Pressure Testing of Valves

Standard Practice
Developed and Approved by the
Manufacturers Standardization Society of the
Valve and Fittings Industry, Inc.
127 Park Street, NE
Vienna, Virginia 22180
Phone: (703) 281-6613
Fax: (703) 281-6671
E-Mail: info@mss-hq.org

www.mss-hq.org

This MSS Standard Practice was developed under the consensus of the MSS Technical Committee 114 and the MSS Coordinating Committee. The content of this Standard Practice is the result of the efforts of competent and concerned volunteers to provide an effective, clear, and non-exclusive specification that will benefit the industry as a whole. This MSS Standard Practice is intended as a basis for common practice by the manufacturer, the user, and the general public. The existence of an MSS Standard Practice does not in itself preclude the manufacture, sale, or use of products not conforming to the Standard Practice. Mandatory conformance is established only by reference in a code, specification, sales contract, or public law, as applicable.

Unless otherwise specifically noted in this MSS SP, any standard referred to herein is identified by the date of issue that was applicable to the referenced standard(s) at the date of issue of this MSS SP. (See Annex A.)

In this Standard Practice all notes, annexes, tables, and figures are construed to be essential to the understanding of the message of this Standard Practice, and are considered part of the text unless noted as "supplemental". All appendices appearing in this document are construed as "supplemental". "Supplemental" information does not include mandatory requirements.

U.S. customary units in this SP are the standard; the metric units are for reference only.

Non-toleranced dimensions in this Standard Practice are nominal, and, unless otherwise specified, shall be considered "for reference only".

Originally Approved February, 1961

FOREWORD

This Standard Practice for Pressure Testing of Valves was originally adopted in 1961. It was developed for the purpose of providing a uniform means of testing valves commonly used in the "full open" and "full closed" type of service. It is not intended for use with control valves. Refer to standards ISA-S75.19 and ANSI/FCI 70-2 for Control Valves.

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PRESSURE TESTING OF VALVES

1. SCOPE

This Standard Practice establishes requirements and acceptance criteria for shell and seat closure pressure testing of valves.

2. DEFINITIONS

2.1 *Production Pressure Test*

Pressure tests which include closure member and shell leakage tests shall be performed on production units manufactured for sale. Production pressure tests verify the pressure containing capability of production units.

2.2 *Shell Leakage Test*

An internal pressure test of the pressure containing envelope to demonstrate pressure containing capability of the external pressure boundary.

2.3 *Seat and Closure Member Test*

An internal pressure test of flow regulating elements (seats, seals, and closure member such as gate, disc, ball, or plug) to demonstrate static performance within allowable leakage tolerances.

2.4 *No Visible Leakage*

2.4.1 The term "no visible leakage" applied to a hydrostatic test liquid is defined as a leak rate that will produce: no visible weeping or formation of drops at the test pressure and for the duration of the test.

2.4.2 The term "no visible leakage" applied to air or gas testing is defined as a leak rate that will produce no visible formation of bubbles in a water immersion test or after application of leak detection fluid at the test pressure and for the duration of the test.

2.4.3 For automatic leak detection methods, this definition shall be considered equivalent to a leak rate no greater then 4.1 x 10^{-5} in^3/sec[(1)](6.7 x 10^{-4} ml/sec) with a pressure differential of 80 to 100 psi (5.5 to 6.9 bar) for application to valves of NPS 8 (DN 200) and smaller.

3. GENERAL REQUIREMENTS

3.1 The manufacturer shall be responsible for the performance of tests specified herein.

3.2 Fluid for shell and seat closure tests shall be air, inert gas, or liquid, such as water (which may contain a corrosion inhibitor), kerosene, or other fluid with viscosity not greater than that of water. Temperature of the test fluid shall not exceed 125°F (52°C).

3.3 Valves shall be substantially relieved of air or gas when tested with liquid.

3.4 Seat closure tests for NPS 4 (DN 100) and larger valves shall be conducted after an acceptable shell test. Seat closure tests for smaller valves may be conducted before or after the shell test at the manufacturer's option. However, when valves conform to ASME B16.34, the requirements of paragraph 7.2 of ASME B 16.34 shall apply.

