

# Process Valve Qualification Procedure

API RECOMMENDED PRACTICE 591  
FOURTH EDITION, DECEMBER 2008





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## Downstream Segment

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# Process Valve Qualification Procedure

## 1 Scope

This recommended practice (RP) provides recommendations for evaluation of a manufacturer's valve construction and quality management system for the purpose of determining a manufacturer's capability to provide new valves manufactured in accordance with the applicable standards listed in Section 2.

Qualification of valves under this RP is "manufacturing facility specific" and does not cover valves manufactured by other manufacturing facilities, whether owned by the same manufacturer or a third party.

Fugitive emissions testing is outside the scope of this RP. However, the purchaser may request that the valve qualification procedure include fugitive emissions testing per Section 4 of API 622. Such results shall be included in the final test report prepared by the qualification facility.

## 2 Normative References

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

API 594, *Check Valves: Flanged, Lug, Wafer, and Butt-welding*

API 598, *Valve Inspection and Testing*

API 599, *Metal Plug Valves—Flanged, Threaded and Welding Ends*

API 600, *Bolted Bonnet Steel Gate Valves for Petroleum and Natural Gas Industries*

API 602, *Steel Gate, Globe and Check Valves for Sizes DN 100 and Smaller for the Petroleum and Natural Gas Industries*

API 603, *Corrosion-resistant, Bolted Bonnet Gate Valves—Flanged and Welding End*

API 608, *Metal Ball Valves—Flanged, Threaded, and Butt-welding Ends*

API 609, *Butterfly Valves: Double Flanged, Lug- and Wafer-type*

ASME B1.1<sup>1</sup>, *Unified Inch Screw Threads (UN & UNR Thread Form)*

ASME B16.5, *Pipe Flanges and Flanged Fittings NPS 1/2 through NPS 24 Metric/Inch Standard*

ASME B16.10, *Face-to-Face and End-to-End Dimensions of Valves*

ASME B16.11, *Forged Fittings, Socket-Welding and Threaded*

ASME B16.25, *Buttwelding Ends*

ASME B16.34, *Valves—Flanged, Threaded, and Welding End*

ASME B18.2.2, *Square and Hex Nuts (Inch Series)*

<sup>1</sup> ASME International, 3 Park Avenue, New York, New York 10016, [www.asme.org](http://www.asme.org).

ASME B31.3, *Process Piping*

ISO 9001<sup>2</sup>, *Quality management systems—requirements*

MSS SP-55<sup>3</sup>, *Quality Standard for Steel Castings for Valves, Flanges, Fittings and Other Piping Components—Visual Method for Evaluation of Surface Irregularities*

### 3 Terms and Definitions

#### 3.1

##### **acceptance criteria**

Specified limits placed on the characteristics of an item, process, or service defined in codes, standards, or other manufacturer provided documents.

#### 3.2

##### **audit**

A planned and documented activity performed to determine by investigation, examination, or evaluation of objective evidence the adequacy of and compliance with established procedures, instructions, drawings, and other applicable documents and the effectiveness of implementation.

#### 3.3

##### **characteristic**

Any property or attribute of an item, process, or service that is distinct, describable, and measurable.

#### 3.4

##### **corrective action**

A measure taken to rectify nonconformance and, where necessary, to preclude repetition of such conditions.

#### 3.5

##### **manufacturer**

The entity whose name or trade mark appears on a valve.

#### 3.6

##### **manufacturing facility specific**

Location of final assembly, inspection and testing of the valve selected for evaluation.

#### 3.7

##### **nonconformance**

Any item or action that does not meet the requirements of the standards listed in Section 2, or the manufacturer's specifications.

#### 3.8

##### **pressure containing components**

Any shell component (bodies, bonnets, covers, caps or end pieces).

#### 3.9

##### **purchaser**

A person, group, company, agency, corporation or designated representative responsible for valve acceptance.

#### 3.10

##### **qualified procedure**

An approved procedure that has been demonstrated to meet the specified requirements for its intended purpose.

<sup>2</sup> International Organization for Standardization, 1, ch. de la Voie-Creuse, Case postale 56, CH-1211, Geneva 20, Switzerland, [www.iso.org](http://www.iso.org).

<sup>3</sup> Manufacturers Standard Society of the Valve and Fittings Industry, Inc., 127 Park Street, N.E., Vienna, Virginia, 22180-4602, [www.mss-hq.com](http://www.mss-hq.com).

**3.11****quality management system**

The planned and systematic actions necessary to provide confidence that a valve is manufactured in accordance with the requirements of the referenced API standard and manufacturer's specifications.

