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Gas-fired low pressure steam and hot water boilers

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J. York	Rinnai America Corporation, Peachtree City, Georgia, USA	

S.M. Corcoran

CSA Group,
Cleveland, Ohio, USA

Project Manager

Preface

This is the Sixth edition of ANSI Z21.13 • CSA 4.9, *Gas-fired low pressure steam and hot water boilers*. It supersedes the previous editions published in 2014, 2013, 2010, 2004, and 2000.

This Standard was prepared by the Z21/CSA Joint Technical Sub-Committee on Standards for Gas-Fired Low Pressure Steam and Hot Water Boilers under the jurisdiction of the Technical Committee on Gas Appliances and Related Accessories, the Z21/83 Technical Committee on Performance and Installation of Gas Burning Appliances and Related Accessories, and the Strategic Steering Committee on Standards for Fuel Burning Appliances, and had been formally approved by the Technical Committee(s), American National Standards Institute, and the Interprovincial Gas Advisory Council.

Interpretations: The Strategic Steering Committee on Standards for Fuel Burning Appliances has provided the following direction for the interpretation of standards under its jurisdiction: “The literal text shall be used in judging compliance of products with the safety requirements of this Standard. When the literal text cannot be applied to the product, such as for new materials or construction, and when a relevant committee interpretation has not already been published, CSA's procedures for interpretation shall be followed to determine the intended safety principle.”

Notes:

- 1) *Use of the singular does not exclude the plural (and vice versa) when the sense allows.*
- 2) *This Standard contains SI (Metric) units corresponding to the yard/pound quantities, the purpose being to allow the standard to be used in SI (Metric) units. (IEEE/ASTM SI 10, American National Standard for Metric Practice, or ISO 80000-1:2009, Quantities and units – Part 1: General, is used as a guide in making metric conversion from yard/pound quantities.) If a value for a measurement and a corresponding value in other units are stated, the first stated value is to be regarded as the requirement. The given corresponding value may be approximate. If a value for a measurement and a corresponding value in other units are both specified as a quoted marking requirement, the first stated unit, or both, are to be provided.*
- 3) *Although the intended primary application of this Standard is stated in its Scope, it is important to note that it remains the responsibility of the users of the Standard to judge its suitability for their particular purpose.*
- 4) *This publication was developed by consensus, which is defined by CSA Policy governing standardization – Code of good practice for standardization as “substantial agreement. Consensus implies much more than a simple majority, but not necessarily unanimity.” It is consistent with this definition that a member may be included in the Technical Committee list and yet not be in full agreement with all clauses of this publication.*
- 5) *This Standard is subject to review at least every five years, and suggestions for its improvement will be referred to the appropriate committee. To submit a proposal for change, please send the following information to inquiries@csagroup.org and include “Proposal for change” in the subject line:*
 - a) *Standard designation (number)*
 - b) *relevant clause, table, and/or figure number;*
 - c) *wording of the proposed change; and*
 - d) *rationale for the change.*
- 6) *To submit a request for interpretation of this Standard, please send the following information to inquiries@csagroup.org and include “Request for interpretation” in the subject line:*
 - a) *define the problem, making reference to the specific clause, and, where appropriate, include an illustrative sketch;*
 - b) *provide an explanation of circumstances surrounding the actual field condition; and*
 - c) *where possible, phrase the request in such a way that a specific “yes” or “no” answer will address the issue.*

Committee interpretations are processed in accordance with the CSA Directives and guidelines governing standardization and are available on the Current Standards Activities page at standardsactivities.csa.ca.

History of the development of the Standards for Gas-Fired Low Pressure Steam and Hot Water Boilers

Note: *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.

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 fourth 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 March 13, 2013, and by the American National Standards Institute, Inc., on March 7, 2013.

The fifth 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 February 24, 2014, and by the American National Standards Institute, Inc., on November 26, 2013.

This, the sixth 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 April 22, 2017, and by the American National Standards Institute, Inc., on May 11, 2017.

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 Z21.13-2010 • CSA 4.9-2010
ANSI Z21.13a-2010 • CSA 4.9a-2010
ANSI Z21.13b-2012 • CSA 4.9b-2012

ANSI Z21.13-2014 • CSA 4.9-2014

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

ANSI Z21.13-2013 • CSA 4.9-2013

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

ANSI Z21.13-2017 • CSA 4.9-2017

Note: *This edition of Z21.13 • CSA 4.9 incorporates changes to the Fifth Edition issued in 2014. Changes other than editorial are noted in the margin.*

ANSI Z21.13-2017 • CSA 4.9-2017

Gas-fired low pressure steam and hot water boilers

1 Scope

1.1

This Standard applies to newly produced gas-fired low-pressure steam and hot water boilers with gas inlet pressure ratings not exceeding 0.5 psi (3.5 kPa) and having input ratings of less than 12,500,000 Btu/hr (3 663 389 W) (see Clause 3, 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 Clause 4, Construction.

