ANSI Z21.24-2006
CSA 6.10-2006

American National Standard/
CSA Standard For

Connectors For Gas Appliances

AMERICAN NATIONAL STANDARD
ANSI Z21.24-2006

CSA STANDARD
CSA 6.10-2006

Third Edition - 2006
This Standard is based on the Standard for

Connectors For Gas Appliances

ANSI Z21.24-2001 • CSA 6.10-2001
and Addenda Z21.24a-2002 • CSA 6.10a-2002,
Z21.24b-2003 • CSA 6.10b-2003

APPROVED

August 25, 2005
American National Standards Institute, Inc.

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Standard Developers

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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.

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Preface

This publication represents a basic standard for safe operation, substantial and durable construction, and acceptable performance of a connector for gas appliances. It is the result of years of experience in the manufacture, testing, installation, maintenance, inspection and research on connectors 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 connectors for gas appliances, 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 Accredited Standards Committee Z21/83, 8501 East Pleasant Valley Road, Cleveland, Ohio 44131, or the Chairman of CSA Technical Committee on Gas Appliances and Related Accessories, 5060 Spectrum Way, Suite 100, Mississauga, Ontario, Canada L4W 5N6.

Safe and satisfactory operation of a connector 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; and 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. In Canada the Standards Committee and the Interprovincial Gas Advisory Council normally stipulate an effective date for the standard.

History Of The Development Of The Standard For Connectors For Gas Appliances

(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.

A draft harmonized standard for connectors for moveable gas appliances was prepared for review by the Z21/CGA Joint Connector Subcommittee. The draft harmonized standard for connectors for gas appliances is based on the American National Standard for Connectors for Gas Appliances (Z21.24-1993 and Z21.24a-1993), the standard American National Standard for Flexible Connectors of Other than All-Metal Construction for Gas Appliances (Z21.45-1992, Z21.45a-1993 and Z21.45b-1993), and the National Standard of Canada for Connectors for Gas-Appliances (CAN/CGA-6.10-M88). At its September 20, 1994 meeting, the Z21/CGA joint Connector Subcommittee considered and modified the proposed harmonized draft standard and agreed to distribute it for industry review during April 1995.

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.

Following reconsideration and modification of the proposed draft standard for connectors for gas appliances, in light of comments received, the joint connector subcommittee, at its November 16, 1995 meeting, recommended the proposed draft to the Z21 Committee and the CGA Standards Steering Committee for approval.

The first edition of the harmonized standard for connectors for gas appliances, as modified by the joint subcommittee, was approved by the Z21 Committee at its April 11, 1996 meeting, by the CGA Standards Steering Committee on May 8, 1996, by the Interprovincial Gas Advisory Council (IGAC) in June 1996, by the CGA Standards Advisory Committee on September 6, 1996, and by the American National Standards Institute, Inc. (ANSI), on June 6, 1997.

The second edition of the harmonized standard for connectors for gas appliances was approved by the Z21/83 Committee on January 31,2001, by the CSA Technical Committee on January 25, 2001, by the IGAC on June 12, 2001, and by ANSI on May 18, 2001.

This, the third edition of the harmonized standards for Connectors for Gas Appliances was approved by the Z21/83 Committee on July 7, 2005, by the CSA Technical Committee April 21, 2005, by the IGAC December 1, 2006 and by ANSI on August 25, 2005.

The previous editions of the connectors for gas appliances standard, and addenda thereto, approved by ANSI and the IGAC, are as follows:

Z21.24-1997 • CGA 6.10-M97
Z21.24a-2000 • CGA 6.10a-2000
Z21.24b-2001 • CGA 6.10b-2001
Z21.24-2001 • CSA 6.10-2001
Z21.24a-2002 • CSA 6.10a-2002
Z21.24b-2003 • CSA 6.10b-2003

The following identifies the designation and year of the harmonized standard:

Z21.24-2006 • CSA 6.22-2006

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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. (Standard for use of the International System of Units (SI): The Modern Metric System, IEEE/ASTM SI IO, is 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.

Harmonized Standard For Connectors For Indoor Gas Appliances

Part I: Construction

1.1 Scope

1.1.1

This standard applies to newly produced gas appliance connectors, constructed entirely of new unused parts and materials, having nominal internal diameters of $^1/_4$, $^3/_8$, $^1/_2$, $^5/_8$, $^3/_4$ and 1 in, and having fittings at both ends provided with taper pipe threads for connection to a gas appliance and to house piping. This standard covers assembled appliance connectors not exceeding a nominal length of 6 ft (1.83 m). Connectors listed under this standard are intended for use with gas appliances that are not frequently moved after installation.

For the purpose of this standard, an unused connector, including end fittings, is considered to be a connector which has not been installed.

1.1.2

Appliance connectors complying with this standard are considered suitable for use with natural, manufactured, mixed and liquefied petroleum gases and LP gas-air mixtures.

1.1.3

Appliance connectors complying with this standard are for use with piping systems having fuel gas pressures not in excess of $^1/_2$ lb/in^2 (3.5 kPa).

1.1.4

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.

1.1.5

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

1.1.6

Exhibit A contains provisions that are unique to Canada.

1.1.7

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

1.2 Test Samples

1.2.1
Connectors submitted for examination under this standard shall be representative production samples.

1.2.2
The manufacturer shall supply the number of samples of each nominal size, type and material specified by the testing agency. For test purposes, the testing agency may specify samples fabricated in lengths not to exceed 6 ft (1.83 m).

1.3 Materials

1.3.1
Materials used in the construction of appliance connectors and fittings shall comply with Table I, Material for Appliance Connectors and Fittings, within commercial tolerances, and satisfactory evidence of this fact shall be furnished to the testing agency.

1.3.2
Materials used in the exterior construction of the connector shall be resistant to deterioration from moisture, common household chemicals, and cooking oils or shall be provided with a coating suitable to prevent such deterioration.

1.3.3
Materials used in the interior construction of the connector shall be resistant to deterioration from fuel gases.

1.3.4
Fittings shall be of good quality with respect to material, workmanship and design.

1.4 Tubing Structure

Metal Tubing shall be of uniform thickness (commercial tolerances allowed) but no section of such tubing shall be less than 0.010 in (0.254 mm) thick. Tubing shall be free from dents, flaws or other defects. Austenitic stainless steel with a minimum thickness of 0.008 in (0.203 mm) is acceptable.

1.5 Connector Dimensions

1.5.1
The nominal length of a connector shall refer to the over-all length, including fittings. The actual length of any sample shall be within minus $^{1}/_{2}$ in (12.7 mm) to plus 2 in (50.8 mm) of its nominal length.

1.5.2
Nominal connector size shall refer to the finished internal diameter of the connector tubing. The actual internal diameter of the tubing shall not be more than 0.025 in (0.635 mm) less than its nominal size, as determined by inserting a cylindrical rod, of the proper diameter, 1 in (25.4 mm) into the end of the connector tubing.

1.6 Connector Nuts And Adapters — Design And Dimensions

1.6.1
Connector nuts and adapters shall be faced or otherwise finished externally to provide an adequate hexagonal or octagonal wrench grip. The dimensions across the flats and the length of the flats for connector nuts and adapters shall not be less than those specified in Table II, Minimum Wrench Grip Dimensions For Flare Connector Nuts, and Table III, Minimum Wrench Grip Dimensions For Adapters Having Pipe Threads, respectively.

1.6.2
Surfaces of connector nuts and adapters which normally may come in contact with the tubing shall have a smooth finish.

1.6.3
Threads on pipe-end connections of adapters shall be taper pipe threads conforming to the Standard for *Pipe Threads, General Purpose (Inch), ANSI/ASME B1.20.1*, or the Standard for *Dryseal Pipe Threads (Inch), ANSI/ASME B1.20.3 NPTF.*

1.6.4
Adapters conforming with the standard for *Refrigeration Tube Fittings -General Specifications, ANSI/SAE J513*, shall also be acceptable.

