ANSI Z21.77-2005
CSA 6.23-2005

American National Standard/
CSA Standard For

Manually Operated Piezo-Electric Spark Gas Ignition Systems And Components

AMERICAN NATIONAL STANDARD
ANSI Z21.77-2005

CSA STANDARD
CSA 6.23-2005

Second Edition - 2005

This Standard is a revised edition
of the former Standard for

MANUALLY OPERATED PIEZO-ELECTRIC SPARK GAS IGNITION SYSTEMS AND COMPONENTS

ANSI Z21.77-1995 • CGA 6.23-M95
and Addenda
Z21.77a-1997 • CGA 6.23a-M97
Z21.77b-2004 • CGA 6.23b-2004

APPROVED

March 9, 2005
American National Standards Institute, Inc.

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Secretariats

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American National Standards Institute, Inc.
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Preface

This publication represents a basic standard for safe operation, substantial and durable construction, and acceptable performance of manually operated piezo-electric spark gas ignition systems and components for gas appliances. It is the result of years of experience in the manufacture, testing, installation, maintenance, inspection and research on manually operated piezo-electric spark gas ignition systems and components for gas appliances 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 manually operated piezo-electric spark gas ignition systems and components for gas appliances, the safety construction and performance of which may exceed the various provisions specified herein. In its preparation, full 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 Accredited Standards Committee Z21/83, 8501 East Pleasant Valley Road, Cleveland, Ohio 44131, or the Chairman of the CSA Technical Committee on Gas Appliances and Related Accessories, 5060 Spectrum Way, Mississauga, Ontario, Canada, L4W 5N6.

Safe and satisfactory operation of a pilot gas filter for gas appliances 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/Canadian Standards Association 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.

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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. In Canada the Standards Committee and the Interprovincial Gas Advisory Council normally stipulate an effective date for the standard.

History Of The Development Of Standard For Manually Operated Piezo-Electric Spark Gas Ignition Systems And Components

(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.

With the formation of joint subcommittees, a Canadian Gas Association Standards Steering Committee on Gas Burning Appliances and Related Accessories was established to parallel Accredited Standards Committees Z21 and Z83, and to support the formation of joint subcommittees. Operating procedures, in accordance with American National Standards Institute procedures, for joint subcommittees were developed and subsequently approved by ANSI on April 1, 1993.

At its September 23-24, 1992 meeting, the Joint Thermostat and Automatic Gas Igntion Systems Subcommittee adopted ANSI Z21.77 for distribution for review and comment as a harmonized standard, in that a comparable Canadian standard did not exist. The first draft harmonized manually operated piezo-electric spark gas ignition systems and components standard was distributed for review and comment during March 1994.

Following reconsideration and modification of the proposed harmonized draft standard for manually operated piezo-electric spark gas ignition systems and components, in light of comments received, the joint thermostat and automatic gas ignition systems subcommittee, at its July 14, 1994 meeting, recommended the proposed standard to the Z21 Committee and the CGA Standards Steering Committee, for approval.

The proposed harmonized standard for manually operated piezo-electric spark gas ignition systems and components was approved by the Z21 Committee by letter ballot dated January 17, 1995. The CGA Standards Steering Committee approved the proposed harmonized standard for manually operated piezo-electric spark gas ignition systems and components by letter ballot dated April 13, 1995.

The first edition of the American National Standard/CSA Standard for Manually Operated Piezo-Electric Spark Gas Ignition Systems and Components was approved by the Interprovincial Gas Advisory Council (IGAC) on October 19, 1995 and by the American National Standards Institute, Inc. (ANSI), on November 19, 1995.

The previous editions of the manually operated piezo-electric spark gas ignition systems standard, and addenda thereto, approved by the IGAC and ANSI are as follows:

ANSI Z21.77-1995 • CGA 6.23-M95
ANSI Z21.77a-1997 • CGA 6.23a-M97
ANSI Z21.77b-2004 • CGA 6.23b-2004

This the second edition of the standard was approved by the IGAC on April 1, 2005, and by ANSI on March 9, 2005.

