ANSI Z21.8 – 2003
CSA 6.22 – 2003

Line Pressure Regulators

REFERENCE COPY

ASNI Z21.80-2003
CSA 6.22-2003

American National Standard/ CSA Standards For

Line Pressure Regulators

AMERICAN NATIONAL STANDARD
ANSI Z21.80-2003

CSA STANDARD
CSA 6.22-2003

Second Edition - 2003

This Standard is based on
the Standard for

LINE PRESSURE REGULATORS

ANSI Z21.80-1997 • CSA 6.22-M97,
and Addenda Z21.80a-2000 • CSA 6.22a-M00,
Z21.80b-2000 • CSA 6.22b-2000

APPROVED

November 14, 2002
American National Standards Institute, Inc.

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Secretariats

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Cleveland, Ohio 44131

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Preface

This publication represents a basic standard for safe operation, substantial and durable construction, and acceptable performance of a line pressure regulator. It is the result of years of experience in the manufacture, testing, installation, maintenance, inspection and research on line pressure regulators. 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 a line pressure regulator, 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 line pressure regulators depends to a great extent upon its proper installation, use and maintenance. It should be installed, as applicable, in accordance with the *National Fuel Gas Code, ANSI Z223.1/NFPA 54*; the *Natural Gas and Propane Installation Code, CSA B149.1*.

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

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

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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 The Standard For Line Pressure Regulators

(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 July 12-13, 1994 meeting, the Joint Automatic Gas Controls Subcommittee adopted the harmonized draft standard for line pressure regulators, Z21.80 • CSA 6.22, for distribution for review and comment. The harmonized draft standard for line pressure regulators was based on American National Standard for Gas Appliance Pressure Regulators, ANSI Z21.18-1993.

At its August 15, 1995 meeting, the Automatic Gas Controls Subcommittee (formerly the Automatic Gas Controls Subcommittee and the Thermostat and Gas Ignition Systems Subcommittee) reconsidered the proposed draft harmonized standard in light of comments received. The proposed harmonized standard was revised and recommended to Accredited Standards Committee Z21 and the Canadian Standards Steering Committee for approval.

The Z21 Committee approved the proposed harmonized standard by letter ballot dated January 31, 1996, for submittal to the American National Standards Institute, Inc. The Canadian Standards Steering Committee approved the proposed harmonized standard by letter ballot dated May 8, 1996, for submittal to the Interprovincial Gas Advisory Council.

The Interprovincial Gas Advisory council approved the proposed harmonized standard by letter ballot dated June 28, 1996. This, the first edition of the harmonized standard for gas appliance sediment traps was approved as American National Standard by the American National Standards Institute, Inc. on March 13, 1997.

The Z21/83 Committee, by letter ballot dated February 18, 2000, approved proposed revisions to the harmonized line pressure regulator standard. The (Interim CSA) Standards Steering Committee concurred with the actions of the Z21/83 Committee and approved the proposed revisions to the harmonized standard.

This the second edition of the harmonized line pressure regulator standard was approved by the Interprovincial Gas Advisory Council on August 25, 2003 and the American National Standards Institute, Inc. on November 14, 2002.

Previous editions of the harmonized line pressure regulator standard, and addenda thereto approved by the Interprovincial Gas Advisory Council and the American National Standards Institute are as follows:

ANSI Z21.80-1997 • CSA 6.22-M97
ANSI Z21.80a-2000 • CSA 6.22a-M00
ANSI Z21.80b-2000 • CSA 6.22b-2000

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

ANSI Z21.80-2003 • CSA 6.22-2003

Note: *This the second edition of Z21.80 • CSA 6.22 incorporates changes to the first 1997 edition of Z21.80 • CSA 2.26 and addenda thereto. Changes are denoted by a vertical line in the margin.*

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

Harmonized Standard For Line Pressure Regulators

Part I: Construction

1.1 Scope

1.1.1 This standard applies to line pressure regulators, (see Part V, Definitions), constructed entirely of new, unused parts and materials, hereinafter referred to as regulator(s), either individual or in combination with over pressure protection devices, hereinafter referred to as device(s), intended for application in gas piping systems between the service regulator or LP-gas 2 psi service regulator and the gas utilization equipment.

1.1.2 Types of gases. This standard applies to regulators for operation with natural, manufactured, and mixed gases, liquefied petroleum gases and LP gas-air mixtures.

1.1.3 This standard applies to regulators classified in accordance with their intended application with reference to inlet and outlet pressures as follows.

Rated Inlet Pressure	Maximum Outlet Pressure	
	Class I	Class II
2 psi (13.8 kPa)	1/2 psi (3.5 kPa)	—
5 psi (34.5 kPa)	1/2 psi (3.5 kPa)	2 psi (13.8 kPa)
10 psi (68.9 kPa)	1/2 psi (3.5 kPa)	2 psi (13.8 kPa)

1.1.4 This standard applies to regulators and devices intended for use in one or more of the following mounting classifications (see 1.12-a):

Upright—single position on a horizontal axis with respect to the inlet connection, as specified by the manufacturer.

Horizontal—any position on a horizontal axis with respect to the inlet connection.

Vertical—any position on a vertical axis with respect to the inlet connection.

Limited Horizontal—any position from upright to 90 degrees (1.57 rad) from upright on a horizontal axis with respect to the inlet connection.

Multipoise—any position on a horizontal, vertical or intermediate axis with respect to the inlet connection.

The tests specified herein shall be conducted with the regulator mounted in the manufacturer's specified upright position, unless otherwise specified herein.

If the manufacturer specifies more than one mounting position, the tests in 2.7 (Outlet Pressure Range) shall be conducted in each mounting position. The data from these tests shall then be analyzed to determine the mounting position which produces the minimum outlet pressure and the mounting position which produces the maximum outlet pressure, based on results observed for the minimum outlet pressure setting of the regulator.

a. The tests in 2.8 (Range of Regulation Capacity) shall be conducted in the mounting position which produces the minimum outlet pressure, as determined in 2.7 (Outlet Pressure Range).

b. The tests in 2.8 and 2.9 (Regulator Lockup Pressure) shall also be conducted in the mounting position which produces the maximum outlet pressure, as determined in 2.7.

1.1.5 The tests specified herein shall be conducted at a room temperature of 77 ± 10°F (25 ± 5.5°C). Regulators and vent limiters complying with the provisions of this standard shall be considered as having an operating temperature range of 32°F (0°C) to 125°F (51.5°C). At the option of the manufacturer, a greater operating temperature range may be specified, in which case additional tests as outlined in 2.4 (Leakage) and 2.10 (Continued Operation) shall be conducted.

1.1.6 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.

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

1.2 Data To Be Furnished By The Manufacturer

The manufacturer shall furnish the following data for use by the testing agency in examining regulators under this standard:

a. Drawings, blueprints, or photographs which describe each model, as specified by the testing agency;

b. Rated inlet pressure of the regulator (see 1.1.3);

c. Outlet pressure adjustment range, related inlet pressure (not to exceed the rated inlet pressure), and related flow rate for adjustable regulators;

d. Outlet pressure, related inlet pressure (not to exceed the rated inlet pressure), and related flow rate for nonadjustable regulators;

e. Mounting classification(s) (see 1.1.4);

f. Ambient temperature range in which the regulator is intended to operate (see 1.1.5);

g. Maximum regulation capacity;

h. Maximum individual load capacity;

i. Supporting documentation relative to the suitability of materials (see 1.11.1);

j. A description of the operating principle;

k. Maximum cycling rate(s) for continued operation testing;

l. Method of overpressure protection provided, if applicable (see 1.14.1);

m. Information as to the gases with which the vent limiter is to be used; and

n. The fuel gas(es) for which it is intended.

1.3 Assembly

1.3.1 Air movement (breathing) from the atmospheric side of the regulator diaphragm shall take place only through the vent opening(s).

1.3.2 The construction of parts not covered by this standard shall be in accordance with reasonable concepts of safety, substantiality, durability and interchangeability.

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.

1.4 Connections

1.4.1 When for connection to pipe, connections shall be provided with cleanly cut taper pipe threads in accordance with the Standard for *Pipe Threads, General Purpose (Inch), ANSI/ASME B1.20.1.*

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

a. A tapping sealed by a minimum $^{1}/_{8}$ inch NPT plug or cap with cleanly cut taper pipe threads in accordance with the Standard for *Pipe Threads, General Purpose (Inch), ANSI/ASME B1.20.1.* If the plug is of the slotted type it shall also incorporate square or hex flats; or

b. A hose fitting which incorporates a captured sealing means.

The fitting shall have a minimum length of 0.355 inch (9.02 mm) and a 0.355 inch (9.02 mm) maximum/0.335 inch (8.50 mm) minimum outside diameter.

1.4.3 Pipe thread length and length to shoulder dimensions shall not be less than shown in Table I (Minimum Thread Length and Length to Shoulder).

1.4.4 A regulator or device equipped with pipe or tubing threads shall be designed to accept a wrench for use in assembly and disassembly to piping.