1.6.5
Each end of a connector shall be equipped with a flare or other union fitting.

1.6.6
An appliance connector shall not incorporate a connector nut employing threads which are capable of being assembled to standard pipe threads. The flare fitting dimensions shall comply with Table IV, Flare Fitting Dimensions, as identified in Figure 2, Flare Figure Dimensions.

1.6.7
Quick-disconnect devices shall not be used as end fittings on connectors covered by this standard.

1.6.8
Valves used as end fittings shall comply with the applicable provisions for an appliance connector valve as specified in the Standard for *Manually Operated Gas Valves for Appliances, Appliance Connector Valves and Hose End Valves, ANSI Z21.15 • CSA 9.1.*

1.6.9
Union seats shall not depend upon gaskets for gastightness.

1.7 General

1.7.1
The construction of tubing and fittings not specifically covered by this standard shall be in accordance with reasonable concepts of safety, substantiality 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.

1.7.2
Neither soldering nor brazing shall be used in the construction of a connector.

1.7.3
Porosity in welds shall be held to a minimum consistent with good manufacturing practice.

1.7.4
Connectors shall be free from scale, loose oxides and acid residue.

1.7.5
If chemicals are used in the processing of a connector, there shall be no evidence of corrosive attack.

1.7.6
When a connector is provided with a protective coating the connector shall comply with this standard without the coating, unless otherwise specified.

1.7.7
Connectors shall not be packaged by the manufacturer's with any bends smaller than $1^1/_2$ in (38.1mm) mandrel size. If connectors are shipped for repackaging, instructions shall be provided specifying that the connector shall not be packaged with any bends smaller than $1^1/_2$ in (38.1mm) in mandrel size.

1.7.8
A protective coating on a connector shall:

a. Cover all portions of the connector which are capable of being bent or flexed;

b. Adhere to or otherwise be tightly bonded to the surface of the tubing;

c. Not react with the tubing to the detriment of the tubing or the coating; and

d. Have no adverse effect upon the performance of the connector.

1.7.9
Nonmetallic exteriors or coatings shall not continue to burn after an ignition source has been removed.

Method of Test

This test shall be conducted in a draft-free location.

One 2 ft (610 mm) connector shall be used for test purposes and the connector shall not be exposed to a relative humidity greater than 70 percent during the 24 hour period prior to the test.

The connector under test shall be supported at one end and hung with its axis vertical.

A Bunsen burner having a nominal $^3/_8$ in (9.5 mm) diameter tube and with means of controlling the primary air and gas input shall be used as an ignition source. The gas at the burner shall be ignited and adjusted to produce a flame 2 to 3 in (50.8 to 76.2 mm) in length.

The flame shall be applied to the nonmetallic exterior approximately 3 in (76.2 mm) above the start of the xterior coating at the bottom end of the connector for 1 minute (by orienting the burner at an angle as needed to ignite the nonmetallic exterior or coating) and then withdrawn. If no burning, flaming or glowing combustion is observed, additional attempts to ignite the nonmetallic exterior covering of the connector shall be made with the flame varied from blue to yellow. If flaming or glowing combustion of

the covering material on the connector is observed and ceases 60 seconds or less after removal of the ignition flame, the flame is to be reapplied at the same location for 1 minute immediately after the flaming or glowing combustion stops. The ignition flame shall then be withdrawn and the duration of flaming or glowing combustion noted.

The duration of flaming or glowing combustion after withdrawal of the ignition flame shall not exceed 60 seconds nor shall any flame or glowing combustion travel to the end of the connector farthest from the point of application of the ignition flame.

1.8 Instructions

1.8.1

Instructions covering proper usage and installation shall be attached to each assembled appliance connector. Instructions may be in a language(s) other than English when distributed in areas outside the U.S. and Canada.

The instructions shall include, as a minimum, statements to the effect that:

a. The gas outlet shall be in the same room as the appliance and the connector must not be concealed within or run through any wall, floor or partition.

b. The connector shall be of adequate length. Connectors shall not be joined together to achieve the required length.

c. The final assembly shall be tested for leaks. CAUTION: Matches, candles, open flame or other sources of ignition shall not be used for this purpose. Leak test solutions may cause corrosion — water rinse after test.

d. Contact with foreign objects or substances shall be avoided.

e. The connector shall not be used if kinked, twisted or bent smaller than $1^1/_2$ in (38.1 mm) internal diameter (i.e., approximately the diameter of a golf ball).

f. Connectors are designed for occasional movement after installation. Repeated bending, flexing or vibration must be avoided. Normal operation of a clothes dryer or similar appliance does not constitute extreme vibration or movement.

g. Connectors are for use only on piping systems having fuel gas pressures not in excess of $^1/_2$ lb/in^2 (3.5 kPa) (see 1.1.3).

h. This connector complies with the *Standard for Connectors for Gas Appliances, ANSI Z21.24 • CSA 6.10* (unless this is shown as a marking, see 1.9.2-e).

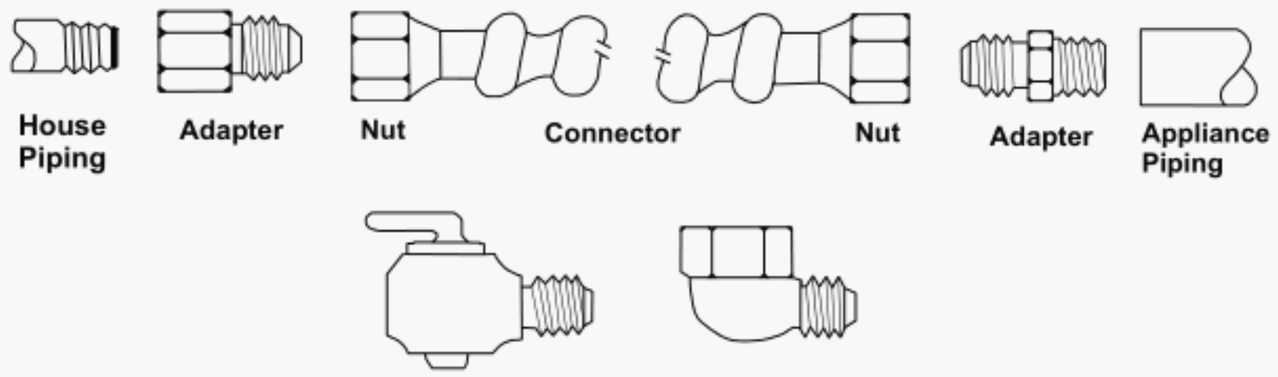
i. The connector and fittings are designed for use only on the original installation and are not to be reused for another appliance or at another location.

j. Keep flare end of adaptor free of grease, oil and thread sealant.

Connectors shall also bear a cautionary statement to the effect that:

CAUTION: CONNECTOR NUTS MUST NOT BE CONNECTED DIRECTLY TO PIPE THREADS. THIS CONNECTOR MUST BE INSTALLED WITH ADAPTERS PROVIDED.

Connectors for flare type fittings shall also bear an illustration similar to the following:



Note: Adapters shown are typical.

The instructions specified in 1.8.1-a through -j need not necessarily be permanent in nature, but shall be sufficiently durable and attached in a manner that they may reasonably be expected to reach the person who will install the connector. A self-adhering label wrapped around the connector will be acceptable. The information on the label shall be printed on an area having minimum dimensions of 2 by 4 in (50.8 by 102 mm).