**3.12****stem cylindricity**

A condition of a surface of revolution in which all points of the surface are equidistant from a common axis.

**3.13****stem run-out**

The difference in diameters of a stem measured at intervals along its length when the stem is rotated 360 degrees.

**3.14****stem straightness**

The condition in which the longitudinal elements of a stem or shaft are compared to a straight line.

**3.15****supplier**

An individual or organization that furnishes items in accordance with a procurement document. It is a term used to indicate any of the following: vendor, seller, contractor, subcontractor, or fabricator.

**3.16****traveler**

A process control document that accompanies the work through various manufacturing stages.

**4 Purchaser Responsibilities and Recommended Actions**

**4.1** It is recommended that the purchaser verify the source of supply to ensure that purchased valves are newly manufactured and in accordance with the applicable standards.

**4.2** The purchaser should determine that the valve manufacturer can supply valves meeting the referenced standards and verify the manufacturer has a working quality management system as described in Section 5.

**4.3** As part of the review and evaluation, it is recommended that the purchaser or designated representative survey the valve manufacturer's facility(s), and where deemed appropriate, the associated primary supplier facilities such as foundry and forging locations. It is also recommended that at the conclusion of the survey(s), a closing review meeting should be conducted with the facility management team for the purpose of communicating areas of concern, suggestions for improvement or observed nonconforming activities, if any.

**5 Manufacturer Quality Management System Evaluation****5.1 General**

The manufacturer shall establish and maintain a quality management group that shall be responsible for establishing and maintaining a quality management system. The quality management system shall follow the principles of ISO 9001.

**5.2 Suggested Record and Documentation Review**

The manufacturer shall upon request make available:

- a) quality manual;
- b) organizational structure and functional responsibilities with levels of authority;

- c) approved supplier list;
- d) most recent supplier evaluation record;
- e) inspection and test plan for purchased pressure containing components;
- f) confirmation of sub-supplier quality management system following the principals of ISO 9001;
- g) documents and records relating to special processes such as those used in welding, heat treatment, and nondestructive examination;
- h) final product examination and testing documents;
- i) test equipment list; and
- j) traceability procedures of pressure containing components:
  - 1) certified mill test reports (CMTRs),
  - 2) certificates of compliance (CoCs).

### **5.3 Right of Access**

The manufacturer's procurement documents shall require their suppliers to provide access to their plant facilities and records for inspection or audit by the manufacturer, his/her designated representative, or other parties authorized by the manufacturer.

### **5.4 Document Control**

Documents supplied during valve qualification shall be controlled documents.

## **6 Valve Qualification**

### **6.1 Data to be Provided by Manufacturer**

**6.1.1** General assembly drawings of one valve size of each design for each pressure class shall be available to the test facility. These drawings shall show all applicable construction details: including stem-to-wedge, disk, ball, or plug connection; guides; bearings; stem seals; body joint, body joint gasket, seat(s) and seal(s). They shall also include descriptions of the construction materials for all of the parts, including fasteners. The manufacturer shall also identify the trim and sealing materials used.

**6.1.2** If welding, including casting repair, was used in the manufacture of the valves being evaluated, the applicable qualification and procedure documents shall, upon request, be available for evaluation.

**6.1.3** The manufacturer shall make available a tabulation of the foundries and forges from which castings or forgings used for bodies, bonnets, covers, and closure elements (e.g. wedges, disks or balls) were obtained and the manufacturing facilities from which completed valves were obtained. The table shall include any special marking or coding used by the manufacturer to trace, distinguish and identify component parts from different sources, including each manufacturing location and address.

**6.1.4** The manufacturer shall provide the recommended closure torques or rim-pull handle forces required to adequately seat the valve for all sizes of valves being evaluated.

**6.1.5** As part of the test program, the manufacturer shall provide written certification, signed by an officer of the manufacturing company, which states that the manufacturer's production valves, regardless of size, pressure class, or materials of construction, are equivalent to the valves involved in the qualification and comply with the applicable product standards.

**6.1.6** The manufacturer shall identify the name and location of the facility where the valves undergo final assembly and testing for inclusion in the final report required by 6.5.

**6.1.7** Manufacturing by a third party (private labeling) where the manufacturing facility does not fully own the name, trademark or symbol on the valve, requires that the following additional information shall be documented in the final report prepared by the test facility:

- a) owning entity of the trademark, valve design, casting patterns or forging dies;
- b) entity responsible for implementing the facilities QMS/QC program; and
- c) the business relationship between the manufacturing facility(s) and the trademark owner (valve supplier, joint venture, partial ownership, majority of controlling ownership).

