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NATIONAL STANDARD

ANSI/CAN/UL/ULC 252:2023

STANDARD FOR SAFETY

Compressed Gas Regulators

Approved American National Standard
ANSI
ANSI/UL 252-2023

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UL Standard for Safety for Compressed Gas Regulators, ANSI/CAN/UL/ULC 252

Eleventh Edition, Dated October 27, 2022

Summary of Topics

This revision of ANSI/CAN/UL/ULC 252 dated August 11, 2023 includes the addition of regulators with electrically operated valves to Accessories Section; 9.4

Text that has been changed in any manner or impacted by ULSE's electronic publishing system is marked with a vertical line in the margin.

The new requirements are substantially in accordance with Proposal(s) on this subject dated February 24, 2023.

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ANSI/UL 252-2023

ANSI/CAN/UL/ULC 252:2023

Standard for Compressed Gas Regulators

The first and second editions were titled Standard for Pressure Regulators or Reducing Valves and numbered UL 252C. The third and fourth editions were titled Gas Pressure Regulators.

First Edition – March, 1928
Second Edition – May, 1951
Third Edition – August, 1960
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Eleventh Edition

October 27, 2022

This ANSI/CAN/UL/ULC Safety Standard consists of the Eleventh Edition including revisions through August 11, 2023.

The most recent designation of ANSI/UL 252 as an American National Standard (ANSI) occurred on August 11, 2023. ANSI approval for a standard does not include the Cover Page, Transmittal Pages, Title Page, Preface or SCC Foreword.

The Department of Defense (DoD) has adopted UL 252 on September 26, 1988. The publication of revised pages or a new edition of this Standard will not invalidate the DoD adoption.

This standard has been designated as a National Standard of Canada (NSC) on August 11, 2023.

No Text on This Page

CONTENTS

ANNEX A (normative) – REGULATORS FOR OXYGEN AND ACETYLENE WELDING

INTRODUCTION

CONSTRUCTION

PERFORMANCE

Preface

This is the Eleventh Edition of ANSI/CAN/UL/ULC 252, Standard for Compressed Gas Regulators.

UL is accredited by the American National Standards Institute (ANSI) and the Standards Council of Canada (SCC) as a Standards Development Organization (SDO). ULC Standards is accredited by the Standards Council of Canada (SCC) as a Standards Development Organization (SDO).

This Standard has been developed in compliance with the requirements of ANSI and SCC for accreditation of a Standards Development Organization.

This ANSI/CAN/UL/ULC 252 Standard is under continuous maintenance, whereby each revision is approved in compliance with the requirements of ANSI and SCC for accreditation of a Standards Development Organization. In the event that no revisions are issued for a period of four years from the date of publication, action to revise, reaffirm, or withdraw the standard shall be initiated.

This joint American National Standard and National Standard of Canada is based on, and now supersedes, the Tenth Edition of UL 252 and ULC/ORD-C252-75.

In Canada, there are two official languages, English and French. All safety warnings must be in French and English. Attention is drawn to the possibility that some Canadian authorities may require additional markings and/or installation instructions to be in both official languages.

Comments or proposals for revisions on any part of the Standard may be submitted at any time. Proposals should be submitted via a Proposal Request in the Collaborative Standards Development System (CSDS) at https://csds.ul.com.

This Edition of the Standard has been formally approved by the Technical Committee (TC) on Compressed Gas Regulators and Accessories, TC 252.

This list represents the TC 252 membership when the final text in this standard was balloted. Since that time, changes in the membership may have occurred.

TC 252 Membership

Name	Represent	Interest Category	Region
Carney, Bob	Western/Scott Fetzer co.	Producer	USA
Fraley, Peter	Wika Instrument Corp.	Producer	USA
Gailey, David	Lincoln Electric Co. Harris Calorific Div	Producer	USA
Johnson, Richard	Thomas Associates	General Interest	USA
Keister, Jason	NASA Glenn Research Center	Government	USA
Layson, P	Applications Engineering Group Inc.	General Interest	USA
Mailvaganam, Miles	M. Mailvaganam	General Interest	Canada
Petersen, James	Petersen Engineering	General Interest	USA
Prusko, Jeff	UL Standards & Engagement	TC Project Manager – Non-voting	USA
Wintonic, Gillian	ULC Standards	TC Chair – Non-Voting	Canada
Wolff-Klammer, Edgar	UL Solutions	Testing and Standards Org.	USA

International Classification for Standards (ICS): 13.240; 17.120; 23.060.40

This Standard is intended to be used for conformity assessment.

The intended primary application of this standard is stated in its scope. It is important to note that it remains the responsibility of the user of the standard to judge its suitability for this particular application.

CETTE NORME NATIONALE DU CANADA EST DISPONIBLE EN VERSIONS FRANÇAISE ET ANGLAISE

INTRODUCTION

1 Scope

1.1 These minimum requirements cover regulators used to reduce the pressure of compressed industrial gases from a source or storage cylinder pressure of not more than 5500 psig (37.91 MPa) to the use pressure.