These instructions shall be examined by the testing agency for accuracy and compatibility with the results of the test from a technical standpoint, and with the *National Fuel Gas Code, ANSI Z223.1/NFPA 54*, and/or *Natural Gas and Propane Installation Code, CSA B149.1.*

The connector shall bear the following warning in 10 point type on a Class IIIA marking material "DO NOT REUSE."

1.8.2

If the manufacturer's instructions include the capacity of the connector, the capacity shall be that shown in Table VIII, Minimum Connector Capacity, or, if the connector is of a length not covered by the table, shall be consistent with Table VIII.

If the capacity is indicated, the instructions shall also include:

a. The nominal internal diameter (I.D.) of the connector;

b. The pressure drop, heating value and specific gravity of the reference gas;

c. A statement that the capacity was determined under test conditions specified in this standard; and

d. A statement that the capacity of 0.2 iwc pressure drop can be determined by multiplying by 0.632.

1.9 Marking

1.9.1

Marking material shall be identified by class number and shall meet the following specifications. All metal marking materials shall be rustproof. All markings shall be suitable for application to the type of surface upon which applied. 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 IIA-3. 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 nonwater-soluble adhesive.

Class IIA-4. Permanent Plate

Shall be made of pressure-sensitive metal foil requiring no solvent or activator.

Class IIIA-1. Permanent Label

Shall be made of material not adversely affected by water, shall be attached by means of nonwater-soluble adhesive.

Class IIIA-2. Permanent Label

Shall be made of material not adversely affected by water, shall be attached by means of nonwater-soluble adhesive. These materials shall not be located on surfaces having temperatures exceeding 175°F (79.5°C).

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).

Class IV. Semi-Permanent Label

Shall be made of material which may be soluble in water, and may use water-soluble 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

1.9.2

Assembled appliance connectors shall bear a Class I marking, on either a nonremovable ring or a portion of a nonremovable fitting not subject to tool usage, on which shall appear the following:

a. Manufacturer's recognizable trademark, symbol or name.

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

c. A number, not less than $^{3}/_{32}$ in (2.4 mm) in height, identical to the last two numbers of the calendar year in which the connectors are manufactured to identify the year of manufacture.

d. A letter(s), not less than $^{3}/_{32}$ in (2.4 mm) in height, identifying either the month or batch of manufacture. The batch size shall be determined by the manufacturer.

e. If the standard under which the connector is certified is not identified in the instructions, a marking to identify this standard as follows: "ANSI Z21.24 • CSA 6.10." (See 1.8.1-h.)

1.9.3

Removable end fittings, other than manual valves or union end pieces, of assembled appliance connectors shall bear a Class I marking showing the connector manufacturer's recognizable trade-mark or symbol. Manual valves and three-part unions shall bear the marking of the valve, or device or union manufacturer(s).

Part II: Performance

2.1 General

2.1.1 Unless otherwise specified, connectors employing protective coatings shall comply with the provisions of this standard without their protective coatings.

2.1.2 During tests for compliance with this standard, connections shall be made using the maximum torque specified in Table VI, Applied Torque During Reconnection of Fitting Test, unless otherwise specified.

2.1.3 Unless otherwise specified, all tests for leakage in Part II shall be made consistent with section 2.2, Leakage.

2.2 Leakage

A connector and its fittings shall not leak. For the purpose of this section, leakage is defined as a flow rate in excess of 10 cm^3/hr at 3 psig (20.7 kPa).

Method of Test

This test shall be conducted at room temperature.

One end of the connector shall be connected to a flow-measuring device, capable of accurately indicating the allowable flow rate, and a pneumatic system capable of supplying clean air at a test pressure of 3 lb/in^2 (20.7 kPa). An airtight connection shall be made at the opposite end of the connector.

Air shall be admitted to the system slowly and maintained at the specified test pressure. The leakage rate shall be measured and shall not exceed 10 cm^3/hr of air corrected to standard conditions of 30 in Hg column (101.3 kPa) and 60°F (15.5°C).

2.3 Strength

A manual valve supplied as an end connection shall be removed and replaced with a plug prior to conduct of the following tests.

2.3.1 The connector shall withstand, without bursting or leakage, a hydrostatic pressure of 250 lb/in^2 (1.72 MPa).

Method of Test

A 2 ft (610 mm) connector shall be assembled in a hydraulic pressure test system, including a pump, gage and heavy-duty pipe fittings, capable of sustaining the desired pressure, care being taken to free all air from the system.

The applied pressure shall be maintained for 1 minute. If no bursting or leakage occurs during this period, this provision shall be deemed met. This test shall be applied to each nominal diameter, type and material of connector submitted.

2.3.2 The connector shall withstand for 5 minutes, without leakage and without becoming detached, a steady lengthwise pull of 800 lb/in (140.2 N/mm) of nominal inside diameter.

Method of Test

One end of a 1 ft (305 mm) connector shall be securely attached to a fixed pipe to which an air supply system and pressure gage is connected. The other end shall be securely attached in a similar manner to a closed pipe connected to a mechanical means by which a constant pulling force of 800 lb/in (140.2 N/mm) of nominal inside diameter can be applied.

The required tension shall be applied to the connector and maintained for 5 minutes. At the end of 5 minutes, there shall be no leakage.

2.4 Bending

The connector shall withstand 30 bends without leakage or damage to the tubing or fittings.

Method of Test

One end of a 2 ft (610 mm) connector shall be securely attached to a fixed pipe to which an air supply system and manometer is connected. The other end shall be closed gastight. Two $2^{1}/_{4}$ in (57.2 mm) diameter mandrels shall be placed, one at each side of the fixed end of the connector, in contact with the connector nut. The center of the mandrels shall be in line with the tubing end of the nut.

Air shall then be admitted to the connector until a pressure equivalent to 3 psi (20.7 kPa) is obtained. The tubing shall be bent from the starting position "A" along the path shown by the dotted circle in Figure 3, Illustration of Bending Test, to the position indicated by "B." It shall then be bent back to the starting position and bent in the opposite direction to position "C." Each 180 degree (3.14 rad) bend and subsequent return to the starting position shall be counted as one cycle. This process shall be repeated until 30 cycles have been completed, the bending motion being applied uniformly at the rate of 5 cycles per minute.

Following completion of the 30 bends, the connector shall not leak. This test shall be applied to each nominal diameter, type and material of connector submitted.

2.5 Torsion

The connector shall withstand, without leakage or damage to the tubing or fittings, 15 applications of 90 degree (1.57 rad) twists in alternate directions.

Method of Test

One end of a 2 ft (610 mm) connector shall be securely attached to a rigid frame and loaded in tension as specified in Table V, Applied Load During Torsion Test.

An air pressure equivalent to 3 lb/in^2 (20.7 kPa) shall be maintained in the system while the tubing is rotated 90 degrees (1.57 rad) at the lower fitting, in a plane perpendicular to the axis of the tubing, and then returned to the original position and rotated 90 degrees (1.57 rad) in the opposite direction. Each 90 degree (1.57 rad) twist and subsequent return to the

original position shall be counted as one cycle, and the twisting motion shall be applied uniformly at a rate of 5 cycles per minute. The connector shall not leak. This test shall be applied to each nominal diameter, type and material of connector submitted.

2.6 Durability At High Temperature

2.6.1 The connector shall withstand a temperature of 800°F (427°C) without leakage.

During this test, a manual valve supplied as an end connection shall be removed and replaced with a plug.

Method of Test

A 1 ft (305 mm) connector shall be connected to a pressure-tight system. Thermocouples shall be soldered, brazed or otherwise firmly attached to end fittings to determine their temperature. The connector shall then be placed in a preheated oven. When the temperature of the fitting reaches 790°F (421°C), the oven temperature shall be adjusted so that the temperature of the fittings does not exceed 810°F (432°C) or drop below 790°F (421°C) in the succeeding 15 minutes. An internal air pressure of 3 ± 0.25 lb/in^2 (20.7 ± 1.7 kPa) shall be maintained throughout the test, unless a drop in pressure occurs. In this event the test shall be discontinued. Otherwise, the connector shall be removed from the oven, cooled to room temperature and shall not leak.

