothing in this standard is to be considered in any way as indicating a measure of quality beyond compliance with the provisions it contains. It is designed to allow compliance of gas-fired low pressure steam and hot water boilers, the safety construction and performance of which may exceed the various provisions specified herein. In its preparation, recognition has been given to possibilities of improvement through ingenuity of design. As progress takes place, revisions may become necessary. When they are believed desirable, recommendations or suggestions should be forwarded to the Chairman of the Z21/83 Committee, CSA America, 8501 East Pleasant Valley Road, Cleveland; Ohio 44131, or the Chairman of the CSA Technical Committee on Gas Appliances and Related Accessories, CSA, 5060 Spectrum Way, Suite 100, Mississauga, Ontario, Canada L4W 5N6.

Safe and satisfactory operation of gas-fired low pressure steam and hot water boilers depends to a great extent upon its proper installation, use and maintenance. It should be installed, as applicable, in accordance with the *National Fuel Gas Code, ANSI Z223.1/NFPA 54*; the *Natural Gas and Propane Installation Code, CSA B149.1*.

Users of this American National Standard/CSA Standard are advised that the devices, products and activities within its scope may be subject to regulation at the Federal, Territorial, Provincial, state or local level. Users are strongly urged to investigate this possibility through appropriate channels. In the event of a conflict with this standard, the Federal, Territorial, Provincial, state or local regulation should be followed.

THIS STANDARD IS INTENDED TO BE USED BY THE MANUFACTURING SECTOR AND BY THOSE APPLYING THE EQUIPMENT AND BY THOSE RESPONSIBLE FOR ITS PROPER INSTALLATION. IT IS THE RESPONSIBILITY OF THESE USERS TO DETERMINE THAT IN EACH CASE THIS STANDARD IS SUITABLE FOR AND APPLICABLE TO THE SPECIFIC USE THEY INTEND.

CAUTION NOTICE: This American National Standard may be revised or withdrawn at any time. The procedures of the American National Standards Institute, Inc., require that action be taken to reaffirm, revise or withdraw this standard no later than five (5) years from the date of approval. Purchasers of American National Standards may receive current information on all standards by calling or writing the American National Standards Institute, Inc., 25 West 43rd Street, Fourth Floor, New York, N.Y. 10036, (212) 642-4900.

EFFECTIVE DATE: An organization using this standard for product evaluation as a part of its certification program will normally establish the date by which all products certified by that organization should comply with this standard.

History Of The Development Of Standards For Gas-Fired Low-Pressure Steam And Hot Water Boilers

(This History is informative and is not part of the standard.)

With the onset of the Free Trade Agreement between the United States and Canada on January 2, 1988, significant attention was given to the harmonization of the United States and Canadian safety standards addressing gas-fired equipment for residential, commercial and industrial applications. It was believed that the elimination of the differences between the standards would remove potential trade barriers and provide an atmosphere in which North American manufacturers could market more freely in the United States and Canada. The harmonization of these standards was also seen as a step toward harmonization with international standards. Joint subcommittees were established to facilitate the standards harmonization process between the United States and Canada.

The first draft of this harmonized standard was based on current coverage from the American National Standard for Gas-Fired Low-Pressure Steam and Hot Water Boilers, Z21.13-1991, Z21.13a-1993, Z21.13b-1994, and the Canadian Gas Association Standards CGA 3.3-1976, Industrial and Commercial Atmospherically Fired Vertical Flue Boilers and Hot Water Supply Heaters, and CGA 4.9-1969, Gas-Fired Steam and Hot Water Boilers.

Following reconsideration and modification of the proposed draft standard, in light of comments received, the joint subcommittee at its December 2, 1998 meeting, recommended the proposed draft standard to Accredited Standards Committee Z21/83 and the (Interim CSA) Standards Steering Committee for approval.

The proposed draft of the harmonized standard for gas-fired low-pressure steam and hot water boilers, as modified by the joint subcommittee, was approved by the Z21/83 Committee at its April 15, 1999 meeting, and by the CSA Standards Steering Committee on Gas Appliances and Related Accessories by letter ballot dated April 9, 1999.

The second edition of the American National Standard/CSA Standard for Gas-Fired Low-Pressure Steam and Hot Water Boilers was approved by the Canadian Interprovincial Gas Advisory Council on May 18, 2004, and by the American National Standards Institute, Inc., on June 23, 2004.

This the third edition of the American National Standard/CSA Standard for Gas-Fired Low-Pressure Steam and Hot Water Boilers was approved by the Canadian Interprovincial Gas Advisory Council on January 4, 2010, and by the American National Standards Institute, Inc., on October 30, 2009.

The previous edition of the Gas-Fired Low-Pressure Steam and Hot Water Boilers standard, and addenda there to, approved by the Interprovincial Gas Advisory Council and American National Standards Institute, Inc. are as follows:

ANSI Z21.13-2000 • CSA 4.9-2000
ANSI Z21.13a-2002 • CSA 4.9a-2002
ANSI Z21.13b-2003 • CSA 4.9b-2003

ANSI Z21.13-2004 • CSA 4.9-2004
ANSI Z21.13a-2005 • CSA 4.9a-2005
ANSI Z21.13b-2007 • CSA 4.9b-2007

The following identifies the designation and year of this edition of the standard:

ANSI Z21.13-2010 • CSA 4.9-2010

Note: This edition of Z21.13 • CSA 4.9 incorporates changes to the 2004 edition and addenda thereto. Changes other than editorial are noted by a vertical line in the margin.

Interprovincial Gas Advisory Council

(February 2009)

S. Cooke	Technical Standards & Safety Authority	<i>(Chair)</i>
B. Bachellier	Government of Nunavut	
M. Davidson	New Brunswick Department of Public Safety	
W. Drover	Government of Newfoundland and Labrador	<i>(Alternate)</i>
D. Eastman	Government of Newfoundland and Labrador	
Z. Fraczkowski	Technical Standards & Safety Authority	<i>(Alternate)</i>
E. Hurd	British Columbia Safety Authority	<i>(Alternate)</i>
W.C. LaRose	Alberta Municipal Affairs	
W. Lock	British Columbia Safety Authority	<i>(Alternate)</i>
R. McRae	Government of the Northwest Territories	
J. Melling	SaskPower	<i>(Alternate)</i>
V. Pao	Manitoba Department of Labour	
B. Reid	P.E.I. Department of Labour	
J. Renaud	Régie d'habitation du Québec	
D.C. Stewart	Nova Scotia Department of Labour	
I.R. Tilgner	Human Resources and Social Development Canada	
D. Warriner	Manitoba Labour	<i>(Alternate)</i>
G.L. Williams	SaskPower	
C.E. Wolfe	Government of Nunavut	<i>(Alternate)</i>
D. Young	Government of Yukon Territory	
A.C. Cautillo	Canadian Standards Association	<i>(Secretary)</i>

Z21/83 Committee on Performance and Installation of Gas Burning Appliances and Related Accessories

DARYL L. HOSLER, Chairman

PAUL E. BEACH, Vice Chairman

ALLEN J. CALLAHAN, Manager, Standards, CSA America, Inc. (NonVoting)

REPRESENTING AIR CONDITIONING, HEATING AND REFRIGERATION INSTITUTE:

Charles W. Adam
Paul Beach
Mark Diesch

Michael Eberlein
Allen Kessler
Norm Mattson

Frank Myers
Gary J. Potter
Neil Rolph (Alternate)

REPRESENTING AMERICAN ASSOCIATION OF FAMILY AND CONSUMER SCIENCE:

JoAnn Emmel

REPRESENTING AMERICAN GAS ASSOCIATION:

Jim Ranfone

REPRESENTING AMERICAN PUBLIC GAS ASSOCIATION

Mike Deegan

REPRESENTING ASSOCIATION OF HOME APPLIANCE MANUFACTURERS:

Peter Hoekstra

REPRESENTING ATMOS ENERGY:

Ronnie Ray Frazier

REPRESENTING BURNER TECHNOLOGY UNLIMITED, INC.:

Carl Suchovsky

REPRESENTING CONSUMER:

Hall Virgil

Amy Sherwin

REPRESENTING DIRECT ENERGY CORPORATION:

Geoff Adkinson

Z21/83 Committee on Performance and Installation of Gas Burning Appliances and Related Accessories

REPRESENTING HEARTH, PATIO AND BARBEQUE ASSOCIATION:

Thomas Stroud

REPRESENTING INDIVIDUAL MEMBERS:

Daryl L. Hosler

Issac Sargunam

Matthew Wilber

REPRESENTING INDUSTRIAL HEATING EQUIPMENT ASSOCIATION:

Doug Perry

REPRESENTING KEYSpan ENERGY:

Edward J. Angelone

REPRESENTING LOWE'S COMPANIES:

Jeff Jacumin

REPRESENTING NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION:

Gerard Winstanley

REPRESENTING NATIONAL PROPANE GAS ASSOCIATION:

Bruce J. Swiecicki

REPRESENTING NORTH AMERICAN ASSOCIATION OF FOOD EQUIPMENT MANUFACTURERS:

Charles Souhrada

Terry Wiseman (Alternate)

REPRESENTING SOUTHERN CALIFORNIA GAS COMPANY:

Lance DeLaura

Ron Caudle (Alternate)

REPRESENTING UNDERWRITERS LABORATORIES:

Robert Wozniak

Travis Hardin (Alternate)

REPRESENTING U.S. CONSUMER PRODUCT SAFETY COMMISSION:

Donald W. Switzer

Z21/83 Committee on Performance and Installation of Gas Burning Appliances and Related Accessories

REPRESENTING U.S. DEPARTMENT OF ENERGY:

Cyrus Nasser

REPRESENTING U.S. DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT:

Victor J. Ferrante

CSA Technical Committee On Gas Appliances And Related Equipment

(February, 2009)

Z. Fraczkowski	Technical Standard and Safety Authority	<i>(Chairman)</i>
G.L. Williams	SaskPower Corporation	<i>(Vice-Chairman)</i>
D. Baxter	Enbridge Gas Distribution	<i>(Vice-Chairman)</i>
M. Binet	Gaz Metro Inc.	
M. Blanchet	Gas Metro Inc.	<i>(Associate Member)</i>
J. Boros	Rheem Manufacturing Company	
T. Brennan	Natural Resources Canada	<i>(Associate Member)</i>
C. Gibbs	Consumers' Association of Canada	
A. Gould	Union Energy	
R. Greiss	Natural Resources Canada	
E. Grzesik	Ontario Ministry of Energy	<i>(Associate Member)</i>
W. Harrigill	Rheem Manufacturing Company	<i>(Associate Member)</i>
D. Hird	SaskPower	<i>(Associate Member)</i>
D.L. Hosler	Wilson Environmental Associates	<i>(Associate Member)</i>
E.J. Hurd	British Columbia Safety Authority	<i>(Associate Member)</i>
D. Jamieson	CFM Corporation	
J.M. Jones	J.M. Jones Consulting, Inc.	
C. Joargenson	British Columbia Safety Authority	
S. Katz	Katz and Associates	<i>(Associate Member)</i>
J. Krill	Union Energy	<i>(Associate Member)</i>
S. Lajoie	Gaz Metro Inc.	<i>(Associate Member)</i>
J. Marshall	Technical Standards and Safety Authority	<i>(Associate Member)</i>
J. Melling	SaskPower	<i>(Associate Member)</i>
J. Overall	Union Gas Limited	<i>(Associate Member)</i>
T. Poulin	GSW Water Heating, a Division of GSW Water Products Inc.	
G. Prociw	Union Gas Limited	
H. Prosper	Natural Resources Canada	
M. Thomas	Natural Resources Canada	<i>(Associate Member)</i>
T. Cautillo	Canadian Standards Association	<i>(Secretary)</i>

Joint Technical Advisory Group On Standards For Gas-Fired Low-Pressure Steam And Hot Water Boilers

FRANK MYERS, Chairman

REPRESENTING GAS COMPANIES:

Ed Angelone
John Overall

REPRESENTING MANUFACTURERS:

Jerine Ahmed
Larry J. Ashton
Paul Beach
Jim Bedford
Paul Cabot
Kevin Carlisle
Ray Donhauser
Don Emen (Alternate)
Robert Glass (Alternate)
Andy Gould
Harold Green
James Hall
Shamel Kassab
Mark Kendall
Bruce Mickelson
Earl J. Rightmier
Neil Rolph
Josh Roberts (Alternate)
Neil Rolph
Atul Saksena
Darrel Schuh (Alternate)
Gary Sirois
Frank Stanonik (Alternate)
Carl Suchovsky
Henry Troost (Alternate)
Cory Weiss
James York
Aymen Youssef

REPRESENTING REGULATORY AUTHORITY:

Ed Grzesik
Cyrus Nasseri

Contents

Page

Part I Construction

1.1	Scope	1
1.2	General Construction	2
1.3	Assembly	4
1.4	Accessibility	5
1.5	Combustion Air And Ventilation Openings	6
1.6	Main Burners	6
1.7	Primary Air Adjustment Means	8
1.8	Orifice Spuds And Orifice Fittings	9
1.9	Automatic Gas Ignition Systems	9
1.10	Flame Spreaders	12
1.11	Manual Gas Valves	12
1.12	Gas Supply Lines	13
1.13	Bleeds And Vents	15
1.14	Automatic Valves And Safety Shutoff Valves	16
1.15	Gas Appliance Pressure Regulators And Gas Pressure Interlocks	17
1.16	Adjustment For Minimum Input Rating	18
1.17	Condensate Disposal	19
1.18	Pilot Gas Filters	19
1.19	Limiting Devices	19
1.20	Safety And Relief Valves	20
1.21	Low Water Cutoffs	20
1.22	Thickness Of Materials	20
1.23	Boiler Construction	21
1.24	Electrical Equipment And Wiring	22
1.25	Motors And Blowers	29
1.26	Protection Of Service Personnel	30
1.27	Flue Collectors	31
1.28	Flue Connections And Integral Venting Systems	31
1.29	Draft Hoods	32
1.30	Automatic Vent Damper Devices	33
1.31	Automatic Flue Damper Devices	34
1.32	Vent-Air Intake Pipes Of Direct Vent Systems	35
1.33	Water Connections	36
1.34	Instructions	36
1.35	User's Information Manual	42
1.36	Marking	44

Part II Performance

2.1	General	55
2.2	Test Gases	57
2.3	Inlet Test Pressures And Burner Adjustments	58
2.4	Category Determination	59
2.5	Combustion	60
2.6	Burner Operating Characteristics	62
2.7	Piloted Ignition Systems	63
2.8	Direct Ignition Systems	68
2.9	Proved Igniter System	70

Contents (Continued)

2.10	Flame Roll-Out Safety Shutoff Means	72
2.11	Efficiency	74
2.12	Main Burner And Flame Spreader Temperatures	76
2.13	Nonload Bearing Flue Gas Baffle Temperatures	77
2.14	Steam Pressure Limiting Devices	77
2.15	Water Temperature Limiting Devices	78
2.16	Manifold And Control Assembly Capacity	78
2.17	Safety Circuit Analysis	79
2.18	Power Interruption	79
2.19	Wall, Floor, Ceiling, Electrical Component And Venting System Temperatures	79
2.20	Flue Gas Temperature	85
2.21	Flue Collectors	86
2.22	Blocked Vent Shutoff System	86
2.23	Draft Hoods	87
2.24	Blocked Vent Test For Boilers Equipped With Forced Or Induced Draft Burners And Without Draft Hoods Or Regulators	90
2.25	Automatic Flue Damper Devices	90
2.26	Direct Vent Systems	94
2.27	Boilers For Outdoor Installation	99
2.28	Boilers Vented Horizontally Through an Outside Wall	100
2.29	Condensate Disposal System(s)	103
2.30	Venting Systems For Category II, III Or IV Boilers	104
2.31	Marking Material Adhesion And Legibility	105

Tables

Table I-A	Maximum Safety Control Timings Natural Draft Atmospheric Burners	108
Table I-B	Maximum Safety Control Timings Other than Natural Draft Atmospheric Burners	108
Table I-C	Maximum Safety Control Timings Natural Draft Atmospheric Burners	109
Table I-D	Maximum Safety Control Timings Other than Natural Draft Atmospheric Burners	110
Table II	Minimum Acceptable Wall Thickness For Semi-Rigid Tubing	111
Table III	Maximum Tubing And Fitting Temperatures	111
Table IV	Minimum Corrosion Protection Of Ferrous Materials Used In The Construction Of Outside Casings Of Heaters For Outdoor Installation	112
Table V	Minimum Thickness Of Vent Pipes And Radiation Shields Exposed To Combustion Products On Direct Vent Boilers	113
Table VI		113
Table VII	Minimum Average Thickness Of Sheet-Metal Junction Boxes	114
Table VIII	Insulation Thickness Of Factory Wiring Exposed In Burner Or Fan Compartment	115
Table IX	Minimum Spacings In Inches (mm)	116
Table X	Maximum Allowable Rise Above Room Temperature For Various Component Parts	117
Table XI	Maximum Allowable Motor Winding Temperatures, °F (°C)	118

Contents (Continued)

Table XII	Characteristics Of Test Gases	118
Table XIII	Inlet Test Pressures	118
Table XIV	Determination Of Category	119
Table XV	Maximum Flame Spreader Temperatures	119
Table XVI	Maximum Nonload-Bearing Flue Gas Baffle Temperatures	120
Table XVII	Maximum Allowable Temperatures of Typical Non-Metallic Vent Materials	121

Figures

Figure 1.	Accessibility and Protection	124
Figure 2.	Arrangement of Vent Pipe for Testing Boilers Having Input Ratings of 400,000 Btu/hr (117 228 W) or Less.....	125
Figure 3.	Piezo Ring and Details of Typical Construction	126
Figure 4.	Chart for Determination of Boiler Category	127
Figure 5.	Suggested Piping Arrangement for Steam Boilers Feed Water Measurement	128
Figure 6.	Arrangement of Apparatus for Testing Hot Water Boilers	129
Figure 7.	Enclosure Types and Clearance Nomenclature	130
Figure 8.	Method of Sealing Annulus Around Vent Connector During Alcove and Closet Installation Tests	131
Figure 9.	Venting Arrangements for Alcove and Closet Installation Tests	131
Figure 10.	Arrangement of Sandbag and Vent-Air Intake Terminal for Impact Test	132
Figure 11.	Arrangement of Spray Heads and Associated Piping for Simulated Rainstorm Test	133
Figure 12.	Spray Head Assembly and Details of Construction	133
EXHIBIT A	Outline Of Lighting Instructions For Appliances Equipped With Continuous Pilots	135
EXHIBIT B	Outline Of Operating Instructions For Appliances Equipped With Intermittent Pilot Or Interrupted Pilot Systems	139
EXHIBIT C	Outline Of Operating Instructions For Appliances Equipped With Direct Ignition Systems	143
EXHIBIT D	Flue Loss Calculations	147
EXHIBIT E	Items Unique To Canada	151
EXHIBIT F	(Optional) Provisions For Listed Gas Appliance Conversion Kits	169
EXHIBIT G	List Of Reference Standards	173
Part III	Manufacturing And Production Tests	177
Part IV	Definitions	179
APPENDIX A	Pertinent References to ANSI Y14.15	191

Contents (Continued)

APPENDIX B	Wire Color Designations	192
APPENDIX C	Recommended Wire Color Usage	193
APPENDIX D	Preferred Graphic Symbols Of Commonly Used Items, Extracted From Standard ANSI/IEEE 315, Graphic Symbols For Electrical And Electronics Diagrams, And Abbreviations For These Items	194
APPENDIX E	Sample Failure Modes and Effects Analysis For Component Miswiring	196
APPENDIX F	Table of Conversion Factors	197

NOTE

This standard contains SI (Metric) equivalents to the yard/pound quantities, the purpose being to allow the standard to be used in SI (Metric) units. (IEEE/ASTM-SI-10 or CAN/CSA Z234.1 are used as a guide in making metric conversion from yard/pound quantities.) If a value for a measurement and an equivalent value in other units, the first stated is to be regarded as the requirement. The given equivalent value may be approximate. If a value for a measurement and an equivalent value in other units, are both specified as a quoted marking requirement, the first stated unit, or both shall be provided.

American National Standard/CSA Standard For Gas-Fired Low Pressure Steam And Hot Water Boilers

Part I: Construction

1.1 Scope

1.1.1

This standard applies to newly produced gas-fired low-pressure steam and hot water boilers with gas inlet pressure ratings not exceeding $\frac{1}{2}$ psi (3.5 kPa) and having input ratings of less than 12,500,000 Btu/hr (3 663 389 W) (see Part IV, Definitions), hereinafter referred to as boilers*, constructed entirely of new unused parts and materials, for operation at or below the following pressures and temperatures:

Steam heating boilers

15 psi (103.42 kPa) steam pressure

Hot water heating boilers

160 psi (1.10 MPa) water pressure

250°F (121°C) water temperature

Hot water supply boilers

160 psi (1.10 MPa) water pressure

250°F (121°C) water temperature

- a. For use with natural gas;
- b. For use with manufactured gas;
- c. For use with mixed gas;
- d. For use with liquefied petroleum gases; and
- e. For use with LP gas-air mixtures.

The construction of boilers for use with the above-mentioned gases is covered under Part I.

The performance of boilers for use with the above-mentioned gases is covered under Part II.

1.1.2

This standard applies to indoor type boilers, of other than the direct vent which are categorized according to vent pressure and temperature as either Category I, Category II, Category III or Category IV (see Part IV, Definitions), and to outdoor type boilers.

* See Exhibit E (E2.1) for boilers covered in Canada which exceed the above limits in gas inlet pressure and/or input ratings.

1.1.3

This standard also applies to direct vent boilers (see Part IV, Definitions). A direct vent boiler anticipated by this standard is essentially a balanced flue appliance with the air intake and vent outlet in proximity. Other designs shall be subjected to such additional tests as believed necessary at the discretion of the testing agency.

1.1.4

This Standard covers the method of test to determine combustion efficiency for indoor boilers with input rates of 300,000 Btu/hr (87 921 W) or greater and the thermal efficiency for both indoor and outdoor boilers. [See Exhibit E, Items Unique to Canada, for minimum efficiencies of indoor boilers with input rates under 300,000 (87 921 W) for sale in Canada].

1.1.5

If a value for measurement as given in this standard is followed by an equivalent value in other units, the first stated value is to be regarded as the specification.

1.1.6

All references to pressure throughout this standard are to be considered gauge pressure, unless otherwise specified.

1.1.7

Exhibit E, Items Unique to Canada, contains provisions unique to, and required by, Canada.

1.2 General Construction

1.2.1

The construction of a boiler, whether specifically covered in this standard or not, shall be in accordance with reasonable concepts of safety, substantiality and durability. Component parts shall be well fitted and not show signs of becoming warped, bent, broken or otherwise damaged during the initial test installation or during any of the tests specified so as to prevent compliance with this standard.

All specifications as to construction set forth herein may be satisfied by the construction actually prescribed or such other construction as will provide at least equivalent performance.

1.2.2

Asbestos shall not be used in the construction of a boiler.

1.2.3

Every part of the boiler shall be secure against displacement and shall be constructed so as to maintain a fixed relationship between essential parts under normal and reasonable conditions of handling and usage.

1.2.4

On a boiler having an input rating 400,000 Btu/hr (117 228 W) or less, the leads or terminals of an individual control, in the gas control circuit, that are provided for making electrical connections and which are intended to be disconnected in order to replace or service the control shall be identified by a number (s), letter(s), symbol(s) or combination thereof, in a color which contrasts with the background. This provision does not apply when:

- a. The control incorporates means which will physically prevent miswiring; or
- b. The control incorporates only two terminals or leads, the interchange of which does not change the operation of the control.

1.2.5

Materials, including insulation, used in the construction of a boiler shall be suitable for the application and the temperatures to which exposed in service and shall not show evidence of deterioration during any of the testing specified herein.

1.2.6

A boiler having an input rating less than 300,000 Btu/hr (87 921 W) shall be equipped with a manual reset or single use flame roll-out safety shutoff means or control system, which will shut off main burner gas in the event the flow of combustion products through the boiler flueway(s) is reduced when tested as specified in 2.10, Flame Roll-out Safety Shutoff Means. Manual reset type systems shall not automatically reset above -31°F (-35°C).

1.2.7

All gas controls shall be pressure rated equal to or greater than the maximum permissible gas supply pressure to the boiler as marked on the rating plate.

1.2.8

A direct vent boiler shall be provided with the ventair intake system as part of the boiler. A ventair intake system shall be provided with means for secure attachment to the boiler or wall structure.

1.2.9

Legs or spacers necessary for installation of a direct vent boiler in accordance with the manufacturer's installation instructions shall be furnished by the manufacturer as an integral part of the boiler, including the vent extension and terminal. These legs or spacers shall be located so as to preclude installation of the boiler at clearances from combustible construction less than those specified by the manufacturer.

1.2.10

A Category II, III, IV, or direct vent boiler shall be provided with the means for venting* the vent gases to the outdoors unless the necessary parts to accomplish this are of specified types listed by a nationally recognized testing agency or the boiler manufacturer's instructions and marking identify and specify the use of such specific parts (see 1.34.1b16 and 1.36.12e).

1.2.11

A boiler for outdoor installation shall have all controls and electrical wiring enclosed and adequately protected from climatic conditions.

1.2.12

A boiler for outdoor installation shall be provided with a venting system approved as a part of the boiler; unless the boiler is suitable for use with a conventional venting system. A venting system which is part of a boiler shall be provided with a means for secure attachment to the boiler.

1.2.13

Special construction provisions applicable to Category II, III or IV boilers are outlined under 1.2.11, 1.17, Condensate Disposal, 1.28.3 through 1.28.5, 1.34.1-b16, -b18, -b19, -c4, -c7 and -c8, 1.35-d and -e, and 1.36.12-e.

1.2.14

Special construction provisions applicable to boilers for outdoor installation are outlined under 1.2.12, 1.2.12, 1.4.7, 1.4.8, 1.5.3, 1.5.4, 1.9.2-a2, 1.22.2, 1.29.1, 1.29.2, 1.36.2-a3, and 1.36.14-c.

* Means for venting may be accomplished by a method specified by the manufacturer.

1.2.15

Special construction provisions applicable to direct vent boilers are outlined under 1.1.3, 1.2.9, 1.2.10, 1.2.11, 1.4.9, 1.6.15, 1.22.3, 1.29.1, 1.32, Vent-Air Intake Pipes of Direct Vent Systems, 1.34.1-b16, 1.34.1-c13, 1.34.4, 1.36.2-a2, 1.36.10, 1.36.12-d, 1.36.12-e, and 1.36.21.

1.2.16

The burner of a boiler incorporating a conversion burner design certified under the Standard for *Domestic Gas Conversion Burners, ANSI Z21.17 • CSA 2.7*, shall be deemed to comply with the following construction provisions: 1.5.1, 1.6.1, 1.6.3, 1.6.4, 1.6.6 through 1.6.9, 1.6.13, 1.7.2 through 1.7.7, 1.8.2, 1.8.3, 1.10.2, 1.10.3, 1.12.1 through 1.12.4, 1.12.9 through 1.12.11, and 1.12.14.

1.2.17

Boilers for indoor installation with input ratings of 400,000 Btu/hr (117 228 W) or less shall comply with the requirements of alcove or closet installations.

1.3 Assembly

1.3.1

Parts that may come in contact with the operator's hand during normal adjustment or servicing shall be free from sharp projections or edges and projecting screw ends.

1.3.2

Fasteners used to attach air shutters, manifold supports, or other parts which must be removed for normal servicing or replacement, shall be of the reusable type, and shall be constructed of corrosion-resistant material or, if of steel, shall have a metallic corrosion-resistant coating.

1.3.3

Insulating materials shall be mechanically or adhesively retained in place. Insulation which may be removed during normal cleaning shall require the use of tools for removal.

Insulation on vertical surfaces of a boiler shall be securely attached to either the boiler or the boiler jacket by the manufacturer except where the combination of jacket and boiler provide full support for the insulation.

Onepiece insulation for field attachment to the vertical surfaces of a boiler is acceptable if properly sized and shaped, including all necessary cutouts, to fit such surfaces. Adequate support shall be provided by not less than two corrosion-resistant straps supplied by the manufacturer with instructions for their proper installation.

1.3.4

Insulation which may be contacted during adjustment, cleaning or servicing shall be of sufficient strength and durability to withstand normal handling or shall be adequately protected.

1.3.5

Insulation on horizontal surfaces in the base which may be exposed to condensation from combustion products shall be nonabsorbent or adequately protected from condensate.

1.4 Accessibility

1.4.1

All controls shall be accessible for normal servicing and functional adjustment in position and shall be replaceable during normal servicing. Manifold assemblies which permit removal of a control(s) intact shall be considered to comply with this provision. Removal of an access panel or door to provide access to a control compartment shall be considered acceptable.

1.4.2

It shall be possible to oil any motor, blower, fan or pump bearings, which require that lubricant be added, without dismantling or removing any portion of the draft hood or venting system.

1.4.3

Flue gas passageways shall be accessible for cleaning.

1.4.4

Heads and nuts of bolts which must be removed to permit removal of clean-out plates shall not be located so as to contact flue gases, unless the bolts and nuts are of corrosion-resistant material.

1.4.5

Flue baffles shall be removable for cleaning or shall be designed so they cannot be dislodged or distorted during cleaning. Flue baffles which are removable for cleaning shall be designed so they cannot be replaced in other than the correct position.

1.4.6

Access panels and such insulation as need be removed for normal service and accessibility shall be designed so repeated removal and replacement will not cause damage or impair insulating value.

1.4.7

Any access door or panel of a boiler for outdoor installation shall be constructed so as to prevent the accumulation of water within the boiler when subjected to the rain test specified in 2.27.1.

1.4.8

Any access door or panel exposed to the outdoors shall require the use of a tool to open.

1.4.9

Connections between the combustion chamber and the casing of a direct vent boiler shall be constructed to prevent leakage of flue gases.

1.4.10

Clean-out panels, when provided, shall prevent leakage through the joint. This may be achieved by the use of mechanical joints or fireproof gaskets with adequate joining pressure applied.

1.4.11

Gaskets shall be suitable for the temperatures to which exposed and shall have sufficient durability to withstand expected usage.

1.5 Combustion Air And Ventilation Openings

1.5.1

When a separate automatic combustion air door is provided, the door shall open by gravity if the automatic controlling means becomes inoperative.

When an automatic combustion air door is directly connected to an automatic valve, the air door need not open should the automatic valve fail to open.

Manipulation of an automatic combustion air door shall not cause the automatic valve connected to it to open.

1.5.2

The bottom of any combustion air or ventilation opening shall not be less than 1 in (25.4 mm) above floor level unless all performance provisions can be met with the bottom of the opening blocked to a distance of 1 in (25.4 mm) above floor level.

1.5.3

On a boiler for outdoor installation, the bottom of the combustion air opening shall not be less than 12 in (305 mm) above the bottom of the boiler.

1.5.4

Each combustion air intake, draft hood relief and vent opening shall have a minimum dimension of not less than $\frac{1}{4}$ in (6.4 mm).

On a boiler for outdoor installation, all outside air inlet openings, including draft hood relief openings, shall prevent the entrance of a $\frac{33}{64}$ in (13.1 mm) diameter rod.

On a boiler for indoor installation having an input rating of 400,000 Btu/hr (117 228 W) or less, the minimum dimension of openings providing direct access to burner flames which are visible with all panels in place shall not be greater than $\frac{3}{4}$ in (19.1 mm). Flames directly accessible from these openings shall not be closer to these openings than five times the openings' minimum dimensions.

1.5.5

Boilers equipped with an induced draft or power burner shall have an air flow proving means to prevent gas flow to the main burners in the event of inadequate air flow, such as pressure switches, sail switches, or differential switches.

1.6 Main Burners

1.6.1

Bodies of burners (including mixer head, mixer tube and burner head) shall be of substantial and durable construction. They shall be constructed of either:

- a. Materials having melting points above 1450°F (788°C); or
- b. Materials having melting points of from 1000 to 1450°F (538 to 788°C).

The design and materials used in "b" above shall comply with 2.12.1.

1.6.2

Burners shall be constructed of a corrosion-resistant material or have a corrosion-resistant finish to resist corrosion by condensate. Steels with coatings, such as paint suitable to the temperature to which exposed, and cast iron are considered corrosion resistant.

1.6.3

Ports shall be machined or otherwise accurately made.

1.6.4

Steel pipe or tubing, when tapped or threaded and used in the construction of a burner, shall comply with the *Standard for Welded and Seamless Wrought Steel Pipe, ANSI/ASME B36.10M*.

1.6.5

Joints, when used in the pressure zone or in the burner head of a burner assembly, shall be gastight and shall not depend for mechanical strength or primarily for tightness on cement or other sealing material, except where such joints form part of the port area. Joints shall be securely bolted, screwed, machined, welded, brazed or be of equivalent construction.

1.6.6

Bolt holes shall not intersect gasways unless provision is made to provide gastightness.

1.6.7

Gauze shall not be used in burner construction.

1.6.8

Burner parts requiring field assembly shall be constructed so they cannot be incorrectly fitted together within the boiler, or they shall bear a Class I marking indicating the correct method of assembly.

1.6.9

Sheetmetal burner parts shall be at least 0.0304 in (0.772 mm)* thick AISI C1010 steel or of metal having equivalent or superior strength and durability.

1.6.10

All burners shall be constructed and installed so they can be easily removed, cleaned and replaced in the field without the use of special tools. Ribbon burners shall be constructed so the ribbon assembly is securely fixed in position.

1.6.11

Main burners and mixer tubes shall be properly placed and securely positioned without the use of set screws in the high temperature zone so they will not twist, slide or drop out of position. They may be attached to their supports by means of hex head bolts, cotter pins, or hex head screws within the burner compartment if the fasteners are easily accessible, are made of corrosionresistant material, and are not located in a high temperature zone. Restrictions as to the method of fastening need not apply to mixer tubes of single port burners or to temporary fastenings for shipping. The construction shall be such that, even without the use of fasteners, the burner can be securely installed in the boiler only in the correct position.

1.6.12

Burner and mixer tubes shall be removable through access openings or doors without disconnecting, dismantling or removing parts other than the access door and the fastening means permitted in 1.6.11. This provision does not apply to pilot burners and main burners or manifolds, or both, which are easily removed as a unit, and mixer tubes of single port burners.

1.6.13

When carryover flames are necessary to accomplish ignition between adjacent rows of ports or adjacent burners, carry over shall be effected by more than one series of ports or by other means which have been demonstrated to be satisfactory in the field.

* This corresponds to No. 20 U.S. Standard gage sheet steel with all applicable minus tolerances included.

1.6.14

Provision shall be made to permit observation of main burner flames during adjustment and under operating conditions.

1.6.15

A flame observation port of a direct vent boiler shall be constructed of heatresistant material and, unless located within the cabinet casing, shall be protected from mechanical damage. Glass, if used, shall be framed and not less than $\frac{1}{8}$ in (3.2 mm) thick.

1.7 Primary Air Adjustment Means

1.7.1

Primary air adjustment means, when provided, shall be designed so the flow of primary air can be controlled to provide proper flame characteristics.

1.7.2

Primary air adjustment means shall not change position by the action of gravity when the means of locking the adjustment is loosened sufficiently to permit adjustment.

1.7.3

Primary air adjustment means, when provided on a main burner, shall be designed so as to give a yellow-tipped flame when adjusted for minimum primary air.

1.7.4

Provisions shall be made for fixing adjustable pilot and main burner primary air adjustment means accurately in position. Main burner primary air adjustment means shall be accessible with the burner in operation.

1.7.5

Air shutters shall be constructed of a corrosion-resistant material, or have a corrosion-resistant finish, except when the type of material or construction employed will prevent the air shutter from sticking or corroding in position. Cast-iron air shutters are considered acceptable.

1.7.6

Sheet-metal air shutters shall be not less than 0.0254 in (0.645 mm)* thick. If sheet-metal air shutters are less than 0.0508 in (1.29 mm)** thick, they shall have the outer edges turned 90 degrees (1.57 rad) or be otherwise reinforced.

1.7.7

When air shutters are used, clearances, such as between air mixer and air shutter faces and around orifice holders, shall be reduced to a practical minimum so as to have no appreciable effect on the flame characteristics when stopped by lint or other materials.

1.8 Orifice Spuds And Orifice Fittings

1.8.1

A threaded hexagon head or equivalent fixed orifice spud shall be provided for each main burner and shall be readily accessible after the burner and mixer tube have been removed.

* This corresponds to No. 22 U.S. Standard gage sheet-steel with all applicable minus tolerances included.

** This corresponds to No. 16 U.S. Standard gage sheet-steel with all applicable minus tolerances included.

1.8.2

Main burner orifice spuds shall be threaded to their holders at least 3¹/₂ full threads.

1.8.3

Main burner orifice spuds and orifice spud holders shall be constructed of metal having a melting point of not less than 1450°F (788°C).

1.8.4

Readily removable fixed orifice spuds shall be provided, independent of the operation of the pilot gas valve, for limiting the amount of gas consumed by the pilot. For continuous pilots, the maximum normal rate obtainable by such means shall not exceed 2000 Btu/hr (586 W) per pilot at 3.5 in wc (871 Pa) pressure with natural, manufactured or mixed gases or LP gasair mixtures, or 11.0 in wc (2.74 kPa) pressure with liquefied petroleum gases, when using the appropriate pilot equipment for each test gas. For intermittent ignition pilots having normal input rates exceeding 2000 Btu/hr (586 W) per pilot, a redundant seated valve shall be provided (see 1.15.4).

When a separate gas appliance pressure regulator is installed in the pilot line, the outlet pressure specified by the manufacturer shall be employed in determining the maximum rate of the pilot in accordance with this provision.

1.9 Automatic Gas Ignition Systems

1.9.1

Automatic gas ignition systems (see Part IV, Definitions) and components shall comply with the applicable provisions of the Standard for *Automatic Gas Ignition Systems and Components ANSI Z21.20 or CAN1-6.4* and, if applicable, the Standard for *Combustion Safety Controls and Solid State Igniters for Gas and Oil Burning Equipment, CSA C22.2 No. 199*.

Automatic gas ignition system timings (see Part IV, Definitions) established under the above standard shall not exceed those shown in Table I-A through Table I-D, as applicable.

1.9.2

Every boiler and each completely separated combustion chamber of the boiler shall be equipped with an automatic gas ignition system(s). This system(s) shall be designed to function in one of the following manners:

- a. Provide for ignition of main burner gas by means of a proved pilot. If the presence of the pilot is not proved, provide for automatic shutoff of:
 1. The main burner gas.
 2. The pilot burner gas, unless the boiler is equipped with an automatic gas ignition system not requiring manual lighting and which complies with 2.7.15, has an input rating of 2,500,000 Btu/hr (732 678 W) or less, and is either for use only with a gas having a specific gravity less than 1.0, or is for outdoor installation only.
- b. Provide for the ignition of main burner gas by using a direct ignition system which only supervises the main burner(s) flame. For boilers utilizing other than natural draft atmospheric burners, a direct ignition system may be used provided the total input is less than or equal to 5,000,000 Btu/hr (1 465 356 W). For boilers with a total input greater than 2,500,000 Btu/hr and less than or equal to 5,000,000 Btu/hr (1 465 356 W), the total input at ignition shall not exceed 2,500,000 Btu/hr. (732 678 W). For boilers utilizing natural draft atmospheric burners, the application of direct ignition systems is limited to burners having input ratings of 400,000 Btu per hour (117 228 W) or less per

ignition system. When multiple direct ignition systems are used, the total input at ignition to all zones shall not exceed 2,500,000 Btu/hr (732 678 W) and there shall be no interconnection between the combustion zones served by separate ignition systems at any point below the draft hood, or the flue outlet if no draft hood is used.

If the presence of the main burner flame is not proved, provide for automatic shutoff of main burner gas.

In the event of main burner flame outage during an operating cycle, provide for automatic shutoff of the main burner gas without reenergizing the direct ignition device or provide for prompt and safe reignition of main burner gas by reenergizing the direct ignition device as specified in 2.8.4.

- c. Provide for ignition of main burner gas using a direct ignition system incorporating a proved igniter which proves that the igniter is capable of ignition prior to initiation of main burner gas flow.

For systems which supervise main burner flame during an operating cycle and deenergize the igniter, provide for automatic shutoff of main burner gas in the event of main burner flame outage.

1.9.3

In addition to the automatic gas ignition system functions specified in 1.9.2-a, a system having an interrupted ignition source shall provide for supervision of the main burner flame only following the main burner trial for ignition period. If the presence of the main burner flame is not proved within the trial for ignition period specified in Table I, the system shall provide for automatic shut off of the main burner and pilot burner gas.

1.9.4

A proved igniter which ignites a pilot is evaluated under 2.7, Piloted Ignition System . A proved igniter which provides for ignition of the main burner gas is evaluated under 2.9, Proved Ignition System . Proved igniter systems, shall comply with the applicable provisions of the *Standard for Automatic Gas Ignition Systems and Components, ANSI Z21.20*.

1.9.5

When an automatic relight pilot system is used, it shall be of a type that will act to reestablish the ignition means in 0.8 second or less, or a mechanical or electrical interlocking means shall be provided to prevent the flow of gas to the main burner(s) when the automatic relight pilot system is energized.

1.9.6

A constant burning pilot shall be placed so as to be easily seen or, if concealed in normal operation, shall be capable of being reached by the simple removal of an access door or panel without the use of tools, except as specified in 1.4.8.

1.9.7

A manually lighted pilot burner shall be located so as to be capable of being lighted without burning the hand. If a pilot burner ignition device or lighter rod is necessary for safe and convenient pilot ignition, it shall be provided. If a lighter rod is used, means shall be provided for permanently attaching it to the boiler.

1.9.8

If a piezo-electric spark device is used for pilot burner ignition, it shall comply with the Standard for *Manually-Operated Piezo-Electric Spark Gas Ignition Systems and Components, ANSI Z21.77 • CSA 6.23*.

1.9.9

When a piezo-electric spark device is provided, the actuating means of the spark generator shall be located so as to be easily seen or, if concealed in normal operation, shall be capable of being reached by the simple removal of an access cover without the use of tools. The use of tools to remove the access cover of a boiler for outdoor installation shall be acceptable.

1.9.10

When a manually lighted pilot is provided on a boiler with a total input rating of 400,000 Btu/hr (117 228 W) or less, the design of the control(s) shall be such that main burner gas flow cannot occur while the pilot is being lighted. The interruption of main burner gas flow shall not depend on the operation of a manual valve which is not mechanically interlocked with the pilot gas control, nor on the thermostat or a separate switch. After the pilot has been established and the safety shutoff device remains in a position that would permit main burner gas flow, an additional manual operation of a control shall be necessary to permit main burner gas flow.

1.9.11

Pilot burners shall be placed so their flames may be directly observed with the main burner(s) off and, unless other means are available for checking operation, shall be observable with the main burner(s) on.

1.9.12

Automatic ignition devices shall be positively positioned with respect to the main burner ports. Means shall be provided to prevent incorrect assembly or reversible mounting of any ignition device in relation to the burner being served.

1.9.13

Automatic gas ignition system components shall be installed so the operation of these components and main burner ignition will not be affected by falling scale and dirt during normal operation.

1.9.14

Automatic gas ignition system components shall be installed so these components will not be subjected to dripping water during installation or service.

1.9.15

Automatic gas ignition system components, and bleed assemblies when used, shall be made secure against accidental displacement. Except as noted below, pilot burner and igniter assemblies shall be constructed and installed so they may be removed without the use of special tools and with reasonable care even when hot without removing main burners, controls or accessories, or breaking or disturbing any gas connections other than that of the pilot supply, bleed supply or manifold unions. Automatic gas ignition system components and main burners which are easily removed as a unit are considered acceptable.

1.9.16

Slotted ports connecting ignition and thermal element ports shall be milled or otherwise accurately formed.

1.9.17

The flame detector of an automatic gas ignition system shall ensure the pilot is lit before main gas is allowed to flow. (See 2.7.16.)

1.9.18

A proved igniter system provided on a boiler with an input rate of 2,500,000 Btu/hr (732 678 W) or greater shall:

- a. Incorporate main burner flame proving means;

- b. Permit ignition of main burner gas only at input rates of 2,500,000 Btu/hr (732 678 W) or less; and
- c. Require proof of main burner flame before allowing the input to the main burner to be increased above 2,500,000 Btu/hr (732 678 W).

1.10 Flame Spreaders

1.10.1

When metal is used in the construction of a flame spreader or its support, the metal shall be in accordance with that specified in 2.12.2.

1.10.2

Flame spreaders and their supports shall be constructed so they cannot be incorrectly fitted together, or they shall bear a Class I marking indicating the correct method of assembly. When it is necessary to remove the flame spreader for service or assembly, it shall not be threaded to its support unless the support is readily removable.

1.10.3

Flame spreader supports shall be constructed so the flame spreader cannot be supported at other than the correct distance from the burner.

1.10.4

Burners shall be provided with means to prevent disintegrated ceramic flame spreader material from falling into the burner port(s). They shall also be designed so disintegration of the ceramic will not cause a hazardous change in the operating characteristics of the burner.

1.11 Manual Gas Valves

1.11.1

Manual gas valves shall comply with the applicable provisions of the Standard for *Manually Operated Gas Valves for Appliances, Appliance Connector Valves and Hose End Valves, ANSI Z21.15 • CGA 9.1*, or the Standard for *Combination Gas Controls for Gas Appliances, ANSI Z21.78 • CSA 6.20*.

1.11.2

When a pilot burner(s) is provided, manual valve means for turning on and shutting off the gas supply to each pilot burner shall be provided and shall be located so as to be accessible.

1.11.3

Boilers with input ratings of 400,000 Btu/hr (117 228 W) or less shall have either:

1. An appliance main gas valve provided in an accessible location for turning on or shutting off the gas to the main burner(s); or
2. An accessible switch integral to the gas control for manually interrupting the ungrounded leg of the electrical power to both automatic valves, provided that the boiler does not have a continuous pilot ignition system and that it has two automatic valves in series controlling main burner gas flow.

Boilers with input ratings greater than 400,000 Btu/hr (117 228 W) shall have an appliance main gas valve provided in an accessible location for turning on or shutting off the gas to the main burner(s).

1.11.4

When a manually lighted pilot is provided on a boiler with a total input rating over 400,000 Btu/hr (117 228 W), the manual gascontrol shutoff valve, a separate valve, or a safety shutoff device incorporating a mechanical interrupter shall be located so main burner gas can be manually shut off and pilot burner gas controlled during manual lighting of the pilot.

1.11.5

Main burner valves shall not be provided on boilers equipped with power burners.

1.11.6

Separate manual pilot shut off valves shall be easily distinguishable from main burner valves.

1.11.7

For boilers with total input ratings over 400,000 Btu/hr (117 228 W) a manually operated shutoff valve shall be provided after the downstream safety shutoff valve for each main burner, except the input flow ratio control valve which may be downstream of the shutoff valve.

1.12 Gas Supply Lines

The following construction provisions apply to the gas supply lines used within a boiler.

1.12.1

Steel pipe employed as gas conduit on a boiler shall comply dimensionally with the Standard for *Welded and Seamless Wrought Steel Pipe, ANSI/ASME B36.10M*.

1.12.2

Tapped holes for gas valves, pilots or other branch supply lines shall have not less than $3\frac{1}{2}$ taper pipe threads in accordance with the Standard for *Pipe Threads, General Purpose (Inch), ANSI/ASME B1.20.1*.

1.12.3

Formed supply lines shall have all bends smoothly made without any appreciable reduction in the crosssectional area, shall reveal no imperfections occasioned by the forming process, shall be annealed if necessary to remove internal stresses, and shall be thoroughly cleaned inside to remove loose particles.

1.12.4

Ends of piping and tubing shall be carefully reamed to remove obstructions or burrs.

1.12.5

When steel pipe is used for pilot burner manifolds, it shall not be less than NPS $\frac{1}{4}$. When used for individual pilot lines, it shall not be less than NPS $\frac{1}{8}$.

1.12.6

When semi-rigid tubing is employed as gas conduit, it shall not be less than nominal $\frac{1}{8}$ inch outside diameter.

1.12.7

Aluminum semi-rigid tubing shall not be exposed to condensate.

1.12.8

Aluminum semirigid tubing shall not be acceptable for use where it passes through insulating material of other than neutral reaction, unless the tubing is protected from the insulation.

1.12.9

Copper semirigid tubing or tubing with internal copper surfaces, when used for conveying gas, shall be internally tinned or equivalently treated to resist sulphur corrosion.

1.12.10

Nonferrous semirigid tubing employed as gas conduit shall have a wall thickness in accordance with Table II, Maximum Acceptable Wall Thickness for Semi-rigid Tubing.

1.12.11

Tubing and fittings used as gas conduit shall be capable of withstanding a temperature of 1000°F (538°C) without melting.

Tubing and fittings used as gas conduit shall not be exposed to temperatures in excess of those specified in Table III, Maximum Tubing and Fitting Temperatures, when the boiler is operated as specified in 2.19.1.

1.12.12

Gas supply piping, tubing, and fittings shall be rigidly supported.

1.12.13

Gas supply piping to which connections are made for main and pilot burners, lighters or other branch supply lines shall be assembled or rigidly supported so as to prevent turning or displacement while making connections to the building piping or during the ordinary handling of the boiler.

1.12.14

Compounds used on threaded joints of gas piping shall be resistant to the action of liquefied petroleum gases.

1.12.15

Unions in gas lines shall be of the ground-joint or flanged-joint type having packing resistant to the action of liquefied petroleum gases and suitable for the temperature to which it is exposed.

1.12.16

When a vertical section of piping is supplied on the upstream side of the gas controls, a sediment trap in this piping shall be supplied by the manufacturer. When a vertical section of piping is not supplied, the installation instructions shall specify the installation of a sediment trap at the inlet of the gas connection to the boiler.

1.12.17

When the pilot gas supply line is taken from a horizontal line, the connection shall be made on the side, top or, if means are provided to prevent condensate from entering the pilot line, the bottom of the horizontal line. When a pilot gas supply line is taken from a vertical line, the connection shall be above the main burner supply line.

1.12.18

Two NPS $\frac{1}{8}$ or NPS $\frac{1}{4}$ plugged tappings, accessible for test gage connection, shall be furnished. One shall be upstream of the gas appliance pressure regulator for measuring the minimum permissible gas supply pressure for the purpose of input adjustment. The other shall be downstream from the last main line gas control for measuring the manifold gas pressure. A boiler with a total input rating over 400,000 Btu/hr (117 228 W) shall also have a test opening downstream of the main burner safety shut-off valve(s) and upstream of the manual test firing valve for checking operation and/or leakage of controls.

The connection shall be a pipe plug or pipe cap with threads in accordance with the *Standard for Pipe Threads, General Purpose (Inch)*, ANSI/ASME B1.20.1. If the plug is of the slotted type, it shall also incorporate square or hex flats, or;

When the pressure test gage connection is provided as part of the control, this pressure test gage connection shall be:

- a. A tapping sealed by a NPS $\frac{1}{8}$ or NPS $\frac{1}{4}$ plug or cap as specified above; or
- b. A hose fitting with a minimum length of 0.355 in (9.02 mm) and a 0.355 in (9.02 mm) maximum/0.335 in (8.50 mm) minimum outside diameter and which incorporates a sealing means. The construction of the hose fitting shall incorporate an internal restriction not greater than 0.0394 in (1.0 mm) in diameter.

1.12.19

Connections for pilot gas supply lines shall be located so that pilot lines of semirigid tubing and the pilot valves will not be unnecessarily exposed to damage hazards.

1.12.20

Gas supply connections shall be suitably plugged, capped, or protected to prevent contamination prior to installation.

1.13 Bleeds And Vents

1.13.1

When required, a bleed line from a diaphragm type automatic valve shall be furnished. The gas appliance pressure regulator shall be equipped with either a vent line or a vent limiter.

1.13.2

A bleed restrictor for a diaphragm type automatic valve on a boiler having a normal input rating of 400,000 Btu/hr (117 228 W) or less shall be integral and nonadjustable. A bleed restrictor may be adjustable and supplied as part of the valve but does not have to be integral when provided on a boiler having a normal input rating over 400,000 Btu/hr (117 228 W).

1.13.3

When there is a continuous pilot:

1. When required, a bleed line from a diaphragm type automatic valve and, when furnished, a vent line from the regulator shall vent into the combustion chamber. A common bleed line and vent line shall not be used.
2. When required, a bleed line or vent line shall terminate in a suitable burner tip constructed of metal having a melting point of not less than 1450°F (788°C). The tip shall be secured in a fixed position relative to the pilot burner and located so the escaping gas shall be readily ignited by the pilot and the heat liberated thereby shall not adversely affect the normal operation of the automatic gas ignition system.

1.13.4

When there is no continuous pilot:

1. A vent line, when furnished, from the regulator shall be vented according to the manufacturer's instructions but not into the combustion chamber, except on a boiler where all combustion air is supplied by mechanical means and which is equipped with a combination control incorporating an integral vent limiter and two automatic valves, one of which is upstream of the regulator diaphragm.

2. When furnished, a bleed line from a diaphragm type automatic valve shall be vented in such a manner as to provide for burning of the bleed gas during normal operation. In the event of diaphragm rupture, the bleed shall not permit the escape of more than 1.0 ft³/hr (7.87 cm³/s) of 0.6 specific gravity (relative density) gas at 7.0 in wc (1.74 kPa) pressure for natural, manufactured or mixed gases or LP gas-air mixtures, and 0.5 ft³/hr (3.93 cm³/s) of 1.53 specific gravity (relative density) gas at 11.0 in wc (2.74 kPa) pressure for liquefied petroleum gases.

1.13.5

When a vent line is provided for a gas appliance pressure regulator, a No. 40 mesh brass, aluminum, or stainless steel wire screen, sufficient in size to provide free area equal to the area of the escapement orifice, shall be installed in and made a part of the connecting fitting for installation at the regulator vent tapping. The fitting, when tightened against the screen, shall provide no opening larger than the mesh of the screen specified. This provision is only applicable to gas appliance pressure regulators having escapement orifices larger than 0.0165 in (0.419 mm) in diameter.

1.13.6

Also see 1.9.15 .

1.14 Automatic Valves And Safety Shutoff Valves

1.14.1

Automatic valves and safety shutoff valves shall comply with the applicable provisions of the Standard for *Automatic Valves for Gas Appliances, ANSI Z21.21 • CSA 6.5*, or the Standard for *Combination Gas Controls for Gas Appliances, ANSI Z21.78 • CSA 6.20*.

1.14.2

All gas to the main burner(s) shall pass through at least two valves in series which may or may not be in a single control body. The boiler shall be equipped as indicated below for the applicable input rate classification or any greater input classifications:

400,000 Btu/hr (117 228 W) or less:

- a. At least two automatic valves (see Part IV, Definitions), which operate each time there is a call for heat and also serve as safety shutoff valves. The operating control may be actuated by boiler water temperature, steam pressure or the temperature of the heated space, outdoor air, or both, and shall control the automatic valves; or
- b. At least one automatic valve and one safety shutoff valve. The automatic valve shall operate each time there is a call for heat and also serve as a safety shutoff valve. The safety shutoff valve shall serve only as a safety shutoff valve, control main burner gas, comply with 1.9.10, when applicable, and shall be controlled at least by the automatic gas ignition system and a secondary limit control. This secondary limit control shall have a sensing element separate from the primary limit control. The secondary limit control must be actuated by boiler water temperature or steam pressure.

Greater than 400,000 Btu/hr (117 228 W) but less than or equal to 5,000,000 Btu/hr (1 465 356 W):

At least two automatic valves (see Part IV, Definitions), which operate each time there is a call for heat and also serve as safety shutoff valves. These valves may be in a single valve body with the valve ports in series leading to the valve outlet.

Greater than 5,000,000 Btu/hr (1 465 356 W):

Two safety shutoff valves in series with at least one valve complying with the requirements for Commercial/Industrial Safety Shut-Off Valves, in Parts III and IV of the Standard for *Automatic Valves for Gas Appliances*, ANSI Z21.21 • CSA 6.5. At least one safety shutoff valve shall incorporate valve seal overtravel (proof of closure) interlock.

1.14.3

A boiler which includes a gas valve with valve seal overtravel interlock shall prevent pre-purge and burner start when the valve overtravel interlock switch verifies that the valve is in the open position.

1.14.4

When an automatic valve is used to control the gas supply to the main burner(s), no means for manual operation shall be permitted.

1.14.5

Reverseacting gasactuated controls shall be arranged so the escapement gas bleeds off only momentarily and there is no continuous bleed during the normal "off" period. Off periods resulting from the operation of controls such as limit controls, low water cutoff devices or safety shutoff devices are not considered to be normal "off" periods.

1.14.6

Main gascontrol equipment and main gas connections thereto, with the exception of connections to controls external to the boiler and upstream from the gas appliance pressure regulator, shall be furnished ready for assembly on the boiler, with the connections cut, formed to exact size and properly identified by means of a Class VI marking.

1.14.7

A safety shutoff valve, other than as required in 1.14.2-b, may perform other control functions in addition to safety shutoff.

1.14.8

All main burner gas conduits must have a safety shutoff valve. For main burner gas conduits exceeding 2,500,000 Btu/hr (732 678 W), the safety shutoff valve(s) shall comply with 1.14.2.

1.14.9 The valve closing times of all safety shutoff valves shall not exceed the applicable timings specified in Table I-A through Table 1-D, as applicable, under normal operating conditions.

1.14.10

All automatic valve(s) or safety shutoff valve(s) in series, which may or may not be in a single control body, that control(s) gas flow rate greater than 400,000 (117 228 W) Btu/hr shall be provided with means to check for leakage on each valve seat independently.

1.15 Gas Appliance Pressure Regulators And Gas Pressure Interlocks

1.15.1

A gas appliance pressure regulator to control the gas supply pressure to the main burner shall be supplied with each boiler.

1.15.2

Gas appliance pressure regulators, including vent limiters when so equipped, shall comply with the applicable provisions of the Standard for *Gas Appliance Pressure Regulators*, ANSI Z21.18 • CSA 6.3, or the Standard for *Combination Gas Controls for Gas Appliances*, ANSI Z21.78 • CSA 6.20 and shall be of either

the adjustable or nonadjustable type (see Part IV, Definitions). The manufacturer's specified hourly Btu rating(s) of the boiler shall be within the regulation range of capacity (see Part IV, Definitions) of the regulator as determined under the above Standards.

1.15.3

When a single gas appliance pressure regulator is used to control the pressure of both the pilot and main burner gas, it shall be of the type suitable for pilot and main burner load application as designated by the following symbol adjacent to the regulator model number:

- a. $\textcircled{\text{P}}$ for an appliance having a pilot gas flow rate less than 0.50 but not less than 0.15 ft³/hr (less than 3.93 but not less than 1.18 cm³/s); or
- b. $\textcircled{\text{P}}$ or $\textcircled{\nabla}$ for an appliance having a pilot gas flow rate of 0.50 cubic foot per hour (3.93 cm³/s) or greater.

1.15.4

On a boiler having a total input rate over 400,000 Btu/hr (117 228W), pilots which exceed 2000 Btu/hr (586 W) input rate shall have the gas supply pressure to the pilot or group of pilots regulated by an approved gas pressure regulator independently of the main burner gas supply.

1.15.5

On a boiler having a total input over 2,500,000 Btu/hr (732 678 W), a high gas pressure switch shall be provided and interlocked so as to cause safety shutdown at a manifold pressure not in excess of 150 percent of the manufacturer's specified manifold gas pressure.

Method of Test

High gas pressure switches with field adjustable settings shall be adjusted to their highest setting. The boiler shall be placed in normal operation and the manifold pressure gradually increased until the high gas pressure switch functions to cause safety shutdown. When the increased manifold pressure cannot be readily obtained by adjustment of the gas appliance pressure regulator, the regulator may be removed or locked in its full open position. The switch shall function before the manifold pressure exceeds 150 percent of the manifold pressure marked on the appliance rating plate in accordance with 1.36.2-f.

1.15.6

High gas pressure switches shall be listed by a nationally recognized testing agency.

1.16 Adjustment For Minimum Input Rating

When controls are designed for two or more rates, the adjustment means, when provided, shall be readily accessible and leakproof. Nonadjustable controls shall be set by the manufacturer so the low-flow condition is not less than the manufacturer's specified minimum input rating.