1.2 Regulators covered by these requirements are intended for use with compressed gases such as air, carbon dioxide, inert gases, fuel gases, nitrogen, nitrogen oxide, and oxygen.

1.3 Products covered by this Standard are intended to be installed and used in accordance with the applicable Codes and Regulations as determined by the Authority Having Jurisdiction (AHJ), such as, but not limited to:

In the United States:

a) The Standard for the Design and Installation of Oxygen-Fuel Gas Systems for Welding, Cutting, and Allied Processes, NFPA 51;

b) Occupational Safety and Health Administration (OSHA) 29 CFR 1926.350 – Gas welding and cutting.

In Canada:

a) Safety in welding, cutting, and allied processes, CSA W117.2.

1.4 Regulators for welding, cutting, and heating operations are intended for use in accordance with the Standard for the Design and Installation of Oxygen-Fuel Gas Systems for Welding, Cutting, and Allied Processes, NFPA 51, or Safety in Welding, Cutting, and Allied Processes, CSA W117.2. Refer to Annex A.

1.5 These requirements do not cover:

a) Liquified Petroleum Gas (LP-Gas) pressure regulators for equipment intended for installation and use in accordance with requirements of the Liquefied Petroleum Gas Code, NFPA 58, or the Natural Gas and Propane Installation Code, CSA B149.1. Refer to the Standard for LP-Gas Regulators, UL/ULC 144.

b) Regulators for handling liquids under cryogenic temperatures.

c) The regulating performance flow characteristics of the regulator, and the physiological effects of regulators to be used with medical gases.

NOTE: For the purposes of this standard the terms “LP-Gas” and “Propane” are interchangeable.

2 Components

2.1 Except as indicated in 2.2, a component of a product covered by this standard shall comply with the requirements for that component.

2.2 A component is not required to comply with a specific requirement that:

a) Involves a feature or characteristic not required in the application of the component in the product covered by this standard, or

b) Is superseded by a requirement in this standard.

2.3 A component shall be used in accordance with its rating established for the intended conditions of use.

2.4 Specific components are incomplete in construction features or restricted in performance capabilities. Such components are intended for use only under limited conditions, such as certain temperatures not exceeding specified limits, and shall be used only under those specific conditions.

3 Units of Measurement

3.1 Values stated without parentheses are the requirement. Values in parentheses are explanatory or approximate information.

3.2 Unless otherwise indicated, all voltage and current values mentioned in this standard are root-mean-square (rms) value.

4 Referenced Publications

4.1 The documents shown below are referenced in the text of this Standard. Unless otherwise stated elsewhere in this Standard such referenced shall be considered to indicate the most recent edition and/or revisions of the document at the date on which the Committee approved this UL/ULC Standard.

ANSI B1.20.3, *Dryseal Pipe Threads*

ASME B1.20.1, *Pipe Threads, General Purpose*

ASTM A53, *Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless*

ASTM B117, *Standard Practice for Operating Salt Spray (Fog) Testing Apparatus*

ASTM D471, *Standard Test Method for Rubber Property-Effect of Liquids*

ASTM D572, *Standard Test Method for Rubber Deterioration by Heat and Oxygen*

ASTM E145, *Standard Specification for Gravity-Convection and Forced-Ventilation Ovens*

CGA V-1, *Standard for Compressed Gas Cylinder Valve Outlet and Inlet Connections*

CGA E-3, *Low Pressure Pipeline Station Outlet Regulator Inlet Connection Standard*

CGA-G-4.1, *Cleaning Equipment for Oxygen Service*

CGA V-1, *Standard for Compressed Gas Cylinder Valve Outlet and Inlet Connections*

CSA C22.2 No. 0.15, *Adhesive Labels*

ISO 3253, *Gas welding equipment – Hose connections for equipment for welding, cutting and allied processes*

NFPA 51, *Standard for the Design and Installation of Oxygen-Fuel Gas Systems for Welding, Cutting, and Allied Processes*

NFPA 58, *Liquefied Petroleum Gas Code*

UL/ULC 252A, *Compressed Gas Regulators Accesories*

UL 404, *Gauges, Indicating Pressure, for Compressed Gas Service*

UL 429, *Electrically Operated Valves*

UL 969, *Marking and Labeling Systems*

ULC/ORD-C404, *Guide for the Investigation of Gauges, Indicating Pressure, for Compressed Gas Service*

5 Glossary

5.1 For the purpose of this standard the following definitions apply.

5.2 FUEL GAS – Acetylene, hydrogen, natural gas, LP-Gas, methylacetylene-propadiene stabilized, and other liquefied and nonliquefied flammable gases that are stable because of their composition or because of the conditions of storage.