2.6.2 A connector employing a protective coating shall be capable of withstanding a temperature of 300°F (149°C) without leakage.

Method of Test

A connector employing a protective coating shall comply with this test with its protective coating.

A fully assembled 1 ft (305 mm) connector shall be connected to a pressure-tight system. Thermocouples shall be soldered, brazed or otherwise firmly attached to end fittings to determine their temperature. The connector shall then be placed in a preheated oven. When the temperature of the fittings reaches 290°F (143.5°C), the oven temperature shall be adjusted so that the temperature of the fittings does not exceed 310°F (154.5°C) nor drop below 290°F (143.5°C) in the succeeding 24 hours. An internal air pressure of 3 ± 0.25 psi (20.7 ± 1.7 kPa) shall be maintained throughout the test, unless a drop in pressure occurs. In this event the test shall be discontinued. Otherwise, the connector shall be removed from the oven after 24 hours, cooled to room temperature, and shall not leak.

At the conclusion of the test, the external connector coating shall show no obvious evidence of cracks, voids or loose adhesion by visual inspection without magnification.

2.7 Reconnection Of Fittings

A connector shall not leak as a result of being connected, disconnected and reconnected.

Method of Test

A connector employing a protective coating shall comply with this test with its protective coating.

The connector to be tested shall be connected to a leakproof system in such a manner that the pipe thread end of the fitting is held rigid.

The union shall be tightened by the application of a torque not to exceed the minimum torque specified in Table VI, Applied Torque During Reconnection of Fitting Test. The connector shall then be tested as described in Section 2.2, Leakage. If the connector leaks, the torque shall be increased sufficiently to overcome the leakage, but shall not be increased in excess of the maximum torque specified in Table VI. There shall be no leakage in excess of that specified in 2.2 after the union is tightened as specified in this paragraph.

A split section of rigid pipe, clamped together to obtain a snug fit over the connector, with edges rounded at the ends, shall then be snugy fitted over the tubing with its nearest edge a distance from the top of the fitting equal to the internal diameter of the tubing. This pipe is to be used as a handle to deflect the tubing at the fitting 60 degrees (1.05 rad) in one direction from the center line of the fitting. The tubing shall then be returned to its original position, deflected 60 degrees (1.05 rad) in the opposite direction, and again returned to its original position. The test for leakage shall again be applied as outlined above. There shall be no leakage in excess of that specified in 2.2.

The union shall then be disconnected, the tubing rotated 55 degrees (0.96 rad) in a clockwise direction, and the union again assembled to the fitting and tightened by the application of a torque not to exceed the torque determined to be necessary to overcome leakage in the previous connection. Leakage tests shall again be applied as outlined above. If no leakage occurs, or if leakage is observed and can be overcome by an increase in torque not to exceed the maximum torque specified in Table VI, Applied Torque During Reconnection of Fitting Test, the tubing shall be deflected as described in the preceding paragraph after which leakage tests shall be applied as outlined above.

The procedure outlined in the preceding paragraph shall be performed a total of 8 times without leakage in excess of that specified in 2.2.

2.8 Strength Of Fittings

2.8.1 The connector shall not leak, break or be otherwise adversely affected by application of a tightening torque of 1040 in-lb/in (4.6 kN•m/m) of nominal tubing diameter.

Method of Test

For this test one sample of each nominal diameter of assembled appliance connector shall be employed.

The pipe thread at one end of the appliance connector shall be rigidly connected to a leakproof system. The other end of the connector shall be sealed so that no leakage will occur at this point under an air pressure of 3 lb/in^2 (20.7 kPa). The fitting assembly shall then be tightened by the application of a torque of 1040 in-lb/in (4.6 kN•m/m) of nominal tubing diameter. The connector shall not leak.

2.8.2 Connector fittings shall withstand the following impacts without leakage, cracking or breakage. This test shall not be applied to manual valves supplied as end fittings on connectors.

Method of Test

The fitting on one end of a connector shall be tightened to a torque of 1040 in-lb/in (4.6 kN•m/m) of tubing diameter, secured to a pipe nipple or fitting mounted on a rigid surface so that the free length of the supporting member is not greater than 2 in (50.8 mm), and struck at a 90 degree (1.57 rad) angle to the gasway with a force equivalent to that shown in Table VII, Impact Applied During Conduct of 2.8.2. The testing device shall be arranged so that the center line of contact between the striking weight and a wrench flat of the nut is at the longitudinal center of the flat.

After this impact, the fitting shall be visually checked and there shall be no cracks or breaks. The connector shall not leak.

2.9 Capacity

The capacity of a 2, 4 or 6 foot connector shall be verified by the testing agency. The capacity shall be determined at a pressure drop of 0.5 iwc (124 Pa) and shall not be less than that specified in Table VIII, Minimum Connector Capacity. During the conduct of this test, end fittings, other than appliance connector valves used as end fittings, shall be in place.

Method of Test

Standard weight pipe, of proper size, reamed to remove burrs caused by cutting, shall be fitted to the inlet and outlet connections of the flexible metal tubing connector. The straight run of pipe before and after the connector shall be of a length not less than 10 pipe diameters (I.D.). Two short lengths of pipe or metal tubing shall be soldered to the pipe, one before the inlet and the other after the outlet connections. Pressure tappings shall be located five pipe diameters (I.D.) from the inlet and outlet connections. A drill shall be inserted in the short length of pipe or metal tubing and a hole drilled through the wall of the large pipe, care being taken to remove any burrs caused thereby. The two pressure tappings shall be connected to a differential pressure gage which may be read directly to at least 0.01 iwc (2.5 Pa).

Either gas or air may be used for the test. If gas is used, it shall be vented or burned as far away from the connector, test meter and other test instruments as will preclude the heating of such equipment. The flow rate shall be adjusted to give an indication on the gage approximately equal to the pressure drop specified above and the necessary observations made and recorded. Observations may also be made at a number of different pressure drops.

Capacity of the connector shall be resolved from these data according to the following formulae:

$$q_{sc} = K Q_1 \sqrt{\frac{P_t \times sp\ gr_t}{pd_t \times \theta_t}}$$

or since

$$sp\ gr_t = \frac{sp\,gr_1\,(P_t - at)}{P_t} + \frac{at\,(sp\ gr_2)}{P_t}$$

$$q_{sc} = KQ_1\sqrt{\frac{sp\,gr_1(P_t - at) + at\,(sp\ gr_2)}{pd_t \times \theta_t}}$$

where

K = 3685 for U.S. customary units (244.040 for metric units);

qsc = capacity with gas of 1000 Btu/ft^3 (37.2 MJ/m^3) and 0.64 sp gr [saturated with water at 60°F (15.6°C) and 30 in Hg column (101.6 kPa)], Btu per hr (kW);

Q_1 = quantity of test gas (or air) as metered, ft^3/hr (m^3/hr);

sp gr_1 = specific gravity of dry test gas (or air) referred to dry air as 1.0;

sp grt = corrected or actual specific gravity of test gas (or air), as metered;

Pt = absolute pressure of test gas (or air) as metered, in Hg column (kPa);

at = aqueous tension of water vapor in test gas (or air), in Hg column (Pa);

sp gr_2 = 0.62 = specific gravity of water vapor referred to dry air as 1.0;

pdt = observed pressure drop (corrected for difference in velocity head, if any, due to change of area at points tappings are taken), iwc (Pa); and

θ t = temperature of test gas (or air) as metered, F absolute (K).