A signed statement shall be included in the final report as required in 6.5.

## **6.2 Valve Qualification Facility**

The manufacturer shall engage an independent qualification facility, to perform the inspections, examinations, and tests described in this section. The facility(s) used shall be mutually agreeable to the purchaser and the manufacturer. The qualification facility staff responsible for testing shall include a degreed or licensed metallurgical engineer or mechanical engineer.

The qualification facility(s) shall be equipped and capable of performing, or supervising the performance of nondestructive examination, physical tests, and chemical analyses on materials. The qualification facility staff shall be familiar with the applicable API valve standards and with the codes, standards, and specifications referenced in those standards. The facility's proposed program shall cover the following:

- a) qualifications of the personnel performing the inspections and tests;
- b) test details and format used to present the results of the tests;
- c) number, sizes, and types of valves examined (see Annex A); and
- d) source of the test valves and test valves selection method.

## **6.3 Selection of Valves**

**6.3.1** In order to ensure that the test valves were not made specifically for the tests, a random sampling feature shall be incorporated into the program. The qualification facility personnel shall select the test valves randomly from the manufacturer's or distributor's stock. Alternatively, the purchaser may choose to select the valves to be tested.

**6.3.2** It is expected that the manufacturer shall have sufficient stock from which a random sampling of their valve products, and shell materials to be qualified, may be selected. Reduced sample lot may be agreed upon by the purchaser and manufacturer. Selected valves shall be clearly identified. Once testing commences, testing shall be limited to the randomly selected sample lot with no substitutions. Random sampling shall include selection from each material category to be qualified per Annex A.

**6.3.3** Casting and forging materials qualification of shell components, in accordance with Annex A, shall be segregated into 3 categories: carbon steel, low chrome alloys (1 1/4 to 9) and stainless steels. Qualification of low chrome alloys (1 1/4 to 9) having the highest percentage of chrome content will qualify lower percent chrome materials.

## **6.4 Required Examination and Testing**

**6.4.1** All of the pressure tests specified in API 598, including the optional high or low pressure closure tests, shall be made on each valve. The double block and bleed test is required for valves identified by the manufacturer as being double block and bleed capable. Seating surfaces shall be dry or coated only with very light oil no heavier than kerosene. For seat tests, valves shall be tightened, if applicable, to the closure torque recommended by the manufacturer.

The torque is to be applied by a calibrated torque wrench either directly or through a gear operator to the center of the stem/shaft. If the torque recommended by the manufacturer should prove to be inadequate, the torque may be increased incrementally, to a maximum of 1.25 times the recommended value, until the seat leakage is within allowable limits. The required closure torques shall be measured and reported. During seat tests, external forces that affect seat leakage shall not be applied to the valve ends.

Prior to the start of the qualification testing, each valve shall be operationally tested (stroked full open and closed) with the stem in the horizontal position (flow in the horizontal direction) to confirm that the closure element does not hang up.

**6.4.2** The following dimensions and finishes shall be measured on each valve, as applicable, and compared with those specified in the applicable standards, and the manufacturer's requirements:

- a) face-to-face dimension (ASME B16.10);
- b) flange dimensions (ASME B16.5), including orientation of bolt holes;
- c) butt-welding end dimensions (ASME B16.25);
- d) center to top (closed and open position);
- e) hand wheel diameter or lever length;
- f) facing finish, including number of grooves per in., of raised-face end flanges (ASME B16.5) and bonnet-joint flanges;
- g) type of bolting threads (ASME B1.1 and B18.2.2);
- h) body and bonnet thickness;
- i) stem diameter at the extremities and midpoint of the packing contact area, stem surface finish over the packing contact area, and stem thread pitch (on gate and globe valves), lead major diameter and minor diameter;
- j) wedge-wear travel for gate valves;
- k) stem projection (where applicable);
- l) number and size of bonnet or cover bolts;
- m) stuffing box dimensions and surface finish, and gland follower dimensions;
- n) socket-weld ends and threaded ends (ASME B16.11);

- o) gasket dimensions;
- p) port opening (flow-way, bore or seat ring inside diameters);
- q) backseat inside diameter and finish for gate and globe valves;
- r) bonnet joint dimensions (where applicable); and
- s) stem cylindricity, run-out and straightness.