3.5 Valves shall be shell tested prior to painting. Corrosion protection treatment such as phosphatizing and linings may be applied prior to shell testing. If pressure tests in the presence of purchaser's representative are specified, valves that were painted following successful pressure testing may be retested without removal of paint.

3.6 Valve test fixture loads applied to valve ends shall be limited to those required to effectively seal the valve ends.

3.7 Leakage detection devices, e.g., pressure decay devices, may be used for detecting leakage provided that they perform at the pressures specified in Sections 4 and 5. The valve manufacturer shall be able to demonstrate that, when these devices are used, the test results are equivalent to the requirements of this Standard Practice.

Note:

(1) This leakage rate is based on the measured leakage of nitrogen gas from a needle valve with a 0.167" OD. x 0.091" I.D. tube submerged in water to a depth of 1". The tube end was cut square and smooth with no chamfers or butts and the tube axis was parallel to the surface of the water. Leakage was adjusted to a level equal to 40 bubbles in 10 minutes at 90 psi. The 40 bubbles equaled 1.6 ml or, 1 bubble = 0.04 SCC. Using these data, a leak rate equivalent to 1 bubble every minute is found to be 4.1 x 10^{-5} in^3/sec (6.7 x 10^{-4} ml/sec).

4. SHELL LEAKAGE TESTS

4.1 Each valve shall be given a shell leakage test at a gauge pressure no less than 1.5 times the valve's 100°F (38°C) design pressure rating, rounded off to the next higher 25 psi (1 bar) increment.

4.2 Shell leakage tests shall be conducted with the valve in the partially open position and with the valve ends closed. Pressure retaining parts of valves may be tested separately when the valves have internal components, such as diaphragms in diaphragm valves, that are not designed to withstand required shell test pressures. The manufacturer's nameplate data shall contain reference to this limitation.

4.3 Visual leakage through the pressure boundary walls is not acceptable. Stem seal leakage during shell test shall not be cause for rejection. Stem seals shall be capable of retaining pressure at least equal to the valve's 100°F (38°C) design pressure rating without visible leakage.

4.4 The minimum duration of the shell leakage test shall be per Table 1.

TABLE 1 – Shell Leakage Test Duration

VALVE SIZE		TEST TIME
NPS	DN	(SECONDS)
2 and Smaller	50 and Smaller	15
2 1/2 - 8	65-200	60
10 and Larger	250 and Larger	180

5. SEAT CLOSURE TESTS

5.1 Each valve designed for shutoff or isolation service, such as stop valves and check valves, shall be given a fluid seat closure tightness test.

5.1.1 The seat closure test shall be performed at a fluid (liquid or gas) pressure no less than 1.1 times the valve's 100°F (38°C) design pressure rating rounded to the next higher 5 psi (0.5 bar). At the manufacturer's option, a gas pressure of no less than 80 psi (5.6 bar) may be substituted for the valve sizes and pressure classes listed in Table 2.

TABLE 2 - Alternate Gas Test

Valve Size	Pressure Class
NPS (DN)	CLASS
12 (300) and Smaller	300 and Lower
4 (100) and Smaller	All

5.1.2 Seat closure testing shall be performed with seat surfaces free of materials that aid in sealing except as provided for in Sections 5.1.3 and 5.1.4.

5.1.3 When necessary to prevent damage during valve actuation, a light oil of viscosity no greater than that of kerosene may be applied to seating surfaces.

5.1.4 When a valve's primary seat design is based on the presence of a sealant material, e.g., lubricated plug valves, the sealant material may be in place. When it is intended that sealants act as secondary or back-up seat seals, the sealant material shall not be in place during the closure test.

5.1.5 When lubricants are used for assembly operations, it is not required that these be removed prior to testing if their presence has no influence on the test results.

5.2 For valves of the double seating type such as many gate, plug, and ball valves, the test pressure shall be applied successively to each end of the closed valve and leakage to the opposite end checked.

5.2.1 As alternate methods for valves with independent double seating (such as double disc or split wedge gate valves), at the option of the manufacturer, the pressure may be applied inside the bonnet (or body) of the closed valve and each seat checked for leakage at the valve ports, or the pressure may be applied to the valve ports and the sum of seat leakage checked at the bonnet (or body). These alternate methods may be used at the option of the manufacturer for valves with single discs (such as solid or flexible wedge gate valves) provided a supplementary closure member test across the disc is performed.

