



Standard Specification for Pressure-Reducing Valves for Air or Nitrogen Systems¹

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1. Scope

1.1 This specification covers the design, construction, testing, and operating requirements for self-contained pressure-reducing valves for air or nitrogen systems.

1.2 The values stated in this specification in inch-pounds units are to be regarded as the standard. The SI equivalent shown in parentheses are provided for information only.

2. Referenced Documents

2.1 ASTM Standards:²

F992 Specification for Valve Label Plates

F1685 Specification for Pressure-Reducing Manifolds for Air or Nitrogen Systems

2.2 American National Standards Institute (ANSI):

B1.1 United Screw Threads (UN and UNR Thread Form)³

B1.20.1 Pipe Threads, General Purpose (Inch)³

B16.11 Forged Steel Fittings, Socket-Welding and Threaded³

B16.25 Buttwelding Ends³

B16.34 Valves—Flanged, Threaded, and Welded End³

2.3 Military Standards and Specifications:

MIL-STD-167-1 Mechanical Vibrations of Shipboard Equipment (Type I—Environmental and Type II—Internally Excited)⁴

MIL-STD-740-1 Airborne Sound Measurements and Acceptance Criteria of Shipboard Equipment⁴

MIL-S-901 Shock Tests, H.I. (High-Impact); Shipboard Machinery, Equipment and Systems, Requirements for⁴

MIL-F-1183 Fittings, Pipe, Cast Bronze, Silver-Brazing, General Specifications for⁴

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² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

³ Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036.

⁴ Available from Standardization Documents Order Desk, Bldg. 4 Section D, 700 Robbins Ave., Philadelphia, PA 19111–5094, Attn: NPODS.

2.4 Government Drawings:

Naval Sea Systems Command (NAVSEA):

NAVSEA 803-1385884 Unions, Fittings and Adapters Butt and Socket Welding 6000 PSI, WOG, NPS

NAVSEA 803-1385943 Unions, Silver Brazing 3000 PSI, WOG, NPS, for UT Inspection

NAVSEA 803-1385946 Unions, Bronze Silver Brazing, WOG for UT Inspection

3. Terminology

3.1 Definitions:

3.1.1 *accuracy of regulation*—the amount by which the downstream pressure may vary when the pressure-reducing valve is set at any pressure within the required set pressure range and is subjected to any combination of inlet pressure, flow demand, and ambient temperature variations within the specified limits.

3.1.2 *bubble-sight*—no visible leakage over a 3-min period using either water submersion or the application of bubble fluid for detection.

3.1.3 *external leakage*—leakage from the pressure-reducing valve which escapes to atmosphere.

3.1.4 *fail-open flow capacity*—the ability of the pressure-reducing valve to pass flow under any given set of pressure conditions when, as a result of mechanical failure, it has assumed a position of least resistance to flow.

3.1.5 *flow capacity*—the ability of the pressure-reducing valve to pass flow under any given set of pressure conditions.

3.1.6 *flow rate demand*—the amount of flow demanded by the system at any given time downstream of the pressure-reducing valve.

3.1.7 *flow rate demand range*—the range over which the flow demand can vary.

3.1.8 *hydrostatic shell test pressure(s)*—The hydrostatic test pressures that the inlet and outlet of the pressure-reducing valve is required to withstand without damage. Pressure-reducing valve operation is not required during application of shell test pressure, but the pressure-reducing valve must meet all performance requirements after the shell test pressure has been removed.

3.1.9 *inlet operating pressure range*—the range over which the inlet pressure supplied to the pressure-reducing valve can

vary under any operational conditions which the pressure-reducing valve can be subjected to in service.

3.1.10 *operating pressure(s)*—the pressures within the pressure-reducing valve during service.

3.1.11 *pressure ratings*—the pressure ratings of the pressure-reducing valve shall be as defined in the documents listed in **Table 1**. The pressure ratings (also called pressure-temperature ratings) establish the maximum allowable working (service) pressures of a component (valve, end connections, and so forth) at various temperatures. For a pressure-reducing valve, the pressure ratings may not be identical for the valve inlet and outlet.