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

ANSI Z21.77-2005 • CSA 6.23-2005

Note: *This edition of Z21.77 • CSA 6.23, incorporates changes to the 1995 edition and addenda thereto. Changes, other than editorial, are denoted by a vertical line in the margin.*

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Contents

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. Except as noted if in Exhibit A, 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.

Harmonized Standard For Manually-Operated Piezo-Electric Spark Gas Ignition Systems And Components

Part I: Construction

1.1 Scope

1.1.1 This standard applies to newly produced manually-operated piezo-electric spark gas ignition systems (see Part IV, Definitions), hereinafter referred to as piezo ignition systems, and components constructed entirely of new, unused parts and materials, which are intended to form an integral part of a gas appliance. A piezo ignition system shall perform the following functions:

a. Generate piezo-electric energy (spark generator);

b. Transmit the energy (high voltage leads); and

c. Utilize the energy to produce arcs (spark electrode).

Components submitted for examination under this standard shall perform one or more of the above functions; however, a component performing only b is not covered under the scope of this standard.

1.1.2 This standard applies to piezo ignition systems and components for use with one or more of the following gases:

a. Natural;

b. Manufactured;

c. Mixed;

d. Liquefied Petroleum; and

e. LP gas-air mixtures.

1.1.3 Compliance of a piezo ignition system or component with this standard does not imply that either is acceptable for use on gas appliances without supplemental tests with the device(s) applied to the particular appliance design.

1.1.4 Each component of a piezo ignition system shall be capable of operation throughout a temperature range of 32°F to 125°F (0°C to 51.5°C). A higher, lower, or both higher and lower temperature may be specified by the manufacturer.

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 psi throughout this standard are to be considered gage pressures unless otherwise specified.

1.1.7 Exhibit A contains provisions that are unique to Canada.

1.1.8 Exhibit B contains provisions that are unique to the United States.

1.1.9 Exhibit C contains a list of standards specifically referenced in this standard, and sources from which these reference standards may be obtained.

1.2 General

1.2.1 Construction of a piezo ignition system or component, whether specifically covered by this standard or not, shall be in accordance with reasonable concepts of safety, substantially and durability.

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 Construction shall be such that those parts generally recognized as removable for servicing cannot be assembled incorrectly in a manner that will result in unsafe operation.

1.2.3 The manufacturer shall provide the following information to the testing agency:

a. Minimum and maximum spark gaps.

b. Minimum and maximum lead lengths. (see 2.1.3.)

c. The minimum and the maximum recommended ambient temperatures for a piezo ignition system or component.

d. The maximum recommended ambient temperatures and points of measurement thereof, for the individual components of the system.

e. Maximum number of spark electrodes per each output terminal.

1.2.4 A piezo ignition system or component shall comply with the provisions of this standard throughout the spark gap range specified by the manufacturer.

1.2.5 If a complete system (see 1.1.1) is not submitted for examination under this standard, the manufacturer shall provide additional components necessary to complete the system for testing purposes only.

1.3 Threaded Fasteners

Bolts, nuts, screws and other threaded parts used in covers, housings casings and external mounting brackets shall have threads conforming to the Standard for *Unified Inch Screw Threads (UN and UNR Thread Form), ANSI B1.1* or the Standard for *Metric Screw Threads - M Profile, ANSI/ASME B1.13M.*

1.4 Adjustments

Suitable means for securing all adjustments shall be provided. This may be accomplished by the design of the component or by the use of a separate means.

1.5 Materials

1.5.1 Frames and mounting brackets of devices intended to be exposed to combustion chamber temperatures shall be constructed of material having a melting point of not less than 1450°F (788°C).

1.5.2 The manufacturer shall supply evidence acceptable to the testing agency that all materials have been evaluated and found to be suitable for their intended usage. Test data based on ASTM or other appropriate test procedures, certifications or historical data may be used for this purpose. The evidence shall show that the materials have been evaluated, as appropriate, for resistance to moisture, corrosion and the effects of fuel gases, including the sulfur compounds therein, and that seal materials are resistant to the effects of ozone.

1.6 Electrical

Coverage for electrical components and wiring is contained in Exhibits A, Items Unique to Canada, and B, Items Unique to the United States.

1.7 Instructions

Complete instructions covering installation, operation and field adjustment shall be furnished by the manufacturer with each type of device.