1.4.5 When for connection to semi-rigid tubing, the connection, together with the fittings used thereon shall be in accordance with or be interchangeable with the fittings described in Part I, *SAE Handbook*, or equivalent.

1.4.6 Standard flange connections, when provided, shall be constructed in accordance with the dimensional specifications for 125-lb. cast-iron flanges of the Standard for *Cast-Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250 and 800, ANSI/ASME B16.1.* (See Figure 1, 125 lb. Cast Iron Pipe Flange Body Connections.)

1.4.7 Inlet and outlet gas connections shall be designed so that when a pipe which is threaded two threads beyond standard size (for the size in question) is run into the threaded portion of a regulator body, it will not adversely affect the operation of the regulator.

1.5 Bolts And Screws

The threads of all bolts, nuts and screws used in the assembly shall be in accordance with the Standard for *Unified Inch Screw Threads (UN and UNR Thread Form), ANSI/ASME B1.1.*

1.6 Adjustments

1.6.1 Adjustable regulators shall be provided with means for making any necessary adjustment of outlet pressure. The adjustment means of spring-type regulators shall be concealed.

Line pressure regulators shall not be capable of an outlet pressure adjustment in excess of the following:

a. Class I - $^1/_2$ psi (3.5 kPa); or

b. Class II - 2 psi (13.8 kPa).

1.6.2 Suitable means for maintaining the positions of all adjustments shall be provided. Locknuts or adjusting nuts held by springs or compression will be considered satisfactory, except when their adjustment can be accidentally disturbed.

1.6.3 Construction of a regulator or device shall be such that in all operating positions of the diaphragm or adjustment means correct alignment will be maintained.

1.6.4 Factory adjustment means not intended for field adjustment shall be sealed by means suitable for both continuous and intermittent exposure at the manufacturer's specified minimum and maximum operating temperatures. Suitability of the sealing means shall be judged before and after completion of all tests specified in this standard. Mechanical sealing means shall require the use of special tools.

1.7 Strength

The strength of all parts and joints of the body of a regulator or device shall be such that no evidence of leakage or permanent deformation will develop as a result of the tests specified herein.

1.8 Vent Connections And Vent Limiters

1.8.1 Vent connections of regulators and devices not incorporating integral vent limiters shall be substantially bossed and tapped for a connection not less than $^1/_8$ inch nominal size taper pipe thread in accordance with the Standard for *Pipe Threads General Purpose (Inch), ANSI/ASME B1.20.1*, or shall have suitable internal threads for tubing connections.

1.8.2 The orifice of a vent limiter shall be protected from foreign particles.

1.8.3 A vent limiter shall be constructed so as to perform satisfactorily within the ambient temperature range specified for the regulator on which the device is employed.

1.9 Springs

Springs actuating the diaphragm shall be constructed of corrosion-resistant material or have a corrosion-resistant finish.

1.10 Finish

The body and other external parts shall be of corrosion-resistant material or have a corrosion-resistant finish or coating. Steel housings shall have a galvanized, plated, baked enamel or equivalent corrosion-resistant finish.

1.11 Materials

1.11.1 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 submitted 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 non-metallic diaphragm and seal materials are suitably resistant to the effects of ozone.

1.11.2 Materials shall be suitable for use throughout the operating temperature range of the regulator or device (see 1.2-f).

1.11.3 Bodies and casings of regulators and devices shall be of materials having melting points of not less than 800°F (427°C).

1.11.4 Vent limiters shall be of materials having melting points of not less than 800°F (427°C).

1.12 Instructions

The manufacturer shall provide printed instructions and diagrams adequate for proper field installation.

These instructions shall include, as applicable:

a. Diagrams to illustrate the specified mounting position(s);

b. Rated inlet pressure of 2, 5 or 10 psi (13.8, 34.5 or 68.9 kPa);

c. Outlet pressure adjustment range or nonadjustable setting;

d. Method of adjusting the regulator pressure setting;

e. Maximum combined input rating of all appliances served by the regulator shall not exceed ___;*

f. Maximum input rating for any individual appliance served by the regulator;

g. Method of venting the regulator;

h. Maximum and minimum ambient temperatures;

i. Instructions regarding operation of the overpressure protection device and reset procedures;

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* *This shall not exceed the maximum regulation capacity.*

j. For an overpressure relief device (see Part V Definitions), instructions for proper installation of the discharge piping to terminate in a safe location, and a description of the most restrictive vent piping configuration which may be used;

k. Instructions for outdoor applications ;

l. The type(s) of fuel gas for which the regulator is intended; and

m. Instructions that the installation shall be performed in accordance with local codes or, in the absence of local codes, in accordance with the *National Fuel Gas Code, ANSI Z223.1*, or the *Natural Gas and Propane Install Code, CAN/CGA-B149.1*, as applicable.

The instructions shall be reviewed by the testing agency for accuracy and compatibility with results of test.

1.13 Marking

The suitability of markings shall be determined as specified in 2.12 (Marking Material Adhesion and Legibility).

1.13.1 Regulators and devices shall be marked to indicate the following, as applicable:

a. Manufacturer's name, trademark or symbol;

b. Model designation, and one of the following, as applicable:

1. Outlet pressure setting for a nonadjustable or factory-set adjustable regulator; or

2. Outlet pressure adjustment range;

c. Rated inlet pressure;

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

e. The direction of gas flow; and

f. Regulator "class" designation (Class I or Class II).

1.13.2 Separate vent limiters shall be marked so as to be individually identifiable.

1.13.3 Regulators and devices not incorporating an integral vent limiter shall be marked "Vent" adjacent to the vent opening, if provided.

1.13.4 Each regulator and device shall bear a separate marking indicating the date of manufacture. This marking shall be as specified in "-a" or "-b" 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 regulator was manufactured (e.g., 03 for 2003).

2. The third and fourth digits indicating the week in which the regulator 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.

Additional numbers, letters or symbols may follow the four digit number specified in "-b1" and "-b2." If additional numbers are used, they must be separated from the date code.

1.14 Overpressure Protection Devices

1.14.1 Line pressure regulators rated for inlet pressures in excess of 2 psi (13.8 kPa) and capable of being adjusted to deliver an outlet pressure of $^1/_2$ psi (3.5 kPa) or less shall be provided with an independent means to limit the downstream pressure to 2 psi (13.8 kPa) maximum in the event of failure of the regulating mechanism.

1.14.2 An overpressure shutoff device (see Part V, Definitions), if provided, shall require a manual procedure to reset the device following actuation.

1.14.3 Line pressure regulators with separate overpressure protection devices shall be factory pre-assembled, and supplied to the field as a unit.

Part II: Performance - Line Pressure Regulators

2.1 General

2.1.1 Unless otherwise specified, tests for compliance with this standard shall be conducted at 77 ± 10°F (25 ± 5.5°C), hereinafter referred to as room temperature.

2.1.2 Separate overpressure protection devices shall be included in the test setup, in accordance with the manufacturers instructions, for the tests in 2.7 (Outlet Pressure Range), 2.8 (Range of Regulation Capacity) and 2.10 (Continued Operation).

2.2 Test And Reference Gases

2.2.1 Unless otherwise specified herein, either gas or air may be used for the tests. The term "test gas" as used herein shall mean either gas or air.

2.2.2 The temperature of the test gas for low temperature operation tests shall be at the manufacturer's specified minimum ambient temperature.

2.2.3 The test results shall be expressed in terms of a 1,000 Btu per cubic foot (37.3 MJ/m^3), 0.64 specific gravity gas at standard conditions [saturated with water at 60°F (15.5°C) and 30 inches mercury column (101.3 kPa) pressure].

2.3 Test Pressures

Unless otherwise specified, the maximum and minimum inlet test pressures shall be as specified in Table II (Inlet Test Pressure).

2.4 Leakage

Regulators shall not leak externally at a rate in excess of 200 cubic centimeters per hour when subjected to the maximum inlet test pressure. This test shall be conducted at:

a. Room temperature if the specified ambient temperature range is 32°F (0°C) to 125°F (51.5°C);

b. Room temperature and the maximum specified ambient temperature if that temperature is above 125°F (51.5°C), (see 1.2-f);

c. Room temperature and the minimum specified ambient temperature if that temperature is below 32°F (0°C), (see 1.2-f); or

d. Both the minimum and maximum specified ambient temperatures if the operating temperature range extends below 32°F (0°C) and above 125°F (51.5°C).

Method of Test

The inlet and outlet of the regulator shall be connected to a pneumatic system capable of supplying clean air. Air shall be admitted slowly and maintained at the maximum inlet test pressure (see Table II, Inlet Test Pressure). Leakage shall be determined by a flowmeter, capable

of accurately indicating the allowable flow, located at the inlet of the air supply. Any observed leakage, corrected to standard conditions of 30 inches mercury column (101.3 kPa) pressure and 60°F (15.5°C), shall not be in excess of 200 cubic centimeters per hour.