The performance of boilers for use with the above-mentioned gases is covered under Clause 5, Performance.

* See Clause 7.2, Scope for boilers covered in Canada that exceed the above limits in gas inlet pressure and/or input ratings.

1.2

This Standard applies to indoor boilers, of other than the direct vent type which are categorized according to vent pressure and temperature as either Category I, Category II, Category III or Category IV (see Clause 3, Definitions), and to outdoor type boilers.

1.3

This Standard also applies to direct vent boilers (see Clause 3, 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 are subjected to such additional tests as believed necessary at the discretion of the testing agency.

1.4

See Clause 7, Items unique to Canada, for the Canadian Method of Test to determine combustion efficiency for indoor boilers and the thermal efficiency for both indoor and outdoor boilers.

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.

1.6

This Standard contains SI (Metric) corresponding to the yard/pound quantities, the purpose being to allow the Standard to be used in SI (Metric) units. (Standard for *Use of the International System of Units (SI): The Modern Metric System*, IEEE/ASTM SI 10 or ISO 80000-1:2009 *Quantities and units – Part 1: General* are used as a guide in making metric conversion from yard/pound quantities.) If a value for a measurement and a corresponding value in other units is stated, the first stated value is to be regarded as the requirement. The given corresponding value may be approximate. If a value for a measurement and corresponding value in other units are both specified as a quoted marking requirement, the first stated unit, or both shall be provided.

1.7

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

1.8

Clause 7, Items unique to Canada, contains clauses unique to, and required by, Canada.

1.9

In this Standard, “shall” is used to express a requirement, i.e., a provision that the user shall satisfy in order to comply with the standard; “should” is used to express a recommendation or that which is advised but not required; and “may” is used to express an option or that which is permissible within the limits of the standard.

Notes accompanying clauses do not include requirements or alternative requirements; the purpose of a note accompanying a clause is to separate from the text explanatory or informative material.

Notes to tables and figures are considered part of the table or figure and may be written as requirements.

Annexes are designated normative (mandatory) or informative (non-mandatory) to define their application.

2 Reference publications

This Standard refers to the following publications, and where such reference is made, it shall be to the edition listed below.

CSA Group

CSA B51-14

Boiler, Pressure Vessel and Pressure Piping Code

CSA C22.1-15

Canadian Electrical Code, Part 1

CAN/CSA C22.2, No. 0.3-09(R2014)

Test Methods for Electrical Wires and Cables

CSA C22.2 No. 0.15-15

Adhesive Labels

CSA C22.2 No. 3-M1988(R2014)

Electrical Features of Fuel-Burning Equipment

CSA C22.2 No.24-15

Temperature Indicating and Regulating Equipment

CSA C22.2, No. 49-14

Flexible Cords and Cables

CSA C22.2 No.77-14

Motors with Inherent Overheating Protection

CSA C22.2 No. 199-2007(R2012)

Combustion Safety Controls and Solid-State Igniters for Gas- and Oil-Burning Equipment

CSA C22.2 No. 210-15

Appliance Wiring Material Products

CAN1-6.4-M79(R2016)

Automatic Gas Ignitions System and Components

CSA C22.2 No. 239-09(R2014)

Control and Instrumentation Cables

CAN/CSA-2.17-M91(R2014)

Gas-Fired Appliances for Use at High Altitude

CSA B149.1-15

Natural Gas and Propane Installation Code

CSA-P.2-13

Testing Methods for Measuring Annual Fuel Utilization Efficiencies of Residential Gas-Fired Furnaces and Boilers

CAN1-3.1-77 (R2016)

Industrial and Commercial Gas-Fired Package Boilers

ANSI Z21.15-2009(R2014) • CSA 9.1-2009(R2014) and Addenda Z21.15a-2012(R2014) • CSA 9.1a-2012 (R2014) and Addenda ANSI Z21.15b-2013(R2014) • CSA 9.1b-2013(R2014)

Manually Operated Gas Valves for Appliances, Appliance Connector Valves and Hose End Valves

ANSI Z21.17-1998(R2014) • CSA 2.7-M98(R2014)

Domestic Gas Conversion Burners

ANSI Z21.18-2007(R2012) • CSA 6.3-2007(R2012)

Gas Appliance Pressure Regulators

ANSI Z21.20-2005(R2016) and Addenda ANSI Z21.20a-2008(R2016)

Automatic Gas Ignition Systems and Components

ANSI Z21.21-2015 • CSA 6.5-2015

Automatic Valves for Gas Appliances

ANSI Z21.35-2005(R2015) • CSA 6.8-2005(R2015)

Pilot Gas Filters

ANSI Z21.66-2015 • CSA 6.14-2015

Automatic Vent Damper Devices for Use with Gas-Fired Appliances

ANSI Z21.77-2005(R2015) • CSA 6.23-2005(R2015)

Manually-Operated Piezo-Electric Spark Gas Ignition Systems and Components

ANSI Z21.78-2010(R2015) • CSA 6.20-2010(R2015)