5.3 INERT GAS – Helium, neon, argon, krypton, xenon and radon.

5.4 REGULATOR:

a) BACKPRESSURE REGULATOR – A regulator provided with a valve that is installed at the end of a system to provide an obstruction to flow and regulate upstream (back) pressure.

b) CYLINDER REGULATOR – A regulator provided with inlet fittings complying with the Standard for Compressed Gas Cylinder Valve Outlet and Inlet Connections, CGA V-1 and intended to reduce the pressure from that of the cylinder to the operating pressure.

c) LINE REGULATOR – A regulator that is provided with threaded inlet ports intended to be installed in a compressed gas system to reduce the source pressure to the use pressure.

d) PRESSURE REGULATOR – A regulator provided with a valve that is installed to a cylinder at the beginning of a system or before pressure sensitive equipment to regulate or reduce higher pressure. A regulator attached to a cylinder is provided with inlet fittings complying with the Standard for Compressed Gas Cylinder Valve Outlet and Inlet Connections, CGA V-1 and intended to reduce the pressure from that of the cylinder to the operating pressure.

e) STATION REGULATOR – A regulator that is provided with an inlet connection complying with the Low Pressure Pipeline Station Outlet/Regulator Inlet Connection Standard, CGA E-3 and intended to reduce a pressure of less than 200 psi (1380 kPa) to the use pressure.

5.5 REGULATOR CLASS – Defines the maximum end use pressure for the product based on the gas pressure or the CGA connection provided on the compressed gas regulator. See Table 5.1. For backpressure regulators the maximum operating pressure is supplied by the manufacturer.

Table 5.1
Regulator Class

Class	Test pressure, psi	(MPa)	Definition
I	200	(1.38)	Station type regulator
II	375	(2.59)	LP-Gas or methylacetylene-propadiene stabilized (MPS) gas regulator
III	500	(3.45)	CGA Nos. 160, 165, 182, 200, 240, 290, 295, 300, 410, 415, 440, 450, 510, 520, 600, 668, 678, 679
IV	1800	(12.41)	Carbon dioxide regulator
V	3000	(20.68)	CGA Nos. 110, 170, 180, 280, 296, 320, 326, 330, 346, 350, 500, 540, 555, 580, 590, 660, 670, 705, 860, 870, 880, 890, 910, 930, 940, 950, 960, 965
VI	4000	(27.58)	CGA No. 577
VII	5500	(37.92)	CGA Nos. 347, 680, 695, 701

5.6 REMOVABLE – Capable of being removed using ordinary hand tools.

5.7 RUPTURE – A fracture in an external component of the product.

CONSTRUCTION

6 Assembly

6.1 A regulator having an external adjusting screw may be shipped with the adjusting screw unassembled and included in the same box with the regulator.

6.2 An inlet filter shall be provided on all regulators intended for use with oxygen. The filter shall be formed from a noncombustible material.

6.3 A regulator having an external adjusting screw shall be constructed so that turning the screw clockwise increases the regulator outlet pressure.

6.4 A regulator intended to be adjusted by the user shall be constructed so that the diaphragm spring cannot be compressed to its compressed solid height.

6.5 An opening created by the removal of a removable element shall be capable of being plugged using flare fittings or pipe plugs.

7 Materials

7.1 A material in contact with the gas to be handled by a regulator shall be resistant to the action of such gas.

7.2 Unalloyed copper or a copper alloy exceeding 67 % copper shall not be used for parts in contact with acetylene or MPS gas.

7.3 If atmospheric corrosion of a part may interfere with the intended function of a regulator, the part shall be of a corrosion-resistant material, such as stainless steel or brass, or be provided with a corrosion-resistant protective coating.

7.4 A protective coating shall provide resistance against corrosion to a degree not less than that provided by the coatings specified in 7.5. See the Comparative Corrosion Tests, Section 22.

7.5 Zinc plating shall not be less than 0.0005 inch (0.013 mm) thick, except on parts where threads constitute the major portion of the area, in which case the zinc plating shall not be less than 0.00015 inch (0.0038 mm) thick.

7.6 Cadmium plating shall not be used.

7.7 Aluminum or aluminum alloys shall not be used for parts in contact with oxygen or oxygen enriched gases, where the percentage of oxygen exceeds 21 % by volume, on regulators intended to reduce a pressure greater than 435 psig (3000 kPa) to the use pressure.

8 Connections

8.1 A regulator intended for attachment to a gas storage cylinder shall be provided with an inlet connection that conforms with the Standard for Compressed Gas Cylinder Valve Outlet and Inlet Connections, CGA V-1. Alternatively, the connection may be of the manufacturer's own proprietary non-interchangeable gas-specific connection, if the regulator is additionally marked in accordance with 24.1(e).

8.2 Station or line regulators shall be provided with either:

a) Inlet pipe threads for direct connection to a piping system;

b) For welding and cutting equipment, an inlet connection complying with the Low Pressure Pipeline Station Outlet/Regulator Inlet Connection, CGA E-3;

c) Male 1/4, 3/8, 1/2, or 5/8 in. SAE flare connection; or

d) For use with nitrogen, carbon-dioxide or inert gases at a maximum pressure of 200 psig, a slip-on hose connector of the serrated stem type, or a quick-connect tube connection.