2.5 Strength And Deformation

2.5.1 Turning Effort

Regulators shall be capable of withstanding, without deformation, breakage or leakage, stresses resulting from installation.

This test shall not apply to regulators having flange connections.

Method of Test

This test shall be conducted at room temperature. A new sample shall be subjected to this test.

a. A regulator with both the inlet and outlet threaded for connection to iron pipe with standard taper pipe threads shall be subjected to the following test.

   1. A length of new, clean and properly threaded Schedule 40 iron pipe or pipe fitting, as applicable, lubricated with SAE 10 viscosity machine oil applied to the pipe threads, shall be threaded to the inlet of the regulator with the torque specified in Table III by gripping the wrench flats on the regulator or any suitable area on the regulator, if wrench flats are not provided. If wrench flats are provided on both ends of the regulator, the inlet end wrench flats shall be used. If wrench flats are not provided, a special tool provided by the regulator manufacturer may be used for this test. The turning effort shall be applied for 15 minutes and then released.

   2. The procedure outlined in "-a1" shall be repeated for the outlet of the regulator using the outlet end wrench flats, if provided.

      NOTE: Any leakage due to dry threads shall be disregarded.

   3. The regulator, with the inlet and outlet pipes in place, shall be tested for leakage as specified in 2.4 (Leakage) at room temperature and shall comply.

      The inlet and outlet pipes shall then be removed and the regulator examined for deformation and breakage.

b. A regulator with both the inlet and outlet designed for connection to tubing shall be subjected to the following test.

   1. A length of the proper size of aluminum tubing with the end squared and deburred shall be assembled to the inlet end of the regulator with the torque specified in Table III (Torques For Turning Effort Test) using the attachment means specified by the manufacturer.

      When applying the torque, the regulator shall be rigidly supported by the wrench flats or any suitable area on the regulator, if wrench flats are not provided. If wrench flats are provided on both ends of the regulator, the inlet end wrench flats shall be used. The torque shall be applied to the tubing fitting for 15 minutes and then released.

2. The procedure outlined in "-b1" shall be repeated for the outlet of the regulator using the outlet end wrench flats, if provided.

3. The regulator, with the inlet and outlet tubing in place, shall be tested for leakage as specified in 2.4 (Leakage) at room temperature and shall comply. The inlet and outlet tubing shall then be removed and the regulator examined for deformation and breakage.

c. For a regulator having only one threaded connection for iron pipe, the pipe thread end shall be tested as in "-a" above, as appropriate.

d. For a regulator having only one tubing connection, the tubing connection shall be tested as in "-b" above, as appropriate.

2.5.2 Bending Moment

A regulator shall withstand without cracking, breaking, or leaking, a bending moment using the weight specified in Table IV (Load for Bending Moment Test) in accordance with the following Method of Test.

Method of Test

This test shall be conducted at room temperature. A new sample shall be subjected to the specified test.

a. The inlet and outlet connections shall be assembled leaktight to the appropriate fittings as described below. The length of the inlet fitting shall be such that, after assembly the dimension from the regulator inlet to the end of the inlet fitting will be 13 inches ± $^1/_2$ inch (330 mm ± 12.7 mm). The tightening torque for threaded pipe or tubing connections shall be one-half that shown in Table III (Torques for Turning Effort Test).

1. Pipe threaded connections shall be assembled to Schedule 40 iron pipe, or pipe fitting, using non-Teflon type pipe joint compound.

2. Tubing connections shall be assembled to steel tubing conforming to *ANSI/SAE J525* which has a minimum wall thickness of 0.028 inch (0.711 mm), using the attachment means specified by the manufacturer.

3. Connections designed for other than threaded pipe or tubing shall be assembled to test fixture(s) representative of the intended connection means.

b. The outlet fitting shall be rigidly supported 1 inch (25.4 mm) from the regulator outlet, unless the following exceptions apply. When the regulator has an integral mounting means independent of the inlet and outlet connections, it shall be mounted using the integral mounting means as specified by the manufacturer. When the regulator is intended to be mounted by either the integral mounting means or the outlet, the mounting means which produces the most severe test condition shall be used. The regulator inlet shall be in the horizontal position.

c. The regulator shall be tested for leakage as specified in 2.4 (Leakage) except at room temperature and shall comply.

d. The system shall be pressurized at 21 inches water column (5.23 kPa) and the appropriate weight as specified in Table IV (Load for Bending Moment Test) shall then be suspended on the inlet fitting, without shock, 12 inches (305 mm) from the inlet of the regulator for 15 minutes. Without removing the weight the regulator shall then be tested for leakage as specified in 2.4 (Leakage) except at room temperature and a pressure of 21 inches water column (5.23 kPa).

e. The test in "-d" shall be repeated three times with the regulator being rotated 90 degrees (1.57 rad) around the horizontal inlet axis between each test. If the application of any bending moment is in a direction which would tend to rotate the regulator with respect to the outlet, that bending moment need not be applied.

At the completion of the above tests, the weight shall be removed and the regulator then subjected to the leakage test as specified in 2.4 (Leakage) at room temperature. The regulator shall then be removed and examined for deformation and breakage.

2.5.3 The body, atmospheric diaphragm chamber and sealing means of a regulator, except the diaphragm, shall withstand, without rupture, a static pressure of 5 times the rated inlet pressure for the regulator.

Method of Test

A separate regulator, not to be used for the conduct of other tests, shall be tested.

The diaphragm employed in the regulator shall be substantially removed to permit the test medium to flow freely to both sides of the diaphragm.

The inlet and outlet of the regulator shall be connected to a suitable hydraulic system. The pressure shall be raised slowly to 5 times the rated inlet pressure of the regulator and held at that pressure for 1 minute.

2.6 Mounting Regulator For Test

Standard weight pipe (Schedule 40, API 5 L Grade B) of proper size, reamed to remove burrs caused by cutting, shall be properly fitted to the inlet and outlet connections of the regulator. When a regulator is provided with semi-rigid tubing connections, fittings and semi-rigid tubing of the proper size reamed to remove burrs caused by cutting shall be used instead of standard weight pipe.

The length of straight run of pipe before the inlet pressure tap shall not be less than 50 pipe diameters (I.D.), or in accordance with the principles established for pipe tap connections as presented in Orifice Metering of Natural Gas (*Gas Measurement Committee Report No. 3*) of the American Gas Association. The length of straight run of pipe between the regulator and any downstream controlling means shall be 10 pipe diameters (I.D.).

Two short lengths of pipe or metal tubing having a small diameter shall be soldered to the pipe or semi-rigid tubing, one before the inlet and the other after the outlet connection. The pressure tap before the inlet shall be located 5 pipe diameters from the discharge end of the inlet pipe or tubing. The pressure tap after the outlet connection shall be located 5 pipe diameters from the inlet end of the discharge pipe or tubing. A $^{1}/_{16}$ inch (1.6 mm) diameter drill shall be inserted in each short length of pipe or metal tubing and a hole drilled through the wall of the larger pipe or semi-rigid tubing, care being taken to remove any burrs caused thereby.

The regulator shall be placed in the mounting position specified in 1.1.4 for the particular test to be conducted. The pressure taps shall be connected to independent pressure measuring devices having an accuracy of 1 percent at the observed value as well as to a differential gage (one tap being connected to each side) which has an accuracy of 1 percent at the observed value. An adjustment control valve system of the same size as the regulator under test, permitting precise control, shall be installed not less than the above specified number of pipe or tubing diameters from the regulator under test. To permit the interruption of gas flow without changing the adjustment control system, an automatic valve having an opening time of 0.1 second or less

from initial flow to a capacity greater than the maximum regulation capacity of the regulator being tested shall be provided downstream from the regulator under test.

A typical arrangement of the required test apparatus is shown in Figure 2A, Typical Arrangement of Test Apparatus for Regulators Rated at 2 psi or Regulators with Integral Overpressure Control or Figure 2B, Typical Arrangement of Test Apparatus for Regulators Rated Over 2 psi With Separate Overpressure Device.

The flow of test gas shall be measured by means which will provide a reading of volumetric accuracy within ± 1 percent at the rated flow. If fuel gas is used for the test gas, it shall be vented or burned as far away from the apparatus and the regulator under test as will preclude the heating of such equipment.

The constant pressure source shall not permit a pressure variation, from no flow to full flow, of more than ± 0.1 inch water column (24.9 Pa) for each 100 cubic feet (2.83 m^3) of air flow at full flow.

2.7 Outlet Pressure Range

2.7.1 Adjustable Regulators

The highest obtainable outlet pressure shall be not less than that specified by the manufacturer. The lowest obtainable outlet pressure shall be not more than that specified by the manufacturer. During the test to determine the limits of the adjustment range, the spring shall not become disengaged.

Method of Test

The regulator shall be mounted as specified in 2.6 (Mounting Regulator for Test) in the upright position (see 1.1.4).

