Valve Inspection and Test

API STANDARD 598
THIRD EDITION, MAY 1977

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NOTES TO PURCHASER

1. If required, the following shall be specified in the order:

   a. Inspection by purchaser at manufacturer's plant (see 2.1)
   b. Inspection by purchaser outside manufacturer's plant (see 2.2)
   c. Any supplementary examination required (see 2.3.3)
   d. Address for inspection notices (see 2.4)
   e. Optional high-pressure closure test (see 3.2)
   f. Use of wetting agent in test water (see 3.4.4).

2. If this standard is used for valves other than those covered by API standards listed herein, the purchaser shall specify the extent to which it is to be applied.

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VALVE INSPECTION AND TEST

SECTION 1—GENERAL

1.1 Scope

1.1.1 This standard covers inspection and pressure test requirements for both resilient seated and metal-to-metal seated valves of the gate, plug, ball, and butterfly types. (Resilient seats are considered to be both the solid type and semi-solid grease type such as lubricated plug valves.) It is intended to supplement the API standards listed in 1.2.2 but may also be applied to other types of valves with the purchaser's approval.

1.1.2 The inspection requirements pertain to inspection by the purchaser at the manufacturer's plant. The test requirements cover pressure tests by the manufacturer at his plant.

1.1.3 Tests specified in this standard are pressure tests as follows:

1. Shell (includes body, bonnet, and cover plate)
2. Backseat (for gate valves only)
3. Low-pressure seat
4. High-pressure closure (not required unless specified)

1.2 Referenced Publications

1.2.1 Except for ANSI Standard B16.5, the latest edition or revision of the following standards shall, to the extent specified herein, form a part of this standard:

ANSI[1]

B16.5 *Steel Pipe Flanges and Flanged Fittings (1968)*
B16.11 *Forged Steel Fittings, Socket-Welding and Threaded*

MSS[2]

SP-53 *Quality Standards for Steel Castings—Dry Powder Particle Magnetic Inspection Method*
SP-54 *Quality Standard for Steel Castings—Radiographic Inspection Method*
SP-55 *Quality Standard for Steel Castings—Visual Method*

1.2.2 The following are the API valve standards which this standard is intended to supplement:

593 *Ductile Iron Plug Valves, Flanged Ends*
597 *Steel Venturi Gate Valves, Flanged or Buttwelding Ends*
599 *Steel Plug Valves, Flanged or Buttwelding Ends*
600 *Steel Gate Valves, Flanged or Buttwelding Ends*
602 *Compact Carbon Steel Gate Valves*
603 *150-pound Light-Wall, Corrosion-Resistant Gate Valves for Refinery Use*
604 *Ductile Iron Gate Valves, Flanged Ends*
606 *Compact Carbon Steel Gate Valves (Extended Body)*
609 *Butterfly Valves, To 150 psig and 150 F*

SECTION 2—INSPECTION

2.1 Inspection at Manufacturer's Plant

If inspection is specified in the purchase order, the valve shall be inspected by the purchaser's inspector at the manufacturer's plant. The purchaser's inspector shall have free access to any part of the plant concerned with manufacture of the valves at any time work on his order is underway.

2.2 Inspection Outside Manufacturer's Plant

If inspection is specified to include shell components manufactured at other than the manufacturer's plant, these components shall be subject to the purchaser's inspection at that location.

2.3 Extent of Inspection

2.3.1 Unless supplementary examination is specified in the purchase order, inspection by the purchaser shall be limited to the following:

1. Examination of the valve (including the use of nondestructive inspection tools) to assure compliance

[1]American National Standards Institute, Inc., 1430 Broadway, New York, New York 10018.

[2]Manufacturers Standardization Society of the Valve and Fittings Industry, 1815 North Fort Meyer Drive, Arlington, Virginia 22209.

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with the specifications of the purchase order.

2. Visual examination of any casting to assure conformance with MSS SP-55.

3. Witnessing of the required and specified optional pressure tests.

The purchaser's inspector may waive any part of this inspection.

2.3.2 For visual examination, a casting may be examined all over and shall be rejected if any defects are of equal or greater extent than those shown as nonacceptable in MSS SP-55.

2.3.3 Supplementary types of examination are required only if specified in the purchase order and to the extent specified. Magnetic particle and radiographic examination of steel castings shall be per MSS SP-53 and SP-54, respectively, or the purchaser's own acceptance criterion, if so specified. These examinations shall be made by the manufacturer subject to witnessing by the purchaser's inspector.