8.3 An inlet connection shall not permit attachment of a station or line regulator to a storage cylinder.

8.4 Pipe threads shall comply with the Standard for Pipe Threads General Purpose, ANSI/ASME B1.20.1, or the Standard for Dryseal Pipe Threads, Inch, ANSI B1.20.3.

Exception: Regulators intended for use in installations where pipe fittings incorporate other than NPT type threads may be provided with pipe threads complying with a national pipe thread standard compatible with those fittings. The pipe thread type shall be identified in accordance with 24.4.

8.5 Outlet hose connections for welding and cutting equipment, if used, shall be provided with right-hand threads for nonfuel gases and with left-hand threads for fuel gases, and comply with the Standard for Rubber Welding Hose for Gas Welding Cutting and Allied Processes, CGA E-1.

8.6 The outlet connection of a regulator for use with nitrogen, carbon-dioxide or inert gases, when provided, may be a slip-on hose connector of the serrated stem type or a quick-connect tube connection.

8.7 The inlet and outlet fittings may comply with the requirements of a Foreign National Standard for inlet fittings when the compressed gas regulator is tested in accordance with the applicable requirements in Sections 10 – 22 and it is additionally marked in accordance with 24.1(e) and 24.1.

9 Accessories

9.1 Accessories provided with or installed in the regulated pressure ports of, the regulator, such as pressure gauges, flowmeters, relief devices and shut-off valves, shall comply with the applicable requirements of the Standard for Compressed Gas Regulator Accessories, UL/ULC 252A.

9.2 Gauges reading over 1000 psig (6.89 MPa) shall conform with the requirements of the Standard for Gauges, Indicating Pressure, for Compressed Gas Service, UL 404, or the Guide for the Investigation of Gauges, Indicating Pressure, for Compressed Gas Service, ULC/ORD-C404.

9.3 Gauges with ranges of 1000 psig (6.89 MPa) or less, shall be subjected to the Excess-Pressure Test, Section 14. Gauges that comply with the Standard for Compressed Gas Regulator Accessories, UL/ULC 252A with a Class Rating equal to or greater than the Class Rating of the regulator need not be subjected to the Excess-Pressure Test, Section 14.

9.4 Regulators with electrically operated valves for use with air, carbon dioxide, inert gases, nitrogen, and nitrogen oxide shall also comply with UL 429, Standard for Electrically Operated Valves.

10 Hydrogen Material

10.1 Materials in contact with hydrogen shall be resistant to the action hydrogen embrittlement and hydrogen accelerated fatigue. This shall include the surface finishing techniques (e.g., electro-polishing) and welding which may also introduce hydrogen into a metal, resulting in accelerated embrittlement.

10.2 Materials and design shall be such that there will be no significant change in the functioning of the device, deformation, or mechanical change in the device, and no harmful corrosion, deformation, or deterioration of the materials. Additional consideration shall be made for nonmetallic materials since hydrogen diffuses through these much easier than through metals.

10.3 Dissimilar metals in interconnecting piping, tubing, fittings, and other components shall be avoided, or properly addressed to prevent electrolytic and/or galvanic corrosion. Metal fittings should be compatible with metal tubing materials. If the use of materials from different galvanic groups are used, standard commercial corrosion mitigation methods shall be used.

Note: A Technical Database for Hydrogen Compatibility of Materials may be found at Sandia National Laboratory Technical Reference for Hydrogen Compatibility of Materials. Additional guidance may be found in:

AIAA G-095A, Guide to Safety of Hydrogen and Hydrogen Systems

ASME B31.12, Hydrogen Piping and Pipelines

CSA/AM ANSI/CSA CHMC 1, Test methods for evaluating material compatibility in compressed hydrogen applications – Metals

CSA/AM CSA/ANSI CHMC 2:19, Test methods for evaluating material compatibility in compressed hydrogen applications – Polymers

ISO TR 15916, Basic considerations for the safety of hydrogen systems

10.4 The manufacturer shall provide documentation verifying the materials' suitability for hydrogen service. Considerations shall be given for such characteristics as permeability, creep, long-term aging, stress cracking, and retention of mechanical properties as appropriate. Acceptable materials include stainless steels (304, 304L, 308, 316, 316L, 321, 347, PH17-7, or PH18-8), aluminum alloys, copper, and copper alloys. Unacceptable materials include nickel, most nickel alloys, titanium alloys, gray iron, ductile iron, and malleable cast iron.

10.5 When the manufacturer is unable to provide conclusive evidence of the compatibility of all materials in the hydrogen gas stream or does not use the acceptable materials listed in 10.4, then the embrittlement test shall be performed.