The regulator shall be adjusted to deliver its minimum outlet pressure. The cap provided for concealing the adjustment shall be in place. The inlet pressure and flow rate specified by the manufacturer (see 1.2-c) shall be established. The outlet pressure shall be noted and shall not be more than the minimum outlet pressure specified by the manufacturer.

The regulator shall be adjusted to deliver its maximum outlet pressure. The inlet pressure and flow rate specified by the manufacturer (see 1.2-c) shall be established. The outlet pressure shall be noted and shall not be less than the maximum outlet pressure specified by the manufacturer.

The above tests shall be repeated with the regulator mounted in each mounting position specified by the manufacturer (see 1.1.4).

The data noted with the minimum outlet pressure adjustment shall be examined to determine the regulator mounting position which produces the minimum outlet pressure and the regulator mounting position which produces the maximum outlet pressure. (See 1.1.4-a and 1.1.4-b.) These two mounting positions are to be used for conduct of 2.8 (Range of Regulation Capacity).

2.7.2 Nonadjustable Regulators

The outlet pressure determined under the following Method of Test shall be the manufacturer's specified outlet pressure (see 1.2-d) ± 5 percent.

Method of Test

The regulator shall be mounted as specified in 2.6 (Mounting Regulator for Test) in the upright position (see 1.1.4).

The inlet pressure and flow rate shall be established as specified by the manufacturer (see 1.2-d).

The outlet pressure shall be observed and shall be as specified by the manufacturer within ± 5 percent.

The above test shall be repeated with the regulator mounted in each mounting position specified by the manufacturer (see 1.1.4).

The data shall be examined to determine the regulator mounting position which produces the minimum outlet pressure and the regulator mounting position which produces the maximum outlet pressure. (See 1.1.4-a and 1.1.4-b.) These two mounting positions are to be used for conduct of 2.8 (Range of Regulation Capacity).

2.8 Range Of Regulation Capacity

The range of regulation capacity as determined by test shall include the upper limit specified by the manufacturer. The lower limit of the range of regulation capacity shall not be greater than 0.15 cubic foot per hour (1.18 cm^3/s).

2.8.1 Nonadjustable Regulators

Method of Test

The regulator shall be mounted for test as specified in **2.6** (Mounting Regulator for Test) and 1.1.4-a.

The inlet test pressure shall be adjusted to the appropriate minimum value specified in Table II (Inlet Test Pressure). If this minimum value exceeds the rated inlet pressure, the rated inlet pressure shall be used as the minimum inlet test pressure. The initial flow rate shall be set at a value less than 0.15 cubic foot per hour (1.18 cm^3/s).

The inlet test pressure shall be gradually increased to the rated inlet pressure. Over this range of inlet pressures, the minimum and maximum obtainable outlet pressures observed and their corresponding flow rates shall be recorded and used to construct a smooth orifice curve (see Part V, Definitions).

The inlet test pressure shall then be increased to the maximum inlet test pressure (see Table II) and the outlet pressure observed shall be recorded.

This procedure shall be repeated for increased flow rates to a flow rate exceeding the upper limit of the manufacturer's specified range of regulation capacity. Sufficient readings shall be recorded to establish smooth curves (see Figure 3, Range of Regulation Curves for Nonadjustable Regulators) when minimum obtainable outlet pressures are joined (Curve A), maximum obtainable outlet pressures are joined (Curve B), and outlet pressures obtained at the maximum inlet test pressure are joined (Curve C).

Pressure variations and flow rates shall be examined along the orifice curves.

a. The minimum and maximum obtainable outlet pressure curves shall be examined to determine the minimum and maximum flow rates between which the outlet pressure variation does not exceed 20 percent of the minimum obtainable outlet pressure. (See Figure 3.)

b. A curve constructed from the outlet pressures obtained at the maximum inlet test pressure shall be examined to determine the minimum and maximum flow rates between which the curve does not vary more than ± 20 percent from the minimum obtainable outlet pressure. (See Figure 3, Range of Regulation Curves for Nonadjustable Regulators.)

c. Both the minimum obtainable outlet pressure curve (Curve A) and the maximum obtainable outlet pressure curve (Curve B) shall be simultaneously examined to determine the flow rate where the outlet pressure varies from the maximum outlet pressure recorded at a flow rate of 0.15 cubic foot per hour (1.18 cm^3/s) (point "-a" in Figure 3 or Figure 4, Range of Regulation Curves for Adjustable Regulators) by 30 percent.

The smallest maximum flow rate determined from "-a," "-b" and "-c" above shall not be less than the upper limit of the manufacturer's specified range of regulation capacity, and the lower limit shall not be greater than 0.15 cubic foot per hour (1.18 cm^3/s).

The entire test shall be repeated with the regulator mounted as specified in 1.1.3-b.

2.8.2 Adjustable Regulators

Method of Test

The regulator shall be mounted for test as specified in 2.6 (Mounting Regulator for Test), and 1.1.4-a.

The regulator shall then be adjusted to deliver the manufacturer's specified maximum outlet pressure with the related inlet pressure and flow rate established as specified by the manufacturer (see 1.2-c). The procedure outlined in 2.8.1 shall then be followed.

The regulator shall then be adjusted to deliver the manufacturer's specified minimum outlet pressure with the related inlet pressure and flow rate established as specified by the manufacturer (see 1.2-c). The procedure outlined in 2.8.1 shall then be repeated.

The smallest maximum flow rate determined from all of the tests above shall not be less than the upper limit of the manufacturer's specified range of regulation capacity, and the lower limit shall not be greater than 0.15 cubic foot per hour (1.18 cm^3/s). (See Figure 4, Range of Regulation Curves for Adjustable Regulators.)

The entire test shall be repeated with the regulator mounted as specified in 1.1.4-b.

2.9 Regulator Lockup Pressure

A regulator shall "lock up" under no-flow conditions to limit the downstream pressure as indicated in the following method of test.

Method of Test

A regulator shall be mounted as specified in 2.6 (Mounting Regulator for Test) and 1.1.4-b.

The regulator, if user adjustable, shall be adjusted to deliver its maximum outlet pressure. The inlet pressure to the regulator shall be adjusted to and maintained at the rated inlet pressure (see 1.1.3). With the instantaneous automatic valve energized (open), the flow adjustment means shall be adjusted to produce a flow equivalent to the maximum individual load capacity specified by the manufacturer (see 1.2-h). The regulator outlet pressure shall be observed and recorded as the initial outlet pressure.

The automatic valve shall then be de-energized, and the resultant regulator lock-up pressure under no-flow conditions shall be allowed to stabilize and shall be noted. This test shall be repeated by cycling the automatic gas valve on and then off for a total of five determinations of the regulator lock-up pressure. None of the lockup pressure readings shall exceed the following (see 1.1.3):

Class I regulator - 150 percent of initial outlet pressure or the initial outlet pressure + 5 inches w.c. (1.24 kPa), whichever is greater.

Class II regulator - 150 percent of initial outlet pressure.

2.10 Continued Operation

The regulator tested under 2.9 (Regulator Lockup Pressure) shall withstand 100,000 cycles of full opening and closing of the regulator valve, without any mechanical failure, impairment of operation, apparent damage, and without the development of leakage.

Method of Test

For this test, the highest setting of the regulator shall be used with no change in the adjustment(s) established in 2.9.

The inlet of the regulator shall be connected to a clean gas or air supply which is controlled in such a manner that gas pressures of zero and the maximum inlet test pressure specified for its rated inlet pressure are alternately exerted at the inlet of the regulator which shall be installed in the manufacturer's specified upright position. The flow rate through the regulator shall be adjusted to a rate sufficient to assure full opening and closing of the valve. The outlet connection of the regulator shall be provided with a suitable mechanism which closes the outlet when the maximum inlet test pressure is applied at the inlet, and which permits access of the outlet to the atmosphere when no pressure is applied at the inlet. All piping and fittings shall be free from dirt, scale or other accumulations which would affect the operation of the regulator.

This test shall be conducted at a cycling rate not greater than that specified by the manufacturer and in the following sequence according to the manufacturer's specified operating temperatures(s):

a. 10,000 cycles at the minimum specified ambient temperature below 32°F (0°C) and 90,000 cycles at the maximum specified ambient temperature above 125°F (51.5°C);

b. 90,000 cycles at room temperature and 10,000 cycles at the minimum specified ambient temperature below 32°F (0°C);

c. 10,000 cycles at room temperature and 90,000 cycles at the maximum specified ambient temperature above 125°F (51.5°C); and

d. 100,000 cycles at room temperature if the specified ambient temperature range is 32°to 125°F (0 to 51.5°C).

At the completion of 100,000 cycles, the regulator shall comply with the following:

1. The room temperature tests specified in 2.4 (Leakage);

2. Regulator Lockup Pressure (2.9); the lockup pressure shall not exceed that observed prior to the continued operation test by more than 2 inches water column (498 Pa), or a lockup pressure of 21 inches water column (5.23 kPa), whichever is less; and

3. Vent Limiter (2.11); if equipped with a vent limiting device of other than the fixed orifice type.

2.11 Vent Limiter Venting Rate

Venting Rate. Vent limiters used with regulators shall limit the flow through the vent of the regulator as shown in Table V (Maximum Allowable Vent Limiter Venting Rate).