In the event the areas at the inlet and outlet tappings are different:

$$pdt = pdo + hv_1 - hv_2$$

where

The velocity head, in. water column (Pa), at the inlet tapping (hv_1) or outlet tapping (hv_2) is found by the following formula:

$$hv = \frac{C \times Q_1^2 \times P \times sp\,gr_t}{D^4\theta_t}$$

and

C	=	1.0335×10^{-5} for U.S. customary units (2.1923×10^{-10} for metric units);
pdo	=	pressure drop (may be negative) between inlet and outlet pressure tappings on manifold as observed, inch water column (kPa);
D	=	inside diameter of pipe at inlet or outlet pressure tappings, inch (m); and
P	=	absolute pressure of test gas (or air) at inlet or outlet pressure tappings, inch mercury column (kPa).

2.10 Resistance To Ammonia Atmosphere

Copper alloy connectors and fittings shall not develop faults which would result in gas leakage under the following Method of Test.

Method of Test

The test specified shall be applied to each nominal diameter, type and material of connector submitted.

On connectors employing a protective coating, this test shall be conducted with the coating in place.

Using the procedure specified in 2.4, Bending, the connector shall be bent two times around a $1^1/_2$ in (38.1 mm) diameter mandrel. The connector shall then be subjected to a lengthwise pull as specified in Table V, Applied Load During Torsion Test, for a period of 30 seconds. The loaded connector shall then be subjected to two 90 degree (1.57 rad) torsions, as described in 2.5, Torsion, applied only in the direction consistent with tightening the connector fitting.

The connector shall then be bent around a $1^1/_2$ in (38.1 mm) diameter mandrel to form a "U" shape. The ends shall be secured with a nonmetallic material to hold the connector in this shape. One end of the connector shall be attached to an air supply system equipped with a manometer downstream from a shutoff valve and the other end sealed gastight. Air shall then be admitted to the connector until a pressure equivalent to 3 lb/in^2 (20.7 kPa) is obtained and the shutoff valve closed.

The connector, from the back of one connector nut to the back of the opposite connector nut, shall be suspended in a sealed plastic container to which 500 milliliters of ammonia solution containing 54 milliliters of full strength ammonia (28 percent) and 446 milliliters of water have been added. (More than one connector may be placed in the container at one time.)

Note: *The connector(s) must not come in contact with the ammonia solution at any time. See Figure 4, Illustration of Ammonia Vapor Corrosion Test.*

If a sudden drop in pressure occurs, the test shall be discontinued. Otherwise, the connector shall be removed from the container after 18 hours and shall not leak.

Tables Referenced In Part I, Part II And Exhibits

Table I
Material For Appliance Connectors And Fittings

Item	Specifications
Welded and Seamless brass tubing	65% Cu minimum 85% Cu maximum
Aluminum Tubing	96% Al minimum
Pure Copper	Prohibited when in contact with fuel gases.
Brass machined fittings	60% Cu minimum 85% Cu maximum
Aluminum-Alloy fittings	86% Al minimum
Cast iron fittings	Prohibited
Malleable iron	Shall conform to *ASTM A197.*
Steel fittings	Protected with corrosion-resistant metallic finish, such as cadmium plate, or galvanized.
Stainless steel	300 series Austenitic type, properly annealed and/or stabilized for maximum corrosion resistance.
All other material	Shall be reasonably in accord with the above and shall comply with the provisions of Part II of this standard.

Table II
Minimum Wrench Grip Dimensions For Flare Connector Nuts

Nominal Connector I.D., Inches	Flare Thread Size, Inches (Class 2B)	Minimum Length of Flats, Inch (mm) (Dimension A, Figure 1)	Dimension Across Flats, Inches (mm) (Dimension B, Figure 1)
1/4	5/8 - 18 UNF	3/8 (9.5)	3/4 (19.1)
3/8	3/4 - 16 UNF	3/8 (9.5)	7/8 (22.2)
1/2	15/16 - 16 UNF	1/2 (12.7)	1 1/16 (27.0)
5/8	1 1/16 - 14 UN	3/4 (19.1)	1 1/4 (31.8)
3/4	1 1/8 - 16 UN	3/4 (19.1)	1 1/2 (38.1)
1	1 3/8 - 16 UN	7/8 (22.2)	1 5/8 (41.3)

Table III
Minimum Wrench Grip Dimensions For Adapters Having Pipe Threads

Nominal Pipe Size, Inch	Minimum Length of Flats, Inch (mm)		Minimum Dimension Across Flats, Inches (mm)	
	Male	Female	Male	Female
1/8	3/16 (4.8)	3/16 (4.8)	7/16 (11.1)	9/16 (14.3)
1/4	1/4 (6.4)	1/4 (6.4)	9/16 (14.3)	11/16 (17.5)
3/8	5/16 (7.9)	5/16 (7.9)	3/4 (19.1)	3/4 (19.1)
1/2	3/8 (9.5)	3/8 (9.5)	7/8 (22.2)	15/16 (23.8)
3/4	13/32 (10.3)	13/32 (10.3)	1 1/16 (27.0)	1 1/8 (28.6)
1	17/32 (13.5)	17/32 (13.5)	1 3/8 (34.9)	1 1/2 (38.1)

Table IV
Flare Fitting Dimensions

Nominal Connector ID	Thread Size	Dim A	Dim B	Dim C	Dim D	Dim E
1/4"	5/8-18 UNF	0.312 ±0.010	0.531 ±0.010	0.22 ±0.010	0.54 MIN.	0.62 ±0.010
3/8"	3/4-16 UNF	0.438 ±0.010	0.641 ±0.010	0.25 ±0.010	0.66 MIN.	0.75 ±0.010
1/2"	15/16-16 UN	0.565 ±0.010	0.843 ±0.010	0.28 ±0.010	0.76 MIN.	0.88 ±0.010

Table V
Applied Load During Torsion Test

Nominal Connector I.D., Inch	Weight, Pounds (kg)	
1/4	12.50	(5.7)
3/8	18.75	(8.5)
1/2	25.00	(11.3)
5/8	31.25	(14.2)
3/4	37.50	(17.0)
1	50.00	(22.7)

Table VI
Applied Torque During Reconnection Of Fitting Test

Nominal Connector I.D., Inch	Torque, Inch-Pounds (N•m)	
	Minimum	Maximum
1/4	150 (16.95)	260 (29.38)
3/8	200 (22.60)	390 (44.06)
1/2	250 (28.25)	520 (58.75)
5/8	300 (33.90)	650 (73.44)
3/4	400 (45.19)	780 (88.13)
1	450 (50.84)	1040 (117.50)

Table VII
Impact Applied During Conduct Of 2.8.2

Nominal Connector I.D., Inch	Impact, Foot-Pounds (N•m)
Up to 5/8	10 (13.6)
5/8 and larger	15 (20.3)

Table VIII
Minimum Connector Capacity

Nominal Connector ID, Inch	Straight Length Capacity $_3$ Btu Per Hr (W).0.64 Sp Gr, 1000 Btu Per Cu Ft (37.2 MJ/m) Gas at 0.5 inch Water Column (125 Pa) Pressure Drop											
	1 foot (0.30 m)		1 1/2 Foot (0.46 m)		2 Foot (0.61 m)		2 1/2 Foot (0.76 m)		3 Foot (0.91 m)		4 Foot (1.22 m)		5 Foot (1.52 m)		6 Foot (1.83 m)	
1/4	48,000	(14 067)	43,800	(12 837)	40,000	(11 723)	36,400	(10 668)	33,400	(9 789)	28,300	(8 294)	24,900	(7 297)	23,100	(6 770)
3/8	102,000	(29 893)	93,100	(27 285)	85,000	(24 911)	77,100	(22 596)	71,100	(20 837)	60,500	(17 731)	53,200	(15 591)	49,100	(14 390)
1/2	180,000	(52 752)	164,200	(48 122)	150,000	(43 961)	136,000	(39 858)	125,000	(36 634)	106,000	(31 066)	93,200	(27 314)	86,000	(25 204)
5/8					177,000	(51 874)	170,200	(49 881)	162,500	(47 624)	147,800	(43 316)	131,800	(38 627)	116,200	(34 055)
3/4					290,900	(85 254)	270,500	(79 276)	255,900	(74 997)	215,000	(63 010)	197,400	(57 852)	173,900	(50 965)
1					581,800	(170 509)	545,200	(159 783)	515,900	(151 196)	442,700	(129 743)	398,900	(116 906)	347,800	(101 930)