PERFORMANCE

11 General

11.1 Representative samples of a regulator shall be subjected to the tests specified in Sections 12 – 15. Additional samples of parts constructed of nonmetallic materials may be subject to testing in accordance with Sections 16 – 20. Samples of protective coating systems may be subject to testing in accordance with Section 22.

11.2 The tests for seat- and external-leakage described in Section 13 are performance tests intended to evaluate the regulator design. They are not intended to specify the manner in which production-line tests for seat- and external-leakage shall be conducted.

12 Torque Test

12.1 Nonmetallic parts with nominal pipe size (NPT) threads and intended for field installation shall be subjected to this test. Joints in a compressed gas regulator shall not leak, nor shall there be evidence of loosening, distortion, or other damage resulting from the stresses imposed on pipe-threaded sections due to the turning effects exerted by assembling the regulator to piping or tubing.

12.2 This test shall be conducted on one sample of each joint type under ambient temperature conditions maintained within the range of 15 °C to 35 °C (59 °F to 95 °F).

12.3 Each sample used in this test shall be rigidly anchored or otherwise supported by a tool that fits snugly about the body, or to a section of the shank shaped for a wrench, when such section is provided, adjacent to the end into which the pipe shall be connected. A section of unused Schedule 80 pipe of sufficient length for wrench engagement shall be connected to the female pipe threaded section of the body. The male threads shall have pipe joint sealing compound or polytetrafluoroethylene (PTFE) tape applied to them first or be coated as specified by the manufacturer. Each pipe section shall then be tightened to the applicable torque specified in Table 12.1.

Table 12.1
Torque Requirements for Pipe Connections

Nominal pipe size, inch [a]	Torque,	
	inch-pounds	(N·m)
1/8	170	(15.2)
1/4	250	(28)
3/8	450	(51)
1/2	800	(90)
3/4	1000	(113)

[a] ANSI/ASME B1.20.1, Pipe Threads, General Purpose (Inch).

12.4 After the torque has been applied to each connected pipe, the test sample shall be subjected to the Seat- and External-Leakage Test, Section 13.

12.5 Upon removal of the pipe from the test sample, the assembly shall be examined for loosening of body joints.

13 Seat- and External-Leakage Test

13.1 A regulator shall not leak across operating seats when tested as described in 13.2 – 13.6.

13.2 To determine compliance with 13.1, two samples of each basic design shall be tested.

13.3 The test shall be conducted using oil-free air or nitrogen. A line regulator or a station regulator shall be tested at its marked inlet pressure. A cylinder regulator shall be tested at not less than the pressure specified in Table 13.1.

Table 13.1
Inlet pressure for leakage test

Regulator class[a]	Test pressure, Psig	(MPa)
I	200	(1.38)
II	375	(2.59)
III	500	(3.45)
IV	1800	(12.41)
V	3000	(20.68)
VI	4000	(27.58)
VII	5500	(37.92)

NOTE - For backpressure regulators the test pressure is the maximum operating pressure as provided by the manufacturer.

[a] For those gases not specifically noted, the test pressure shall be the maximum pressure defined for the Foreign National Standard or the CGA connection provided. Typical pressures as defined by the CGA V-1 fitting are shown. The pressure rating for the test and that marked on the product [see 24.1(e)] are based on a cylinder pressure at 49 °C (120 °F).

13.4 A shut-off valve shall be installed at the regulator outlet. The volume enclosed between the regulator and shut-off valve shall not exceed 1.5 in^3 (25 cm^3). With the regulator pressure-adjusting screw turned in to obtain the maximum rated delivery pressure and with the regulator outlet valve closed, the supply valve shall be opened and it shall be determined that there is no external leakage. The regulator outlet valve shall then beopened and closed rapidly. The regulator outlet valve opening and closing sequence shall be repeated three times.

13.5 The regulator adjusting screw then shall be backed off or shut off to the no-flow position. With the regulator outlet valve and the supply valve open it shall be determined that there is no seat leakage. The test pressure shall be maintained for at least 1 min.

13.6 If the regulator is not of a type that shuts off the flow when the adjusting screw is backed off, or is of the preset type with no adjustment, seat-leakage determinations may be made after several intermittent operations of the regulator mechanism, during which the outlet pressure is varied between the pressure obtained with the outlet blocked (no flow condition) and flowing pressure to atmosphere. Following these operations, it shall be determined that there is no increase in outlet pressure with the regulator outlet blocked (no flow). Allowing at least 1 min for stabilization, no increase in pressure shall be noted for at least 1 min. A gauge shall be installed between the regulator outlet and the shut-off valve to measure outlet pressure. The volume between the regulator and shut-off valve is not to exceed 25 cm^3.

14 Excess-Pressure Test

14.1 Except as provided in 14.5, when all passages and chambers of a regulator are subjected to the sudden application of full inlet pressure for the gas intended, the regulator shall either retain or release the pressure without rupture or throwing of parts.