In the case of a power burner, the control shall be constructed so no adjustment of the rate of gas flow is permitted, unless the burner system is such that adjustment of the control will not adversely affect the proportion of gas and air supplied to the burner.

1.17 Condensate Disposal

1.17.1

On a Category II or IV boiler, means shall be provided for the collection and disposal of condensate.

1.17.2

A venting system supplied with a Category II or IV boiler shall have means provided for the collection and disposal of condensate.

1.17.3

A condensate trap(s), if necessary for compliance with 2.29, Condensate Disposal System(s), shall be provided as part of the boiler or supplied with the boiler along with instructions for proper installation.

1.17.4

The condensate drain line(s) supplied shall not be adversely affected by the composition of the condensate.

1.17.5

Where a condensate neutralizer is provided, an overflow means shall be provided for the collection and disposal of condensate in the event the neutralizer becomes plugged.

1.18 Pilot Gas Filters

1.18.1

Pilot gas filters complying with the Standard for *Pilot Gas Filters*, ANSI Z21.35 • CGA 6.8, shall be provided for pilots on boilers:

- a. Having pilot burner input rates of 1000 Btu/hr (293 W) or less per pilot burner.
- b. For use with manufactured gas.

1.18.2

The manufacturer's specified capacity of a pilot gas filter shall not be less than the rated capacity of the pilot burner with which it is used.

1.18.3

A pilot gas filter shall be installed at the point of pilot gas takeoff from the main gas supply line. When the pilot valve is combined with another control and does not constitute the pilot flow adjustment means, the pilot gas filter may be installed in the pilot line take-off from the combination control.

1.19 Limiting Devices

1.19.1

A high steam pressure limit control to limit steam pressure shall be supplied with a steam boiler. This control shall be listed by a nationally recognized testing agency.

1.19.2

A temperature limit control to limit hot water temperature shall be supplied with a hot water boiler. This control shall be listed by a nationally recognized testing agency.

1.19.3

A limit control shall be separate from the operating control. When the control system contains a separate safety shutoff valve, the limit control shall be wired to control this valve and may also control the operating valve.

1.19.4

On a boiler having a total input rating over 2,500,000 Btu/hr (732 678 W), a control for sensing steam pressure or water temperature, as applicable, shall be provided in addition to the limit control specified in 1.19.1 or 1.19.2. This additional control shall comply with 2.14, Steam Pressure Limiting Devices, or 2.15.1 and 2.15.2, as applicable, and may be used as an operating control.

1.20 Safety And Relief Valves

1.20.1

Hot water boilers shall be provided with a safety relief valve(s) that complies with the *ANSI/ASME Boiler and Pressure Vessel Code, Section IV ("Heating Boilers")*, or *CSA B51, Boiler, Pressure Vessel, and Pressure Piping Code*, as applicable.

1.20.2

Steam boilers shall be provided with a safety valve(s) which complies with the *ANSI/ASME Boiler and Pressure Vessel Code, Section IV ("Heating Boilers")*, or *CSA B51, Pressure Vessel, and Pressure Piping Code*, as applicable.

1.21 Low Water Cutoffs

1.21.1

A low water cutoff shall be supplied on a steam boiler. This cutoff may be in combination with a water feeder device.

1.21.2

Low water cutoffs shall comply with the Safety Standard for *Limit Controls, ANSI/UL 353*, or the *Standard for Temperature-Indicating and Regulating Equipment, CAN/CSA C22.2, No. 24*, as applicable.

1.21.3

The pressure rating of a low water cutoff shall be at least equal to the pressure setting of the safety valve.

1.21.4

Low water cutoffs shall be located so as to provide adequate access for cleaning, repairing, testing and inspection.

1.22 Thickness Of Materials

1.22.1

Outside casings constructed of sheet steel shall not be less than 0.0195 in (0.495 mm)* thick unless reinforcing or a double construction is employed, in which case strength equivalent to that afforded above shall be acceptable. The thickness of other metallic and nonmetallic outside casings shall be of equivalent strength and rigidity.

1.22.2

On a boiler for outdoor installation, ferrous materials used in the construction of the outside casing, and in an outside cabinet which is the sole enclosure of current carrying parts, shall be protected against corrosion by one of the coatings appropriate to the thickness of the part as outlined in Table IV, Minimum Corrosion Protection Of Ferrous Materials Used In The Construction Of Outside Casings Of Heaters For Outdoor Installation, and the notes applicable thereto, or by other metallic or nonmetallic coatings which have been shown to give equivalent protection.

* This corresponds to No. 24 U.S. Standard gage sheet steel with all applicable minus tolerances included.

Nonferrous cabinets, enclosures and outside portions of casings may be employed without special corrosion protection. The acceptability of the material shall be judged on the basis of its strength and rigidity.

1.22.3

Materials used in the construction of direct vent boilers shall have strength, rigidity, durability, resistance to corrosion and other physical properties at least equivalent to:

Vent pipes, and radiation shields exposed to combustion products as shown in Table V, Minimum Thickness Of Vent Pipes And Radiation Shields Exposed To Combustion Products On Direct Vent Boilers. In addition, vent pipes of aluminum may be used provided the material is 0.020 in (0.508 mm) thick having a corrosion resistance at least equivalent to Type 1100.

Liners, air intakes within the exterior casings, and radiation shields not exposed to combustion products and recessed portion of casings	0.0152 in (0.386 mm)** thick low carbon steel
Outside casings (casings of appliances which upon installation are isolated from physical contact are exempt from this specification	0.0254 in (0.645 mm)* thick low carbon steel
Air intakes exterior to casing	0.0152 in (0.386 mm)** thick with a zinc or cadmium coating equivalent to that specified in Table IV.

Materials shall be of such composition that they will not disintegrate to the extent that particles will separate and drop upon the burner and affect the safe operation of the boiler.

1.23 Boiler Construction

1.23.1

Boilers submitted for examination under this standard shall be ASME H-stamped in accordance with the *ANSI/ASME Boiler and Pressure Vessel Code, Section IV ("Heating Boilers")*, or *CSA B51, Boiler, Pressure Vessel, and Pressure Piping Code*, as applicable.

1.23.2

A dry leg, placed vertically above the burner level and formed as an integral extension of the intermediate heating section of the boiler shall not be subjected to direct heat.

1.23.3

A boiler for installation on combustible floors shall be constructed to prevent incandescent particles from falling onto the floor. Screens are not acceptable if the combustion air must pass through them.

* This corresponds to No. 26 U. S. Standard gage sheet steel with all applicable minus tolerances included.

** This corresponds to No. 22 U. S. Standard gage sheet steel with all applicable minus tolerances included.

1.24 Electrical Equipment And Wiring

This section is unique to United States. The Canadian electrical equipment and wiring provisions are contained in the *Standard for Electrical Features of Fuel-Burning Equipment, CAN/CSA-C22.2, No.3*, and in Exhibit E, Items Unique to Canada.

The provisions of this section apply to all wiring and electrical components unless otherwise specified. Room thermostats and thermostat wires are excluded.

Wiring to be done in the field between the boiler and devices not attached to the boiler, or between separate devices which are field installed and located, shall conform with the temperature limitation for wire [63°F (35°C) rise] when installed in accordance with the manufacturer's instructions.

Line-voltage wiring exterior to a boiler between the burner assembly and a limit control that can be accomplished with Type T wire enclosed in approved conduit or with approved metalclad cable as specified in this standard, need not be furnished by the manufacturer as part of the boiler if adequate instructions for installing such wiring are furnished with each boiler.

When wiring other than as indicated above is required, the wiring materials shall be furnished by the manufacturer with the boiler. When the boiler is not assembled and wired at the factory, such wiring shall be furnished as a harness with each boiler and arranged to facilitate attachment to the boiler when the boiler is assembled, in which case a connection diagram (see Part IV, Definitions) showing the exact arrangement of the wiring shall be provided with each boiler.

1.24.1

All electrical equipment, wiring and accessories built in or supplied by the manufacturer for direct attachment to the boiler shall be submitted for examination with the boiler.

1.24.2

Electrical equipment and linevoltage and safety circuit wiring supplied for use with and as a part of a boiler shall be of approved types and shall also be judged with respect to their suitability for the particular application, or shall be tested as an integral part of and with the boiler. All other lowvoltage wiring shall be suitable for the application and shall not be less than No. 18 AWG (0.82 mm²) with neoprene, thermoplastic or equally durable insulation having a minimum thickness of 0.012 in (0.305 mm).

Electrical equipment and wiring listed or certified by a nationally recognized testing agency qualified to certify or list electrical equipment or wiring shall be deemed to be of approved types.

1.24.3

Electrical circuits intended for connection at the boiler to field-installed line-voltage wiring shall terminate in a suitable junction box or boxes for permanent field connection to the supply circuit. Boxes shall have provisions to accommodate fittings for metal-clad cable or conduit and shall be located on a part of the assembly that does not require movement for normal servicing.

If wiring larger than No. 14 AWG (2.1 mm²) is used in the conduct of the test specified in 1.24.39, or if the temperature rise of conductors within the junction box, or of surfaces of the box likely to be in contact with conductors, exceeds 95°F (35°C) when the boiler is tested in accordance with 1.24.39, the following statement, or that part of it which may be applicable, shall be prominently displayed on the box by means of a Class V marking: "For field-wired connections use No. AWG wires rated for at least °F (°C)." The specified wire size shall be that used in the test, and the specified temperature rating shall not be more than 194°F (90°C). When connections for more than one supply circuit are made in the junction box, the marking shall be modified as appropriate, and shall require that all connections be made with wire rated for the highest temperature encountered in the test.

Compartments or junction boxes for connection of field wiring shall not be ventilated.

The size of a junction box in which field-installed conductors are to be connected by splicing shall not be less than that indicated in Table VI. A conductor passing through the box is counted as one conductor, and each conductor terminating in the box is also counted as one conductor. A field-furnished conductor for line-voltage circuits is considered to be not smaller than No. 14 AWG (2.1 mm²).

A junction box shall be fabricated in accordance with Table VII, Minimum Average Thickness of Sheet Metal Junction Boxes, except that steel shall not be less than 0.032 in (0.81 mm) thick [0.034 in (0.86 mm) thick if zinc coated], and nonferrous metal shall not be less than 0.045 in (1.14 mm) thick at points where conduit or metal-clad cable is to be connected in the field.

1.24.4

Enclosures of listed devices which contain terminals for electrical connections need not comply with the free space specifications of 1.24.3. However, the space provided shall be sufficient to provide ample room for the distribution of wires and cables required for the proper wiring of the device.

1.24.5

The general construction and assembly of electrical equipment and wiring shall be of a neat and workmanlike character. The wiring shall be positively located and supported. Electrical wiring shall be protected against damage from movable parts.

1.24.6

Wiring shall be done with insulated conductors having voltage and temperature ratings consistent with their use. Line voltage conductors shall not be smaller than No. 18 AWG (0.82 mm²), except in coils, resistance units or the internal wiring of electrical components.

1.24.7

Switches shall have current and voltage ratings not less than those of the circuit loads they control.

1.24.8

When within a burner, control or similar compartment, factory wiring involving line voltage of not more than 300 volts between parts attached to the same assembly with a predetermined fixed relationship, one to the other, may be done with Type SJO, SJT, or SPT3 cord or appliance wiring material having neoprene, thermoplastic or equally durable insulation of a thickness no less than as specified in Group B of Table VIII, Insulation Thickness of Factory Wiring Exposed in Burner or Fan Compartment, or Group A of the table when the wiring material is covered as specified in the footnote to Table VIII, judged on temperature limitations and usage suitability as defined in the *National Electrical Code, ANSI/NFPA 70*, provided:

- a. The compartment normally is closed;
- b. Wiring below openings located in other than vertical surfaces is protected;
- c. Openings in vertical surfaces will not permit the entrance of a $\frac{33}{64}$ in (13.1 mm) diameter rod where such straight rod may cause damage to the wiring; and
- d. Permitted openings are at least 2 in (50.8 mm) above the bottom of the compartment, if the compartment contains a motor.

Cords and other wiring material permitted in the preceding paragraphs shall be arranged to avoid being mechanically damaged, such as by closely following surfaces, and shall be supported.

Exception: Wiring of the types and thickness in Group A of Table VIII may be employed without regard to the footnote, if secured and supported to prevent damage.

1.24.9

Factory wiring of a lowvoltage safety circuit may be done with:

- a. SP2 cord having all neoprene insulation;
- b. SPT2 cord complying with the Standard for *Flexible Cords and Cables*, CSA C22.2 No. 49, or the Standard for *Flexible Cords and Fixture Wires*, UL 62;
- c. appliance wiring material having neoprene, thermoplastic or equally durable insulation having insulation thickness of no less than $\frac{2}{64}$ in (0.8 mm) complying with the Standard for *Appliance Wiring Material Products*, CSA C22.2 No. 210.2, or the Standard for *Flexible Cords and Fixture Wires*, UL 62; or
- d. "Power Limited Circuit Cable," complying with the Standard for *Control and Instrumentation Cables*, CSA C22.2 No. 239, or the Standard for *Power Limited Circuit Cables*, UL 13, if such wiring is located in a cavity or compartment of the boiler and shielded from damage.

1.24.10

Line-voltage and safety circuit wiring which is part of the boiler and which is external to the boiler jacket when all panels are in place shall be protected by metal conduit, metal-clad cable or race-ways. "Power Limited Circuit Cable" need not be provided with the protection specified above if it is securely fastened to the boiler jacket and follows the contour of the boiler jacket.

1.24.11

Splices in wiring shall be located only in accessible junction boxes or electrical enclosures. Splices shall be made mechanically secure, soldered and insulated with tape, or fixture-type splicing connectors may be employed. Provision shall be made to prevent accidental mechanical strain on splicing devices. (No additional strain relief is necessary when wiring is done in conduit, metal-clad cable or race-ways.)

1.24.12

Splicing devices and uninsulated live-metal parts having a potential in excess of 30 volts shall be installed within enclosures having covers or access panels provided with means for firmly securing in place.

Terminals in a low-voltage safety circuit external to a boiler to which wiring is connected shall be enclosed to the extent specified above when accidental shorting would result in an unsafe condition.

Terminals in a low-voltage safety circuit within a boiler compartment or cavity to which factory wiring is connected need not otherwise be enclosed provided (a) such terminals are recessed or located so the terminals are shielded from accidental shorting or grounding, or (b) accidental shorting or grounding of such terminals would not result in an unsafe condition.

1.24.13

Strain relief shall be provided for all conductors leaving an enclosure except when the wiring is done in conduit, metal-clad cable or race-ways. For low-voltage wiring, strain relief at the point of exit from an enclosure is not necessary if, by wire location or support, protection is provided against accidental strain.

1.24.14

An enclosure for uninsulated live parts at line voltage shall have no openings which are not closed when the boiler is installed, except that an enclosure for parts other than a fuse or thermal cutout may have openings as needed for ventilation or for the device to function. Such openings shall prevent the entrance of a $\frac{33}{64}$ in (13.1 mm) diameter rod. If the distance measured from a straight edge placed across the outer face of any opening to the nearest uninsulated live part within the enclosure is 4 in (102 mm) or more, such openings shall prevent the entrance of a $\frac{49}{64}$ in (19.4 mm) diameter rod.

Such livemetal parts as indicated above shall not be located where contact could be made during normal servicing. (See 1.26, Protection of Service Personnel.)

1.24.15

At points where conduit or metal-clad cable terminate, conductors shall be protected from abrasion. If metal-clad cable is used, an insulating bushing or its equivalent shall be provided between conductors and the metal. The connector or clamp by which metal-clad cable is fastened to boxes or devices shall be such that the insulating bushing or its equivalent will be visible for inspection.

1.24.16

Wireways shall be smooth and entirely free from sharp edges, burrs, fins, etc., which may cause abrasion of the insulation on wiring. In order to prevent abrasion of the insulation, openings in metal walls through which insulated wires not in wireways pass shall be provided with smoothly rounded bushings or an acceptable metal grommet, or shall have smooth well-rounded surfaces as formed by rolling or extruding the metal around the opening. Bushings shall be phenolic, porcelain, hard fibre or other suitable material having a smoothly rounded surface.

1.24.17

Electrical connections which need to be broken to service controls shall be made in such a manner that they may be disconnected and reconnected without breaking soldered connections and without breaking or cutting the wire(s).

1.24.18

Connections from low-voltage electrical devices on the same boiler shall be made in such a manner as to be identifiable in the field.

1.24.19

The electrical circuit of low-voltage control equipment shall be free from and protected from grounds or short-circuiting when the accidental grounding of any circuit wiring could render any safety device inoperative.

1.24.20

A low-voltage circuit shall be supplied by an energy-limiting transformer or a combination of transformer and overcurrent protection device suitable for an NEC Class 2 circuit (see the *National Electrical Code, ANSI/NFPA 70*) or by a combination of transformer and fixed impedance having output characteristics suitable for a Class 2 circuit.

When an overcurrent protection device is used, it shall be an integral part of the transformer or be located at the point where the circuit to be protected receives its supply, shall not be of the automatic-reclosing type, and shall be trip-free from any reclosing mechanism. The device shall be inaccessible to tampering, except for a replaceable fuse which is not interchangeable with a device of a higher current rating.

When a combination of transformer and fixed impedance is used, the electrical interconnection between the two shall be made with wiring materials suitable for Class 1 circuits, unless the two components are incorporated in a single enclosure and located in a normally closed compartment.

A low-voltage supply shall not be obtained from a power source above 30 volts by the use of voltagedropping resistors.

1.24.21

Detachable plug connectors shall not be used in circuits when disconnection of the circuits may allow unsafe operation of the boiler, unless means are provided to prevent accidental disconnection.

1.24.22

Unless supplied with insulation suitable for the highest voltage involved, insulated conductors of different circuits shall be separated by barriers or shall be segregated from each other, and shall in any case be so separated or segregated from uninsulated current-carrying parts connected to different circuits.

1.24.23

The electrical clearance resulting from the assembly of parts into the complete equipment, including clearances to grounded metal or enclosure, when assembled by the manufacturer and furnished as a part of the boiler, shall comply with the spacing specifications of Table IX, Minimum Spacing. Electrical clearances in motors and in components listed by a nationally recognized testing agency shall be deemed to comply with this provision.

1.24.24

Conductors or terminals for line-voltage intended for connection to an external grounded supply conductor shall be identified (e.g., finished a white or gray color, or given a metallic-plated coating substantially white in color, or ribbed). Other line-voltage conductors shall be finished in colors other than white or natural gray.

Any conductor intended solely for grounding purposes shall be identified by a covering finished a continuous green color or a continuous green color with one or more yellow stripes, unless it be bare. Conductors having such coloring shall not be used for other than grounding purposes when terminating within an enclosure used for field connections.

1.24.25

The boiler shall be constructed so the enclosure, frame and similar noncurrent-carrying metal parts are electrically continuous to the point of connection of the boiler grounding means. This provision shall be deemed met when the electrical resistance between the point of connection of the boiler grounding means and any noncurrent-carrying metal part is not more than 0.1 ohm.

Method of Test

The electrical resistance between the point of connection of the boiler grounding means and each noncurrent-carrying metal part shall be determined by either a Wheatstone bridge or by measuring the potential drop between the two points when an alternating current of 20 amperes, derived from a power supply of not more than 12 volts, is passed between the two points and dividing the measured potential drop by the current. The electrical resistance shall not be more than 0.1 ohm. (Insulating resistant finishes may be scraped from the test points.)

1.24.26

Single-pole safety circuit switches such as high temperature limiting devices and pilot switches shall not be connected in a grounded line.

1.24.27

No automatic resetting device, control, or switch shall be installed in the wiring between the main gas valve terminals on the automatic gas ignition system and the terminals on the main gas valve(s) unless evaluated for this application by the certifying agency. This does not preclude the installation of manually operated test switches for the purpose of testing tight closure of individual fuel valves.

1.24.28

A switch or similar device provided as a part of a boiler shall be mounted securely and prevented from turning.

1.24.29

High-tension terminals for transformers and wire leads shall provide protection against electrical shocks.

1.24.30

High-tension terminals on transformers shall be located on the boiler so as to be free from contact with metal parts during normal use of the boiler.

1.24.31

High-tension leads shall be fabricated from cable recognized as acceptable for the purpose and conforming to a nationally recognized standard. Such leads shall be provided at each end with brass loops, eyes or other equivalent means to facilitate positive connection. The leads may be integrally joined to the transformer windings provided proper strain relief is furnished.

1.24.32

High-tension leads or cables shall be as short as possible, free from any sharp bends, and protected from rough usage, soakage with water or condensate, or abrasion.

1.24.33

Electrodes and bus bars of the uninsulated type shall be suspended away from metal parts and insulated and arranged so as to be free from arc-overs at any point throughout the assembly when an a.c. voltage 50 percent in excess of the maximum possible voltage to ground is impressed for a period of 1 minute between the normal point of transformer connection and ground. Such tests shall be conducted both before and after the other performance tests specified herein.

1.24.34

Electrodes or bus bars supporting electrodes shall be designed so they may be readily locked into proper position, and no adjustment of any mechanical nature shall be allowed in electrodes of this type.

1.24.35

Electrode tips shall be designed so extreme burning of the points will not result over a period of time.

1.24.36

Flexibility in electrodes at their outer ends may be permitted if designed to resist warping and accidental dislocation.

1.24.37

If electric ignition is used, the means for igniting the gas shall be designed and located so as to eliminate the collection of carbon or other materials, or the dislocation, distortion or burning of parts as the result of normal conditions of heating or vibration of parts.

1.24.38

Insulators shall consist of highgrade porcelain or equivalent noncombustible insulating material. Such insulation material shall be glazed or otherwise made impervious to internal collection of moisture from the gas and shall be readily cleanable. Insulators shall not be used where carbon may accumulate.

1.24.39

Electrical equipment and wiring shall be suitable for the temperatures to which they are exposed and the service to which they are subjected. Maximum allowable temperature rises of some typical wires and components are shown in Table X, Maximum Allowable Rise Above Room Temperature for Various Component Parts.

Method of Test

The boiler shall be operated as specified in 2.19, Wall, Floor Ceiling, Electrical Components and Venting System Temperatures, at normal inlet test pressure until equilibrium temperatures have been attained.

Temperatures of electrical equipment, controls and wiring shall be determined for each component at points subjected to maximum temperatures by means of thermocouples not larger than No. 24 AWG (0.20 mm²) placed in good thermal contact with the material. At the option of the manufacturer, the temperature of motor windings and coils may be measured by the resistance method. Observed temperatures shall not be in excess of those for which wires or components are approved.

1.24.40

The leakage current measured on a boiler tested in accordance with the following Method of Test shall not exceed the limits specified below.

Method of Test

When connected in the manner intended to a supply circuit of rated voltage and frequency, the boiler shall be operated as specified in 2.19, Wall, Floor Ceiling, Electrical Components and Venting System Temperatures. When equilibrium temperatures have been attained and with continued application of rated voltage and frequency, leakage current between each of the supply terminals and all noncurrent-carrying metal parts (ungrounded) which might become energized shall be measured using the instrumentation specified in the *Standard for Leakage Current for Appliances, ANSI/UL 101*. The leakage current shall not exceed 0.5 milliamperes, except that for boilers equipped with capacitor-type motors leakage current shall not exceed 1.15 milliamperes.

For Canada see Exhibit E, Items Unique to Canada.

1.24.41

Adequate dielectric shall be interposed between ungrounded current-carrying parts and those external surfaces which can be contacted.

Method of Test

When connected in the manner intended to a supply circuit of rated voltage and frequency, the boiler shall be operated as specified in 2.19, Wall, Floor Ceiling, Electrical Components and Venting System Temperatures. When equilibrium temperatures have been attained, the applicable dielectric withstand test(s) outlined below shall be conducted.

While conducting the dielectric withstand tests, a 500 voltampere or larger transformer, having an essentially sinusoidal output voltage which can be varied, shall be used. The applied potential shall be increased gradually from zero until the required test voltage is reached and shall be held at that value for 1 minute. The use of a 500 voltampere or larger transformer is not necessary if the high potential testing equipment used maintains the specified high potential voltage at the boiler during the test.

- a. A boiler shall be capable of withstanding, for 1 minute without breakdown, the application of a 60 hertz potential between high-voltage live parts and dead-metal parts, and between live parts of high- and low-voltage circuits. The test potential shall be:

1000 volts plus twice rated voltage, except

1000 volts for motors rated at not more than $\frac{1}{2}$ hp (373 W) and not more than 250 volts.

When higher than rated voltage is developed in a motor circuit through the use of capacitors, the rated voltage of the boiler shall be employed to determine the dielectric withstand test potential, unless the developed steady-state capacitor voltage exceeds 500 volts, in which case the test potential for the parts affected shall be 1000 volts plus twice the developed voltage.

- b. A low-voltage circuit shall be capable of with-standing, for 1 minute without breakdown, a 60 hertz potential of 500 volts applied between low-voltage live parts of opposite polarity and between low-voltage live parts and dead-metal parts.

The dielectric withstand test between low-voltage parts of opposite polarity need not be conducted on the complete assembly if the components have been separately subjected to this test condition.

The arrangement of the test circuit shall be such that if the dielectric material breaks down, a positive signal will be obtained, rather than depending upon a visual inspection of the material.

On a boiler for outdoor installation, the above test shall be conducted at the conclusion of the operating period specified in 2.29.1.

1.25 Motors And Blowers

1.25.1

Electrical motors shall be designed for continuous duty and shall be provided with overload protection in accordance with the *National Electrical Code, ANSI/NFPA 70*, or the *Canadian Electrical Code Part I, CSA C22.1*, or *Motors with Inherent Overheating Protection CSA C22.2, No. 77*, as applicable. A fractional horsepower motor may be protected with a temperature or current-sensitive device or a temperature and current-sensitive device which will prevent motor winding temperatures from exceeding those specified in Table XI, Maximum Allowable Motor Winding Temperatures. If the impedance of the motor windings is sufficient to prevent winding temperatures in an open motor or enclosure temperatures on a totally enclosed motor of over 302°F (150°C) with the rotor locked, no additional motor protection is necessary, but the motor shall bear a Class III marking indicating that it is impedance protected. The above tests may, at the option of the manufacturer submitting the equipment, be conducted using the resistance method for determining temperature rise.

1.25.2

Motors shall operate at temperatures not in excess of the limits specified in Table XI, Maximum Allowable Motor Winding Temperatures, when the boiler is operating at the normal input rate. At the option of the manufacturer, the temperature of motor windings may be measured by the resistance method. The boiler shall be operated in a normal manner at normal inlet test pressure as specified in 2.11.2 until motor temperatures have attained equilibrium.

1.25.3

Motor, blower, fan or pump bearings shall be either (a) permanently lubricated, or (b) provided with accessible means for lubrication. (See 1.4.2 and 1.34.1-c-2.)

1.25.4

Bearings of motors, blowers or pumps shall be of a type suitable for the temperatures to which subjected in normal operation.

1.26 Protection Of Service Personnel

1.26.1

An uninsulated live part in a high-voltage or high-tension ignition circuit (see Part IV, Definitions and in Canada see Exhibit E, Items Unique to Canada) within the boiler cabinet, shall be located, guarded or enclosed so as to minimize accidental contact by service personnel performing mechanical (plumbing) service functions which may have to be performed with the equipment energized.

The following shall be considered in determining compliance with this provision:

- a. Mechanical service functions which may have to be performed with the equipment energized, such as (1) operating valves; (2) connecting fittings; (3) adjusting water control valves; (4) adjusting the setting of temperature or pressure controls with or without marked dial settings; (5) resetting control trip mechanism; or (6) operating manual switches.

A factory set and sealed control is not considered to be adjustable.

- b. Adjustable or resettable electrical control or manual switching devices may be located or oriented with respect to uninsulated live parts so that manipulation of the mechanism for adjusting, resetting or operating can be accomplished in the normal direction of access if uninsulated live parts are (1) not located in front (in the direction of access) of the mechanism; and are (2) not located within 6 in (152 mm) on any side or behind the mechanism, unless guarded.

This provision is not applicable to mechanical service functions which are not normally performed with the equipment energized.

1.26.2

An electrical control component which may require examination, adjustment, servicing or maintenance while energized shall be located and mounted with respect to other components and with respect to grounded metal parts so it is accessible for electrical service functions without subjecting the serviceman to the likelihood of shock hazard from adjacent uninsulated live parts or to accident hazard from adjacent hazardous moving parts.

The following shall be considered in determining compliance with this provision:

- a. Accessibility and protection from the likelihood of shock and accident hazard may be obtained by mounting the control components in an assembly so unimpeded access is provided to each component through an access cover or panel in the outer cabinet and the cover of the control assembly enclosure with the following arrangement. See Figure 1, Accessibility and Protection.
 - 1. The components are located with respect to the access opening in the outer cabinet so the farthest component in the control assembly is not more than 14 in (356 mm) from the plane of this access opening.
 - 2. Uninsulated live parts outside the projected clear space or unguarded hazardous moving parts are located not closer than 6 in (152 mm) from any side of the access area. The projected clear space is considered to be bounded on the sides by the projection of the smallest rectangular perimeter surrounding the outside edge of the component or control enclosure, when provided. The access area is considered to be bounded on the sides by the projection of the perimeter of the access opening in the outer cabinet to the closest rectangular perimeter surrounding the outside edge of the component or control enclosure.
 - 3. The volume generated by the projected clear space of the control assembly to the access opening in the outer cabinet (within the access area) is completely free of obstructions, including wiring.
 - 4. Access to the components in the control assembly is not impeded in the direction of access by other components or by wiring in this assembly.
 - 5. Extractor-type fuseholders and snap switches mounted through the control assembly enclosure are to be located so there is unimpeded access to these components through the access opening in the outer cabinet and so they are not immediately adjacent to uninsulated live parts outside the control assembly enclosure, unless guarded. See 1.26.1-b.

Other arrangements of location of components, guarding of components, or both, are also acceptable where electrical components are accessible for service.

- b. The electrical components referred to in the preceding paragraphs include the following: fuses, adjustable or resettable overload relays, manual or magnetic motor controllers, magnetically operated relays, adjustable or resettable pressure or temperature controllers, manual switching devices, clock timers, and incremental voltage tap and motor speed tap terminals for variable-speed motors. Such components in a low-voltage circuit (see Part IV, Definitions) are to comply with this provision in their relation to uninsulated live parts in a high-voltage circuit (see Part IV, Definitions) and to hazardous moving parts.
- c. The following are not considered to be uninsulated live parts: coils of controllers, relays and solenoids, and transformer windings, if the coils and windings are provided with recognized insulating over-wraps; enclosed motor windings; terminals and splices with recognized insulation; and insulated wire.

1.27 Flue Collectors

1.27.1

Flue collectors shall be constructed of corrosion resistant materials, such as aluminum coated steel in which the bond between the steel and the aluminum is an iron-aluminum alloy or chromium coated low carbon steel in which the chromium is diffused into the surface of the steel to form an iron-chromium alloy, or of materials of equivalent corrosion resistance.

1.27.2

Flue collectors shall not melt, soften, or distort as a result of the tests specified herein.

1.27.3

Flue collectors shall be supported on the boiler by mechanical means not exposed to flue gases (see 1.4.4).

1.27.4

A flue collector shall be sufficiently rigid in construction and supported on the boiler so it will comply with 2.23.6.

1.28 Flue Connections And Integral Venting Systems

1.28.1

When a flue pipe extension other than a standard 90 degree (1.57 rad) elbow is used between the flue collar and draft hood, it shall be permanently attached to either the flue collar or the draft hood and shall be constructed of a material equivalent in strength and corrosion resistance to that of the draft hood.

1.28.2

A flue connection shall extend beyond the casing a sufficient distance to facilitate fastening of the vent connector or draft hood. A flue connection for attachment of a vent connector shall accommodate one of integral inch diameter, or to accommodate a conduit as specified in the manufacturer's installation instructions. When a draft hood of other than the readily detachable type is employed, the construction shall be such as to provide a tight joint between the flue collar and the draft hood.

1.28.3

A venting system supplied with a Category II or IV boiler shall be constructed of material resistant to corrosion by condensate (see 1.2.11).

Nonmetallic material shall be judged on its temperature limitations, strength, and resistance to the action of condensate.

1.28.4

A venting system supplied with a Category III or IV boiler shall be gastight (see 2.30, Venting Systems for Category II, III or IV Boilers).

1.28.5

A venting system supplied with a Category II or IV boiler shall be watertight (see 2.30, Venting Systems for Category II, III or IV Boilers).

1.29 Draft Hoods

1.29.1

A suitably designed draft hood shall be furnished with each boiler, except:

- a. When the boiler is supplied with a power burner or operates under forced or induced draft, in which case 2.24, Blocked Vent Test for Boilers Equipped with Forced or Induced Draft Burners and Without Draft Hoods or Regulators, all be complied with;
- b. When a direct vent system is employed; or
- c. When the boiler is for outdoor installation and is provided with an integral venting system as part of the boiler.

1.29.2

Each boiler having an input rating less than 300,000 Btu/hr (87 921 W) and equipped with a draft hood, except those boilers for outdoor installation only, shall be equipped with a blocked vent shutoff system designed to shut off main burner gas in the event the venting system is totally blocked. The blocked vent shutoff system shall be of the single use or manual reset type and its components shall comply with applicable nationally recognized standards. Manual reset type systems shall not automatically reset above -31°F (-35°C).

1.29.3

Sensors of a blocked vent shutoff system shall be positively located with respect to their mounting means.

1.29.4

All parts of the draft hood shall be constructed of a corrosion-resistant material or of a material having a corrosion-resistant finish.

1.29.5

All parts of the draft hood shall be constructed of a material not less than 0.0152 in (0.386 mm)* thick.

1.29.6

A detachable draft hood shall be designed so removal and replacement in normal usage will not permanently deform any part or alter the relative position of any part with respect to another.

1.29.7

Joints used in the construction of draft hoods shall not depend primarily on solder for strength or tightness.

* This corresponds to No. 26 U. S. Standard gage sheet steel with all applicable minus tolerances included.

1.29.8

A draft hood shall be constructed of such material that there will be no melting, softening, or distortion of any part as a result of the tests specified herein.

1.29.9

The outlet collar of a draft hood shall be of such size as to accommodate vent pipe of integral inch diameter.

1.29.10

Provision shall be made for the firm support of the vent piping. A horizontal outlet shall have a 1 in (25.4 mm) minimum lip for attachment of vent piping of 5 in (127 mm) diameter or less and a 1¹/₄ in (31.8 mm) minimum lip for vent piping of 6 in (152 mm) diameter or larger.

1.29.11

A draft hood shall be sufficiently rigid in construction and supported on the boiler so it will comply with 2.23.6.

1.29.12

Manually operated dampers shall not be used.

1.30 Automatic Vent Damper Devices

1.30.1

Automatic vent damper devices shall comply with the applicable provisions of the *Standard for Automatic Vent Damper Devices for Use with Gas-Fired Appliances, ANSI Z21.66 • CGA 6.14*.

1.30.2

A boiler equipped with a vent damper device shall have two automatic valves, in series, which may or may not be in a single control body, each of which opens and closes the main gas supply when called upon to function. For purposes of this provision, a thermostatically operated valve is an automatic valve.

1.30.3

The construction of the appliance and damper device shall be such that the damper device cannot be installed on the appliance in other than the correct position.

1.30.4

See Exhibit E, "Items Unique to Canada" for additional requirements for automatic vent dampers, E3.1 and E3.2.

1.31 Automatic Flue Damper Devices

1.31.1

A flue damper device (see Part IV, Definitions), if provided, and all its components shall be factory installed, except those components which may be external to the boiler casing and must be installed at the time of boiler installation. These components, including their connecting means, shall be supplied with the boiler by the manufacturer. (Also see 1.34.3-a.)

1.31.2

All parts of a flue damper device, including fasteners, shall be corrosion resistant, suitable for the application and temperatures to which exposed and shall not show evidence of deterioration during the tests specified herein.

Metal parts in contact with flue gases or subject to condensation shall be one of the following:

- a. Aluminum-coated steel at least 0.018 in (0.457 mm) thick with not less than 0.04 oz/ft² (0.123 kg/m²) of aluminum with the bond between the steel and aluminum being an iron-aluminum alloy;
- b. Chromium-coated low-carbon steel in which the chromium is diffused into the surface of the steel to form an iron-chromium alloy;
- c. Type 1100 aluminum at least 0.016 in (0.406 mm) thick; or
- d. Other metal having equivalent durability and resistance to corrosion and heat.

Cast iron may be used for nonmoving parts if it can be demonstrated that corrosion or heat will not impair the intended function and durability of the damper.

1.31.3

The outlet connection of a flue damper device for a boiler not equipped with a draft hood (other than a direct vent appliance) shall accommodate a vent connector of integral inch diameter size and shall have at least a 1¹/₄ in (31.8 mm) lip for attachment of the vent connector.

1.31.4

For a boiler equipped with a continuous pilot, the minimum internal free venting area of the flue gas passageway of the flue damper device, with the damper in the closed position, shall not be less than 1¹/₂ in² (3.2 cm²).

1.31.5

A boiler equipped with a flue damper device shall have two automatic valves in series, each of which independently controls the main gas supply. These valves may or may not be in a single control body. For purposes of this provision, a thermostatically operated valve is an automatic valve.

1.31.6

All electrical components of an electrically operated flue damper device shall be factory wired into the electrical circuit of the boiler, or the flue damper device shall be supplied with a wiring harness. (Also see 1.34.3-c.)

1.31.7

The mechanical circuits and connections of a mechanically actuated flue damper device shall comply with the following:

- a. All materials and fittings built in or supplied by the manufacturer with the flue damper device shall be submitted for examination.
- b. All materials and fittings supplied for use with and as a part of the flue damper device shall be judged with respect to their suitability for the particular application.
- c. The general construction and assembly of mechanical circuits shall be of a neat and workmanlike character and shall be mechanically secure without strain on any member. The circuits shall be positively located, supported and protected against damage from moving parts. Mechanical circuit material shall be protected from any combustion product condensate unless suitable for such service.
- d. Connections which need to be broken for any component intended to be serviced shall be made in such a manner that they may be disconnected and reconnected without new connections being required.

1.31.8

The damper of a flue damper device shall assume its open position in the event of motive power failure or deenergization of the flue damper device unless electrically interlocked with an automatic gas ignition system so as to prevent operation of the automatic gas ignition system when the damper is in other than the fully open position, or unless the loss of motive power will prevent operation of the automatic gas ignition system when the damper is in other than the fully open position.

1.31.9

Operation of a flue damper device shall produce a single closed position of the damper.

1.31.10

The design of the boiler shall be such that the flue damper position can be visually determined when the appliance is installed in accordance with the manufacturer's installation instructions.

1.31.11

Flue damper devices shall incorporate integral means actuated directly by the damper, or by the assembly of parts securely attached to the damper, to maintain a fixed relationship to the damper, which will provide an interlock with both the automatic valves specified in 1.31.5 to prevent main burner firing unless the damper is in the fully open position.

1.31.12

A boiler shall be equipped with a means, in addition to the interlock specified in 1.31.11, which will either prevent main burner firing, provide for main burner shutdown if the damper is in other than the open position, or bring the damper to permanent full open position if the interlock specified in 1.31.11 fails unsafe, when tested in accordance with 2.25.3.

A flue damper device having two systems, either of which will prevent main burner gas flow with the damper in other than the full open position, one of which complies with 1.31.11 and the other being either means specified in this section, shall be deemed as complying with the intent of this section. Each system shall operate completely independently of the other and each shall have a separate switch for operating either a separate automatic valve or two automatic valves in series.

1.32 Vent-Air Intake Pipes Of Direct Vent Systems

1.32.1

Pipe sizes for vent-air intake pipes shall be determined by the manufacturer, and construction shall be in accordance with reasonable concepts of safety, substantiality and durability. Component parts shall be secured against distortion, warpage or other damage and supported to maintain a fixed relationship between essential parts under normal and reasonable conditions of handling and usage.

1.32.2

The design and specifications of a direct vent system shall be such that the vent-air intake pipes are supplied as parts of the boiler, unless they are specific types listed by a nationally recognized testing agency and identified in the manufacturer's installation instructions.

1.32.3

Specifications for materials used in the construction of vent-air intake pipes shall be in accordance with 1.22.3.

1.32.4

Lockseam joints are acceptable for the longitudinal joints in vent-air intake pipes.

1.32.5

If a telescoping slip-fit connection is used in the vent-air intake pipes to provide for installation in walls of varying thickness, the minimum overlap shall be $1\frac{1}{4}$ in (31.8 mm).

1.32.6

If a slip-fit connection is used at the junction of the vent pipe with the boiler, or at the junction of the vent pipe with the vent cap, the minimum overlap at each connection shall be $1\frac{1}{4}$ in (31.8 mm).

1.32.7

If a slip-fit connection is used at the junction of the air intake pipe with the boiler, or at the junction of the air intake pipe with the vent cap, the minimum overlap at each connection shall be $\frac{1}{2}$ in (12.7 mm).

1.32.8

Construction at the outer ends of the vent-air intake pipes shall provide a firm connection to the vent-air intake terminal(s).

1.32.9

Exterior grilles, vent caps and vent-air intake pipes shall be constructed of rust-and corrosion-resistant material or have a rust- and corrosion-resistant finish.

1.33 Water Connections

Aluminum tubing shall not be used for water connections.

1.34 Instructions

1.34.1

Each boiler shall be accompanied by clear, concise printed instructions and diagrams stated in terms clearly understandable to the consumer and adequate for proper field assembly, installation, maintenance, safe use and operation of the boiler.

Instructions shall bear the seal or symbol of the testing agency.

These instructions shall be supplied in a pocket which is a part of the boiler whenever practical. If no pocket can be provided, the instructions shall be supplied in an envelope marked with instructions (1) to the installer to affix them adjacent to the boiler; and (2) to the consumer to retain them for future reference.

Units of measure required shall be expressed in either imperial units of measure, or both imperial and metric units of measure.

The instructions shall be reviewed by the testing agency for comprehensibility, accuracy and compatibility with results of test and with the *National Fuel Gas Code*, *ANSI Z223.1/NFPA 54*, and/or *Natural Gas and Propane Installation Code*, *CAN/CSA B149.1*.

The instructions shall include:

- a. Assembly instructions for fieldinstalled parts and components, including all controls, wiring and accessories (when applicable).
- b. Installation instructions indicating:

1. The installation must conform to the requirements of the authority having jurisdiction or, in the absence of such requirements, to the *National Fuel Gas Code, ANSI Z223.1/NFPA 54*, and/or *Natural Gas and Propane Installation Code, CAN/CSA B149.1*.
2. Where required by the authority having jurisdiction, the installation must conform to the *Standard for Controls and Safety Devices for Automatically Fired Boilers, ANSI/ASME CSD1*.

At the option of the manufacturer, for boilers having an input rating greater than 400,000 Btu/hr (117 228 W), a Specific Component Identification List may be supplied for the components shown below, as applicable. The components shall be identified by the name of the manufacturer and the model number or other unique identification. The part number corresponding to this list shall be shown on the boiler's rating plate. (See 1.36.2-p.)

- (a) Automatic, Combination and Safety Shutoff Gas Valve(s);
- (b) Gas Appliance Pressure Regulator(s);
- (c) Automatic Gas Ignition Control;
- (d) Ignition Device;
- (e) Fuel Gas Pressure Switch(s);
- (f) Steam Pressure Limit Control;
- (g) Water Temperature Limit Control;
- (h) Low Water Cutoff (Steam Boilers Only); and
- (i) Packaged Burner(s).

If items (a) through (e) are included as part of a packaged burner listed by a nationally recognized testing agency, they are not required to be separately identified.

Alternately, the above information can be provided on a Class IIIA marking in lieu of the above instructions.

3. If the relief valve supplied with the boiler is not factory installed, instructions must be provided for installation of the relief valve consistent with the *ANSI/ASME Boiler and Pressure Vessel Code, Section IV*, or *Boiler, Pressure Vessel and Pressure Piping Code, CSA B51*, as applicable.
4. The manufacturer's or distributor's name and address as it appears on the appliance rating plate, and the model or series number of the appliance.
5. A hot water boiler installed above radiation level or as required by the Authority having jurisdiction, must be provided with a low water cutoff device either as a part of the boiler or at the time of boiler installation.
6. For steam boilers, illustration(s) of the boiler piping consistent with the *ANSI/ASME Boiler and Pressure Vessel Code, Section IV*, or *Boiler, Pressure Vessel and Pressure Piping Code, CSA B51*, as applicable.
7. The boiler and its individual shutoff valve must be disconnected from the gas supply piping system during any pressure testing of that system at test pressures in excess of $\frac{1}{2}$ psi (3.5 kPa).

The boiler must be isolated from the gas supply piping system by closing its individual manual shutoff valve during any pressure testing of the gas supply piping system at test pressures equal to or less than $\frac{1}{2}$ psi (3.5 kPa).

8. A statement that the boiler shall be installed such that the gas ignition system components are protected from water (dripping, spraying, rain, etc.) during appliance operation and service (circulator replacement, condensate trap, control replacement, etc.).

9. The boiler and its gas connection must be leak tested before placing the boiler in operation.
10. After placing the boiler in operation, the ignition system safety shutoff device must be tested. The method of testing must be specified in detail.
11. If an external electrical source is utilized, the boiler, when installed, must be electrically bonded to ground in accordance with the requirements of the authority having jurisdiction or, in the absence of such requirements, with the *National Electrical Code, ANSI/NFPA 70*, and/or the *Canadian Electrical Code Part I, CSA C22.1, Electrical Code*.
12. Provisions for combustion and ventilation air in accordance with the section "Air for Combustion and Ventilation," of the *National Fuel Gas Code, ANSI Z223.1/NFPA 54*, or Sections 8.2, 8.3 or 8.4 of *Natural Gas and Propane Installation Code, CAN/CSA B149.1*, or applicable provisions of the local building codes.
13. Clearances from combustible construction for boiler, vent connector, and steam and hotwater pipes.
14. The boiler must not be installed on carpeting.
15. Clearances for servicing and proper operation.
16. For a Category II, III, IV, or direct vent boiler:
 - (a) When the manufacturer supplies the venting system, the instructions shall include a parts list and instructions covering the installation of properly identified parts to provide for the venting of the vent gases to the outdoors (see 1.2.11).
 - (b) When the parts for venting the vent gases are not provided by the boiler manufacturer and they are specific types listed by a nationally recognized testing agency, these instructions shall clearly identify and specify the use of the specific parts (see 1.36.12e).
17. Instructions to the effect that when an existing boiler is removed from a common venting system, the common venting system is likely to be too large for proper venting of the appliances remaining connected to it.

The instructions shall include the test procedure set forth below:

At the time of removal of an existing boiler, the following steps shall be followed with each appliance remaining connected to the common venting system placed in operation, while the other appliances remaining connected to the common venting system are not in operation.

- (a) Seal any unused openings in the common venting system.
- (b) Visually inspect the venting system for proper size and horizontal pitch and determine there is no blockage or restriction, leakage, corrosion and other deficiencies which could cause an unsafe condition.
- (c) Insofar as is practical, close all building doors and windows and all doors between the space in which the appliances remaining connected to the common venting system are located and other spaces of the building. Turn on clothes dryers and any appliance not connected to the common venting system. Turn on any exhaust fans, such as range hoods and bathroom exhausts, so they will operate at maximum speed. Do not operate a summer exhaust fan. Close fireplace dampers.

- (d) Place in operation the appliance being inspected. Follow the lighting instructions. Adjust thermostat so appliance will operate continuously.
- (e) Test for spillage at the draft hood relief opening after 5 minutes of main burner operation. Use the flame of a match or candle, or smoke from a cigarette, cigar, or pipe.
- (f) After it has been determined that each appliance remaining connected to the common venting system properly vents when tested as outlined above, return doors, windows, exhaust fans, fireplace dampers, and any other gas-burning appliance to their previous condition of use."
- (g) Any improper operation of the common venting system should be corrected so the installation conforms with the *National Fuel Gas Code, ANSI Z223.1/NFPA 54*, and/or the *Natural Gas and Propane Installation Code, CAN/CSA B149.1*. When resizing any portion of the common venting system, the common venting system should be resized to approach the minimum size as determined using the appropriate tables in Chapter 13 of the *National Fuel Gas Code, ANSI Z223.1/NFPA 54*, and/or the *Natural Gas and Propane Installation Code, CAN/CSA B149.1*.

18. Proper vent installation and type of gas vent or vent connector.

For boilers for connection to gas vents or chimneys, vent installations shall be in accordance with "Venting of Equipment," of the *National Fuel Gas Code, ANSI Z223.1/NFPA 54*, or "Venting Systems and Air Supply for Appliances," of the *Natural Gas and Propane Installation Code, CAN/CSA B149.1*, or applicable provisions of the local building codes.

Vent connectors serving appliances vented by natural draft shall not be connected into any portion of mechanical draft systems operating under positive pressure.

For Category II, III and IV boilers, the venting system shall be installed in accordance with the boiler manufacturer's installation instructions.

The instructions for the installation of the venting system shall specify that the horizontal portions of the venting system shall be supported to prevent sagging; the methods of and intervals for support shall be specified. These instructions shall also specify that the venting system:

- (a) For Category I, II and IV boilers, have horizontal runs sloping upwards not less than $\frac{1}{4}$ in/ft (21 mm/m) from the boiler to the vent terminal;
- (b) For Category III boilers, slope shall be as specified in the boiler manufacturer's instructions;
- (c) For Category II and IV boilers, be installed so as to prevent accumulation of condensate; and
- (d) For Category II and IV boilers, where necessary, have means provided for drainage of condensate.

19. Information on where the vent terminal should and should not terminate, including:

- (a) The minimum distance from adjacent public walkways, adjacent buildings, openable windows and building openings shall not be less than those values specified in the *National Fuel Gas Code, ANSI Z223.1/NFPA 54* and/or the *Natural Gas and Propane Installation Code, CAN/CSA B149.1*;

- (b) Information on preventing blockage by snow;
 - (c) Information on protecting building materials from degradation by flue gases; and
 - (d) Minimum clearance of 4 ft (1.22 m) horizontally from, and in no case above or below, unless a 4 ft (1.22 m) horizontal distance is maintained, from electric meters, gas meters, regulators and relief equipment.
20. Provisions for vent, bleed and gas relief lines (when applicable).
 21. A sediment trap must be provided upstream of the gas controls. (See 1.12.16.)
 22. Location of manual main shutoff valve outside the jacket when codes require.
 23. The boiler, when used in connection with a refrigeration system, must be installed so the chilled medium is piped in parallel with the boiler with appropriate valves to prevent the chilled medium from entering the boiler.
 24. The boiler piping system of a hot water boiler connected to heating coils located in air handling units where they may be exposed to refrigerated air circulation must be equipped with flow control valves or other automatic means to prevent gravity circulation of the boiler water during the cooling cycle.
- c. Service instructions (including recommended frequency guidelines) suggesting:
1. Periodic cleaning of filters (when supplied).
 2. Lubrication of moving parts (when applicable), including type and amount of lubricant.
 3. Periodic examination of venting systems.
 4. Periodic cleaning of the screens in the vent terminal (where applicable).
 5. Periodic inspection of low water cutoffs, including flushing of float types.
 6. The proper procedures for cleaning flue gas passageways.
 7. When a means is provided to neutralize condensate, a maintenance schedule if required.
 8. Periodic cleaning of the condensate collection and disposal system(s) (if applicable).
 9. Information covering the cleaning of the burner(s).
 10. Periodic visual check of pilot and burner flames, with pictorial sketches or drawings.
 11. Keeping boiler area clear and free from combustible materials, gasoline and other flammable vapors and liquids.
 12. Not obstructing the flow of combustion and ventilation air.
 13. For direct vent appliances, proper reassembly and resealing of the vent-air intake system.
 14. Directions for maintaining combustion air filters, if used.

- d. Lighting and shutdown instructions as specified in 1.36.3 or 1.36.6, as applicable, including sketches or diagrams.
- e. A diagram of the gas manifold and control assembly.
- f. Electrical diagrams in the form(s) specified in 1.36.22.
- g. The following statements:
 - “Caution: Label all wires prior to disconnection when servicing controls. Wiring errors can cause improper and dangerous operation.”
 - “Verify proper operation after servicing.”
- h. A list of replacement parts and the source where such parts are available.
- i. Adjustment procedure to provide a lowflow rate setting equal to or greater than the manufacturer’s specified minimum input rating as shown on the appliance rating plate. (See 1.16, Adjustment for Minimum Input Rating.)

1.34.2

The manufacturer’s instructions for a boiler equipped with a vent damper device shall also include the following:

- a. Location and method of installation, without modification of either the draft hood or the vent damper device.
- b. A statement to the effect that the venting system be so arranged that only the boiler is served by the vent damper device supplied with the boiler.
- c. Method of the proper interconnection of the wiring harness, if applicable.
- d. Instructions and illustrations indicating the manner in which field-installed mechanical connections shall be made and routed, and the materials to be used.
- e. A statement that the damper position indicating means be in a visible location following installation.
- f. Instructions that a minimum clearance of not less than 6 in (152 mm) between the vent damper device and combustible construction be maintained and that there be provisions for access for service of the vent damper device.
- g. Information relative to proper adjustment of the room thermostat heat anticipator, if necessary.
- h. The statement, “Damper must be in open position when appliance main burner(s) is operating.”
- i. If the vent damper device is thermally actuated, a description of how the damper operates.

1.34.3

The manufacturer’s instructions for a boiler equipped with a flue damper device shall also include the following:

- a. Location and method of installation of those flue damper device components external to the boilers, without modification of either the draft hood, if provided, or the flue damper device.

- b. A statement of the minimum clearances from the flue damper device for access for service and, if applicable, the minimum distance from combustible material.
- c. Method of the proper interconnection of the wiring harness (see 1.31.6).
- d. Instructions and illustrations indicating the manner in which field-installed mechanical connections shall be made and routed, and the materials to be used (see 1.31.7).
- e. A statement that the damper position indicating means be in a visible location following boiler installation (see 1.31.10).
- f. The statement “Damper must be in open position when appliance main burner(s) is operating.” (See 1.31.11 and 1.31.12.)

1.34.4

For a direct vent boiler, complete information shall be provided covering wall thickness and part numbers of vent kits, if several vent kits are available, for use with various ranges of wall thickness.

1.34.5

For a boiler utilizing materials containing crystalline silica, or if the manufacturer determines crystalline silica may be found in “after service” materials, and if the crystalline silica may be exposed during installation, servicing or removing the boiler, the manufacturer shall provide appropriate warnings and instructions at the beginning of the service instructions, using letters that are easily readable.

1.34.6

Also see 1.3.3, 1.12.16, 1.13.4, 1.24, Electrical Equipment and Wiring, (prefatory note), 1.30.3 and 2.19.2.

1.35 User’s Information Manual

Each boiler shall be accompanied by separate printed instructions, to be referred to as the user’s information manual, attached with a clip or located in a pocket within the confines of the boiler and readily visible when the automatic control valve is exposed. At the option of the manufacturer, a label may be placed adjacent to the automatic control valve indicating the location of the user’s information manual.

For a boiler utilizing materials containing crystalline silica, or if the manufacturer determines crystalline silica may be found in “after service” materials, and if the crystalline silica may be exposed during installation, servicing or removing the boiler, the manufacturer shall provide appropriate warnings and instructions at the beginning of the User’s Information Manual, using letters that are easily readable.

The front cover or, in the absence of a cover, the first page of the user's manual shall bear the following boxed warning. It shall be boxed as shown:

WARNING: If the information in this manual is not followed exactly, a fire or explosion may result causing property damage, personal injury or loss of life.

— Do not store or use gasoline or other flammable vapors and liquids in the vicinity of this or any other appliance.

— **WHAT TO DO IF YOU SMELL GAS**

- Do not try to light any appliance.
- Do not touch any electrical switch; do not use any phone in your building.
- Immediately call your gas supplier from a neighbor's phone. Follow the gas supplier's instructions.
- If you cannot reach your gas supplier, call the fire department.

— Installation and service must be performed by a qualified installer, service agency or the gas supplier.

The letters used for the boxed statements above shall be boldfaced type having a minimum uppercase letter height of 0.120 in (3.05 mm). The minimum vertical spacing between lines of type shall be 0.046 in (1.17 mm).^{*} Lowercase letters shall be compatible with the uppercase letter size specification.

The user's information manual shall contain the following minimum instructions:

- a. Clearly defined, legible and complete instructions for lighting and shutting down the boiler. These instructions shall pictorially illustrate and locate all components referred to on the instruction label(s) (see 1.36.3 or 1.36.6, as applicable).
- b. For a boiler equipped with a blocked vent shutoff system, information relative to the purpose and function of the system, and clear and concise instructions for the recommended action to be taken in the event that the system has actuated to shut off the main burner gas. These instructions may be one of the following:
 1. Instructions not to attempt to place the boiler in operation, but to contact a qualified service agency.
 2. Instructions for resetting of the blocked vent shutoff system.
 3. Instructions for replacement of a single use device which is part of a blocked vent shutoff system.

With respect to "-b2" or "-b3" above, the instructions shall also advise the owner to contact a qualified service agency if the boiler cannot be restored to normal operation.

^{*} This letter height and line spacing correspond to 12-point type.

- c. For a boiler equipped with a flame roll-out safety shutoff means or control system, information relative to the purpose and function of the means, and clear and concise instructions for the recommended action to be taken in the event that the means has actuated to shut off the main burner gas. These instructions may be one of the following:
 - 1. Instructions not to attempt to place the boiler in operation, but to contact a qualified service agency.
 - 2. Instructions for resetting of the flame roll-out safety shutoff means or control system.
 - 3. Instructions for replacement of a single use device which is part of a flame roll-out safety shutoff means or control system.

With respect to “-c2” or “-c3” above, the instructions shall also advise the owner to contact a qualified service agency if the boiler cannot be restored to operation.

- d. Periodic cleaning of the condensate collection and disposal system(s), if applicable.
- e. When a means to neutralize condensate is provided, instructions and a schedule for maintenance, if required.
- f. Clearly defined, legible and complete instructions for examining all flue product carrying areas of the boiler, its vent system, and pilot and main burners for continued safe operation, with particular attention given to deterioration from corrosion or other sources. The manual shall indicate the necessity and minimum frequency of these examinations by the owner and shall also specify the periodic inspection of the boiler by a qualified service agency.
- g. The following statement or its equivalent: “Should overheating occur or the gas supply fail to shut off, do not turn off or disconnect the electrical supply to the pump. Instead, shut off the gas supply at a location external to the appliance.”
- h. The following statement: Do not use this boiler if any part has been under water. Immediately call a qualified service technician to inspect the boiler and to replace any part of the control system and any gas control which has been under water.

1.36 Marking

1.36.1

Marking material shall be identified by class number and shall meet the following specifications. All metal marking materials shall be rustproof. All marking material shall be suitable for application to the type and temperature of the surface to which applied. Class II and III marking material shall either be recognized as complying with the Standard for *Marking and Labelling Systems*, ANSI/UL 969, CSA Standard for *Adhesive Labels*, CSA C22.2 No. 0.15, or be tested as specified under 2.31, Marking Material Adhesion and Legibility. The designation of any class of marking shall not preclude the use of marking of a lower number class.

Class I. Integral Marking

Marking that is embossed, cast, stamped or otherwise formed in the part. This includes markings baked into an enameled surface.

Class IIA1. Permanent Plate

Shall be made of metal having a minimum thickness of 0.012 in (0.30 mm) and shall be securely attached by mechanical means.

Class IIA2. Permanent Plate

Shall be made of metal having a thickness of 0.006 to 0.012 in (0.15 to 0.30 mm) and shall have mechanical attachment means at all corners with a maximum spacing of 6 in (152 mm) between mechanical fasteners.

Class IIA3. Permanent Plate

Shall be made of metal having a thickness less than 0.006 in (0.15 mm). Such plates shall be attached by means of nonwatersoluble adhesive which will comply with 2.31, Marking Material Adhesion and Legibility. These materials shall not be located on surfaces having temperatures exceeding 300°F (149°C) as determined during conduct of 2.19, Wall, Floor, Ceiling, Electrical Component and Venting System Temperatures.