**6.4.3** All valve parts shall be visually examined to confirm and document the following, as applicable:

- a) markings are as specified in ASME/ASTM and the applicable API valve standard and match corresponding mill test reports;
- b) identification plate markings are as specified in the applicable API or ASME valve standard;
- c) construction is as specified in the applicable API valve standard;
- d) hand wheel, gear operator or lever operates clockwise to close when viewed from the outboard end of the stem, and that the hand wheel, gear operator or lever is properly marked with an arrow and the word "open" to indicate the opening direction;
- e) hand wheel conditions, material and method of fabrication (where applicable);
- f) packing type and arrangement, size, and number of rings as well as the number of rings that could be added after the shell hydro-test;
- g) method of attaching the seat ring to the body (where applicable);
- h) presence of lubrication on the stem nut for gate and globe valves;
- i) nothing other than light lubricant, having a viscosity no greater than kerosene, has been used on valve sealing surface, except for valves using lubricant as their primary sealing mechanism;
- j) type of closure element;
- k) t-head is integral (without welding or weld buildup) with the stem for gate valves;
- l) a fully open gate/plug/ball fully opens to the applicable API specified limits;
- m) any disk nut on swing check valves is positively locked in place;
- n) number, location, and size of any tapped openings in pressure-containing parts;
- o) type and direction of the stem threads for gate and globe valves;
- p) markings on the bolting for the body, bonnet, and cover joints are as specified in applicable ASTM specifications;
- q) method of attachment of the hand wheel nut (where applicable);
- r) tack welding is used or is not used in securing various components;
- s) type of end protection used in shipment;

- t) body-to-bonnet cover gasket design and material (where applicable); and
- u) blow-out proof stem design.

**6.4.4** After completion of required dimensional and visual examinations, paint and sealants shall be removed from the bodies, bonnets, and covers, and each of these valve pressure-containing components shall be visually examined to determine the following:

- a) forgings are free from laps and seams; and
- b) surface quality of castings, including the body, bonnet, and cover, is as specified in MSS SP-55.

After completing visual examination a photograph of the disassembled valve parts, readable nameplate, and cast-in markings shall be made.

**6.4.5** Material examinations listed in Table 1 shall be made on a minimum of five of the sample valves. The source of each body and bonnet (or cover) as well as each material group from each material source shall be sampled. Chemical composition and hardness shall be nondestructively determined except that small samples may be removed from the body, bonnet, or cover in a manner that will not affect the integrity of the component (e.g. areas such as bosses, ribs, and flange perimeters). In addition, casting weld repairs and other pressure containing welds shall have chemical composition and hardness nondestructively determined.

**Table 1—Material Examination**

Tests	Body	Cover/ Bonnet/ Tailpiece	Seat Ring	Stem	Yoke Nut <sup>e</sup>	Disc/ Plug/ Ball	Back Seat <sup>e</sup>	Body/ Bonnet RTJ gasket	Bonnet/ Tailpiece Bolts <sup>c</sup>
Chemical Composition	x	x	x <sup>a</sup>	x	x	x <sup>a</sup>	x	x	x
Tensile Strength	b	b	—	—	—	—	—	—	x <sup>d</sup>
Yield Strength	b	b	—	—	—	—	—	—	—
Elongation	b	b	—	—	—	—	—	—	—
Reduction of Area	b	b	—	—	—	—	—	—	—
Hardness (HB)	x	x	x	x	x	x	x	x	x

NOTE RTJ = ring type joint.

<sup>a</sup> If seating surfaces are welded, chemical analysis shall be made on both metals (weld metal and base metal). If seating surfaces are applied in the form of thin plates welded to the disk, chemical analysis shall be made on the disk, the thin plates, and the attachment welds. Any welds attaching seats or seating surfaces shall be dye-penetrant examined. Neither cracks nor lack of fusion is allowed.

<sup>b</sup> These test results may be taken from mill test reports except when physical testing is required per 6.4.12.

<sup>c</sup> Four sizes of bonnet bolts and nuts shall be tested, randomly selected from two of the largest and two of the smallest valve sizes in the sample lots from Table A.3 to Table A.7.

<sup>d</sup> Bonnet bolt tensile strength shall be estimated using the measured hardness readings and the correlations (hardness to tensile strength) in ASTM A370.

<sup>e</sup> These examinations apply to gate and globe valves only.

**6.4.6** Strength tests of the stem/shaft-to-closure element connection shall be performed on valves as indicated in Annex A, in accordance with the requirements of Annex B.

The manufacturer shall make available to the qualification facility conducting the strength tests a guide for sizing the required test fixtures by providing the calculated stem shaft-to-closure element failure loads for the valves to be tested.