3.1.12 *pressure-reducing valve*—a component which accomplishes automatic regulation of the downstream pressure. In this component, the upstream pressure is reduced to the desired downstream pressure.

3.1.13 *pressure reversal*—a condition in which pressure exists at the outlet of a pressure-reducing valve when the loading element is deactivated (set spring adjustment backed off fully or dome charge vented off completely) and inlet pressure is vented off.

3.1.14 *seat-tightness*—the ability of the pressure-reducing valve to prevent leakage from the valve inlet to the valve outlet.

3.1.15 *self-contained pressure-reducing valve*— a pressure-reducing valve that does not use an external power source, such as compressed air, electricity, or hydraulic fluid for operation, but instead uses the line fluid for operation.

3.1.16 *set pressure*—the outlet pressure delivered by the pressure-reducing valve at the time the pressure setting is made. For the purposes of this specification, it will be assumed

that the setting is made when there is no flow demand on the pressure-reducing valve (“lock-up” condition), and the pressure-reducing valve is at surrounding ambient temperature.

3.1.17 *set pressure range*—the range of set pressures (set pressure limits) over which the pressure-reducing valve can be adjusted while meeting the performance requirements specified.

3.1.18 *soft-seating insert*—the insert, incorporated in either the poppet or the seat of the pressure-reducing valve, which ensures bubble-tight seat tightness under all operating conditions.

3.1.19 *valve poppet*—the part of the pressure-reducing valve trim which established a rate of flow by moving toward or away from the valve seat.

4. Classification

4.1 Pressure-reducing valves shall be of the following types, sizes, pressure ratings, and end connections, as specified in Section 5.

4.1.1 *Types*—Pressure-reducing valves shall be either Type I (inlet outlet end connections of the same pressure rating) or Type II (outlet end connection pressure rating lower than the inlet end connection rating) and specified in Section 5.

4.1.2 *Sizes*—Pressure-reducing valve sizes shall be 1/8 NPS (10.2 mm), 1/4 NPS (13.5 mm), 3/8 NPS (17.2 mm), 1/2 NPS (21.3 mm), 3/4 NPS (26.9 mm), 1 NPS (33.7 mm), 1 1/4 NPS (42.4 mm), 1 1/2 NPS (48.3 mm), and 2 NPS (60.3 mm).

4.1.3 *Pressure Ratings*— Pressure-reducing valves shall have pressure rating(s) selected (see 3.1) from **Table 1**. The pressure rating(s) selected shall be specified in Section 5.

4.1.4 *End Connections*— Pressure-reducing valves shall have end connections selected from those listed in **Table 1** and specified in Section 5.

5. Ordering Information

5.1 Ordering documentation for pressure-reducing valves under this specification shall include the following information as required to describe the equipment adequately.