Class IIA4. Permanent Plate

Shall be made of pressuresensitive metal foil requiring no solvent or activator, provided such plates comply with 2.31, Marking Material Adhesion and Legibility. These materials shall not be located on surfaces having temperatures exceeding 300°F (149°C) as determined during conduct of 2.19, Wall, Floor, Ceiling, Electrical Component and Venting System Temperatures.

Class IIIA1. Permanent Label

Shall be made of material not adversely affected by water, shall be attached by means of nonwatersoluble adhesive and shall comply with 2.31, Marking Material Adhesion and Legibility. These materials shall not be located on surfaces having temperatures exceeding 300°F (149°C) as determined during conduct of 2.19, Wall, Floor, Ceiling, Electrical Component and Venting System Temperatures.

Class IIIA2. Permanent Label

Shall be made of material not adversely affected by water, shall be attached by means of nonwatersoluble adhesive and shall comply with 2.31, Marking Material Adhesion and Legibility. These materials shall not be located on surfaces having temperatures exceeding 175°F (79.5°C) as determined during conduct of 2.19, Wall, Floor, Ceiling, Electrical Component and Venting System Temperatures.

Class IIIB. Waterproof Marking

Shall be printed directly on the part with waterproof marking not adversely affected by a temperature of 175°F (79.5°C). This marking shall not be used on surfaces having temperatures exceeding 175°F (79.5°C) as determined during conduct of 2.19, Wall, Floor, Ceiling, Electrical Component and Venting System Temperatures.

Class IV. Semi-Permanent Label

Shall be made of material which may be soluble in water, and may use watersoluble adhesive for attachment means.

Class V. Printed Marking

Marking shall be clear and prominent and may be applied directly by any printing means.

Class VI. Attached Tags

1.36.2

RATING PLATE(S). Each boiler shall bear a plate or a combination of adjacent plates of Class IIIA marking material located so as to be easily read when the boiler is in a normally installed position. A plate visible after removal of an access panel without the use of tools is satisfactory. Tools may be used to remove an outdoor access panel. This plate(s) shall include the following information:

a. Identification as a boiler plus the following statement(s), when applicable:

1. A boiler designed to directly provide supplemental heat to the room in which it is installed:

“Combination Boiler and Space Heater.”

2. A boiler for direct vent installation only:

“DIRECT VENT BOILER.”

If a direct vent type may also be installed to use indoor combustion air:

“FOR EITHER DIRECT VENT INSTALLATION OR FOR INSTALLATION USING INDOOR COMBUSTION AIR.”

3. A boiler for outdoor installation only:

“For outdoor installation only.”

4. A boiler for either indoor or outdoor installation

“For either indoor or outdoor installation.”

5. A boiler for installation directly on combustible flooring:

“For installation on combustible flooring.”

6. A boiler for installation on noncombustible flooring or a boiler which requires a separate base for installation on combustible flooring:

“For installation on noncombustible floors only.”

7. A boiler for installation on combustible flooring only when installed on a separate base:

“For installation on combustible flooring only when installed on special base Part No.____.”

An asterisk after the statement in “-a6” above shall refer to this statement and both statements shall appear on the same plate. (Also see 1.36.17.)

8. A boiler suitable for use only with a vent damper device:

“For use only with automatic vent damper device Part No. _____. Follow installation instructions.”

9. A boiler suitable for use with or without a vent damper device:

"May be used with automatic vent damper device Part No. _____. Follow installation instructions."

10. A boiler suitable for use only with a flue damper device:

"For use only with automatic flue damper device Part No. _____. Follow installation instructions."

11. Category of boiler as follows:

"Category I;"
 "Category II;"
 "Category III;" or
 "Category IV."

- b. The manufacturer's or distributor's name and address.
- c. The manufacturer's or distributor's number of the boiler.
- d. A distinctive number which will identify an individual boiler.
- e. The manufacturer's normal hourly input rating (1) per individual combustion chamber and (2) total.
- f. Manifold pressure ("wc) (kPa).
- g. The output rating in Btu/hr, as applicable. The output rating shall be computed as follows:

$$\left(\begin{array}{c} \text{output} \\ \text{rating} \end{array} \right) = \left(\begin{array}{c} \text{hourly Btu} \\ \text{input rating} \end{array} \right) \times \left(\begin{array}{c} \text{manufacturer's} \\ \text{specified thermal} \\ \text{efficiency} \\ \hline 100 \end{array} \right)$$

- h. The manufacturer's minimum hourly input rating for a boiler for operation at a rating less than full input rating.
- i. Type of gas for which equipped: Nat., Mfd., Mix., LP, or Btu LP gas-air mixture (the heating value for the LP gas-air mixture shall be indicated).

A boiler for use with natural, manufactured and mixed gases, or any two of these gases, with no change other than a change in orifices, may be marked as equipped for operation with the specific gases. A boiler which takes advantage of this multiple gas marking shall be shipped with the smallest orifice(s) in place, and extra main burner and pilot orifices, properly identified, shall be provided for the other gas(es).

- j. The statement, "Minimum relief valve capacity lbs. per hour." (For safety and relief valve sizing, the valve capacity in pounds per hour is to equal the normal output rating in Btu per hour divided by 1000.)
- k. Maximum inlet gas pressure ("wc) (kPa).

- l. Minimum inlet gas pressure ("wc) (kPa).
- m. Electrical rating voltage, frequency (Hz), and total input in amperes. If the total input of all components is less than 12 amperes, the input marking may optionally be shown as "less than ____* amperes."
- n. Identification of this standard by indicating either this edition of the standard, or the most recent effective addenda thereto, with one of the following markings:

"ANS Z21.13-(year) • CSA 4.9 Low Press. Boiler;"
"ANS Z21.13a-(year) • CSA 4.9a Low Press. Boiler;" or
"ANS Z21.13b-(year) • CSA 4.9b Low Press. Boiler."
- o. Symbol of the organization making the tests for compliance with this standard.
- p. When a Specific Component Identification List is provided in the instructions, the corresponding part number(s). (See 1.34.1-b2.)

1.36.3

INSTRUCTIONS TO PUT THE BOILER IN OPERATION. A boiler having an input rating of 400,000 Btu/hr (117 228 W) or less shall bear a single label or a series of adjacent labels of Class IIIA marking material located in a conspicuous position where the label(s) can be easily read by the operator during the lighting/operating and shutdown procedures.

Where a series of labels is used, they shall:

- a. Be capable of being viewed simultaneously (in the same plane) in the sequence as shown in Exhibit A, B or C, as applicable; and
- b. Not be separated from each other by more than 1 in (25.4 mm).

A separate means may be provided for mounting the lighting/operating instructions label(s). This means shall be permanently attached to the boiler in a manner such that, when lighting the boiler, the lighting/operating instructions can be easily read without detachment from the boiler.

The label(s) may be on the interior of a removable panel which provides access to the gas controls.

If the above label(s) is not visible on the boiler when all panels are in place, a Class IIIA marking shall be affixed on the exterior of the boiler in a location where it can be easily read when the boiler is installed at the minimum clearances for which the boiler is to be listed. This marking shall indicate where the lighting/operating instructions are to be found.

1.36.4

The lighting/operating instructions label(s) specified in 1.36.3 shall contain at least the following:

- a. For a boiler equipped with a continuous (piloted) ignition system, as outlined in Exhibit A.
- b. For a boiler equipped with an intermittent pilot or interrupted pilot ignition system, as outlined in Exhibit B.

* This amperage rating shall be equal to or greater than the total input in amperes.

- c. For a boiler equipped with a direct ignition system, as outlined in Exhibit C.

The pictorial representation required in Exhibits A, B or C shall be specific only to the control system supplied on the individual boiler. For a boiler equipped with a continuous (piloted) ignition system, the illustration shall be specific only to the pilot burner and sensing element supplied with the individual boiler.

The statements in quotes in the above referenced Exhibits shall be worded as shown in the applicable Exhibit.

1.36.5

The physical specifications of the lighting/operating instructions label(s) specified in 1.36.3 shall be as follows:

- a. Each of the three sections shall be boxed by a red border, the top dimensions being a minimum $\frac{1}{4}$ in (6.4 mm) solid red line.

The solid red line shall be broken to show the title of these three sections on a white background as shown in Figures A, B or C, as applicable.

- b. The titles of each section shall be black boldfaced type having a minimum letter height of 0.140 in (3.56 mm)* and located within the top border line.
- c. The word "WARNING" shall be black boldfaced type having a minimum letter height of 0.120 in (3.05 mm).**
- d. The text of the label(s) shall be black boldfaced letters on a white background having a minimum uppercase letter height of 0.100 in (2.54 mm) with a minimum vertical spacing between lines of type of 0.038 in (0.97 mm).*** Lowercase letters shall be compatible with the uppercase letter size specification.

1.36.6

INSTRUCTION PLATE. A boiler having an input rating over 400,000 Btu/hr (117 228 W) shall bear clearly defined, legible and complete instructions for lighting and shutting down the boiler, on Class IIIA marking material, located on or adjacent to the controlling device or in an equally conspicuous position where the instructions can be easily read while lighting or shutting down the boiler. Lighting instructions shall specify a 5 minute complete shutoff period before attempting to relight the boiler.

The information specified on the instruction plate may be combined with the information on the rating plate.

1.36.7

When instruction or rating plates are shipped detached, the space for attachment shall bear the statement on Class V marking: "This installation is not complete unless Instruction (Rating) Plate attached here." Means for permanent attachment of the plates shall be provided, and the plates shall be Class IIA-1 marking material.

* This letter height corresponds to 14-point type.

** This letter height corresponds to 12-point type.

*** This letter height and line spacing correspond to 10-point type and normal vertical spacing, zero leaded.

1.36.8

The marking of boilers shall conform to the *ANSI/ASME Boiler and Pressure Vessel Code, Section IV* ("Heating Boilers"), Part HG, General Requirements for All Materials of Construction, paragraph HG530.

1.36.9

A label of Class IIIB marking material shall, when practical, be affixed to the boiler in a conspicuous location by the manufacturer. When not practical, this label shall be supplied by the manufacturer with explicit instructions to affix the label in a conspicuous location adjacent to the boiler. This label shall include the following information:

WARNING: Improper installation, adjustment, alteration, service or maintenance can cause property damage, personal injury (exposure to hazardous materials)* or loss of life. Refer to the user's information manual provided with this boiler. Installation and service must be performed by a qualified installer, service agency or the gas supplier (who must read and follow the supplied instructions before installing, servicing, or removing this boiler. This boiler contains materials that have been identified as carcinogenic, or possibly carcinogenic, to humans).*

1.36.10

Each direct vent boiler shall bear a marking on Class III marking material stating the necessity for proper resealing or reinstallation of the vent-air intake system. This marking shall be located on an exterior surface and shall be visible at the time of installation or servicing of the appliance.

1.36.11

Fixed setting hot water temperature limit controls shall be temperature marked and steam pressure controls shall be pressure marked at their cut-out calibration point. Adjustable setting for hot water temperature limit controls shall have their temperature range marked and steam pressure controls shall have their pressure range marked.

1.36.12

INSTALLATION MARKING. Each boiler shall bear:

- a. A marking on Class III marking material located on an exterior surface which will be visible at the time of installation stating, "This boiler must be installed in accordance with local codes, if any; if not, follow the *National Fuel Gas Code, ANSI Z223.1/NFPA 54*, or the *Natural Gas and Propane Installation Code, CAN/CSA B149.1*, as applicable."
- b. If not a direct vent boiler, a marking on Class III marking material located on a surface that will be visible after the boiler has been installed stating, "This boiler needs fresh air for safe operation and must be installed so there are provisions for adequate combustion and ventilation air."
- c. If not a direct vent boiler, a marking on Class III marking material located on an exterior surface adjacent to the flue collar stating, "This boiler must be properly vented."
- d. If a direct vent boiler, a marking on Class V marking material located so as to be conspicuous prior to installation stating, "This boiler must be installed with the vent-air intake system as specified and installed in accordance with the manufacturer's installation instructions."

* Must be included or appear on a separate warning label, if the boiler contains materials that contain or may come to contain crystalline silica that may be exposed during installation, servicing or removing the boiler. See 1.34.5 and 1.3.

- e. A Category II, III, IV, or direct vent boiler shall bear a Class III marking which states:

“This appliance requires a special venting system. Refer to installation instructions No. ____ for parts list and method of installation.”

On parts supplied by the boiler manufacturer for venting vent gases from the boiler to the outdoors, the parts shall be identified.

1.36.13

Flue pipe extensions, other than a standard 90 degree (1.57 rad) elbow, used between the flue outlet and the draft hood, shall be clearly labelled with a Class V marking to the effect that the extension must be installed and used without modification.

Boilers equipped with an external draft hood having a vertical inlet shall have a Class IIA1 marking on the skirt of the draft hood reading: “This draft hood must be installed without alteration.”

Additionally, the draft hood skirt, or the draft hood inlet connection within 6 in (152 mm) of the skirt, or the rating plate, shall bear a Class IIA1 marking indicating the minimum vertical distance between the jacket top and the draft hood relief opening. When the rating plate is used to denote this distance, the draft hood shall in addition bear a Class IIA1 marking reading: “See rating plate.”

1.36.14

CLEARANCE MARKING. Each boiler shall bear a Class IIIA marking to specify minimum clearances to combustible construction.

- a. The marking for a boiler for indoor installation with an input rating of 400,000 Btu/hr (117 228 W) or less shall specify whether the boiler is for alcove or closet installation.
- b. If the marking for a boiler for indoor installation with an input rating over 400,000 Btu/hr (117 228 W) specifies minimum clearances of 24 in (610 mm) or more to any combustible wall(s) and ceiling, it shall also specify that the boiler shall be installed in a space large in comparison to the size of the boiler.
- c. The marking of a boiler for outdoor installation tested without adjacent overhead cover shall specify that there shall be no combustible construction above the boiler.

1.36.15

A boiler tested with a listed Type B gas vent or vent connector shall be provided with a Class V marking in a location conspicuous prior to installation clearly indicating the specific type of vent or vents, such as B0, B1, B1^{1/2}, etc., with which the boiler is to be used.

1.36.16

A boiler which requires clearances from any type of construction for serviceability or proper operation, shall bear a marking on Class III marking material, located on the surface(s) requiring such clearance, indicating the minimum distance required.

1.36.17

A separate base for combustible floors shall bear a Class III marking visible from the front after installation of the boiler, as follows:

“Base Part No. ____.”

1.36.18

Each boiler shall bear a label of Class IIIA marking material located so as to be easily read when the boiler is in a normally installed position, on which shall appear the following:

FOR YOUR SAFETY Do not store or use gasoline or other flammable vapors and liquids in the vicinity of this or any other appliance.
--

1.36.19

A flue damper device shall bear a Class III marking on which shall appear the following:

- a. The hot water boiler manufacturer's part number of the flue damper device.
- b. Unless the device can be installed only in the correct position, the inlet, outlet or direction of flue gas flow.
- c. On mechanically actuated flue damper devices, type and range of motive power which will permit normal functioning of the flue damper device.

1.36.20

A flue damper device shall bear a Class III marking attached to the device stating clearly and legibly: "WARNING Follow instructions for proper installation." The word "WARNING" shall be in letters having a minimum height of 0.240 in (6.10 mm).* The remainder of the warning shall be in letters having a minimum uppercase letter height of 0.120 in (3.05 mm) with a minimum vertical spacing between lines of 0.046 in (1.17 mm).** Lowercase letters shall be compatible with the uppercase letter size specification.

1.36.21

A direct vent boiler shall bear a marking to indicate the minimum and maximum thickness of the wall through which it may be installed. This marking may appear on the rating plate or on a separate Class III marking adjacent to the rating plate.

1.36.22

ELECTRICAL DIAGRAMS.

This section is unique to the United States. The Canadian electrical equipment and wiring provisions are contained in *Electrical Features of Fuel-Burning Equipment, CAN/CSA-C22.2, No. 3*.

- a. Except when electrical equipment is limited to a simple series circuit, electrical diagrams (see Part IV, Definitions) on Class IV marking material applicable to all electrical circuits within the boiler shall be supplied in each of the following forms:
 1. A connection diagram to aid in locating components for field service and to provide for the connection of external interlock proving devices.
 2. A schematic diagram of the ladder form, in addition to the connection diagram. When necessary for clarification, a cycle chart or printed sequence of switching action accompanying the schematic diagram.

* This letter height corresponds to 24-point type.

** This letter height and line spacing correspond to 12-point type.

- b. If wire other than that conforming to the temperature limitation of 63°F (35°C) rise has been specified for use on the boiler, the following statement shall appear on all electrical diagrams: "If any of the original wire as supplied with the appliance must be replaced, it must be replaced with type ____ wire or its equivalent."

If wire other than that conforming to the temperature limitation of 63°F (35°C) rise has been specified for connection of the boiler, the following statement shall appear on all electrical diagrams: "When connecting field wiring to the boiler, wiring material having a minimum size of ____* AWG and a temperature rating of at least ____°F ____* shall be used."

If wiring larger than No. 14 AWG (2.1 mm²) or with a temperature rating greater than 60°C (140°F) has been specified for field-wired connections, the marking required by 1.24.3 shall appear on all electrical diagrams.

- c. Electrical diagrams shall conform to the *Standard for Electrical and Electronics Diagrams, ANSI Y14.15*. See Appendix A for reference to pertinent provisions of ANSI Y14.15. The wire color designations specified under 153.11 of ANSI Y14.15 are shown in Appendix B.

It is recommended that the usage of wire colors be as shown in Appendix C.

- d. Unidentified graphical symbols used for electrical diagrams shall conform to the *Standard for Graphic Symbols for Electrical and Electronics Diagrams (Including Reference Designation Class Designation Letters), ANSI/IEEE 315*. See Appendix D for preferred symbols of commonly used items, as extracted from ANSI/IEEE 315. Abbreviations for identified items shall be as shown in Appendix D.
- e. The electrical diagrams specified in "a" above shall be attached to the boiler in a location where they are accessible during servicing of the electrical components. Some means of color, letter or number coding corresponding to the boiler wiring shall be used in the diagrams to facilitate circuit identification.

1.36.23

Also see 1.6.8, 1.10.2, 1.14.6, 1.15.3, 1.24.3, 1.25.1, and 1.35, User Information Manual.

* These marked values shall conform with those on the label specified in 1.24.3.

Part II: Performance

2.1 General

2.1.1

The boiler shall be installed and operated in accordance with the manufacturer's instructions unless specifically required otherwise by the test method.

2.1.2

A boiler submitted for examination under this standard shall be tested with the type(s) of gas selected by the manufacturer.

2.1.3

When a thermocouple is specified for the measurement of air, water, flue or vent gas temperatures, a thermocouple or an equivalent temperature measuring device complying with the *Performance Test Codes, Supplement on Instruments and Apparatus, Part 3, Temperature Measurement, ANSI/ASME PTC 19.3*, shall be used.

2.1.4

A vent limiter, when provided on the gas appliance pressure regulator, shall be in place during all performance tests.

2.1.5

During tests for compliance with this standard, unless otherwise specified, a Category I boiler shall be connected to an uninsulated sheetmetal vent pipe the same size as the draft hood outlet, unless otherwise specified. Elbows shall be 90 degree (1.57 rad), fourpiece, sheetmetal elbows. The vent pipe shall have a reasonably smooth inner contour. The vent pipe shall be arranged as follows:

- a. Input Ratings of 400,000 Btu/hr (117 228 W) or Less: (See Figure 2, Arrangement of Vent Pipe for Testing Boilers Having Input Ratings of 400,000 Btu/hr (117 228 W) or Less.)

When the flue gases discharge horizontally, a 2 ft (610 mm) horizontal section of vent pipe, an elbow and a length of vertical vent pipe that will provide a total height of 5 ft (1.52 m) shall be attached to the draft hood outlet, or in the absence of a draft hood, to the flue collar. The total vertical height of 5 ft (1.52 m) is measured from the highest point of the draft hood relief opening(s), or in the absence of a draft hood, the base of the flue collar to the top of the vertical vent pipe.

When the flue gases discharge vertically, an elbow shall be attached to the draft hood outlet, or flue collar, and the above arrangement attached to it to provide a total height of 5 ft (1.52 m) as described above.

The horizontal run of vent pipe shall be pitched upward $\frac{1}{4}$ in to the ft (21 mm to the meter).

- b. Input Ratings Over 400,000 Btu/hr (117 228 W):

When the flue gases discharge horizontally, an elbow and 5 ft (1.52 m) of vertical vent pipe shall be attached to the draft hood outlet or in the absence of a draft hood, to the flue collar.

When the flue gases are vented vertically, 4 ft (1.22 m) of vertical vent pipe shall be attached to the draft hood outlet or flue collar.

2.1.6

Category II, III, IV, and Direct Vent Boilers.

The minimum vent length arrangements recommended by the manufacturer shall be installed. It shall be of material supplied by, or specified by the manufacturer.

2.1.7

Draft hoods shall be in place during all performance tests unless otherwise specified herein.

2.1.8

When a boiler with a vent damper device is submitted for examination, the manufacturer shall specify whether the boiler is for use only with the vent damper device or for use both with and without the vent damper device.

If the boiler is for use only with the vent damper device, the vent damper device shall be in place for all tests specified herein.

If the boiler is for use both with and without the vent damper device, the tests specified in 2.23.2 through 2.23.5 shall be conducted both with and without the vent damper device in place. The tests specified in 2.5, Combustion; 2.11, Efficiency; 2.20, Flue Gas Temperature; and 2.23.1 shall be conducted without the vent damper device in place. All other tests specified herein shall be conducted with the vent damper device in place.

All boiler performance tests for which an electrically operated vent damper device is specified to be in place shall be conducted with the damper open to the minimum degree that would permit the boiler's automatic valve to open.

2.1.9

When a boiler is equipped with a flue damper device, the flue damper device shall be in place for all tests specified herein, with the exception of 2.25.4 and 2.25.5, which are tests of the flue damper device itself and which may be conducted separately.

All boiler performance tests shall be conducted with the damper open to the minimum degree that would permit the boiler's automatic valves to remain open.

2.1.10

A direct vent boiler shall be tested adjacent to a wall constructed of nominal 2-inch-thick studs spaced 16 in (406 mm) on center. This framing shall be covered on both sides by $\frac{3}{4}$ inch-thick plywood finished in dull black. The studs shall be of a width to provide a total wall thickness in accordance with the manufacturer's instructions. The vent-air intake terminal shall be installed through this wall in accordance with the manufacturer's printed instructions. The portion of the vent-air intake terminal located within the wall shall be enclosed on the top, bottom and sides, as close as the configuration of the boiler will permit, with nominal 2 inch-thick wood framing of the same width used to construct the wall.

In addition to the thermocouples specified in 2.19.1, thermocouples shall be installed within the wall and on the outer surface of the wall at all probable high temperature points. For structural elements in contact with parts of the boiler, the junctions of the thermocouples shall be placed flush with the surfaces of the parts of the boiler. Other thermocouples shall be held in thermal contact with the wood surface by a radiation transparent adhesive tape finished in dull black.

When the design of the boiler is such as to clearly indicate that it is not intended to be installed in the manner described above, the test structure shall be such as to simulate the normal installation and venting of the boiler at the discretion of the testing agency and in accordance with the manufacturer's printed instructions.

2.1.11

Boilers for use with natural and mixed gases or natural, manufactured and mixed gases shall have identical input ratings for these gases.

2.1.12 A boiler equipped with a fixed limit control set at less than 240°F (115.5°C) shall be tested under 2.5.1, 2.12.2, 2.13, Nonload-bearing Flue Gas Baffle Temperatures, 2.19.2 and 2.20, Flue Gas Temperature, at the temperature specified in the Method of Test, or at the maximum outlet water temperature as determined in 2.15, Water Temperature Limiting Devices, whichever is less.

2.1.13 A boiler equipped with automatic step-rate or automatic modulating controls, which provide ignition and operation at input rates less than the normal input rate, shall also be tested at the minimum test input rate (see 2.3.4) under 2.5.1, 2.6.1-e, 2.6.2, 2.6.3, 2.6.4, 2.6.5, 2.6.6, 2.7.2, 2.7.4, 2.21, Flue Collectors and 2.23.5.

A boiler having automatic modulating controls which act to reduce the input rate after ignition of the main burner gas shall also be tested at the minimum test input rate (see 2.3.4) under 2.5.1, 2.6.1-f, 2.6.2, 2.6.3, 2.6.4, 2.6.5, 2.6.6, 2.7.2, 2.7.4, 2.21 and 2.23.5.

A boiler having automatic modulating controls which act to reduce the input rate after ignition of the main burner gas shall also be tested at the minimum test input rate (see 2.3.4) under 2.5.1, 2.5.4, 2.6.1-f, 2.6.4 2.6.6 and 2.23.5.

Tests at the minimum test input rate (see 2.3.4) shall be conducted at normal inlet test pressure only.

A boiler having means to provide momentary input rate reduction upon ignition shall have all tests applied with such controls in operation.

2.1.14

When unsupervised pilots are provided, they shall be in operation only when conducting the tests specified in 2.5, Combustion, 2.23, Draft Hoods and 2.24, Blocked Vent Test for Boilers Equipped With Forced or Induced Draft Burners and Without Draft Hoods or Regulators. Unburned pilot gas shall be allowed to flow when conducting the test specified in 2.7.15.

2.1.15

Room temperature, whenever specified, shall be the arithmetic average temperature of the test area determined by measurement with four No. 24 AWG (0.20 mm²) iron-constantan bead-type or copper constantan bead type thermocouples with junctions shielded against radiation, located approximately at 90 degree (1.57 rad) positions on a circle circumscribing the boiler or boiler test enclosure, in a horizontal plane approximately at the vertical midpoint of the boiler or test enclosure, approximately 24 in (610 mm) from the sides of the boiler or test enclosure, and located so as not to be affected by other than room air.

2.1.16

A boiler for outdoor installation shall also comply with 2.19.4, 2.19.5 and 2.27, Boilers for Outdoor Installation. (Also see 2.1.5, 2.20, Flue Gas Temperatures and 2.23, Draft Hoods.)

2.2 Test Gases

In conducting the performance tests specified herein, gases with characteristics approximately as shown in Table XII, Characteristics of Test Gases, shall be used.

- a. A boiler for use with natural gas shall have the tests specified herein conducted with test Gas A.

Additional tests shall be conducted with test Gas G, or at the manufacturer's option, test Gas H, as specified in 2.3.1 at the inlet test pressures specified in Table XIII, Inlet Test Pressures, for test Gas A. With no change whatever in the test Gas A adjustments, the tests with test Gas G or H shall comprise those specified in 2.6.1a, 2.7.2 or 2.8.3. Under conditions of these tests, yellowtipped flames are considered acceptable as long as carbon is not being deposited. Resonance encountered during conduct of burner operating characteristics tests with test Gas G or H is not to be considered cause for rejection. Compliance with these supplemental tests does not imply that the boiler has been examined under this standard for use with LP gas-air mixtures.

- b. A boiler for use with manufactured gas shall have the tests specified herein conducted with test Gas B.
- c. A boiler for use with mixed gas shall have the tests specified herein conducted with test Gas C.
- d. A boiler for use with natural, manufactured and mixed gases shall be tested with test Gases A and G, as specified in 2.2a, and test Gas B.

The tests specified in 2.5.1, 2.6, Burner Operating Characteristics, and 2.7, Piloted Ignition Systems or 2.8, Direct Ignition Systems, shall also be conducted with test Gas C (1) when the boiler is equipped with different burners for natural and manufactured gas, or (2) when a third burner is supplied specifically for use with mixed gas. In the former case, the burner equipment employed for the mixed gas tests shall be that specified by the manufacturer.

- e. A boiler for use with liquefied petroleum gases shall have the tests specified herein conducted with test Gas E. The tests specified in 2.6 and 2.7.2, 2.7.3, 2.7.4, 2.7.10, 2.7.11, 2.7.12 and 2.7.13 (or 2.8.3 through 2.8.6) shall also be conducted with test Gas D with no change whatever in burner equipment.
- f. A boiler for use with LP gasair mixtures shall have the tests specified herein conducted with test Gas H. The tests specified in 2.5.1, 2.6 and 2.7.2, 2.7.3, 2.7.4, 2.7.10, 2.7.11, 2.7.12 and 2.7.13 (or 2.8.3 through 2.8.6) shall also be conducted with test Gas F without change in the boiler except for main burner and pilot orifices and air shutter adjustment.
- g. When use with more than one type of gas is desired, the tests specified in 2.11, Efficiency and 2.13, Nonload-bearing Flue Gas Baffle Temperatures, through 2.31, Marking Material Adhesion and Legibility, need be conducted with only one test gas provided there are no changes in the boiler or input rating for different gases which, in the opinion of the testing agency, would affect the results of these tests.

2.3 Inlet Test Pressures And Burner Adjustments

2.3.1

Unless otherwise stated, each test specified herein shall consist of a series of three tests: one at normal inlet test pressure, one at reduced inlet test pressure and one at increased inlet test pressure, as shown in Table XIII, Inlet Test Pressures.

The increased inlet test pressure shall be the greater of that listed in Table XIII or the marked maximum inlet gas pressure for the gas being used. This pressure shall not exceed the lowest rated inlet pressure of the controls.

When the manifold pressure at increased inlet test pressure is not greater than the manifold pressure at normal inlet test pressure, the tests at increased inlet test pressure need not be applied. However, tests at normal inlet test pressure shall be conducted whenever tests at increased inlet test pressure are specified.

When the manifold pressure at reduced inlet test pressure is greater than at normal inlet test pressure or at increased inlet test pressure, tests at both reduced inlet test pressure and the inlet test pressure resulting in the lowest manifold pressure shall be conducted.

2.3.2

The inlet test pressure shall be taken ahead of all controls and the manifold gas pressure downstream of all controls at the point specified by the manufacturer.

2.3.3

Burners shall be adjusted to their input rates at normal inlet test pressure unless otherwise specified herein. After the boiler has been operated for 15 minutes starting with all parts at room temperature, the burner adjustments shall be within ± 2 percent of the manufacturer's specified normal hourly Btu input rate. The manifold pressure shall be within ± 10 percent of that printed on the rating plate. Primary air shall be set to give a good flame at this adjustment and neither burner nor primary air adjustments shall be changed during a series of tests with any one test gas unless otherwise specified. Any adjustment resulting in the deposit of carbon during any test specified herein shall not be acceptable.

2.3.4

For test purposes, the minimum test input rate on a boiler provided with controls which will reduce the input rate by automatic means shall be 87 percent of the minimum input rate specified by the manufacturer. The manufacturer's specified minimum input rate shall not be less than 20 percent of the manufacturer's specified normal input rate.

2.4 Category Determination

An indoor boiler of other than the direct vent type shall be determined to be a Category I, II, III, or IV boiler (see Part IV, Definitions) by the following Method of Test.

Method of Test

During the conduct of this test, water temperature shall be maintained as specified in 2.5.1, or at the maximum outlet water temperature as determined in 2.15, Water Temperature Limiting Devices, whichever is less.

This test shall be conducted using Test Gas A only, unless the boiler is for use with LP gas only or if the manufacturer specifies different inputs for natural and LP gas. In the latter case, testing shall be conducted using Test Gas E.

Applicable to Boilers Having Input Ratings of 400,000 Btu/hr (117 228 W) or Less:

For a boiler having a vertical flue, a vent pipe, as specified in 2.1.5-a, shall be equipped with: (1) a piezo ring (see Figure 3, Piezo Ring and Details of Typical Construction) installed at the midpoint of the 2 ft (610 mm) section of vent pipe extending horizontally; and (2) a thermocouple grid (as specified in 2.20, Flue Gas Temperatures) installed 12 in (305 mm) from the outlet of the test vent. A differential pressure gage which can be read directly to 0.005 in wc (1.24 Pa) pressure shall be attached to the piezo ring to measure static pressure. The vent pipe shall be insulated* and all pipe seams and joints shall be sealed.

For a boiler having a horizontal flue, a 90 degree (1.57 rad) insulated* sheetmetal elbow of suitable diameter shall be attached directly to the point of connection of the venting system to the boiler and the test vent attached to the elbow.

* Insulation shall be by means of foil-faced R7 material or greater.

Applicable to Boilers Having Input Ratings Over 400,000 Btu/hr (117 228 W):

A vent pipe, as specified in 2.1.5-b, shall be equipped with: (1) a piezo ring (see Figure 3) installed 12 in (305 mm) from the inlet of the test vent; and (2) a thermocouple grid (as specified in 2.20) installed 12 in (305 mm) from the outlet of the test vent. A differential pressure gage which can be read directly to 0.005 iwc (1.24 Pa) pressure shall be attached to the piezo ring to measure static pressure. The vent pipe shall be insulated* and all pipe seams and joints shall be sealed.

a. For a Boiler Having a Single Input Rating

The boiler shall be operated at normal inlet test pressure. When equilibrium conditions are attained, the temperatures indicated by the thermocouples shall be recorded. A sample of the vent gases shall be secured at the outlet of the test vent and analyzed for carbon dioxide as specified in 2.5.1. The net vent gas temperature shall be determined by subtracting the room temperature from the vent temperature. (See Figure 4, Chart for Determination of Boiler Category.)

The static pressure of the vent shall be measured by use of the piezo ring and recorded. If this pressure is positive, the boiler shall be subjected to the tests specified in 2.30, Venting Systems for Category II, III, or IV Boilers.

The category of the boiler with respect to the venting system shall be determined using Table XIV, Determination of Category, and Figure 4.

b. For a Boiler Having Multiple Input Ratings

This test shall be conducted as specified in “-a” above except as follows:

The test to determine the static pressure in the vent shall be conducted at the maximum input rating only.

The net vent gas temperature and carbon dioxide concentration shall be determined at both minimum and maximum input ratings.

Using the data obtained above, the category of the boiler with respect to the venting system shall be determined using Table XIV, Determination of Category and Figure 4, Chart for Determination of Boiler Category.

If two categories are determined during conduct of these, the boiler shall be rated at the higher of the two category numbers, and the venting system specified shall be suitable for the highest flue gas temperatures determined above.

2.5 Combustion

2.5.1

A boiler shall not produce a concentration of carbon monoxide in excess of 0.04 percent in an air-free sample of the flue gases when tested in an atmosphere having approximately a normal oxygen supply.

Method of Test

After adjustment (also see provisions of 1.5.2) and with all parts of the boiler at room temperature, the pilot(s), if provided, shall be placed in operation and allowed to operate for a period of 5 minutes.

* Insulation shall be by means of foil-faced R7 material or greater.

The main burner(s) shall then be placed in operation, and the boiler operated for 3 minutes at normal inlet test pressure and rated voltage, at which time a sample of the flue gases shall be secured. Immediately upon securing the sample at normal inlet test pressure, the reduced inlet test pressure (see 2.3.1) shall be applied and, following a purge period of at least 2 minutes, another sample of the flue gases shall be secured. After this sample has been secured, the normal inlet test pressure shall be restored.

The gas appliance pressure regulator shall then be adjusted to provide an input rate of 106.25 percent of the manufacturer's specified input rate. The boiler shall then be allowed to continue in operation for 15 minutes after it was initially placed in operation, at which time another sample of the flue gases shall be secured. When the increased input rate cannot be readily obtained by adjustment of the gas appliance pressure regulator, this increase may be obtained with the regulator removed or locked in its full open position. Immediately after the flue gas sample has been obtained the manifold pressure shall be returned to the value determined in 2.3.3 for the rated input.

During conduct of the above tests, water at a temperature of $80 \pm 10^{\circ}\text{F}$ ($26.5 \pm 5.5^{\circ}\text{C}$) shall be admitted through the return inlet water connection when the water in the boiler has reached a temperature of 180°F (82°C), at a rate just sufficient so the outlet water temperature will not exceed 180°F (82°C) or the outlet water temperature as determined in 2.15, Water Temperature Limiting Devices, whichever is less.

On a boiler provided with a power burner or induced draft, an additional combustion sample shall be secured with the boiler operating at normal inlet test pressure and with the supply voltage reduced to 85 percent of the rating plate voltage of the boiler. This sample shall be secured 20 minutes after the boiler has been placed in operation. Immediately after the flue gas sample has been obtained the voltage shall be returned to the rated value.

Samples shall be secured between the boiler and draft hood or vent terminal at a point where uniform samples can be obtained. When this method of sampling is not practical, the procedure shall be left to the discretion of the testing agency. The flue gas samples shall be analyzed for carbon dioxide and carbon monoxide.

2.5.2

Combustion characteristics shall not be affected by opening a control chamber panel. This provision shall be deemed met when a sample of flue gases secured with the panel open contains a percentage of carbon dioxide within 0.4 percent of the percentage in a sample secured with the panel in place.

Method of Test

With the boiler operating at normal inlet test pressure, samples of flue gases shall be secured both with the control chamber panel in place and with the panel open or removed. These samples shall be taken not less than 2 minutes nor more than 5 minutes apart beginning 30 minutes after the boiler has been placed in operation, and shall be analyzed for carbon dioxide. The difference between the two samples shall not exceed 0.4 percent.

2.5.3

A boiler for use with natural gas shall comply with 2.5.1 when adjusted and operated with test Gas A at 4.0 in wc (995 Pa) inlet test pressure.

Method of Test

This test need not be applied when the manifold pressure at the 4.0 in wc (995 Pa) inlet test pressure adjustment is not less than the normal manifold pressure specified by the manufacturer for natural gas.

With all parts of the boiler at room temperature, the boiler shall be placed in operation with test Gas A at 4.0 in wc (995 Pa) inlet test pressure. After 15 minutes of operation, the input rate shall be adjusted to the manufacturer's specified normal input rate and the primary air adjustment set to give a good flame. Following adjustment, all gas to the boiler shall be turned off and all parts of the boiler allowed to cool to room temperature. The pilot(s), if provided, shall then be placed in operation and allowed to operate for a period of 5 minutes, at which time the main burner(s) shall be placed in operation. The boiler shall be operated for 3 minutes, at which time a sample of the flue gases shall be secured and analyzed as specified in 2.5.1.

2.6 Burner Operating Characteristics

2.6.1

Burner flames shall not flash back when the gas is turned on and off:

- a. At the burner adjustment and inlet test pressures specified in 2.3, Inlet Test Pressure and Burner Adjustments;
- b. At 4.0 in wc (995 Pa) inlet test pressure with test Gas A as specified in 2.5.2 when use with natural gas is desired [this test need not be applied when the manifold pressure at the 4.0 in wc (995 Pa) inlet test pressure is not less than the normal manifold pressure specified by the manufacturer for natural gas];
- c. With the gas valve partially closed until the input rate is $\frac{1}{3}$ of the normal input rate at normal inlet test pressure. In the event the boiler control system shuts off the main burner gas supply before the input rate is reduced to $\frac{1}{3}$ of normal rate, the test shall be conducted at the lowest input rate at which the control system will permit ignition. In this event, the shutoff point of a control system as described in "-e" or "-f" below shall not exceed 87 percent of the minimum input rate;
- d. At normal inlet test pressure with the voltage supply adjusted to both 85 percent and 110 percent of the boiler rating plate voltage. This test shall be conducted only on boilers equipped with power burners or induced draft devices;
- e. At normal inlet test pressure and at 87 percent of the minimum input rate if the boiler is equipped with automatic step-rate or automatic modulating controls which provide for ignition and operation at a reduced input rate, if this results in an input rate less than $\frac{1}{3}$ the normal input rate; and
- f. At normal inlet test pressure and at 87 percent of the minimum input rate if the boiler is equipped with automatic modulating controls which act to reduce the input rate after ignition of the main burner gas, if this results in an input rate less than $\frac{1}{3}$ the normal input rate. (Test for operation and extinction only.)

Tests shall be conducted with the burner(s) both hot and cold.

2.6.2

The arrangement of main burners and ignition devices shall be such that the gas from any burner or combination of burners will be effectively ignited without delayed ignition, flashback or danger to the boiler under the test conditions specified in 2.6.1-a through -e.

These tests shall be conducted with the burner(s) both hot and cold.

2.6.3

When ignition is made in a normal manner under the adjustment conditions specified in 2.6.1-a through -e, flames shall not flash outside the boiler.

2.6.4

Burner flames shall not flash back when the boiler is operated under the adjustment conditions specified in 2.6.1 and when the gas is turned on or off by the temperature control device regularly furnished with the boiler.

Method of Test

The gas supply shall be turned off by means of the temperature control device. Immediately after all of the flames have become extinguished on the burner ports, the temperature control device shall be operated to turn on the gas supply. If there is no evidence of continuous flame at the orifice(s) or in the mixer tube(s), the boiler shall be considered as complying with this provision.

2.6.5

There shall be no back pressure at the burner mixer face under the test conditions specified in 2.6.1.

Method of Test

Back pressure shall be determined by playing a flame on the mixer face in such a manner that any gas-air mixture escaping from the mixer head will be ignited.

2.6.6

Burners shall ignite, operate and extinguish without undue noise under the adjustment conditions specified in 2.6.1.

2.7 Piloted Ignition Systems

2.7.1

The pilot(s) shall effect ignition of gas at the main burner(s) after gas reaches the main burner port(s). Continuous pilots shall not become extinguished and remain extinguished when the gas to the main burner(s) is turned on and off in a normal manner.

Method of Test

This test shall be conducted at all inlet test pressures specified in 2.3.1 for each type gas selected.

At least 25 successive ignition tests shall be conducted. The thermostat shall be manually cycled to provide a 30 second on time, beginning with the initial ignition of main burner gas, and a 30 second off time, beginning after any post purge function ceases. Failure to effect ignition immediately after gas reaches the main burner port(s) in any one instance, continued extinction of the pilot, or a lockout of the automatic ignition system shall be considered as noncompliance with this provision.

For a continuous pilot these tests shall be repeated using the manual shutoff valve provided to cycle the main burner gas on and off. Movement of the handle shall be in a smooth continuous motion.

2.7.2

The pilot shall not deposit appreciable carbon during any tests specified in the performance provisions when adjusted according to the manufacturer's instructions.

2.7.3

The pilot shall effect ignition of the gas at the main burner(s) under the following conditions. A pilot which becomes extinguished after having completed main burner ignition is considered as complying with this provision.

The following tests shall be conducted at normal inlet test pressure:

- a. Single-Flame Pilot Burners (Pilot burners which produce a single flame with substantially uniform contour under turndown conditions.)

The pilot shall effect ignition of the gas within 4 seconds from the time gas is admitted to the main burner(s) without excessive flame flashback or damage to the boiler when the pilot gas supply is reduced to an amount just sufficient to keep the valve of the safety shutoff device open, or just above the point of flame extinction, whichever represents the higher pilot gas rate.

A flame can be considered as equivalent to a substantially uniform contour flame if its deviation from uniform contour is occasioned by a flame baffle(s) or channel(s).

- b. Multiflame Pilot Burners (Pilot burners which produce a flame(s) with substantial variation in contour under turndown conditions.)

The pilot shall effect ignition of the gas within 4 seconds from the time gas is admitted to the main burner(s) without excessive flame flashback or damage to the boiler when all the pilot burner ports, except those for heating the thermal element, are blocked, and the pilot gas supply is reduced to an amount just sufficient to keep the valve of the safety shutoff device open or just above the point of flame extinction, whichever represents the higher pilot gas rate.

The above test shall also be conducted under sufficient conditions of increased pilot burner input rating to determine that main burner ignition will take place within 4 seconds from the time that gas is admitted to the main burner(s) with the pilot burner input at any level from the turndown condition described above, up to and including that providing normal flow through the unblocked port(s) based on the manufacturer's specified normal input rating for the pilot burner.

- c. Pilot Burner and Thermal Element Assemblies Which Supply Electrical Energy for an Automatic Control System.

When the thermal element is the only source of electric power for operation of the automatic valve, the tests under "-a" and "-b" shall be conducted with the pilot adjusted to the minimum size (pull-in millivoltage) required to open the automatic valve. This test condition shall be based on the performance of the system when only the thermal element and automatic valve are present. Under these conditions, the pilot shall effect ignition of the gas within 4 seconds from the time gas is admitted to the main burner(s) without excessive flame flashback or damage to the boiler.

Room thermostats and any other system components shall be excluded during this test.

When a multiflame pilot burner is provided, the tests outlined under "-b" at increased pilot input ratings shall also be conducted.

- d. Recycling Pilot Burners

In the case of pilot burners which operate every time the main burner(s) is turned on or off, either manually or by automatic controls, the ignition flame(s) shall provide ignition of the gas within 4 seconds from the time gas is admitted to the main burner(s), without excessive flame flashback or damage to the boiler when the gas supply to the ignition flame is just sufficient to allow main burner gas to flow.

2.7.4

The time from the initiation of gas flow to proof of the ignition source shall not exceed the ignition means pilot flame-establishing period specified in Table I-A through Table I-D, as applicable, when the boiler is operated at normal inlet test pressure. For purposes of this test, the control manufacturer's specified maximum pilot flame-establishing period for the automatic gas ignition system shall be used.

2.7.5 When an interrupted ignition source is provided, the time required for the main burner flame to be proved from the initiation of main burner gas flow shall not exceed the main burner trial for ignition period specified in Table I-A when the boiler is operated at normal inlet test pressure. For purposes of this test, the control manufacturer's specified maximum main burner trial for ignition period for the automatic gas ignition system shall be used.

2.7.6 On a boiler equipped with an interrupted ignition source, the ignition system shall act to shut off main burner and pilot gas within the maximum main burner trial for ignition period specified in Table I-A when the main burner flame is not proved within that period.

For purposes of this test, the control manufacturer's specified maximum main burner trial for ignition period for the automatic gas ignition system shall be used.

Method of Test

This test shall be conducted at normal inlet test pressure. The main burner flame proving means shall be rendered inoperative. The ignition source shall be established and main burner gas allowed to flow. The time from the initiation of main burner gas flow until the ignition system acts to shut off the valve(s) controlling main burner and pilot gas shall not exceed the maximum main burner trial for ignition period specified in Table I-A through Table I-D, as applicable.

2.7.7

The time required for the automatic gas ignition system to shut off the gas supply following loss of the supervised flame shall not exceed the flame failure response time and the valve closing time specified in Table I-A through Table I-D, as applicable. For purposes of this test, the control manufacturer's specified maximum flame failure response time for the automatic gas ignition system shall be used.

Method of Test

The boiler shall be operated for 30 minutes at normal inlet test pressure. All gas shall then be turned off and the gas flow to a continuous or intermittent pilot immediately reestablished but not ignited. The flame failure response time and the valve closing time shall not exceed those specified in Table I-A. An interrupted pilot having a separate sensing device from that for the main burner flame shall also be tested by turning off all gas after the pilot has been proved but before the main burner gas is ignited. The gas flow to the interrupted pilot shall be immediately reestablished but not ignited. The flame failure response time and the valve closing time shall not exceed that specified in Table I-A through Table I-D, as applicable.

2.7.8

When the automatic gas ignition system is designed to shut off the pilot as well as the main burner gas supply, the time and conditions specified in 2.7.7 shall apply.

2.7.9

Any type of pilot equipped with an automatic igniter shall not cause excessive flame flashback or damage to the boiler. For purposes of this test, the control manufacturer's specified maximum flame failure response time in combination with the control manufacturer's specified minimum recycle time for the automatic gas ignition system shall be used.

Method of Test

The pilot igniter shall be rendered inoperative.

The boiler shall be instrumented with a sampling tube(s) to measure the gas-air ratio at various points in the boiler. This sampling tube(s) shall be connected to a gas-air analyzer coupled to a chart-type single-point recording potentiometer in order to produce a constant trace of the gas-air ratio at the sample point for sufficient time to allow a complete evaluation of the system. The gas-air ratio trace shall be developed with the boiler both hot and cold, and with all test gases for which the boiler is tested. Supplemental natural gas tests with test Gas G need not be conducted.

Unburned gas shall be allowed to flow into the boiler for the control manufacturer's specified maximum flame failure response time plus the valve closing time. Immediately following shutoff of the gas supply, an ignition cycle shall be initiated and continued until the pilot igniter would be energized, as determined by the control manufacturer's specified minimum recycle time.

If the gas-air ratio at the time at which the pilot igniter would be energized does not exceed the lower flammable limit, the boiler shall be considered as complying with this provision. If this ratio is above the lower flammable limit, sufficient ignition tests shall be conducted, between the time of energization of the ignition means and the time when the atmosphere within the boiler returns to below the lower flammable limit, to determine that the automatic igniter does not cause excessive flame flashback or damage to the boiler.

A boiler with a control system not providing complete gas shutoff, but having a purge period (recycle time) of 5 minutes or longer, shall be tested as outlined above except the purge time shall be 4½ minutes. Pilot gas shall be allowed to flow during the purge period.

A boiler with a control system providing complete gas shutoff and a purge period of 5 minutes or longer shall be considered as complying with this provision.

2.7.10

Flames shall travel freely to all pilot burner ports when the gas is ignited at any one port.

Method of Test

This test shall be applied only to a pilot burner in which separate ports are used for heating the thermal element of the safety shutoff device and for ignition of gas at the main burner(s). The pilot burner shall be adjusted according to the manufacturer's instructions and the pilot gas ignited. The flames shall then be extinguished by means other than interrupting the gas supply, and gas from the ports which serve to heat the thermal element of the safety shutoff device immediately reignited. The flames shall travel freely to all other ports on the pilot burner.

2.7.11

The pilot shall be protected from drafts.

Method of Test

With the pilot burner adjusted to its normal gas rate and with the gas supply to the main burner(s) shut off, a draft having a velocity of 300 ft/min (1.52 m/s) and of sufficient volume to encompass the entire boiler shall be directed alternately at the front, sides and rear of the boiler. The pilot shall not be extinguished under these conditions.

2.7.12

A bleed burner shall be located so that gas issuing from it will be ignited by a continuous pilot.

2.7.13

Temperatures developed on automatic gas ignition system components shall not exceed those for which the components are designed.

Method of Test

Thermocouples shall be attached by positive thermal attachment such as peening or brazing to the following points as applicable to the system provided:

- a. Pilot burner tip;
- b. Pilot burner orifice fitting;
- c. Electric igniter;
- d. Flame sensor;
- e. Spark electrode;
- f. Surfaces of the hot and cold junction of thermoelectric types;
- g. Valve body;
- h. Electric switch;
- i. Spark generator;
- j. Contact mechanism; and
- k. Magnetic assembly.

The main burner(s) and pilot burner(s) shall be operated at normal inlet test pressure until equilibrium component temperatures have been attained, at which time the temperatures at the points listed above shall be recorded.

2.7.14

A pilot not provided with automatic shutoff when the presence of the ignition source is not proved shall not cause excessive flame flashback or damage to the boiler.

Method of Test

The pilot igniter shall be rendered inoperative. Main burner gas flow shall be shut off.

This test shall be conducted in a draft free environment.

The boiler shall be instrumented with a sampling tube(s) to measure the gas-air ratio at various points in the boiler. This sampling tube(s) shall be connected to a gas-air analyzer coupled to a chart-type single-point recording potentiometer in order to produce a constant trace of the gas-air ratio at the sample point for sufficient time to allow a complete evaluation of the system. The gas-air ratio trace shall be developed with the boiler both hot and cold and with all test gases for which the boiler is tested. Supplemental natural gas tests with test Gas G need not be conducted.

Unburned pilot gas including standing pilot gas shall be allowed to flow into the boiler until equilibrium of the gas-air ratio is obtained. If the gas-air ratio during this time does not exceed the lower explosive limit, the boiler shall be considered as complying with this provision. If this ratio is above the lower explosive limit, sufficient ignition tests shall be conducted at any time up to 1 hour of pilot gas flow to determine that the unsupervised pilot system does not cause excessive flame flashout or damage to the boiler.

2.7.15

Under the conditions of voltage variation and pilot rate reduction specified in the following Method of Test, an automatic pilot ignition system shall ignite the pilot burner gas within 30 seconds after gas reaches the pilot burner port(s).

Method of Test

These tests shall be conducted at normal inlet test pressure under the following voltage and pilot input rate conditions:

a. Undervoltage

The voltage to the boiler shall be adjusted to 85 percent of the boiler rating plate voltage.

b. Overvoltage

The voltage to the boiler shall be adjusted to 110 percent of the boiler rating plate voltage.

c. Reduced Pilot Input Rate

The pilot gas supply shall be reduced to an amount just sufficient to keep the valve of the safety shutoff device open or to an amount just above the point of flame extinction, whichever represents the higher pilot gas flow, and the boiler rating plate voltage shall be supplied to the boiler.

Under the conditions specified in "-a," "-b" and "-c" above, ignition cycles shall be repeated 10 times.

In each case the pilot igniter shall ignite the pilot burner gas within 30 seconds after gas reaches the pilot burner port(s).

2.7.16

It shall be verified that the flame detector of an automatic gas ignition system shall insure the pilot is lit before main gas is allowed to flow. (See 1.9.17.)

2.8 Direct Ignition Systems

For boilers utilizing other than natural draft atmospheric burners, a direct ignition system may be used provided the total input is less than or equal to 5,000,000 Btu/hr (1 465 356 W) and a maximum input at ignition less than or equal to 2,500,000 Btu/hr (732 678 W). For boilers utilizing natural draft atmospheric burners, the application of direct ignition systems is limited to burners having input ratings of 400,000 Btu/hr (117 228 W) or less per combustion chamber under control of the ignition system.

2.8.1

On a boiler with an input rating of 400,000 Btu/hr (117 228 W) or less and where all air for combustion is supplied by mechanical means, the ignition system may incorporate an automatic restart if the ignition

means is reactivated after a pre-purge time sufficient to provide a minimum of 4 air changes of the combustion chamber and appliance flue. For systems which incorporate an automatic restart, the minimum automatic restart time shall not be less than 1 hour.

On all other boilers equipped with a direct ignition system, an automatic restart is not permitted.

2.8.2

The ignition system shall effect ignition of the gas at the main burner(s) immediately after gas reaches the main burner port(s) when operated at appliance rating plate voltage.

Method of Test

While maintaining appliance rating plate voltage to the boiler, the ignition system shall be placed in operation and ignition observed.

The procedure described above shall be repeated 25 times, and in each instance ignition shall occur immediately after gas reaches the main burner port(s).

2.8.3

Under the conditions of voltage variation specified in the following Method of Test, the direct ignition system shall ignite main burner gas within 4 seconds after gas reaches the main burner port(s).

Method of Test

The following voltages shall be used during conduct of this test:

a. Undervoltage

The voltage to the boiler shall be adjusted to 85 percent of the boiler rating plate voltage.

b. Overvoltage

The voltage to the boiler shall be adjusted to 110 percent of the boiler rating plate voltage.

Under the conditions specified in “-a” and “-b” above, ignition cycles shall be repeated 25 times.

In each case the direct ignition system shall ignite main burner gas within 4 seconds after gas reaches the main burner port(s).

2.8.4

With the boiler at equilibrium temperatures while operating at normal inlet test pressure, the time required for the main burner gas supply to be shut off in the event of flame outage during an operational cycle shall not exceed 4 seconds. (See Tables I-A, Maximum Safety Control Timings Natural Draft Atmospheric Burners, and I-B, Maximum Safety Control Timings Other Than Natural Draft Atmospheric Burners.)

If the ignition system incorporates flame failure reignition, it shall be capable of reestablishing ignition in not more than 0.8 second following flame outage, and it shall reignite the main burner gas without flame flashout or damage to the boiler.

On a boiler where all air for combustion is supplied by mechanical means, the ignition means may be reactivated after a purge period (recycle time) sufficient to provide a minimum of 4 air changes of the combustion chamber and flue gas passageways. For purposes of this test, the control manufacturer's specified maximum flame failure response time shall be used.

If the ignition means is reactivated, the control manufacturer's specified maximum flame failure reignition time or minimum recycle time for the automatic ignition system shall be used.

2.8.5

The construction of the boiler and the arrangement of the ignition system shall be such that in the event of a delay in ignition of the main burner gas, such as might be caused by foreign debris or electrical shorting of the ignition means, the boiler will vent itself without excessive flame flashback or damage.

For purposes of this test, the control manufacturer's specified maximum trial for ignition period for the automatic gas ignition system shall be used. For systems which deactivate the ignition means prior to the end of the trial for ignition period, the test shall be conducted using the control manufacturer's specified maximum ignition activation period timing.

Method of Test

With the boiler at room temperature, the boiler shall be placed in operation at normal inlet test pressure with the ignition means temporarily circumvented for varying intervals of time up to the control manufacturer's maximum specified trial for ignition period or maximum specified ignition activation period, whichever is shorter. For multitry systems, attempts to ignite shall be made for varying intervals of time for each trial for ignition period and any time the ignition means is activated throughout the total operating sequence up to lockout.

The resulting ignition in each trial shall be observed for excessive flame flashback or damage to the boiler.

2.8.6

Temperatures developed on automatic gas ignition system components shall not exceed those for which the components are designed when tested in accordance with the Method of Test specified in 2.7.13.

2.9 Proved Igniter System

This section is applicable to a proved igniter system which provides for ignition of the main burner gas.

2.9.1

Proved igniter systems shall comply with the applicable performance provisions of the *Standard for Automatic Gas Ignition Systems and Components, ANSI Z21.20*, or *CAN1-6.4*.

2.9.2

The proved igniter system shall effect ignition of the gas at the main burner(s) when tested in accordance with the Method of Test specified in 2.9.3.

2.9.3

Under the conditions of voltage variation specified in the following Method of Test, the proved igniter system shall ignite main burner gas within 4 seconds after gas reaches the main burner port(s).

Method of Test

The following voltages shall be used during conduct of this test:

- a. Undervoltage.

The voltage to the appliance shall be adjusted to 85 percent of the appliance rating plate voltage.

b. Overvoltage.

The voltage to the appliance shall be adjusted to 110 percent of the appliance rating plate voltage.

Under the conditions specified in “-a” and “-b” above, ignition cycles shall be repeated 25 times.

In each case the proved igniter system shall ignite main burner gas within 4 seconds after gas reaches the main burner port(s).

2.9.4

The proved igniter system shall effect ignition of the gas at the main burner(s) under the following conditions:

The test shall be conducted at normal inlet test pressure and with the appliance both hot and cold.

The proved igniter system shall be placed in operation with the igniter proving characteristic reduced to the minimum value specified by the control manufacturer. Under these conditions the proved igniter system shall effect ignition of the gas within 4 seconds after gas reaches the main burner port(s) without damage to the boiler or excessive flame flashback. Ignition shall occur at an input rate of 2,500,000 Btu/hr (732 678 W) or less. While maintaining these conditions, the ignition cycle shall be repeated a total of 25 times.

2.9.5

For proved igniter systems which incorporate an interrupted ignition source together with main burner flame proving, the time required for the system to shut off the main burner gas supply following loss of the supervised main burner flame shall not exceed the flame failure response time and valve closing time specified in Table I-A through Table I-D, as applicable.

For purposes of this test, the control manufacturer’s specified maximum flame failure response time for the proved igniter system shall be used.

Method of Test

The appliance shall be operated for a period of 30 minutes at normal inlet pressure. All gas shall then be turned off and the gas flow immediately reestablished, but not ignited. The time for the main burner gas to be shut off shall be recorded and shall not exceed that specified in Table I-A through Table I-D, as applicable.

2.9.6

A proved igniter system which incorporates an interrupted ignition source together with main burner flame proving shall not cause excessive flame flashback damage to the boiler.

For purposes of this test, the control manufacturer’s specified maximum flame failure response time in combination with the control manufacturer’s specified minimum recycle time for the proved igniter system shall be used.

Method of Test

The boiler shall be instrumented with a sampling tube(s) to measure the gas-air ratio at various points in the appliance. This sampling tube(s) shall be connected to a gas-air analyzer coupled to a chart-type single-point recording potentiometer in order to produce a constant trace of the gas-air ratio at the sample point for sufficient time to allow a complete evaluation of the system. The gas-air ratio trace shall be developed with the appliance both hot and cold and with all test gases for which the appliance is tested. Supplemental natural gas test with test Gas G need not be conducted.

Unburned gas shall be allowed to flow into the appliance for the control manufacturer's maximum specified flame failure response time plus the valve closing time. Immediately following shut off of the gas supply, an ignition cycle shall be initiated at normal rated voltage and continued until the igniter would be energized, as determined by the control manufacturer's specified minimum recycle time.

If the gas-air ratio at the time at which the igniter would be energized is below the lower explosive limit, the appliance shall be considered as complying with this provision. If this ratio is above the lower explosive limit, sufficient ignition tests shall be conducted between the time of energization of the proved igniter and when the atmosphere within the boiler returns to below the lower explosive limit, to determine that the igniter does not cause excessive flame flashback or damage to the appliance.