**6.4.7** All pressure-retaining welds shall be completely radiographed in accordance with the requirements of Table 341.3.2 of ASME B31.3, using the acceptance criteria for normal fluid service conditions. Butt-welding end preparations, welds in fabricated wedges, and pressure-retaining welds that can not be radiographed shall be examined in accordance with ASME B16.34, Appendix II or Appendix III by either the magnetic particle or the liquid penetrant method.

**6.4.8** All cast valves in the sample lot, of each casting type (investment and sand) and material category per 6.3.3, shall have 100 % of the pressure containing components examined by radiography. A minimum of three valve pressure containing components shall be examined from each foundry source. The procedure shall be in accordance with ASME B16.34, Appendix I-1. The qualification facility shall report each type of discontinuity for each film, with sketches illustrating the locations of all films. Casting quality shall be determined and reported for each valve (body, bonnet, cover or end piece). The suggested minimum acceptable casting radiographic results are given in Annex C.

**6.4.9** Pressure containing components shall be magnetic particle or dye penetrant examined with acceptance criteria in accordance with ASME B16.34, Appendix II or III.

**6.4.10** For valves employing handwheels, four hand wheels out of the sample lot shall be subjected to a hammer test. Using normal force, the hammer [3 lb (13.34 N) for valves NPS 4 and smaller, 10 lb (44.482 N) for valves NPS 6 and larger] should strike the outer rim between the spokes at an angle perpendicular to the plane of the hand wheel, and any damage reported.

**6.4.11** Each test hand wheel shall be subjected to a torque test, applying three times the torque recommended by the manufacturer for closure. In applying the torque, the center of the hand wheel is to be restrained and the force required to produce the desired torque applied to the outer rim of the hand wheel at the spoke junction, using an attachment mounted to the wrench. Any damage shall be reported.

**6.4.12** Mechanical testing and metallurgical examination shall be made on the pressure containing components of two valves. If additional alloys are included in the test lot, one chrome moly sample and/or one austenitic stainless steel sample shall also be examined. Mechanical testing shall include tensile, yield, elongation, reduction of area and if required by ASTM materials standards, hardness and charpy impact testing. Microetch testing shall be conducted per ASTM A703 and shall include a 100× photomicrograph to assess the microstructure in accordance with ASTM E340. A wet-chemical, emission spectrometry or equivalent analysis shall be made of these two samples and all elements, including trace elements shall be noted. Testing and examination results, as applicable, shall be compared to the appropriate ASTM standard and reported in the final document.

## **6.5 Documentation of Examination and Test Results**

**6.5.1** The qualification facility shall assemble all the data required by this section into a single document. The distribution of the final document shall be specified by the manufacturer.

**6.5.2** The testing report shall be maintained for a period of seven years. A distribution log shall be maintained by the manufacturer for the purpose of notification of changes as specified in 7.3 and 7.4.

## **7 Post Qualification**

**7.1** Changes to the following items shall void the qualification of valves for which this recommended practice was intended to qualify:

- a) design change that will reduce the strength or impair the operability or performance of the valve; or

b) location of the manufacturing facilities.

**7.2** Changes to any item listed below will not void the qualification of valves for which this RP was intended to qualify, provided that the manufacturer notifies the purchaser and complies with any additional requirements the purchaser may specify:

a) material grade;

b) ownership;

c) types and materials of packing and gaskets; and

d) quality control procedures.

**7.3** Changes or additions of suppliers and/or location of supply of pressure-containing forgings and castings that are not included in the current qualification will not void the qualification provided that the manufacturer qualifies the components from the changed or new supply source in accordance with 6.4.4, 6.4.5, 6.4.8, 6.4.9 and 6.4.12. Selection requirements for parts to be examined shall be in accordance with 6.3. Documentation of examination and test results shall be in accordance with 6.5. Recipients of previously provided information in accordance with 6.1.3 shall be notified of these changes.

**7.4** Supply of pressure containing forgings and castings in material categories identified in 6.3.3 not previously qualified with existing suppliers will not void the qualification provided that the manufacturer qualifies the components in accordance with 6.4.4, 6.4.5, 6.4.8, 6.4.9 and 6.4.12. Selection requirements for parts to be examined shall be in accordance with 6.3. Documentation of examination and test results shall be in accordance with 6.5. Recipients of previously provided information in accordance with 6.1.3 shall be notified of these changes.

## Annex A (informative)

### Suggested Selection Quantities for Examination and Test of Valves Made in Accordance with API Valve Standards

For each specified valve design, the minimum suggested sample lot is provided in Table A.1 through Table A.11.