Table IX
Displacement For Flexing Test

Diameter (Nominal ID-Inches)	Length (inches)	Total Displacement
½ (12.7mm)	24 (610 mm)	2 (50.8 mm)
¾ (19.1 mm)	24 (610 mm)	2 (50.8 mm)
½ (12.7 mm)	36 (914 mm)	3 (76.2 mm)
¾ (19.1 mm)	36 (914 mm)	6 (152 mm)

Figures Referenced In Part I, Part II And Exhibits

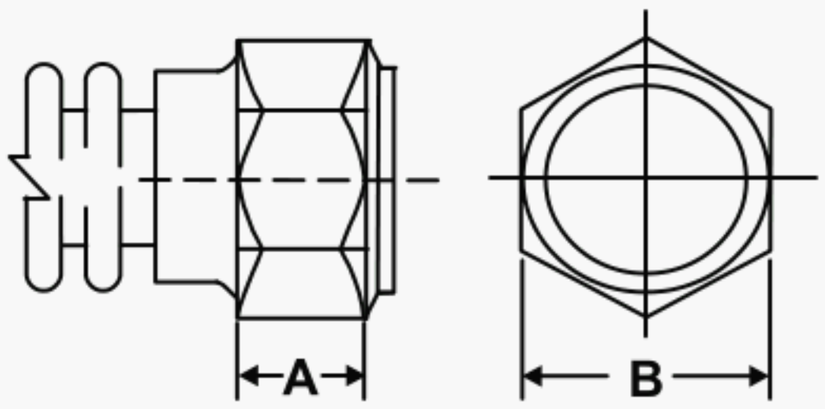


Figure 1
Flare Figure Dimensions

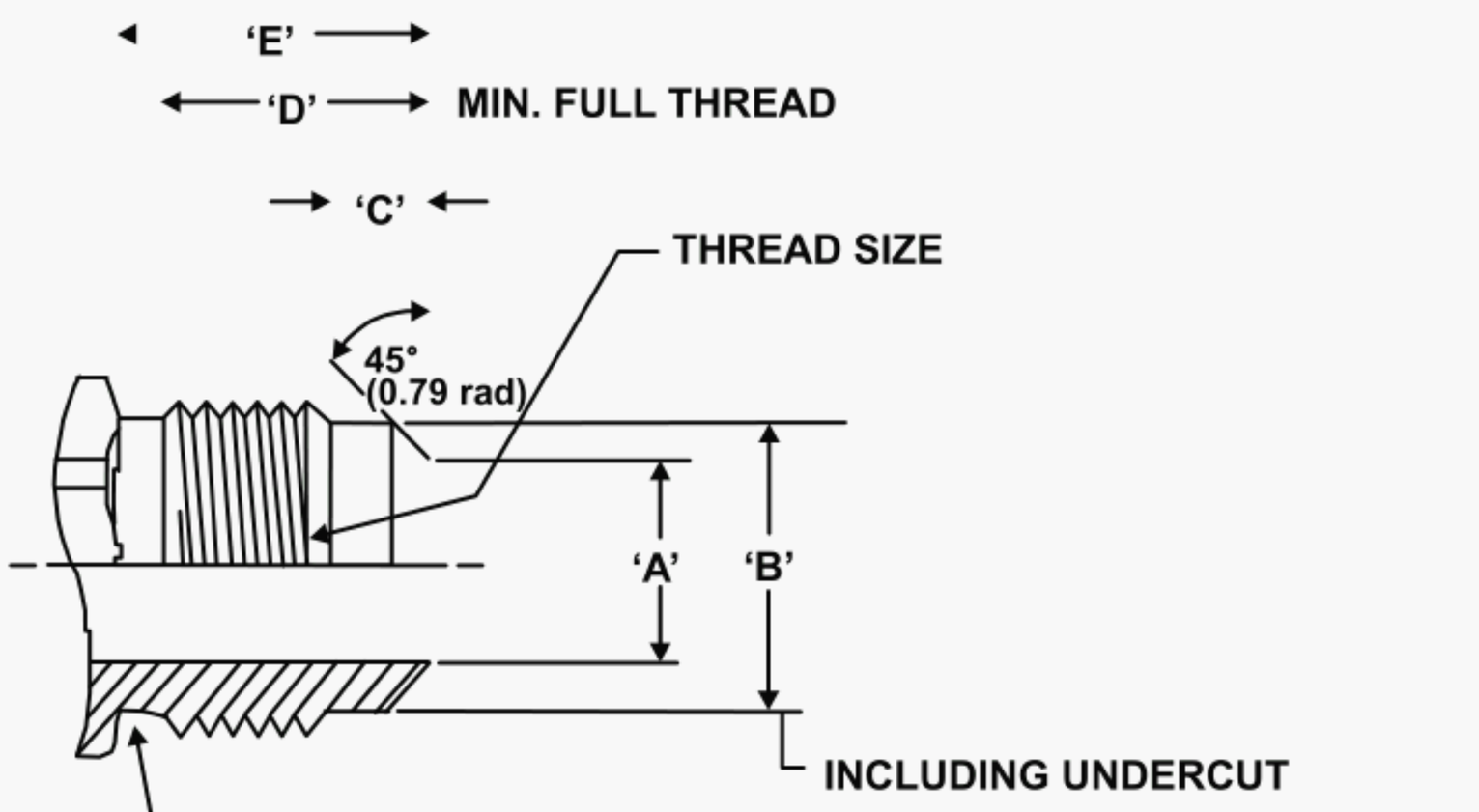
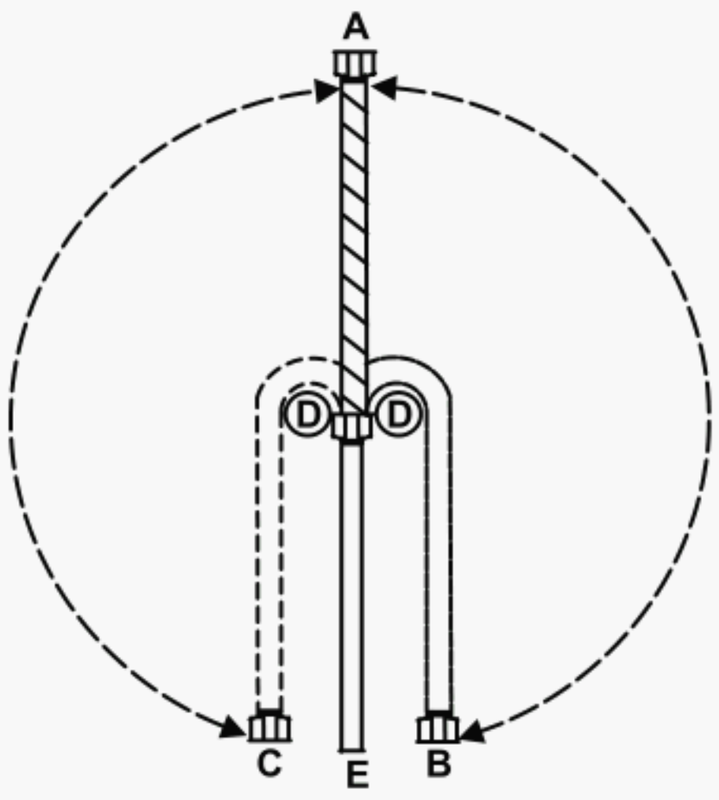


Figure 2
Flare Figure Dimensions



A - Position of free end at start of bending test.