These instructions shall include:

a. Maximum and minimum spark gaps;

b. Maximum and minimum permissible lead lengths;

c. Maximum and minimum ambient temperatures (see 1.1.4). If any component(s) is for direct flame immersion, it shall be so noted; and

d. Specifications for additional component(s) required to complete the system.

1.8 Marking

1.8.1 Electrodes, when not an integral part of the system, shall bear a marking of the following:

a. Name, trademark or symbol of the manufacturer or listee; and

b. Model number or other positive means for identification.

1.8.2 Generators shall bear a marking of the following:

a. Name, trademark or symbol of the manufacturer or listee;

b. Model number or other positive means for identification; and

c. Symbol of the organization making the tests for compliance with this standard.

1.8.3 Each separable component shall bear a separate marking indicating the date of manufacture. This marking shall be specified in "-a," "-b" or "-c" below.

a. The date in the form of:

1. The month, day and year; or

2. The day, month and year.

The abbreviation of the month shall be at least the first three letters of the month. The day may be the Monday of the week and the year must be at least the last two digits of the year.

b. A four digit code consisting of:

1. The first and second digits indicating the calendar year in which the component was manufactured (e.g., 05 for 2005); and

2. The third and fourth digits indicating the week in which the component was manufactured (e.g., 03 for the third week of the year). For purposes of this marking, a week shall begin at 0001 hours on Sunday and end at 2400 hours on Saturday.

A four digit code may be used for more than one week; however, it shall not be used for more than four consecutive weeks, nor more than two weeks into the next calendar year.

If space limitation prevents the use of a four digit code, an alternative date code acceptable to the testing agency shall be provided.

Additional numbers, letters or symbols may follow the four digit code. If additional numbers are used, they shall be separated from the four digit code.

c. A five digit code consisting of:

1. The first and second digits indicating the calendar year in which the component was manufactured (e.g., 05 for 2005); and

2. The third, fourth and fifth digits indicating the day of the year in which the component was manufactured (e.g., 183 for the one hundred and eighty third day in the year 2005, which is July 2, 2005).

Additional numbers, letters or symbols may follow the five digit code. If additional numbers are used, they shall be separated from the five digit code

1.8.4 When different parts are required for use with various gases, a marking which complies with 2.7, Marking Material Adhesion and Legibility, shall be provided to identify the type(s) of gas for which the part is intended.

Part II: Performance

2.1 General

2.1.1 Piezo ignition systems and components shall be tested with the test gas(es) selected by the manufacturer, unless otherwise specified herein.

2.1.2 The tests specified in 2.3, Operating Effort, shall be conducted on two samples of the device. These same two test samples shall also be used for conduct of 2.4, Arc Overs, 2.5, Ignition, and 2.6, Endurance.

2.1.3 All components used during the tests specified in this standard shall be those supplied by the manufacturer (see 1.2.5).

2.1.4 Thermocouples of wire size not larger than No. 24 AWG (0.20 mm²) shall be attached by the testing agency to one device submitted for test and shall be used to preset the test chamber to develop the temperatures specified in 1.2.3-c.

2.1.5 Unless otherwise specified herein, tests shall be conducted with the electrode positioned adjacent to a test burner(s) having suitable port configuration in accordance with the relationship specified by the manufacturer. The specified dimensions and positions are given for test purposes only and are not to be construed as limiting the appliance application.

2.1.6 Unless otherwise specified herein, performance tests shall be conducted at a room temperature of 77 ±10°F (25 ±5.5°C).

For tests conducted at other than room temperature, the test temperature shall be within ±3°F (±1.5°C) of the specified value.

2.2 Test Gases

For all tests, gases with characteristics approximately as shown in Table I, Characteristics of Test Gases, shall be used as specified by the manufacturer. (See 2.1.1.)

When use with more than one type of gas is desired, the tests need be conducted with only one test gas, provided there are no changes in the device for use with different gases which, in the opinion of the testing agency, would affect the results of these tests.

2.3 Operating Effort

The operating effort shall not exceed, as applicable:

a. A torque of 5 lb/in (0.56 N•m) at an angular velocity of 180 degrees (3.14 rad) per second; or

b. A linear force of 8 lb (35.6 N).