A boiler with a control system providing a purge period of 5 minutes or longer shall be considered as complying with this provision.

2.9.7

For a proved igniter system which incorporates an intermittent ignition source, the time required for the gas supply to the main burner to be shut off following failure of the supervised proved igniter shall not exceed that specified in Table I-A through Table I-D, as applicable.

Method of Test

The appliance shall be operated for a period of 30 minutes at normal inlet pressure. The proved igniter shall then be disabled. The time required for the proved igniter system to shut off the main burner gas supply shall not exceed the igniter failure response time and valve closing time specified in Table I-A through Table I-D, as applicable.

For purposes of this test, the control manufacturer's specified maximum igniter failure response time shall be used.

2.9.8

The temperature developed on an automatic gas ignition system component shall not exceed those for which the component is designed when tested in accordance with the Method of Test specified in 2.7.13.

2.10 Flame Roll-Out Safety Shutoff Means

This test is applicable only to boilers having an input rating less than 300,000 Btu/hr (87 921 W).

The means specified in 1.2.7 shall shut off the main burner gas in the event the flow of combustion products through the boiler flueway(s) is reduced as determined in the following Method of Test.

Method of Test

This test shall be conducted prior to conduct of those test specified under 2.19, Wall, Floor, Ceiling, Electrical Component and Venting System Temperatures, and the leakage current (1.24.40) and dielectric withstand (1.24.41) tests or the tests specified in *Electrical Features of Fuel Burning Equipment, CSA C22.2 No. 3*, or other referenced CSA Part II electrical standards.

a. For Other Than Induced Draft Boilers

This test shall be conducted at normal inlet test pressure and input rating.

For test purposes, a progressive blockage of the heat exchanger outlet(s) shall be simulated* until the gas to the main burner shuts off.

Controls which may actuate due to the method of simulation selected, but which would not provide protection against heat exchanger blockage, shall be bypassed.

The boiler shall be operated until equilibrium conditions are attained. A blockage of 20 percent shall be imposed and the boiler permitted to stabilize for 5 minutes. The blockage shall then be increased in 20 percent increments, based on the initial flow area, allowing a 5 minute stabilization period between increments, until the means acts to shut off the gas supply to the main burner(s).

If the boiler is capable of operation at 100 percent blockage, the boiler shall not operate in excess of 10 minutes under this condition.

At no time during this test shall flames issue outside the face of the jacket.

Following conduct of this test, all blockage shall be removed and all controls restored to normal operating conditions. Except for a single-use device(s), which may be replaced, controls and wiring shall not be repaired or replaced. It shall then be determined that:

1. The boiler continues to operate normally; and
2. No control function has been rendered inoperative.

b. For Induced Draft Boilers

This test shall be conducted at normal inlet test pressure and input rating.

For test purposes, this test shall be conducted either by disconnecting the motor to the inducer or by progressively blocking the outlet of the blower. Controls which may actuate due to disconnection of the motor to the inducer, but which would not provide protection against heat exchanger blockage, shall be bypassed.

The boiler shall be operated until equilibrium conditions are attained.

The motor to the inducer shall be deenergized. If the boiler is capable of operation without the inducer in operation, the boiler shall not operate in excess of 10 minutes under this condition.

At no time during this test shall flames issue outside the face of the jacket.

Following conduct of this test, the inducer shall be reconnected and all controls restored to normal operating conditions. Except for a single-use device(s), which may be replaced, controls and wiring shall not be repaired or replaced. It shall then be determined that:

1. The boiler continues to operate normally; and
2. No control function has been rendered inoperative.

* For a boiler equipped with a draft hood, this simulation may be accomplished by sealing the relief opening(s) of the draft hood and progressively blocking the draft hood outlet(s).

2.11 Efficiency

Refer to Exhibit E, Items Unique to Canada, for efficiency determination of boilers in Canada with input rates less than 300,000 Btu/hr (87 921 W).

Boilers, with input rates of 300,000 Btu/hr (87 900 W) or more shall have an efficiency of not less than 98 percent of that specified by the manufacturer, stated to 0.1 percent, but not less than 80 percent combustion efficiency or the applicable federal mandated* minimum when determined as outlined in this section.

Prior to beginning the tests, the boiler shall be proved free from water leaks by hydrostatic testing.

The efficiency of the boiler shall be determined when the boiler is operating at normal inlet gas test pressure.

2.11.1

Combustion Efficiency of Steam Boilers for Indoor Installation.

Method of Test

The boiler shall be installed for test as specified in Figure 5, Suggested Piping Arrangement for Steam Boilers - Feed Water Measurement, or in accordance with the manufacturer's instructions, and placed where it will not be subject to excessive draft.

An efficient steam separator shall be placed in the steam outlet as near the boiler as practicable. The separator shall be open to the atmosphere through a water seal, permitting any water separated from the steam to drain immediately into a container for weighing. Any test in which the maximum amount of water, as determined below, is exceeded shall be discontinued. The maximum amount of water permitted from the separator shall be determined by the following formula:

$$\text{Max Water Collected, lb} = \frac{(\text{Boiler Input (Btu)}) \times (100 - \text{Flue-Loss}) \times 0.03}{970 \text{ Btu/lb}}$$

Steam or flow piping shall be full size to a point 18 in (457 mm) above the boiler outlet(s) before connection to the separator is made. This distance shall be measured between the center lines of the boiler outlet and the connection to the separator.

Piping up to and including the separator shall be insulated to a minimum of R-4 thermal resistance.

Outlet piping from the separator shall pitch away from the separator.

Feed water shall be supplied by an automatic feeder of the slow feed type which will maintain a constant water level in the gage glass.

Tests shall be started and stopped by the running method, which consists of operating the boiler until all conditions have reached equilibrium before starting the test and maintaining these conditions throughout the test. An initial combustion test shall be conducted with two additional readings taken at 15 minute intervals.

* Refer to Exhibit E for efficiency determination of boilers in Canada.

A calibrated pressure gage or manometer shall be used to determine the steam pressure in the boiler. The steam temperature shall be determined by means of a thermometer or thermocouple inserted in the steam as near the boiler as possible.

The test shall be made with an inlet water temperature of $80 \pm 10^{\circ}\text{F}$ ($26.5 \pm 5.5^{\circ}\text{C}$) and the boiler operated at atmospheric pressure.

The temperature of the flue gases and a sample of the flue gases shall be obtained at a suitable point immediately before their discharge from the boiler. The sample of the flue gases shall be analyzed for carbon dioxide.

The flue loss shall be computed as the summation of heat, above room temperature, carried by carbon dioxide, free air and water vapor. For the purpose of the computation, water is assumed to exist as a vapor above room temperature, condensation occurring at room temperature. Flue loss shall be determined in accordance with Exhibit D, Flue Loss Calculations.

The combustion efficiency of the boiler shall be 100 minus the percent of flue loss.

2.11.2

Combustion Efficiency for Hot Water Boilers for Indoor Installation.

Method of Test

The boiler shall be installed for test as specified in Figure 6, Arrangement of Apparatus for Testing Hot Water Boilers.

The test shall be made at equilibrium with a supply water temperature [T1] of $80 \pm 10^{\circ}\text{F}$ ($26 \pm 5.5^{\circ}\text{C}$) and an outlet water temperature [T2] of $180 \pm 2^{\circ}\text{F}$ ($82 \pm 1^{\circ}\text{C}$).

An initial combustion test shall be conducted with two additional readings taken at 15 minute intervals.

The combustion efficiency shall be determined as specified in 2.11.1.

2.11.3

Thermal Efficiency for Hot Water Boilers

This test is mandatory for outdoor boilers. This test may also be applied to indoor boilers if specified by the manufacturer.

Method of Test

The boiler shall be installed for test as specified in Figure 6, Arrangement of Apparatus for Testing Hot Water Boilers.

Two tests with $80 \pm 10^{\circ}\text{F}$ ($26 \pm 5.5^{\circ}\text{C}$) supply water temperature [T1] shall be made with the outlet water temperature [T2] at $180 \pm 2^{\circ}\text{F}$ ($82 \pm 1^{\circ}\text{C}$). Each test shall be of not less than 1 hour duration and shall be started and stopped by the running method.

The thermal efficiency of the boiler shall be determined by the calorimetric method.

The boiler shall be operated until conditions have reached an equilibrium.

A water meter of proven accuracy may be used for recording the amount of water supplied to the boiler. The meter shall be checked for its accuracy before beginning each series of tests.

2.12 Main Burner And Flame Spreader Temperatures

2.12.1

The design and materials used in the construction of a burner shall be such that no part of the burner having a melting point below 1450°F (788°C) will attain a temperature above 875°F (468°C) and the burner will not sag, distort, melt, exhibit appreciable corrosion or damage to any protective coating sufficient to expose the base metal, or show leakage of gas during any of the tests specified herein or when the burner is operated with flame burning within the mixer tube or burner head.

Method of Test

The following test need only be conducted when parts of the burner have a melting point of from 1000°F to 1450°F (538°C to 788°C).

The test shall be conducted at the increased inlet test pressure.

Thermocouples shall be suitably attached to all probable high temperature points of material having a melting point of from 1000°F to 1450°F (538°C to 788°C).

- a. During conduct of 2.19, Wall, Floor, Ceiling, Electrical Components Venting System Temperatures, and the temperatures indicated by the thermocouples shall be recorded and shall not exceed 875°F (468°C).
- b. The gas to the burner shall be ignited in such a manner that it will burn within the mixer tube or burner head and shall continue to burn there for 30 minutes. If the flame cannot be maintained within the mixer tube or burner head, the gas rate to the burner shall be reduced by pressure reduction to a point where it can be so maintained.

A burner design in which a gas flame within these burner parts cannot be maintained due to boiler design or because the boiler control system, which includes all safety devices, acts to shut off the main burner gas supply to the burner, is deemed to comply with this provision.

At the end of this test, as well as at the conclusion of all performance tests specified herein, the burner shall be carefully examined for evidence of sagging, distortion, melting, appreciable corrosion, damage to protective coating sufficient to expose the base metal, or leakage of gas.

2.12.2

Metal used in the construction of a flame spreader and its support shall be suitable for the temperatures developed during conduct of the following test and shall be in accordance with Table XV, Maximum Flame Spreader Temperatures.

Method of Test

This test shall be conducted at normal inlet test pressure with the feed water inlet throttled until the boiler temperature has reached (1) 212°F (100°C) for a steam boiler, or (2) 180°F (82°C) for a hot water boiler, or the maximum outlet water temperature as determined in 2.15, Water Temperature Limiting Devices, whichever is less. Boilers suitable for either hot water or steam shall be tested as steam boilers. Appropriate equipment shall be used, as specified by the manufacturer, with test gases as follows:

<u>Flame Spreader For Use With</u>	<u>Test Gas</u>
Natural Gas	A
Manufactured Gas	B
Mixed Gas	C
Natural, Mfd. and Mixed Gases	B
Natural and Mixed Gases	C
Liquefied Petroleum Gases	E
LP Gas/Air Mixture	H

Thermocouples shall be peened into the metal at the outer edges and at other probable high temperature points on the flame spreader and its support. The boiler shall be placed in operation and the main burner(s) adjusted to give a hard, stable flame. When equilibrium conditions are attained, the temperatures as indicated by the thermocouples shall be recorded.

The main burner(s) shall then be adjusted to give a soft flame and continued in operation until equilibrium conditions are attained. Temperatures as indicated by the thermocouples shall be compared with the previously recorded temperatures.

The temperatures developed on any part of the flame spreader and its support during either test condition shall not be in excess of that permitted for the metal employed as specified in Table XV.

2.13 Nonload-Bearing Flue Gas Baffle Temperatures

Metal used in the construction of nonloadbearing flue gas baffles shall be suitable for the temperatures developed during conduct of the following test and shall be in accordance with Table XVI, Maximum Nonload-bearing Flue Gas Baffle Temperatures.

Method of Test

This test shall be conducted at normal inlet test pressure with the feed water inlet throttled until the boiler temperature has reached (1) 212°F (100°C) for steam boilers, or (2) 180°F (82°C) for hot water boilers, or the maximum outlet water temperature as determined in 2.15, Water Temperature Limiting Devices, whichever is less. Boilers suitable for either hot water or steam shall be tested as steam boilers.

Thermocouples shall be suitably attached to the baffles at probable high temperature points. The boiler shall be placed in operation and the main burner(s) adjusted to give a hard flame. When equilibrium conditions are attained, the temperatures as indicated by the thermocouples shall be recorded.

The main burner(s) shall then be adjusted to give a soft flame and continued in operation until equilibrium conditions are attained. Temperatures as indicated by the thermocouples shall be recorded.

The temperatures developed on any part of the baffles during either test condition shall not be in excess of that permitted for the metal employed as specified in Table XVI, Maximum Nonload-Bearing Flue Gas Baffle Temperatures.

2.14 Steam Pressure Limiting Devices

A steam boiler shall be provided with a device which will limit the maximum steam pressure to 15 psi (103.42 kPa). This device shall be listed by a nationally recognized testing agency.

A steam heating boiler having a total input rating over 2,500,000 Btu/hr (732 678 W) shall be provided with a second control which will prevent a steam pressure in excess of 15 psi (103.42 kPa).

2.15 Water Temperature Limiting Devices

2.15.1

A water temperature limiting device, when adjusted at the maximum temperature setting, shall not allow the water temperature to exceed the value shown on the ASME rating plate. In no case shall the water temperature exceed 250°F (121°C).

Method of Test

The boiler shall be filled with water. A reseating type pressure relief valve set to relieve at approximately 40 psi (275.8 kPa) shall be connected to the boiler at a suitable point.

If adjustment features designed for consumer's use are provided in the device, this adjustment shall be at the maximum temperature setting. A limiting device without an adjustable feature designed for consumer's use shall be tested as received, the manufacturer's setting being considered the maximum. Arrangements shall be made so the maximum temperature of the stored water may be obtained at any time by means of a beadtype thermocouple, accurate to 1°F (0.5°C), or equivalent means, located not more than 4 in (102 mm) downstream between the boiler and hot water outlet shutoff valve.

The boiler shall be operated at normal inlet test pressure. Feed water may be premixed with boiler outlet water if a maximum temperature rise through the boiler is specified for test purposes by the manufacturer (see Figure 6, Arrangement of Apparatus for Testing Hot Water Boilers). Both inlet and outlet water valves shall be adjusted in such a manner that a portion of the hot water is flowing past the temperature measuring point at all times. The maximum water temperature in the boiler shall be determined and shall not be in excess of 250°F (121°C). This test shall be repeated 4 times.

2.15.2

The assembly of a water temperature limiting device shall be of such tightness as to permit no leakage of water when the device is subjected to a hydrostatic pressure of 160 lb•in² (1.10 MPa) on surfaces normally exposed to boiler water.

Method of Test

The device shall be connected to the outlet of a suitable boiler test pump in a manner that will permit the application of hydrostatic pressure to all parts normally in contact with water. A Bourdon pressure gage, graduated in increments of not more than 5 psi (34.5 kPa), shall be connected in the system near the device. By means of the pump, hydrostatic pressure shall be applied and gradually increased to 160 psi (1.10 MPa). Under these conditions, no leakage shall be evidenced within a period of 5 minutes.

2.15.3

A hot water heating boiler having a total input over 2,500,000 Btu/hr (732 678 W) shall be provided with a second control which satisfies the requirements of 2.15.1 and 2.15.2.

2.16 Manifold And Control Assembly Capacity

The manifold and control assembly shall have sufficient flow capacity to provide the manufacturer's normal hourly Btu input rating and manifold pressure when supplied with the gas pressure designated as the minimum permissible for the purpose of input adjustment.

Method of Test

The boiler shall be equipped with the manifold and gas control assembly having the lowest flow capacity for the applicable gas. The boiler shall be adjusted and operated as specified in 2.3.3. The inlet test pressure shall then be reduced so as to maintain the minimum permissible gas supply pressure for the purpose of input adjustment at the upstream pressure tapping specified in 1.12.18. With no additional change other than minor adjustment of the gas appliance pressure regulator outlet pressure setting, the manufacturer's normal hourly Btu input rating and manifold pressure shall be maintained. The manifold pressure shall be measured at the downstream tapping specified in 1.12.18.

2.17 Safety Circuit Analysis

On a boiler having an input rate less than 400,000 Btu/hr (117 228 W) the manufacturer shall supply "Failure Modes and Effects Analysis" (FMEA) for each individual control. A typical analysis is shown in Appendix E. This FMEA shall be evaluated to determine that:

1. The failure to connect an individual lead or terminal in the gas control circuit shall not result in an unsafe operation.
2. The interchange of lead or terminal connections on an individual control in the gas control circuit, that are physically interchangeable* without alteration shall not result in an unsafe operation.

Control wiring bases which are not intended to be disconnected to replace the control need not comply.

Method of Test

Sufficient tests shall be conducted on each individual control, one at a time, to verify the completeness and accuracy of the control miswiring FMEA provided by the manufacturer.

2.18 Power Interruption

Boilers shall be investigated to insure no unsafe condition exists upon power interruption or upon restoration of power following an outage. This investigation shall be at the discretion of the testing agency during any phase of boiler operation. Upon restoration of power, the appliance shall either require manual restart or shall safely resume normal operation.

2.19 Wall, Floor, Ceiling, Electrical Component And Venting System Temperatures

The floor temperature provisions of this section shall not apply when the boiler is marked, "For installation on noncombustible floors only."

The wall and ceiling temperature provisions of this section shall not apply when a boiler with an input rating over 400,000 Btu/hr (117 228 W) is marked to indicate minimum clearances of 24 in (610 mm) or more to combustible walls and ceiling or overhang.

* For example, $\frac{1}{4}$ in quick-connects, $\frac{3}{16}$ in quick-connects and screw terminals are not to be considered interchangeable with each other.

2.19.1 Test Enclosure and Instrumentation

Figure 7, Enclosure Types and Clearance Nomenclature, shows typical boiler test enclosures and clearance nomenclature.

The vertical walls, combustible flooring and ceiling of the enclosure shall be constructed of nominal 1 inch thick wooden boards or $\frac{3}{4}$ inch plywood finished in dull black. All joints shall be sealed.

For a direct vent boiler, the wall through which the ventair intake system passes shall be constructed as specified in 2.1.10.

The draft hood of a boiler not of the direct vent type shall be located within the enclosure. The distance between the draft hood relief opening, or any portion of an external draft hood, and the enclosure shall be 6 in (152 mm) or greater.

A boiler not of the direct vent type shall be tested with either a singlewall galvanized vent connector or a listed Type B vent connector, at the option of the manufacturer. When a singlewall vent connector is used, it shall have a clearance of 6 in (152 mm) between its surface and the walls and ceiling of the test enclosure. Where the vent connector pierces the enclosure, an opening having a diameter 4 in (102 mm) larger than the diameter of the vent connector shall be provided and the vent connector centered in the opening. The 2 in (50.8 mm) annulus thus formed shall be sealed on the outer surface (see Figure 8, Method of Sealing Annulus Around Vent Connector During Alcove and Closet Installation Tests). If a Type B vent connector is used, the clearance from its surface to the walls and ceiling of the enclosure shall be in accordance with its listing. At its point of passage through the enclosure, the annulus shall be sealed as specified for singlewall vent connectors.

Inlet water connections, outlet steam or hot water connections, and flue gas outlets shall be extended to the outside of the enclosure. Boilers not of the direct vent type with vertical flue outlets shall be tested with vent arrangement Style I, as shown in Figure 9, Venting Arrangements for Alcove and Closet Installation Tests. Boilers not of the direct vent type having horizontal outlets shall be tested with two vent arrangements, Styles II and III, as shown in Figure 9.

Where steam or hot water pipes pierce the enclosure, an opening 2 in (50.8 mm) larger than the pipe shall be provided, and the space between the pipe and the enclosure shall be filled with insulating material and sealed.

Wall, floor and ceiling temperatures shall be determined by means of a potentiometer and No. 24 AWG (0.20 mm²) ironconstantan beadtype or copper constantan bead type thermocouples. The thermocouples shall be made by contact welding with the free ends clipped off beyond the junction. The junction and $\frac{3}{8}$ in (9.5 mm) of the lead shall be exposed on the test surface, the remainder of the lead extending through the enclosure. Thermocouples shall be secured to the surfaces by staples over the insulated portion of the leads. The junctions shall be held in thermal contact with the surfaces by a radiation transparent adhesive tape finished in dull black, except that when zero clearance is desired it shall be assumed that any part of the casing may be in close contact with combustible construction, and the junctions of the thermocouples shall be in contact with the surfaces of the casing. Temperatures shall be measured at points subjected to maximum temperatures. Where a vent connector pierces the enclosure, temperature measurements shall be made on the inside combustible surface $\frac{1}{4}$ in (6.4 mm) away from the annulus around the vent.

Room temperature shall be measured as specified in 2.1.15.

2.19.2

Boilers, 400,000 Btu/hr (117 228 W) or Less, for Indoor Installation

The temperatures on combustible surfaces adjacent to a boiler for indoor installation with an input rating of 400,000 Btu/hr (117 228 W) or less shall not exceed 90°F (50°C) above room temperature when determined as specified in the following Method of Test.

Method of Test

- a. A boiler for alcove installation shall be placed on a floor (combustible or noncombustible as specified by the manufacturer) and a back wall erected perpendicular to the floor. Two side walls extending 18 in (457 mm) beyond the front of the boiler shall be erected at 90 degrees (1.57 rad) to the back wall. The distance between the boiler and the back and side walls, in integral inches, shall be as specified by the manufacturer, but shall not exceed 18 in (457 mm). A ceiling shall be installed above the boiler at a distance, in integral inches, specified by the manufacturer. The height of the ceiling above the floor shall not exceed 7 ft 6 in (2.29 m).

A hot water and steam boiler shall be operated at a nominal boiler pressure of 15 psi (103.42 kPa). A boiler for hot water use only shall have the water flow throttled during the test until the limit control functions. The temperature of the outlet water shall be recorded. The recorded temperature $\pm 5^\circ\text{F}$ ($\pm 3^\circ\text{C}$) shall be maintained throughout the remainder of the test. (Feed water may be premixed with outlet water if a maximum temperature rise through the boiler is specified for test purposes by the manufacturer. (See Figure 6, Arrangement of Apparatus for Testing Hot Water Boilers.) A boiler suitable for either hot water or steam shall be tested with the outlet water temperature maintained at $250 \pm 5^\circ\text{F}$ ($121 \pm 3^\circ\text{C}$). A steam boiler shall be maintained at 15 psi (103.42 kPa) and feed water shall be supplied to maintain a constant water level in the gage glass.

The boiler shall be operated at normal inlet test pressure at the maximum normal input rate specified by the manufacturer until equilibrium temperatures on the enclosure have been attained, at which time no wall, combustible flooring or ceiling temperature shall exceed 90°F (50°C) above room temperature.

- b. A boiler for closet installation shall have specified clearances of 6 in (152 mm) or less from all adjacent combustible construction and shall be installed in an enclosure as specified in 2.19.2a. When auxiliary equipment outside the boiler casing does not permit the 6 in (152 mm) clearance from the casing, one side wall of the test enclosure shall be placed as close to the casing as the auxiliary equipment will allow. A simulated enclosure door or front shall also be erected as shown in Figure 7 at the clearance specified by the manufacturer but not exceeding 6 in (152 mm). The door shall have two openings located so the lower edge of the lower opening is 6 in (152 mm) above the floor level of the enclosure, and the other so its upper edge is 6 in (152 mm) below the ceiling of the enclosure. The height of each opening shall be $\frac{1}{2}$ of the width. The free area of each of the two openings shall be 1 square inch per 1000 Btu/hr (22 cm² per kW) of the boiler input rating, with a minimum of 100 in² (645 cm²) for each opening.

The boiler shall be operated and equilibrium temperatures on the enclosure determined as specified in 2.19.2a.

2.19.3

Boilers, over 400,000 Btu/hr (117 228 W), for Indoor Installation Adjacent to Combustible Construction

The temperatures on combustible surfaces adjacent to a boiler for indoor installation with an input rating over 400,000 Btu/hr (117 228 W) shall not exceed 90°F (50°C) above room temperature when determined as specified in the following Method of Test.

Method of Test

The boiler shall be installed in an enclosure as specified in 2.19.2-a except the wall clearances shall be less than 24 in (610 mm) and the ceiling height shall be as specified by the manufacturer with the walls extending to the ceiling.

The boiler shall be operated and equilibrium temperatures on the enclosure determined as specified in 2.19.2-a.

2.19.4

Boilers, 400,000 Btu/hr (117 228 W) or Less, for Outdoor Installation

The temperatures on combustible surfaces adjacent to a boiler for outdoor installation with an input rating of 400,000 Btu/hr (117 228 W) or less shall not exceed 90°F (50°C) above room temperature when determined as specified in the following Method of Test.

Method of Test

The boiler shall be installed in an enclosure as specified in 2.19.2-a except one side wall and the ceiling shall be omitted, and the remaining back and side walls shall extend 8 ft (2.44 m) above the floor or 2 ft (610 mm) above the boiler, whichever is higher. If the manufacturer specifies a minimum clearance to a combustible ceiling overhang, a ceiling constructed in accordance with 2.19.1 shall be installed at the specified clearance above the boiler with the two walls extending to the ceiling. The ceiling shall be rectangular and match the wall length.

The boiler shall be operated and equilibrium temperatures on the enclosure determined as specified in 2.19.2-a.

2.19.5

Boilers, over 400,000 Btu/hr (117 228 W), for Outdoor Installation Adjacent to Combustible Construction

The temperatures on combustible surfaces adjacent to a boiler for outdoor installation with an input rating over 400,000 Btu/hr (117 228 W) shall not exceed 90°F (50°C) above room temperature when determined as specified in the following Method of Test.

Method of Test

The boiler shall be installed in an enclosure as specified in 2.19.4 except the wall clearances shall be less than 24 in (610 mm). If the manufacturer specifies a minimum clearance to a combustible ceiling or overhang, a ceiling shall be provided as specified in 2.19.4.

The boiler shall be operated and equilibrium temperatures on the enclosure determined as specified in 2.19.2-a.

2.19.6

Boilers, over 400,000 Btu/hr (117 228 W), for Installation in Large Spaces on Combustible Flooring

For a boiler with an input rating over 400,000 Btu/hr (117 228 W) and marked for wall clearances of 24 in (610 mm) or more and for installation on combustible flooring, the temperatures on combustible floors shall not exceed 90°F (50°C) above room temperature when determined as specified in the following Method of Test.

Method of Test

The boiler shall be installed on a test floor constructed as specified in 2.19.1 with no walls or ceiling. The boiler shall be operated and equilibrium temperatures on the flooring determined as specified in 2.19.2-a.

2.19.7

Venting System Temperatures

a. Metallic

The temperature inside the venting system shall not exceed the temperature for which the venting system material has been determined to be acceptable.

Method of Test

The boiler shall be installed in an enclosure as specified in 2.19.1. The venting system shall be installed in accordance with the manufacturer's instructions and at the clearances from combustible materials specified by the manufacturer.

This test shall be conducted in conjunction with 2.20, Flue Gas Temperature. The temperatures inside the venting system shall be determined by the temperature of the vent gases at the inlet of the vent connector.

b. Non-metallic

For a boiler utilizing a non-metallic venting system, the temperature of the venting system shall not exceed the value specified in Table XVII, Maximum Allowable Temperatures of Typical Non-Metallic Vent Material.

If an automatic means is utilized to shut off the main burner gas to prevent the venting system from exceeding those values specified in Table XVII, the boiler shall be tested at the maximum field adjustable setpoint of the automatic means.

Method of Test

The boiler shall be installed and operated as specified in 2.19. When applicable, this test may be conducted concurrently with it.

1. For venting materials having a Heat Deflection Temperature (HDT) only: The first elbow of the vent system shall be located at the closest possible distance from the flue gas outlet permitted by the manufacturer's instructions, but not more than 4 ft (1.22 m). Five No. 24 AWG (20 mm²) bead type thermocouple shall be embedded within $\frac{1}{32}$ in (0.8 mm) of its inside wall. A thermocouple shall be located at the beginning and end of the outer radius of the elbow. The remaining thermocouple shall be equally spaced in between.
2. For venting materials having a Heat Deflection Temperature (HDT) and a Relative Thermal Index (RTI). Four thermocouple, spaced 90 degrees (1.57 rad) apart, shall be secured to the inside surface of the vent pipe. They shall be located as close as possible to the flue gas outlet, or the highest temperature area, which may be at the closest elbow. An additional four thermocouple shall be located around the outside circumference of the pipe, directly opposite the thermocouple on the inside surface.

Temperature readings shall be recorded at 15 minutes intervals until equilibrium conditions have been attained as indicated by temperature changes of not more than +5°F (3°C) between readings.

The temperature of the venting system shall be:

For HDT only material, the maximum temperature recorded for any of the five thermocouple at equilibrium. For HDT and RTI material, the average of all eight temperatures recorded at equilibrium with the additional requirement that none of the inside temperatures have exceeded the maximum RTI temperatures.

2.19.8

Draft Hood Performance in Test Enclosure

Operational characteristics of the draft hood of a boiler for installation with wall clearances of less than 24 in (610 mm) shall not be affected when the boiler is installed and operated as specified in 2.19.2, 2.19.3, 2.19.4 or 2.19.5, as applicable.

Method of Test

After equilibrium temperatures on the enclosure have been attained and recorded, the boiler shall be continued in operation and shall comply with the tests specified in 2.23.1 and 2.23.2.

2.19.9

Electrical Component Temperatures

Temperatures attained by electrical conductors, controls and other components shall not exceed the limits specified in Table X, Maximum Allowable Rise Above Room Temperature for Various Component Parts, for products in the U.S.A., or *Test Methods for Electrical Wires and Cables, CAN/CSA C22.2, No. 0.3* in Canada.

Method of Test

The manufacturer shall specify the supply wire size to be used for conduct of this test. (See 1.24.3).

The specified conductor size shall be consistent with the *National Electrical Code, ANSI/NFPA 70*, in the U.S.A., or in Canada, *Test Methods for Electrical Wires and Cables, CAN/CSA C22.2, No. 0.3*. If the boiler has pigtail leads for electrical power connection, the supply conductors shall not be more than two AWG sizes larger than the leads. All unused electrical connection openings shall be closed during the test.

This test is applicable to all boilers. A boiler for installation with wall clearances of less than 24 in (610 mm) shall be installed as specified in 2.19.2, 2.19.3, 2.19.4 or 2.19.5, as applicable.

The boiler shall be operated as specified in 2.19.2-a until equilibrium temperatures are attained.

Temperatures of controls and wiring for each electrical component shall be determined at points subjected to maximum temperatures, at the discretion of the testing agency. Temperatures shall be determined by means of beadtype thermocouples not larger than No. 24 AWG (0.20 mm²) placed in good thermal contact with the material. Temperatures attained by electrical conductors, controls and other components shall not exceed those shown in Table X. If the ambient temperature of air surrounding the controls [temperature to be measured 2 in (50.8 mm) from the control except when the control is mounted on a warm surface in which case ambient temperature within the control enclosure should be determined] exceeds room temperature by more than 20°F (11°C), a test shall be conducted to determine that the temperature of the parts forming the controls are not higher than those specified in Table X.

2.20 Flue Gas Temperature

The average temperature of the flue gases shall not exceed the values specified below:

480°F (266.5°C) above room temperature for a boiler equipped with a draft hood; or

400°F (222°C) above room temperature for a boiler intended for use with Type B vent.

This provision does not apply to Category II, IV, outdoor or direct vent boilers or any boiler complying with 2.19.7-b.

Method of Test

The flue gas temperature shall be measured by an indicating or recording potentiometer.

Two lines intersecting at 90 degrees (1.57 rad) shall be established in the plane of measurement and oriented so they will divide the internal area of the flue collar into quadrants. One temperature shall be taken at the intersection of the 2 lines. Eight temperatures shall be taken in sets of 4 along each line at points $\frac{1}{3}$ and $\frac{2}{3}$ of the distance from the intersection to the periphery. Temperatures shall be determined with a beadtype thermocouple not greater than No. 24 AWG (0.20 mm²) placed successively at the specified locations. The flue gas temperature shall be the average of these 9 individual readings. When flue outlets are nonsymmetrical or of unusual shapes, the location of points at which the temperature of the flue gases is measured shall be at the discretion of the testing agency.

Room temperature shall be determined as specified in 2.1.15.

The boiler shall be operated at normal inlet pressure and the feed water inlet throttled until the boiler temperature has reached (1) 212°F (100°C) for a steam boiler or (2) 180°F (82°C) for a hot water boiler or the maximum outlet water temperature as determined in 2.15, Water Temperature Limiting Devices, whichever is less. Boilers suitable for either hot water or steam shall be tested as steam boilers.

The boiler shall be operated until equilibrium conditions are attained as indicated by temperature changes in the flue gas of not more than $\pm 5^\circ\text{F}$ ($\pm 3^\circ\text{C}$) between readings 15 minutes apart when the flue gas temperature thermocouple is located in the center position of the vent pipe.

For Boilers Equipped With A Draft Hood

- a. The flue gas temperature shall be measured in a plane perpendicular to the axis of the flue outlet immediately before the inlet to the draft hood.

The outlet of the draft hood shall be blocked and the boiler shall be operated as specified above. The average temperature of the flue gases shall not exceed 480°F (266.5°C) above room temperature.

- b. When a draft hood is incorporated integrally in the body of the boiler, the temperature of the flue gases shall be measured separately at the flue outlet of the boiler and at the relief opening of the diverter with the outlet blocked. In either case, the average temperature of the flue gases shall not exceed 480°F (266.5°C) above room temperature.

For Boilers Not Equipped With A Draft Hood

The flue gas temperature shall be measured in a plane perpendicular to the axis of the flue outlet immediately before the inlet to the vent system.

The boiler shall be operated as specified above. The outlet of the vent pipe shall gradually be restricted until maximum flue gas temperatures are obtained. The average temperature of the flue gases shall not exceed 400°F (222°C) above room temperature.

When the foregoing method of temperature measurement is not practical, the procedure shall be at the discretion of the testing agency. In such an event, the procedure shall be recorded and reported.

2.21 Flue Collectors

All flue gases shall be discharged through the flue collar. There shall be no leakage of flue gases through door cracks, flue collector joints or other openings.

Method of Test

This test shall be for a boiler equipped with a draft hood or a draft diverting device, as applicable. This test shall not be applied to a direct vent boiler (see 2.26, Direct Vent Systems).

This test shall be conducted with the flue collector installed in accordance with the manufacturer's installation instructions. A fuming or smoking material, such as titanium tetrachloride, shall be introduced into the combustion chamber in sufficient amount to give assurance that, if flue gases are discharged through the door cracks, flue collector joints or other openings, their presence would be revealed by the smoke. If the discharge of smoke is not continuous, the boiler shall be considered as complying with this provision.

2.22 Blocked Vent Shutoff System

This test applies only to boilers having an input rating less than 300,000 Btu/hr (87 921 W) and equipped with a draft hood(s).

When tested as outlined in the following Method of Test, main burner gas shall shut off if the boiler is called upon to operate when the vent to which it is connected is totally blocked.

Method of Test

These tests shall be conducted at normal inlet test pressure and input rating.

When use with one gas is specified, these tests shall be conducted with the appropriate gas as specified in 2.2, Test Gases.

When use with more than one gas is specified, and the boiler input ratings are not identical for different gases, these tests shall be conducted at the specified input ratings for individual gases, or if variable rated, at the minimum input rating. The number of tests conducted shall be at the discretion of the testing agency.

When use with more than one gas is specified, and the boiler input rating is identical for the various gases, these tests shall be conducted in accordance with the following:

1. If the gases specified by the manufacturer include natural gas, use Test Gas A.
2. If the gases specified by the manufacturer do not include natural gas but include liquefied petroleum gases, use Test Gas E.

3. If the gases specified by the manufacturer include neither natural gases nor liquefied petroleum gases, the test gas used shall be at the discretion of the testing agency.

Test Condition A

This test shall be conducted at the manufacturer's specified minimum clearances.

The pilot and main burner(s) shall be operated for a sufficient period of time at normal input rating and maximum outlet water temperature or steam pressure (limit control shutoff), as applicable, to determine that the boiler will operate continuously using the applicable vent pipe configurations specified in 2.1.5.

Test Condition B

This test shall be conducted with the boiler installed in a draft-free open room, using the applicable vent pipe configurations specified in 2.1.5.

With the boiler adjusted as specified in Test Condition A, it shall be operated until equilibrium conditions are attained. The outlet of the vent pipe shall then be totally blocked and the time for the gas to the main burner(s) to be shut off by the blocked vent shutoff system shall not exceed 10 minutes.

2.23 Draft Hoods

A draft hood shall comply with the following provisions when attached to the boiler in a normal position.

When use with one gas is desired, these tests shall be conducted with the appropriate gas as specified in 2.2, Test Gases.

When use with more than one gas is desired and the boiler input ratings are not identical for the different gases, these tests shall be conducted at the specified input ratings for the individual gases. The number of tests conducted shall be at the discretion of the testing agency.

When use with more than one gas is desired and the boiler input rating is identical for the various gases, these tests shall be conducted in accordance with the following:

- a. If the gases selected include liquefied petroleum gases or LP gas/air mixtures, use test Gas E or H, as applicable.
- b. If the gases selected are natural and mixed, or natural, manufactured and mixed, use test Gas A.
- c. If the gases selected are mixed and manufactured, use test Gas C.

2.23.1

With the outlet of the draft hood blocked, the concentration of carbon monoxide in an airfree sample of the flue gases shall not exceed 0.04 percent when the boiler is tested in an atmosphere having a normal oxygen supply.

Method of Test

The boiler shall be operated for at least 15 minutes at normal inlet test pressure. The outlet of the draft hood shall then be blocked and a sample of the flue gases secured and analyzed as specified in 2.5.1.

2.23.2

Total downdraft pressures ranging from zero to 0.05 in wc (12 Pa) imposed at the outlet of the draft hood shall not extinguish the main burner flames nor cause them to flash back, lift, float, burn outside the boiler, nor produce a concentration of carbon monoxide in an airfree sample of the flue gases in excess of 0.04 percent when the boiler is tested in an atmosphere having a normal oxygen supply.

Method of Test

The boiler shall be operated for at least 15 minutes at normal inlet test pressure. A straight section of vent pipe of suitable diameter and of a length at least equal to 10 pipe diameters shall be attached directly to the outlet of the draft hood and connected to the outlet of a blower. The total draft pressure shall be measured with a pitot tube* and a differential gage which may be read directly to 0.005 in wc (1.24 Pa) pressure. The pitot tube shall be inserted in the straight section of vent pipe at a point midway between its ends so that (1) the head of the tube is coincident with the axis of the vent pipe, and (2) the impact opening of the pitot tube faces the flow stream.

The draft in the vent pipe shall be varied from the minimum total pressure to the maximum value specified above, and the effect on the main burner flames noted. A sample of the flue gases shall be secured and analyzed as specified in 2.5.1.

2.23.3

Downdrafts imposed as specified in 2.23.2 shall not extinguish the pilot(s) nor cause it to flash back when operated separately from the main burner(s).

2.23.4

A chimney action consisting of a static updraft and velocity updraft numerically totalling between 0.06 and 0.07 in wc (15 and 17 Pa) pressure, applied to the outlet of the draft hood, shall not cause a fractional increase in the volume of the flue gases greater than twice the numerical sum of the pressure head and 5 times the velocity head expressed in inches water column pressure.

Method of Test

The boiler shall be operated for at least 15 minutes at normal inlet test pressure without a test stack, and a sample of the flue gases secured ahead of the draft hood and analyzed for carbon dioxide.

A straight section of vent pipe of suitable diameter and of a length at least equal to 10 pipe diameters shall then be attached directly to the outlet of the draft hood and connected to the inlet of a blower. The pressure and velocity heads shall be measured with a pitot tube (see 2.23.2) and a differential gage which may be read directly to 0.005 in wc (1.24 Pa) pressure. The pitot tube shall be inserted in the straight section of vent pipe at a point midway between its ends so that (1) the head of the tube is coincident with the axis of the vent pipe, and (2) the impact opening of the pitot tube faces the flow stream.

The boiler shall again be operated, for at least 15 minutes, at normal inlet test pressure. An updraft shall be imposed at the outlet of the draft hood so the numerical sum of the pressure head and velocity head will be between 0.06 and 0.07 in wc (15 and 17 Pa) pressure. Under this condition, a sample of the flue gases shall be secured ahead of the draft hood and analyzed for carbon dioxide. The ratio of carbon dioxide concentration for normal operation, as determined without a test stack, to that for updraft operation as determined above, shall not be more than $1 + 2(h_p + 5h_v)$ where "hp" is the pressure head and "hv" is the velocity head.**

* The pitot tube shall be of a recognized standard type or one calibrated by comparison with a standard type under conditions of air and flue gas flow comparable to those prevailing under draft conditions specified herein.

** The formula considers friction, e.g., for a 45 ft (13.72 m), 9 in (229 mm) diameter chimney, $h_p + 5h_v = 0.13$ and $1 + 2(h_p + 5h_v) = 1.25$ (approx.). The same proportion holds for other values in the neighborhood of $h_p + 5h_v = 0.13$.

Method of Test

The appliance shall be operated for at least 15 minutes at normal test pressure.

A straight length of flue pipe of suitable diameter and of a length at least equal to 10 pipe diameter shall be attached directly to the outlet of the draft hood and connected to the inlet of a blower. The pressure and velocity heads shall be measured with a pitot tube and a differential gauge which may be read directly to 0.005 in wc (1.24 Pa). The pitot tube shall be inserted in the straight section of flue pipe at a point midway between its ends, so that (1) the head of the tube is coincident with the axis of the flue pipe, and (2) the impact opening of the pitot tube faces the flow stream.

An up-draft shall be imposed at the outlet of the draft hood such that the numerical sum of the pressure head and velocity head shall be between 0.06 and 0.07 in wc (15 and 17 Pa). Under this condition a sample of the flue gases shall be taken ahead of the draft hood. The ratio of carbon dioxide concentration for normal operation, to that under updraft, as above, shall be not more than $1 + 2(h_p + 5h_v)$ where "hp" is the pressure head and "hv" is the velocity head.

2.23.5

Flue gases shall not issue from the relief opening(s) of a draft hood when tested as specified in the following Method of Test.

Method of Test

The boiler shall be operated for at least 15 minutes at normal inlet test pressure. A fuming or smoking material, such as titanium tetrachloride, shall be introduced into the combustion chamber to form a dense smoke. A beam of light shall be directed across the relief opening(s). This provision shall be deemed met when no smoke can be observed escaping from the relief opening(s).

2.23.6

A draft hood and flue collector shall be sufficiently rigid in construction and supported on the boiler so they will withstand a load equivalent to that specified in the following Method of Test without becoming distorted and without alteration of their position with respect to the boiler.

Method of Test

A vertical or horizontal to vertical type draft hood shall be installed on the boiler in its normal operating position. When special means are provided for bolting or otherwise securing the draft hood to the collar of the flue collector, such means shall be employed. A vertical compression load equal to 5 lb/in (0.09 kg/mm) of nominal outlet diameter shall then be applied without impact to the draft hood outlet. This load shall not cause distortion of any part of the draft hood and flue collector, or alteration of their position relative to the boiler.

A horizontal or vertical to horizontal draft hood shall be installed on the boiler in its normal operating position. When special means are provided for bolting or otherwise securing the draft hood to the collar of the flue collector, such means shall be employed. A 10 ft (3.05 m) length of vent pipe, made of sheet steel not less than 0.0195 in (0.495 mm)* thick, of suitable diameter, shall then be attached in a horizontal position to the outlet connection of the draft hood, the other end of the length of pipe being supported at a point not more than 1 in (25.4 mm) from its extremity. This load shall not result in distortion of any part of the draft hood and flue collector or alteration of their position relative to the boiler.

* This corresponds to No. 24 U. S. Standard gage sheet steel with all applicable minus tolerances included.

2.24 Blocked Vent Test For Boilers Equipped With Forced Or Induced Draft Burners And Without Draft Hoods Or Regulators

A boiler equipped with a forced or induced draft burner shall not produce flue gases which contain carbon monoxide in excess of 0.04 percent, on an air free basis, when the outlet of the flue collar or vent is blocked to any degree up to and including complete closure.

Method of Test

When use with one gas is desired, these tests shall be conducted with the appropriate gas as specified in 2.2, Test Gases.

When use with more than one gas is desired and the boiler input ratings are not identical for the different gases, these tests shall be conducted at the specified input ratings for the individual gases. The number of tests conducted shall be at the discretion of the testing agency.

When use with more than one gas is desired and the boiler input rating is identical for the various gases, these tests shall be conducted in accordance with the following:

- a. If the gases selected include liquefied petroleum gases or LP gasair mixtures, use test Gas E or H, as applicable.
- b. If the gases selected are natural and mixed, or natural, manufactured and mixed, use test Gas A.
- c. If the gases selected are mixed and manufactured, use test Gas C.

This test shall be conducted at normal inlet test pressure only.

The boiler shall be operated for at least 15 minutes. If there is a control to automatically shut off the main burner gas under blocked vent conditions the area shall be gradually decreased to the minimum set point including worst case tolerances at which the control will allow the main burner to operate. A sample of the flue gases shall then be secured and analysed as specified in 2.5.1.

In case of outage, the blocked condition shall be maintained for 3 minutes to allow for operation of any safety devices, and then removed and observation made.

2.25 Automatic Flue Damper Devices

Whenever the use of air above room temperature is specified and required for conducting the following performance tests, flue gases from a boiler or burner assembly, mixed with air to obtain the specified temperature, shall be used.

2.25.1

Strength

A flue damper device shall withstand a load as specified in the following Method of Test without impairment of operation.

Method of Test

The flue damper device shall be installed on the boiler as specified in the boiler manufacturer's installation instructions. The flue damper device shall then be operated for 10 cycles to ascertain that the damper is operating properly.

- a. For a flue damper device having a vertical outlet, a vertical compression lead, equal to 5 lb/in (0.09 kg/mm) of nominal outlet diameter, shall be applied without impact to the outlet. With this load imposed, the flue damper device shall be operated for 10 cycles and shall exhibit no impairment of operation.
- b. For a flue damper device having a horizontal outlet, a 10 ft (3.05 m) length of vent pipe, made of sheet steel not less than 0.0195 in (0.495 mm)* thick, of suitable diameter, shall be attached horizontally to the outlet. The other end of the vent pipe shall be supported at a point not more than 1 in (25.4 mm) from its extremity. With this load imposed, the flue damper device shall operate for 10 cycles and shall exhibit no impairment of operation.

2.25.2

Operation Under Variable Voltage or Variable Motive Power

- a. An electrically operated flue damper device shall function properly and shall not adversely affect the operation of the boiler control system when the electrical supply voltage to the boiler is varied over a range of 85 to 110 percent of the voltage marked on the appliance rating plate.

Method of Test

The flue damper device shall be installed on the boiler as specified in the manufacturer's installation instructions.

The supply voltage to the boiler shall be adjusted to 85 percent of the voltage marked on the appliance rating plate and, with the boiler at room temperature, the boiler control system shall be operated by a switch in the thermostat circuit to allow the main burner to alternately operate and turn off. This procedure shall be repeated 10 times, and during each cycle the flue damper device and main burner automatic gas valve shall function properly. The damper shall be fully open before the gas is admitted to the main burner.

The procedure shall be repeated with the supply voltage to the boiler adjusted to 110 percent of the voltage marked on the appliance rating plate.

- b. A mechanically actuated flue damper device shall function properly when the motive power is varied from 75 to 125 percent of the range of motive power marked on the flue damper device (see 1.36.19-c).

Method of Test

At room temperature, damper operation shall be observed when the motive power to the flue damper device is varied from 75 to 125 percent of the manufacturer's specified range of motive power. The flue damper device shall function properly for 10 cycles under each of these conditions.

* This corresponds to No. 24 U.S. Standard gage sheet steel with all applicable minus tolerances included.

2.25.3

Flue Damper Failure

The main burner shall not operate, or shall shut down, if the damper is in other than the open position, or if the damper is closed to a point where normal combustion is affected.

Method of Test

Tests shall be conducted with test Gases A and E, as applicable. Inlet water temperature shall be $70^{\circ}\text{F} \pm 5^{\circ}\text{F}$ ($21^{\circ}\text{C} \pm 3^{\circ}\text{C}$). The thermostat shall be set at maximum temperature. The flue damper device interlock specified in 1.31.11 (not the interlock switch or means specified in 1.31.12) and, if necessary, the sensing device of the ignition system, shall be bypassed to allow main burner operation.

With the damper in the open position, the boiler shall be placed in operation at normal inlet test pressure. The damper shall then be closed slowly to the point just before the main burner shuts down. At this damper setting, the level of carbon monoxide (CO) shall not exceed 0.04 percent air free. A boiler which cannot be placed in operation under these test conditions is deemed to comply with this provision.

2.25.4

Exposure to Temperature Extremes

All components of a flue damper device, installed as part of a boiler, shall withstand exposure to high and low temperature extremes without damage or impairment of operation.

Method of Test

- a. The flue damper device shall be installed on the boiler or in a simulated flue system in the position(s) specified in the boiler manufacturer's installation instructions. The damper shall be opened in a normal manner and maintained in this position for a period of 24 hours with air at a temperature of $725^{\circ}\text{F} \pm 25^{\circ}\text{F}$ ($385^{\circ}\text{C} \pm 14^{\circ}\text{C}$) continually passing through the flue damper device.

At the end of this period, room temperature air shall be introduced until the flue damper device has been brought to room temperature, and the flue damper device shall then be operated for 10 cycles to determine that it functions properly and has not become damaged.

- b. The flue damper device, with the damper in the closed position, shall be maintained in an ambient temperature of $32^{\circ}\text{F} \pm 5^{\circ}\text{F}$ ($0^{\circ}\text{C} \pm 3^{\circ}\text{C}$) for a period of 24 hours.

At the end of this period and while subjected to this temperature, the flue damper device shall be operated for 10 cycles to determine that all components function properly and have not become damaged.

2.25.5

Continued Operation

A flue damper device shall withstand 100,000 cycles without any mechanical failure, impairment of operation or damage.

Method of Test

The flue damper device shall be installed in the position(s) specified in the boiler manufacturer's installation instructions on the boiler or in a simulated flue system capable of alternately delivering to the flue damper device a supply of room temperature air and a supply of air at a temperature of $725^{\circ}\text{F} \pm 25^{\circ}\text{F}$ ($385^{\circ}\text{C} \pm 14^{\circ}\text{C}$).

A control system which will actuate the flue damper device to assume its open and closed damper positions shall be connected to the flue damper device and to the air delivery means.

The damper shall be caused to assume its open position, and a supply of air at $725^{\circ}\text{F} \pm 25^{\circ}\text{F}$ ($385^{\circ}\text{C} \pm 14^{\circ}\text{C}$) shall be passed through the flue damper device for at least 5 seconds. This temperature shall be measured in the air stream at the outlet of the flue damper device.

The source of heat for the air supply then be shut off and the damper caused to assume its closed position for at least 5 seconds. The damper shall then be caused to assume its open position until the air passing through the flue damper device attains a temperature of $175^{\circ}\text{F} \pm 25^{\circ}\text{F}$ ($79.5^{\circ}\text{C} \pm 14^{\circ}\text{C}$).

The damper shall then be caused to assume its closed position for at least 5 seconds, after which the damper shall be caused to assume its open position and the source of heat for the air supply turned on.

This cycling sequence shall be repeated 100,000 times, after which all components of the flue damper device shall function properly. In addition, there shall be no evidence of breakage, deformation or other damage to the flue damper device.

2.25.6

The outlet water temperature of a boiler equipped with a flue damper device and a continuous pilot shall not exceed the limits specified in the following Method of Test.

Method of Test

The boiler shall be filled with water. A reseating type pressure relief valve set to relieve at approximately 40 psi (275.8 kPa) shall be connected to the boiler at a suitable point.

If the boiler includes temperature adjustment features designed for consumer's use, this adjustment shall be set to the maximum temperature setting. A limiting device without an adjustable feature designed for consumer's use shall be tested as received, the manufacturer's setting being considered the maximum. The temperature of the stored water at a point not more than 4 in (102 mm) downstream from the boiler outlet, shall be monitored by a temperature measurement means, accurate within 1°F (0.5°C).

An additional temperature measurement means, accurate within 1°F (0.5°C), shall be installed in the vessel immersed in the water adjacent to the sensing element of the water temperature limiting device.

The room temperature shall not vary more than $\pm 7.5^{\circ}\text{F}$ ($\pm 4^{\circ}\text{C}$) from the average during the test.

The boiler shall be operated for 1 hour at normal inlet test pressure with the outlet of the draft hood blocked and the feed water inlet throttled until the boiler outlet water temperature has reached 180°F (82°C) or the maximum outlet water temperature as determined in 2.15, Water Temperature Limiting Devices, whichever is less.

The damper shall then be caused to assume its closed position, and the feed water inlet shall be closed so the flow of water through the boiler is shut off. The water temperature adjacent to the sensing element of the water temperature limiting device shall be monitored for a period of 1 hour and shall not exceed the maximum outlet water temperature as determined in 2.15.

2.26 Direct Vent Systems

The provisions outlined under this section are applicable only to direct vent boilers.

2.26.1

The pilot(s) shall be capable of being ignited when the ventair intake terminal is exposed to a wind having a velocity of 10 mph (4.47 m/s) as specified in the following Method of Test.

Method of Test

The test shall be conducted at normal inlet test pressure.

The boiler shall be installed in the test wall structure as specified in 2.1.10. Deflector walls shall be installed against the test wall structure so the wind will not affect that section of the boiler normally located within the room.

A wind produced by a blower having sufficient capacity to develop a 0.04 in wc (10 Pa) static pressure [nominal 10 mph (4.47 m/s) wind velocity] shall be directed against the outside surface of the test structure on which the ventair intake terminal is attached. The blower shall be located so the wind is directed perpendicularly to the surface of the wall structure. Static pressure shall be measured by means of static pressure taps encompassing the area of the vent terminal. The static pressures at these points shall indicate uniform pressure distribution.

With the boiler subjected to the above wind conditions, the pilot(s) shall be capable of being ignited.

At the discretion of the testing agency, additional tests may be conducted with the same blower setting and distance as determined above, with the wind directed from other directions.

2.26.2

The pilot(s) and main burner(s) flames shall not become extinguished, and the main burner gas shall ignite from the automatic ignition device(s) without excessive delay, when the ventair intake terminal is exposed to a wind having a velocity of 40 mph (17.88 m/s) as specified in the following Method of Test.

Method of Test

The test shall be conducted at normal inlet test pressure.

The test method specified in 2.26.1 shall be applied except the blower shall be capable of producing a static pressure on the surface of the test wall of 0.66 in wc (164 Pa) [nominal 40 mph (17.88 m/s) wind velocity], and the pilot(s) shall be ignited before the boiler is subjected to the wind. While operating under the above wind conditions, the pilot(s) when operating alone, and the pilot(s) and main burner(s) when operating simultaneously, shall not become extinguished during a 10 minute period.

The main burner valve shall then be shut off. After a period of at least 30 seconds, the main burner valve shall be turned on and the main burner gas shall ignite from the automatic ignition device(s) without excessive delay. The boiler shall also comply with this test when the burner(s) is turned on and off by the automatic controls.

At the discretion of the testing agency, additional tests may be conducted with the same blower setting and distance as determined above, with the wind directed from other directions.

2.26.3

A direct vent boiler shall not produce a concentration of carbon monoxide in excess of 0.04 percent in an airfree sample of the flue gases when tested in an atmosphere having approximately a normal oxygen supply and exposed to winds from zero to 40 mph (17.88 m/s) as specified in the following Method of Test.

Method of Test

This test shall be conducted at normal inlet test pressure.

Burner and primary air adjustments shall be made in accordance with 2.3.3.

The boiler shall be operated until an equilibrium condition, ascertained by a constant flue gas temperature, is attained. A blower as specified in 2.26.1 shall then be placed in operation perpendicular to the surface of the wall structure. Sufficient flue gas samples shall be secured and analyzed to determine that the carbon monoxide concentration is not in excess of the allowable limit when winds having sufficient capacity to develop from zero to 0.66 in wc (164 Pa) static pressure [nominal 40 mph (17.88 m/s) wind velocity], when measured as specified in 2.26.1, are directed at the ventair intake terminal.

At the discretion of the testing agency additional tests may be conducted with the wind directed from other directions.

2.26.4

The operating characteristics of a direct vent boiler shall not be affected by the wind conditions specified in 2.26.3. This provision shall be deemed met when the variation in the carbon dioxide concentration in the flue gases is not in excess of the limits specified in the following Method of Test.

Method of Test

Burner and primary air adjustments shall be made in accordance with 2.3.3.

The boiler shall be operated at normal inlet test pressure until an equilibrium condition, ascertained by a constant flue gas temperature, is attained under a still air condition. A flue gas sample shall then be secured and analyzed for carbon dioxide.

The wind condition specified in 2.26.3 shall then be imposed on the ventair intake terminal, and flue gas samples at various wind conditions secured and analyzed to determine the carbon dioxide concentration.

The carbon dioxide concentration with the boiler subjected to any of the wind conditions specified in 2.26.3 shall not be less than 50 percent of the carbon dioxide concentration produced by the boiler when operated at normal inlet test pressure under a still air condition.

2.26.5

With the flue outlet blocked to any degree up to and including complete closure, the concentration of carbon monoxide in an air-free sample of the flue gases shall not exceed 0.04 percent when the boiler is tested in an atmosphere having a normal oxygen supply. Should outage occur, raw gas shall not be readmitted into the combustion chamber on reopening the flue outlet. During the conduct of the test, flue gases shall not be emitted from a condensate drain line.

Method of Test

The boiler shall be operated for at least 15 minutes at normal inlet test pressure. When the boiler incorporates a control to automatically shut off the main gas supply under blocked flue conditions, the area of the flue outlet shall be gradually decreased to the lower point (including tolerances) at which the control shall allow the appliance to operate. A sample of the flue gases shall be secured and analysed as specified in 2.5.1.

In the event of outage, the blocked condition shall be maintained for 3 minutes to allow for operation of safety devices, and then removed and determination made that raw gas had not been readmitted into the combustion chamber.

This test shall be repeated with the blockage applied to the air intake.

2.26.6

The ventair intake terminal shall be sufficiently rigid in construction and supported so it will withstand a load of 150 lb (68 kg) without extensive damage or alteration of its position with respect to the boiler. Following application of this load, the boiler shall comply with the combustion test specified in the following Method of Test.

Method of Test

A vertical suspension load of 150 lb (68 kg) shall be evenly distributed without impact over the ventair intake terminal.

The load shall then be removed and shall not have caused substantial distortion of any part of the ventair intake terminal or alteration of its position relative to the boiler so the boiler would not operate satisfactorily.

The boiler shall then be operated at normal inlet test pressure until equilibrium conditions are attained. A sample of the flue gases shall then be secured and analyzed as prescribed in 2.5.1. The concentration of carbon monoxide, based on an airfree sample of the flue gases, shall not exceed 0.04 percent.

2.26.7

The ventair intake terminal shall be sufficiently rigid in construction so as not to become damaged to the extent that it would be unsafe for use when subjected to impact in accordance with the following Method of Test. Following impact of the vent-air intake terminal, the boiler shall comply with the combustion test specified in the following Method of Test.

Method of Test

The impact shall be produced by a pendulum consisting of a cloth bag, filled with sand, weighing 25 lb (11.3 kg), suspended from a steel cable or rope. The bag shall be formed from a flat section of burlap, canvas or other suitable material. A plastic liner may be used to prevent sand loss. All sides and corners of the cloth shall be drawn up as tightly as possible around the sand and the excess material tied as closely as possible at the top of the bag. The bag shall have an atrest position not more than 1 in (25.4 mm) from the edge of the bag to the nearest edge of the ventair intake terminal. The point of impact shall be opposite the center of gravity of the bag. The distance of swing [angle 45 degrees (0.79 rad)] shall be measured as the angle between the pendulum arm with the bag at its atrest position and the pendulum arm at its elevated position. The length of the pendulum, measured from the point of rotation to the center of gravity of the bag (see Figure 10, Arrangement of Sandbags and Vent-Air Intake Terminal for Impact Test) shall be 7 ft (2.13 m).