5.1.1 ASTM designation and year of issue,

5.1.2 Valve type (see 4.1.1),

5.1.3 Valve inlet and outlet sizes (see 4.1.2),

5.1.4 Pressure rating(s) (see 4.1.3),

5.1.5 Type of end connections (see 4.1.4),

5.1.6 Inlet operating pressure range.

5.1.7 Set pressure and set pressure range, if other than specified (see 7.1.3).

5.1.8 Flow rate demand range (see 7.1.1, S1.1.2).

5.1.9 Accuracy of regulation required, if set pressure is below 10 psig (see 7.1.2).

5.1.10 Tamper-proof set-point adjustment, if required (see 6.1.9),

5.1.11 Supplementary requirements, if any (S1 through S4).

5.1.12 Maximum vibration frequency and displacement amplitude, if other than specified (see S1.1.4).

6. Valve Construction

6.1 Valves shall incorporate the design features specified in 6.1.1-6.1.19.

TABLE 1 Pressure Ratings for Pressure-Reducing Valve

Type of End Connection	Pressure Rating	Applicable Documents for Dimensional Details of End Connections
Butt-welded	ANSI B16.34 Class 150, 300, 400, 600, 900, 1500, 2500, or 4500	ANSI B16.25
Socket-welded	ANSI B16.34 Class 150, 300, 400, 600, 900, 1500, 2500, or 4500	ANSI B16.11
Threaded (tapered pipe thread)	ANSI B16.34 Class 150, 300, 400, 600, 900, 1500, or 2500	ANSI B1.20.1 and ANSI B16.11
Union end, ^A silver-brazed	MIL-F-1183 (O-ring type) 400 lb/in. ² (2.758 MPa)	MIL-F-1183 (O-ring type) 400 lb/in. ² (2.758 MPa)
Union end, ^A silver-brazed	803-1385946 1500 lb/in. ² (10.342 MPa)	803-1385946 1500 lb/in. ² (10.342 MPa)
Union end, ^A silver-brazed	803-1385943 3000 lb/in. ² (20.64 MPa)	803-1385943 3000 lb/in. ² (20.64 MPa)
Union end, ^A butt/socket weld	803-1385884 6000 lb/in. ² (41.369 MPa)	803-1385884 6000 lb/in. ² (41.369 MPa)
Other, as specified	as specified	as specified

^A For union inlet and outlet end connections, only the pertinent dimensions listed in the applicable documents (Military Specification or NAVSEA requirements) shall apply. The valve shall be supplied with the thread pieces only, without the tail pieces and union nuts.

6.1.1 *General Requirements*—Pressure-reducing valves shall be self-contained, requiring no external power source for operation. The pressure-reducing valve shall be capable of meeting all requirements of this specification and provide extended reliable operation when protected by a 5- μm nominal/18- μm absolute filter installed upstream and when subjected to conditions specified in Section 5.

6.1.2 *Materials of Construction*—Material requirements for the pressure-reducing valve shall be as follows: The pressure containing envelope (body, gas dome, or spring housing) shall be 300 series corrosion-resistant steel (304, 304L, 316, or 316L). Internal parts including springs, poppets, seal rings, and retainers shall be 300 series corrosion-resistant steel, nickel-aluminum bronze, nickel-copper (70–30), or bronze. Other materials for both the pressure-containing envelope and internal parts may be selected to assure compatibility with the line medium, weldability, and to provide corrosion resistance without requiring painting, coating, or plating. Materials for contacting parts shall be selected to minimize electrolytic corrosion and galling.

6.1.3 *Pressure Envelope*—The pressure-reducing valve shall be designed to pass a hydrostatic shell test at pressure(s) of at least 1.5 times the 100°F (38°C) pressure rating(s) of the valve without damage.

6.1.4 *Port Configuration*—The pressure-reducing valve shall have in-line inlet and outlet ports.

6.1.5 *Pressure Lines*—All pressure lines in the pressure-reducing valve shall be internally ported.

6.1.6 *Soft-Seating Insert*—A field replaceable soft-seating insert shall be incorporated in the pressure-reducing valve. Soft-seating inserts shall be protected from direct flow impingement, excessive loading and extrusion, or any other effect jeopardizing their useful life. Soft-seating inserts shall be of the simplest practical configuration to facilitate emergency replacement manufacture where necessary.

6.1.7 *Joints*—The bonnet or spring housing and bottom cap shall be attached to the body by bolting, a threaded connection, or a threaded union connection.

6.1.8 *Springs*—Any spring incorporated in the pressure-reducing valve shall not be compressed solid during operation. Spring ends shall be squared and ground. Engagement or disengagement of parts against spring compression shall not be permitted.

6.1.9 *Set Point Adjustment*—For mechanical spring-loaded pressure-reducing valves, the set point shall be adjustable under pressure and shall incorporate right-hand threads so that a clockwise rotation increases the set pressure. Means shall be used to prevent an accidental or inadvertent change in set pressure. The option of a tamper-proof set point adjustment (lead seal, and so forth) shall be available and provided if specified in Section 5. For gas-dome loaded pressure-reducing valves, set point adjustment shall be in accordance with 6.1.10.