Method of Test

Operating effort shall be measured on two spark generators both before and after conduct of 2.6, Endurance.

2.4 Arc-Overs

A piezo ignition system or component shall not produce arc-overs when tested as specified in the following Method of Test.

Method of Test

The two devices previously tested under 2.3, Operating Effort, shall be subjected to this test and both shall comply.

For this test the manufacturer's specified minimum high voltage lead length shall be used (see 1.2.3-b).

The piezo ignition system or component shall be installed in a manner to simulate application to an appliance in accordance with the manufacturer's instructions (see 1.7, Instructions). The electrode gap shall be adjusted to 150 percent of the maximum gap specified by the manufacturer.

The spark generator shall be operated ten times in a darkened room or test chamber with at least a five second waiting period between each operation.

There shall be no visual evidence of arc-overs at any point other than at the electrode gap.

2.5 Ignition

2.5.1 The test apparatus to be used for conducting ignition tests shall be provided by the manufacturer or the test agency, at the manufacturer’s discretion.

2.5.2 A piezo ignition system or component shall reliably ignite the test burner gas as specified in the following Method of Test.

Method of Test

Two devices previously tested under 2.3, Operating Effort, and 2.4, Arc-Overs, shall be subject to this test and both shall comply.

The piezo-electric generator of the ignition system shall be mounted in a test chamber with the articulating means projecting through a suitable opening in the chamber wall.

Each output terminal of a generator of the ignition system shall be connected to the specified number of spark electrodes. One spark electrode from each output shall be subjected, in turn, to the ignition test specified below.

If a component which does not include an electrode assembly is being examined, the electrode provided as part of the test burner assembly specified in 2.5.1 shall be used for test purposes. If a component which does not include a spark generator is being examined, the generator supplied by the component manufacturer for test purposes shall be used and Test Conditions I and II below shall not be conducted.

This test shall be conducted using the maximum high voltage lead length and the maximum spark gap specified by the manufacturer (see 1.2.3–a and –b).

Tests will be conducted under each of the following environmental conditions:

a. With the generator maintained at the manufacturer's specified maximum ambient temperature.

b. With the generator maintained at the manufacturer's specified minimum ambient temperature.

c. With all components maintained at 85 ± 5 percent relative humidity and 77 ± 10°F (25 ± 5.5°C).

The inlet test pressure to the burner shall be set at 3.5 iwc (871 Pa). For Test Conditions I and II, the components shall be stabilized for at least one hour. The ignition test shall then be conducted as follows:

Ten single ignition attempts shall be conducted at each of the specified test conditions. Each ignition attempt ends 4 seconds after gas is available at the test burner. There shall be at least a 5 minute waiting period between each attempt.

For each test condition, two or more ignition failures constitute noncompliance with this provision. If only one failure occurs, ten more attempts shall be conducted, all of which shall be successful.

2.6 Endurance

A piezo ignition system or component shall perform its intended function without failure or impairment of operation when cycled 10,000 times as specified in the following Method of Test.

Method of Test

The two devices previously tested under 2.3, Operating Effort, 2.4, Arc-Overs and 2.5, Ignition, shall be used for this test.

A spark generator shall be tested in accordance with Test Condition I.

An electrode(s) shall be tested in accordance with Test Condition II.

For a system, Test Conditions I and II may be conducted simultaneously.

These tests shall be conducted with the maximum spark gap dimension and maximum high voltage lead length specified by the manufacturer.

Test Condition I (Generator)

Two spark generators with appropriate electrodes connected (see 1.2.5) shall be cycled according to their intended usage in the following sequence.

a. 2000 cycles at the specified minimum ambient temperatures;

b. 6000 cycles at room temperature; and

c. 2000 cycles at the specified maximum ambient temperature(s).

Following completion of the 10,000 cycles, the two generators shall comply with 2.3, 2.4 and 2.5. The retest under 2.5 shall be conducted only with maximum component temperatures and maximum spark gap.