5.3 For other valve types, the test pressure shall be applied across the closure member in the direction producing the most adverse seating condition. For example, a globe valve shall be tested with pressure under the disc. A check valve, or other valve type designed, sold, and marked as a one-way valve, requires a closure test only in the appropriate direction. A stop check valve requires both tests.

5.4 Valves conforming to this Standard Practice in all respects, except that they are designed for operating conditions that have pressure differential across the closure member limited to values less than the 100°F (38°C) pressure rating and having closure members and/or actuating devices (direct, mechanical, fluid, or electrical) that would be subject to damage at high differential pressures, shall be tested as described above except that the closure test requirement may be reduced to 1.1 times the maximum specified closed position differential pressure. This exception may be exercised upon agreement between the purchaser and manufacturer. The manufacturer's name plate data shall include reference to any such limitations.

5.5 Valves of single or symmetrical seat design, capable of seating in two directions, e.g., butterfly or weir type diaphragm valves, require seat testing in only one direction.

5.6 Butterfly valves of the offset stem-seat design may be closure tested in only one direction. The manufacturer shall be able to demonstrate that the direction selected is that least likely to attain effective tightness.

5.7 Allowable leakage rates, except for the conditions of Sections 5.7.2 and 5.7.3 shall be as in Section 5.7.1.

5.7.1 The maximum allowable leakage of each seat closure shall be 10 ml/hr of liquid or 0.1 standard cu ft/hr of gas per unit of NPS (0.4 ml/hr of liquid or 120 standard ml/hr of gas per unit of DN) under the specified test condition. See Table 4.

5.7.2 In the case of valves having pressure or flow reversal actuated closure, e.g., check valves, the allowable leakage rate may be increased by a factor of 4.

5.7.3 In the case of valves having a seat closure member that uses a compliant material, e.g., plastic or elastomer, for fluid sealing at closure, there shall be no visible leakage for the duration of the seat test.

5.8 The duration of each seat closure test shall be per Table 3.

TABLE 3 – Seat Closure Test Duration

VALVE SIZE		TEST TIME
NPS	DN	(SECONDS)
2 and Smaller	50 and Smaller	15
21/2-8	65-200	30
10 - 18	250 - 450	60
20 and Larger	500 and Larger	120

TABLE 4 – Units of Leakage per NPS/DN

LIQUID		GAS	
Per NPS	Per DN	Per NPS	Per DN
10 cc/hr	0.4 cc/hr	0.1 SCFH 2.88 SCIM	120 cc/hr
0.167 cc/min.	6.6×10^{-3} cc/min.	47.2 cc/min.	2cc/min.
2.66(1) drops/min.	0.11(1) drops/min.	1180(2) bubble/min	50(2) bubble/min

General Notes:

1. 1 ml = 1 cc
2. SCFH = Standard cubic feet per hour (14.7 psia @ 60°F)(1.01 bar @ 16°C)
3. SCIM = Standard cubic inch per minute (14.7 psia @ 60°F)(1.01 bar @ 16°C)

Notes:

(1) For information only. Based on 16 drops per cc, which is the equivalent of a spherical shaped drop having an approximate diameter of ½ cm (3/16 inch).

(2) For information only. Based on 25 bubbles per cc, which is the equivalent of a spherical shaped bubble having an approximate diameter of 0.42 cm (5/32 inch). See Page 1, Footnote (1).

ANNEX A
Referenced Standards and Applicable Dates

This Annex is an integral part of this Standard Practice and is placed after the main text for convenience.