Method of Test

Separate vent limiters shall be installed in an upright position in a gastight piping system so that the test medium passes through the vent limiter. It shall then be determined that there is no leakage at points other than through the vent limiter. The rate of flow through the test meter shall be determined at pressures from 2 inches water column (498 Pa) up to and including the rated inlet pressure of the regulator as specified in 2.3 (Test Pressures) or 3.4 (Test Pressures) and corrected for 1.53 specific gravity for vent limiters for use with liquefied petroleum gases, and 0.64 specific gravity for vent limiters for use only with natural, manufactured, mixed gases and LP gas-air mixtures. The corrected flow rate shall not exceed the maximum allowable specified values (see Table V). If the vent limiter is is designed for use in positions other than upright, additional tests to determine the rate of flow shall be conducted when the vent limiter is installed in other positions.

When the vent limiter is an integral part of the regulator, the regulator diaphragm shall be substantially removed to permit the test medium to flow freely through the vent limiter. With the regulator installed in a gastight piping system in the manufacturer's specified upright position, the flow rate through the integral vent limiter shall be determined as described for separate vent limiters. The corrected flow rate shall not exceed the maximum allowable specified values. Additional tests to determine the rate of flow shall be conducted with the regulator in any other position for which compliance with this standard is desired.

2.12 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 the completion of the tests specified in 2.10 (Continued Operation), or equivalent periods of time and temperature. 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, when labels are used;

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

c. Good adhesion when scraped across edges of the test sample plate with a metal blade (dulled knife blade or back of pocketknife blade) held at right angles to the test panel.

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

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.

Part III: Performance – Overpressure Protection Devices

3.1 Scope

3.1.1 This part applies to line pressure regulators (see Part V Definitions), rated for inlet gas pressures in excess of 2 psi (13.8 kPa) which include an integral overpressure protection device (see 1.1.3).

3.1.2 This part also applies to separate overpressure protection devices which are provided by the line pressure regulator manufacturer for installation in conjunction with a line pressure regulator which is capable of being adjusted to deliver an outlet pressure of $^1/_2$ psi (3.5 kPa) or less (see 1.14.1).

3.2 General

3.2.1 The text of 2.1.1 shall apply.

3.3 Test And Reference Gases

3.3.1 The text of 2.2.1 shall apply.

3.3.2 The text of 2.2.2 shall apply.

3.3.3 The text of 2.2.3 shall apply.

3.4 Test Pressures

3.4.1 The text of 2.3.1 shall apply.

3.5 Leakage

3.5.1 For an overpressure protection device which is an integral part of a line pressure regulator, the device shall be tested as part of the regulator in 2.4 (Leakage).

3.5.2 For a separate overpressure protection device, the device shall be separately tested using the procedure specified in 2.4. Any observed leakage for a separate device shall not exceed 200 cubic centimeters per hour when tested as outlined in 2.4 (Leakage).

3.6 Strength And Deformation

3.6.1 For an overpressure protection device which is an integral part of a line pressure regulator, the device shall be tested as part of the regulator in 2.5 (Strength and Deformation).

3.6.2 For a separate overpressure protection device, the device shall be separately tested using the procedure specified in 2.5.1, 2.5.2 and 2.5.3 and shall comply.

3.7 Mounting For Test

A separate overpressure protection device shall be mounted in series with the line pressure regulator in accordance with 2.6 (Mounting Regulator for Test) and with the manufacturer's installation instructions (see Figure 2B, Typical Arrangement of Test Apperatus for Regulators Rated Over 2 psi With Overpressure Device).

For a device which is an integral part of a line pressure regulator, the regulator/device shall be mounted in the manufacturer's specified upright position in accordance with 2.6 (see Figure 2A, Typical Arrangement of Test Apperatus for Regulators Rated at 2 psi or Regulators with Integral Overpressure Control).

For a separate overpressure protection device, the line pressure regulator and the device shall be mounted in their upright positions in accordance with 2.6 and 3.7 (see Figure 2B).

3.8 Overpressure Protection

This provision applies only to overpressure protection devices which are an integral part of, or provided for use with, Class I line pressure regulators having an inlet pressure rating in excess of 2 psi (13.8 kPa) (see 1.1.3 and 3.1, Scope).

3.8.1 In the event of failure of the regulating mechanism of a line pressure regulator, the overpressure protection device shall act to limit the pressure in the downstream system to a maximum of 2 psi (13.8 kPa), when tested as specified in the following method of test.

For an overpressure relief device (see Part V, Definitions), this test shall be conducted using the most restrictive vent piping configuration as specified by the manufacturer (see 1.12-i).

Method of Test

This test shall be conducted at room temperature. The device, if adjustable, shall be adjusted to produce the maximum possible downstream pressure.

A flow rate equal to the manufacturer's specified maximum regulation capacity shall be established through the system with an inlet test pressure equal to the rated inlet pressure, and with the line pressure regulator adjusted (if adjustable) to its maximum possible setting.

With no change in the flow rate adjustment, the inlet test air supply shall be shut off, and the regulating mechanism of the line pressure regulator shall be disabled to simulate a worst case operational failure of the regulator. (If necessary, the regulator shall be disassembled to disable the mechanism.)

The inlet test air supply shall then be reestablished and adjusted to the rated inlet pressure of the line pressure regulator. The automatic valve of the test setup shall then be closed. The pressure in the system immediately downstream of the overpressure protection device shall be monitored and shall not exceed 2 psi (13.8 kPa) at any time during this test.

For a monitoring regulator type overpressure protection device, the automatic valve of the test setup shall then be reopened to establish gas flow through the system with no change in the previous adjustments. The pressure immediately downstream of the monitoring regulator shall be observed, and shall not be less than 5.0 inches water column (1.24 kPa).

3.8.2 If optional mounting positions (see 1.1.4) for the regulator and/or separate overpressure protection device are specified by the manufacturer, the test in 3.8.1 shall be repeated with the component(s) mounted in each position specified.

3.8.3 If the manufacturer's specified operating temperature range for the regulator or separate overpressure protection device is outside of the standard 32°F to 125°F (0°C to 51.5°C) range (see 1.1.5), the tests in 3.8.1 and 3.8.2, as applicable, shall be repeated with the components maintained at the temperature extreme(s) specified by the manufacturer.

3.9 Continued Operation

3.9.1 Overpressure Shutoff Devices

An overpressure shutoff device shall withstand 100 cycles of operation without damage and without malfunctioning when tested in accordance with the following method of test.

Method of Test

The device shall be caused to actuate at maximum flow rate and rated inlet pressure (see 3.8.1) and then left in the actuated state for five minutes. The device shall then be reset, and the cycle repeated for a total of 100 actuating and resetting cycles.

Following the 100 cycle test, the device shall comply with 3.5 (Leakage) and 3.8.1.

3.9.2 Monitoring Regulators

The monitoring regulator (see Part V, Definitions) used in the conduct of 2.10 (Continued Operation) shall be used in this test (see 2.1.2).

The monitoring regulator shall comply with 3.5 (Leakage) and 3.8.1, and shall then be subjected to 100,000 cycles of operation, using the method of test specified in 2.10, as applicable.

Following the 100,000 cycle test, the monitoring regulator shall be retested under 3.5 (Leakage) and 3.8.1, and shall comply.

3.9.3 Overpressure Relief Devices

An overpressure relief device (see Part V, Definitions) shall comply with 3.5 and 3.8.1, and shall then be subjected to 100 cycles of operation in accordance with the following method of test.

Method of Test

This test shall be conducted at room temperature with the device mounted as specified in 3.7 (Mounting for Test).

The outlet (discharge) of the device shall be connected to a vent line in accordance with the manufacturer's instructions, using the most restrictive vent piping configuration, as specified by the manufacturer (see 1.12-i).

The device shall then be subjected to 100 cycles of pressure relief operation, using the method of test specified in 3.8.1 for each cycle.

Following the 100 cycle test, the device shall be retested under 3.5 (Leakage) and 3.8.1, and shall comply.