For each NPS and class combination listed in the tables, the sample lot for each manufacturing plant location shall include at least one valve for each body and bonnet (or cover) source, and one valve for each material group: carbon steel, low chrome alloy, and stainless steel.

For valve types not covered in this standard, the minimum suggested sample lot may be established by agreement between the manufacturer and end user.

**Table A.1—Suggested Size and Class to be Tested for Each Type Check Valve (Single Plate, Dual Plate, Swing Type) Made in Accordance with API 594**

NPS	Class	Quantity (Each NPS)
4, 16	150	1
3, 12	300	1

**Table A.2—Suggested Size and Class to be Tested for Each Type Plug Valve (Lubricated, Non-lubricated, Elastomer Lined, Wedge Type) Made in Accordance with API 599**

NPS	Class	Strength Test (NPS) <sup>1</sup>	Quantity (Each NPS)
4, 8	150	8	1
3	300	3	1
3, 6	600	—	1

<sup>1</sup> See Annex B for test details.

**Table A.3—Suggested Size and Class to be Tested for Steel Gate Valves Made in Accordance with API 600 <sup>1</sup>**

NPS	Class	Strength Test (NPS) <sup>2</sup>	Quantity (Each NPS)
4, 12, 24	150	4, 12	1
3, 12	300	3, 12	1
3, 12	600	—	1

<sup>1</sup> Unless otherwise requested, all selected valves shall have flanged ends.  
<sup>2</sup> See Annex B for test details.

**Table A.4—Suggested Size and Class to be Tested for Flanged Steel Gate Valves Made in Accordance with API 602**

NPS	Class	Strength Test (NPS) <sup>1</sup>	Quantity (Each NPS)
3/4, 1	150	3/4	1
3/4, 1	300	3/4	1
1 1/2, 2	600	1 1/2	1
1, 2	1500	—	1

<sup>1</sup> Strength test required for only one valve for each material group. See Annex B for test details.

**Table A.5—Suggested Size and Class to be Tested for Threaded/SW Steel Gate Valves Made in Accordance with API 602**

NPS	Class	Strength Test (NPS) <sup>1</sup>	Quantity (Each NPS) <sup>2</sup>
1/2, 1 1/2	800	1/2	3
3/4	800	3/4	6
1	800	1	4
3/4, 2	1500	3/4	3
1, 1 1/2	1500	1	4

<sup>1</sup> Strength test required for only one valve for each material group. See Annex B for test details.

<sup>2</sup> For each NPS/Class combination, one valve shall be of socket weld construction, except that for 3/4 NPS Class 800, two valves shall be of socket weld construction. The remaining valves shall be supplied with threaded ends.

**Table A.6—Suggested Size, Class and Type to be Tested for Steel Globe and Check Valves Made in Accordance with API 602 <sup>1</sup>**

NPS	Class	Globe Quantity	Ball or Piston Check Quantity	Swing Check Quantity
3/4	800	2	1	1
1	800	1	—	—
1	1500	—	1	—
1 1/2	1500	1	—	—

<sup>1</sup> Unless otherwise requested, valves shall be supplied with threaded ends.

**Table A.7—Suggested Size and Class to be Tested for Steel Gate Valves Made in Accordance with API 603 <sup>1</sup>**

NPS	Class	Strength Test (NPS) <sup>2</sup>	Quantity (Each NPS)
4, 12, 24	150	4, 12	1
3, 12	300	3, 12	1
3, 12	600	—	1

<sup>1</sup> Unless otherwise requested, all selected valves shall have flanged ends.

<sup>2</sup> See Annex B for test details.

**Table A.8—Suggested Size and Class to be Tested for Each Type Ball Valve (Floating Type: End Entry, Split Body, Three Piece and Top Entry; Trunnion Type: Split Body, Three Piece) Made in Accordance with API 608 <sup>1</sup>**

NPS	Class	Strength Test (NPS) <sup>2</sup>	Quantity (Each NPS)
4, 8	150	4	1
3, 6	300	6	1

<sup>1</sup> Metal-seated valves are not covered by this table.

<sup>2</sup> See Annex B for test details.

**Table A.9—Suggested Size and Material Type to be Tested for Butterfly Valves  
(Class 150, Ductile Iron, Grey Iron) Made in Accordance with API 609 (Category A)**

NPS	Class/Material	Quantity (Each NPS)
8, 12, 24	150	1
12, 24	Ductile Iron	1
12, 24	Grey Iron	1

**Table A.10—Suggested Size and Class to be Tested for Each Type of Offset Butterfly Valves  
Made in Accordance with API 609 (Category B)**

NPS	Class	Strength Test (NPS) <sup>2</sup>	Quantity (Each NPS) <sup>1</sup>
3, 12, 24	150	12	1
4, 12	300	12	1
3, 12	600	12	1

<sup>1</sup> Selection shall include at least one flanged and one lug style design for each class.  
<sup>2</sup> See Annex B for test details.