14.2 To determine compliance with 14.1, two samples of each design, with and without accessories, shall be tested at the highest inlet pressure rating for that design. The method of conducting the test may differ from that described in 14.4, provided that it has been evaluated and determined to be equivalent.

14.3 Prior to the test, removable relief devices shall be removed and the body openings plugged. Bolted-on components are not to be removed, and shall be tested as part of the assembly.

14.4 The low pressure side of the regulator or inlet for a backpressure regulator shall be connected to the air side of a piston-type hydraulic accumulator. For Class I, II, III, and IV regulators, not more than 10 ft (3.05 m) of 1/4-in (6.35-mm) outside diameter metal tubing having a minimum inside diameter of 0.190 in (4.82 mm) shall be used. For Class V, VI, and VII regulators, not more than 10 ft (3.05 m) of schedule 80 pipe shall be used. The piping and tubing shall have the appropriate pressure rating for the desired test pressure. The accumulator shall have a volume of approximately 600 cubic inches (9.83 L) and be provided with a 1/4-turn full-open valve at the air-inlet port. The air inlet port shall be charged with air or nitrogen from a conventional cylinder and compressed to the appropriate pressure specified in 13.3 by applying hydrostatic pressure at the hydraulic-inlet port. The 1/4-turn valve to the regulator is then to be opened as suddenly as possible.

14.5 A regulator designed for an inlet pressure of 200 psig (1.38 MPa) or less is not required to be tested as described in 13.1, if it either retains, for at least 1 min, or releases an internal aerostatic pressure of 200 psig (1.38 MPa) without rupture or throwing of parts. The test pressure shall be applied to the outlet of the regulator.

15 Endurance Test

15.1 A pin-type pressure contents indicator incorporated in a regulator assembly shall withstand 25,000 cycles of operation under the test conditions specified in 15.2 and 15.3 without mechanical breakdown, impairment of operation, or the development of leakage throughout its entire range of travel.

15.2 The regulator inlet shall be connected to a source of aerostatic pressure using oil-free air or nitrogen, compressed to the appropriate pressure specified in 13.3. The test apparatus shall be arranged to result in intermittent operation of the indicator mechanism, during which the regulator inlet pressure shall be increased to maximum and then reduced to atmospheric pressure so as to subject the indicator mechanism to maximum movement.

15.3 The test apparatus shall be constructed so that it operates the regulator mechanism at a rate of not less than 20 nor more than 30 times per min. The number of cycles shall be determined by a counter linked with the pressure-control mechanism, or by other means that have been evaluated and determined to be equivalent. During and after completion of the cycling, the regulator shall be checked for external leakage at the indicator mechanism.

16 Volume-Change and Weight-Loss Tests

16.1 General

16.1.1 A synthetic-rubber part intended to be in contact with the gases specified in Table 16.1 shall not show excessive volume change or loss of weight, following immersion for at least 70 h in the specified test liquid.

Exception: Specimens immersed in IRM 903 Oil are not required to be evaluated for weight loss.

Table 16.1
Test Liquids for Synthetic-Rubber Materials

Gas in contact with part	Test liquid
LP-Gas	n-Hexane
Manufactured and Natural Fuel Gases	IRM 903 Oil (ASTM D471) and n-Hexane
MPS Gas	Liquified MPS Gas
Propylene	Liquid Propylene

16.1.2 A change in volume shall not exceed 25 % swelling or 1 % shrinkage, and weight loss (extraction) shall not exceed 10 %. If the volume change or weight loss exceed these values, a complete assembly shall be filled with the specified test liquid for at least 70 h and then subjected to the Seat- and External-Leakage Test, Section 13, and the Excess-Pressure Test, Section 14.

16.1.3 The volume-change and weight-loss values shall be determined in accordance with the Test Method for Rubber Property – Effect of Liquids, ASTM D471 except as modified by 16.2.1 – 16.3.5.

16.2 Tests using n-Hexane and IRM 903 Oil

16.2.1 Three specimens shall be used in each test. Each specimen shall be placed on a small-diameter wire hook. The volume of each specimen shall then be determined by weighing it first in air (M_1) and then in water (M_2). The specimens shall then be wiped dry and placed in the test liquid for at least 70 h. The temperature of the test liquid shall be maintained at 23 ±2 °C (73 ±3.6 °F).

16.2.2 The specimens shall be individually removed from the liquid, immediately wiped dry, and weighed in air while on the same hook (M_3). The weight shall be obtained within 30 s after removal from the test liquid. The final weight in water (M_4) shall be determined immediately thereafter. Before obtaining the weights in water (M_2 and M_4), each specimen shall be dipped in ethyl alcohol, then dipped in water, in order to eliminate surface air bubbles.