Tables Referenced In Parts I, Part II And Exhibits

Table I

Minimum Thread Length And Length To Shoulder

Nominal Pipe Size, Inches	Minimum Lengths, Inches (mm)					
	Length of Thread*		Length to Shoulder Male Thread**		Length to Shoulder Female Thread***	
1/8	0.25	(6.4)	0.3924	(10.0)	0.3096	(7.9)
1/4	0.32	(8.1)	0.5946	(15.1)	0.4500	(11.4)
3/8	0.36	(9.1)	0.6006	(15.3)	0.4622	(11.7)
1/2	0.43	(10.9)	0.7815	(19.9)	0.6057	(15.4)
3/4	0.50	(12.7)	0.7935	(20.2)	0.6247	(15.9)
1	0.58	(14.7)	0.9845	(25.0)	0.7478	(19.0)
1 1/4	0.67	(17.0)	1.0085	(25.6)	0.7678	(19.5)
1 1/2	0.70	(17.8)	1.0252	(26.0)	0.7678	(19.5)
2	0.75	(19.1)	1.0582	(26.9)	0.7838	(19.9)
2 1/2	0.92	(23.4)	1.5712	(39.9)	1.0570	(26.8)
3	0.98	(24.8)	1.6337	(41.5)	1.1410	(29.0)
4	1.08	(27.4)	1.7337	(44.0)	1.2190	(31.0)

* Use where threads are back relieved. (Reference: The Standard for *Malleable-Iron Threaded Fittings, Class 150 and 300, ANSI/ASME B16.3.*)

** Male threads = L4 (overall length of male thread).

*** Female Thread = L1 + L3 + 1 pitch.

(L1, L3 and L4 as specified in the Standard for *Pipe Threads, General Purpose (Inch), ANSI/ASME B1.20.1*).

Table II

Inlet Test Pressure

Rated Inlet Pressure psi (kPa)		Maximum Inlet Pressure psi (kPa)		Minimum Inlet Pressure psi (kPa)
2	(13.8)	4	(27.6)	1 psi (6.9 kPa) or Manufacturer's Specified Minimum Outlet Pressure (see 1.2) plus 7.0 inches w.c. (1.74 kPa), whichever is greater.
5	(34.5)	7.5	(51.7)	1.5 psi (10.4 kPa) or Manufacturer's Specified Minimum Outlet Pressure (see 1.2) plus 14 inches w.c. (3.48 kPa), whichever is greater.
10	(68.9)	15	(103.5)	2 psi (13.8 kPa) or Manufacturer's Specified Minimum Outlet Pressure (see 1.2) plus 1 psi (3.5 kPa), whichever is greater.

Table III

Torques For Turning Effort Test

Pipe Connections		Tubing Connections	
Nominal Pipe Size, Inches	Torque, Inch-Pounds (N•m)	Inlet Tubing O.D., Inch	Torque, Inch-Pounds (N•m)
1/8	170 (19.2)	1/8	38 (4.29)
1/4	220 (24.9)	3/16	75 (8.47)
3/8	280 (31.6)	1/4	100 (11.3)
1/2	375 (42.4)	5/16	125 (14.1)
3/4	560 (63.3)	3/8	150 (16.9)
1	750 (84.7)	7/16	175 (19.8)
1 1/4	875 (98.9)	1/2	200 (22.6)
1 1/2	940 (106.2)	5/8	300 (33.9)
2	1190 (134.5)	—	—
2 1/2	1310 (148.0)	—	—
3	1310 (148.0)	—	—
4	1500 (169.5)	—	—

Table IV

Load For Bending Moment Test

Pipe Connections		Tubing Connections	
Nominal Inlet Pipe Size, Inches	Weight, lb. (kg)	Inlet Tubing O.D., Inch (mm)	Weight, lb. (kg)
1/8	2.0 (0.9)	1/8	1/4 (0.11)
1/4	3.5 (1.6)	3/16	1/2 (0.23)
3/8	5.0 (2.3)	1/4	3/4 (0.34)
1/2	10.0 (4.5)	5/16	1 1/4 (0.57)
3/4	18.0 (8.2)	3/8	2 (0.91)
1	32.0 (14.5)	7/16	2 3/4 (1.2)
1 1/4	47.0 (21.3)	1/2	3 3/4 (1.7)
1 1/2	75.0 (34.0)	5/8	6 1/2 (2.9)
2	160.0 (72.6)	—	—
2 1/2	200.0 (90.7)	—	—
3	200.0 (90.7)	—	—
4	200.0 (90.7)	—	—

Table V

Maximum Allowable Vent Limiter Venting Rate

	Specific Gravity	Maximum Allowable Flow Rate, Cubic Feet Per Hour (cm^3/s)	
Vent Limiter for Use Only With Natural, Manufactured, Mixed gases and LP Gas-Air Mixtures	0.64	2.5	(19.7)
Vent Limiter for Use With Liquefied Petroleum Gas	1.53	1.0	(7.87)

Figures Referenced In Parts I, II And Exhibits

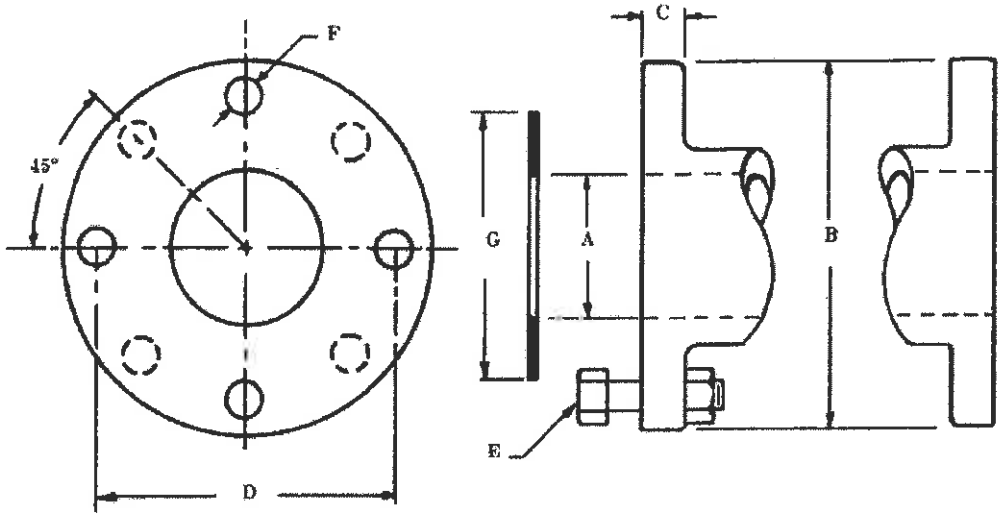

Figure 1. 125 lb. Cast Iron Pipe Flange Body Connections

Nominal Pipe Size, in.	Flange Diameter in. (mm)	Flange Thickness, in. (mm)	Bolt Circle Dia., in. (mm)	Bolts			Bolt Hole Dia., in. (mm)	Gasket Dia., in. (mm)
				No.	Size, In.	Length, in. (mm)		
A	B	C	D	E			F	G
1	4 1/4 (108)	7/16 (11.1)	3 1/8 (79.4)	4	1/2	1 3/4 (44.5)	5/8 (15.9)	2 5/8 (66.7)
1 1/4	4 5/8 (117)	1/2 (12.7)	3 1/2 (88.9)	4	1/2	2 (50.8)	5/8 (15.9)	3 (76.2)
1 1/2	5 (127)	9/16 (14.3)	3 7/8 (98.4)	4	1/2	2 (50.8)	5/8 (15.9)	3 3/8 (85.7)
2	6 (152)	5/8 (15.9)	4 3/4 (121)	4	5/8	2 1/4 (57.2)	3/4 (19.1)	4 1/8 (105)
2 1/2	7 (178)	11/16 (17.5)	5 1/2 (140)	4	5/8	2 1/2 (63.5)	3/4 (19.1)	4 7/8 (124)
3	7 1/2 (191)	3/4 (19.1)	6 (152)	4	5/8	2 1/2 (63.5)	3/4 (19.1)	5 3/8 (137)
4	9 (229)	15/16 (23.8)	7 1/2 (191)	8	5/8	3 (76.2)	3/4 (19.1)	6 7/8 (175)
6	11 (279)	1 (25.4)	9 1/2 (241)	8	3/4	3 1/4 (82.6)	7/8 (22.2)	8 3/4 (222)

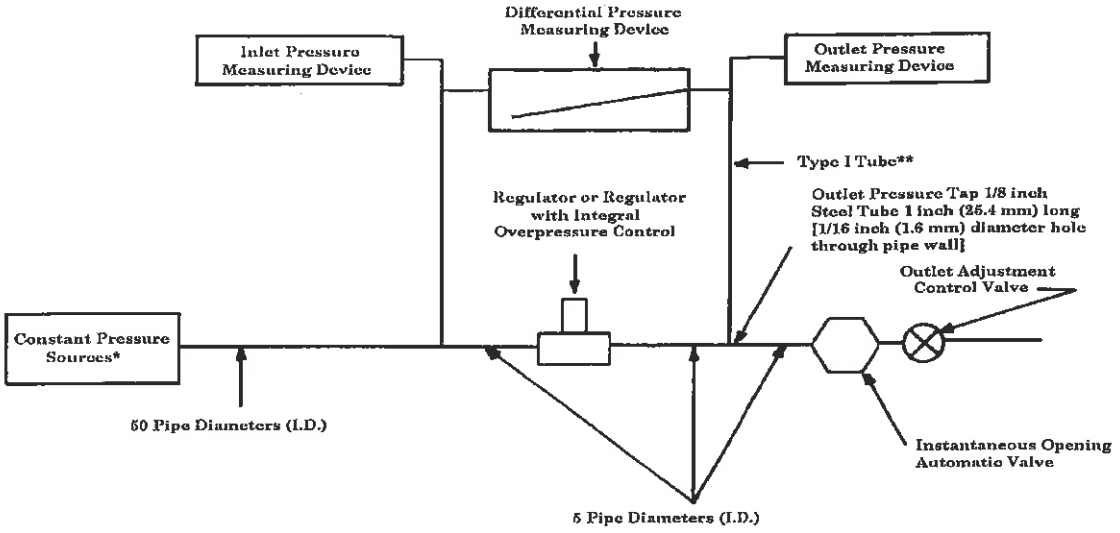

***Figure 2A. Typical Arrangement of Test Apparatus for Regulators Rated at 2 psi or Regulators with Integral Overpressure Control**