**Table A.11—Suggested Size and Class to be Tested for Steel Globe Valves  
Made in Accordance with ASME B16.34 <sup>1</sup>**

NPS	Class	Quantity (Each NPS)
4	150	1
3	300	1

<sup>1</sup> Unless otherwise requested, all selected valves shall have flanged ends.

## Annex B (normative)

### Strength Tests for Stem Shaft-to-closure Element Connections

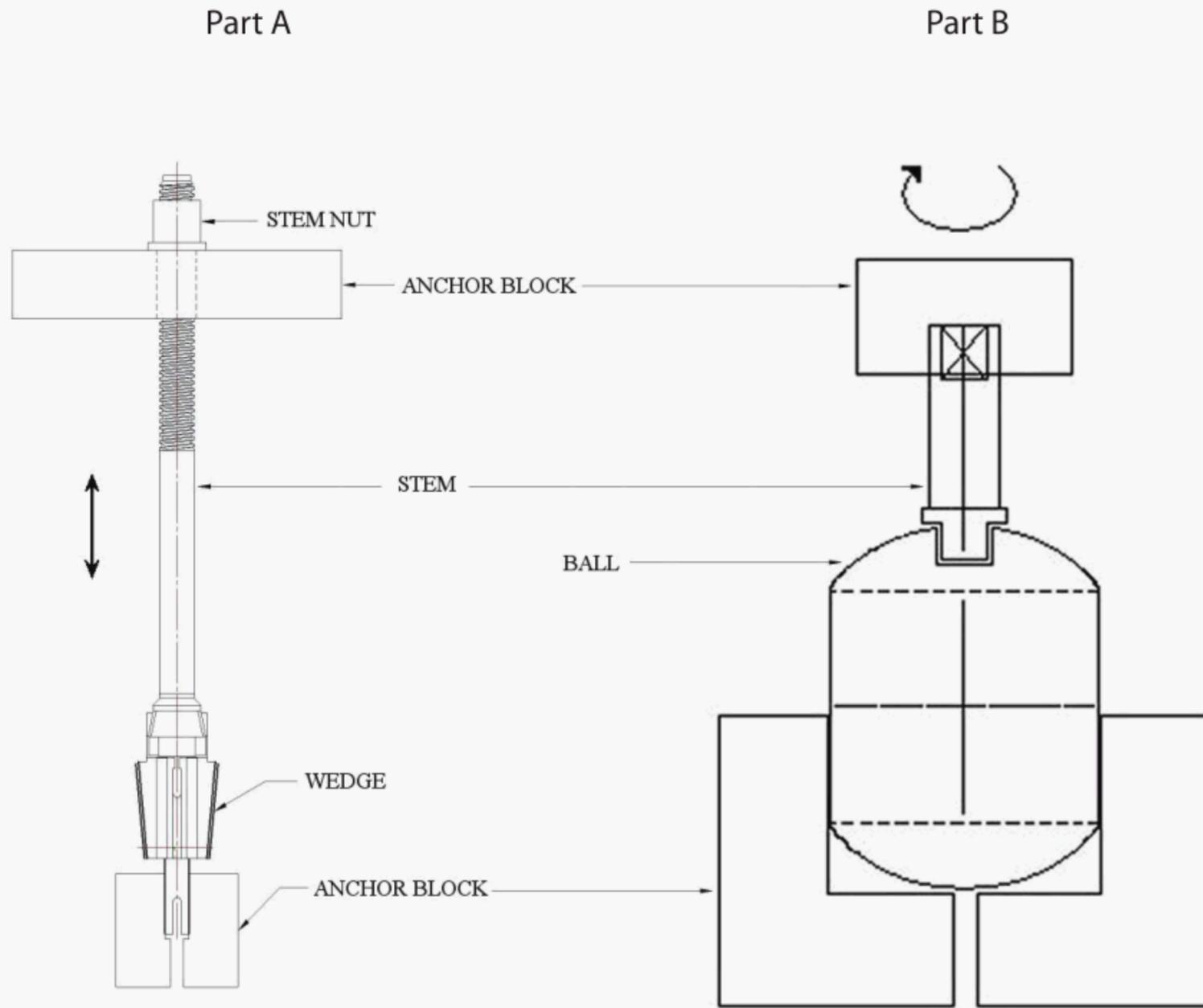
**B.1** For steel gate valves, direct tensile loads shall be applied to wedge-stem-stem nut assemblies to determine the location of the first point of failure and the magnitude of the loads at failure. The first point of failure must occur at a location that is outside the valve pressure boundary. Testing shall continue to determine the failure load of the stem-to-wedge connection and the results shall be reported.