6.1.10 *Gas Dome*—For gas-dome loaded pressure-reducing valves, the set point shall be adjustable under pressure and shall maintain its charge without adjustment or recharge more frequently than once a year to remain within its specified performance envelope. Upstream pressure shall be used to establish dome load. Dome loading shall be accomplished by

two valves installed in series, with a bleed-off valve in-between. If these valves are metal seated, they shall not seat directly into the structure of the dome so that damage or wear to the seating surfaces would not require repair or replacement of the dome. Only a single dome penetration is allowed. The valves shall be operable by a standard-size hex wrench or other suitable means. There shall be no external leakage past the threads during dome bleeding. Flow from the bleed-off valve shall be ported in such a way that it does not impinge directly on the person making the adjustment, cause excessive noise, or potentially lead to ice formation within the dome loading circuit.

6.1.11 *Threads*—Threads shall be as specified in ANSI B1.1. Where necessary, provisions shall be incorporated to prevent the accidental loosening of threaded parts. The design shall be such that standard wrenches can be used on all external bolting. Lock-wire shall not be used. Any exposed threads shall be protected by plastic caps for shipping.

6.1.12 *Accessibility*—All internal parts of the pressure-reducing valve shall be accessible for adjustment or service, without removing the pressure-reducing valve from the line.

6.1.13 *Interchangeability*—The pressure-reducing valve including all associated piece parts, shall have part number identity, and shall be replaceable from stock or the manufacturer on a nonselective and random basis. Parts having the same manufacturer's part number shall be directly interchangeable with each other with respect to installation (physical) and performance (function). Physically interchangeable assemblies, components, and parts are those that are capable of being readily installed, removed, or replaced without alternation, misalignment or damage to parts being installed or to adjoining parts. Fabrication operations such as cutting, filing, drilling, reaming, hammering, bending, prying, or forcing shall not be required.

6.1.14 *Nonmetallic Element Interchangeability*—Nonmetallic elements, including but not limited to, soft-seating inserts, cushions, and O-rings, shall be treated as separately identified and readily replaceable parts.

6.1.15 *Maintainability*—Maintenance shall require standard tools to the maximum extent possible. Any special tools required for maintenance shall be identified, and shall be supplied as part of the valve.

6.1.16 *Reversibility*—Seating inserts shall not be physically reversible unless they are also functionally reversible to preclude incorrect assembly.

6.1.17 *Adjustments*—There shall be no adjustments required in the pressure-reducing valve during or after assembly other than the set point.

6.1.18 *Pressure Reversal*—The pressure-reducing valve shall not be damaged when subjected to a maximum pressure reversal (maximum set pressure exists at the outlet).

6.1.19 *Guiding*—The valve poppet shall be guided to prevent binding or seizing and ensure proper seating under all operating conditions. Proper alignment of all internal operating parts shall be maintained with interchangeable parts and under all tolerance stack-up conditions.

7. Performance Requirements

7.1 Pressure-reducing valves shall meet the performance requirements of 7.1.1-7.1.5.

7.1.1 *Flow Rate Demand Range*—The maximum and minimum flow rate demand required shall be specified (see Section 5) in standard cubic feet per minute [at 60°F (16°C) and 14.7 psia (101 kPa)]. The pressure-reducing valve shall meet the specified maximum and minimum flow rate demand requirements, or any intermediate flow rate demand requirement, and shall operate without hunting or chattering under all specified conditions.

7.1.2 *Accuracy of Regulation*—The pressure-reducing valve shall maintain set pressure within the accuracy of regulation limits specified in Table 2 under all flow rate demand and inlet operating pressure conditions specified.