One impact shall be made at each of the following points, as shown in Figure 10:

- a. The center of the vertical front surface of the ventair intake terminal.
- b. The leading edge on the left side of the ventair intake terminal, pendulum rotated left at an angle 45 degrees (0.79 rad) from the point described in "-a."
- c. The leading edge on the right side of the ventair intake terminal, pendulum rotated right at an angle 45 degrees (0.79 rad) from the point described in "-a."

Following each impact, the boiler shall be operated at normal inlet test pressure until equilibrium conditions are attained. A sample of the flue gases shall then be secured and analyzed as specified in 2.5.1. In each case, the concentration of carbon monoxide, based on an airfree sample of the flue gases, shall not exceed 0.04 percent.

At the option of the manufacturer the ventair intake terminal may be replaced following each impact and combustion test.

2.26.8

Joints in direct vent systems shall be tight. This provision shall be deemed met if leakage from the system is not in excess of the limits specified in the following Method of Test.

Method of Test

- a. This test applies to a boiler having a separate air intake section and a separate combustion chamber/vent section.

The vent and air intake terminals shall be removed, and the entrance of the air intake section sealed at the point it enters the combustion chamber. The entire system, including the combustion air and flue gas connections between the boiler and the vent and air intake terminals, shall be installed and sealed in accordance with the manufacturer's instructions.

Both the flue outlet and the air inlet shall then be sealed at the point of connection to the vent and air intake terminals. The sealing means shall include fittings for supplying air to both the air intake and combustion chamber/vent sections of the system and provisions for measuring the internal pressure in each section of the system.

The internal system pressure shall be determined by connecting the means for determining internal pressure to a waterfilled manometer which may be read directly to 0.01 in wc (2.5 Pa).

A suitable supply of clean air shall be permitted to flow through a wet test meter and into the section of the direct vent system being pressurized through the air supply fitting. The air supply fitting to the section of the system not being pressurized shall be open.

The meter pressure shall be adjusted to produce an internal air pressure of 0.1 in wc (25 Pa) above the normal operating system pressure (atmosphere for other than forced draft systems) in the section of the system being pressurized and the leakage rate noted in ft³/hr (cm³/sec) for both the air intake and combustion chamber-vent sections of the direct vent system.

Compliance with this provision shall be deemed met if leakage from the combustion chamber-vent section of the system does not exceed 2.0 percent of the products of combustion and leakage from the air intake section of the system does not exceed 8.0 percent of the products of combustion. These values shall be determined by the following appropriate formulae*:

$$L_c = 0.02 \times V \times I$$

$$L_a = 0.08 \times V \times I$$

where

L_c = allowable leakage rate from combustion chamber-vent section of direct vent system, ft³/hr;

L_a = allowable leakage rate from air intake section of direct vent system, ft³/hr;

V = 15 ft³ of flue products (based on the formation of approximately 10 ft³ of dry flue products plus 5 ft³ of excess air, when 1000 Btu of fuel gas is burned); and

I = input rate, in thousands of Btu/hr.

[NOTE: Allowable leakage rates in cubic centimeters per second (cm³/s) for boilers rated in watts (W) can be determined by multiplying the input rating in kilowatts (kW): (1) by 8.05 for combustion chamber-vent sections and (2) by 32.2 for air intake sections.]

- b. This test applies to a boiler with all or part of the vent portion of the combustion chamber-vent section enclosed within the air intake section.

On such a boiler, the combustion chamber-vent section of the system shall be considered that portion of the combustion chamber-vent section not contained within the air intake section.

The vent-air intake terminal shall be removed, and the entrance of the air intake section sealed at the point it enters the combustion chamber. The entire system, including the combustion air and flue gas connections between the boiler and the vent-air intake terminal, shall be installed and sealed in accordance with the manufacturer's instructions. Any vent extension located within the air intake section need not be installed.

The direct vent system shall then be sealed at the point of connection to the vent-air intake terminal. The sealing means shall include fittings for supplying air simultaneously to the air intake and combustion chamber-vent sections of the system and provisions for measuring the internal pressure.

Using the test apparatus and the Method of Test specified in 2.26.8-a, the total system shall be pressurized and the leakage rate noted in ft³/hr (cm³/sec).

The combustion chamber-vent section of the system shall then be sealed, with the appropriate fittings noted above, at the first joint of the vent portion of the combustion chamber-vent section contained within the air intake section downstream of the combustion chamber. Using the test apparatus and the Method of Test specified in 2.26.7-a, the combustion chamber-vent section shall be pressurized and the leakage rate noted in cubic feet per hour (cm³/sec).

* These formulae may be simplified to read $L_c = 0.3 I$ and $L_a = 1.2 I$.

Compliance with this provision shall be deemed met if leakage from the combustion chamber-vent section of the system, as calculated in 2.26.7-a, does not exceed 2.0 percent of the products of combustion, and leakage from the total system does not exceed 8.0 percent of the products of combustion plus the leakage, in percent, determined for the combustion chamber-vent section.

2.26.9

A direct vent boiler equipped with an intermittent ignition system (see Part IV, Definitions) shall be tested to determine that gas leakage through the control assembly will not result in an accumulation of gas which could cause excessive flame flashback or damage to the boiler.

Method of Test

This test shall be conducted in a draft-free environment.

The boiler shall be instrumented with a sampling tube(s) to measure the gas-air ratio at various points in the boiler. This sampling tube(s) shall be connected to a gas-air analyzer coupled to a chart-type single-point recording potentiometer in order to produce a constant trace of the gas-air ratio at the sample point for sufficient time to allow a complete evaluation of the system. The gas-air ratio trace shall be developed with the boiler both hot and cold and with all test gases for which the boiler is tested. Supplemental natural gas tests with test Gas G need not be conducted.

An amount of gas equal to 10 percent of the combustion chamber volume shall be evenly introduced through the gas control system into the combustion chamber over a period of 5 minutes. The gas-air ratio shall be monitored for the next 30 minutes. If the gas-air ratio during this period is below the lower explosive limit, the boiler shall be considered as complying with this provision. If the gas-air ratio is above the lower explosive limit, sufficient ignition tests shall be conducted to determine that ignition does not cause excessive flame flashback or damage to the boiler.

A boiler where combustion air is supplied by mechanical means and the igniter is activated or reactivated only after a purge period sufficient to provide 4 air changes of the combustion chamber and flue gas passageways shall be considered as complying with this provision.

2.27 Boilers For Outdoor Installation

2.27.1

A boiler for outdoor installation shall function normally when subjected to a simulated rainstorm.

Method of Test

The boiler shall be placed on the test platform of the rain test apparatus described in Figure 11, Arrangement of Spray Heads and Associated Piping for Simulated Rainstorm Test, and Figure 12, Spray Head Assembly and Details of Construction, in the position, with respect to the spray heads, deemed most critical by the testing agency.

The boiler shall be adjusted at normal inlet test pressure and the pilot(s), if provided, placed in operation.

The rain test apparatus shall then be placed in operation and each spray head adjusted by means of the control valve to operate at 5 psi (34.5 kPa). The spray head unit shall be adjusted to varying elevations and horizontal distances from the test platform to determine the most critical location. The exposure at the position deemed most critical by the testing agency shall be maintained throughout the test.

After adjustment of the spray head unit, the rain test apparatus shall be operated for a period of 15 minutes. Then the main burner(s) shall be placed in operation and the rain test apparatus operated for an additional 15 minutes. The above test procedure shall be repeated with the boiler located in any other position(s) with respect to the spray heads deemed necessary by the testing agency.

The boiler shall function normally during exposure to the simulated rainstorm. Upon completion of exposure to the simulated rainstorm, there shall be no evidence of damage or malfunctioning of any part of the boiler, nor evidence of water retained in any part of the boiler.

2.27.2

The pilot(s) of a boiler for outdoor installation shall be capable of being ignited when the boiler is exposed to a wind having a velocity of 10 mph (4.47 m/s).

Method of Test

The test shall be conducted at normal inlet test pressure.

A wind produced by a blower having sufficient capacity to develop a 10 mph (4.47 m/s) wind shall be directed against the outer surface of the boiler at the point(s) deemed to be most critical by the testing agency. The blower shall be located so a uniform wind covering the total vertical projected area of the boiler is directed horizontally toward the boiler at a velocity of 10 mph (4.47 m/s) measured in a vertical plane 18 in (457 mm) from the windward surface of the boiler.

With the boilers subjected to the above wind conditions the pilot(s) shall be capable of being ignited.

2.27.3

The main burner flames, and the pilot(s), if provided, of a boiler for outdoor installation shall not become extinguished and the main burner gas shall ignite from the ignition device without excessive delay when the boiler is exposed to a wind having a velocity of 40 mph (17.88 m/s).

Method of Test

The test shall be conducted at normal inlet test pressure.

A wind produced by a blower having sufficient capacity to develop a 40 mph (17.88 m/s) wind shall be directed against the outer surface of the boiler and the outlet of the draft hood or integral venting system at points deemed to be most critical by the testing agency. The blower shall be located so a uniform wind covering the total vertical projected area of the boiler is directed horizontally toward the boiler at a velocity of 40 mph (17.88 m/s) measured in a vertical plane 18 in (457 mm) from the windward surface of the boiler.

With the boiler operating under the above wind conditions, the pilot(s) when operating alone, and the pilot(s) and the main burner(s) when operating simultaneously, shall be operated for a sufficient length of time to determine whether or not they will be extinguished.

The main burner gas shall ignite from the ignition device without excessive delay.

2.27.4

A boiler for outdoor installation shall comply with 2.5.1 under the following Method of Test when operating at normal inlet test pressure.

Method of Test

A wind produced by a blower having a sufficient capacity to develop a 10 mph (4.47 m/s) wind shall be directed against the outer surface of the boiler at the point(s) deemed to be most critical by the testing agency. The blower shall be located so a uniform wind covering the total vertical projected area of the boiler is directed horizontally toward the boiler at a velocity of 10 mph (4.47 m/s) measured in a vertical plane 18 in (457 mm) from the windward surface of the boiler.

The boiler shall be operated for 15 minutes at normal inlet test pressure. A sample of the flue gases shall then be secured and analyzed as specified in 2.5.1.

2.28 Boilers Vented Horizontally Through an Outside Wall

These tests shall be conducted at normal inlet pressure only. If variable lengths are specified by the manufacturer, testing shall be at both the minimum and maximum lengths specified.

At the discretion of the testing agency, tests may also be conducted with the wind from any horizontal direction.

The method of test specified for the following tests is such that they can be run consecutively.

2.28.1

The pilot(s) shall be capable of being ignited when the vent terminal is exposed to a wind having a velocity of 10 mph (4.47 m/s) as specified in the following Method of Test.

Method of Test

The test shall be conducted at normal inlet test pressure.

The boiler shall be installed in the test wall structure as specified in 2.1.10. Deflector walls shall be installed against the test wall structure so the wind will not affect that section of the boiler normally located within the room.

A wind produced by a blower having sufficient capacity to develop a 0.04 in wc (10 Pa) static pressure [nominal 10 mph (4.47 m/s) wind velocity] shall be directed against the outside surface of the test structure on which the vent terminal is attached. The blower shall be located so the wind is directed perpendicularly to the surface of the wall structure. Static pressure shall be measured by means of static pressure taps encompassing the area of the vent terminal. The static pressures at these points shall indicate uniform pressure distribution.

With the boiler subjected to the above wind conditions, the pilot(s) shall be capable of being ignited.

At the discretion of the testing agency, additional tests may be conducted with the same blower setting and distance as determined above, with the wind directed from other directions.

2.28.2

The pilot(s) and main burner(s) flames shall not become extinguished, and the main burner gas shall ignite from the automatic ignition device(s) without excessive delay, when the vent terminal is exposed to a wind having a velocity of 40 mph (17.88 m/s) as specified in the following Method of Test.

Method of Test

The test shall be conducted at normal inlet test pressure.

The test method specified in 2.28.1 shall be applied except the blower shall be capable of producing a static pressure on the surface of the test wall of 0.66 in wc (164 Pa) [nominal 40 mph (17.88 m/s) wind velocity], and the pilot(s) shall be ignited before the boiler is subjected to the wind. While operating under the above wind conditions, the pilot(s) when operating alone, and the pilot(s) and main burner(s) when operating simultaneously, shall not become extinguished during a 10 minute period.

The main burner valve shall then be shut off. After a period of at least 30 seconds, the main burner valve shall be turned on and the main burner gas shall ignite from the automatic ignition device(s) without excessive delay. The boiler shall also comply with this test when the burner(s) is turned on and off by the automatic controls.

At the discretion of the testing agency, additional tests may be conducted with the same blower setting and distance as determined above, with the wind directed from other directions.

2.28.3

A horizontally vented boiler shall not produce a concentration of carbon monoxide in excess of 0.04 percent in an airfree sample of the flue gases when tested in an atmosphere having approximately a normal oxygen supply and exposed to winds from zero to 40 mph (17.88 m/s) as specified in the following Method of Test.

Method of Test

This test shall be conducted at normal inlet test pressure.

Burner and primary air adjustments shall be made in accordance with 2.3.3.

The boiler shall be operated until an equilibrium condition, ascertained by a constant flue gas temperature, is attained. A blower as specified in 2.28.1 shall then be placed in operation perpendicular to the surface of the wall structure. Sufficient flue gas samples shall be secured and analyzed to determine that the carbon monoxide concentration is not in excess of the allowable limit when winds having sufficient capacity to develop from zero to 0.66 in wc (164 Pa) static pressure [nominal 40 mph (17.88 m/s) wind velocity], when measured as specified in 2.28.1, are directed at the vent terminal.

At the discretion of the testing agency additional tests may be conducted with the wind directed from other directions.

2.28.4

The operating characteristics of a horizontally vented boiler shall not be affected by the wind conditions specified in 2.28.3. This provision shall be deemed met when the variation in the carbon dioxide concentration in the flue gases is not in excess of the limits specified in the following Method of Test.

Method of Test

Burner and primary air adjustments shall be made in accordance with 2.3.3.

The boiler shall be operated at normal inlet test pressure until an equilibrium condition, ascertained by a constant flue gas temperature, is attained under a still air condition. A flue gas sample shall then be secured and analyzed for carbon dioxide.

The wind condition specified in 2.28.3 shall then be imposed on the vent terminal, and flue gas samples at various wind conditions secured and analyzed to determine the carbon dioxide concentration.

The carbon dioxide concentration with the boiler subjected to any of the wind conditions specified in 2.28.3 shall not be less than 50 percent of the carbon dioxide concentration produced by the boiler when operated at normal inlet test pressure under a still air condition.

2.28.5

The vent terminal shall be sufficiently rigid in construction and supported so it will withstand a load of 150 lb (68 kg) without extensive damage or alteration of its position with respect to the boiler. Following application of this load, the boiler shall comply with the combustion test specified in the following Method of Test.

Method of Test

A vertical suspension load of 150 lb (68 kg) shall be evenly distributed without impact over the vent terminal.

The load shall then be removed and shall not have caused substantial distortion of any part of the vent terminal or alteration of its position relative to the boiler so the boiler would not operate satisfactorily.

The boiler shall then be operated at normal inlet test pressure until equilibrium conditions are attained. A sample of the flue gases shall then be secured and analyzed as prescribed in 2.5.1. The concentration of carbon monoxide, based on an airfree sample of the flue gases, shall not exceed 0.04 percent.

2.28.6

The vent terminal shall be sufficiently rigid in construction so as not to become damaged to the extent that it would be unsafe for use when subjected to impact in accordance with the following Method of Test. Following impact of the vent terminal, the boiler shall comply with the combustion test specified in the following Method of Test.

Method of Test

The impact shall be produced by a pendulum consisting of a cloth bag, filled with sand, weighing 25 lb (11.3 kg), suspended from a steel cable or rope. The bag shall be formed from a flat section of burlap, canvas or other suitable material. A plastic liner may be used to prevent sand loss. All sides and corners of the cloth shall be drawn up as tightly as possible around the sand and the excess material tied as closely as possible at the top of the bag. The bag shall have an atrest position not more than 1 in (25.4 mm) from the edge of the bag to the nearest edge of the vent terminal. The point of impact shall be opposite the center of gravity of the bag. The distance of swing [angle 45 degrees (0.79 rad)] shall be measured as the angle between the pendulum arm with the bag at its atrest position and the pendulum arm at its elevated position. The length of the pendulum, measured from the point of rotation to the center of gravity of the bag (see Figure 10, Arrangement of Sandbag and Vent-Air Intake Terminal for Impact Test) shall be 7 ft (2.13 m).

One impact shall be made at each of the following points, as shown in Figure 10:

- a. The center of the vertical front surface of the vent terminal.
- b. The leading edge on the left side of the vent terminal, pendulum rotated left at an angle 45 degrees (0.79 rad) from the point described in "-a."
- c. The leading edge on the right side of the vent terminal, pendulum rotated right at an angle 45 degrees (0.79 rad) from the point described in "-a."

Following each impact, the boiler shall be operated at normal inlet test pressure until equilibrium conditions are attained. A sample of the flue gases shall then be secured and analyzed as specified in 2.5.1. In each case, the concentration of carbon monoxide, based on an airfree sample of the flue gases, shall not exceed 0.04 percent.

At the option of the manufacturer the vent terminal may be replaced following each impact and combustion test.

2.29 Condensate Disposal System(s)

2.29.1

The design of a Category II or IV boiler shall be such that flue products will not be discharged from the condensate drain line(s) under the following Method of Test.

Method of Test

The condensate trap(s), if provided or supplied as part of the boiler, shall be installed in accordance with the manufacturer's installation instructions and filled with water prior to conduct of this test.

This test shall be conducted simultaneously with those tests specified under 2.23, Draft Hoods, or 2.24, Blocked Vent Test for Boilers Equipped with Forced or Induced Draft Burners and Without Drafthoods or Regulators, as applicable, up to and including maximum blocked flue conditions where the boiler continues to operate.

This provision shall be deemed met if the flue products do not issue from the condensate drain line(s).

2.29.2

A boiler having a flue (vent) condensate disposal system(s) shall, under conditions of a blocked condensate drain line(s), continue to operate satisfactorily or shall shut off main burner gas during conduct of the following Method of Test.

Method of Test

The condensate disposal system(s) shall be installed in accordance with the manufacturer's installation instructions. The condensate drain line(s) shall be blocked at or upstream of the narrowest point in the system(s).

The boiler shall be placed in operation at normal input rate(s) and normal inlet test pressure. The condensate disposal system(s) shall be filled to the maximum level of water attainable or to the point just prior to causing the boiler to shut off (the method of filling shall be at the discretion of the testing agency). The combustion shall be monitored during filling. At no time shall the combustion level [concentration of carbon monoxide in an airfree sample of the flue (vent) gases when tested in an atmosphere having a normal oxygen supply] exceed 0.04 percent, or the boiler shall shut off main burner gas before the combustion level reaches 0.04 percent.

The safety shutoff device shall be bypassed, if necessary, and the boiler cycled as it would be under normal operating conditions. The main burner(s) and ignition device(s) shall ignite without delayed ignition, flame rollout or flashback.

The bypass shall be removed. The boiler shall comply with the leakage current and dielectric withstand tests specified in 1.24.40 and 1.24.41.

A boiler which cannot be placed in operation under conditions of a blocked condensate drain line(s) shall be deemed to comply with this test.

2.30 Venting Systems For Category II, III, Or IV Boilers

A venting system supplied with a Category III or IV boiler shall be gastight. A venting system supplied with a Category II or IV boiler shall be watertight.

This provision shall be deemed met if leakage from the venting system is not in excess of the limit specified in the following Method of Test.

Method of Test

This test shall be conducted using the maximum vent length and number of joints, including fittings, as specified by the manufacturer (see 1.34.1-b16). For purposes of this test, the manufacturer shall supply (1) the venting system which incorporates the maximum specified number of fittings, and (2) a sealed test fitting incorporating the vent collar to which the venting system is to be attached. This test fitting shall also have an inlet tap(s) to which a pressure source and a pressure measuring device can be attached.

The entire venting system, including the vent connector and terminal cap, shall be installed (and sealed, if applicable) in accordance with the manufacturer's instructions.

The outlet of the venting system shall be sealed. The inlet fitting shall be connected to an air supply (pressure source) and a pressure measuring device for measuring the internal pressure of the system. This device shall be capable of being read to 0.01 in wc (2.5 Pa).

A suitable supply of clean air shall be permitted to flow through a metering device and into the venting system being pressurized through the air supply fitting.

The internal air pressure in the system being pressurized shall be maintained at 2 in wc (498 Pa) or 2 times the maximum system operating pressure as specified by the manufacturer, whichever is greater. The leakage rate shall be measured in ft³/hr (cm³/s).

This provision shall be deemed met if leakage from the venting system does not exceed 2.0 percent of the products of combustion. This value shall be determined by the following formula*:

$$L_c = .02 \times V \times I$$

where

$$L_c = \text{allowable leakage rate from the venting system, ft}^3/\text{hr};$$

$$V = 15 \text{ ft}^3 \text{ of flue products (based on the formation of approximately } 10 \text{ ft}^3 \text{ of dry flue products, plus } 5 \text{ ft}^3 \text{ of excess air, when } 1000 \text{ Btu of fuel gas is burned); and}$$

$$I = \text{input rating, in thousands of Btu/hr.}$$

[NOTE: Allowable leakage rates in cubic centimeters per second (cm³/s) for boilers rated in watts (W) can be determined by multiplying the input rating in kilowatts (kw) by 8.05.]

* This formula may be simplified to read $L_c = 0.3 I$.

2.31 Marking Material Adhesion And Legibility

Marking materials recognized as complying with *Standard for Adhesive Labels, CSA C22.2 No. 0.15*, or *Standard for Marking and Labelling Systems, ANSI/UL 969*, are exempt from this test.

The adhesive quality of Class IIA3, IIA4, IIIA1 and IIIA2 marking materials and the legibility of all Class II and III marking materials (see 1.36.1) shall not be adversely affected when the marking materials are exposed to heat and moisture as specified in the following Method of Test.

Method of Test

- a. Adhesive type marking materials shall be applied to a sample test panel having the particular type of finish used on the boiler in production. A sample metal panel of this finish shall be cleaned with a solvent and dried. Half of the panel shall be wiped with a clean cloth lightly oiled with SAE30 medium machine oil. Two samples of marking material shall be applied to the panel, one on the dry area and one on the oiled area. Test samples shall be applied with firm pressure, unless the manufacturer's application instructions specify otherwise. Each sample shall be allowed to set for 24 hours at room temperature.

Each sample of marking material shall exhibit:

1. Good adhesion and no curling at edges;
 2. No illegible or defaced printing when rubbed with thumb or finger pressure; and
 3. Good adhesion when a dull metal blade (as the back of pocketknife blade) is held at 90 degrees (1.57 rad) to the applied marking and scraped across the edges of the marking.
- b. Nonadhesive type marking materials shall exhibit no illegible or defaced printing when rubbed with thumb or finger pressure. Two samples of marking material shall be tested.
 - c. Samples of both adhesive and nonadhesive type marking materials shall then be placed in an oven for a period of 2 weeks with the oven temperature maintained at:
 1. 350°F (176.5°C) for Class IIA1, IIA2, IIA3, IIA4 and IIIA1 marking materials; or
 2. 250°F (121°C) for Class IIIA2 and IIIB marking materials.

Following the oven test, adhesion and legibility of the samples shall be checked again as specified in "-a" or "-b" above.

Samples shall then be immersed in water for a period of 24 hours, after which adhesion and legibility shall be rechecked as specified in "-a" or "-b" above.

Good adhesion and legibility qualities shall be obtained for all samples under the above specified test conditions.

Final acceptance of marking materials shall be based on the suitability of the marking material on the boiler.

***Tables Referenced In
Part I, Part II And Exhibits***

Table I-A

**Maximum Safety Control Timings
Natural Draft Atmospheric Burners**

Total Input of 400,000 Btu/hr (117 228 W) or Less
(Timings in Seconds)

	Continuous Ignition	Intermittent Ignition	Interrupted Ignition	Direct Ignition	Proved Igniter
Pilot flame-establishing period	120	15 (e)	15 (e)	----	----
Trial for ignition period	----	----	15 (d)	15	----
Valve sequence period	----	----	----	60	----
Flame failure response time	180	4	4 (b)	4	4 (c)
Flame failure re-ignition time	----	0.8	0.8	0.8	0.8 (c)
Valve closing time	(a)	5	5	5	5
Igniter failure response time	----	----	----	----	4

- (a) Included in flame failure response time.
- (b) Applicable to both pilot and main burner flame failure.
- (c) These values apply when the ignition system utilizes an interrupted ignition source (2.9.5 and 2.9.6).
- (d) May be 30 seconds for burners with a safety shutoff valve having a full opening time of not less than 25 seconds.
- (e) May be 90 seconds if pilot has an input of 2500 Btu/hr (733 W) or less.

Table I-B

**Maximum Safety Control Timings
Other than Natural Draft Atmospheric Burners**

Total Input of 400,000 Btu/hr (117 228 W) or Less
(Timings in Seconds)

	Continuous Ignition	Intermittent Ignition	Interrupted Ignition	Direct Ignition	Proved Igniter
Pilot flame-establishing period	120	15 (d)	15 (d)	----	----
Trial for ignition period	----	----	15	15	----
Valve sequence period	----	----	----	60	----
Flame failure response time	180	4	4 (b)	4	4 (c)
Flame failure re-ignition time	----	0.8	0.8	0.8	0.8 (c)
Valve closing time	(a)	5	5	5	5
Igniter failure response time	----	----	----	----	4

- (a) Included in flame failure response time.
- (b) Applicable to both pilot and main burner flame failure.
- (c) These values apply when the ignition system utilizes an interrupted ignition source (2.9.5 and 2.9.6).
- (d) May be 90 seconds if pilot has an input of 2500 Btu/hr (733 W) or less.

Table I-C

**Maximum Safety Control Timings
Natural Draft Atmospheric Burners**

Total Input Greater Than 400,000 Btu per Hour (117 228 W)

Total input in million Btu per hour (W)

(Timings in Seconds)

	Above 0.4 (117 228) To 2.5 (732 678)	Above 2.5 (732 678) To 5.0 (1 465 360)	Above 5.0 (1 465 360) < 12.5 (3 663 390)
Continuous Ignition			
Pilot flame-establishing period	15 (f) (g)	10 (f) (g)	10 (f) (g)
Flame failure response time	4	4	4
Valve closing time	5	1	1
Intermittent Ignition			
Pilot flame-establishing period	15 (e)	10 (e)	10 (e)
Flame failure response time	4	4	4
Flame failure re-ignition time	0.8	0.8	0.8
Valve closing time	5	1	1
Interrupted Ignition			
Pilot flame-establishing period	15 (e)	10 (e)	10 (e)
Trial for ignition period	15 (a)	10 (a)	10 (a)
Flame failure response time (b)	4	4	4
Flame failure re-ignition time	0.8	0.8	0.8
Valve closing time	5	1	1
Direct Ignition			
Trial for ignition period			
Valve sequence period	(c)	(c)	(c)
Flame failure response time	See Table I-A	See Table I-A	See Table I-A
Flame failure re-ignition time			
Valve closing time			
Proved Ignitor			
Igniter failure response time	4	4	4
Flame failure response time	4 (d)	4 (d)	4 (d)
Flame failure re-ignition time	0.8 (d)	0.8 (d)	0.8 (d)
Valve closing time	5	1	1

- (a) May be 30 seconds for burners with a safety shutoff valve having a full opening time of not less than 25 seconds.
- (b) Applicable to both pilot and main burner flame failure.
- (c) Multiple direct ignition systems and separated combustion zones shall be provided in accordance with 1.9.2-b.
- (d) These values apply when the ignition system utilizes an interrupted ignition source (2.9.5 and 2.9.6).
- (e) May be 90 seconds if pilot has an input of 2500 Btu/hr (733 W) or less.
- (f) Initial start only.
- (g) May be 120 seconds if pilot has an input of 2500 Btu/hr (733 W) or less.

Table I-D

**Maximum Safety Control Timings
Other than Natural Draft Atmospheric Burners**

Total Input Greater Than 400,000 Btu per Hour (117 228 W)

Total input in million Btu per hour (W)

(Timings in Seconds)

	Above 0.4 (117 228) To 2.5 (732 678)	Above 2.5 (732 678) To 5.0 (1 465 360)	Above 5.0 (1 465 360) < 12.5 (3 663 390)
Continuous Ignition			
Pilot flame-establishing period	15 (e) (f)	10 (e) (f)	10 (e) (f)
Flame failure response time	4	4	4
Valve closing time	5	1	1
Intermittent Ignition			
Pilot flame-establishing period	15 (d)	10 (d)	10 (d)
Flame failure response time	4	4	4
Flame failure re-ignition time	0.8	0.8	0.8
Valve closing time	5	1	1
Interrupted Ignition			
Pilot flame-establishing period	15 (d)	10 (d)	10 (d)
Trial for ignition period	15	10	10
Flame failure response time (b)	4	4	4
Flame failure re-ignition time	0.8	0.8	0.8
Valve closing time	5	1	1
Direct Ignition		(g) (h)	
Trial for ignition period	4	4	
Valve sequence period	60	60	(b)
Flame failure response time	4	4	See Table I-B
Flame failure re-ignition time	0.8	0.8	
Valve closing time	5	5	
Proved Ignitor			
Igniter failure response time	4	4	4
Flame failure response time	4 (c)	4 (c)	4 (c)
Flame failure re-ignition time	0.8 (c)	0.8 (c)	0.8 (c)
Valve closing time	5	1	1

- (a) Applicable to both pilot and main burner flame failure.
- (b) Multiple direct ignition systems and separated combustion zones shall be provided in accordance with 1.9.2-b.
- (c) These values apply when the ignition system utilizes an interrupted ignition source (2.9.5 and 2.9.6).
- (d) May be 90 seconds if pilot has an input of 2500 Btu/hr (733 W) or less.
- (e) Initial start only.
- (f) May be 120 seconds if pilot has an input of 2500 Btu/hr (733 W) or less.
- (g) When multiple direct ignition systems are used, the requirements of 1.9.2-b and Table I-B shall be met.
- (h) The total input at ignition shall not exceed 2,500,000 Btu/hr. (732 678 W). See 1.9.2-b. For inputs at ignition over 2,500,000 multiple direct ignition systems are required see note (g).

Table II

**Minimum Acceptable
Wall Thickness For Semi-Rigid Tubing**

Outside Diameter,		Minimum Acceptable Wall Thickness,	
Inch	(mm)	Inch	(mm)
$\frac{1}{8}$	(3.2)	0.020	(0.51)
$\frac{3}{16}$	(4.8)	0.025	(0.64)
$\frac{1}{4}$	(6.4)	0.029	(0.74)
$\frac{5}{16}$	(7.9)	0.029	(0.74)
$\frac{3}{8}$	(9.5)	0.032	(0.81)
$\frac{7}{16}$	(11.1)	0.032	(0.81)
$\frac{1}{2}$	(12.7)	0.038	(0.97)
$\frac{9}{16}$	(14.3)	0.038	(0.97)
$\frac{5}{8}$	(15.9)	0.038	(0.97)
$\frac{3}{4}$	(19.1)	0.045	(1.14)
$\frac{7}{8}$	(22.2)	0.045	(1.14)

Table III

Maximum Tubing And Fitting Temperatures

Material	Maximum Allowable Temperature, °F (°C)	
Aluminum	700	(371)
Tinned Copper	350	(176.5)
Steel (AISI Type C1010)	800	(427)
AISI Type 410 Stainless Steel	1000	(538)
AISI Type 430 Stainless Steel	1240	(671)
AISI Type 446 Stainless Steel	1600	(871)

Table IV

**Minimum Corrosion Protection Of Ferrous Materials
Used In The Construction Of Outside Casings Of Heaters
For Outdoor Installation**

HEATER PART	METAL THICKNESS	COMPLIANCE WITH NOTE(S):
Outside Casings	Not less than 0.0508 inch (1.29 mm)*	1, 2 or 3
Outside Casings	Less than 0.0508 inch (1.29 mm)*	4, 5, 6, 7 or 8
Outside cabinet which is the sole enclosure of current carrying parts	Of any thickness	4, 5, 6, 7 or 8

NOTES APPLICABLE TO TABLE IV

- Hotdipped mill galvanized sheet steel conforming with the coating designation G60, A40 or A60 specified in Table I of the *Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot Dip Process, ASTM A653/A653 M*, with not less than 40 percent of the zinc on either side. The weight of zinc coating may be determined by any suitable method. However, in case of question, the weight of coating shall be established in accordance with *Standard Test Method for Weight (Mass) of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings, ASTM A90*. A hotdipped mill galvanized A40 or A60 (alloyed) coating or an annealed zinc coating which is bent or similarly formed after annealing shall be additionally painted in the bent or formed area if the bending or forming process damages the zinc coating, except on the inside surfaces of a cabinet or enclosure not exposed to water when tested in accordance with 2.23.1. (This shall also apply to annealed coatings complying with Notes 2 and 5);
- A zinc coating, provided by a method other than that specified in Note 1, uniformly applied to an average thickness of not less than 0.00041 in (0.0104 mm) on each surface with a minimum thickness of 0.00034 in (0.0086 mm). The thickness of the coating shall be established in accordance with *Method for Measurement of Metal and Oxide Coating Thicknesses of Microscopical Examination of a Cross Section, ASTM B487, Method for Measurement of Coating Thicknesses by the Magnetic Method: Nonmagnetic Coatings on Magnetic Basis Metals, ASTM B499 or Method for Measuring The Thickness of Metallic Coatings by the Coulometric Method, ASTM B504*; or
- Two coats of an organic finish of the epoxy or alkydresin type or other outdoor paint on both surfaces. The suitability of the paint may be determined by consideration of its composition or by corrosion tests if these are considered necessary;
- Hotdipped mill galvanized sheet steel conforming with the coating designation G90 specified in Table I of ASTM A653/A653 M, with not less than 40 percent of the zinc on either side. The weight of zinc coating may be determined by any suitable method. However, in case of question, the weight of coating shall be established in accordance with ASTM A90;
- A zinc coating, provided by a method other than that specified in Note 4, uniformly applied to an average thickness of not less than 0.00061 in (0.0155 mm) on each surface, with a minimum thickness of 0.00054 in (0.0137 mm). The thickness of the coating shall be established in accordance with ASTM B487, B499, or B504;
- A cadmium coating not less than 0.001 in (0.025 mm) thick on both surfaces. The thickness of coating shall be established in accordance with ASTM B487, B499, or B504;
- A zinc coating conforming with Note 1 or 2 with one coat of outdoor paint of the type specified in Note 3 applied to the outside surface; or
- A cadmium coating not less than 0.00075 in (0.0191 mm) thick on both surfaces with one coat of outdoor paint on both surfaces, or not less than 0.0005 in (0.0127 mm) thick on both surfaces with two coats of outdoor paint on both surfaces. The thickness of the cadmium coating shall be established in accordance with ASTM B487, B499, or B504, and the paint shall be as specified in Note 3.

* This corresponds to No. 16 U.S. Standard gage sheet steel with all applicable minus tolerances included.

Table V
Minimum Thickness Of Vent Pipes And Radiation Shields
Exposed To Combustion Products On Direct Vent Boilers

Metal	Minimum Thickness, Inch (mm)
Low Carbon Steel	0.0304 (0.772)
Gray Cast Iron	as cast
Chrome Alloy Cast Iron, 0.5 to 1.0% Cr, 0.2 to 0.5% Cu or Ni	as cast
Low Carbon Steel Coated with A-19 Enamel, Thickness of Base Metal	0.0254 (0.654)
Aluminum-Coated Steel in which the bond between the steel and the aluminum is an iron- aluminum alloy	0.0254 (0.654)
Chromium-Coated Low Carbon Steel in which the chromium is diffused into the surface of the steel to form an iron-chromium alloy	0.0254 (0.654)
AISI Type 409	0.0254 (0.654)
AISI Type 410	0.0225 (0.572)
AISI Type 430	0.0225 (0.572)
AISI Type 321	0.0195 (0.495)
AISI Type 309C	0.0195 (0.495)
AISI Type 347	0.0195 (0.495)
Galvanized Steel Thickness of Base Metal	0.0195 (0.495)

Table VI

AWG	Conductor, (mm ²)	Free Space Per Conductor,	
		in ³	(cm ³)
18, 16	(0.82, 1.3)	1.5	(24.6)
14	(2.1)	2.0	(32.8)
12	(3.3)	2.25	(36.9)
10	(5.3)	2.5	(41.0)
8	(8.4)	3.0	(49.2)

Table VII

**Minimum Average Thickness Of
Sheet-Metal Junction Boxes***

MAXIMUM DIMENSIONS OF ENCLOSURE		STEEL				COPPER, BRASS, OR ALUMINUM	
		Without Supporting Frame		With Supporting Frame or Equivalent Reinforcing		Without Supporting Frame	With Supporting Frame or Equivalent Reinforcing
Length or Width	Area	Zinc Coated	Uncoated	Zinc Coated	Uncoated		
Inches (mm)	Sq. In. (cm ²)	Inch (mm)	Inch (mm)	Inch (mm)	Inch (mm)	Inch (mm)	Inch (mm)
3 (76.2)	6† (39)	.023 (0.58) (24)‡	.020 (0.51) (24)‡	.023 (0.58) (24)‡	.020 (0.51) (24)‡	.023 (0.58) (22)§	.023 (0.58) (22)§
8 (203)	36 (232)	.029 (0.74) (22)‡	.026 (0.66) (22)‡	.023 (0.58) (24)‡	.020 (0.51) (24)‡	.036 (0.91) (18)	.029 (0.74) (20)
12 (305)	90 (581)	.034 (0.86) (20)	.032 (0.81) (20)	.023 (0.58) (24)‡	.020 (0.51) (24)‡	.045 (1.14) (16)	.029 (0.74) (20)
18 (457)	135 (871)	.045 (1.14) (18)	.042 (1.07) (18)	.034 (0.86) (20)	.032 (0.81) (20)	.058 (1.47) (14)	.045 (1.14) (16)
24 (610)	360 (2323)	.056 (1.42) (16)	.053 (1.35) (16)	.045 (1.14) (18)	.042 (1.07) (18)	.075 (1.91) (12)	.058 (1.47) (14)
48 (1219)	1200 (7742)	.070 (1.78) (14)	.067 (1.70) (14)	.056 (1.42) (16)	.053 (1.35) (16)	.095 (2.41) (10)	.075 (1.91) (12)
60 (1524)	1500 (9677)	.097 (2.46) (12)	.093 (2.36) (12)	.056 (1.42) (16)	.053 (1.35) (16)	.122 (3.10) (8)	.075 (1.91) (12)
more than 60 (1524)	more than 1500 (9677)	.126 (3.20) (10)	.123 (3.12) (10)	.056 (1.42) (16)	.053 (1.35) (16)	.153 (3.89) (6)	.075 (1.91) (12)

* The figures in parentheses below the minimum average thicknesses are the Galvanized Sheet Gage numbers (for zinc-coated steel), the manufacturers' Standard Gage numbers (for uncoated steel) and the American Wire Gage (B&S) numbers (for copper, brass, or aluminum) which provide the specified minimum average thickness of metal.

† Volume of enclosure not more than 12 in³ (197 cm³).

‡ Sheet steel for an enclosure intended for outdoor use (raintight) shall not be less than 0.034 in (0.86 mm) in thickness if zinc coated and not less than 0.032 in (0.81 mm) in thickness if uncoated (No. 20 gage).

§ Sheet copper, brass, or aluminum for an enclosure intended for outdoor use (raintight) shall not be less than 0.029 in (0.74 mm) in thickness (No. 20 gage).

Table VIII**Insulation Thickness Of Factory Wiring
Exposed In Burner Or Fan Compartment**

Group*	Type of Wire, Cord, Cable or Appliance Wiring Material
A	RF2, FF2, FFH2, TF, TFF, TFN, TFFN, SF2, SFF2, RH, RHH, RHW, RUH, RUW, THW, XHHW, MTW, THWMTW, THWN, TW, or thermoplastic appliance wiring material with insulation thickness of: $\frac{2}{64}$ in (0.8 mm) for No. 10 AWG (5.3 mm ²) and smaller $\frac{3}{64}$ in (1.2 mm) for No. 8 AWG (8.4 mm ²) $\frac{4}{64}$ in (1.6 mm) for No. 6, 4, 3 or 2 AWG (13.3, 21.2, 26.7 or 33.6 mm ²) $\frac{5}{64}$ in (2.0 mm) for No. 1, 1/0, 2/0, 3/0 or 4/0 AWG (42.4, 53.5, 67.4, 85.0 or 107.2 mm ²)
B	SO, ST, SJO, SJT, or thermoplastic or neoprene appliance wiring material with insulation thickness of: $\frac{4}{64}$ in (1.6 mm) for No. 18 or 16 AWG (0.82 or 1.3 mm ²) $\frac{5}{64}$ in (2.0 mm) for No. 14, 12 or 10 AWG (2.1, 3.3 or 5.3 mm ²) $\frac{6}{64}$ in (2.4 mm) for No. 8 AWG (8.4 mm ²) $\frac{8}{64}$ in (3.2 mm) for No. 6 AWG (13.3 mm ²)

* Thermoplastic wiring materials, as referenced in Group A, with insulation thickness of $\frac{2}{64}$ in (0.8 mm) for No. 18 or 16 AWG (0.82 or 1.3 mm²) and $\frac{3}{64}$ in (1.2 mm) for No. 14, 12, 10 or 8 AWG (2.1, 3.3, 5.3 or 8.4 mm²), are considered equivalent to the wiring material referenced in Group B, when the wiring materials are covered with $\frac{1}{32}$ in (0.8 mm) wall thickness thermoplastic insulating tubing of a type recognized as suitable for the purpose from the standpoint of dielectric properties, heat resistance, moisture resistance, flammability, etc.

Table IX**Minimum Spacings In Inches (mm)**

	General			Maximum Rating Volt-Amperes *a			
				2000 VA	100 VA *b		
	0-150 volts	151-300 volts	301-600 volts	0-300 volts	0-30 volts	31-600 volts	601-1000 volts
Between uninsulated live part and:							
(1) uninsulated part of opposite polarity; or							
(2) uninsulated grounded metal part other than enclosure							
through air	$\frac{1}{8}$ (3.2)*c	$\frac{1}{4}$ (6.4)	$\frac{3}{8}$ (9.5)	$\frac{1}{8}$ (3.2)*c	$\frac{1}{32}$ (0.8)*c	$\frac{1}{16}$ (1.6)*c	$\frac{3}{16}$ (4.8)*c
oversurface;	$\frac{1}{4}$ (6.4)*d	$\frac{3}{8}$ (9.5)*d	$\frac{1}{2}$ (12.7)	$\frac{1}{4}$ (6.4)*d	$\frac{1}{32}$ (0.8)*c	$\frac{1}{16}$ (1.6)*c	$\frac{3}{16}$ (4.8)*c
(3) exposed metal part which is isolated,							
through air	$\frac{1}{8}$ (3.2)*c	$\frac{1}{4}$ (6.4)	$\frac{3}{8}$ (9.5)	$\frac{1}{8}$ (3.2)*c	$\frac{1}{32}$ (0.8)*c	$\frac{1}{8}$ (3.2)*c	$\frac{1}{4}$ (6.4)
over surface;	$\frac{1}{4}$ (6.4) *d	$\frac{3}{8}$ (9.5) *d	$\frac{1}{2}$ (12.7)	$\frac{1}{4}$ (6.4)*d	$\frac{1}{32}$ (0.8)*c	$\frac{1}{4}$ (6.4)	$\frac{3}{8}$ (9.5)
(4) walls of enclosure, including fittings for conduit or cable, *e							
shortest distance.	$\frac{1}{2}$ (12.7)	$\frac{1}{2}$ (12.7)	$\frac{1}{2}$ (12.7)	$\frac{1}{4}$ (6.4)	$\frac{1}{8}$ (3.2)*c	$\frac{1}{4}$ (6.4)	$\frac{1}{2}$ (12.7)

*a The through-air and over-surface spacings at an individual component part are to be judged on the basis of the total volt-ampere consumption of the load or loads which the component controls. However, the spacing from the component to the enclosure shall be judged on the basis of the total load on all components in the enclosure.

*b. These spacing values apply to a safety circuit connected to an isolated secondary of a 100-volt-ampere or smaller transformer. Short-circuiting of the parts involved, regardless of polarity, shall not result in unsafe operation of the controlled equipment. These values apply only to spacings between components of the circuit under consideration, or between these components and dead metal, no reduction of spacings to other circuits of combination equipment is acceptable.

*c The spacing between wiring terminals of opposite polarity and the spacing between a wiring terminal and a grounded dead-metal part shall not be less than $\frac{1}{4}$ in (6.4 mm); except that if short-circuiting or grounding of such terminal will not result from projecting strands of wire, the spacing need not be greater than that indicated in the table.

In a safety control, the spacing between wiring terminals regardless of polarity and between a wiring terminal and a dead-metal part (including the enclosure) which may be grounded when the device is installed, shall not be less than $\frac{1}{4}$ in (6.4 mm) if a short circuit between such parts may result in unsafe operation of the appliance.

*d For circuits not exceeding 300 volts, the over-surface spacings for glass-insulated terminals of motors may be $\frac{1}{8}$ in (3.2 mm) where $\frac{1}{4}$ in (6.4 mm) is specified; and may be $\frac{1}{4}$ in (6.4 mm) where $\frac{3}{8}$ in (9.5 mm) is specified.

*e A metal piece attached to the enclosure is considered to be a part of the enclosure if deformation of the enclosure is liable to reduce spacings between the metal piece and insulated live-metal parts.

Table X

Maximum Allowable Rise Above Room Temperature For Various Component Parts

Part	Maximum Allowable Rise Above Room Temperature, F (°C) (*1)		NOTES APPLICABLE TO TABLE X
WIRE, CODE (*2)			(*1) - The values shown are applicable to all boilers and are the limits permitted during conduct of test specified in 2.23, Draft Hoods.
Types RF, FF, RW, RU	63	(35)	
Types RH, RFH, FFH	90	(50)	(*2) - Wires, other than those listed above, may be used providing the application and temperature limitation are in accordance with Article 310 of the <i>National Electrical Code, ANSI/NFPA 70</i> .
Types TF, TFF, TW	63	(35)	
Type TA	117	(65)	(*3) - This wire is satisfactory if temperatures are such as to require the use of this type of wire and other approved wire is not readily available.
Type CF	117	(65)	
Types AF (*3), SFF (*4)	225	(125)	(*4) - This wire may not meet the insulation thickness specifications.
Type SF (*4)	315	(175)	
Type GTF (CSA)	180	(100)	(*5) - Flexible cords, other than those listed above, may be used providing the application is in accordance with the <i>National Electrical Code, ANSI/NFPA 70</i> and the temperature limitation is in accordance with the <i>Safety Standard for Flexible Cord and Fixture Wire, ANSI/UL 62</i> .
APPLIANCE WIRING MATERIAL			
Thermoplastic 80 C Rating	99	(55)	(*6) - The classes of material used for electrical insulation referred to include materials as follows:
Thermoplastic 90 C Rating	117	(65)	
Thermoplastic 105 C Rating	144	(80)	Class A- A Class A insulation system is one which by experience or accepted test can be shown to have suitable thermal endurance when operating at the limiting Class A temperature specified in the temperature rise standard for the device under consideration. Typical materials used in Class A systems include cotton, paper, cellulose acetate films, enamel-coated wire and similar organic materials impregnated with suitable substances.
Power Limited Circuit Cable	108	(60)	
or Higher as Marked			Class B- A Class B insulation system is one which by experience or accepted test can be shown to have suitable thermal endurance when operating at the limiting Class B temperature specified in the temperature rise standard for the device under consideration. Typical materials used in a Class B system include mica, glass fiber, and other materials, not necessarily inorganic, with compatible bonding substances having suitable thermal stability.
FLEXIBLE CORD, LINE OR LOW VOLTAGE (*5)			
Types ST, SJT, SO, SJO, SPT-3	63	(35)	Class C- Inorganic materials such as pure mica, quartz, porcelain, etc.
Type SPT-3 with Thermoplastic Class 12	75	(41.5)	
FLEXIBLE CORD, LOW VOLTAGE			Class H- A Class H insulation system is one which by experience or accepted test can be shown to have suitable thermal endurance when operating at the limiting Class H temperature specified in the temperature rise standard for the device under consideration. Typical materials used in Class H systems include mica, glass fiber, silicone elastomer, and other materials, not necessarily inorganic, with compatible bonding substances, such as silicone resins, having suitable thermal stability.
Types SP-2, SPT-2	63	(35)	
Type HPN	117	(65)	(*7) - At a point on the surface of an insulated coil where the temperature is affected by an external source of heat, the temperature rise measured by means of a thermocouple may be 9°F (5°C) (for fractional-horsepower a.c. motors) and 27°F (15°C) (for d.c., Universal, and integral-horsepower a.c. motors) more than the indicated maximum, provided that the temperature rise of the coil, as measured by the resistance method, is not more than that specified in the table.
ELECTRICAL INSULATING MATERIAL (*6)			
Class A	144	(80)	(*8) - For a thermocouple-measured temperature on the coil of a fractional-horsepower a.c. motor (other than a Universal motor) the thermocouple is to be applied to the conducting material, or it is to be separated from that material by not more than the integrally applied insulation of the conductor itself. For a thermocouple-measured temperature of a coil of any other motor, the thermocouple is to be mounted as described above, or it may be separated from the conductor by not more than the integrally applied insulation of the conductor itself and the conventional coil wrap normally encountered. Ordinarily, temperatures are to be measured by means of thermocouples, except that motor-coil temperatures may be determined by the resistance method if the coil is inaccessible for mounting thermocouples.
Class B	180	(100)	
Class C Unspecified			(*9) - For an electrolytic capacitor which is physically integral with or attached to a motor, the temperature rise on insulating material integral with the capacitor enclosure may not be more than 117°F (65°C).
Class H As Determined by Test			
Fiber	117	(65)	(*10)- These limitations do not apply to capacitors which are recognized as being suitable for service at higher temperatures.
Phenolic Composition	225	(125)	
Windings of Relays, Solenoids, and Other Coils (*7) (*8)			
Class A Insulation			
Thermocouple Method	117	(65)	
Resistance Method	153	(85)	
Class B Insulation			
Thermocouple Method	153	(85)	
Resistance Method	171	(95)	
Coil Windings of d.c., Universal and Integral Horsepower a.c. Motors (*7) (*8)			
Thermocouple Method			
Class A Insulation			
open motors	117	(65)	
totally enclosed motors	126	(70)	
Class B Insulation			
open motors	153	(85)	
totally enclosed motors	162	(90)	
Resistance Method			
Class A Insulation			
open motors	135	(75)	
totally enclosed motors	144	(80)	
Class B Insulation			
open motors	171	(95)	
totally enclosed motors	180	(100)	
Coil Windings of Fractional Horsepower a.c. Motors (*7) (*8)			
Thermocouple or Resistance Method			
Class A Insulation			
open motors	135	(75)	
totally enclosed motors	144	(80)	
Class B Insulation			
open motors	171	(95)	
totally enclosed motors	180	(100)	
CLASS 2 TRANSFORMER ENCLOSURE	108	(60)	
POWER AND IGNITION TRANSFORMER ENCLOSURE	117	(65)	
CAPACITORS - Electrolytic Types (*9)	72	(40)	
CAPACITORS - Other Types (*10)	117	(65)	
SEALING COMPOUND	Maximum Temperature 27 (15) less than melting point		
DIAPHRAGMS/ FILTERS	73	(40.5)	
	90	(50)	

Table XI**Maximum Allowable Motor
Winding Temperatures, °F (°C)**

Motor Condition	Class A Insulation	Class B Insulation
1. Locked rotor, during first hour of operation.	392 (200)	437 (225)
2. Maximum Temperature, locked rotor, after first hour of operation.	347 (175)	392 (200)
3. Average temperature, locked rotor, after first hour of operation.	302 (150)	347 (175)
4. Motor operating at any load.	284 (140)	329 (165)

Table XII**Characteristics Of Test Gases**

	Heating Value		Sp Gr (Air = 1.0)
	(Btu/ft ³)	(MJ/m ³)	
Gas A (Natural)	1075	(40.1)	0.65
Gas B (Manufactured)	535	(19.9)	0.38
Gas C (Mixed)	800	(29.8)	0.50
Gas D (n-Butane)	3200	(119.2)	2.00
Gas E (Propane HD-5)	2500	(93.1)	1.55
Gas F (Propane-Air)	700	(26.1)	1.16
Gas G (Butane-Air)	1400	(52.2)	1.42
Gas H (Propane-Air)	1400	(52.2)	1.30

Table XIII**Inlet Test Pressures**

Test Pressure - Inches Water Column (kPa)			
Test Gas	Reduced	Normal	Increased
A	3.5 (0.87)	7.0 (1.74)	10.5 (2.61)
B	3.0 (0.75)	6.0 (1.49)	9.0 (2.24)
C	3.0 (0.75)	6.0 (1.49)	9.0 (2.24)
D	8.0 (1.99)	11.0 (2.74)	13.0 (3.23)
E	8.0 (1.99)	11.0 (2.74)	13.0 (3.23)
F	3.0 (0.75)	6.0 (1.49)	9.0 (2.24)
G	3.5 (0.87)	7.0 (1.74)	10.5 (2.61)
H	3.0 (0.75)	6.0 (1.49)	9.0 (2.24)

Table XIV**Determination Of Category**

	Vent Pressure	Vertical Location of Flue Gas Temperature Relative to Line on Figure 4
Category I	non-positive	on or above
Category II	non-positive	below
Category III	positive	on or above
Category IV	positive	below

Table XV
Maximum Flame Spreader
Temperatures*

Metal	Maximum Temperature Rise Above Room Temperature, °F (°C)
Gray Cast Iron	930 (516.5)
Chrome Alloy Cast Iron, 0.5 to 1.0% Cr, 0.2 to 0.5% Cu or Ni	1230 (683.5)
Ductile (Nodular) Cast Iron	1230 (683.5)
Chrome Alloy Steel, 5% Cr, 0.45 to 0.65% Mo, 1.0% Si	1280 (711.0)
AISI Type 430	1325 (736.0)
AISI Type 442	1550 (861.0)
AISI Type 446	1640 (911.0)
AISI Type 309C	1730 (961.0)

* The maximum usage temperature of steels not shown shall be 90 percent of scaling temperature for the material. (Temperatures shown have been determined on this basis. Temperatures of Chrome Alloy and Ductile Cast Iron are limited on the basis of excessive decarbonization above temperatures shown.)

Table XVI**Maximum Nonload-Bearing Flue Gas
Baffle Temperatures***

<u>Metal</u>	<u>Maximum Temperature Rise Above Room Temperature, °F (°C)</u>
Low Carbon Steel	930 (516.5)
Gray Cast Iron	930 (516.5)
Ceramic-Coated Steel (A-19 or equivalent	1030 (572)
Aluminum-Coated Steel in which the bond between the steel and the aluminum is an iron- aluminum alloy	1030 (572)
Chrome Alloy Cast Iron, 0.5 to 1.0% Cr, 0.2 to 0.5% Cu or Ni	1230 (683.5)
Ductile (Nodular) Cast Iron	1230 (683.5)
Chromium-Coated Low Carbon Steel in which the chromium is diffused into the surface of the steel to form an iron-chromium alloy	1280 (711)
Chrome Alloy Steel, 5% Cr, 0.45 to 0.65% Mo, 1.0% Si	1280 (711)
AISI Type 430	1325 (736)
AISI Type 309C	1730 (961)

* The maximum usage temperature of steels not shown shall be 90 percent of scaling temperature for the material. (Temperatures shown have been determined on this basis, temperatures of Chrome Alloy and Ductile Cast Iron are limited on the basis of excessive decarbonization above temperatures shown.)

Table XVII**Maximum Allowable Temperatures
of Typical Non-Metallic Vent Materials**

Material	HDT, °F (°C)		RTI, °F (°C)	Standard
PVC	158	(70)	-	ASTM F891 * ASTM D2665 ** ASTM D1785 ** ASTM D2241 **
CPVC	210	(100)	-	ASTM D2846/D2846M ** ASTM F441/F441M ** ASTM F442/F442M **
ABS	180	(82)	-	ASTM D2661 *** ASTM F628 ***

* Allowable temperatures based on Classifications covered in ASTM D4396 [Deflection Temperatures under Load (264 psi) (1819 KPa)].

** Allowable temperatures based on Classifications covered in ASTM D1784 [Deflection Temperatures under Load (264 psi) (1819 KPa)].

*** Allowable temperatures based on Classifications covered in ASTM D3965 [Deflection Temperatures under Load (264 psi) (1819 KPa)].

***Figures Referenced In
Parts I, II And Exhibits***

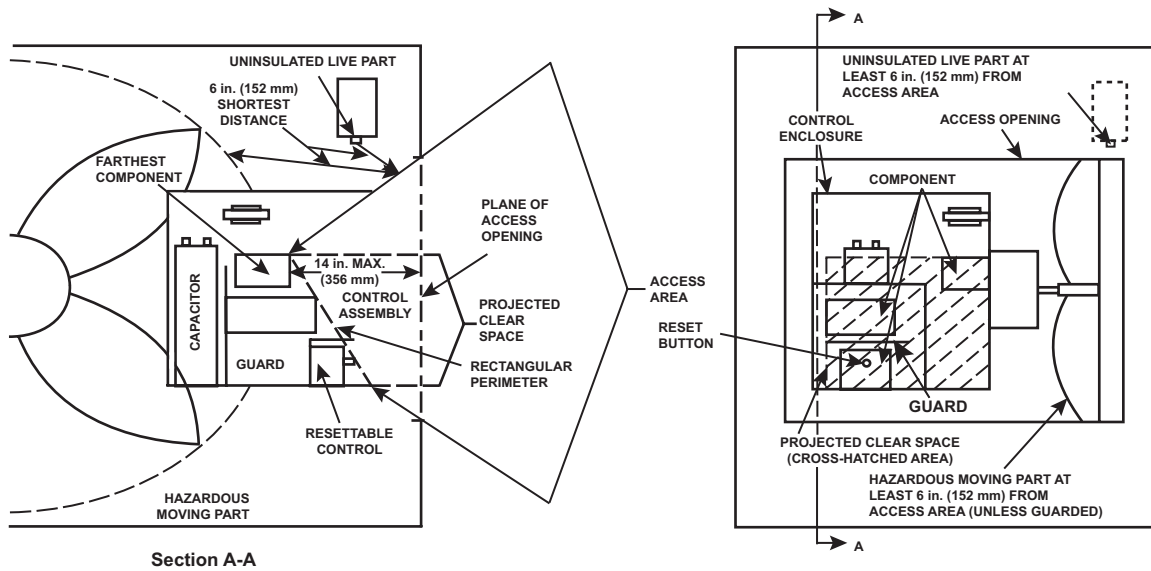
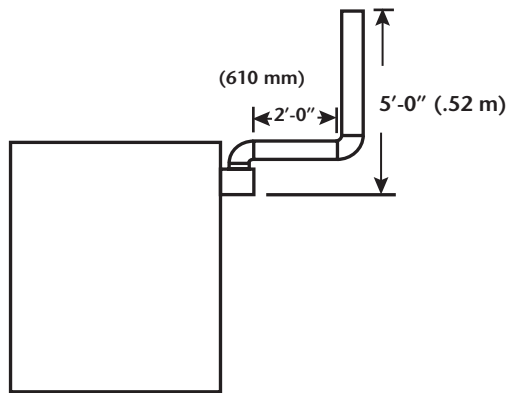
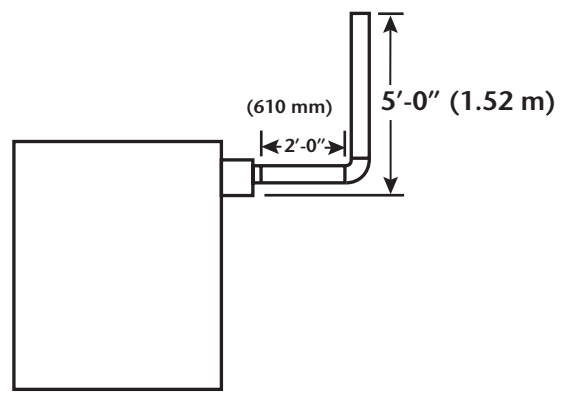


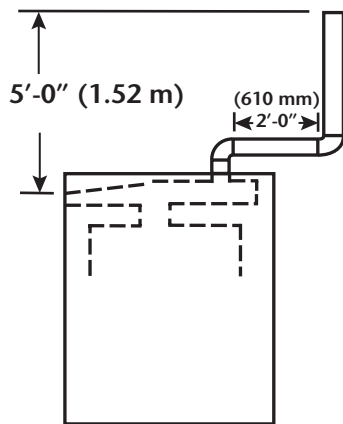
Figure 1. Accessibility and Protection



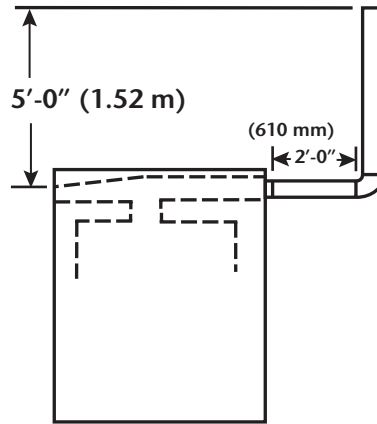
External Draft Hood With
Vertical Discharge



External Draft Hood With
Horizontal Discharge



Built-In Draft Hood With
Vertical Discharge



Built-In Draft Hood With
Horizontal Discharge

Figure 2. Arrangement of Vent Pipe for Testing Boilers Having Input Ratings of 400,000 Btu/hr (117 228 W) or Less. (See 2.1.5.)