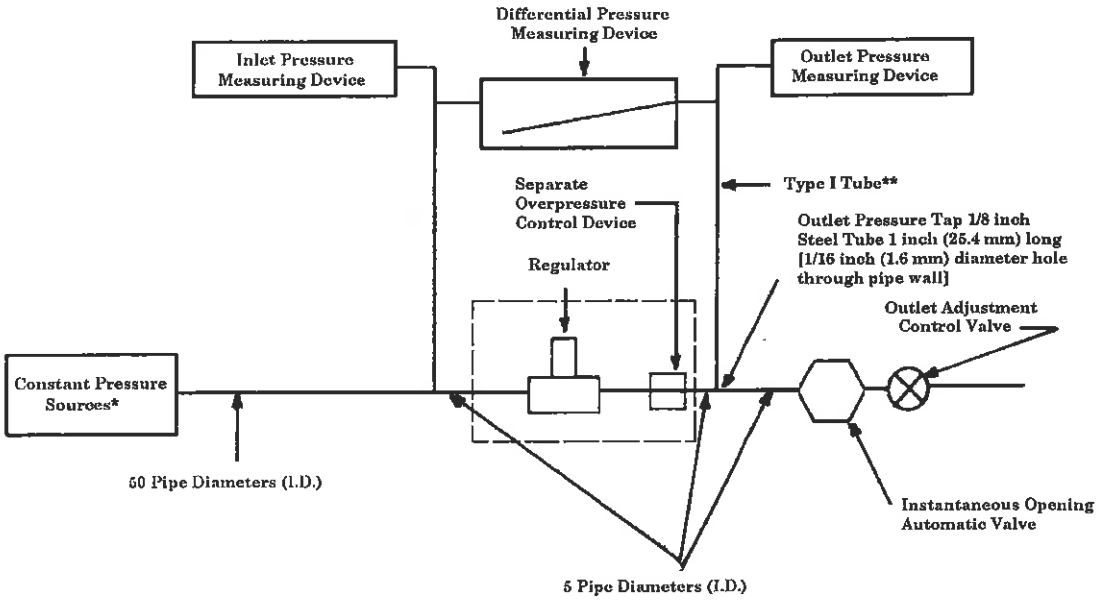

***Figure 2B. Typical Arrangement Of Test Apparatus For Regulators Rated Over 2 psi With Separate Overpressure Device**

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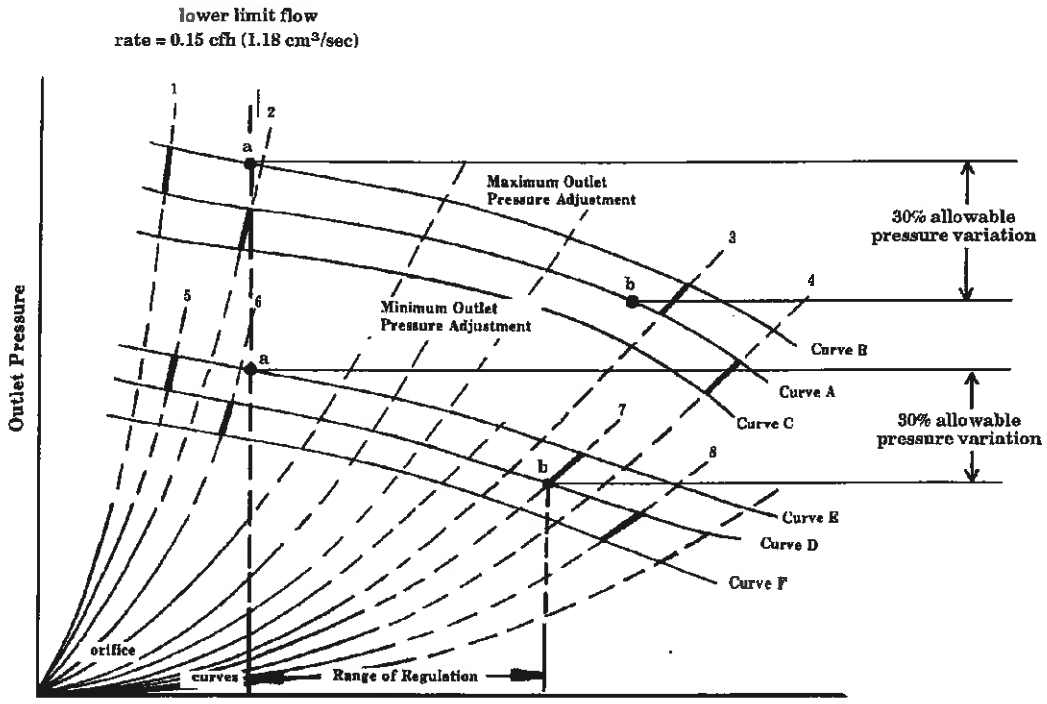
* *The constant pressure source shall not permit a pressure variation from no flow to full flow, of more than ± 0.1 inch water column (2.5 Pa) for each 100 cubic feet (2.83 m^3) of air flow at full flow.*

** *Type I Tube - Curtis Matheson Scientific Stock #203-414, Black Pure Gum Tubing $^3/_{16}$ inch Bore, $^1/_{16}$ inch Wall.*



Curves 1 and 3

Orifice curves at which maximum obtainable outlet pressure varies from minimum obtainable outlet pressure by 20%

Curves 2 and 4

Orifice curves at which outlet pressure at maximum inlet test pressure varies from minimum obtainable outlet pressure by 20%

Curve A

Minimum Obtainable Outlet Pressure Curves

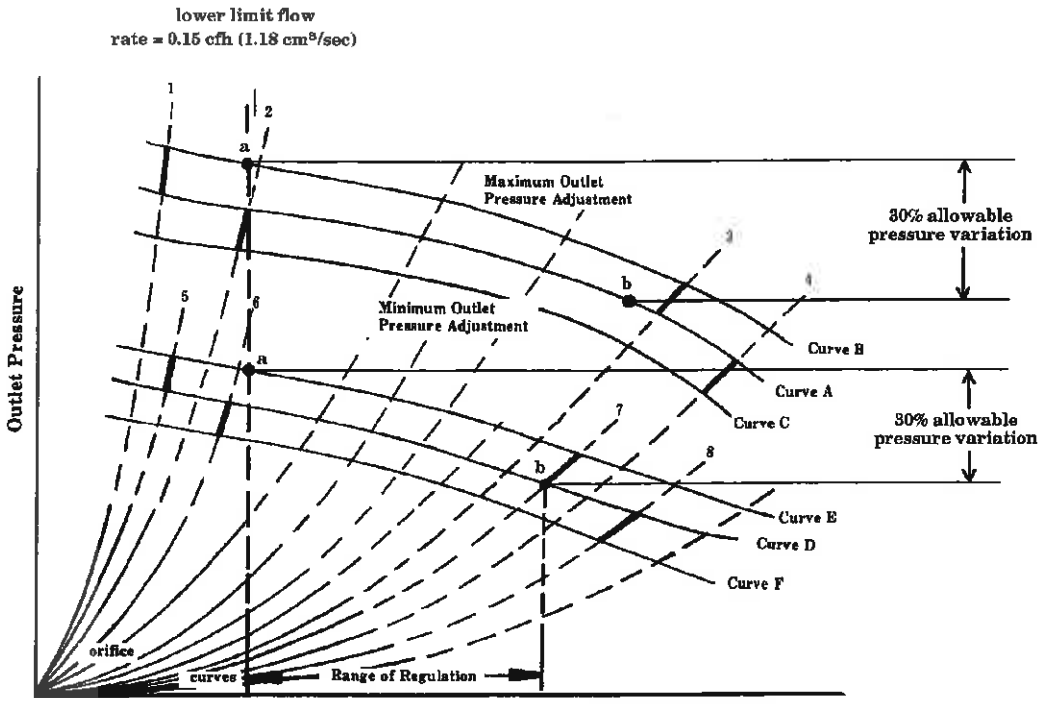
Curve B

Maximum Obtainable Outlet Pressure Curves

Curve C

Outlet Pressure Curves at Maximum Inlet Test Pressure

Figure 3. Range of Regulation Curves for Nonadjustable Regulators



Flow Rate - Btu per Hour [1000 Btu/cu. ft. (37.3 MJ/m³) 0.64 sp. gr. gas - natural]

Maximum Outlet Pressure Adjustment

Curves 1 and 3 - Orifice curves at which maximum obtainable outlet pressure varies from minimum obtainable outlet pressure by 20%

Curves 2 and 4 - Orifice curves at which outlet pressure at maximum inlet test pressure varies from minimum obtainable outlet pressure by 20%

Minimum Outlet Pressure Adjustment

Curves 5 and 7 - Orifice curves at which maximum obtainable outlet pressure varies from minimum obtainable outlet pressure by 20%

Curves 6 and 8 - Orifice curves at which outlet pressure at maximum inlet test pressure varies from minimum obtainable outlet pressure by 20%

Curves A and D

Minimum Obtainable Outlet Pressure Curves

Curves S and E

Maximum Obtainable Outlet Pressure Curves

Curves C and F

Outlet Pressure Curves at Maximum Inlet Test Pressure

Figure 4. Range of Regulation Curves for Adjustable Regulators

Exhibit A
Items Unique To One Country (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.