Test Condition II (Electrode)

Two spark electrodes shall be placed in a test chamber and operated by the spark generator to ignite a suitable test burner(s). If the spark electrode is being tested as a separate component, an appropriate spark generator shall be used (see 1.2.5). Upon ignition, the temperature of the component parts of the spark electrodes shall be raised to the maximum operating temperatures within plus 5 percent specified by the manufacturer (see 1.2.3-d). The test burner(s) shall then be cycled off and the component parts of the spark electrodes cooled to a temperature of 125°F (51.5°C) or less. The parts may be cooled naturally or by passing room temperature air over them as specified by the manufacturer.

This ignition-heating-cooling cycle shall be repeated for a total of 2500 cycles.

The test shall then be continued for an additional 7500 cycles as specified above except, on the cooling cycle, the component parts of the spark electrodes shall be cooled to 250°F (121°C).

Following completion of the 10,000 cycles, the two spark electrodes shall comply with 2.4 and test condition III of 2.5.2 at maximum spark gap.

2.7 Marking Material Adhesion And Legibility

The adhesive quality of marking materials and the legibility of all marking materials 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

These tests shall be conducted on two devices as received and following completion of the tests specified in 2.6, Endurance, or an equivalent period of time and temperature. The total test time shall not be less than two weeks. The manufacturer shall have applied the marking materials to the devices as they would be applied in production.

Each sample of marking material shall exhibit:

a. Good adhesion and no curling at edges;

b. No illegible or defaced printing by rubbing with thumb or finger pressure; and

c. Good adhesion when a dull metal blade (as the back of a pocketknife blade) is held at right angles to the applied marking and scraped across the edges of the marking.

The manufacturer shall supply evidence that the marking materials and adhesives will not be adversely affected by water.

Good adhesion qualities shall be obtained under all of the above test conditions.

Final acceptance of marking materials shall be based on the suitability of the application of the marking material to the device.

Tables Referenced In Parts I And II

Table I

Characteristics Of Test Gases

	Heating Value (Btu/ft^3)	Heating Value (MJ/m^3)	Sp Gr (Air = 1.0)
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	(93.2)	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

Exhibit A
Items Unique To Canada

A.1 All installation and marking provisions specified in this standard are required to be in a form easily understood in both English and French.

A.2 Units of measurement required on printed instructions and markings shall include the SI (metric) values as a minimum.

A.3 Electrical equipment and wiring supplied on the system shall comply with the applicable sections of the current Standard for *Electrical Features of Fuel-Burning Equipment, CSA C22.2 No. 3.*

Exhibit B
Items Unique To The United States

B.1 Electrical

B.1.1 Electrical components and wiring supplied as part of the system shall be of approved types or shall be investigated as an integral part of the system for construction and performance equivalent to approved types.

Electrical components 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 an approved type.

B.1.2 Material used for electrical construction shall be judged with respect to its suitability for the particular application.

a. Electrical insulation shall be of moisture-resistant material.

b. In determining the acceptability of an electrical insulating material, consideration shall be given to its mechanical strength, dielectric strength, heat-resistant properties, the degree to which it is enclosed or protected, and any other features having a bearing on its application in the device.

c. Where corrosion could interfere with the electrical characteristics of the device, parts shall be constructed of corrosion-resistant material or have a corrosion-resistant finish.

d. Electrode insulators shall be impervious to moisture and cleanable by wiping.

B.1.3 High-voltage leads shall consist of a cable recognized as acceptable for the purpose and conforming to a suitable nationally recognized standard. Leads shall be provided with means to facilitate positive connection at each end. The leads may be integrally joined to the generator or electrode or both.

B.1.4 Electrodes shall be designed so that they may be locked into proper position.

Exhibit C
List Of Reference Standards

AMERICAN SOCIETY OF MECHANICAL ENGINEERS
United Engineering Center, 345 East 47th Street, New York, New York 10017

ANSI/ASME B1.1-1989, Unified Inch Screw Threads (UN and UNR Thread Form)

ANSI/ASME B1.13M-1983 (R1989), Metric Screw Threads - M Profile

AMERICAN SOCIETY FOR TESTING AND MATERIALS
100 Barr Harbor Dr., West Conshohocken, Pennsylvania 19428-2959

IEEE/ASTM SI-10-02, Standard for Use of the International System of Units (SI): The Modern Metric System