B and C - Position of free end after bending around mandrel.

D - Mandrel - $2^{1}/_{4}$ in (57.2 mm) diameter.

E - Fixed pipe.

Figure 3
Illustration of Bending Test

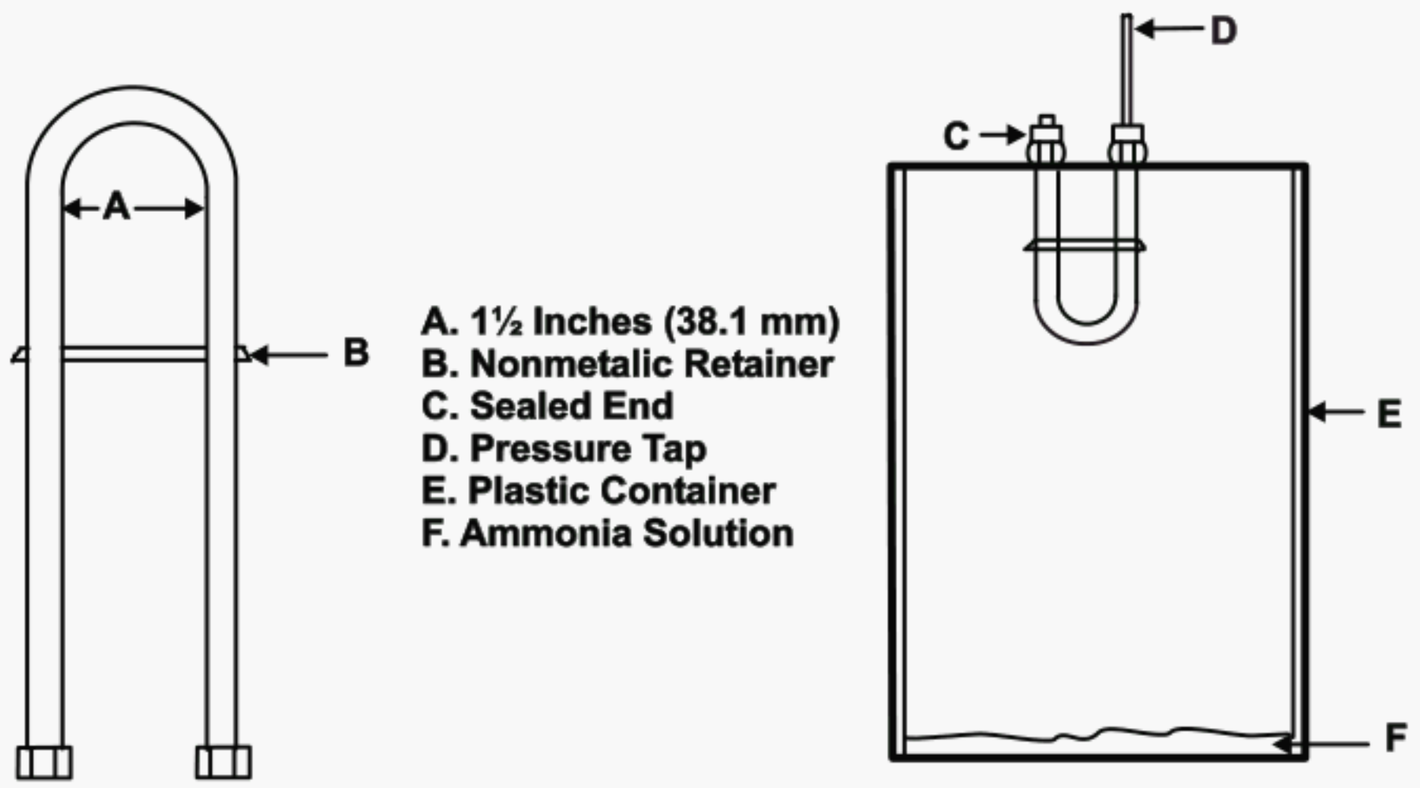


Figure 4
Ilustration of Ammonia Vapor Corrosion Test

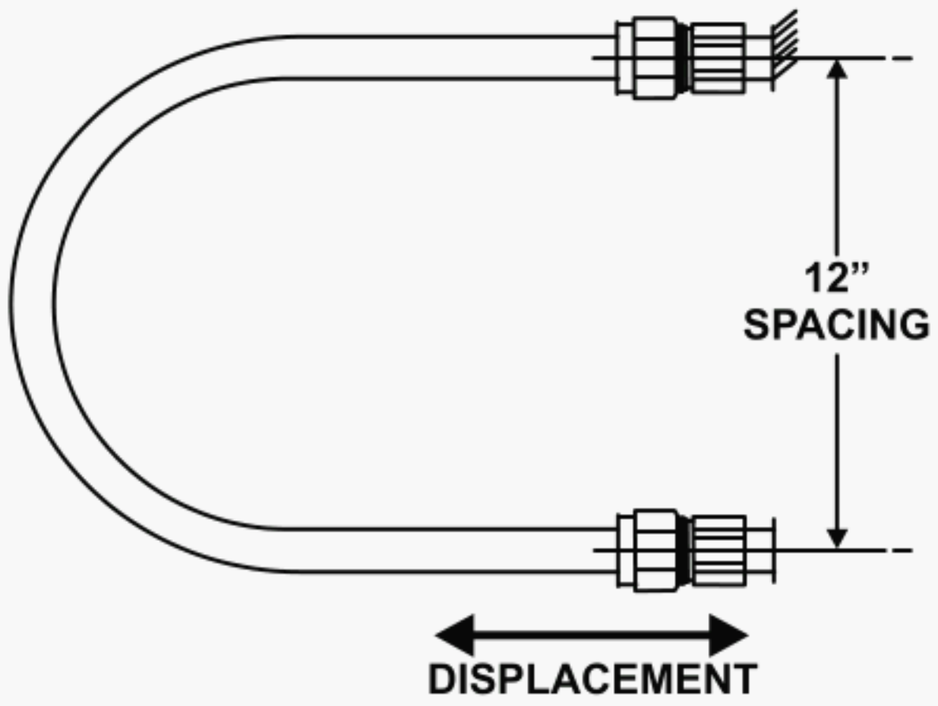


Figure 5
Repeated Flex Test Configuration

Exhibit A
Items Unique to the United States

A.1
Connectors, when designated and tested in accordance with 2.11, Repeated Flexing Test, are also intended to be used with infrared radiant tube heaters that have repeated movements caused by thermal expansion and contraction.

A.2 Instructions
Connectors complying with A.4, Repeated Flexing Test, shall also state: "This connector is suitable for use with a radiant tube heater, provided it is at least the length and diameter specified by the radiant tube heater instructions and is installed in strict accordance with those instructions."

Connectors that do not comply with A.4, shall state: "This connector is not suitable for use with infrared radiant tube heaters."

A.3 Repeated Flexing

A.3.1
Connectors designated by the manufacturer to be used with infrared radiant tube heaters shall also meet the requirements of A.4, Repeated Flexing Test.