16.2.3 The change in volume shall be calculated as follows:

$$Volume\ Change\ (percent) = \frac{(M_3 - M_4) - (M_1 - M_2)}{(M_1 - M_2)} \times 100$$

16.2.4 The specimens are then to be allowed to reach constant weight by conditioning in air at a temperature of 23 ±2 °C (73 ±3.6 °F) for at least 70 h. The specimens are then again weighed in air (M_2). The loss in weight shall be calculated as follows:

$$Weight\ Loss\ (percent) = \frac{M_1 - M_2}{M_1} \times 100$$

16.2.5 The resulting volume-change and weight-loss values for the three specimens shall be averaged.

16.3 Tests using liquid MPS gas

16.3.1 The test shall be conducted at outside air temperatures within the range of -30 °C to +40 °C (-22 °F to +104 °F). The volume of each of three specimens shall be determined by weighing as described in 16.2.1, except that M_2 shall be obtained by weighing in ethyl alcohol instead of water.

16.3.2 After weighing, the specimens shall be wiped dry and placed in a closed chamber having its inlet connected to a cylinder of MPS gas. With the discharge valve from the chamber open, liquid MPS gas shall be allowed to flow through the chamber until the air is displaced. The discharge valve shall then be closed. With the inlet connection to the cylinder open, exposure shall continue for at least 70 h.

16.3.3 After 70 h, the specimens shall then to be removed from the chamber and immediately placed in a stoppered flask. The specimens shall be individually removed and weighed in air (M_3). The weight shall be obtained within 30 s after removal from the flask. The final weight in ethyl alcohol (M_4) shall be determined immediately thereafter.

16.3.4 The specimens shall then be conditioned in air at a temperature of 23 ± 2 °C (73 ± 3.6 °F) for at least 70 h and weighed. This final weight shall be used for calculating the weight loss.

16.3.5 The volume-change and weight-loss values shall be calculated as described in 16.2.3 and 16.2.4.

17 Accelerated-Aging Test

17.1 For oxygen regulators the parts made of an elastomer shall not crack or show visible evidence of deterioration following exposure for at least 96 h to oxygen at a pressure of 300 ±10 psig (2.07 ±0.07 MPa) and at a temperature of 70.0 ±1.0 °C (158.0 ±1.8 °F) when tested in accordance with the Test Method for Rubber Deterioration by Heat and Oxygen, ASTM D572.

17.2 For all other regulators, the parts made of an elastomer shall not crack or show visible evidence of deterioration following exposure for at least 70 h at 100 ±2 °C (212 ±3.6 °F) in Type IIA oven as specified in the Standard Specification for Gravity-Convection and Forced-Ventilation Ovens, ASTM E145.

18 Accelerated Aging Test for Nonmetallic Bonnet Bodies

18.1 Samples of a nonmetallic bonnet and body shall be subjected to conditioning for 30, 60, and 90 days in an air oven maintained at a temperature of 90 ±2 °C (194 ±3.6 °F). Two samples shall be subjected to each time period.

18.2 Following the conditioning, each sample shall be subjected to and shall comply with the Excess Pressure Test, Section 14.

18.3 When synthetic rubber materials deteriorate under this conditioning, they shall be replaced prior to conducting the tests described in 18.2.

19 Accelerated Hydrogen-Pressure Aging Test

19.1 An elastomeric part for use with hydrogen service shall be subjected to hydrogen gas as described in 19.2. After conditioning, the part shall not crack, blister, or show visible deterioration.

19.2 An elastomeric part shall be exposed for 14 days to hydrogen gas at a pressure of 300 ±15 psig (2068 ±103 kPa) and at a temperature of 80 ±1 °C (168 ±1.8 °F) in accordance with the Standard Test Method for Rubber-Deterioration by Heat and Oxygen, ASTM D572, except that hydrogen gas is substituted for oxygen gas in the description.

20 Hydrogen Low Temperature Test

20.1 An elastomeric part for hydrogen use shall not show any cracking or other damage after being tested as described in 20.2.

20.2 Three samples of the elastomeric part, together with a steel mandrel having a diameter of 6.4 mm (0.25 in) shall be placed for 24 h in a cold chamber at a temperature of -40 ±1°C (-40 ±2°F). While still at the temperature of the cold chamber, each sample shall be bent around the mandrel until the segments of the sample touch. The operator shall wear gloves while handling the samples and the mandrel to reduce heat transfer to the samples.

21 Embrittlement Test

21.1 One of the following tests shall be performed:

a) Standard Test Method for Determination of Susceptibility of Metals to Embrittlement in Hydrogen Containing Environments at High Pressure, High Temperature, or both, ASTM G142; or

b) Standard Test Method for Determination of the Susceptibility of Metallic Materials to Hydrogen Gas Embrittlement (HGE), ASTM F1459.

1) Results of testing done in accordance with ASTM G142 shall be at least one. Ratios below one indicate a susceptibility to hydrogen embrittlement with the test method outlined in ASTM G142.

2) Ratios above two indicate a susceptibility to hydrogen embrittlement with the test method outlined in ASTM F1459.