**B.2** For metal plug/ball valves and Category B butterfly valves, direct torsional loads shall be applied to stem-to-closure element assemblies to determine the location of the first point of failure (first permanent deformation of a drive train component) and the magnitude of the loads at failure as defined in the applicable API standards.

**B.3** If any of the tested assemblies fail to meet the requirements of the first two paragraphs, all of the valves in the sample lot shall have the strength tests for stem shaft-to-closure element connections performed, and the results reported.

**B.4** A dimensional analysis of the stem-to-closure element connection of all of the valve sizes for which approval is sought shall demonstrate that all of the connections are similarly proportioned to the tested stems and closure elements. If different product forms or different material mechanical properties are involved with untested valve sizes, additional stem-to-closure element tests shall be made to demonstrate the soundness of the other designs and/or materials.

**B.5** Strength testing is potentially hazardous and it is essential that the safety of personnel be given prime consideration. The testing equipment shall be designed to apply the required tensile or torsional loads as applicable to all components. The test lab shall insure that the test fixture does not misalign or introduce side loading that can influence the results of the strength test. Testing equipment shall not restrict or interfere with the movement of the wedge ears. Testing methods which involve welding to the closure element shall have nondestructive hardness testing performed before and after welding to insure the stem connection characteristics of the closure element have not been altered. Machining or drilling of the closure element below the center line is allowed as in Figure 1 to provide a satisfactory surface for clamping. Torsional testing as in Figure 2 may be conducted in the original as assembled valve.



NOTE Part A and B are only examples of allowed fixtures for strength testing.

Figure B.1

## Annex C (informative)

### Suggested Minimum Acceptable Casting Radiographic Results for Wall Thickness $\leq 50$ mm (2 in.)

Acceptable Comparative Discontinuity Type	Category	Plate ASTM E446
Gas	A	A3
Sand	B	B4
Shrink, Type 1	C	CA3
Shrink, Type 2	C	CB4
Shrink, Type 3	C	CC4
Shrink, Type 4	C	CD4
Hot Tears and Cracks	D and E	None
Inserts (Chills, Chaplets)	F	None

## Annex C (informative)

### Suggested Minimum Acceptable Casting Radiographic Results for Wall Thickness $\leq$ 50 mm (2 in.)

Acceptable Comparative Discontinuity Type	Category	Plate ASTM E446
Gas	A	A3
Sand	B	B4
Shrink, Type 1	C	CA3
Shrink, Type 2	C	CB4
Shrink, Type 3	C	CC4
Shrink, Type 4	C	CD4
Hot Tears and Cracks	D and E	None
Inserts (Chills, Chaplets)	F	None

## Annex C (informative)

### Suggested Minimum Acceptable Casting Radiographic Results for Wall Thickness $\leq$ 50 mm (2 in.)

Acceptable Comparative Discontinuity Type	Category	Plate ASTM E446
Gas	A	A3
Sand	B	B4
Shrink, Type 1	C	CA3
Shrink, Type 2	C	CB4
Shrink, Type 3	C	CC4
Shrink, Type 4	C	CD4
Hot Tears and Cracks	D and E	None
Inserts (Chills, Chaplets)	F	None

## Annex C (informative)

### Suggested Minimum Acceptable Casting Radiographic Results for Wall Thickness $\leq 50$ mm (2 in.)

Acceptable Comparative Discontinuity Type	Category	Plate ASTM E446
Gas	A	A3
Sand	B	B4
Shrink, Type 1	C	CA3
Shrink, Type 2	C	CB4
Shrink, Type 3	C	CC4
Shrink, Type 4	C	CD4
Hot Tears and Cracks	D and E	None
Inserts (Chills, Chaplets)	F	None

## Annex C (informative)

### Suggested Minimum Acceptable Casting Radiographic Results for Wall Thickness $\leq 50$ mm (2 in.)

Acceptable Comparative Discontinuity Type	Category	Plate ASTM E446
Gas	A	A3
Sand	B	B4
Shrink, Type 1	C	CA3
Shrink, Type 2	C	CB4
Shrink, Type 3	C	CC4
Shrink, Type 4	C	CD4
Hot Tears and Cracks	D and E	None
Inserts (Chills, Chaplets)	F	None