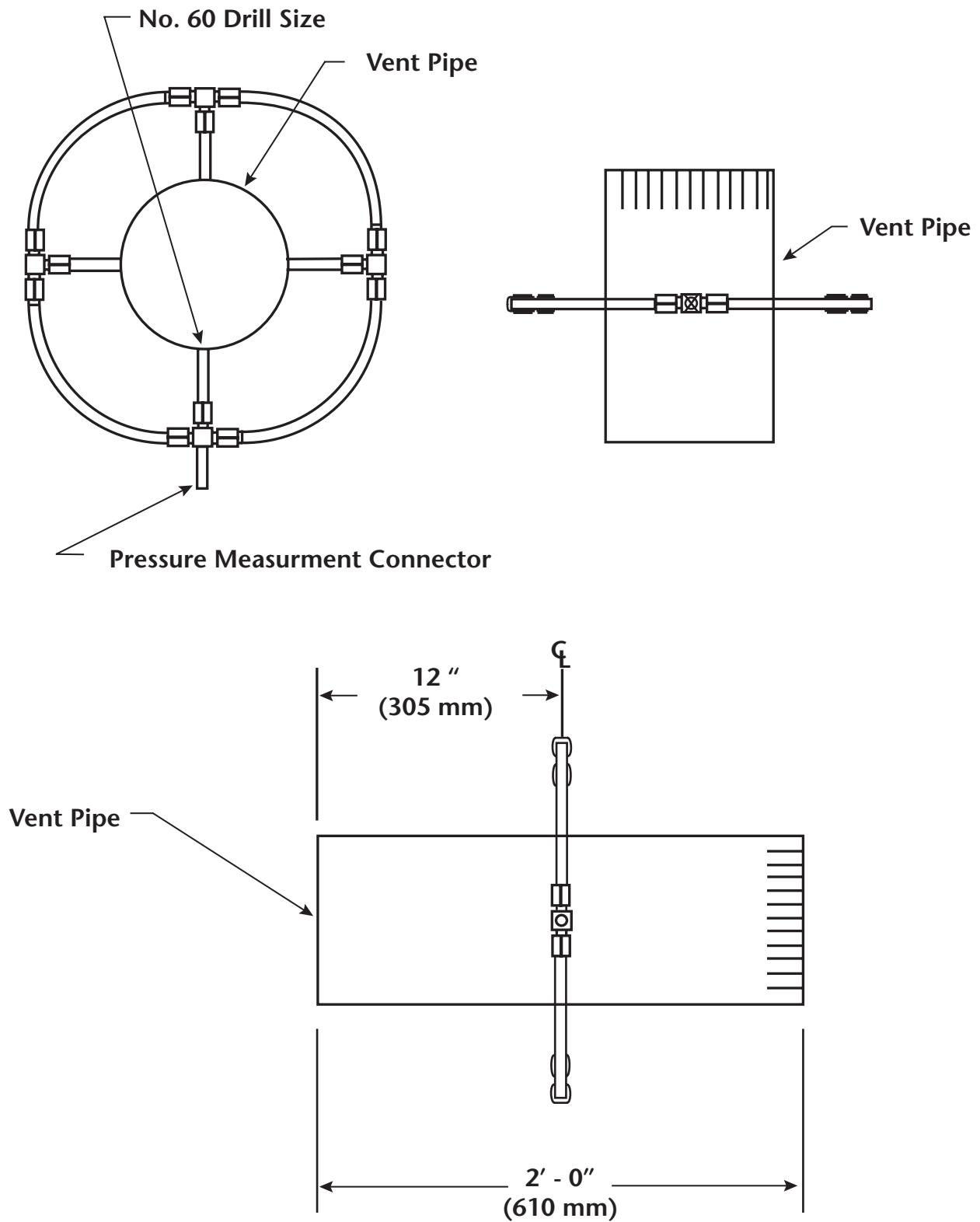


Figure 3. Piezo Ring and Details of Typical Construction

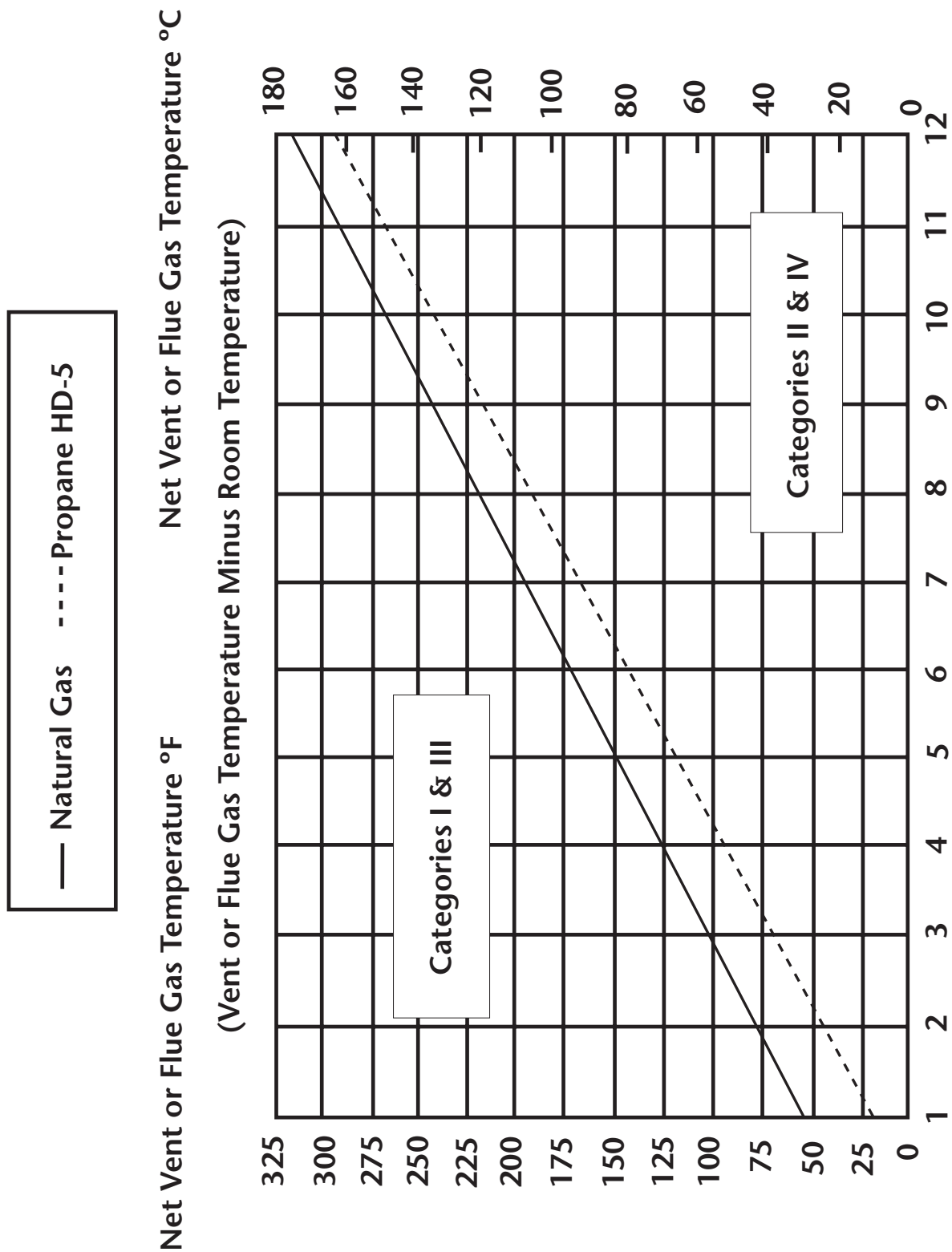
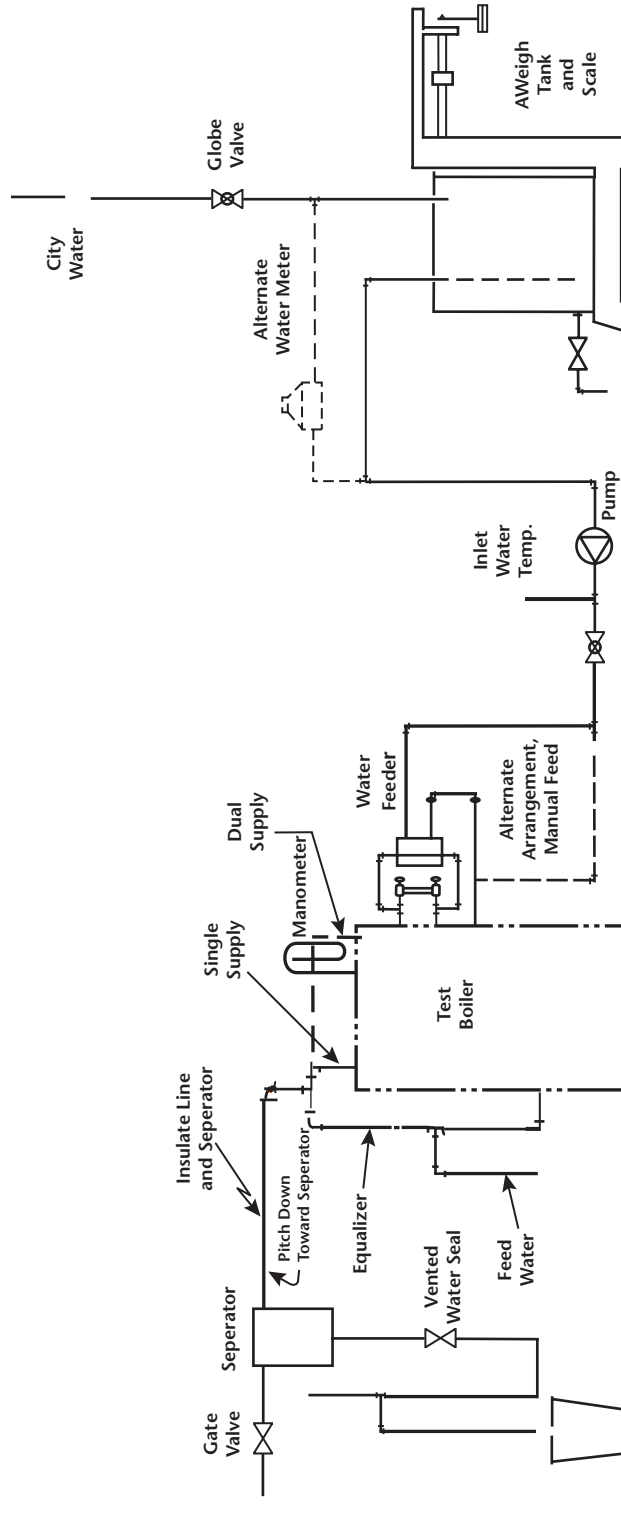
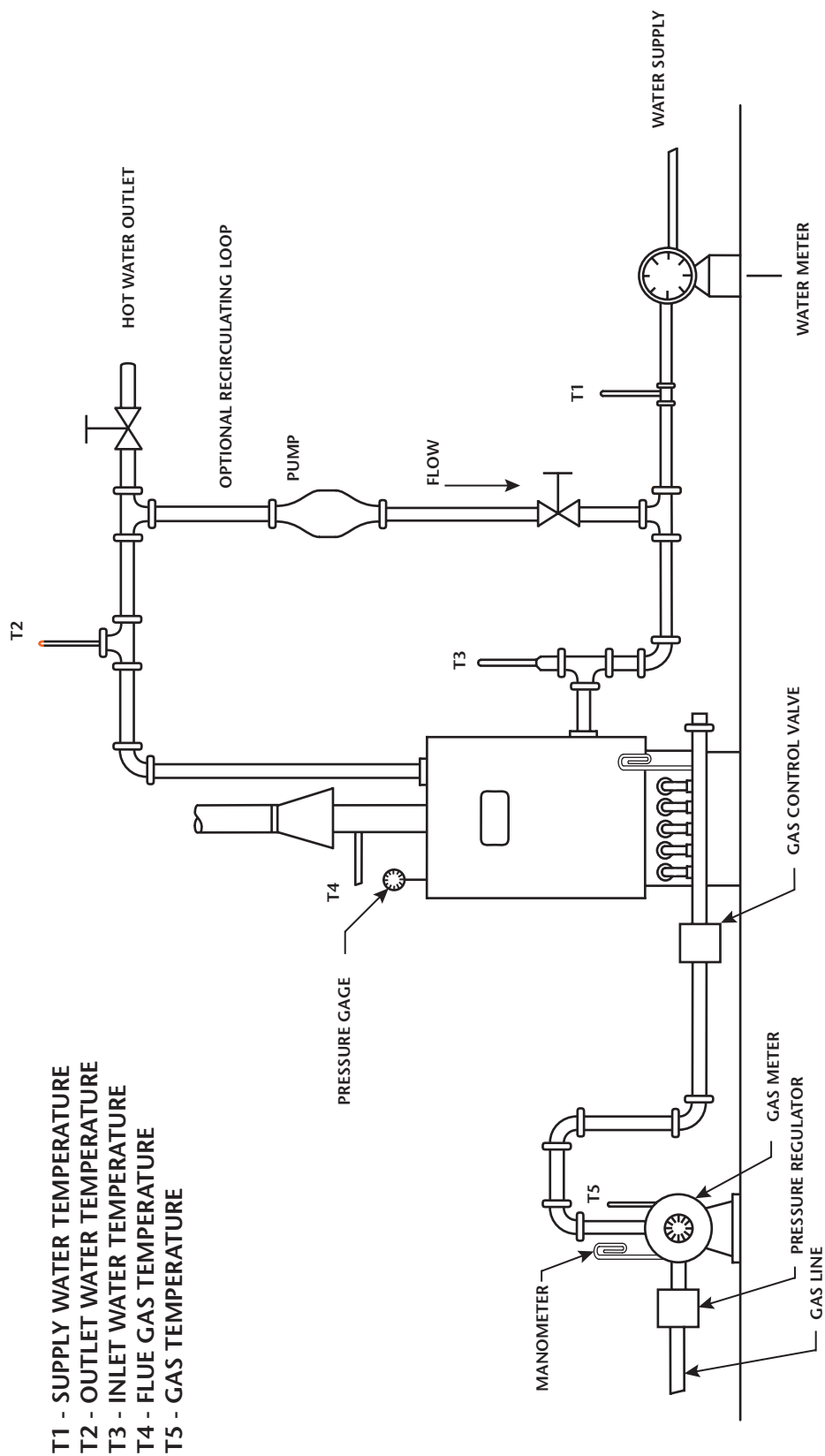


Figure 4. Chart for Determination of Boiler Category

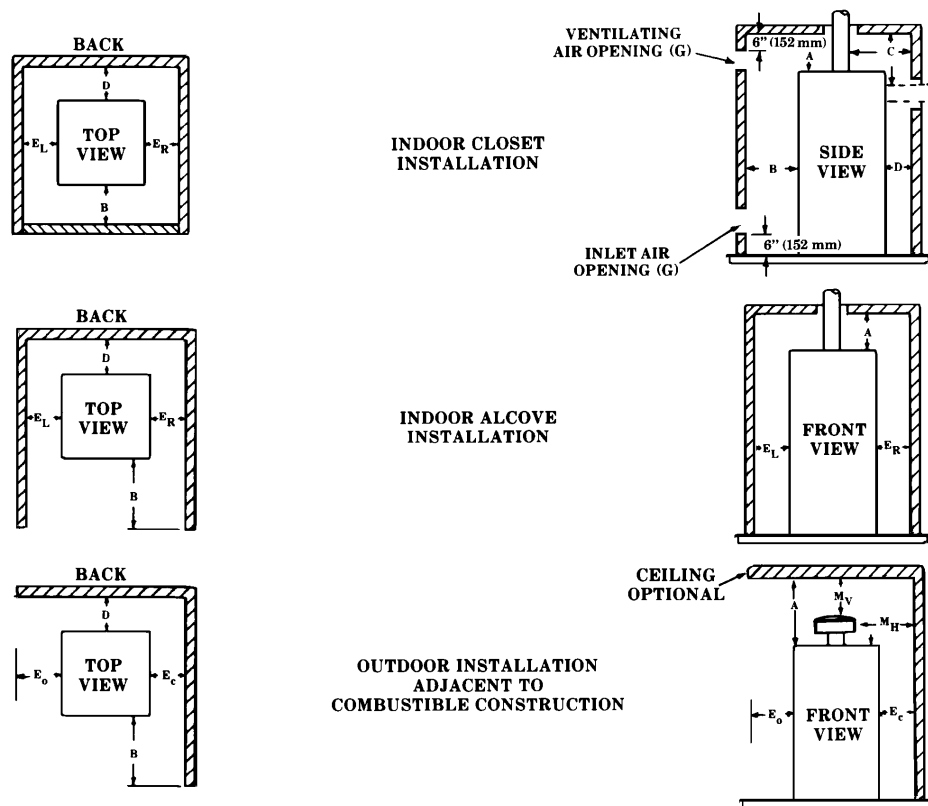


**Figure 5. Suggested Piping Arrangement for Steam Boilers
(Feed Water Measurement)**



NOTE - THE HOT WATER LINES ARE COVERED WITH INSULATION

Figure 6. Arrangement of Apparatus for Testing Hot Water Boilers



Symbol Designation

- A — From Top of Boiler
- B — From Front of Boiler—For alcove or outdoor installation tests, B shall be 18 in. (457 mm)
- C — From Flue or Vent Connector in any Direction
- D — From Back of Boiler
- E_c — From Side of Boiler
- E_L — From Left Side of Boiler
- E_R — From Right Side of Boiler
- E_o — Back Wall Projection From Open Side of Boiler
- F — Type of Floor: "NC" for Noncombustible—"C" for Combustible
- G — Area of Each Opening—1 in² per 1,000 Btu/hr (22 cm² per kW) input with a minimum of 100 in² (645 cm²)
- M_H — From Flue Outlet to Combustible Construction Horizontally
- M_v — From Flue Outlet to Combustible Construction Vertically

Figure 7. Enclosure Types and Clearance Nomenclature

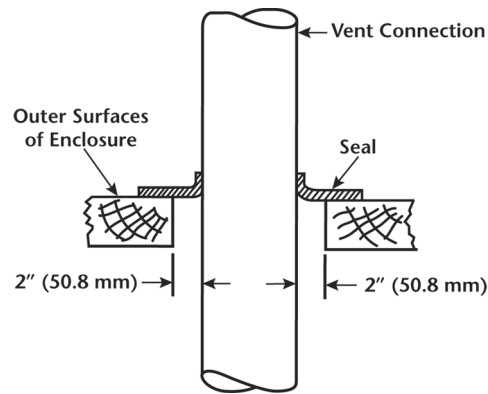


Figure 8. Method of Sealing Annulus Around Vent Connector During Alcove and Closet Installation Tests

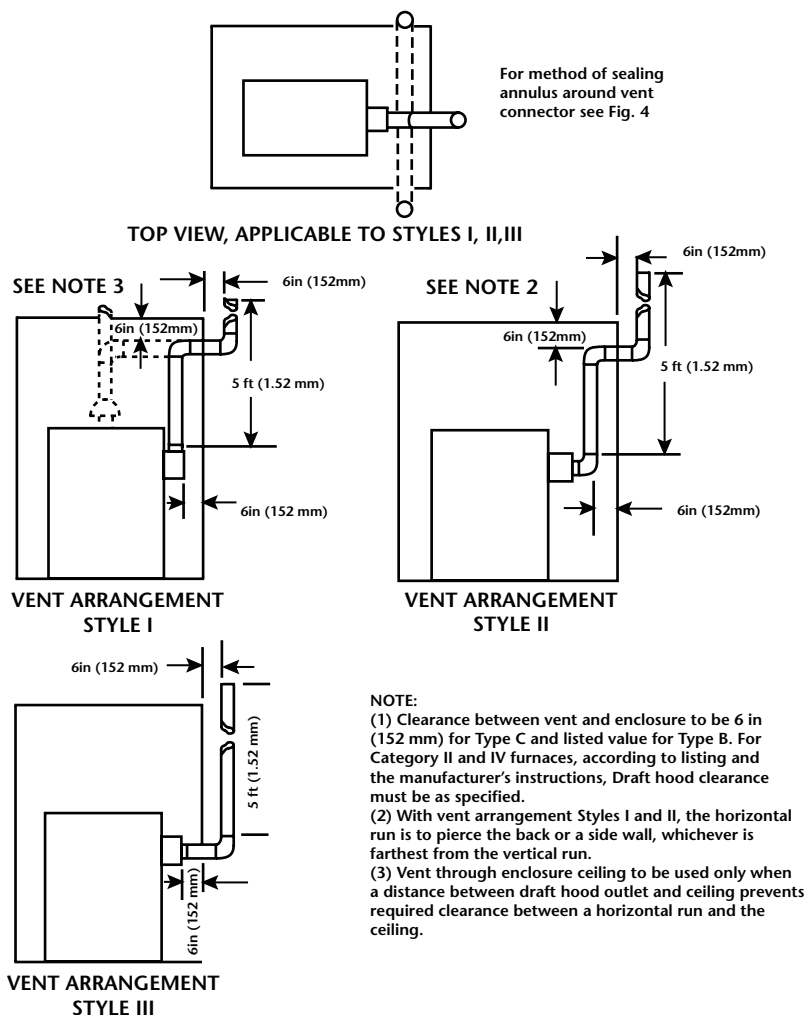


Figure 9. Venting Arrangements for Alcove and Closet Installation Tests

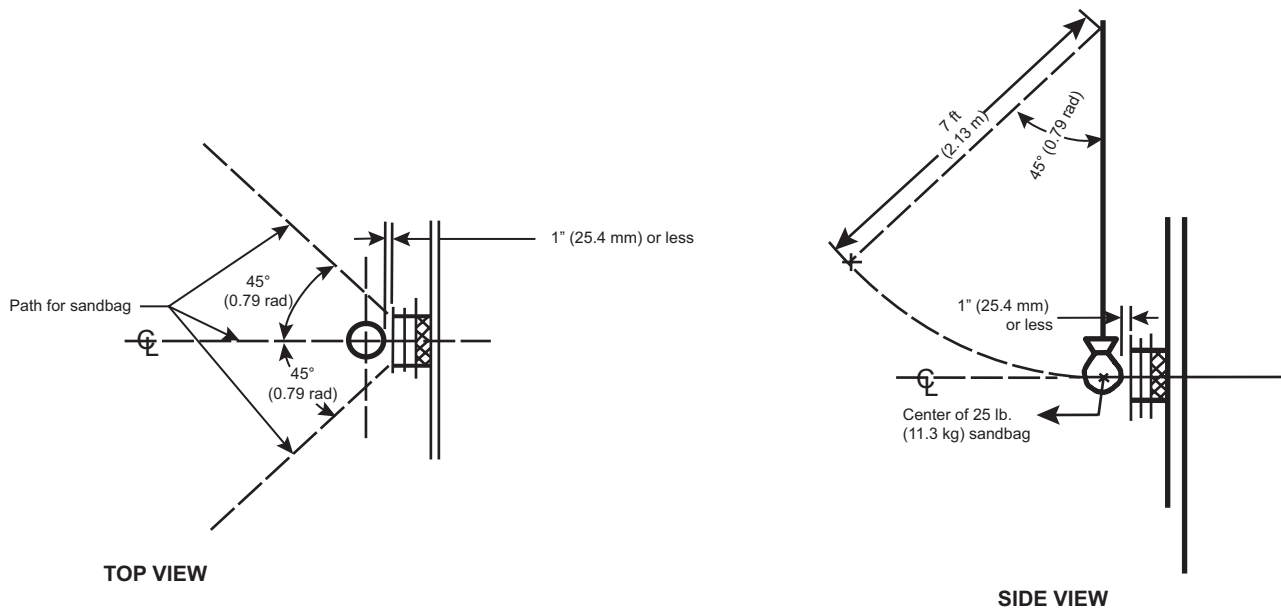


Figure 10. Arrangement of Sandbag and Vent-Air Intake Terminal for Impact Test

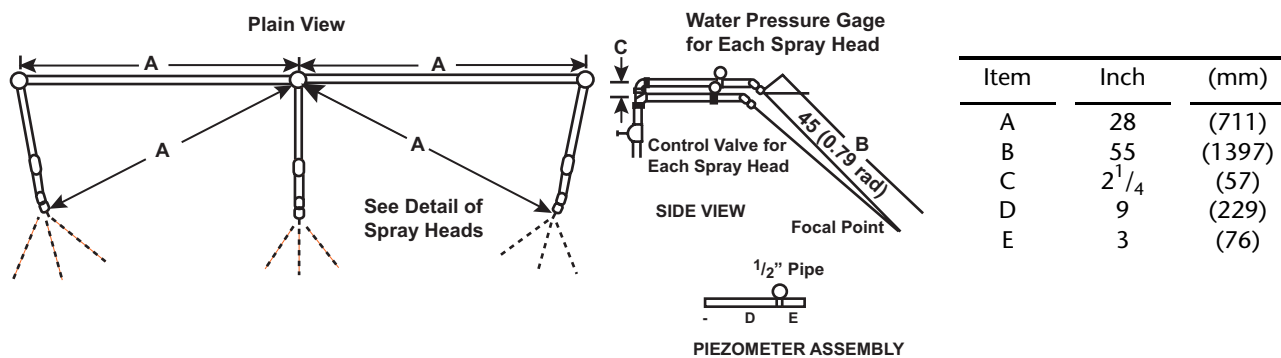
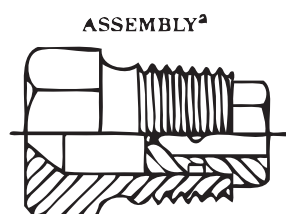


Figure 11. Arrangement of Spray Heads and Associated Piping for Simulated Rainstorm Test



Item	Inch	(mm)	Item	Inch	(mm)
A	1 1/32	(30.96)	N	1/32	(0.79)
B	7/16	(11.11)	P	0.575	(14.60)
C	9/16	(14.29)		0.576	(14.63)
D	0.578	(14.68)	Q	0.453	(11.51)
	0.580	(14.73)		0.454	(11.53)
E	1/64	(0.40)	R	1/4	(6.35)
F	c	c	S	1/32	(0.79)
G	0.06	(1.52)	T	(No. 35) ^b	(2.79)
H	(No. 9) ^b	(5.00)	U	(No. 40) ^b	(2.49)
J	23/32	(18.26)	V	5/8	(15.88)
K	5/32	(3.97)	W	0.06	(1.52)
L	1/4	(6.35)			
M	3/32	(2.38)			

^a - Molded nylon rain-test spray heads are available from Underwriters Laboratories Inc.

^b - ANSI/ASME B94.11M, Twist Drills drill size.

^c - Optional - To serve as wrench grip.

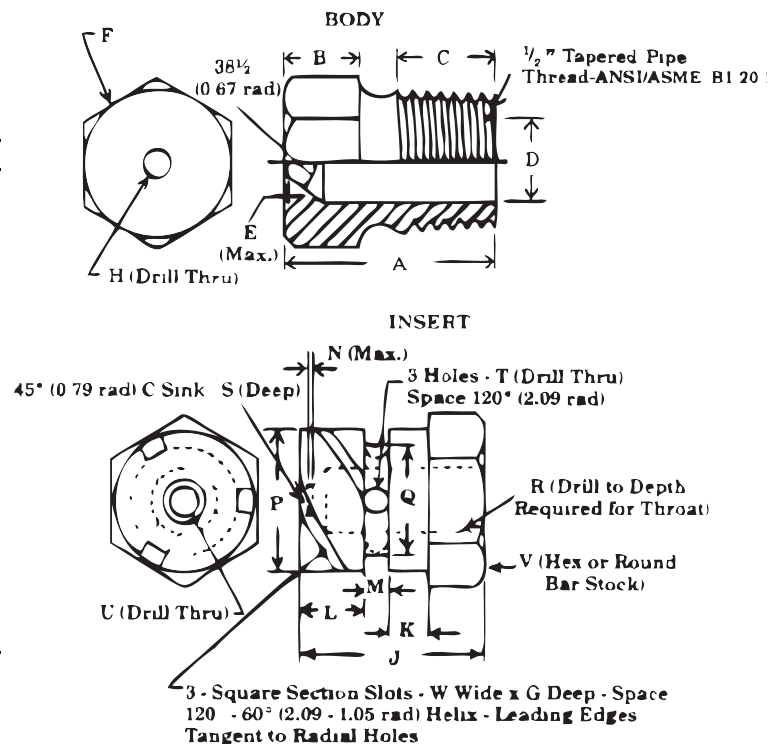


Figure 12. Spray Head Assembly and Details of Construction

Exhibit A

Outline Of Lighting Instructions For Appliances Equipped With Continuous Pilots

The following is a guide to aid in the writing of the lighting instructions label for an appliance equipped with a continuous pilot. The statements in quotes are to be worded as shown. For purposes of this Exhibit, the word "knob" is used. An actual label shall use the word knob, button, lever, switch, etc., as appropriate. If the action necessary to operate the control is other than stated below, modification of the sentence(s) is acceptable.

A sample of this label is shown in Figure A.

Section 1

"FOR YOUR SAFETY READ BEFORE LIGHTING"

The following warning shall be indented and boxed at the top of this section:

"WARNING: If you do not follow these instructions exactly, a fire or explosion may result causing property damage, personal injury or loss of life

"A. This appliance has a pilot which must be lighted by hand. When lighting the pilot, follow these instructions exactly."

"B. BEFORE LIGHTING smell all around the appliance area for gas. Be sure to smell next to the floor because some gas is heavier than air and will settle on the floor.

WHAT TO DO IF YOU SMELL GAS

- Do not try to light any appliance.
- Do not touch any electric switch; do not use any phone in your building.
- Immediately call your gas supplier from a neighbor's phone. Follow the gas supplier's instructions.
- If you cannot reach your gas supplier, call the fire department."

"C. Use only your hand to push in or turn the gas control knob. Never use tools. If the knob will not push in or turn by hand, don't try to repair it, call a qualified service technician. Force or attempted repair may result in a fire or explosion."

"D. Do not use this appliance if any part has been under water. Immediately call a qualified service technician to inspect the appliance and to replace any part of the control system and any gas control which has been under water."

Section 2

"LIGHTING INSTRUCTIONS"

1. "STOP! Read the safety information above (to the left) on this label."
2. For an appliance which utilizes an external electrical supply:
"Turn off all electric power to the appliance."
3. For an appliance equipped with or for use with an adjustable thermostat:
"Set the thermostat to lowest setting."
4. For an appliance which requires removal of a panel(s) or other part to gain access to the gas control, instructions for gaining access to the gas control.
5. Instructions, with an illustration, for turning the gas control manual valve to the full OFF position.*
6. "Wait five (5) minutes** to clear out any gas. Then smell for gas, including near the floor. If you smell gas, STOP! Follow "B" in the safety information above (to the left) on this label. If you don't smell gas, go to the next step."
7. For an appliance which requires removal of a part(s) to gain access to the pilot, instructions for gaining access to the pilot.
8. Instructions for locating the pilot. Illustration of the pilot is required.
9. Instructions for putting the gas control into the PILOT position.*
10. Step by step instructions for lighting the pilot.

An indented statement relative to maloperation of the control such as:

- If the knob does not pop up when released, stop and immediately call your service technician or gas supplier.
- "If the pilot will not stay lit after several tries, turn the gas control knob to "OFF" and call your service technician or gas supplier."*

* Wherever rotation is required, the following words and symbols shall be used to indicate direction:

clockwise  counterclockwise 

** The manufacturer may specify a longer time.

11. If applicable, instructions to replace the pilot access panel(s).
12. Instructions for turning the gas control manual valve to the ON position.*
13. If applicable, instructions to replace the gas control access panel(s) or other part(s).
14. If applicable:
"Set thermostat to desired setting."
15. If applicable:
"Turn on all electric power to the appliance."

* Wherever rotation is required, the following words and symbols shall be used to indicate direction:

clockwise  counterclockwise 

Section 3

"TO TURN OFF GAS TO APPLIANCE"

1. If applicable:
"Turn off all electric power to the appliance if service is to be performed."
2. If applicable:
"Set the thermostat to lowest setting."
3. If applicable, instructions for gaining access to the gas control.
4. Instructions for turning the gas control manual valve to the full OFF position.*
5. If applicable, instructions to replace the gas control access panel(s).

FOR YOUR SAFETY READ BEFORE LIGHTING

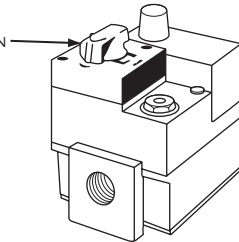
WARNING: If you do not follow these instructions exactly, a fire or explosion may result causing property damage, personal injury or loss of life.

- A. This appliance has a pilot which must be lighted by hand. When lighting the pilot, follow these instructions exactly.
- B. **BEFORE LIGHTING** smell all around the appliance area for gas. Be sure to smell next to the floor because some gas is heavier than air and will settle on the floor.
WHAT TO DO IF YOU SMELL GAS
 - Do not try to light any appliance.
 - Do not touch any electric switch; do not use any phone in your building.
 - Immediately call your gas supplier from a neighbor's phone. Follow the gas supplier's instructions.
- C. If you cannot reach your gas supplier, call the fire department.
- D. Use only your hand to push in or turn the gas control knob. Never use tools. If the knob will not push in or turn by hand, don't try to repair it, call a qualified service technician. Force or attempted repair may result in a fire or explosion.
- E. Do not use this appliance if any part has been under water. Immediately call a qualified service technician to inspect the appliance and to replace any part of the control system and any gas control which has been under water.

LIGHTING INSTRUCTIONS

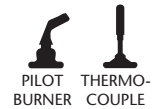
1. **STOP!** Read the safety information above on this label.
2. Set the thermostat to lowest setting.
3. Turn off all electric power to the appliance.
4. Remove control access panel.
5. Push in gas control knob slightly and turn clockwise ↻ to "OFF".

GAS CONTROL
KNOB SHOWN IN
"OFF" POSITION



NOTE: Knob cannot be turned from "PILOT" to "OFF" unless knob is pushed in slightly. Do not force.

6. Wait five (5) minutes to clear out any gas. Then smell for gas, including near the floor. If you smell gas, **STOP!** Follow "B" in the safety information above on this label. If you don't smell gas, go to the next step.
7. Remove the pilot access panel located below and behind the gas control unit.
8. Find pilot — follow metal tube from gas control. The pilot is between the two burner tubes behind the pilot access panel.
9. Turn knob on gas control counterclockwise ↻ to "PILOT".
10. Push in control knob all the way and hold in. Immediately light the pilot with a match. Continue to hold the control knob in for about one (1) minute after the pilot is lit. Release knob and it will pop back up. Pilot should remain lit. If it goes out, repeat steps 5 through 10.
 - If knob does not pop up when released, stop and immediately call your service technician or gas supplier.
 - If the pilot will not stay lit after several tries, turn the gas control knob to "OFF" and call your service technician or gas supplier.
11. Replace pilot access panel.
12. Turn gas control knob counterclockwise ↻ to "ON."
13. Replace control access panel.
14. Turn on all electric power to the appliance.
15. Set thermostat to desired setting.



TO TURN OFF GAS TO APPLIANCE

1. Set the thermostat to lowest setting.
2. Turn off all electric power to the appliance if service is to be performed.
3. Remove control access panel.
4. Push in gas control knob slightly and turn clockwise ↻ to "OFF." Do not force.
5. Replace control access panel.

Figure A. Sample Lighting Instructions Label for an Appliance Equipped with a Continuous Pilot

Exhibit B

Outline Of Operating Instructions For Appliances Equipped With Intermittent Pilot Or Interrupted Pilot Systems

The following is a guide to aid in the writing of the operating instructions label for an appliance equipped with an intermittent pilot or interrupted pilot system. The statements in quotes are to be worded as shown. For purposes of this Exhibit, the word "knob" is used. An actual label shall use the word knob, button, lever, switch, gas control (main valve or accessible switch), etc., as appropriate. If the action necessary to operate the control is other than stated below, modification of the sentence(s) is acceptable.

A sample of this label is shown in Figure B.

Section 1

"FOR YOUR SAFETY READ BEFORE OPERATING"

The following warning shall be indented and boxed at the top of this section:

WARNING: If you do not follow these instructions exactly, a fire or explosion may result causing property damage, personal injury or loss of life.

- "A. This appliance is equipped with an ignition device which automatically lights the pilot. Do not try to light the pilot by hand."
- "B. BEFORE OPERATING smell all around the appliance area for gas. Be sure to smell next to the floor because some gas is heavier than air and will settle on the floor."

WHAT TO DO IF YOU SMELL GAS

- Do not try to light any appliance.
- Do not touch any electric switch; do not use any phone in your building.
- Immediately call your gas supplier from a neighbor's phone. Follow the gas supplier's instructions.
- If you cannot reach your gas supplier, call the fire department."
- "C. Use only your hand to push in or turn the gas control knob. Never use tools. If the knob will not push in or turn by hand, don't try to repair it, call a qualified service technician. Force or attempted repair may result in a fire or explosion."
- "D. Do not use this appliance if any part has been under water. Immediately call a qualified service technician to inspect the appliance and any part of the control system and any gas control which has been under water."

Section 2

"OPERATING INSTRUCTIONS"

1. "STOP! Read the safety information above (to the left) on this label."
2. For an appliance which utilizes an external electrical supply:
"Turn off all electric power to the appliance."
3. For an appliance equipped with or for use with an adjustable thermostat:
"Set the thermostat to the lowest setting."
4. Instructions not to attempt to light the pilot by hand.
5. For an appliance which requires removal of a panel(s) or other part to gain access to the gas control, instructions for gaining access to the gas control.
6. Instructions, with an illustration, for turning the gas control main valve or accessible switch to the full OFF position.* If a remote switch is provided the illustration shall show its location.
7. "Wait five (5) minutes** to clear out any gas. Then smell for gas, including near the floor. If you smell gas, STOP! Follow "B" in the safety information above (to the left) on this label. If you don't smell gas, go to the next step."
8. Instructions for turning the gas control manual valve to the ON position.*
9. If applicable, instructions to replace the gas control access panel(s) or other part(s).
10. If applicable:
"Set thermostat to desired setting."
11. If applicable:
"Turn on all electric power to the appliance."
12. Instructions as to what to do next if the appliance fails to operate after following the above steps, and the following:

* Wherever rotation is required, the following words and symbols shall be used to indicate direction:

clockwise  counterclockwise 

**The manufacturer may specify a longer time.

"If the appliance will not operate, follow the instructions "To Turn Off Gas To Appliance" and call your service technician or gas supplier."

Section 3

"TO TURN OFF GAS TO APPLIANCE"

1. If applicable:

"Turn off all electric power to the appliance if service is to be performed."

2. If applicable:

"Set the thermostat to lowest setting."

3. If applicable, instructions for gaining access to the gas control.
4. Instructions for turning the gas control main valve or accessible switch to the full OFF position.*
5. If applicable, instructions to replace the gas control access panel(s).

* Wherever rotation is required, the following words and symbols shall be used to indicate direction:

clockwise  counterclockwise 

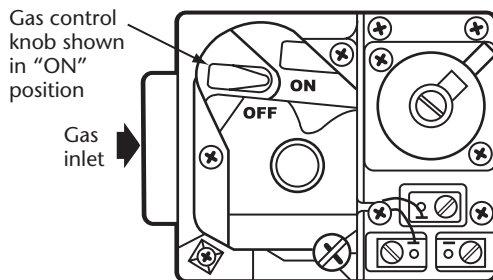
FOR YOUR SAFETY READ BEFORE OPERATING

WARNING: If you do not follow these instructions exactly, a fire or explosion may result causing property damage, personal injury or loss of life.

- | | |
|--|--|
| <p>A. This appliance is equipped with an ignition device which automatically lights the pilot. Do <u>not</u> try to light the pilot by hand.</p> <p>B. BEFORE OPERATING smell all around the appliance area for gas. Be sure to smell next to the floor because some gas is heavier than air and will settle on the floor.</p> <p>WHAT TO DO IF YOU SMELL GAS</p> <ul style="list-style-type: none"> • Do not try to light any appliance. • Do not touch any electric switch; do not use any phone in your building. • Immediately call your gas supplier from a neighbor's phone. Follow the gas supplier's instructions. | <ul style="list-style-type: none"> • If you cannot reach your gas supplier, call the fire department. <p>C. Use only your hand to push in or turn the gas control knob. Never use tools. If the knob will not push in or turn by hand, don't try to repair it, call a qualified service technician. Force or attempted repair may result in a fire or explosion.</p> <p>D. Do not use this appliance if any part has been under water. Immediately call a qualified service technician to inspect the appliance and to replace any part of the control system and any gas control which has been under water.</p> |
|--|--|

OPERATING INSTRUCTIONS

- | | |
|---|--|
| <ol style="list-style-type: none"> 1. STOP! Read the safety information above on this label. 2. Set the thermostat to lowest setting. 3. Turn off all electric power to the appliance. 4. This appliance is equipped with an ignition device which automatically lights the pilot. Do <u>not</u> try to light the pilot by hand. 5. Remove control access panel. | <ol style="list-style-type: none"> 6. Push in gas control knob slightly and turn clockwise ↻ to "OFF." <p>NOTE: Knob cannot be turned to "OFF" unless knob is pushed in slightly. Do not force.</p> <ol style="list-style-type: none"> 7. Wait five (5) minutes to clear out any gas. If you then smell gas, STOP! Follow "B" in the safety information above on this label. If you don't smell gas, go to next step. 8. Turn gas control knob counterclockwise ↺ to "ON." 9. Replace control access panel. 10. Turn on all electric power to the appliance. 11. Set thermostat to desired setting. 12. If the appliance will not operate, follow the instructions "To Turn Off Gas To Appliance" and call your service technician or gas supplier. |
|---|--|



TO TURN OFF GAS TO APPLIANCE

- | | |
|---|---|
| <ol style="list-style-type: none"> 1. Set the thermostat to lowest setting. 2. Turn off all electric power to the appliance if service is to be performed. 3. Remove control access panel. | <ol style="list-style-type: none"> 4. Push in gas control knob slightly and turn clockwise ↻ to "OFF." Do not force. 5. Replace control access panel. |
|---|---|

Figure B. Sample Operating Instructions Label for an Appliance Equipped with an Intermittent Pilot or Interrupted Pilot System.

Exhibit C

Outline Of Operating Instructions For Appliances Equipped With Direct Ignition Systems

The following is a guide to aid in the writing of the operating instructions label for an appliance equipped with a direct ignition system. The statements in quotes are to be worded as shown. For purposes of this Exhibit, the word "knob" is used. An actual label shall use the word knob, button, lever, switch, gas control (main valve or accessible switch), etc., as appropriate. If the action necessary to operate the control is other than stated below, modification of the sentence(s) is acceptable.

A sample of this label is shown in Figure C.

Section 1

"FOR YOUR SAFETY READ BEFORE OPERATING"

The following warning shall be indented and boxed at the top of this section:

"WARNING: If you do not follow these instructions exactly, a fire or explosion may result causing property damage, personal injury or loss of life."

- "A. This appliance does not have a pilot. It is equipped with an ignition device which automatically lights the burner. Do not try to light the burner by hand."
- "B. BEFORE OPERATING smell all around the appliance area for gas. Be sure to smell next to the floor because some gas is heavier than air and will settle on the floor."

WHAT TO DO IF YOU SMELL GAS

- Do not try to light any appliance.
 - Do not touch any electric switch; do not use any phone in your building.
 - Immediately call your gas supplier from a neighbor's phone. Follow the gas supplier's instructions.
 - If you cannot reach your gas supplier, call the fire department."
- "C. Use only your hand to push in or turn the gas control knob. Never use tools. If the knob will not push in or turn by hand, don't try to repair it, call a qualified service technician. Force or attempted repair may result in a fire or explosion."
- "D. Do not use this appliance if any part has been under water. Immediately call a qualified service technician to inspect the appliance and to replace any part of the control system and any gas control which has been under water."

Section 2

"OPERATING INSTRUCTIONS"

1. "STOP! Read the safety information above (to the left) on this label."
2. For an appliance which utilizes an external electrical supply:
"Turn off all electric power to the appliance."
3. For an appliance equipped with or for use with an adjustable thermostat:
"Set the thermostat to lowest setting."
4. Instructions not to attempt to light the burner by hand.
5. For an appliance which requires removal of a panel(s) or other part to gain access to the gas control, instructions for gaining access to the gas control.
6. Instructions, with an illustration, for turning the gas control main valve or accessible switch to the full OFF position.*
7. "Wait five (5) minutes** to clear out any gas. Then smell for gas including near the floor. If you smell gas, STOP! Follow "B" in the safety information above (to the left) on this label. If you don't smell gas, go to the next step."
8. Instructions for turning the gas control manual valve to the ON position.*
9. If applicable, instructions to replace the gas control access panel(s) or other part(s).
10. If applicable:
"Set thermostat to desired setting."
11. If applicable:
"Turn on all electric power to the appliance."
12. Instructions as to what to do next if the appliance fails to operate after following the above steps, and the following:
"If the appliance will not operate, follow the instructions "To Turn Off Gas To Appliance" and call your service technician or gas supplier."

* Wherever rotation is required, the following words and symbols shall be used to indicate direction:

clockwise  counterclockwise 

** The manufacturer may specify a longer time.

Section 3

“TO TURN OFF GAS TO APPLIANCE”

1. 1.If applicable:
“Turn off all electric power to the appliance if service is to be performed.”
2. 2.If applicable:
“Set the thermostat to lowest setting.”

3. 3.If applicable, instructions for gaining access to the gas control.
4. 4.Instructions for turning the gas control main valve or accessible switch to the full OFF position.*
5. 5.If applicable, instructions to replace the gas control access panel(s).

* Wherever rotation is required, the following words and symbols shall be used to indicate direction:

clockwise  counterclockwise 

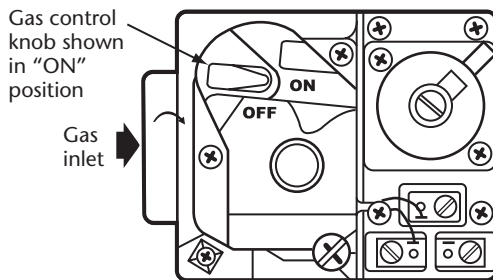
FOR YOUR SAFETY READ BEFORE OPERATING

WARNING: If you do not follow these instructions exactly, a fire or explosion may result causing property damage, personal injury or loss of life.

- A. This appliance does not have a pilot. It is equipped with an ignition device which automatically lights the burner. Do not try to light the burner by hand.
- B. **BEFORE OPERATING** smell all around the appliance area for gas. Be sure to smell next to the floor because some gas is heavier than air and will settle on the floor.
- WHAT TO DO IF YOU SMELL GAS**
- Do not try to light any appliance.
 - Do not touch any electric switch; do not use any phone in your building.
 - Immediately call your gas supplier from a neighbor's phone. Follow the gas supplier's instructions.
- If you cannot reach your gas supplier, call the fire department.
- C. Use only your hand to push in or turn the gas control knob. Never use tools. If the knob will not push in or turn by hand, don't try to repair it, call a qualified service technician. Force or attempted repair may result in a fire or explosion.
- D. Do not use this appliance if any part has been under water. Immediately call a qualified service technician to inspect the appliance and to replace any part of the control system and any gas control which has been under water.

OPERATING INSTRUCTIONS

1. **STOP!** Read the safety information above on this label.
 2. Set the thermostat to lowest setting.
 3. Turn off all electric power to the appliance.
 4. This appliance is equipped with an ignition device which automatically lights the burner. Do not try to light the burner by hand.
 5. Remove control access panel.
 6. Push in gas control knob slightly and turn clockwise  to "OFF."
- NOTE: Knob cannot be turned to "OFF" unless knob is pushed in slightly. Do not force.
7. Wait five (5) minutes to clear out any gas. Then smell for gas, including near the floor. If you smell gas, STOP! Follow "B" in the safety information above on this label. If you don't smell gas, go to the next step.
 8. Turn gas control knob counterclockwise  to "ON."
 9. Replace control access panel.
 10. Turn on all electric power to the appliance.
 11. Set thermostat to desired setting.
 12. If the appliance will not operate, follow the instructions "To Turn Off Gas To Appliance" and call your service technician or gas supplier.



TO TURN OFF GAS TO APPLIANCE

1. Set the thermostat to lowest setting.
2. Turn off all electric power to the appliance if service is to be performed.
3. Remove control access panel.
4. Push in gas control knob slightly and turn clockwise  to "OFF." Do not force.
5. Replace control access panel.

Figure C. Sample Operating Instructions Label for an Appliance Equipped with a Direct Ignition System

Exhibit D

Flue Loss Calculations

Figures D1, Nomograph for Determining Flue Loss with Natural Gas, and D2, Nomograph for Determining Flue Loss with Propane HD-5, are nomographs for use in calculating the flue loss (percent) of a heater operating on normally distributed gases whose characteristics fall within the following ranges:

	<u>Natural Gas</u>	<u>Propane HD-5</u>
Heating value (gross), Btu per cu. ft.	970-1100	2466-2542
Specific gravity	0.57-0.70	1.522-1.574
Ultimate carbon dioxide (CO ₂), %	11.7-12.2	13.73-13.82

In lieu of these nomographs or for a heater operating on normally distributed gases any of whose characteristics falls outside of the ranges specified above, the flue loss (percent) may be calculated from the following formula:

$$\begin{aligned}
 L_f = & \frac{1}{379} \left\{ \left(\frac{PU}{1000} \right) \left[16.2(T_f - T_r) + 6.53 \times 10^3 \ln \frac{T_r}{T_f} + 1.41 \times 10^6 (T_{r-1} - T_{f-1}) \right] \right. \\
 & + \left(\frac{P}{10} \right) \left(1 - \frac{U}{100} \right) \left[9.47(T_f - T_r) + 3.47 \times 10^3 \ln \frac{T_r}{T_f} + 1.16 \times 10^6 + (T_{r-1} - T_{f-1}) \right] \\
 & + \left(\frac{P}{10} \right) \left(\frac{U-C}{C} \right) \left[9.46(T_f - T_r) + 3.29 \times 10^3 \ln \frac{T_r}{T_f} + 1.07 \times 10^6 + (T_{r-1} - T_{f-1}) \right] \\
 & + \left\{ \left(\frac{T-P}{10} \right) = 0.00174hA \left[1 - \frac{p}{A} \left(\frac{U-C}{C} \right) \right] \right\} \left[19.86(T_f - T_r) + 1194(\sqrt{T_r} - \sqrt{T_f}) + 7.50 \times 10^3 \ln \frac{T_r}{T_f} \right] \\
 & + 5.04(T - P)
 \end{aligned}$$

where

- A = air required for complete combustion, SCF per 1000 Btu of gas burned;
- C = carbon dioxide (CO₂) in flue gases, percent of total dry constituents in the flue gases;
- h = relative humidity of air supplied for combustion, percent/100;
- L_f = flue loss, percent of heat input rate;
- P = dry constituents in flue gases from stoichiometric combustion, SCF per 1000 Btu of gas burned;
- T = total constituents in flue gases from stoichiometric combustion, SCF per 1000 Btu of gas burned;
- T_f = flue gas temperature, degree R;
- T_r = room temperature, degree R; and
- U = ultimate carbon dioxide (CO₂) of fuel gas, percent.

When using metric units, the appropriate nomograph (Figure I1 or I2) may be used when the specific gravity and ultimate carbon dioxide percentage for the gas are within the same ranges specified above and when the heating value (gross) is within the following range (15°C, 760 mm Hg, dry):

<u>Natural Gas</u>	<u>Propane HD-5</u>
36.76 - 41.69 MJ/m ³	93.46 - 96.34 MJ/m ³

In lieu of the nomographs or for a furnace operating on normally distributed gases any of whose characteristics falls outside the ranges specified above, the flue loss (percent) may be calculated from the following formula using metric units:

$$\begin{aligned}
 L_f = & 9.82 \times 10^{-2} \left\{ \left(\frac{PU}{1000} \right) \left[29.2(T_f - T_r) + 6.53 \times 10^3 \ln \frac{T_r}{T_f} + 7.83 \times 10^6 (T_{r-1} - T_{f-1}) \right] \right. \\
 & + \left(\frac{P}{10} \right) \left(1 - \frac{U}{100} \right) \left[17.05(T_f - T_r) + 3.47 \times 10^3 \ln \frac{T_r}{T_f} + 6.44 \times 10^6 + (T_{r-1} - T_{f-1}) \right] \\
 & + \left(\frac{P}{10} \right) \left(\frac{U-C}{C} \right) \left[17.03(T_f - T_r) + 3.29 \times 10^3 \ln \frac{T_r}{T_f} + 5.94 \times 10^6 + (T_{r-1} - T_{f-1}) \right] \\
 & + \left\{ \left(\frac{T-P}{10} \right) = 0.00174hA \left[1 - \frac{p}{A} \left(\frac{U-C}{C} \right) \right] \right\} \left[35.75(T_f - T_r) + 1.602 \times 10^3 (\sqrt{T_r} - \sqrt{T_f}) + 7.50 \times 10^3 \ln \frac{T_r}{T_f} \right] \\
 & + 187.7(T - P)
 \end{aligned}$$

where

A	=	air required for complete combustion, m ³ per MJ of gas burned under standard conditions;
C	=	carbon dioxide (CO ₂) in flue gases, percent of total dry constituents in the flue gases;
h	=	relative humidity of air supplied for combustion, percent/100;
L _f	=	flue loss, percent of heat input rate;
P	=	dry constituents in flue gases from stoichiometric combustion, m ³ per MJ of gas burned under standard conditions;
T	=	total constituents in flue gases from stoichiometric combustion, m ³ per MJ of gas burned under standard conditions;
T _f	=	Flue gas temperature, °K;
T _r	=	room temperature, °K; and
U	=	ultimate carbon dioxide (CO ₂) of fuel gas, percent.

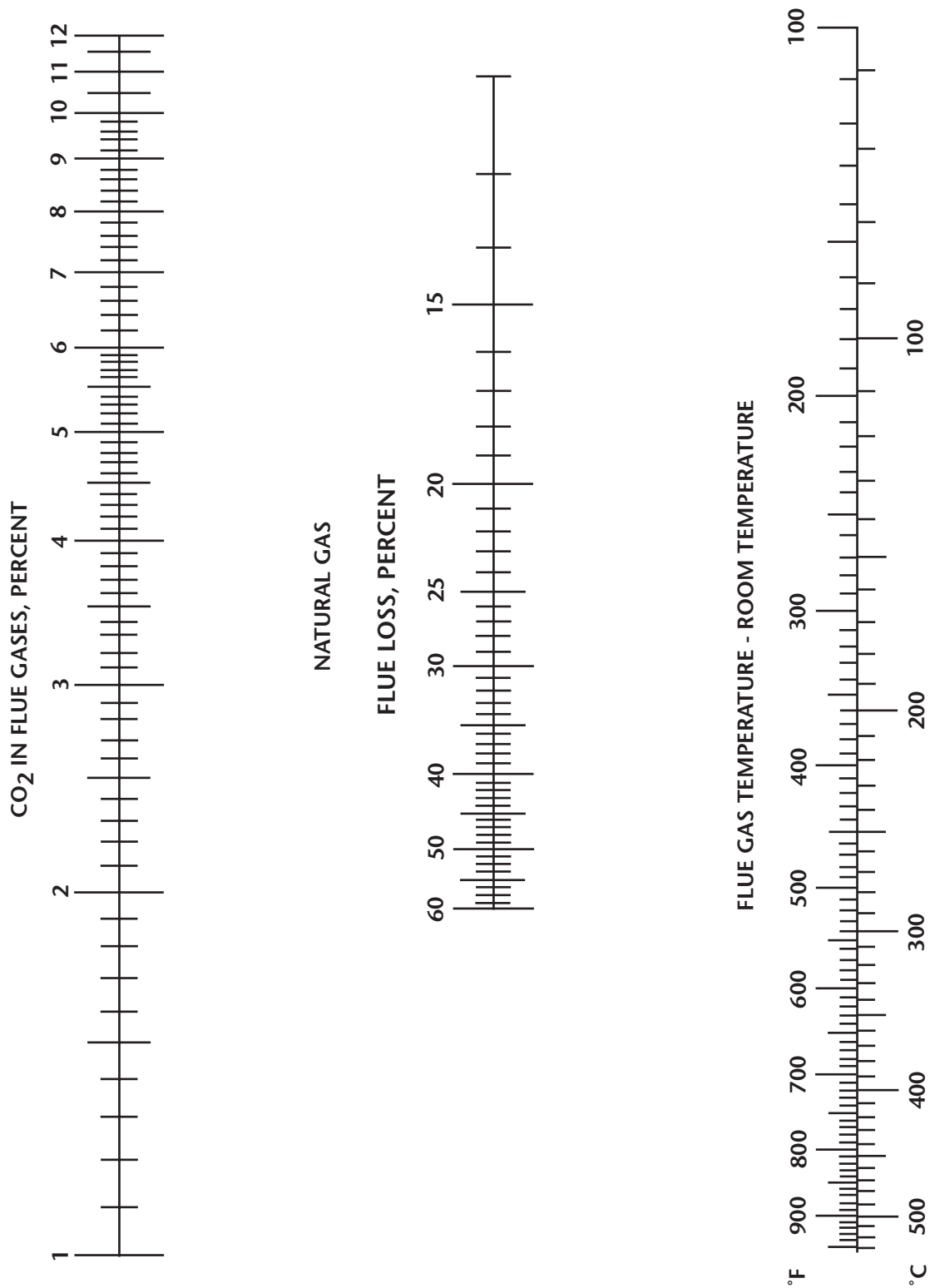


Figure D1.
Nomograph for Determining Flue Loss With Natural Gas
 (See Text of Exhibit D for Usage Limitations)

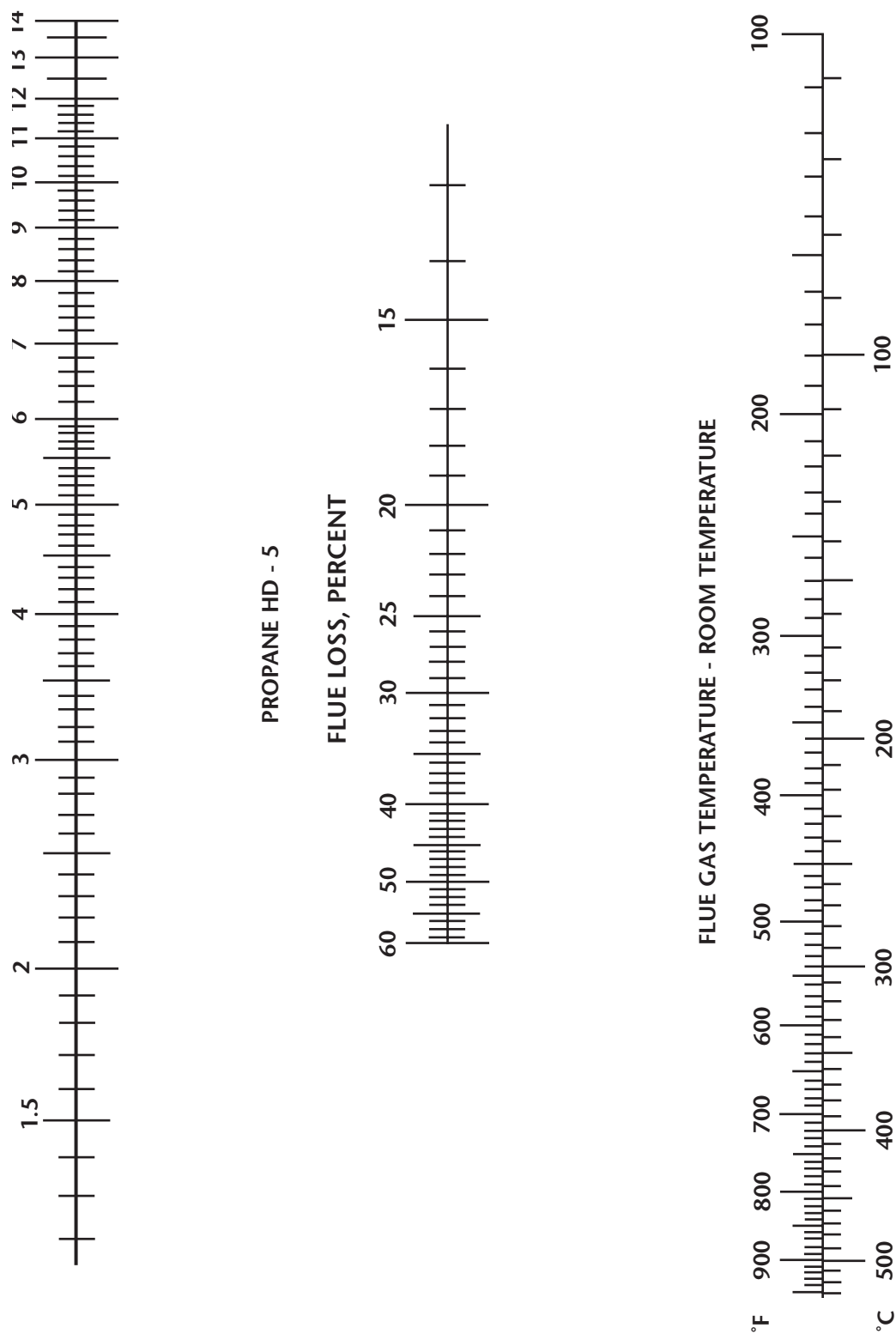


Figure D2.
Nomograph for Determining Flue Loss With Propane HD-5
 (See Text of Exhibit D for Usage Limitations)

Exhibit E

Items Unique To Canada

E.1. Annual Fuel Utilization Efficiency

E.1.1.