2.4 Inspection Notice

If inspection is specified, the manufacturer shall notify the purchaser 5 days prior to the required valve testing and any supplementary examination addressing the notice as stated in the purchase order. Also, the manufacturer shall give the purchaser 5 days' notice as to where and when shell components manufactured outside the manufacturer's plant may be inspected, if such inspection is required.

SECTION 3—PRESSURE TESTS

3.1 Tests Required

3.1.1 The following pressure tests shall be made on each valve:

Test	Valve Type
Shell	All
Backseat	Gate Only
Low pressure seat	All*

* Except butterfly valves, which shall be tested per 3.5.2, Table 2.

3.1.2 Valves that contain features that permit the emergency injection of a grease-type sealant to the seat area shall be tested with the injection system unfilled and not in use.

3.2 Optional High-Pressure Closure Test

The high-pressure closure test is not required unless specified in the purchase order, but the valve is required to be capable of passing this test (as a test of the design of the valve closure structure). It is considered unnecessary as a production test.

3.3 Test Location

Tests shall be performed by the manufacturer at his plant.

3.4 Test Fluid

3.4.1 For shell, backseat, and high-pressure closure tests, the test fluid shall be air, inert gas, kerosine, or water (including liquid with viscosity no higher than that of water).

3.4.2 For the low-pressure seat test, the test fluid shall be air or inert gas.

3.4.3 For shell and backseat tests, if air or gas is used, the manufacturer shall demonstrate the adequacy of his method for detecting any leakage. If kerosine or water is used, the valve shall first be essentially freed of air.

3.4.4 Water used for any test may contain a water-soluble oil or a rust inhibitor, and, when specified by the purchaser, it shall contain a wetting agent.

3.5 Test Pressure

3.5.1 The shell test pressure shall be as listed in Table 1.

Table 1—Shell Test Pressure

API Standard	Class	Shell Test Pressure[a] (minimum)
593	150, 300	See ANSI B16.5 (1968)
597	150 to 600	See ANSI B16.5 (1968)
599	150 to 2500	See ANSI B16.5 (1968)
600	150 to 2500	See ANSI B16.5 (1968)
602	150, 300, 600	See ANSI B16.5 (1968)
602, 606	800	3000 psig (207 bar)
603	150	300 psig (20.7 bar)
604	150, 300	See ANSI B16.5 (1968)
609	150 psig (10.3 bar)	225 psig (15.5 bar)

[a]For a valve not covered by the API standards referenced in this publication, the shell test pressure shall be 1½ times the pressure rating at 100 degrees Fahrenheit (38 degrees Celsius) rounded off to the next higher 25 pounds per square inch gage (1 bar) increment.

Table 2—Other Test Pressures

Test	Test Pressure
Backseat	110% Cold pressure rating, [a] minimum
Low-pressure seat	60 to 100 psig (4.1 to 6.9 bar)
High-pressure closure	110% Cold pressure rating, [a] minimum
Butterfly valve seat	150 psig (10.3 bar)

[a]Maximum allowable pressure at 100 degrees Fahrenheit (38 degrees Celsius) in accordance with the applicable purchase specification.

3.5.2 Other test pressures shall be as listed in Table 2.

3.6 Test Duration

The required test pressure as listed in Table 3 shall be maintained for each type of test.

Table 3—Duration of Required Test Pressure

Valve Size (NPS)	Test Duration (seconds, minimum)		
	Shell	Backseat	Seat and Closure
2 and smaller	15	15	15
2½ to 6	60	15	60
8 to 12	120	15	120
14 and larger	300	15	120

3.7 Test Leakage

3.7.1 For shell and backseat tests, no leakage is permitted. If the test fluid is liquid, there shall be no visible evidence of drops or any wetting of the external surfaces. If the test fluid is air or gas, no leakage shall be revealed by the established detection method.

3.7.2 For both the low-pressure seat test and the high-pressure closure test, no leakage is permitted for resilient-seated valves for the duration of the test. For valves with metal-to-metal seats, the allowable leakage rate of the test fluid for the duration of the test is listed in Table 4.

Table 4—Allowable Leakage Rate for Valves with Metal-to-Metal Seats

Valve Size (NPS)	Allowable Leakage Rate[a] (units[b]/minute, maximum)
2 and smaller	0[c]
2½ to 6	12
8 to 12	20
14 and larger	28

[a]These leakage rates are not recommended for valves with closures activated by flow reversal, for example, check valves. Refer to the appropriate standard for the type of valve under consideration.