Standard Name or Designation

ASME, ANSI/ASME, ANSI, ASME/ANSI

B16.34 – 2004	Valves - Flanged, Threaded and Welding End

FCI

70-2 – 2006	Control Valve Seat Leakage

ISA

S75.19.01 – 2007	Hydrostatic Testing of Control/Valves

Publications of the following organizations appear in the above list:

ANSI	American National Standards Institute, Inc. 25 West 43rd Street New York, NY 10036
ASME	The American Society of Mechanical Engineers Three Park Avenue New York, NY 10016-5990
FCI	Fluid Controls Institute 1300 Sumner Avenue Cleveland, OH 44115
ISA	ISA - The Instrumentation, Systems, and Automation Society 67 Alexander Drive Research Triangle Park, NC 27709

List of MSS Standard Practices
(Price List Available Upon Request)

Number	
SP-6-2007	Standard Finishes for Contact Faces of Pipe Flanges and Connecting-End Flanges of Valves and Fittings
SP-9-2008	Spot Facing for Bronze, Iron and Steel Flanges
SP-25-2008	Standard Marking System for Valves, Fittings, Flanges and Unions
SP-42-2009	Corrosion Resistant Gate, Glove, Angle and Check Valves with Flanged and Butt Weld Ends (Classes 150, 300 & 600)
SP-43-2008	Wrought and Fabricated Butt-Welding Fittings for Low Pressure, Corrosion Resistant Applications
SP-44-2006	Steel Pipeline Flanges
SP-45-2003	(R 08) Bypass and Drain Connections
SP-51-2007	Class 150LW Corrosion Resistant Flanges and Cast Flanged Fittings
SP-53-1999	(R 07) Quality Standard for Steel Castings and Forgings for Valves, Flanges and Fittings and Other Piping Components - Magnetic Particle Examination Method
SP-54-1999	(R 07) Quality Standard for Steel Castings for Valves, Flanges, and Fittings and Other Piping Components - Radiographic Examination Method
SP-55-2006	Quality Standard for Steel Castings for Valves, Flanges and Fittings and Other Piping Components - Visual Method for Evaluation of Surface Irregularities
SP-58-2002	Pipe Hangers and Supports - Materials, Design and Manufacture
SP-60-2004	Connecting Flange Joint Between Tapping Sleeves and Tapping Valves
SP-61-2009	Pressure Testing of Valves
SP-65-2008	High Pressure Chemical Industry Flanges and Threaded Stubs for Use with Lens Gaskets
SP-67-2002a	Butterfly Valves
SP-68-1997	(R 04) High Pressure Butterfly Valves with Offset Design
SP-69-2003	Pipe Hangers and Supports - Selection and Application (ANSI/MSS Edition)
SP-70-2006	Gray Iron Gate Valves, Flanged and Threaded Ends
SP-71-2005	Gray Iron Swing Check Valves, Flanged and Threaded Ends
SP-72-1999	Ball Valves with Flanged or Butt-welding Ends for General Service
SP-75-2008	Specification for High Test Wrought Butt Welding Fittings
SP-77-1995	(R 00) Guidelines for Pipe Support Contractual Relationships
SP-78-2005a	Gray Iron Plug Valves, Flanged and Threaded Ends
SP-79-2004	Socket-Welding Reducer Inserts
SP-80-2008	Bronze Gate, Globe, Angle and Check Valves
SP-81-2006a	Stainless Steel, Bonnetless, Flanged, Knife Gate Valves
SP-83-2006	Class 3000 Steel Pipe Unions, Socket-Welding and Threaded
SP-85-2002	Gray Iron Globe & Angle Valves, Flanged and Threaded Ends
SP-86-2002	Guidelines for Metric Data in Standards for Valves, Flanges, Fittings and Actuators
SP-88-1993	(R 01) Diaphragm Valves
SP-89-2003	Pipe Hangers and Supports - Fabrication and Installation Practices
SP-90-2000	Guidelines on Terminology for Pipe Hangers and Supports
SP-91-1992	(R 96) Guidelines for Manual Operation of Valves
SP-92-1999	MSS Valve User Guide
SP-93-2008	Quality Standard for Steel Castings and Forgings for Valves, Flanges, and Fittings and Other Piping Components - Liquid Penetrant Examination Method
SP-94-2008	Quality Std for Ferritic and Martensitic Steel Castings for Valves, Flanges, and Fittings and Other Piping Components - Ultrasonic Examination Method
SP-95-2006	Swage(d) Nipples and Bull Plugs