22 Comparative Corrosion Tests

22.1 General

22.1.1 When subjected to comparative corrosion tests as described in 22.1.2 – 22.4.2, a protective coating shall provide protection against corrosion at least equivalent to that provided by the zinc coatings specified in 7.5.

22.1.2 Two samples of a protective coating system applied to steel, and two comparison samples of the appropriate zinc-coated steel shall be subjected to each corrosive medium.

22.1.3 These tests shall be continued until the protective coating or the zinc coating on the comparison samples is broken down and significant amounts of corrosion products are formed on the underlying steel.

22.1.4 Samples shall be examined periodically during the tests for the appearance or progress of corrosion. The test chambers shall be operated throughout each day, except for the short time required for examination of the samples on working days, and incidental maintenance. The samples are not to be cleaned during the corrosion tests. Additional details of the apparatus and procedures used in these tests are specified in 22.2.1 – 22.4.2.

22.2 Tests in the presence of salt spray (fog)

22.2.1 Salt-spray tests shall be conducted using the apparatus and methods described in the Standard Practice for Operating Salt Spray (Fog) Testing Apparatus, ASTM B117.

22.3 Tests in the presence of moist hydrogen sulfide-air mixture

22.3.1 The test samples shall be supported vertically in a closed chamber having openings for gas inlet and outlet.

22.3.2 Hydrogen sulfide shall be supplied to the test chamber from a commercial cylinder containing this gas under pressure. An amount of hydrogen sulfide equivalent to 1 % of the volume of the test chamber shall be introduced into the chamber each working day after examining the samples, and after purging the test chamber for at least 15 min with compressed air at reduced pressure. A small amount of water shall be maintained at the bottom of the chamber.

22.4 Tests in the presence of moist sulfur dioxide-carbon dioxide-air mixture

22.4.1 The test samples shall be supported vertically in a closed chamber having openings for gas inlet and outlet.

22.4.2 Sulfur dioxide and carbon dioxide shall be supplied to the test chamber from commercial cylinders containing these gases under pressure. An amount of sulfur dioxide equivalent to 1 % of the volume of the test chamber, and an equal volume of carbon dioxide shall be introduced into the chamber each working day after examining the samples, and after purging the test chamber for at least 15 min with compressed air at reduced pressure. A small amount of water shall be maintained at the bottom of the chamber.

MANUFACTURING AND PRODUCTION TESTS

23 General

23.1 The manufacturer shall provide the necessary production control, inspection, and test equipment. The program shall include at least the following:

a) All regulator parts shall be cleaned of oil, grease, and other foreign substances;

b) A seat-leakage test shall be conducted on each regulator; and

c) An external-leakage test shall be conducted on each oxygen or fuel gas regulator at a pressure not less than its maximum rated delivery pressure.

23.2 The inlet pressure for the leakage tests shall be a minimum of 50 % of the values indicated in Table 13.1.

Exception: Other methods of determining leakage may be used if evaluated and found to be equivalent.

MARKINGS

24 General

24.1 Each regulator shall be clearly and permanently marked with the following:

a) The manufacturer's or private labeler's name or identifying symbol;

b) A distinctive catalog designation or the equivalent;

c) The name of the gas or gases with which it shall be used;

d) For station or line regulators, only, the maximum inlet pressure, and inlet and outlet ports or direction of flow; and

e) For compressed gas regulators intended for attachment to a gas storage cylinder and provided with other than CGA V-1 or a manufacturer's own proprietary non-interchangeable inlet fitting, the type of inlet fitting which is provided and the pressure rating of the regulator at 49 °C (120 °F).

24.2 If a manufacturer produces regulators at more than one factory, each regulator shall have a distinctive marking to identify it as the product of a particular factory.

24.3 Markings shall be legible and shall be metal stamped, molded in a casting, a decal transfer, metal nameplate, engraving or laser etching, or printed on a pressure-sensitive label complying with the Standard for Marking and Labeling Systems, UL 969, or CSA C22.2 No. 0.15.

24.4 Regulators constructed using pipe thread in accordance with the Exception to 8.4 or fittings in accordance with 8.7 shall be provided with a tag, label, or similar marking on the product or smallest unit package, identifying the pipe thread type for the installer. This marking is not required to be permanent.

INSTRUCTIONS

25 General

25.1 The instructions shall include such directions and information necessary for the intended installation, maintenance and use of the device. See 25.2.

25.2 If the regulator has an open port, the instructions shall indicate the intended use of the port, the thread sealants that can be used and their restrictions. The reference to thread sealants shall either specify a particular sealant or indicate that sealants compatible with the gases involved shall be used in the assembly. If a pressure gauge is to be added, the instructions shall indicate that each gauge with pressure ranges over 1000 psig (6.89 MPa) shall conform with the Standard for Gauges, Indicating Pressure, for Compressed Gas Service, UL 404, or the Guide for the Investigation of Gauges, Indicating Pressure, for Compressed Gas Service, ULC/ORD-C404.