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

CAN/CSA Z234.1-00, Canadian Metric Practice Guide

CSA C22.2 No. 3-M1988 (R1999), Electrical Features of Fuel-Burning Equipment

CAN/CGA-B149.1-2000, Natural Gas Installation Code

INSTITIUTE OF ELECTRICAL AND ELECTRONIC ENGINEERS
445 Hose Lane, Piscataway, New Jersey 08855-1331

IEEE/ASTM-S1-10-2002, Standard for Use of the International System of Units (SI): The Modern Mertric System

NATIONAL FIRE PROTECTION ASSOCIATION
1 Batterymarch Park, P.O. Box 9101, Quincy, Massachusetts 02269

NFPA 54-2002/ANSI Z223.1-2002, National Fuel Gas Code

Part III: Manufacturing And Production Tests

The manufacturer shall submit to the certifying agency a plan which is mutually acceptable to the manufacturer and certifying agency and which describes the programs and test procedures specified in 3.1 and 3.2 and the records to be kept by the manufacturer.

3.1 The manufacturer shall use a program to qualify raw materials, parts, assemblies and purchased components.

3.2 The manufacturer shall use a program which includes a mutually acceptable schedule(s) to conduct the following tests:

a. Operating Effort (2.3);

b. Arc-Overs (2.4);

c. Ignition (2.5.2); and

d. Endurance (2.6).

3.3 The manufacturer's test method(s) shall be capable of relating back to the test(s) specified in the standard. For ease of reference, section numbers of tests in Part I and Part II of the standard are provided in parentheses.

Part IV: Definitions

HIGH VOLTAGE LEAD. The component of a piezo-electric spark gas ignition system which transmits electrical energy from the spark generator to the spark electrode.

NORMAL BUTANE (n-BUTANE), TECHNICAL GRADE. A liquefied petroleum gas composed of a minimum of 95 percent n-butane (C4H10) which may contain other impurities such as isobutane, butylenes and propane not in excess of 5 percent.

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 gas at an appliance burner.

PROPANE HD-5. A special grade of liquefied petroleum gas composed of a minimum of 90 percent liquid volume of propane (C3H8) and a maximum of 5 percent liquid volume of propylene (C3H6).

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.

Appendix
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	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^{2}	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	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	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^2s	kilogram/meter^2•second
	pound/inch^2•hour	lb/in^2•hr	1.953×10^{-1}	5.120	kg/m^2s	kilogram/meter^2•second
VOLUME FLOW RATE	foot^3/second	ft^3/s	2.832×10^{-2}	35.31	m^3/s	meter^3/second
	foot^3/second	ft^3/s	2.832×10	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^{-1}	2.119×10	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^{-2}	1.585×10	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^{-3}	9.505×10^{2}	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_2O (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
		Btu	1.055	9.478×10^{-1}	kJ	kilojoule
	horsepower hour	hphr	2.685×10^{6}	3.724×10^{-7}	J	joule
	horsepower hour	hphr	2.685	3.724×10^{-1}	MJ	megajoule
	kilowatt hour	kwhr	3.6×10^{6}	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^{-4}	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 (m_S^3) measured @ 15°C and 760 mm Hg, dry. (SI Conditions)
Normal cubic meter (m_n^3) 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 (°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 °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 (°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 (°F–32) = °C

d. The formula for "temperature rise," (°F–32) = °C

°C	°F	°C	°F	°C	°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 • CGA 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 • CGA 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 • CGA 2.6

Gas Food Service Equipment, Z83.11 • CGA 1.8

Gas-Fired High-Intensity Infrared Heaters, Z83.19 • CSA 2.35

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 Liquified Petroleum (LP) Gases, Z21.76

Fuel Cell Power Plants, Z21.83

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 Utilization Equipment in Large Boilers, Z83.3

Gas-Fired Infrared Heaters, Z83.6

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

Direct Gas-Fired Circulating Heaters for Agricultural Animal Confinement Buildings, LC 2

Appliance Stands and Drain Pans, LC 3

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, CSA 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, CGA 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 Atmospherical-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

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CSA AMERICA, INC.
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Cleveland, Ohio, U.S. 44131
Fax: (216) 520-8979

or

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Fax: (416) 747-2473

DATE: _____NAME: _____

ADDRESS: _____

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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:

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