Combination Gas Controls for Gas Appliances

American Gas Association

ANSI Z223.1-2015/NFPA 54-2015

National Fuel Gas Code

American National Standards Institute

ANSI/UL C101.1-1992

Leakage Current for Appliances

ANSI Y14.15-1966 (R1988)

Electrical and Electronics Diagrams

ASME International

ANSI/ASME CSD-1-2015

Controls and Safety Devices for Automatically Fired Boilers

ANSI/ASME B1.20.1-2016

Pipe threads, General Purpose (Inch)

ANSI/ASME B36.10M-2015
Welded and Seamless Wrought Steel Pipe

ANSI/ASME B94.11M-1993
Twist Drills

ASME PTC 19.3 TW-2016
Performance Test Codes - Temperature Measurement

ANSI/ASME BPVC 2015
Boiler and Pressure Vessel Code

ASTM International

ASTM A90/A90M-13
Standard Test Method for Weight (Mass) of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings

ASTM A653/A653M-15
Standard Specifications for Sheet Steel, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot Dip Process

ASTM B487-85(R2013)
Standard Test Method for Measurement of Metal and Oxide Coating Thickness by Microscopical Examination of a Cross Section

ASTM B499-2009(R2014)
Standard Test Method for Measurement of Coating Thicknesses by the Magnetic Method: Nonmagnetic Coatings on Magnetic Basis Metals

ASTM B504-90(R2011)
Standard Test Method for Measurement of Thickness of Metallic Coatings by the Coulometric Method

ASTM D1785-15
Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120

ASTM D2241-15
Standard Specification for Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)

ASTM D2661-14
Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) Schedule 40 Plastic Drain, Waste, and Vent Pipe and Fittings

ASTM D2665-14
Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings

ASTM D2846/D2846M-14
Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Hot- and Cold-Water Distribution Systems

ASTM F441/F441M-2015

Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Schedules 40 and 80

ASTM F442/F442M-13e1

Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe (SDR-PR)

ASTM F628-12e1

Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) Schedule 40 Plastic Drain, Waste, and Vent Pipe With a Cellular Core

Institute of Electrical and Electronic Engineers

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-10-2010

American National Standard for Metric Practice

National Fire Protection Association

ANSI/NFPA 54-2015/Z223.1-2015

National Fuel Gas Code

ANSI/NFPA 70-2014

National Electrical Code

Underwriters Laboratories, Inc.

UL 13-2015

Power Limited Circuit Cables

UL 62-2014

Flexible Cords and Cables

ANSI/UL 353-2011

Limit Controls

ANSI/UL 969-2008

Marking and Labeling Systems

3 Definitions

The following definitions shall apply in this Standard:

Air shutter — an adjustable device for varying the size of the primary air inlet(s).

Appliances, automatically controlled — appliances equipped with automatic devices that:

- a) accomplish complete “turn on” or “shut off” of the gas to the main burner(s); or
- b) 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, that 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:

- a) automatically ignite gas at the main burner or gas at the pilot burner so the pilot can ignite the main burner;
- b) prove the presence of either the ignition source, the main burner flame, or both; and
- c) 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

Automatic restart — the automatic action to initiate another ignition sequence after a soft lockout occurs.

Automatic restart time — the period of time between a soft lockout and the automatic action to initiate another ignition sequence.

Flame failure re-ignition time — the period of time between loss of the supervised ignition source or the supervised main burner flame and a re-ignition attempt. During this time period the main burner gas supply is not shut off.

Ignition activation period — the period of time between energizing the main gas valve and deactivation of the ignition means prior to the lockout time.

Igniter proving time — the period of time between energizing the igniter and achieving the proved igniter characteristic, which allows gas flow.

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.

Purge time — the period of time intended to allow for the dissipation of any unburned gas or residual products of combustion.

Pre-purge time — the purge time that occurs at the beginning of an appliance operating cycle prior to initiating ignition.

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 multi-try system.

Post-purge time — the purge time that occurs at the end of an appliance burner operating cycle.

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.

Trial for ignition period — the period of time between energizing and de-energizing the gas valve if proof of the supervised flame is not established.

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.

Electrically operated — an automatic vent damper device that employs electrical energy to control the device.

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, low pressure — 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.

Category I — a boiler that operates with a non-positive vent static pressure and with a vent gas temperature that avoids excessive condensate production in the vent.

Category II — a boiler that operates with a non-positive vent static pressure and with a vent gas temperature that may cause excessive condensate production in the vent.

Category III — a boiler that operates with a positive vent static pressure and with a vent gas temperature that avoids excessive condensate production in the vent.

Category IV — a boiler that 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

Boiler, hot water heating — a boiler designed to heat water for circulation through an external space heating system.

Boiler, hot water supply — a boiler used to heat water for purposes other than space heating.

Boiler, steam heating — a boiler designed to convert water into steam which is supplied to an external space heating system.