7.1.3 *Set Pressure Range*—The set pressure range shall be as follows: Where the pressure-reducing valve is mechanically spring loaded, the set pressure shall be adjustable through a range of at least $\pm 5\%$ of the set pressure, or ± 2 psi (13.8 kPa), whichever is greater. Where the pressure-reducing valve is gas dome loaded, the set point shall be adjustable through a range of at least $\pm 25\%$ of the set pressure or 10 psi (68.9 kPa), whichever is greater.

7.1.4 *Seat Tightness*—The pressure-reducing valve shall meet the seat tightness requirements of 8.1.3. Where necessary, leakage measurement shall start after temperature stabilization.

7.1.5 *External Leakage*—Pressure-reducing valve external leakage shall be bubble tight at operating pressure conditions over a 3-min period.

8. Tests Required

8.1 Each pressure-reducing valve must pass the tests outlined in 8.1.1-8.1.4.

8.1.1 *Visual Examination*—The pressure-reducing valve shall be examined visually to determine conformance with the ordering data, interface dimensions, and workmanship without disassembly.

8.1.2 *Hydrostatic Shell Test*—The pressure-reducing valve shall be hydrostatically tested with water by applying test pressure(s) not less than 1.5 times the 100°F (38°C) pressure

rating(s) to the inlet and outlet ports to check structural integrity. Test pressure(s) shall be applied for 3 min. Air or nitrogen may be used in lieu of water, providing appropriate safety precautions are taken to minimize the risk associated with the use of a compressible fluid. There shall be no external leakage, permanent distortion, or structural failure.

8.1.3 *Seal Tightness Test*—The pressure-reducing valve shall be tested for seat tightness with air or nitrogen gas at an inlet test pressure not less than the maximum inlet operating pressure. The valve shall be isolated downstream using a dead-ended volume not exceeding ten diameters of downstream pipe and monitored with bubble fluid to assure tightness. There shall be no detectable rise in the outlet pressure over a 3-min period after pressure-reducing valve temperature stabilizes.

8.1.4 *External Leakage Test*—Air or nitrogen gas shall be applied to the inlet of the pressure-reducing valve at the rated pressure. External leakage shall be checked using bubble fluid or by submerging the pressure-reducing valve in water. There shall be no visible external leakage over a 3-min period.

9. Marking

9.1 *Identification Plate*—An identification plate of corrosion-resistant metal in accordance with Specification F992, Types I, II, III, or IV shall be permanently attached to the pressure-reducing valve and shall include the following information (some or all information may instead be stamped or etched directly on the outside surface of the pressure-reducing valve):

- 9.1.1 Manufacturer's name,
- 9.1.2 ASTM designation and year of issue,
- 9.1.3 Valve size, type, and pressure rating(s),
- 9.1.4 Nominal operating conditions (inlet pressure, set pressure, and flow capacity),
- 9.1.5 Manufacturer's model/part number.

10. Quality Assurance System

10.1 The manufacturer shall establish and maintain a quality assurance system that will ensure all the requirements of this specification are satisfied. This system shall also ensure that all valves will perform in a similar manner to those representative pressure-reducing valves subjected to original testing for determination of the operating and flow characteristics.

10.2 A written description of the quality assurance system the manufacturer will use shall be available for review and acceptance by the inspection authority.

10.3 The purchaser reserves the right to witness the production tests and inspect the pressure-reducing valves in the manufacturer's plant to the extent specified on the purchase order.

TABLE 2 Required Accuracy of Regulation

Set Pressure, psig	Accuracy of Regulation (Percent of Set Pressure)
0–9 (0–69 kPa)	As specified in Section 5
10–25 (70–172 kPa)	($-30 \pm 5\%$)
26–50 (173–345 kPa)	($-20 \pm 5\%$)
51–100 (346–689 kPa)	($-16 \pm 2\%$)
101–250 (690–1725 kPa)	($-12 \pm 2\%$)
251–750 (1726–5170 kPa)	($-10 \pm 2\%$)
751–1000 (5171–6895 kPa)	($-9 \pm 1\%$)
Above 1000 (above 6896 kPa)	($-7 \pm 1\%$)