A.3.2
Connectors for use with infrared radiant tube heaters shall be installed per the requirements of the Standard for *Gas-Fired Low-Intensity Infrared Heaters, ANSI Z83.20•CSA 2.34.*

A.4 Repeated Flexing Test

Connectors of the sizes in Table IX, Displacement For Flexing Test, and designated by the manufacturer for use with infrared radiant tube heaters, shall not leak in excess of 10 cc/hr, at 3 lb/in^2 (20.7 kPa), when tested as described in this section. The connector shall be cycled 600,000 times as shown in Figure 5. The free end of the connector shall be displaced linearly with a smooth motion at a rate between 15 and 60 cycles per minute.

Method of Test

The connector shall be installed as follows:

1. Attach one end of connector using the maximum torque specified in Table VI, Applied Torque During Reconnection of Fitting Test.

2. Bend the connector smoothly consistent with the configuration shown in Figure 5, Repeated Flex Test Configuration.

3. Connect the free end of the connector to the cycle tester and tighten using the maximum torque specified in Table VI.

   The total displacement of the cycle test shall be as specified in Table IX. Compliance with this test is the basis for marking according to 1.8.1f.

Exhibit B
Items Unique to Canada

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

1.8 Instructions

1.8.1-j	"DO NOT REUSE."	«Ne pas réutiliser.»

1.9 Marking

1.9.2-e	"ANSI Z21.24 • CSA 6.10."	(No French translation required by this Standard.)

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

Exhibit C
List Of Reference Standards

AMERICAN GAS ASSOCIATION
400 N. Capitol Street, Washington, D.C. 20001

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

ASME INTERNATIONAL
345 East 47th Street, New York, NY, 10017

ANSI/ASME B1.20.1-1993 (R2001), Pipe Threads, General Purpose (Inch)

ANSI/ASME B1.20.3, 1976 Dryseal Pipe Threads, Inch

ASTM INTERNATIONAL
100 Barr Harbor Dr., West Conshohocken PA, 19428-2959

ASTM A197-2000, Specification for Cupola Malleable Iron

IEEE-ASTM-SI-10 IEEE/ASTM SI-10-2000, Standard for Use of the International System of Units (SI):The Modern Metric System

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

CAN/CSA Z234.1-2000, Canadian Metric Practice Guide

CSA 6.16-2002 • ANSI Z21.69-2002, and Addenda CSA 6.16a-2003 • ANSI Z21.69a-2003, Connectors for Movable Gas Appliances

CGA 9.1-M97 • ANSI Z21.15-1997, and Addenda CGA 9.1a-2001 • ANSI Z21.15a-2001, Manually Operated Gas Valves for Appliances, Appliance Connector Valves, and Hose End Valves

CSA B149.1-2000, Natural Gas and Propane Installation Code

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

ANSI Z21.15-1997 •CGA 9.1-M97, and Addenda ANSI Z21.15a-2001 • CGA 9.1a-2001, Manually Operated Gas Valves for Appliances, Appliance Connector Valves, and Hose End Valves

ANSI Z21.69-2002 • CSA 6.16-2002, and Addenda ANSI Z21.69a-2003 • CSA 6.16a-2003, Connectors for Movable Gas Appliances

ANSI Z83.20 • CSA 2.34, Gas-Fires Low-Intensity Infrared Heaters

NATIONAL FIRE PROTECTION ASSOCIATION
1 Batterymarch Park, Quincy, Massachusetts 02269

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

SOCIETY OF AUTOMOTIVE ENGINEERS
400 Commonwealth Drive, Warrendale, PA 15096

ANSI/SAE J513-1999, Refrigeration Tube Fittings —General Specifications

Part III: Manufacturing And Production Tests

The manufacturer shall submit to the certifying agency a plan which is mutually acceptable to the manufacturer and the certifying agency and which describes the programs and test procedures specified in 3.1, 3.2 and 3.3 and the records to be kept by the manufacturer.

3.1T
he manufacturer shall use a program to qualify new materials, parts, assemblies and purchased components.

3.2
The manufacturer shall test each connector tube for leakage.

3.3
The manufacturer shall use a program which includes a mutually acceptable schedule(s) to conduct:

a. Bending tests;

b. Torsion tests;

c. Resistance to ammonia atmosphere test;

d. Reconnection of fittings tests; and

e. Impact tests on fittings provided with both external and internal threads.

Part IV: Definitions

APPLIANCE. All gas utilization equipment.

ADAPTER. As used in this standard, a metal fitting designed to connect standard taper pipe threads to the connector nut.

CAPACITY. As used in this standard, the amount of a specified gas that will flow through a connector at a specified pressure drop in a fixed period of time.

CONDUIT, GAS. The gas passageway of the connector.

CONNECTOR, GAS APPLIANCE. A factory-fabricated assembly of gas conduit and related fittings designed to convey gaseous fuel, and used for making connections between a gas supply piping outlet and the gas inlet to an appliance. It is equipped at each end for attachment to standard taper pipe threads. A gas appliance connector is not for vibration isolation. Connectors for Gas Appliances, Z21.24 • CSA 6.10, are not designed for repeated movement after being connected nor for repeated disconnecting and connecting and shall not be used with quick-disconnect devices. For installation requiring movement of the appliance on a regular basis, refer to the Standard for C*onnectors for Movable Gas Appliances, ANSI Z21.69 • CSA 6.16.*

CONNECTOR, GAS HOSE. A connector designed for use only with portable gas-fired equipment. The gas conduit depends for gastightness on the wall structure of the hose material. The conduit may be supported with internal metal or other reinforcement. The design and application presuppose that the connector will not be pressurized when the appliance served by the connector is not in use. Gas hose connector includes:

1. **Gas Hose Connector for Portable Indoor Gas-Fired Equipment.** A gas hose connector for use only with laboratory, shop or ironing equipment used indoors that requires mobility during operation.

2. **Gas Hose Connector for Portable Outdoor Gas-Fired Appliances.** A gas hose connector for use with portable gas-fired equipment used outdoors.

CONNECTOR, MOVABLE GAS APPLIANCE (ANSI Z21.69 • CSA 6.16). CONNECTOR, MOVABLE GAS APPLIANCE (ANSI Z21.69 • CSA 6.16). A connector for use with all castered appliances as well as Food Service appliances that may, or may not utilize casters and, under conditions of normal use are moved on a regular basis for service, positioning, or area cleanliness. A connector of this type is not designed for continuous movement and may be equipped with a quick-disconnect device.

CONNECTOR NUT. A threaded nut permanently attached to a connector conduit which mates with an adapter or gas valve to form a union joint.

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.

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.

PROTECTIVE COATING. As used in this standard, material applied to the exterior surface of the connector to enhance resistance to corrosive materials.

TUBING. As used in this standard, the material from which the gas conduit of a connector is fabricated.

UNION. An assembly of parts to facilitate connection or disconnection between the connector and gas piping without rotation of the connector tubing.

UNION, GROUND JOINT. A union consisting of three parts (nut, swivel and end piece) concentrically machined to provide alignment.

VALVE, APPLIANCE CONNECTOR. A manually operated valve having a nondisplaceable movable valve member, a minimum specified capacity (code marked on the valve), a taper pipe thread inlet and an outlet for flared tubing connection. An appliance connector valve is intended to be used between the gas supply piping and the appliance connector attached to the appliance.

VALVE, GAS. A manually operated valve which permits control of the flow of gas at any rate from none to "full on."

Appendix A
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 x 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 x 10	3.613×10^{-2}	iwc	inch water column
	pounds/square inch	psi	6.895 x 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/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 (ms^3) measured @ 15°C and 760 mm Hg, dry. (SI Conditions)
Normal cubic meter (mn^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," 5/9 °F = °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 • 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 • CGA 2.6

Gas Food Service Equipment, Z83.11 • CGA 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 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 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, 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, 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

FAX OR MAIL TO:

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

or

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