SP-96-2001	(R 05) Guidelines on Terminology for Valves and Fittings
SP-97-2006	Integrally Reinforced Forged Branch Outlet Fittings - Socket Welding, Threaded and Buttwelding Ends
SP-98-2001	(R 05) Protective Coatings for the Interior of Valves, Hydrants, and Fittings
SP-99-1994	(R 05) Instrument Valves
SP-100-2002	Qualification Requirements for Elastomer Diaphragms for Nuclear Service Diaphragm Valves
SP-101-1989	(R 01) Part-Turn Valve Actuator Attachment - Flange and Driving Component Dimensions and Performance Characteristics
SP-102-1989	(R 01) Multi-Turn Valve Actuator Attachment - Flange and Driving Component Dimensions and Performance Characteristics
SP-104-2003	Wrought Copper Solder Joint Pressure Fittings
SP-105-1996	(R 05) Instrument Valves for Code Applications
SP-106-2003	Cast Copper Alloy Flanges and Flanged Fittings, Class 125, 150 and 300
SP-108-2002	Resilient-Seated Cast-Iron Eccentric Plug Valves
SP-109-1997	(R 06) Welded Fabricated Copper Solder Joint Pressure Fittings
SP-110-1996	Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends
SP-111-2001	(R 05) Gray-Iron and Ductile-Iron Tapping Sleeves
SP-112-1999	(R 04) Quality Standard for Evaluation of Cast Surface Finishes -Visual and Tactile Method. This SP must be sold with a 10-surface, three Dimensional Cast Surface Comparator, which is a necessary part of the Standard. Additional Comparators may be sold separately.
SP-113-2001	(R 07) Connecting Joint between Tapping Machines and Tapping Valves
SP-114-2007	Corrosion Resistant Pipe Fittings Threaded and Socket Welding, Class 150 and 1000
SP-115-2006	Excess Flow Valves, 1 1/4 NPS and Smaller, for Fuel Gas Service
SP-116-2003	Service Line Valves and Fittings for Drinking Water Systems
SP-117-2006	Bellows Seals for Globe and Gate Valves
SP-118-2007	Compact Steel Globe & Check Valves - Flanged, Flangeless, Threaded & Welding Ends (Chemical & Petroleum Refinery Service)
SP-119-2003	Factory-Made Belled End Socket Welding Fittings
SP-120-2006	Flexible Graphite Packing System for Rising Stem Steel Valves (Design Requirements)
SP-121-2006	Qualification Testing Methods for Stem Packing for Rising Stem Steel Valves
SP-122-2005	Plastic Industrial Ball Valves
SP-123-1998	(R 06) Non-Ferrous Threaded and Solder-Joint Unions for Use with Copper Water Tube
SP-124-2001	Fabricated Tapping Sleeves
SP-125-2000	Gray Iron and Ductile Iron In-Line, Spring-Loaded, Center-Guided Check Valves
SP-126-2007	Steel In-Line Spring-Assisted Center Guided Check Valves
SP-127-2001	Bracing for Piping Systems Seismic-Wind-Dynamic Design, Selection, Application
SP-128-2006	Ductile Iron Gate Valves
SP-129-2003	(R 07) Copper-Nickel Socket-Welding Fittings and Unions
SP-130-2003	Bellows Seals for Instrument Valves
SP-131-2004	Metallic Manually Operated Gas Distribution Valves
SP-132-2004	Compression Packing Systems for Instrument Valves
SP-133-2005	Excess Flow Valves for Low Pressure Fuel Gas Appliances
SP-134-2006a	Valves for Cryogenic Service Including Requirements for Body/Bonnet Extensions
SP-135-2006	High Pressure Steel Knife Gate Valves
SP-136-2007	Ductile Iron Swing Check Valves
SP-137-2007	Quality Standard for Positive Material Identification of Metal Valves, Flanges, Fittings, and Other Piping Components
SP-138-2009	Quality Standard Practice for Oxygen Cleaning of Valves & Fittings

(R-YEAR) Indicates year standard reaffirmed without substantive changes

A large number of former MSS Practices have been approved by the ANSI or ANSI Standards, published by others. In order to maintain a single source of authoritative information, the MSS withdraws its Standard Practices in such cases.

Manufacturers Standardization Society of the Valve and Fittings Industry, Inc.
127 Park Street, N.E., Vienna, VA 22180-4620 (703) 281-6613 • Fax # (703) 281-6671