[b]If test fluid is liquid, the unit is a drop (about 480 per ounce/16 per cubic centimeter). If test fluid is air or gas, the unit is a bubble.

[c]There shall be zero leakage for the minimum specified test duration (see Table 3).

SECTION 4—PRESSURE TEST PROCEDURE

4.1 Shell Test

4.1.1 The shell test shall be made prior to any painting of the shell.

4.1.2 The shell test shall be made by applying the pressure inside the assembled valve with the valve ends closed, the valve partially closed, and the packing gland sufficiently tight to maintain the test pressure, thereby testing the stuffing box also. The stuffing box shall not leak during the shell test. (Packing leakage shall not be cause for rejection if the manufacturer demonstrates that the packing will not leak at the rated pressure of the valve.)

4.2 Backseat Test

The backseat test of a gate valve shall be made by applying the pressure inside the assembled valve with the valve ends closed, the valve fully open, and the packing gland loose. This test may be made immediately following the shell test (see 4.1.2).

4.3 Low-Pressure Seat Test

4.3.1 The low-pressure seat test[3] shall be made in accordance with one of the following procedures:

1. For gate or plug valves and for ball and butterfly valves designed for flow in both directions, the pressure shall be applied successively to each side of the closed valve with the other side open to the atmosphere to check for leakage of the downstream side of the closure. For ball and butterfly valves designed for flow in one direction only, and so mark-

[3]The method of seat leakage testing must result in the filling and pressurizing of the body cavity between the seats and the bonnet area, as applicable, with the test fluid to ensure that no seat leakage can escape detection because of gradual filling of these volumes during the test period.

ed on the valve, the pressure shall be applied on the upstream side of the valve only. Any leakage at the seat on the open side of the valve shall be detected by observation of bubbles when the seat is either covered with water or coated with a soap or similar solution. As an alternative, a displacement measuring device may be used providing the leakage rate is equal to that called for in this standard and has been developed by agreement between the purchaser and the manufacturer.

2. For a gate valve other than a solid wedge gate, the pressure may be applied to the shell between the seats through a tapped connection, checking both seats for leakage either simultaneously or separately. Leakage shall be detected as specified in Item 1 above.

3. For a gate valve, the pressure may be applied separately to each seat through the valve port. Leakage into the shell between the seats shall be checked as an indication of leakage at the upstream side of the gate. Alternatively, for a gate valve other than a solid wedge gate valve over 2 NPS, this pressure may be applied simultaneously to both seats, in which case the leakage from each seat shall not exceed the allowable leakage for a single seat tested separately.

A tapped connection in the shell, if made to permit testing procedures described in Items 2 and 3 above, shall not exceed ½ NPS and shall be fitted prior to shipment with a solid pipe plug (per ANSI B16.11) of a material composition equivalent to that of the valve shell or having corrosion resistance not less than that of the shell.

4.3.2 The low-pressure seat test shall be made with the seats clean and free of oil. However, if necessary to prevent galling, the seats may be coated with a film of oil not heavier than kerosine. This requirement does not apply to a valve in which a lubricant provides the primary seal.

NOTE: The trapping of the test fluid in the shell between the seats and subsequent coverage of the seats with water or coating them with a soap or similar solution is not an acceptable test.

4.4 High-Pressure Closure Test

4.4.1 The high-pressure closure test[4] procedure shall be the same as for the low-pressure seat test.

4.4.2 If liquid is used in testing a gate valve, the bonnet shall be full of liquid during the application of the test pressure.

4.5 End Loading Under Test

During seat tests, external forces that affect seat leakage shall not be applied to valve ends.

[4]The method of seat leakage testing must result in the filling and pressurizing of the body cavity between the seats and the bonnet area, as applicable, with the test fluid to ensure that no seat leakage can escape detection because of gradual filling of these volumes during the test period.

SECTION 5 — VALVE RETEST

5.1 Certification

A completed valve is not required to be retested unless inspection by the purchaser is specified in the order. This retesting may be waived by the purchaser's inspector upon written certification by the manufacturer that the valve has been completely tested and conforms to the requirements of this standard. Painted valves need not have paint removed for retest. Stored valves shall be commercially clean before retest and before shipment.

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2.1.1 Valve Limit Switches