This section is unique to CSA 4.9 (In the U.S.A., boiler efficiency is regulated by Federal Energy Acts.) For boilers with input rates less than 300,000 Btu/hr (87 917 W).

Hot water and steam boilers shall have a minimum AFUE (Annual Fuel Utilization Efficiency) of 80 percent and 75 percent respectively. The minimum AFUE shall be based on the *Testing Method for Measuring Annual Fuel Utilization Efficiencies of Residential Gas-Fired Furnaces and Boilers, CSA-P.2*.

E.2. Scope

E.2.1.

This section is unique to CAN1-3.1. A boiler having a gas inlet pressure exceeding $\frac{1}{2}$ psi or input ratings of 12,500,000 Btu/hr (3 663 389W) and above shall comply with *Industrial and Commercial Gas-Fired Package Boilers, CAN1-3.1*.

E.3. Automatic Vent Damper Devices

E.3.1.

The damper shall not assume its fully-closed position in less than 14 seconds from the time the main gas valve closes.

E.3.2.

Energization of an intermittent or interrupted ignition source shall neither occur in less than 4.5 seconds from the time the damper device is called upon to open from the closed position, nor before the damper has reached its fully-open position.

E.4. Instructions

E.4.1.

The *Canadian Natural Gas and Propane Installation Code, B149.1*, specifies a 6 ft (1.83 m) horizontal vent terminal clearance to gas and electric meters and relief devices (this clearance is specified as 4 ft (1.22 m) in the U.S. under the *National Fuel Gas Code, ANSI Z223.1/NFPA 54*). Therefore, instruction provision 1.34.1-b19(d), which specifies compliance with the 4 ft (1.22 m) clearance, applies in the U.S. only, and the B149.1 installation code applies in Canada.

E.5. Electrical Requirements

Electrical equipment and wiring supplied on a boiler shall comply with the applicable provisions of the *Canadian Electrical Code Part I, CSA C22.1 and Part II CSA C22.2* and shall be investigated specifically for compliance with the applicable sections of *Electrical Features of Fuel Burning Equipment, CSA C22.2 No. 3*.

Voltage of a circuit means the greatest root-mean-square (effective) voltage between any two conductors of the circuit concerned.

Extra-low voltage means any voltage up to and including 30 V.

Low voltage means any voltage from 31 to 750 V inclusive.

High voltage means any voltage above 750 V.

E.6. French Translations For Quoted Instructions And Markings

E.6.1.

Information required under instructions and marking provisions specified in this standard are required to be in a form easily understood in both English and French.

The following are French translations for only the quoted text required under the Instruction and Marking provisions.

1.34 Instructions

	English	French
1.34.1-b-17	The instructions shall include the test procedure set forth below: At the time of removal of an existing boiler, the following steps shall be followed with each appliance remaining connected to the common venting system placed in operation, while the other appliances remaining connected to the common venting system are not in operation.	«Les instructions doivent comprendre le mode opératoire d’essai indiqué ci-dessous: » «Au moment du retrait d’une chaudière existante, les mesures suivantes doivent être prises pour chaque appareil toujours raccordé au système d’évacuation commun et qui fonctionne alors que d’autres appareils toujours raccordés au système d’évacuation ne fonctionnent pas: »
1.34.1-b-17(a)	Seal any unused openings in the common venting system.	«Sceller toutes les ouvertures non utilisées du système d’évacuation. »
1.34.1-b-17(b)	Visually inspect the venting system for proper size and horizontal pitch and determine there is non blockage or restriction, leakage, corrosion and other deficiencies which could cause an unsafe condition.	«Inspecter de façon visuelle le système d’évacuation pour déterminer la grosseur et l’inclinaison horizontale qui conviennent et s’assurer que le système est exempt d’obstruction, d’étranglement, de fuite, de corrosion et autres défaillances qui pourraient présenter des risques. »
1.34.1-b-17(c)	Insofar as is practical, close all building doors and windows and all doors between the space in which the appliances remaining connected to the common venting system are located and other spaces of the building. Turn on clothes dryers and any appliance not connected to the common venting system. Turn on any exhaust fans, such as range hoods and bathroom exhausts, so they will operate at maximum speed. Do not operate a summer exhaust fan. Close fireplace dampers.	«Dans la mesure du possible, fermer toutes les portes et les fenêtres du bâtiment et toutes les portes entre l’espace où les appareils toujours raccordés au système d’évacuation sont installés et les autres espaces du bâtiment. Mettre en marche les sècheuses, tous les appareils non raccordés au système d’évacuation commun et tous les ventilateurs d’extraction comme les hottes de cuisinière et les ventilateurs des salles de bain. S’assurer que ces ventilateurs fonctionnent à la vitesse maximale. Ne pas faire fonctionner les ventilateurs d’été. Fermer les registres des cheminées. »

1.34.1-b-17(d)	Place in operation the appliance being inspected. Follow the lighting instructions. Adjust thermostat so appliance will operate continuously.	«Mettre l'appareil inspecté en marche. Suivre les instructions d'allumage. Régler le thermostat de façon que l'appareil fonctionne de façon continue. »
1.34.1-b-17(e)	Test for spillage at the draft hood relief opening after 5 minutes of main burner operation. Use the flame of a match or candle, or smoke from a cigarette, cigar or pipe.	«Faire fonctionner le brûleur principal pendant 5 min ensuite, déterminer si le coupe-tirage déborde à l'ouverture de décharge. Utiliser la flamme d'une allumette ou d'une chandelle ou la fumée d'une cigarette, d'un cigare ou d'une pipe. »
1.34.1-b-17(f)	After it has been determined that each appliance remaining connected to the common venting system properly vents when tested as outlined above, return doors, windows, exhaust fans, fireplace dampers and any other gas-burning appliance to their previous condition of use.	«Une fois qu'il a été déterminé, selon la méthode indiquée ci-dessus, que chaque appareil raccordé au système d'évacuation est mis à l'air libre de façon adéquate. Remettre les portes et les fenêtres, les ventilateurs, les registres de cheminées et les appareils au gaz à leur position originale. »
1.34.1-b-17(g)	Any improper operation of the common venting system should be corrected so the installation conforms with the National Fuel Gas Code, ANSI Z223.1/NFPA 54 and/or CAN/CSA B149.1, Natural Gas and Propane Installation Code. When resizing any portion of the common venting system, the common venting system should be resized to approach the minimum size as determined using the appropriate tables in Appendix F in the National Fuel Gas Code, ANSI Z223.1/NFPA 54 and/or CAN/CSA B149.1, Natural Gas and Propane Installation Codes.	«Tout mauvais fonctionnement du système d'évacuation commun devrait être corrigé de façon que l'installation soit conforme au National Fuel Gas Code, ANSI Z223.1/NFPA 54 et (ou) aux codes d'installation CAN/CSA-B149.1. Si la grosseur d'une section du système d'évacuation doit être modifiée, le système devrait être modifié pour respecter les valeurs minimales des tableaux pertinents de l'appendice F du National Fuel Gas Code, ANSI Z223.1/NFPA 54 et (ou) les codes d'installation CAN/CSA-B149.1.»
1.34.1-b-18	The instructions for the installation of the venting system shall specify that the horizontal portions of the venting system shall be supported to prevent sagging; the methods of and intervals for support shall be specified. These instructions shall also specify that the venting system:	«Les instructions d'installation du système d'évacuation doivent préciser que les sections horizontales doivent être supportées pour prévenir le fléchissement. Les méthodes et les intervalles de support doivent être spécifiés. Les instructions doivent aussi indiquer les renseignements suivants: »
1.34.1-b-18(a)	For Category I, II and IV boilers, have horizontal runs sloping upwards not less than 1/4 inch per foot (21 mm/m) from the boiler to the vent terminal;	«les chaudières de catégories I, II et IV doivent présenter des tronçons horizontaux dont la pente montante est d'au moins 1/4 po par pied (21 mm/m) entre la chaudière et l'évent; »
1.34.1-b-18(b)	For Category III boilers, slope shall be as specified in the boiler manufacturer's instructions;	«dans le cas des chaudières de catégorie III, la pente doit respecter les instructions du fabricant de la chaudière en cause; »
1.34.1-b-18(c)	For Category II and IV boilers, be installed so as to prevent accumulation of condensate; and	«les chaudières de catégories II et IV doivent être installées de façon à empêcher l'accumulation de condensat; et»
1.34.1-b-18(d)	For Category II and IV boilers, where necessary, have means provided for drainage of condensate.	«si nécessaire, les chaudières de catégories II et IV doivent être pourvues de dispositifs d'évacuation du condensat. »

1.34.1-g

"Caution: Label all wires prior to disconnection when servicing controls. Wiring errors can cause improper and dangerous operation."

«ATTENTION. Au moment de l'entretien des commandes, étiquetez tous les fils avant de les débrancher. Les erreurs de câblage peuvent nuire au bon fonctionnement et être dangereuses.

"Verify proper operation after operation servicing."

«S'assurer que l'appareil fonctionne adéquatement une fois l'entretien terminé. »

1.34.2-h

"Damper must be in open position when appliance main burner(s) is operating."

«Le registre doit être ouvert lorsque le brûleur principal de l'appareil fonctionne. »

1.34.3-f

"Damper must be in open position when appliance main burner(s) is operating."

«Le registre doit être ouvert lorsque le brûleur principal de l'appareil fonctionne. »

1.34.5

"after service"

«apr(s l'entietien'»

1.35 User's Information Manual

"after service"

«apr(s l'entietien'»

WARNING: If the information in these instructions are not followed exactly, a fire or explosion may result causing property damage, personal injury or death.

— Do not store or use gasoline or other flammable vapors and liquids in the vicinity of this or any other appliance.

— WHAT TO DO IF YOU SMELL GAS

- Do not try to light any appliance.
- Do not touch any electrical switch; do not use any phone in your building.
- Immediately call your gas supplier from a neighbor's phone. Follow the gas supplier's instructions.
- If you cannot reach your gas supplier, call the fire department.

— Installation and service must be performed by a qualified installer, service agency or the gas supplier.

AVERTISSEMENT. Assurez-vous de bien suivre les instructions données dans cette notice pour réduire au minimum le risque d'incendie ou d'explosion ou pour éviter tout dommage matériel, toute blessure ou la mort.

— Ne pas entreposer ni utiliser d'essence ni d'autres vapeurs ou liquides inflammables dans le voisinage de cet appareil ou de tout autre appareil.

— QUE FAIRE SI VOUS SENTEZ UNE ODEUR DE GAZ:

- Ne pas tenter d'allumer d'appareils.
- Ne touchez à aucun interrupteur. Ne pas vous servir des téléphones dans le bâtiment où vous vous trouvez.
- Appelez immédiatement votre fournisseur de gaz depuis un voisin. Suivez les instructions du fournisseur.
- Si vous ne pouvez rejoindre le fournisseur de gaz, appelez le service des incendies.
-

— L'installation et l'entretien doivent être assurés par un installateur ou un service d'entretien qualifié ou par le fournisseur de gaz.

1.35-g

"Should overheating occur or the gas supply fail to shut off, do not turn off or disconnect the electrical supply to the pump. Instead, shut off the gas supply at a location external to the appliance."

En cas de surchauffe ou si l'admission de gaz ne peut être coupée, ne pas couper ni débrancher l'alimentation électrique de la pompe. Fermer plutôt le robinet d'admission de gaz à l'extérieur de l'appareil.

1.36 Marking

1.36.2-a-1	"Combination Boiler and Space Heater."	«Chaudière et radiateur combiné»
1.36.2-a-2	"Direct Vent Boiler." "FOR EITHER DIRECT VENT INSTALLATION OR FOR INSTALLATION USING INDOOR COMBUSTION AIR."	«Chaudière à évent direct» «POUR INSTALLATION AVEC ÉVACUATION DIRECTE OU AVEC AIR COMBURANT»
1.36.2-a-3	"For outdoor installation only."	«Installer à l'extérieur seulement»
1.36.2-a-4	"For either indoor or outdoor installation."	«Installer à l'intérieur ou à l'extérieur»
1.36.2-a-5	"For installation on combustible flooring."	«Installer seulement sur un plancher combustible»
1.36.2-a-6	"For installation on noncombustible floors only."	«Installer seulement sur un plancher non combustible»
1.36.2-a-7	"For installation on combustible flooring only when installed on special base Part No. ____."	«Installer sur un plancher combustible seulement si la base no ____ est utilisée. »
1.36.2-a-8	"For use only with automatic vent damper device Part No. _____. Follow installation instructions."	«Pour utilisation avec un registre de conduit d'évacuation automatique, no _____ seulement. Suivre les instructions d'installation. »
1.36.2-a-9	"May be used with automatic vent damper device Part No. _____. Follow installation instructions."	«Peut être utilisé avec un registre de conduit d'évacuation automatique, no _____. Suivre les instructions d'installation.
1.36.2-a-10	"For use only with automatic flue damper device Part No. _____. Follow installation instructions."	«Pour utilisation avec un registre de conduit d'évacuation automatique, no _____ seulement. Suivre les instructions d'installation. »
1.36.2-a-11(1)	"Category I"	«Catégorie I»
1.36.2-a-11(2)	"Category II"	«Catégorie II»
1.36.2-a-11(3)	"Category III"	«Catégorie III»
1.36.2-a-11(4)	"Category IV."	«Catégorie IV»
1.36.2-j	"Minimum relief valve capacity ____ lbs. per hour."	«Capacité minimale de la soupape de sécurité ____ lb/h. »
1.36.2-m	"less than ____ * amperes." * This amperage rating shall be equal to or greater than the total input in amperes.	«Moins de ____ * ampères. * «Cette valeur doit être égale ou supérieure à l'entrée totale en ampères. »
1.36.2-n	"ANSI Z21.13-(year) • CSA 4.9 Low-Press, Boiler, "ANSI Z21.13a-(year) • CSA 4.9 Low-Press, Boiler," or "ANSI Z21.13b-(year) • CSA 4.9 Low-Press, Boiler,"	«ANSI Z21.13-(année) • CSA 4.9, Low-Press. Boiler ; ANSI Z21.13a-(année) • CSA 4.9, Low-Press. Boiler ; ou ANSI Z21.13b-(année) • CSA 4.9, Low-Press. Boiler. »
1.36.5-c	"WARNING"	«AVERTISSEMENT»

1.36.9

WARNING: Improper installation, adjustment, alteration, service or maintenance can cause property damage, personal injury (exposure to hazardous materials)* or loss of life. Refer to the user's information manual provided with this boiler. Installation and service must be performed by a qualified installer, service agency or the gas supplier (who must read and follow the supplied instructions before installing, servicing, or removing this boiler. This boiler contains materials that have been identified as carcinogenic, or possibly carcinogenic, to humans).

«AVERTISSEMENT. Une installation, un réglage, une modification, une réparation ou un entretien non conforme aux normes peut entraîner des dommages matériels, des blessures (exposition à des matières dangereuses) ou la mort. Lisez attentivement le mode d'emploi fourni avec la chaudière. L'installation et l'entretien doivent être effectués par un installateur ou un service d'entretien qualifié ou le fournisseur de gaz (qui doivent avoir lu les instructions fournies avant de faire l'installation, l'entretien ou l'enlèvement de la chaudière et les respecter. Cette chaudière contient des matériaux qui ont été identifiés comme étant cancérogènes ou pouvant l'être). »

1.36.12-a

"This boiler must be installed in accordance with local codes if any; if not, follow ANSI Z223.1/NFPA 54 or CAN/CSA B149.1, Natural Gas and Propane Installation Code, as applicable."

«Cette chaudière doit être installée selon les règlements locaux ; en l'absence de tels règlements, se conformer aux codes d'installation ANSI Z223.1/NFPA 54, ou les Code d'installation CAN/CSA-B149.1, selon le cas.»

1.36.12-b

"This boiler needs fresh air for safe operation and must be installed so there are provisions for adequate combustion and ventilation air."

«Cette chaudière doit être alimentée en air frais pour fonctionner en toute sécurité et doit être installée de façon que la combustion et l'alimentation en air de ventilation soient adéquates. »

1.36.12-c

"This boiler must be properly vented."

«Cette chaudière doit être raccordée à un système d'évacuation adéquate.»

1.36.12-d

"This boiler must be installed with the vent-air intake system supplied as part of the boiler and in accordance with the manufacturer's installation instructions."

«Cette chaudière doit être équipée d'un système d'évacuation/d'admission d'air et être installée conformément aux instructions d'installation du fabricant. »

1.36.12-e

This appliance requires a special venting system. Refer to installation instructions No. for parts list and method of installation."

«Cet appareil doit être équipé d'un système d'évacuation particulier. Voir les instructions d'installation no ____ pour la liste des pièces et la méthode d'installation. »

1.36.13

"This draft hood must be installed without alteration."

«Ce coupe-tirage doit être installé sans modification. »

"See rating plate."

«Voir la plaque signalétique. »

1.36.17

"Base Part No. ____."

« Base no ____ . »

1.36.18

FOR YOUR SAFETY

Do not store or use gasoline or other flammable vapors and liquids in the vicinity of this or any other appliance.

POUR VOTRE SÉCURITÉ

Ne pas entreposer ni utiliser d'essence ni d'autres vapeurs ou liquides inflammables à proximité de cet appareil ou de tout autre appareil.

1.36.20

"WARNING - Follow instructions for proper installation."

«AVERTISSEMENT. Suivre les instructions d'installation. »

1.36.22-b

"If any of the original wire as supplied with the appliance must be replaced, it must be replaced with type _____ wire or its equivalent. "

"When connecting field wiring to the boiler, wiring material having a minimum size of _____ AWG and a temperature rating of at least _____ shall be used."

«Si un des conducteurs fourni avec l'appareil doit être remplacé, utiliser un conducteur de type _____, ou l'équivalent. »

«Utiliser des conducteurs de section égale ou supérieure à _____ AWG, convenant à au moins _____°C (_____°F) pour les raccordements à pied d'oeuvre à la chaudière. »

Exhibit E (Continued)

Exhibits -- Exhibit A, Outline of Lighting Instructions for Appliances Equipped with Continuous Pilots

The following is a guide to aid in the writing of the lighting instructions label for an appliance equipped with a continuous pilot. The statements in quotes are to be worded as shown. For purposes of this Exhibit, the word "knob" is used. An actual label shall use the word knob, button, lever, switch, etc., as appropriate. If the action necessary to operate the control is other than stated below, modification of the sentence(s) is acceptable.

A sample of this label is shown in Figure A.

Section 1

"FOR YOUR SAFETY READ BEFORE LIGHTING"

The following warning shall be indented and boxed at the top of this section:

"WARNING: If you do not follow these instructions exactly, a fire or explosion may result causing property damage, personal injury or loss of life."

"A. This appliance has a pilot which must be lighted by hand. When lighting the pilot, follow these instructions exactly."

"B. BEFORE LIGHTING smell all around the appliance area for gas. Be sure to smell next to the floor because some gas is heavier than air and will settle on the floor."

WHAT TO DO IF YOU SMELL GAS

- Do not try to light any appliance.
- Do not touch any electric switch; do not use any phone in your building.
- Immediately call your gas supplier from a neighbor's phone. Follow the gas supplier's instructions.
- If you cannot reach your gas supplier, call the fire department."

"C. Use only your hand to push in or turn the gas control knob. Never use tools. If the knob will not push in or turn by hand, don't try to repair it, call a qualified service technician. Force or attempted repair may result in a fire or explosion."

Cette annexe vise à aider à la rédaction des instructions d'allumage des appareils pourvus de veilleuses. Les énoncés entre guillemets doivent être repris tels quels. Dans les exemples donnés plus bas le terme « manette » est utilisé, mais les termes précis (bouton, levier, etc.) devraient être utilisés dans les mises en garde. Si l'utilisation des commandes est différente de celle donnée ci-dessous, les énoncés peuvent être modifiés.

Une étiquette type est montrée à la figure A.

Section 1

« POUR VOTRE SÉCURITÉ LISEZ AVANT D'ALLUMER. »

« AVERTISSEMENT. Quiconque ne respecte pas à la lettre les instructions dans la présente notice risque de déclencher un incendie ou une explosion entraînant des dommages, des blessures ou la mort. »

« A. Cet appareil est muni d'une veilleuse qui doit être allumée manuellement. Respectez les instructions ci-dessous à la lettre. »

« B. Avant d'allumer la veilleuse, reniflez tout autour de l'appareil pour déceler une odeur de gaz. Reniflez près du plancher, car certains gaz sont plus lourds que l'air et peuvent s'accumuler au niveau du sol. »

QUE FAIRE SI VOUS SENTEZ UNE ODEUR DE GAZ :

- Ne pas tenter d'allumer d'appareil.
- Ne touchez à aucun interrupteur ; ne pas vous servir des téléphones se trouvant dans le bâtiment.
- Appelez immédiatement votre fournisseur de gaz depuis un voisin. Suivez les instructions du fournisseur.
- Si vous ne pouvez rejoindre le fournisseur, appelez le service des incendies.

« C. Ne poussez ou tournez la manette d'admission du gaz qu'à la main ; ne jamais utiliser d'outil. Si la manette reste coincée, ne tentez pas de la réparer ; appelez un technicien qualifié. Le fait de forcer la manette ou de la réparer peut déclencher une explosion ou un incendie. »

"D. Do not use this appliance if any part has been under water. Immediately call a qualified service technician to inspect the appliance and to replace any part of the control system and any gas control which has been under water."

« D. N'utilisez pas cet appareil s'il a été plongé dans l'eau, même partiellement. Faites inspecter l'appareil par un technicien qualifié et remplacez toute partie du système de contrôle et toute commande qui ont été plongés dans l'eau. »

Section 2

"LIGHTING INSTRUCTIONS"

1. 1. "STOP! Read the safety information above (to the left) on this label."
2. 2. For an appliance equipped with or for use with an adjustable thermostat:
"Set the thermostat to lowest setting."
3. 3. For an appliance which utilizes an external electrical supply:
"Turn off all electric power to the appliance."
4. 4. For an appliance which requires removal of a panel(s) or other part to gain access to the gas control, instructions for gaining access to the gas control.
5. 5. Instructions, with an illustration, for turning the gas control manual valve to the full OFF position.*
6. 6. "Wait five (5) minutes** to clear out any gas. Then smell for gas, including near the floor. If you smell gas, STOP! Follow "B" in the safety information above (to the left) on this label. If you don't smell gas, go to the next step."
7. 7. For an appliance which requires removal of a part(s) to gain access to the pilot, instructions for gaining access to the pilot.
8. 8. Instructions for locating the pilot. Illustration of the pilot is required.
9. 9. Instructions for putting the gas control into the PILOT position.*

* Wherever rotation is required, the following words and symbols shall be used to indicate direction:

clockwise  counterclockwise 

** The manufacturer may specify a longer time.

Section 2

« Instructions d'allumage »

1. 1. «ARRÊTEZ ! Lisez les instructions de sécurité sur la portion supérieure (à gauche) de cette étiquette. »
2. 2. «Appareil pourvu d'un thermostat réglable ou destiné à être utilisé avec un tel dispositif: »
« Réglez le thermostat à la température la plus basse. »
3. 3. «Appareil à alimentation électrique externe:»
«Coupez l'alimentation électrique de l'appareil.»
4. 4. «Si des panneaux ou des pièces de l'appareil doivent être retirés pour atteindre la commande d'admission du gaz, des instructions doivent indiquer la marche à suivre.»
5. 5. «Des instructions, et une illustration, doivent être fournies pour la fermeture complète (position OFF) du robinet manuel de l'admission du gaz.»
6. 6. «Attendre cinq (5) minutes** pour laisser échapper tout le gaz. Reniflez tout autour de l'appareil, y compris près du plancher, pour déceler une odeur de gaz. Si vous sentez une odeur de gaz, ARRÊTEZ ! Passez à l'étape B des instructions de sécurité sur la portion supérieure (à gauche) de cette étiquette. S'il n'y a pas d'odeur de gaz, passez à l'étape suivante. »
7. 7. «Si des pièces doivent être retirées pour atteindre la veilleuse, des instructions doivent indiquer la marche à suivre.»
8. 8. «Fournir des instructions sur la façon de localiser la veilleuse. Fournir une illustration de la veilleuse.»
9. 9. «Fournir des instructions sur la façon de mettre la commande de gaz à la position veilleuse. *»

* Lorsqu'une rotation est requise, les mots et symboles suivants doivent être utilisés pour indiquer le sens de la rotation.

sens horaire  sens antihoraire 

** Le fabricant peut spécifier un intervalle plus long.

10. Step by step instructions for lighting the pilot.

An indented statement relative to maloperation of the control such as:

- "If the knob does not pop up when released, stop and immediately call your service technician or gas supplier."
- "If the pilot will not stay lit after several tries, turn the gas control knob to "OFF" and call your service technician or gas supplier."*

11. If applicable, instructions to replace the pilot access panel(s).

12. Instructions for turning the gas control manual valve to the ON position.*

13. If applicable, instructions to replace the gas control access panel(s) or other part(s).

14. If applicable:

"Turn on all electric power to the appliance."

15. If applicable:

"Set thermostat to desired setting."

Section 3

"TO TURN OFF GAS TO APPLIANCE"

1. If applicable:

"Set the thermostat to lowest setting."

2. If applicable:

"Turn off all electric power to the appliance if service is to be performed."

3. If applicable, instructions for gaining access to the gas control.

4. Instructions for turning the gas control manual valve to the full OFF position.*

5. If applicable, instructions to replace the gas control access panel(s).

* Wherever rotation is required, the following words and symbols shall be used to indicate direction:

clockwise  counterclockwise 

10. Fournir des instructions détaillées sur la façon d'allumer la veilleuse.

Un énoncé, en retrait, visant le mauvais fonctionnement de la commande :

- « Si le bouton ne se soulève pas de lui-même lorsqu'on le relâche, arrêtez et appelez immédiatement un technicien qualifié ou le fournisseur de gaz. »
- « Si la veilleuse ne reste pas allumée après plusieurs tentatives, réglez la manette d'admission du gaz à la position OFF et appelez un technicien qualifié ou le fournisseur de gaz. »

11. Le cas échéant, fournir des instructions pour la réinstallation des panneaux d'accès à la veilleuse.

12. Fournir des instructions pour l'ouverture (position ON) du robinet manuel de l'admission du gaz.

13. Le cas échéant, fournir des instructions sur la réinstallation des panneaux d'accès à la commande d'admission de gaz ou autres pièces.

14. Le cas échéant :

« Mettez l'appareil sous tension. »

15. Le cas échéant :

« Réglez le thermostat à la température désirée. »

Section 3

« Comment couper l'admission de gaz de l'appareil. »

1. Le cas échéant :

« Réglez le thermostat à la température la plus basse. »

2. Le cas échéant :

« Coupez l'alimentation électrique de l'appareil s'il faut procéder à l'entretien. »

3. Le cas échéant, fournir des instructions sur la marche à suivre pour atteindre la commande d'admission du gaz.

4. Fournir des instructions pour la fermeture complète (position OFF) du robinet manuel de l'admission du gaz.

5. Le cas échéant, fournir des instructions sur la réinstallation des panneaux d'accès à la commande d'admission de gaz.

* Lorsqu'une rotation est requise, les mots et symboles suivants doivent être utilisés pour indiquer le sens de la rotation.

sens horaire  sens antihoraire 

Exhibit E (Continued)

Exhibits -- Exhibit B, Outline of Operating Instructions for Appliances Equipped with Intermittent Pilot or Interrupted Pilot Systems

The following is a guide to aid in the writing of the operating instructions label for an appliance equipped with an intermittent pilot or interrupted pilot system. The statements in quotes are to be worded as shown. For purposes of this Exhibit, the word "knob" is used. An actual label shall use the word knob, button, lever, switch, gas control (main valve or accessible switch), etc., as appropriate. If the action necessary to operate the control is other than stated below, modification of the sentence(s) is acceptable.

A sample of this label is shown in Figure B.

Section 1

"FOR YOUR SAFETY READ BEFORE OPERATING"

The following warning shall be indented and boxed at the top of this section:

"WARNING: If you do not follow these instructions exactly, a fire or explosion may result causing property damage, personal injury or loss of life."

- "A. This appliance is equipped with an ignition device which automatically lights the pilot. Do not try to light the pilot by hand."
- "B. BEFORE OPERATING smell all around the appliance area for gas. Be sure to smell next to the floor because some gas is heavier than air and will settle on the floor."

WHAT TO DO IF YOU SMELL GAS

- Do not try to light any appliance.
- Do not touch any electric switch; do not use any phone in your building.
- Immediately call your gas supplier from a neighbor's phone. Follow the gas supplier's instructions.
- If you cannot reach your gas supplier, call the fire department."

Cette annexe vise à aider à la rédaction des instructions de fonctionnement des appareils pourvus de veilleuses intermittentes ou d'un système à veilleuse interrompue. Les énoncés entre guillemets doivent être repris tels quels. Dans les exemples donnés plus bas le terme « manette » est utilisé, mais les termes précis bouton, levier, interrupteur, régulateur du débit de gaz (soupape principale ou interrupteur accessible, etc.) doivent être utilisés dans les mises en garde. Si l'utilisation des commandes est différente de celle donnée cidessous, les énoncés peuvent être modifiés. Une étiquette type est montrée à la figure B.

Une étiquette type est montrée à la figure B.

Section 1

«POUR VOTRE SÉCURITÉ LISEZ AVANT DE METTRE EN MARCHÉ»

« AVERTISSEMENT. Quiconque ne respecte pas à la lettre les instructions dans la présente notice risque de déclencher un incendie ou une explosion entraînant des dommages, des blessures ou la mort. »

- « A. Cet appareil est muni d'un dispositif d'allumage qui allume automatiquement la veilleuse. Ne tentez pas d'allumer la veilleuse manuellement.»
- « B. AVANT DE FAIRE FONCTIONNER, reniflez tout autour de l'appareil pour déceler une odeur de gaz. Reniflez près du plancher, car certains gaz sont plus lourds que l'air et peuvent s'accumuler au niveau du sol. »

QUE FAIRE SI VOUS SENTEZ UNE ODEUR DE GAZ :

- Ne pas tenter d'allumer d'appareil.
- Ne touchez à aucun interrupteur ; ne pas vous servir des téléphones se trouvant dans le bâtiment.
- Appelez immédiatement votre fournisseur de gaz depuis un voisin. Suivez les instructions du fournisseur.
- Si vous ne pouvez rejoindre le fournisseur, appelez le service des incendies.

“C. Use only your hand to push in or turn the gas control knob. Never use tools. If the knob will not push in or turn by hand, don’t try to repair it, call a qualified service technician. Force or attempted repair may result in a fire or explosion.”

“D. Do not use this appliance if any part has been under water. Immediately call a qualified service technician to inspect the appliance and to replace any part of the control system and any gas control which has been under water.”

Section 2

“OPERATING INSTRUCTIONS”

1. “STOP! Read the safety information above (to the left) on this label.”
2. For an appliance equipped with or for use with an adjustable thermostat:
“Set the thermostat to lowest setting.”
3. For an appliance which utilizes an external electrical supply:
“Turn off all electric power to the appliance.”
4. Instructions not to attempt to light the pilot by hand.
5. For an appliance which requires removal of a panel(s) or other part to gain access to the gas control, instructions for gaining access to the gas control.
6. Instructions, with an illustration, for turning the gas control (main valve or accessible switch) to the full OFF position.* If a remote switch is provided the illustration shall show its location.
7. “Wait five (5) minutes** to clear out any gas. Then smell for gas, including near the floor. If you smell gas, STOP! Follow “B” in the safety information above (to the left) on this label. If you don’t smell gas, go to the next step.”
8. Instructions for turning the gas control manual valve to the ON position.*

* Wherever rotation is required, the following words and symbols shall be used to indicate direction:

clockwise  counterclockwise 

** The manufacturer may specify a longer time.

« C. Ne poussez ou tournez la manette d’admission du gaz qu’à la main ; ne jamais utiliser d’outil. Si la manette reste coincée, ne tentez pas de la réparer ; appelez un technicien qualifié. Le fait de forcer la manette ou de la réparer peut déclencher une explosion ou un incendie. »

« D. N’utilisez pas cet appareil s’il a été plongé dans l’eau, même partiellement. Faites inspecter l’appareil par un technicien qualifié et remplacez toute partie du système de contrôle et toute commande qui ont été plongés dans l’eau. »

Section 2

« INSTRUCTIONS DE MISE EN MARCHÉ »

1. « ARRÊTEZ ! Lisez les instructions de sécurité sur la portion supérieure (à gauche) de cette étiquette. »
2. Appareil pourvu d’un thermostat réglable ou destiné à être utilisé avec un tel dispositif :
« Réglez le thermostat à la température la plus basse. »
3. Appareil à alimentation électrique externe :
« Coupez l’alimentation électrique de l’appareil. »
4. Fournir des instructions qui indiquent de ne pas tenter d’allumer la veilleuse de façon manuelle.
5. Si des panneaux ou des pièces de l’appareil doivent être retirés pour atteindre la commande d’admission du gaz, des instructions doivent indiquer la marche à suivre.
6. Des instructions, et une illustration, doivent être fournies pour la fermeture complète (position OFF) du robinet manuel de l’admission du gaz (soupape principale ou interrupteur accessible).* Si l’appareil est équipé d’un interrupteur éloigné, son emplacement doit être montré sur l’illustration.
7. « Attendre cinq (5) minutes** pour laisser échapper tout le gaz. Reniflez tout autour de l’appareil, y compris près du plancher, pour déceler une odeur de gaz. Si vous sentez une odeur de gaz, ARRÊTEZ ! Passez à l’étape B des instructions de sécurité sur la portion supérieure (à gauche) de cette étiquette. S’il n’y a pas d’odeur de gaz, passez à l’étape suivante. »
8. Fournir des instructions pour l’ouverture (position ON) du robinet manuel de l’admission du gaz.

* Lorsqu’une rotation est requise, les mots et symboles suivants doivent être utilisés pour indiquer le sens de la rotation.

sens horaire  sens antihoraire 

** Le fabricant peut spécifier un intervalle plus long.

9. If applicable, instructions to replace the gas control access panel(s) or other part(s).
10. If applicable:
"Turn on all electric power to the appliance."
11. If applicable:
"Set thermostat to desired setting."
12. Instructions as to what to do next if the appliance fails to operate after following the above steps, and the following:

"If the appliance will not operate, follow the instructions "To Turn Off Gas To Appliance" and call your service technician or gas supplier."

Section 3

"TO TURN OFF GAS TO APPLIANCE"

1. If applicable:
"Set the thermostat to lowest setting."
2. If applicable:
"Turn off all electric power to the appliance if service is to be performed."
3. If applicable, instructions for gaining access to the gas control.
4. Instructions for turning the gas control (main valve or accessible switch) to the full OFF position.*
5. If applicable, instructions to replace the gas control access panel(s).

* Wherever rotation is required, the following words and symbols shall be used to indicate direction:

clockwise  counterclockwise 

9. Le cas échéant, fournir des instructions sur la réinstallation des panneaux ou pièces d'accès à la commande d'admission de gaz.
10. Le cas échéant :
« Mettez l'appareil sous tension. »
11. Le cas échéant :
« Réglez le thermostat à la température désirée. »
12. Fournir des instructions donnant les mesures à prendre si l'appareil ne fonctionne pas même si les instructions ci-dessus ont été respectées ainsi que l'énoncé suivant :

« Si l'appareil ne se met pas en marche, suivez les instructions intitulées « Comment couper l'admission de gaz de l'appareil » et appelez un technicien qualifié ou le fournisseur de gaz. »

Section 3

« Comment couper l'admission de gaz de l'appareil. »

1. 1. Le cas échéant :
« Réglez le thermostat à la température la plus basse. »
2. 2. Le cas échéant :
« Coupez l'alimentation électrique de l'appareil s'il faut procéder à l'entretien. »
3. 3. Le cas échéant, fournir des instructions sur la marche à suivre pour atteindre la commande d'admission du gaz.
4. Fournir des instructions pour la fermeture complète (position OFF) du robinet manuel de l'admission du gaz (soupape principale ou interrupteur accessible).
5. Le cas échéant, fournir des instructions sur réinstallation des panneaux d'accès à la commande d'admission de gaz.

* Lorsqu'une rotation est requise, les mots et symboles suivants doivent être utilisés pour indiquer le sens de la rotation.

sens horaire  sens antihoraire 

Exhibit E (Continued)

Exhibits -- Exhibit C, Outline of Operating Instructions for Appliances Equipped with Direct Ignition Systems

The following is a guide to aid in the writing of the operating instructions label for an appliance equipped with a direct ignition system. The statements in quotes are to be worded as shown. For purposes of this Exhibit, the word "knob" is used. An actual label shall use the word knob, button, lever, switch, gas control (main valve or accessible switch), etc., as appropriate. If the action necessary to operate the control is other than stated below, modification of the sentence(s) is acceptable.

A sample of this label is shown in Figure C.

Section 1

"FOR YOUR SAFETY READ BEFORE OPERATING"

The following warning shall be indented and boxed at the top of this section:

"WARNING: If you do not follow these instructions exactly, a fire or explosion may result causing property damage, personal injury or loss of life."

- "A. This appliance does not have a pilot. It is equipped with an ignition device which automatically lights the burner. Do not try to light the burner by hand."
- "B. BEFORE OPERATING smell all around the appliance area for gas. Be sure to smell next to the floor because some gas is heavier than air and will settle on the floor."

WHAT TO DO IF YOU SMELL GAS

- Do not try to light any appliance.
 - Do not touch any electric switch; do not use any phone in your building.
 - Immediately call your gas supplier from a neighbor's phone. Follow the gas supplier's instructions.
 - If you cannot reach your gas supplier, call the fire department."
- "C. Use only your hand to push in or turn the gas control knob. Never use tools. If the knob will not push in or turn by hand, don't try to repair it, call a qualified service technician. Force or attempted repair may result in a fire or explosion."

Cette annexe vise à aider à la rédaction des instructions de fonctionnement des appareils pourvus d'un système d'allumage direct. Les énoncés entre guillemets doivent être repris tels quels. Dans les exemples donnés plus bas le terme « manette » est utilisé, mais les termes précis bouton, levier, interrupteur, régulateur du débit de gaz (soupape principale ou interrupteur accessible, etc.) doivent être utilisés dans les mises en garde. Si l'utilisation des commandes est différente de celle donnée cidessous, les énoncés peuvent être modifiés.

Une étiquette type est montrée à la figure C.

Section 1

POUR VOTRE SÉCURITÉ LISEZ AVANT DE METTRE EN MARCHÉ

« AVERTISSEMENT. Quiconque ne respecte pas à la lettre les instructions dans la présente notice risque de déclencher un incendie ou une explosion entraînant des dommages, des blessures ou la mort. »

- « A. Cet appareil ne comporte pas de veilleuse. Il est muni d'un dispositif d'allumage qui allume automatiquement le brûleur. Ne tentez pas d'allumer le brûleur manuellement.»
- « B. AVANT DE FAIRE FONCTIONNER, reniflez tout autour de l'appareil pour déceler une odeur de gaz. Reniflez près du plancher, car certains gaz sont plus lourds que l'air et peuvent s'accumuler au niveau du sol. »

QUE FAIRE SI VOUS SENTEZ UNE ODEUR DE GAZ :

- Ne pas tenter d'allumer d'appareil.
 - Ne touchez à aucun interrupteur ; ne pas vous servir des téléphones se trouvant dans le bâtiment.
 - Appelez immédiatement votre fournisseur de gaz depuis un voisin. Suivez les instructions du fournisseur.
 - Si vous ne pouvez rejoindre le fournisseur, appelez le service des incendies.
- « C. Ne poussez ou tournez la manette d'admission du gaz qu'à la main ; ne jamais utiliser d'outil. Si la manette reste coincée, ne pas tenter de la réparer ; appelez un technicien qualifié. Le fait de forcer la manette ou de la réparer peut déclencher une explosion ou un incendie. »

- D. Do not use this appliance if any part has been under water. Immediately call a qualified service technician to inspect the appliance and to replace any part of the control system and any gas control which has been under water."

Section 2

"OPERATING INSTRUCTIONS"

1. "STOP! Read the safety information above (to the left) on this label."
2. For an appliance equipped with or for use with an adjustable thermostat:
"Set the thermostat to lowest setting."
3. For an appliance which utilizes an external electrical supply:
"Turn off all electric power to the appliance."
4. Instructions not to attempt to light the burner by hand.
5. For an appliance which requires removal of a panel(s) or other part to gain access to the gas control, instructions for gaining access to the gas control.
6. Instructions, with an illustration, for turning the gas control (main valve or accessible switch) to the full OFF position.*
7. "Wait five (5) minutes** to clear out any gas. Then smell for gas, including near the floor. If you smell gas, STOP! Follow "B" in the safety information above (to the left) on this label. If you don't smell gas, go to the next step."
8. Instructions for turning the gas control manual valve to the ON position.*
9. If applicable, instructions to replace the gas control access panel(s) or other part(s).
10. If applicable:
"Turn on all electric power to the appliance."

* Wherever rotation is required, the following words and symbols shall be used to indicate direction:

clockwise  counterclockwise 

** The manufacturer may specify a longer time

- « D. N'utilisez pas cet appareil s'il a été plongé dans l'eau, même partiellement. Faites inspecter l'appareil par un technicien qualifié et remplacez toute partie du système de contrôle et toute commande qui ont été plongés dans l'eau. »

Section 2

«INSTRUCTIONS DE MISE EN MARCHÉ »

1. « ARRÊTEZ ! Lisez les instructions de sécurité sur la portion supérieure (à gauche) de cette étiquette. »
2. Appareil pourvu d'un thermostat réglable ou destiné à être utilisé avec un tel dispositif :
« Réglez le thermostat à la température la plus basse. »
3. Appareil à alimentation électrique externe :
« Coupez l'alimentation électrique de l'appareil. »
4. Fournir des instructions qui indiquent de ne pas tenter d'allumer la veilleuse de façon manuelle.
5. Si des panneaux ou des pièces de l'appareil doivent être retirés pour atteindre la commande d'admission du gaz, des instructions doivent indiquer la marche à suivre.
6. Des instructions, et une illustration, doivent être fournies pour la fermeture complète (position OFF) du robinet de l'admission du gaz (soupape principale ou interrupteur accessible)*.
7. « Attendre cinq (5) minutes** pour laisser échapper tout le gaz. Reniflez tout autour de l'appareil, y compris près du plancher, pour déceler une odeur de gaz. Si vous sentez une odeur de gaz, ARRÊTEZ ! Passez à l'étape B des instructions de sécurité sur la portion supérieure (à gauche) de cette étiquette. S'il n'y a pas d'odeur de gaz, passez à l'étape suivante. »
8. Fournir des instructions pour l'ouverture (position ON) du robinet manuel de l'admission du gaz.
9. Le cas échéant, fournir des instructions sur la réinstallation des panneaux ou pièces d'accès à la commande d'admission de gaz.
10. Le cas échéant :
« Mettez l'appareil sous tension. »

* Lorsqu'une rotation est requise, les mots et symboles suivants doivent être utilisés pour indiquer le sens de la rotation.

sens horaire  sens antihoraire 

** Le fabricant peut spécifier un intervalle plus long.

11. If applicable:

“Set thermostat to desired setting.”

12. Instructions as to what to do next if the appliance fails to operate after following the above steps, and the following:

“If the appliance will not operate, follow the instructions “To Turn Off Gas To Appliance” and call your service technician or gas supplier.”

Section 3

“TO TURN OFF GAS TO APPLIANCE”

1. If applicable:

“Set the thermostat to lowest setting.”

2. If applicable:

“Turn off all electric power to the appliance if service is to be performed.”

3. If applicable, instructions for gaining access to the gas control.

4. Instructions for turning the gas control (main valve or accessible switch) to the full OFF position.*

5. If applicable, instructions to replace the gas control access panel(s).

* Wherever rotation is required, the following words and symbols shall be used to indicate direction:

clockwise  counterclockwise 

11. Le cas échéant :

« Réglez le thermostat à la température désirée. »

12. « Fournir des instructions donnant les mesures à prendre si l'appareil ne fonctionne pas même si les instructions ci-dessus ont été respectées ainsi que l'énoncé suivant: »

« Si l'appareil ne se met pas en marche, suivez les instructions intitulées « Comment couper l'admission de gaz de l'appareil » et appelez un technicien qualifié ou le fournisseur de gaz. »

Section 3

« Comment couper l'admission de gaz de l'appareil. »

1. Le cas échéant :

« Réglez le thermostat à la température la plus basse. »

2. Le cas échéant :

« Coupez l'alimentation électrique de l'appareil s'il faut procéder à l'entretien. »

3. Le cas échéant, fournir des instructions sur la méthode à suivre pour atteindre la commande d'admission du gaz.

4. Fournir des instructions pour la fermeture complète (position OFF) du robinet manuel de l'admission du gaz (soupape principale ou interrupteur accessible).

5. Le cas échéant, fournir des instructions sur la réinstallation des panneaux d'accès à la commande d'admission de gaz.

* Lorsqu'une rotation est requise, les mots et symboles suivants doivent être utilisés pour indiquer le sens de la rotation.

sens horaire  sens antihoraire 

Exhibit E (Continued)

Exhibits — Exhibit F, Optional Provisions for Listed Gas Appliance Conversion Kits

F.III.-b

WARNING

This conversion kit shall be installed by a qualified service agency in accordance with the manufacturer's instructions and all applicable codes and requirements of the authority having jurisdiction. If the information in these instructions is not followed exactly, a fire, an explosion or production of carbon monoxide may result causing property damage, personal injury or loss of life. The qualified service agency is responsible for the proper installation of this kit. The installation is not proper and complete until the operation of the converted appliance is checked as specified in the manufacturer's instructions supplied with the kit.

AVERTISSEMENT

Cette trousse de conversion ne doit être installée que par le représentant d'un organisme qualifié et conformément aux instructions du fabricant et aux codes et exigences pertinents de l'autorité compétente. Quiconque ne respecte pas à la lettre les instructions du présent guide risque de déclencher un incendie, une explosion ou le dégagement de monoxyde de carbone entraînant des dommages matériels, des lésions corporelles ou la perte de vies humaines. L'organisme qualifié qui effectue les travaux est responsable de l'installation de cette L'installation n'est pas terminée tant que le fonctionnement de l'appareil converti n'a pas été vérifié selon la notice du fabricant qui accompagne la trousse.

F.III-f

"Caution the gas supply shall be shut off prior to disconnecting the electrical power, before proceeding with the conversion."

«Attention. Avant d'effectuer la conversion, coupez d'abord l'alimentation en gaz, ensuite, coupez l'alimentation électrique. »

F.IV-d

"This boiler was converted on day-month-year to _____ gas with Kit

No. _____ by _____ (name and address of organization making this conversion, who accepts the responsibility for the correctness of this conversion)."

« Cette chaudière a été convertie le (année/mois/jour) _____ pour fonctionner au gaz _____ à l'aide de la trousse n° _____ par (nom et adresse de l'organisme qui a effectué la conversion), qui accepte l'entière responsabilité de la qualité de la conversion. »

F.IV-e

"This control has been converted for use with _____ gas."

« Cette commande a été convertie pour fonctionner au gaz _____.»

E.7. Direct Ignition Systems Over 400,000 Btu/h

E.7.1.

In Canadian boilers with input ratings over 400,000 Btu/h (117 228 W) shall comply with the applicable requirements of the *Standard for Industrial and Commercial Gas-Fired Package Boilers, CAN1-3.1*.

E.8. Metrication

E.8.1.

In Canada, the units of measurement required on printed instructions and markings shall include the SI (metric) values as a minimum.

E.9. High Altitude

E.9.1.

For 400,000 Btu/h (117 228 W) and under, boilers certified for use in Canada above an altitude of 2000 ft (610 m) shall comply with the applicable requirements of the *Standard for Gas-Fired Appliances for Use at High Altitudes*, CAN/CGA 2.17.

Exhibit F

(Optional) Provisions For Listed Gas Appliance Conversion Kits

The following provisions are for use by manufacturers who wish to make available field conversion kits when provision is made for the simple conversion of a boiler from one approved gas to the other.

Listing of conversion kits is permitted provided they meet the following criteria:

F.I Types Of Conversion Kits To Be Listed

Gas appliance conversion kits listed under these provisions may include, but are not limited to, the following:

1. Main burner orifices and pilot burner orifices;
2. New gas controls or kits for pressure regulators;
3. Primary air shutters, spoiler screws;
4. Ignition control(s);
5. Main burner(s);
6. Gas supply pressure switches;
7. Rating plates, labels, instructions;
8. Vent pressure switches, combustion air proving means switches;
9. NOx control devices; and
10. Turbulators.

Conversion kits shall be listed only for boilers having listing for use with both natural and liquefied petroleum gases.

Conversions are not permitted which require:

- a. Modifications to baffles or draft diverters; or
- b. Use of any component that has not been tested and listed as part of the boiler.

F.II Control Modifications

Conversions which require modifications to a control at the time of conversion are permitted with a listed conversion kit only if, at the time the conversion kit is submitted to the testing agency for purposes of listing, a letter from the control manufacturer agreeing with the specified control modifications accompanies the submittal.

F.III Instructions

Each conversion kit shall be accompanied by clear, concise printed instructions and diagrams, stated in terms clearly understandable, adequate for the proper field assembly, installation, service and safe use of the conversion kit.

- a. Instructions that the conversion kit shall be installed by a qualified service agency.
- b. The following boxed warning in boldfaced type:

WARNING This conversion kit shall be installed by a qualified service agency in accordance with the manufacturer's instructions and all applicable codes and requirements of the authority having jurisdiction. If the information in these instructions is not followed exactly, a fire, an explosion or production of carbon monoxide may result causing property damage, personal injury or loss of life. The qualified service agency is responsible for the proper installation of this kit. The installation is not proper and complete until the operation of the converted appliance is checked as specified in the manufacturer's instructions supplied with the kit.

The warning shall be in letters having a minimum uppercase letter height of 0.120 in (3.05 mm) with a minimum vertical spacing between lines of 0.046 in (1.17 mm).^{*} Lowercase letters shall be compatible with uppercase letter size specification.

- c. Boiler model number or series of models acceptable for use with the kit.
- d. Complete parts list identifying all components provided in the kit.
- e. Identification of the gas to which the boiler is to be converted.
- f. Step by step instructions for converting the boiler. If necessary, these instructions shall provide illustrations of the pilot assembly, the manifold or the manifold and main burner assembly. Instructions shall state: "Caution the gas supply shall be shut off prior to disconnecting the electrical power, before proceeding with the conversion."
- g. Illustrations indicating the proper relationship of the igniter to the main burner with instructions to verify this relationship prior to completing the conversion.
- h. Procedures for proper leak testing of the converted boiler prior to placing it into operation.
- i. Manifold pressure of the converted boiler with instructions for checking and properly adjusting this gas pressure.
- j. Minimum and maximum inlet gas pressures with the instructions for checking the gas pressure.
- k. The required input rating of the converted boiler.
- l. Details on adjustment for proper pilot and main burner flame appearance, including written instructions and pictorial illustrations.
- m. Details for verifying the input rate of the converted boiler.

^{*} This letter height and line spacing corresponds to 12-point type.

- n. Instructions for placing all markings provided in the kit in the appropriate location on the converted boiler.
- o. Instructions for checking out the normal operating sequence of the ignition system.
- p. The instructions are to address derating at altitudes above 2000 feet (610 m).

F.IV Marking

Each conversion kit shall be provided with the following markings:

- a. All components provided with the kit must be marked or color coded so as to make them visibly distinguishable from the components they are replacing. This marking or color coding shall be identified in the instructions provided with the kit.
- b. All orifices provided with the kit must be permanently marked to indicate the orifice size. The orifice size shall be specified in the instructions accompanying the kit.
- c. A conversion plate on Class IIIA marking material, with explicit instructions to affix the conversion plate as close as possible to the existing rating plate. This plate shall include the following information or reference the information on the existing rating plate:
 - 1. Boiler model number or series of models;
 - 2. The gas to which the boiler has been converted;
 - 3. Minimum and maximum inlet gas pressures of the converted boiler;
 - 4. Manifold pressure;
 - 5. Input rating; and
 - 6. Identification of the conversion kit by part number.
- d. The following Class IIIA marking, with explicit instructions to affix the label in a conspicuous location adjacent to the boiler:

“This boiler was converted on day/month/year to _____ gas with Kit No. ____ by _____ (name and address of organization making this conversion), which accepts the responsibility that this conversion has been properly made.”
- e. If the entire control is not replaced when the boiler is converted, a separate Class IIIA marking shall be affixed on or near the gas control(s) stating:

“This control has been converted for use with gas.”
- f. The following information marked on the exterior of the kit:
 - 1. Identification of the conversion kit by part number;
 - 2. Boiler model number or series of models acceptable for use with the kit; and
 - 3. Identification of the gas to which the boiler is to be converted.

Exhibit G

List Of Reference Standards

AMERICAN GAS ASSOCIATION

400 N. Capitol Street, N. W., Washington, D.C. 20001.

ANSI Z223.1-2009/NFPA 54-2009, National Fuel Gas Code

AMERICAN NATIONAL STANDARDS INSTITUTE

11 West 42nd Street, New York, New York 10036

ANSI C101.1-1992, Leakage Current for Appliances

ANSI Y14.15-1966 (R1988), Electrical and Electronics Diagrams

AMERICAN SOCIETY OF MECHANICAL ENGINEERS

United Engineering Center, 345 East 47th Street, New York, New York 10017

ANSI/ASME CSD-1-2006, Controls and Safety Devices for Automatically Fired Boilers

ANSI/ASME B1.20.1-1983 (R2006), Pipe threads, General Purpose (Inch)

ANSI/ASME B36.10M-2004, Welded and Seamless Wrought Steel Pipe

ANSI/ASME B94.11M-1993, Twist Drills

ANSI/ASME PTC 19.3-1974 (R2004), Performance Test Codes - Temperature Measurement

ANSI/ASME 2007 Boiler and Pressure Vessel Code

AMERICAN SOCIETY FOR TESTING & MATERIALS

100 Barr Harbor Dr., West Conshohocken, PA 19428-2959

ASTM A90/A90M-07, Standard Test Method for Weight (Mass) of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings

ASTM A653/A653M-08, Standard Specifications for Sheet Steel, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot Dip Process

ASTM B487-85 (2007), Standard Test Method for Measurement of Metal and Oxide Coating Thickness by Microscopical Examination of a Cross Section

ASTM B499-96 (2002), Standard Test Method for Measurement of Coating Thicknesses by the Magnetic Method: Nonmagnetic Coatings on Magnetic Basis Metals

ASTM B504-90 (2007), Standard Test Method for Measurement of Thickness of Metallic Coatings by the Coulometric Method

ASTM D1785-06, Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120

ASTM D2241-05, Standard Specification for Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)

ASTM D2661-08, Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) Schedule 40 Plastic Drain, Waste, and Vent Pipe and Fittings

ASTM D2665-08b, Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings

ASTM D2846/D2846M-06, Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Hot- and Cold-Water Distribution Systems

ASTM F441/F441M-02 (2008), Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Schedules 40 and 80

ASTM F442/F442M-99 (2005)e1, Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe (SDR-PR)

ASTM F628-08, Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) Schedule 40 Plastic Drain, Waste, and Vent Pipe With a Cellular Core

ASTM F891-07, Standard Specification for Coextruded Poly (Vinyl Chloride) (PVC) Plastic Pipe With a Cellular Core

CSA

5060 Spectrum Way, Suite 100, Mississauga, Ontario, Canada L4W 5N6

CSA B51-03 (R2007), Boiler, Pressure Vessel and Pressure Piping Code

CSA C22.1-06, Canadian Electrical Code, Part 1

CAN/CSA C22.2, No. 0.3-01 (R2005), Test Methods for Electrical Wires and Cables

CSA C22.2 No. 0.15-01 (R2006), Adhesive Labels

CSA C22.2 No. 3-M1988 (R2004), Electrical Features of Fuel-Burning Equipment

CSA C22.2 No.24-93 (R2008), Temperature Indicating and Regulating Equipment

CSA C22.2, No. 49-2006, Flexible Cords and Cables

CSA C22.2 No.77-95 (R2004), Motors With Inherent Overheating Protection

CSA C22.2 No. 199-M89 (R2004), Combustion Safety Controls and Solid-State Igniters for Gas- and Oil-Burning Equipment

CSA C22.2 No. 210.2-05, Appliance Wiring Material Products

CAN1-6.4-M79 (R2001), Automatic Gas Ignitions System and Components

CSA C22.2 No. 239-97 (R2006), Control and Instrumentation Cables

CAN/CSA-2.17-M91 (R2003), Gas-Fired Appliances For Use at High Altitude

CSA B149.1-05, Natural Gas and Propane Installation Code

CSA 2.7-M98 • ANSI Z21.17-1998 (R2009), Domestic Gas Conversion Burners

CSA 6.3-2007 • ANSI Z21.18-2007, Gas Appliance Pressure Regulators

CSA 6.5-2005 • ANSI Z21.21-2005, Automatic Valves for Gas Appliances

CSA 6.8-2005 • ANSI Z21.35-2005, Pilot Gas Filters

CGA 6.14-M96 • ANSI Z21.66-1996 (R2007), Automatic Vent Damper Devices for Use With Gas-Fired Appliances

CSA 6.20-2005 • ANSI Z21.78-2005 and Addenda CSA 6.20a-2007 • ANSI Z21.78a-2007, and Addenda CSA 6.20b-2008 • ANSI Z21.78b-2008, Combination Gas Controls for Gas Appliances

CSA 6.23-2005 • ANSI Z21.77-2005, Manually-Operated Piezo-Electric Spark Gas Ignition Systems and Components

CGA 9.1-M97 • ANSI Z21.15-1997 (R2008) and Addenda CGA 9.1a-2001 • ANSI Z21.15a-2001 (R2008) and Addenda CGA 9.1b-2006 • ANSI Z21.15b-2006 (R2008), Manually Operated Gas Valves for Appliances, Appliance Connector Valves and Hose End Valves

CSA-P.2-2007, Testing Methods for Measuring Annual Fuel Utilization Efficiencies of Residential Gas-Fired Furnaces and Boilers

CAN1-3.1-77 (R2006), Industrial and Commercial Gas-Fired Package Boilers

CSA AMERICA

8501 East Pleasant Valley Road, Cleveland, Ohio 44131

ANSI Z21.15-1997 (R2008) • CGA 9.1-M97 and Addenda ANSI Z21.15a-2001 (R2008) • CGA 9.1a-2001 and Addenda ANSI Z21.15b-2006 (R2008) • CGA 9.1b-2006, Manually Operated Gas Valves for Appliances, Appliance Connector Valves and Hose End Valves

ANSI Z21.17-1998 (R2009) • CSA 2.7-M98, Domestic Gas Conversion Burners

ANSI Z21.18-2007 • CSA 6.3-2007, Gas Appliance Pressure Regulators

ANSI Z21.21-2005 • CSA 6.5-2005, Automatic Valves for Gas Appliances

ANSI Z21.35-2005 • CSA 6.8-2005, Pilot Gas Filters

ANSI Z21.78-2005 • CSA 6.20-2005 and Addenda ANSI Z21.78a-2007 • CSA 6.20a-2007 and Addenda ANSI Z21.78b-2008 • CSA 6.20b-2008, Combination Gas Controls for Gas Appliances

ANSI Z21.66-1996 (R2007) • CGA 6.14-M96, Automatic Vent Damper Devices for Use With Gas-Fired Appliances

ANSI Z21.77-2005 • CSA 6.23-2005, Manually-Operated Piezo-Electric Spark Gas Ignition Systems and Components

ANSI Z21.20-2005 and Addenda ANSI Z21.20a-2008, Automatic Gas Ignition Systems and Components

INSTITUTE OF ELECTRICAL AND ELECTRONIC ENGINEERS

445 Hose Lane, Piscataway, New Jersey 08855-1331

ANSI/IEEE 315-1975 (R1994), and Supplement, ANSI/IEEE 315A-1986, Graphic Symbols for Electrical and Electronics Diagrams (Including Reference Designation Class Designation Letters)

ANSI/IEEE-SI-10-2002, Standard For Use of International Systems of Units (SI) The Modern Metric System

NATIONAL FIRE PROTECTION ASSOCIATION

1 Batterymarch Park, P.O. Box 9101, Quincy, Massachusetts 02269

ANSI/NFPA 54-2009/Z223.1-2009, National Fuel Gas Code

ANSI/NFPA 70-2008, National Electrical Code

UNDERWRITERS LABORATORIES INC.