1.13 Marking

1.13.1 "Class I or Class II" «Classe I or Classe II»

1.13.3 "Vent" «D'évacuation»

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

Exhibit B
List Of Reference Standards

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

GAS MEASUREMENT COMMITTEE REPORT No. 3, 1969, *Orifice Metering of Natural Gas*

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

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

ANSI/ASME B1.1-1989 (R2001), *Unified Inch Screw Threads (UN and UNR Thread Form)*

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

ANSI/ASME B16.1-1998, *Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, and 250*

ANSI/ASME B16.3-1998, *Malleable-Iron Threaded Fittings, Class 152 and 300*

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

IEEE/ASTM SI 10, *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 Z234.1-00, *Canadian Metric Practice Guide*

CAN/CSA B149.1-00, *Natural Gas and Propane Installation Code*

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

ANSI/SAE J525-1999, *Welded and Cold-Drawn Low-Carbon Steel Tubing Annealed for Bending and Flaring*

SAE Handbooks -2003, Volume I - *Materials*

Part IV: 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, that describes the programs and test procedures specified in 4.1 through 4.4 and the records which are to be kept by the manufacturer.

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

4.2 The manufacturer shall test each regulator at room temperature for:

a. Leakage (2.4);

b. Outlet pressure setting; and

c. Lockup Test (2.9).

4.3 The manufacturer shall test each overpressure protection device at room temperature as follows:

a. Each device shall be tested for Leakage (3.5);

b. Each overpressure shutoff device and monitoring regulator shall be tested for Overpressure Protection (3.8.1); and

c. Each overpressure relief device shall be tested for "start-to-discharge" pressure and reseating pressure, using a test method which can be related to the overpressure protection test (3.8.1).

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

a. Continued operation (2.10, 3.9);

b. Outlet pressure range (2.7);

c. Range of regulation capacity (2.8);

d. Strength (2.5, 3.6); and

e. Performance at high and low temperatures (2.4, 3.5, 3.8.3).

4.5 The manufacturer's test method(s) used shall be capable of relating back to the test(s) specified in the standard. The section numbers of tests in the standard are provided in parenthesis for ease of reference.

Part V: Definitions

ADJUSTMENT MEANS. A means for loading the diaphragm and thus regulating the outlet pressure.

ADJUSTMENT, OUTLET PRESSURE (SETTING). The outlet pressure to which the regulator is adjusted.

BODY. The principal structure of the device which contains and supports the actuating mechanism and constitutes the primary gas passage.

CAPACITY, PRESSURE DROP. The equivalent flow rate for a loss in pressure of $^1/_2$ psi (3.5 kPa) with the regulator valve in a nominally wide open position.

CUBIC FOOT OF GAS. The amount of gas which would occupy 1 cubic foot (0.03 m^3) when at a temperature of 60°F (15.5°C) saturated with water vapor and under an absolute pressure of 30 inches mercury column (101.3 kPa).

DIAPHRAGM. A flexible member upon which gas pressure acts to perform a mechanical function.

DIAPHRAGM PLATE. A rigid disc in contact with the diaphragm, which transmits the force of fixed weight, fixed springs or adjustable springs to the diaphragm.

INLET PRESSURE, RATED. The highest inlet pressure for which the control is intended to be used.

INLET TEST PRESSURE, MAXIMUM. The highest inlet pressure at which tests have been conducted to determine that the regulator will control the outlet pressure within acceptable limits.

MAXIMUM INDIVIDUAL LOAD CAPACITY. The maximum capacity or flow at which a line pressure regulator will control lockup pressure within acceptable limits.

ORIFICE CURVE. A plot showing the relationship between flow rate and orifice pressure as the pressure is varied immediately upstream of a fixed orifice.

OVERPRESSURE PROTECTION DEVICE. For the purposes of this standard, a device which under abnormal conditions will act to reduce, restrict or shut off the supply of gas flowing into a system to prevent gas pressure in that system from exceeding 2 psi (13.8 kPa).

a. **Overpressure Shutoff Device.** An overpressure protection device which functions by completely shutting off the flow of gas into the downstream system.

b. **Overpressure Relief Device.** An overpressure protection device which functions by discharging gas from the downstream system to a safe location.

c. **Monitoring Regulator.** An overpressure protection device which functions as a second gas pressure regulator in series with the primary gas pressure regulator.

REGULATION RANGE. The high and low limits of flow between which is found acceptable regulating characteristics. For regulators designed to control pilot flow, the minimum regulation capacity is 0.15 cubic foot per hour (1.18 cm^3/s) of 1,000 Btu per cubic foot (37.3 MJ/m^3) 0.64 specific gravity gas for a regulator designated by the symbol Ⓟ, or 0.50 cubic foot per hour (3.93 cm^3/s) of 1,000 Btu per cubic foot (37.3 MJ/m^3) 0.64 specific gravity gas for a regulator designated by the symbol ▽P.

REGULATOR, GAS PRESSURE. A device for controlling a selected outlet gas pressure.

1. **Adjustable - Spring Type, Standard Adjustment.** A regulator in which the regulating force acting upon the diaphragm is derived principally from a spring, the loading of which is adjustable. The adjustment means shall be concealed.

2. **Nonadjustable**

   a. **Spring Type, Nonadjustable.** A regulator in which the regulating force acting upon the diaphragm is derived principally from a spring, the loading of which is not field adjustable.

   b. **Weight Type.** A regulator in which the regulating force acting upon the diaphragm is derived from a weight or combination of weights.

REGULATOR, LINE PRESSURE. A gas pressure regulator intended for installation in a building gas distribution system between the building service regulator or LP-gas 2psi service regulator and gas utilization equipment.

For purposes of this standard, a line pressure regulator is rated for an inlet gas pressure of either 2, 5 or 10 psi (13.8, 34.5 or 68.9 kPa) and is designated as either Class I or Class II as follows:

Class I - Maximum outlet pressure of $^1/_2$ psi (3.5 kPa)

Class II - Maximum outlet pressure of 2 psi (13.8 kPa)

SPECIFIC GRAVITY. The ratio of the weight of a given volume of gas to that of the same volume of air, both measured at the same temperature and pressure.

TOOLS, SPECIAL. Those tools which are not available on the open retail market.

VALVE. The movable member which, in conjunction with the valve seat, controls flow.

VALVE SEAT. A stationary member which, in conjunction with the valve, controls flow.

VALVE STEM. A rod which positions the valve relative to the diaphragm and seat, directly or through linkage.

VENT LIMITER. A means which limits the flow of gas from the atmospheric diaphragm chamber to the atmosphere in the event of a diaphragm rupture. This may be either a limiting orifice or a limiting device.

Limiting Orifice Type - A vent limiter where the flow through the limiter is the same in both directions.

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
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^{-4}	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
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•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^{-4}	J/kg•°C	joule/kg•degree Celsius
	Btu/pound•degree F	Btu/lb•°F	4.187	2.388×10^{-1}	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)	

* *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.

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 • CGA 1.6

Decorative Gas Appliances for Installation in Solid-Fuel Burning Fireplaces, Z21.60 • CSA 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 • CSA 2.6

Gas Food Service Equipment, Z83.11 • CSA 1.8

Gas-Fired High-Intensity Infrared 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

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

Recirculating 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 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 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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REPRESENTING (Please indicate organization, company or self): _____

1. a) Title of Standard: _____

   b) Section/Paragraph Number and Title: _____

2. Proposal Recommends: (check one) ☐ New Text ☐ Revised Text ☐ Deleted Text

3. Proposal (Include proposed wording change(s)* or identification of wording to be deleted. If proposed wording change(s) is not original, provide source.):

4. Statement of Rationale for Proposal:

5. ☐ This proposal is original material.

   ☐ This proposal is not original material, its source (if known) is as follows: _____

* (Note: Proposed wording and original material is considered to be the submitter's own idea based on, or as a result of, his/her own experience, thought or research, and to the best of his/her knowledge is not copied from another source.)

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