333 Pfingsten Road, Northbrook, Illinois 60062

UL 13-2007, Power Limited Circuit Cables

UL 62-2006, Flexible Cord and Fixture Wire

ANSI/UL 353-1995, Limit Controls

ANSI/UL 969-2008, Marking and Labelling Systems

Part III: Manufacturing And Production Tests

The following manufacturing and production tests are intended to provide the means for certifying agencies to uniformly apply quality control standards to all boilers certified as complying with the standard.

3.1

The manufacturer shall check, inspect and test the components and the assemblies of each boiler in the following manner:

- a. Inspect raw materials and purchased components using a sampling plan mutually acceptable to the manufacturer and the certifying agency.
- b. Inspect each heat exchanger to determine conformance with manufacturing specifications by application of a light test, a pressure test, a visual inspection of welded seams, or other means found to be mutually acceptable to the manufacturer and the certifying agency.
- c. Test each factory assembled manifold and control assembly for proper gas valve operation and verify the gastightness of the manifold and control assembly.
- d. Test each boiler to determine that electrical components function properly. This test shall be conducted on completely assembled boilers, when feasible. When not feasible, either (1) subassemblies shall be tested separately, or (2) written assurance from the component manufacturers that operational tests have been conducted on their devices shall be kept on file.
- e. Conduct dielectric withstand tests on each factory assembled boiler incorporating high-voltage electrical circuits. If the boiler employs a component, such as a solid-state device, that can be damaged by the dielectric potential, the test may be conducted with the point of connection of the component to ground disconnected or before the component is electrically connected. The tests shall consist of the application of the 60 hertz potential between high-voltage current-carrying parts and the casing, frame and similar noncurrent-carrying parts of the boiler with any switch contacts both open and closed. The test potential shall be in accordance with the dielectric withstand test specified in 1.24.40 applied for 1 minute, or a potential of 120 percent of that value applied for 1 second.

3.2

Using a sampling plan mutually agreeable to the manufacturer and the certifying agency, completely assembled boilers shall be tested to determine satisfactory operation with respect to:

- a. Burner operating characteristics;
- b. Ignition systems and pilot safety shutoff devices;
- c. Combustion;
- d. Allowable water temperatures or steam pressures;
- e. Flue loss;
- f. Dielectric withstand with solid-state components connected (if not tested under 3.1-e);
- g. Flame roll-out safety shutoff means; and
- h. Blocked vent shutoff systems.

If a boiler is not shipped assembled from the factory, the manufacturer shall periodically assemble a boiler from production to check the compatibility of the subassemblies. The boiler shall be capable of ready assembly. Each boiler so assembled shall be subjected to the tests noted in 3.1-c, -d and -e. It is suggested that one boiler be so checked for each 100 boilers produced, but not less than one for each week's production.

The manufacturer's test method(s) shall be capable of relating back to the test(s) specified in the standard.

The results of these tests shall be recorded and maintained by the manufacturer for review by the certifying agency.

Part IV: Definitions

AIR SHUTTER. An adjustable device for varying the size of the primary air inlet(s).

APPLIANCES-AUTOMATICALLY CONTROLLED. Appliances equipped with automatic devices which:

1. Accomplish complete “turn on” or “shut off” of the gas to the main burner(s); or
2. Graduate the gas supply to the burner(s) but do not effect complete shutoff of the gas.

AUTOMATIC FLUE DAMPER DEVICE. A device, in the flue outlet or in the inlet of, or upstream of the draft hood of an individual automatically operated gas-fired appliance, which is designed to automatically open the flue outlet during appliance operation and to automatically close off the flue outlet when the appliance is in standby condition.

Electrically Operated. An automatic flue damper device that employs electrical energy to control the device.

AUTOMATIC GAS IGNITION CONTROL. A control directly responsive to flame properties or proven ignition source, sensing the presence of flame or the ignition source and, in the event of ignition failure or loss of flame, causing safety shutdown.

AUTOMATIC GAS IGNITION SYSTEM. A system designed to ignite and reignite an appliance burner(s). Such systems shall:

1. Automatically ignite gas at the main burner, or gas at the pilot burner so the pilot can ignite the main burner;
2. Prove the presence of either the ignition source, the main burner flame, or both; and
3. Automatically act to shut off the gas supply to the main burner or to the pilot and main burner, when the supervised flame or ignition source is not proved.

AUTOMATIC GAS IGNITION SYSTEM TIMINGS.

1. **Automatic Restart.** The automatic action to initiate another ignition sequence after a soft lockout occurs.
2. **Automatic Restart Time.** The period of time between a soft lockout and the automatic action to initiate another ignition sequence.
3. **Flame Failure Reignition Time.** The period of time between loss of the supervised ignition source or the supervised main burner flame and a reignition attempt. During this time period the main burner gas supply is not shut off.
4. **Ignition Activation Period.** The period of time between energizing the main gas valve and deactivation of the ignition means prior to the lockout time.
5. **Igniter Proving Time.** The period of time between energizing the igniter and achieving the proved igniter characteristic which allows gas flow.
6. **Lockout Time.** The period of time between energizing the system and lockout if proof of the supervised ignition source or the supervised main burner flame is not established.

7. **Purge Time.** The period of time intended to allow for the dissipation of any unburned gas or residual products of combustion.
 - a. **Pre-purge Time.** The purge time which occurs at the beginning of an appliance operating cycle prior to initiating ignition.
 - b. **Inter-purge Time.** The purge time that takes place between the end of a trial for ignition period and reactivation of the ignition means on a multitry system.
 - c. **Post-purge Time.** The purge time which occurs at the end of an appliance burner operating cycle.
8. **Recycle Time.** The period of time between shutoff of the gas supply following loss of the supervised ignition source or the supervised main burner flame and reactivation of the ignition source.
9. **Trial for Ignition Period.** The period of time between energizing and deenergizing the gas valve if proof of the supervised flame is not established.
10. **Valve Sequence Period.** The sum of all trial for ignition periods prior to lockout, if proof of the supervised ignition source or the supervised main burner flame is not established.

AUTOMATIC VENT DAMPER DEVICE. A device intended for installation in the venting system, in the outlet of or downstream of the appliance draft hood, of an individual automatically operated gas-fired appliance and which is designed to automatically open the venting system when the appliance is in operation and to automatically close off the venting system when the appliance is in a shutdown or standby condition.

1. **Electrically Operated.** An automatic vent damper device that employs electrical energy to control the device.
2. **Thermally Actuated.** An automatic vent damper device dependent for operation exclusively upon the direct conversion of the thermal energy of the vent gases into mechanical energy.

BAFFLE. An object placed in an appliance to change the direction of or retard the flow of air, gas-air mixtures or flue gases.

BASE. The lowest supporting frame or structure of the appliance, exclusive of legs.

BLOCKED VENT SHUTOFF SYSTEM. A system designed to interrupt appliances main burner gas flow if the appliance venting system is totally blocked.

BOILER, LOWPRESSURE. A boiler that supplies steam at a pressure not exceeding 15 psi (100 kPa), or hot water at a pressure not exceeding 160 psi (1100 kPa) at a temperature not exceeding 250°F (121°C).

Indoor Boilers of other than the direct vent type, are divided into four categories based on the static pressure in the vent and the flue loss.

1. **Category I.** A boiler which operates with a nonpositive vent static pressure and with a vent gas temperature that avoids excessive condensate production in the vent.
2. **Category II.** A boiler which operates with a nonpositive vent static pressure and with a vent gas temperature that may cause excessive condensate production in the vent.

3. **Category III.** A boiler which operates with a positive vent static pressure and with a vent gas temperature that avoids excessive condensate production in the vent.
4. **Category IV.** A boiler which operates with a positive vent static pressure and with a vent gas temperature that may cause excessive condensate production in the vent.

A boiler can be of the following types:

1. **Boiler, Hot Water Heating.** A boiler designed to heat water for circulation through an external space heating system.
2. **Boiler, Hot Water Supply.** A boiler used to heat water for purposes other than space heating.
3. **Boiler, Steam Heating.** A boiler designed to convert water into steam which is supplied to an external space heating system.

BTU. Abbreviation for British Thermal Unit. The quantity of heat required to raise the temperature of 1 pound of water 1°F.

BURNER. A device for the final conveyance of the gas, or a mixture of gas and air, to the combustion zone.

1. **Forced Draft Burner.** (See Power Burner.)
2. **Induced Draft Burner.** A burner which depends on the draft induced by a fan beyond the appliance for its proper operation.
3. **Injection (Bunsen) Burner.** A burner employing the energy of a jet of gas to inject air for combustion into the burner and mix it with the gas.
 - a. **Atmospheric Injection Type Burner.** A burner in which the air at atmospheric pressure is injected into the burner by a jet of gas.
4. **Luminous or YellowFlame Burner.** A burner in which secondary air only is depended on for combustion of the gas.
5. **Power Burner.** A burner in which either gas or air, or both, are supplied at pressures exceeding, for gas, the line pressure, and for air, atmospheric pressure; this added pressure being applied at the burner. A burner for which air for combustion is supplied by a fan ahead of the appliance is commonly designated as a forced draft burner.
 - a. **Premixing Burner.** A power burner in which all or nearly all of the air for combustion is mixed with the gas as primary air.
6. **Pressure Burner.** A burner which is supplied with a gasair mixture under pressure (usually from 0.5 to 14.0 inches of water column and occasionally higher).

BURNER HEAD. That portion of a burner beyond the outlet end of the mixer tube which contains the ports.

CHIMNEY. One or more passageways, vertical or nearly so, for conveying flue or vent gases to the outside atmosphere.

1. **Factory-Built Chimney.** A chimney composed of listed factory-built components assembled in accordance with the terms of listing to form the completed chimney.

2. **Masonry Chimney.** A field-constructed chimney of solid masonry units, bricks, stones, listed masonry chimney units or reinforced portland cement concrete, lined with suitable chimney flue liners.
3. **Metal Chimney.** A field-constructed chimney of metal.

CIRCUIT. (IN THE U.S.)

1. **High-Tension.** A circuit involving a potential of more than 600 volts supplied by a step-up transformer or by a suitable combination of devices which will increase line voltage to over 600 volts.
2. **High-Voltage.** A circuit involving a potential of not more than 600 volts and having circuit characteristics in excess of those of a low-voltage circuit.
3. **Low-Voltage.** A circuit involving a potential of not more than 30 volts.
4. **Thermoelectric.** A circuit which receives its electrical energy by a conversion of heat to electricity by means of a thermocouple or thermopile.

COMINATION CONTROL. An assembly of two or more different functions, at least one of which conveys gas in a single unit without the use of pipe nipples, including the following:

1. Manually Operated Gas Valves;
2. Gas Appliance Pressure Regulator;
3. Automatic Valves;
4. Thermostat Other than Electric Type;
5. Ignition System Components; and
6. Automatic Gas Shutoff Device.

COMBUSTIBLE MATERIAL. As pertaining to materials adjacent to or in contact with heat producing appliances, vent connectors, gas vents, chimneys, steam and hot water pipes, and warm air ducts, shall mean materials made of or surfaced with wood, compressed paper, plant fibers, or other materials that are capable of being ignited and burned. Such material shall be considered combustible even though flame-proofed, fire-retardant treated, or plastered.

COMBUSTION. The rapid oxidation of fuel gases accompanied by the production of heat, or heat and light.

COMBUSTION CHAMBER. The entire appliance volume within which combustion occurs.

COMBUSTION EFFICIENCY. 100 percent less the losses due to (1) dry flue gas, (2) incomplete combustion and (3) moisture formed by combustion of hydrogen.

COMBUSTION PRODUCTS. Constituents resulting from the combustion of a fuel gas with the oxygen of the air, including the inerts, but excluding excess air.

CONDENSATE (CONDENSATION). The liquid which separates from a gas (including flue gases) due to a reduction in temperature.

CONTROLS. Devices designed to regulate the gas, air, water or electrical supplies to a gas appliance. These may be manual, semi-automatic or automatic.

CUBIC FOOT OF GAS. The amount of gas which would occupy 1 cubic foot when at a temperature of 60°F, if saturated with water vapor, and under a pressure equivalent to that of 30 inches mercury column.

CUT-OFF POINT OF CONTROL. The temperature at which the control acts to shut off the gas to the main burner(s).

CUT-ON POINT OF CONTROL. The temperature at which the control acts to turn on the gas to the main burner(s).

DAMPER. The valve or plate which controls the flow through an automatic vent damper device.

DIRECT VENT BOILER. A system consisting of:

1. A boiler for indoor installation;
2. Combustion air connections between the boiler and the outdoor atmosphere;
3. Flue gas connections between the boiler and the vent cap; and
4. A vent cap for installation outdoors.

This system shall be supplied by the manufacturer and constructed so that all air for combustion is obtained from the outdoor atmosphere and all flue gases are discharged to the outdoor atmosphere.

DRAFT HOOD. A non-adjustable device built into the appliance or made a part of the vent connector from an appliance, which is designed to:

1. Provide for the ready escape of the flue gases in the event of no draft, backdraft, or stoppage beyond the draft hood;
2. Prevent a backdraft from entering the appliance; and
3. Neutralize the effect of stack action of the chimney or gas vent upon the operation of the appliance.

DRAFT REGULATOR. A device that functions to maintain a desired draft in the appliance by automatically reducing the draft to the desired value.

ELECTRICAL DIAGRAMS.

1. **Connection.** A diagram which shows the connections of an installation or its component devices or parts. It may cover internal or external connections, or both, and contains such detail as is needed to make or trace connections that are involved. The Connection Diagram usually shows general physical arrangement of the component devices or parts.
2. **Schematic.** A diagram which shows, by means of graphic symbols, the electrical connections and functions of a specific circuit arrangement. The Schematic Diagram facilitates tracing the circuit and its functions without regard to the actual physical size, shape or location of the component device or parts.
 - a. **Ladder Form of Schematic.** A diagram drawn in the form of a vertical ladder. The outer vertical lines represent the electrical supply conductors. The horizontal steps represent each individual circuit with all component devices.

EXCESS AIR. Air which passes through the combustion chamber and the appliance flues in excess of that which is required for complete combustion.

FLAME DETECTOR. A device which provides the automatic gas ignition system with a signal indicating the presence or absence of flame.

FLAMMABLE LIMITS. The lowest (lower limit) and highest (higher limit) concentrations of a specific gas or vapor in a mixture with air that can be ignited at ordinary temperature and pressure of the mixture. Also called COMBUSTIBLE LIMITS.

FLUE. The general term for the passages and conduits through which flue gases pass from the combustion chamber to the outer air.

FLUE, APPLIANCE. The passage(s) within an appliance through which combustion products pass from the combustion chamber of the appliance to the draft hood inlet opening on an appliance equipped with a draft hood or to the outlet of the appliance on an appliance not equipped with a draft hood.

FLUE, CHIMNEY. The passage(s) in a chimney for conveying the flue or vent gases to the outside atmosphere.

FLUE COLLAR. A projection or recess provided and designed for attachment of a draft hood, vent connector, or venting system.

FLUE COLLECTOR. The general term for a device built into the appliance which collects the flue gases leaving the heat exchanger and directs the flow of flue gases to the flue collar.

FLUE GAS BAFFLE. An object in the path of the flue gases and exposed to flue gases or radiant heat, which is intended to restrict or modify flue gas flow. It may be a projection from the heat exchanger or suspended in the flue gas passages by some other means.

FLUE GASES. Products of combustion plus excess air in appliance flues or heat exchangers.

FLUE LOSSES. The sensible heat and latent heat above room temperature of the flue gases leaving the appliance.

FLUE OUTLET (VENT). The opening provided in an appliance for the escape of the flue gases.

GAS VENT. A passageway composed of listed factory-built components assembled in accordance with the terms of listing for conveying vent gases from gas appliances or their vent connectors to the outside atmosphere.

HEATING ELEMENT. All parts which transmit heat from flames or flue gases to the medium being heated and in contact with both.

HEATING VALUE (TOTAL). The number of British Thermal Units produced by the combustion at constant pressure of 1 cubic foot of gas when the products of combustion are cooled to the initial temperature of the gas and air, when the water vapor formed during combustion is condensed, and when all the necessary corrections have been applied.

IGNITER. A device which utilizes electrical energy to ignite gas at a pilot burner or main burner.

IGNITER FAILURE RESPONSE TIME. The period of time between loss of the supervised proved igniter and the action to shut off the gas supply.

IGNITER, PROVED. An igniter which is proven to be capable of ignition prior to initiating gas flow.

IGNITER PROVING TIME. The period of time between energizing the igniter and the action to allow gas flow.

IGNITION DEVICE. A device for igniting gas at a burner. It may be a pilot or an igniter.

IGNITION DEVICE, DIRECT. An igniter utilized to ignite gas at a main burner.

IGNITION SOURCE.

1. **Continuous.** An ignition source which, once placed in operation, is intended to remain ignited or energized continuously until manually interrupted.
2. **Intermittent-Continuous.** An ignition source which is ignited or energized upon appliance user initiation of the operational cycle and which remains continuously ignited or energized during the appliance use cycle. The ignition source is extinguished or deenergized when the appliance use cycle is completed.
3. **Intermittent.** An ignition source which is automatically ignited or energized when an appliance is called on to operate and which remains continuously ignited or energized during each period of main burner operation. The ignition source is automatically extinguished or deenergized when each main burner operating cycle is completed.
4. **Intermittent-Interrupted.** An ignition source which is ignited or energized upon appliance user initiation of the operational cycle and which is extinguished or deenergized after the appliance use cycle has been initiated.
5. **Interrupted.** An ignition source which is automatically ignited or energized when an appliance is called on to operate and is automatically extinguished or deenergized during the Trial For Ignition Period.

IID. (See Intermittent Ignition System.)

INPUT FLOW RATIO CONTROL VALVE. A manual valve usually with stops set to limit the gas flow to the maximum required input rate.

INPUT RATING. The gas-burning capacity of an appliance in Btu per hour as specified by the manufacturer.

INTERLOCK. A control to prove the physical state of a required condition, and to furnish that proof to the safety shutoff device circuit.

INTERMITTENT IGNITION SYSTEM. A system in which the ignition source is automatically shut off when the appliance is in an off or standby condition.

LIMIT CONTROL. A device which acts automatically to interrupt the gas flow to the main burner(s) when the outlet water temperature or steam pressure exceeds the maximum allowable for the equipment. This device is not considered an operating control.

LIQUEFIED PETROLEUM GASES. The terms "Liquefied Petroleum Gases," "LPG" and "LPGas" as used in this standard shall mean and include any material which is composed predominantly of any of the following hydrocarbons, or mixtures of them: propane, propylene, butanes (normal butane or isobutane), and butylenes.

LISTED. Equipment or materials included in a list published by a nationally recognized testing laboratory, inspection agency, or other organization concerned with product evaluation that maintains periodic inspection of production of listed equipment or materials, and whose listing states either that the equipment or material meets nationally recognized standards or has been tested and found suitable for use in a specified manner.

LOCKOUT. The automatic action to end an ignition sequence.

- a. **Hard Lockout.** Reinitiating another ignition sequence requires a manual operation at the appliance or interruption of the main electrical power supply to the appliance.

- b. **Soft Lockout.** Reinitiating another ignition sequence is accomplished by manual or automatic means which may be remote from the appliance.

LOCKOUT TIME. The period of time between energizing the system and lockout if proof of the supervised ignition source or the supervised main burner is not established.

LOW WATER CUTOFF. A device constructed so as to automatically cut off the fuel supply when the surface of the water in a boiler falls to the lowest safe water level. This point should not be lower than the bottom of the water-glass.

LP GAS-AIR MIXTURE. Liquefied petroleum gases distributed at relatively low pressures and normal atmospheric temperatures which have been diluted with air to produce desired heating value and utilization characteristics.

MAIN BURNER. A device or group of devices essentially forming an integral unit for the final conveyance of gas or a mixture of gas and air to the combustion zone, and on which combustion takes place to accomplish the function for which the appliance is designed.

MANIFOLD. The conduit of an appliance which supplies gas to the individual burner.

MANUAL BURNER TEST FIRING VALVE. A manually operated lubricated plug-type variable position valve which is usually operated with an attached handle or, in the larger sizes, by a loose fitting or extended wrench downstream of all other valves on the valve train.

MANUAL PILOT SHUTOFF VALVE. A manually operated valve in the gas line for the purpose of completely turning on or shutting off the gas supply to the pilot(s).

MAXIMUM REGULATION CAPACITY. The high limit of flow below which is found acceptable regulating characteristics.

MIXER. The combination of mixer head, mixer throat and mixer tube.

1. **Mixer Head.** The portion of an injection (Bunsen) type burner, usually enlarged, into which primary air flows to mix with the gas stream.
2. **Mixer Throat.** The portion of the mixer which has the smallest cross-sectional area and which lies between the mixer head and the mixer tube.
3. **Mixer Tube.** The portion of the mixer which lies between the throat and the burner head.

MIXER FACE. The air inlet end of the mixer head.

MULTITRY SYSTEM. An ignition system that allows for more than one trial for ignition period during the ignition sequence.

NONCOMBUSTIBLE MATERIAL. For the purpose of this standard, material which is not capable of being ignited and burned, such as materials consisting entirely of, or a combination of, steel, iron, brick, tile, concrete, slate, asbestos, glass and plaster.

NONDISPLACEABLE ROTOR MEMBER. A valve member which cannot be moved from its seat by a force applied to the valve handle, or force applied by a plane surface to any exterior portion of the valve.

NORMAL BUTANE (nBUTANE), TECHNICAL GRADE. A liquefied petroleum gas composed of a minimum of 95 percent n-butane (C_4H_{10}) which may contain other impurities such as isobutane, butylenes and propane not in excess of 5 percent.

NORMAL INLET TEST PRESSURES. Those pressures specified for testing purposes at which adjustment of burner ratings and primary air adjustments are made.

OPERATING CONTROL. A device which acts to automatically control either the outlet water temperature or steam pressure delivered by the appliance or the temperature of the space to be heated.

OPERATING VALUE. An operating value is an automatic value controlled by an operating control.

ORIFICE. The opening in an orifice cap, orifice spud or other device whereby the flow of gas is limited and through which the gas is discharged.

ORIFICE SPUD. A removable plug or cap containing an orifice which permits adjustment of the flow of gas by substitution of a spud with a different size orifice.

PACKAGED BURNER. A burner that is factory-built as a single assembly or as two or more subassemblies that include all essential parts necessary for its normal function when installed as intended.

PILOT. A gas flame(s) utilized to ignite gas at a main burner(s).

PIEZO-ELECTRIC. A characteristic of some materials by which electrical energy is generated as a result of an application of a pressure or impact to the material.

PIEZO-ELECTRIC SPARK GAS IGNITION SYSTEM. A combination of a piezo-electric spark generator, high voltage lead(s) and a spark electrode(s) designed to ignite pilot burner gas at an appliance burner.

PORT. Any opening in a burner head through which gas or a gas-air mixture is discharged for ignition.

PRIMARY AIR. Air introduced into a burner at the mixer head which mixes with the gas before reaching the port(s).

PRIMARY AIR INLET. The opening(s) through which primary air is admitted into a burner.

PROPANE HD-5. A special grade of liquefied petroleum gas composed of a minimum of 90 percent liquid volume of propane (C_3H_8) and a maximum of 5 percent liquid volume of propylene (C_3H_6).

QUALIFIED AGENCY. Any individual, firm, corporation, or company that either in person or through a representative is engaged in and is responsible for (a) the installation, testing, or replacement of gas piping or (b) the connection, installation, testing, repair, or servicing of equipment; that is experienced in such work; that is familiar with all precautions required, and that has complied with all the requirements of the authority having jurisdiction.

RADIATION SHIELD. A separate panel or panels interposed between heating surfaces and jackets to reduce heat losses through radiation.

REGULATION CAPACITY, RANGE. The high and low limits of flow between which is found acceptable regulating characteristics. For regulators designed to control pilot flow, the minimum regulation capacity is 0.15 cubic foot per hour of 1,000 Btu per cubic foot 0.64 specific gravity gas for a regulator designed by the symbol $\textcircled{P}$, or 0.50 cubic foot per hour of 1,000 Btu per cubic foot 0.64 specific gravity gas for a regulator designated by the symbol $\nabla\textcircled{P}$.

REGULATOR, GAS APPLIANCE PRESSURE. A device for controlling a selected outlet gas pressure.

1. **Adjustable.**

- a. **Spring Type, Limited Adjustment.** A regulator in which the regulating force acting upon the diaphragm is derived principally from a spring, the loading of which is adjustable over a range of not more than ± 15 percent of the outlet pressure at the midpoint of the adjustment range.

- b. **Spring Type, Standard Adjustment.** A regulator in which the regulating force acting upon the diaphragm is derived principally from a spring, the loading of which is adjustable. The adjustment means shall be concealed.
- 2. **Convertible.** A regulator for conversion between gases having different heating values whose adjustment means can be positioned from one predetermined outlet pressure setting for one gas to another predetermined outlet pressure setting for the other gas with no intermediate pressure settings and without addition, deletion or substitution of parts.
- 3. **Multi-Rate.** A standard adjustment regulator, the multi-rate adjustment means of which is not concealed and which provides nonfield adjustable high and nonfield adjustable low-pressure settings for high-low rates on appliances.
- 4. **Nonadjustable.**
 - a. **Spring Type, Nonadjustable.** A regulator in which the regulating force acting upon the diaphragm is derived principally from a spring, the loading of which is not adjustable.
 - b. **Weight Type.** A regulator in which the regulating force acting upon the diaphragm is derived from a weight or combination of weights.

SAFETY CIRCUIT. A circuit or portion thereof involving one or more safety controls.

SAFETY SHUTDOWN. Shutting off of the fuel as the result of the action of a safety control or the detection of an internal fault of the automatic gas ignition system.

SAFETY SHUTOFF DEVICE. A device that will shut off the gas supply to the controlled burner(s) in the event the source of ignition fails. This device may interrupt the flow of gas to the main burner(s) only, or to the pilot(s) and main burner(s) under its supervision.

SECONDARY AIR. The air externally supplied to the flame at the point of combustion.

SPARK ELECTRODE. The component of a piezo-electric spark gas ignition system which provides the point from which electrical energy is released to produce an arc. This component includes insulation means, a metallic conductor and provision for connection of the high voltage lead(s).

SPARK GENERATOR. The component of a piezo-electric spark gas ignition system which produces electrical energy by the use of a piezo-electric material.

SPECIFIC COMPONENT IDENTIFICATION. The identification of specific components that have been design certified as part of a boiler in accordance with this standard.

SPECIFIC GRAVITY. As applied to gas, the ratio of the weight of a given volume to that of the same volume of air, both measured at the same temperature and pressure.

TOOLS, SPECIAL. Those tools which are not available on the open retail market.

VALVE. (Gas)

- 1. **Automatic.** An automatic or semiautomatic device consisting essentially of a valve and operator that controls the gas supply to the burner(s) during normal operation of an appliance. The operator may be actuated by application of gas pressure on a flexible diaphragm, by electrical means, by mechanical means or by other means.
- 2. **Burner.** A manually or mechanically operated valve which permits control of the flow of gas.

3. **Diaphragm Type Automatic.** A device consisting essentially of an automatic valve actuated by means of the application of gas pressure upon a flexible diaphragm.
4. **Electric Type Automatic.** A device actuated by electrical energy for controlling the gas supply.
5. **Manual Main Shutoff.** A manually operated valve in the gas line for the purpose of completely turning on or shutting off the gas supply to the appliance, except to pilot(s) provided with independent shutoff valves.
6. **Safety Shutoff.** A valve that is automatically closed by the safety control system or by an emergency device. Such valve may be of the automatic or manually opened type.
7. **Semi-Automatic.** A valve that is opened manually and closed automatically, or vice versa.

VALVE. (Safety)

1. **Pressure-Temperature Relief.** An automatic relieving device actuated by the static pressure upstream of the valve (which opens further with increase in pressure over the opening pressure) or by temperature of the fluid. It is used primarily for liquid service.
2. **Safety.** An automatic pressure relieving device actuated by the static pressure upstream of the valve and characterized by full-opening pop action. It is used for gas or vapour service.
3. **Safety, Lift Off.** The movement of the disk off the seat of a safety, safety relief, or relief valve when the valve is opened. It normally refers to the amount of movement of the disk off the seat when the valve is discharging at rated pressure.
4. **Safety Relief.** An automatic pressure relieving device actuated by the pressure upstream of the valve and characterized by opening pop action with further increase in lift with an increase in pressure over popping pressure.

VENT. A passageway used to convey flue gases from gas utilization equipment, or their vent connectors, to the outside atmosphere.

VENTAIR INTAKE TERMINAL. The device used with a direct vent appliance which is located on the outside of the structure through which the air for combustion is taken from the outdoor atmosphere and from which flue gases are discharged.

1. **Air Intake Terminal.** The fitting at the inlet of the air intake pipe that allows entrance of the outdoor atmosphere to the air intake pipe.
2. **Vent Terminal.** The fitting at the end of the vent pipe that directs the flue gases to the outdoor atmosphere.

VENT CONNECTOR. That portion of the venting system which connects the gas appliance to the gas vent, chimney or singlewall metal pipe.

VENT GASES. Products of combustion from gas appliances plus excess air, plus dilution air in the venting system above the draft hood or draft regulator.

VENT LIMITER. A means which limits the flow of gas from the atmospheric diaphragm chamber to atmosphere in the event of diaphragm rupture. This may be either a limiting orifice or a limiting device.

VENTING SYSTEM. The gas vent, chimney or single-wall metal pipe, and vent connector if used, assembled to form a continuous open passageway from the gas appliance to the outdoor atmosphere for the purpose of removing vent gases.

Appendix A

Pertinent References to ANSI Y14.15

(This appendix is informative and is not part of the standard.)

The following sections of ANSI Y14.15 are pertinent to wiring diagrams for gas appliances accessories.

15-2.2	Schematic Diagrams
15-2.3	Connection Diagrams
15-2.4	Interconnection Diagrams
15-3.6.1	Representation of Contacts
15-3.7	Abbreviations
15-3.11	Wire Colors
15-9.2.5	Circuit Arrangements
15-10.3.1	Views-Conn. Diagrams
15-10.3.2	Wiring Views
15-10.3.3	Device Representation

Appendix B

Wire Color Designations

(This appendix is informative and is not part of the standard.)

Wire color	Designation specified in 15-3.11 of ANSI Y14.15
Black	BK
Brown	BR
Red	R
Orange	O
Yellow	Y
Green	G
Blue	BL
Violet (Purple)	V (PR)
Gray (Slate)	GY (S)
White	W

Appendix C

Recommended Wire Color Usage

(This appendix is informative and is not part of the standard.)

Line Voltage Conductors

Single Phase				Three Phase		Three Phase/Single Phase	
	120v	240v	*120v/240v	208v		208v/120v*	240v/208v*
	208v	480v		240v		240v/277v*	
	277v			480v			
				(Alternative)		(Alternative)	
L ₁ (Hot)	Black	Black	Black	Black	Black	Black	Black
L ₂ (Neutral)	White	—	White	—	—	White	White
L ₂ (Hot)	—	Red	Red	Black	Red	Black	Red
L ₃ (Hot)	—	—	—	Black	Blue	Black	Blue

The equipment grounding conductor shall be Green, Green with Yellow stripe(s), or bare.

*120v, 208v, 277v circuits, — use Black & White

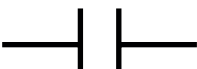
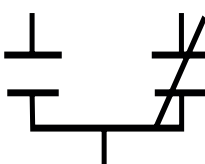
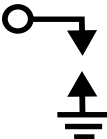
Line Voltage Component Leads

Capacitors		Brown
Single Phase Multi-Speed Motors	Common (208v, 240v, 480v)	Purple
	Common (120v, 277v) (Neutral)	White
	High Speed	Black
	Low Speed	Red
	Medium Speed	Blue

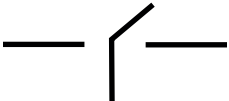
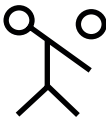
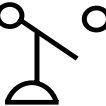
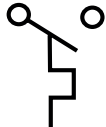
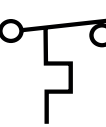
Appendix D

Preferred Graphic Symbols Of Commonly Used Items, Extracted From Standard ANSI/IEEE 315, Graphic Symbols For Electrical And Electronics Diagrams, And Abbreviations For These Items

(This appendix is informative and is not part of the standard.)

Item description	Abbreviation	Symbol	IEEE Standard 315 Section reference
Capacitor (*Closest To Grnd)	CAP		2.2.1
Coil, Relay	R		4.5
Contact, Normally Closed	N.C.		4.3.1
Contact, Normally Open	N.O.		4.3.2
Contact, Transfer Single Pole Double Throw	S.P.D.T.		4.3.3
Crossing of Paths (Conductors not Connected)	—		3.1.5
Fuse, General	FUSE		9.1.1
Ground (Direct Circuit Return to Earth)	GND		3.9.1
Igniter; Glow Bar, Glow Coil, Hot Wire	IGN		—
Igniter, Spark, Grounded	IGN		—
Igniter, Spark, Ungrounded	IGN		—

(Continued)

Item description	Abbreviation	Symbol	IEEE Standard 315 Section reference
Junction of Paths (Conductor or Cable)	—		3.1.6.3
Link, Fusible	FL		2.12.3
Motor, General	MOT		13.1.3
Resistor, Adjustable	RES		2.1.3
Resistor, Heating	RES		2.1.8
Resistor, Variable	RES		2.1.4
Switch, Double Throw General	S.P.D.T.		4.6.2
Switch, Normal Closed Time Delay Opening	N.C.SW		4.16.2
Switch, Normally Open Time Delay Closing	N.O.SW		4.16.1
Switch, Pressure or Vacuum Actuated (Closes on Rising Pressure)	N.O.SW		4.19.1
Switch, Single Throw General	N.O.SW		4.6.1
Switch, Temperature Actuated (Closes on Rising Temperature)	N.O.SW		4.20.1
Switch, Temperature Actuated (Opens on Rising Temperature)	N.C.SW		4.20.2
Transformer, Magnetic Core Nonsaturating	TRAN.		6.4.2.1

Appendix E ***Sample Failure Modes and Effects Analysis For Component Miswiring****

MODEL NO.		REFERENCES: Mode	
SUBMITTED BY:		Mode description:	
DATE:			
ELECTRICAL COMPONENT	WIRING MODE	EFFECT AND CONSEQUENCES	FAILURE CONTROL ACTIONS
Limit, L1	Lead H1 disconnected	Main valve circuit open	No main burner gas. Safe condition.
Limit, L1	Lead H1, H2 Interchanged	None	Normal operation.
Ignition control	Lead disconnected from Terminal 7	Pilot Igniter disabled	No pilot ignition. No main burner gas. Pilot gas locks out after 15 seconds.

* For reference only, background information on FEMA can be found in Procedures for Performing a Failure, Mode, Effects and Critical Analysis, MIL-STD-1629A, dated December 24, 1980.

Appendix F

Table of Conversion Factors

(This appendix is informative and is not part of the standard.)

Quantity	U. S. Unit		Multiplying Factor		SI Units*	
	Name	Symbol	U.S. to SI	SI to U.S.	Symbol	Name
TORQUE	ounce-force-inch	ozf-in	7.061×10^{-3}	141.62	N•m	newton-meter
	pound-force-inch	lbf-in	1.129×10^{-1}	8.85	N•m	newton-meter
	pound-force-foot	lbf-ft	1.355	7.38×10^{-1}	N•m	newton-meter
LENGTH	inch	in	2.540×10^{-2}	39.37	m	meter
	inch	in	2.540×10^{-2}	39.37×10^{-3}	mm	millimeter
	foot	ft	3.048×10^{-1}	3.281	m	meter
AREA	square inch	in ²	6.452×10^{-4}	1550	m ²	square meter
	square inch	in ²	6.452×10^{-4}	1550×10^{-6}	mm ²	square millimeter
	square foot	ft ²	9.290×10^{-2}	10.76	m ²	square meter
VOLUME	cubic inch	in ³	1.639×10^{-5}	61.02×10^3	m ³	cubic meter
	cubic foot	ft ³	2.832×10^{-2}	35.31	m ³	cubic meter
	cubic foot	ft ³	2.832×10^{-2}	35.31×10^{-3}	l	liter
	gallon	gal	3.785×10^{-3}	264.1	m ³	cubic meter
	gallon	gal	3.785	264.1×10^{-3}	l	liter
VELOCITY	foot/second	ft/s	3.048×10^{-1}	3.281	m/s	meter/second
	foot/minute	ft/min	5.080×10^{-3}	196.8	m/s	meter/second
	mile/hour	m/hr	4.470×10^{-1}	2.236	m/s	meter/second
	mile/hour	m/hr	1.609	6.214×10^{-1}	k/hr	kilometer/hour
ACCELERATION	foot/second ²	ft/s ²	3.048×10^{-1}	3.281	m/s ²	meter/second ²
FREQUENCY	cycle/second	c/s	1	1	Hz	hertz
MASS	ounce	oz	2.835×10^{-2}	35.27	kg	kilogram
	ounce	oz	2.835×10^{-2}	35.27×10^{-3}	g	gram
	pound	lb	4.536×10^{-1}	2.204	kg	kilogram
	grain	gr	6.480×10^{-5}	15.43×10^{-3}	kg	kilogram
MASS PER UNIT AREA	pound/foot ²	lb/ft ²	4.882	2.048×10^{-1}	kg/m ²	kilogram/meter ²
MASS PER UNIT VOLUME	pound/foot ³	lb/ft ³	1.602×10	6.243×10^{-2}	kg/m ³	kilogram/meter ³
SPECIFIC VOLUME	foot ³ /pound	ft ³ /lb	6.243×10^{-2}	1.602×10	m ³ /kg	meter ³ /kilogram
MASS FLOW RATE	pound/hour	lb/hr	1.260×10^{-4}	7.936×10^3	kg/s	kilogram/second
	pound/foot ² •hour	lb/ft ² •hr	1.356×10^{-3}	7.374×10^2	kg/m ² s	kilogram/meter ² •second
	pound/inch ² •hour	lb/in ² •hr	1.953×10^{-1}	5.120	kg/m ² s	kilogram/meter ² •second
VOLUME FLOW RATE	foot ³ /second	ft ³ /s	2.832×10^{-2}	35.31	m ³ /second	meter ³ /second
	foot ³ /second	ft ³ /s	2.832×10^{-2}	35.31×10^{-3}	l/s	liter/second
	foot ³ /minute	ft ³ /min	4.719×10^{-4}	2.119×10^{-3}	m ³ /s	meter ³ /second
	foot ³ /minute	ft ³ /min	4.719×10^{-4}	2.119×10^{-3}	l/s	liter/second
	gallon/minute	gal/min	6.309×10^{-5}	1.585×10^{-4}	m ³ /s	meter ³ /second
	gallon/minute	gal/min	6.309×10^{-5}	1.585×10^{-4}	l/s	liter/second
	gallon/hour	gal/hr	1.052×10^{-6}	9.505×10^{-5}	m ³ /s	meter ³ /second
	gallon/hour	gal/hr	1.052×10^{-6}	9.505×10^{-5}	l/s	liter/second
PRESSURE	pound force/inch ²	lbf/in ²	6.895×10^3	1.450×10^{-4}	Pa	pascal
	pound force/foot ²	lbf/ft ²	4.788×10	2.088×10^{-2}	Pa	pascal
		inch H ₂ O (4°C)	2.491×10^2	4.014×10^{-3}	Pa	pascal
	atmosphere	inch Hg (0°C)	3.386×10^3	2.953×10^{-4}	Pa	pascal
		atm (std)	1.013×10^5	9.871×10^{-6}	Pa	pascal
	pounds/square inch***	psi	2.768×10	3.613×10^{-2}	iwc	inch water column
	pounds/square inch	psi	6.895×10	1.450×10^{-2}	mb	millibar
	inch water column	iwc	2.491	4.015×10^{-1}	mb	millibar
ENERGY, WORK, QUANTITY OF HEAT		Btu	1.055×10^3	9.478×10^{-4}	J	joule
	horsepower hour	hph	1.055	9.478×10^{-1}	kJ	kilojoule
	horsepower hour	hph	2.685×10^6	3.724×10^{-7}	J	joule
	horsepower hour	hph	2.685	3.724×10^{-1}	MJ	megajoule
	kilowatt hour	kwhr	3.6×10^5	2.777×10^{-7}	J	joule
	kilowatt hour	kwhr	3.6	2.777×10^{-1}	MJ	megajoule
POWER, HEAT FLOW RATE		Btu/hr	2.931×10^{-1}	3.412	W	watt
		Btu/hr	2.931×10^{-4}	3.412×10^3	kW	kilowatt
		hp	7.457×10^2	1.341×10^{-3}	W	watt
		hp	7.457×10^{-1}	1.341	kW	kilowatt
	ton refrigeration (12,000 Btu/hr)		3.516×10^3	2.844×10^{-4}	W	watt
	ton refrigeration (12,000 Btu/hr)		3.516	2.844×10^{-1}	kW	kilowatt
	Btu/hour	Btu/hr	2.929×10^{-4}	3.414×10^3	kW	kilowatt
	Btu/hour•foot ²	Btu/hr•ft ²	3.155	3.1695×10^{-1}	W/m ²	watt/meter ²
HEAT CAPACITY	Btu/degree F	Btu/°F	1.899×10^3	5.265×10^{-4}	J/°C	joule/degree Celsius
SPECIFIC HEAT CAPACITY	Btu/pound•degree F	Btu/lb•°F	4.187×10^3	2.388×10^{-2}	J/kg•°C	joule/kg•degree Celsius
	Btu/pound•degree F	Btu/lb•°F	4.187	2.388×10^{-5}	kJ/kg•°C	kilojoule/kg•degree Celsius
LATENT HEAT	Btu/pound	Btu/lb	2.326×10^3	4.299×10^{-4}	J/kg	joule/kilogram
	Btu/pound	Btu/lb	2.326	4.299×10^{-1}	kJ/kg	kilojoule/kilogram
VOLUME AT STD. CONDITIONS**	ft ³ (60°F, 30 inches Hg, sat)		.9826	1.0177	ft ³ (60°F, 30 inches Hg, dry)	
	" " "		.02784	35.92	m ³ (15°C, 760 mm Hg, dry)	
	" " "		.02832	35.31	m ³ (15°C, 760 mm Hg, sat)	
	" " "		.02639	37.89	m ³ (0°C, 760 mm Hg, dry)	
	" " "		.02655	37.66	m ³ (0°C, 760 mm Hg, sat)	
HEATING VALUE	Btu/cubic foot	Btu/ft ³	3.752×10^{-2}	2.684×10	MJ/m ³	megajoule/meter ³

*SI Units (International System of Units) have been adopted by the International Gas Union for use within the gas industry. Where the same quantities have been defined by ISO (International Standards Organization), they are identical to the SI Units.

**Standard cubic foot (SCF) measured @ 60°F and 30 inches Hg, Saturated. (U.S. Conditions)

Standard cubic meter (ms³) measured @ 15°C and 760 mm Hg, dry. (SI Conditions)

Normal cubic meter (nm³) measured @ 0°C and 760 mm Hg, dry.

***U.S. unit to U.S. unit.

Temperature Scales and Conversions

The unit of temperature in the International System of Units (SI) is the kelvin (K), but it is generally accepted practice to express temperature differences in terms of degrees Celsius ($^{\circ}\text{C}$) because the degree intervals are identical. The term “centigrade” was abandoned in 1948 by the General Conference on Weights and Measures but in fact is still in common use. The accepted abbreviation for centigrade is also $^{\circ}\text{C}$ and for all practical purposes the degree intervals of centigrade, Celsius and kelvin, are identical.

Many temperature measurements are still made in terms of degrees Fahrenheit ($^{\circ}\text{F}$). Although a formal definition of the Fahrenheit scale does not exist, it is based on:

- (a) The freezing (ice) point of water = 32°F
- (b) The boiling point of water under standard pressure conditions = 212°F
- (c) The formula for absolute temperature, $5/9 (^{\circ}\text{F}-32) = ^{\circ}\text{C}$
- (d) The formula for “temperature rise,” $5/9 ^{\circ}\text{F} = ^{\circ}\text{C}$

$^{\circ}\text{C}$	$^{\circ}\text{F}$	$^{\circ}\text{C}$	$^{\circ}\text{F}$	$^{\circ}\text{C}$	$^{\circ}\text{F}$
-40	-40.0	25	77.0	70	158.0
-20	-4.0	30	86.0	80	176.0
0	32.0	35	95.0	90	194.0
10	50.0	40	104.0	100	212.0
15	59.0	50	122.0	110	230.0
20	68.0	60	140.0	120	248.0

Multiples and Submultiples of Basic Units

Factor by which the unit is multiplied	Prefix	Symbol
1 000 000 000 000 = 10^{12}	tera	T
1 000 000 000 = 10^9	giga	G
1 000 000 = 10^6	mega	M
1 000 = 10^3	kilo	k
100 = 10^2	hecto	h
10 = 10^1	deka	da
0.1 = 10^{-1}	deci	d
0.01 = 10^{-2}	centi	c
0.001 = 10^{-3}	milli	m
0.000 001 = 10^{-6}	micro	μ
0.000 000 001 = 10^{-9}	nano	n
0.000 000 000 001 = 10^{-12}	pico	p

List of Harmonized Z21/Z83 • CSA/CGA Series of American National Standards • CSA/Canadian Gas Association Standards for Gas Appliances and Gas Appliance Accessories

(The information in this list is informative and is not to be considered part of the standard.)

Appliances

Gas Clothes Dryers,

Volume I (Z21.5.1 • CSA 7.1) Type 1 Clothes Dryers

Volume II (Z21.5.2 • CSA 7.2) Type 2 Clothes Dryers

Gas Water Heaters,

Volume I (Z21.10.1 • CSA 4.1) Storage Water Heaters With Input Ratings of 75,000 Btu Per Hour or Less

Volume III (Z21.10.3 • CSA 4.2) Storage, With Input Ratings Above 75,000 Btu Per Hour, Circulating and Instantaneous Water Heaters

Gas-Fired Low Pressure Steam and Hot Water Boilers, Z21.13 • CSA 4.9

Refrigerators Using Gas Fuel, Z21.19 • CSA 1.4

Gas-Fired, Heat Activated Air Conditioning and Heat Pump Appliances, Z21.40.1 • CGA 2.91

Gas-Fired, Work Activated Air-Conditioning and Heat Pump Appliances (Internal Combustion), Z21.40.2 • CGA 2.92

Performance Testing and Rating of Gas-Fired Air-Conditioning and Heat Pumping Appliances, Z21.40.4 • CGA 2.94

Gas-Fired Central Furnaces (Except Direct Vent Central Furnaces), Z21.47 • CSA 2.3

Vented Decorative Gas Appliances, Z21.50 • CSA 2.22

Gas-Fired Pool Heaters, Z21.56 • CSA 4.7

Outdoor Cooking Gas Appliances, Z21.58 • CSA 1.6

Decorative Gas Appliances for Installation in Solid-Fuel Burning Fireplaces, Z21.60 • CGA 2.26

Portable Type Camp Heaters, Z21.63 • CSA 11.3

Portable Type Camp Cook Stoves, Z21.72 • CSA 11.2

Portable Type Camp Lights, Z21.73 • CSA 11.1

Vented Gas-Fired Space Heating Appliances, Z21.86 • CSA 2.32

Vented Gas Fireplace Heaters, Z21.88 • CSA 2.33

Outdoor Cooking Specialty Gas Appliances, Z21.89 • CSA 1.18

Accessories

Manually Operated Gas Valves for Appliances, Appliance Connector Valves and Hose End Valves, Z21.15 • CSA 9.1

Domestic Gas Conversion Burners, Z21.17 • CSA 2.7

Gas Appliance Pressure Regulators, Z21.18 • CSA 6.3

Automatic Valves for Gas Appliances, Z21.21 • CSA 6.5

Relief Valves for Hot Water Supply Systems, Z21.22 • CSA 4.4

Connectors for Gas Appliances, Z21.24 • CSA 6.10

Pilot Gas Filters, Z21.35 • CGA 6.8

Quick-Disconnect Devices for Use With Gas Fuel, Z21.41 • CSA 6.9

Gas Hose Connectors for Portable Outdoor Gas-Fired Appliances, Z21.54 • CGA 8.4

Automatic Vent Damper Devices for Use With Gas-Fired Appliances, Z21.66 • CGA 6.14

Connectors for Movable Gas Appliances, Z21.69 • CSA 6.16

Connectors for Outdoor Gas Appliances and Manufactured Homes, Z21.75 • CSA 6.27

Manually-Operated Piezo-Electric Spark Gas Ignition Systems and Components, Z21.77 • CGA 6.23

Combination Gas Controls for Gas Appliances, Z21.78 • CSA 6.20

Gas Appliance Sediment Traps, Z21.79 • CGA 6.21

Line Pressure Regulators, ANSI Z21.80 • CSA 6.22

Cylinder Connection Devices, ANSI Z21.81 • CSA 6.25

Automatic Gas Shutoff Devices for Hot Water Supply Systems, ANSI Z21.87 • CSA 4.6

Gas Convenience Outlets and Optional Enclosures, ANSI Z21.90 • CSA 6.24

Manually Operated Electric Gas Ignition Systems and Components, ANSI Z21.92 • CSA 6.29

List of Harmonized Z83/CGA Series of American National Standard/Canadian Gas Association Standards

Direct Gas-Fired Make-Up Air Heaters, Z83.4 • CSA 3.7

Gas-Fired Construction Heaters, Z83.7 • CSA 2.14

Gas Unit Heaters and Gas-Fired Duct Furnaces, Z83.8 • CSA 2.6

Gas Food Service Equipment, Z83.11 • CSA 1.8

Gas-Fired High Intensity Heaters, Z83.19 • CSA 2.35

Gas-Fired Tubular and Low Intensity Infrared Heaters, Z83.20 • CSA 2.34

List of LC Series of Harmonized Standards for Gas Equipment

Fuel Gas Piping Systems Using Corrugated Stainless Steel Tubing (CSST), LC1 • CSA 6.26

List of Z21 Series of American National Standards for Gas Appliances and Gas Appliance Accessories

Appliances

Household Cooking Gas Appliances, Z21.1

Gas-Fired Room Heaters, Volume II Unvented Room Heaters, Z21.11.2

Domestic Gas Conversion Burners, ANSI Z21.17

Gas-Fired Illuminating Appliances, Z21.42

Recreational Vehicle Cooking Gas Appliances, Z21.57

Gas-Fired Toilets, Z21.61

Portable Refrigerators for Use With HD-5 Propane Gas, Z21.74

Gas-Fired Unvented Catalytic Room Heaters for Use With Liquefied Petroleum (LP) Gases, Z21.76

Stationary Fuel Cell Power Systems, FC 1

Manually Lighted, Natural Gas Decorative Gas Appliances for Installation in Solid-Fuel Burning Fireplaces, Z21.84

Ventless Firebox Enclosures for Gas-Fired Unvented Decorative Room Heaters, Z21.91

Accessories

Draft Hoods, Z21.12

Automatic Gas Ignition Systems and Components, Z21.20

Gas Appliance Thermostats, Z21.23

Automatic Intermittent Pilot Ignition Systems for Field Installation, Z21.71

Installation

Domestic Gas Conversion Burners, Z21.8

List of Z83 Series of American National Standards

Gas-Fired Unvented Commercial and Industrial Heaters, Z83.16

Direct Gas-Fired Industrial Air Heaters, Z83.18

List of LC Series of American National Standards for Gas Equipment

Gas Piping Systems Using Corrugated Stainless Steel Tubing, LC1 • CSA 6.26

Direct Gas-Fired Circulating Heaters for Agricultural Animal Confinement Buildings, LC 2

Appliance Stands and Drain Pans, LC 3

Press-Connect Copper and Copper Alloy Fittings for Use in Fuel Gas Distribution Systems, LC 4 • CSA 6.32

Natural Gas Operated Diaphragm Pumps, LC 6

Pipe Joint Sealing Compound and Materials, LC 7

List of CSA/CGA Series of Canadian Gas Association Standards/National Standards of Canada for Gas Appliances and Gas Appliance Accessories

Appliances

Domestic Gas Ranges, CAN1-1.1-M81

Domestic Hot Plates and Laundry Stoves, CGA 1.3

Propane-Fired Cooking Appliances for Recreational Vehicles, CAN1-1.16

Gas-Fired Unvented Construction Heaters (Unattended Type), CGA 2.14

Gas-Fired Domestic Lighting Appliances, CAN1-2.15

Gas-Fired Appliances for Use at High Altitudes, CGA 2.17

Gas-Fired Appliances for Outdoor Installation, CAN1-2.21

Gas-Fired Waterless Toilet, CGA 5.2

Portable Type Gas Camp Refrigerators, CAN1-11.4

Accessories

Lever Operated Pressure Lubricated Plug Type Gas Shut-Off Valves, CGA 3.11

Lever Operated Non-Lubricated Gas Shut-Off Valves, CGA 3.16

Draft Hoods, CAN1-6.2

Automatic Gas Ignition Systems and Components, CAN1-6.4

Gas Appliance Thermostats, CAN1-6.6

Internal Relieved Service Regulators for Natural Gas, CGA 6.18

Residential Carbon Monoxide Detectors, CAN/CGA-6.19

Elastomeric Composite Hose and Hose Couplings for Conducting Propane and Natural Gas, CAN/CGA-8.1

Thermoplastic Hose and Hose Couplings for Conducting Propane and Natural Gas, CAN1-8.3

Manually Operated Shut-Off Valves for Gas Piping Systems, CGA 9.2

Installation

Definitions and General Field Recommendations, CGA 3.0

Natural Gas and Propane Installation Code, CGA B149.1

Code for Digester Gas and Landfill Installations, CAN/CGA-B105

Code for the Field Approval of Fuel-Related Components on Appliances and Equipment, CAN/CGA-B149.3

Performance

Testing Method for Measuring Annual Fuel Utilization Efficiencies of Residential Furnaces and Boilers, CSA P.2

Testing Method for Measuring Energy Consumption and Determining Efficiencies of Gas-Fired Water Heaters, CAN/CSA-P.3

Testing Method for Measuring Per-Cycle Energy Consumption and Energy Factor of Domestic Gas Clothes Dryers, CGA P.5

Testing Method for Measuring Thermal and Operating Efficiencies of Gas-Fired Pool Heaters, CGA P.6

Testing Method for Measuring Energy Loss of Gas-Fired Instantaneous Water Heaters, CAN/CSA-P.7

Thermal Efficiencies of Industrial and Commercial Gas-Fired Package Furnaces, CGA P.8

List of Canadian Gas Association Commercial/Industrial Standards

Gas-Fired Infra-Red Heaters, CAN1-2.16

Gas-Fired Appliances for Use at High Altitudes, CGA 2.17

Gas-Fired Brooders, CAN1-2.20

Gas-Fired Portable Infra-Red Heaters, CAN1-2.23

Decorative Gas Appliances for Installation in Solid Fuel Burning Fireplaces, CGA-2.26

Industrial and Commercial Gas-Fired Package Boilers, CAN1-3.1

Industrial and Commercial Gas-Fired Package Furnaces, CGA 3.2

Industrial and Commercial Gas-Designed Atmospheric-Fired Vertical Flue Boilers and Hot Water Supply Heaters, CGA 3.3

Industrial and Commercial Gas-Fired Conversion Burners, CGA 3.4

Gas-Fired Equipment for Drying Farm Crops, CAN/CGA-3.8

Direct Gas-Fired Door Air Heaters, CAN1-3.12

Internal Relieved Service Regulators for Natural Gas, CGA 6.18

STANDARDS PROPOSAL FORM

FAX OR MAIL TO:

CSA AMERICA, INC.
8501 East Pleasant Valley Road,
Cleveland, Ohio, U.S. 44131
Fax: (216) 520-8979

or CANADIAN STANDARDS ASSOCIATION
5060 Spectrum Way, Suite 100,
Mississauga, Ontario, Canada L4W 5N6
Fax: (416) 747-2473

DATE: _____ NAME: _____

ADDRESS: _____

TELEPHONE NUMBER: () _____

REPRESENTING (Please indicate organization, company or self):

1. a) Title of Standard: _____

b) Section/Paragraph Number and Title: _____

2. Proposal Recommends: (check one) ☐ New Text ☐ Revised Text ☐ Deleted Text

3. Proposal (Include proposed wording change(s)* or identification of wording to be deleted.
If proposed wording change(s) is not original, provide source.):

4. Statement of Rationale for Proposal:

5. ☐ This proposal is original material.

☐ This proposal is not original material, its source (if known) is as follows:

* (Note: Proposed wording and original material is considered to be the submitter's own idea based on, or as a result of, his/her own experience, thought or research, and to the best of his/her knowledge is not copied from another source.)

I hereby assign to CSA and CSA America Inc., all worldwide right, title, and interest in and to the proposed change(s) or original material listed above, including, but not limited to, the copyrights thereon and all subsidiary rights, including rights of publication in any and all media, therein.

Signature

PLEASE USE SEPARATE FORM FOR EACH PROPOSAL.

FOR OFFICE USE ONLY: _____ Date Received: _____



ISBN 978-1-55491-129-5