Reconditioning of Metallic Gate, Globe, and Check Valves

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1 Scope

1.1 This Recommended Practice (RP) provides guidelines for reconditioning of API Standard 594, API Standard 599, API Standard 600, API Standard 603, API Standard 608, API Standard 609, and API Standard 623 valves. Guidelines contained in this RP apply to flanged and butt weld cast or forged valves. Parts of this standard may also be applied to other valves not specifically addressed with agreement between the Owner and the valve Reconditioner.

1.2 This RP does not cover reconditioning or remanufacturing of used or surplus valves intended for resale. It does not cover the modification of new valves (e.g. converting or changing the trim). For modification of new valves, see MSS SP-141, *Multi-Turn and Check Valve Modifications*. Electric and pneumatic actuator repair and reconditioning are not included in the scope of this document. The only intent of this RP is to provide guidelines for refurbishing an end user's (Owner) valves for continued service in the Owner's facility. Valves reconditioned to this RP may not meet API Standard requirements for new valves. The correct application of a valve reconditioned to this RP remains the responsibility of the Owner.

2 Normative References

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any addenda) applies.

API Recommended Practice 571, *Damage Mechanisms Affecting Fixed Equipment in the Refining Industry*

API Recommended Practice 591, *Process Valve Qualification Procedure*

API Recommended Practice 751, *Safe Operation of Hydrofluoric Acid Alkylation Units*

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

API Standard 598, *Valve Inspection and Testing*

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

API Standard 600, *Steel Gate Valves—Flanged and Butt-welding Ends, Bolted Bonnets*

API Standard 603, *Corrosion-resistant, Bolted Bonnet Gate Valves – Flanged and Butt-welding Ends*

API Standard 608, *Metal Ball Valves—Flanged, Threaded, and Welding Ends*

API Standard 609, *Butterfly Valves: Double-flanged, Lug and Wafer-type, and Butt-welding Ends*

API Standard 622, *Type Testing of Process Valve Packing for Fugitive Emissions*

API Standard 623, *Steel Globe Valves—Flanged and Butt-welding Ends, Bolted Bonnets*

ASME B1.5 [1], *Acme Screw Thread*

ASME B1.8, *Stub Acme Screw Threads*

ASME B16.5, *Pipe Flanges and Flanged Fittings NPS $^1/_2$ Through NPS 24 Metric/Inch Standard*

[1] ASME International, Two Park Avenue, New York, New York 10016, www.asme.org.

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

ASME B16.47, *Large Diameter Steel Flanges NPS 26 Through NPS 60 Metric/Inch Standard*

ASME *Boiler and Pressure Vessel Code, Section V, Nondestructive Examination*

ASME *Boiler and Pressure Vessel Code, Section IX, Welding, Brazing, and Fusing Qualifications*

ASME Post Construction Code, *PCC-1 Guidelines for Pressure Boundary Bolted Flange Joint Assembly*

ISO 9001 [2] , *Quality Management Systems—Requirements*

MSS SP-9[3] , *Spot Facing for Bronze, Iron, and Steel Flanges*

MSS SP-55, *Quality Standard for Steel Casting for Valves, Flanges, Fittings, and Other Piping Components—Visual Method for Evaluation of Surface Irregularities*

MSS SP-141, *Multi-Turn and Check Valve Modifications*

MSS SP-143, *Live-Loaded Valve Stem Packing Systems*

NACE MR0103, *Metallic Materials Resistant to Sulfide Stress Cracking in Corrosive Petroleum Refining Environments*

NACE SP0472, *Methods and Controls to Prevent In-Service Environmental Cracking of Carbon Steel Weldments in Corrosive Petroleum Refining Environments*

3 Terms and Definitions

For the purposes of this document, the following terms and definitions apply.

3.1
large valve
A valve that is typically NPS 26 or larger. The size may increase or decrease depending on pressure class, type of valve, or Owner specifications.

3.2
new valve
A valve that has been manufactured under a quality assurance program to a specific design and tolerances by an OEM, was never installed or used, and does not meet the definition of a surplus valve.

3.3
obturator (closure member)
Part of a valve, such as ball, disc/plate, disc gate or plug, that is positioned in the flow stream to restrict, control, or prevent flow.

3.4
reconditioned valves
A valve that is no longer new, has been restored to the requirements of this RP, and is the property of the Owner.

[2] International Organization for Standardization, 1, ch. de la Voie-Creuse, Case postale 56, CH-1211 Geneva 20, Switzerland, www.iso.org.

[3] Manufacturers Standard Society of the Valve and Fittings Industry, 127 Park Street NE, Vienna, Virginia 22180, www.mss-hq.com.

3.5
safety data sheet (SDS)
Formerly known as material safety data sheet (MSDS), which is used to communicate the hazards of chemical products.

3.6
surplus valves
Valves that were purchased new for a specific project or application but were never installed or used. Also, the valve may not have been stored in conditions recommended by the OEM and thereby require reconditioning to return to useful operation.

3.7
traveler document
A paper or an electronic record that identifies the current condition, necessary repairs, completed repairs, and inspection and testing for any or all component parts of a valve.

4 Owner Access and Responsibilities

4.1 General

4.1.1 Owner shall have access to all reconditioning work, documentation, inspections, and test results at all times.

4.1.2 Access by the Owner shall be conducted in a manner that is not disruptive to the reconditioning work.

4.1.3 It is an expectation of this RP that a contractual agreement shall be established between the Owner and the valve Reconditioner. The reconditioning facility may be OEM owned/operated or directly associated and approved by the OEM. At the Owner's option, an independent facility may be used. It is the Owner's responsibility to confirm that the valve Reconditioner selected for valve reconditioning has a documented and established working Quality Assurance Program. The Quality Assurance Program should include the essential elements described in the ISO 9001 standard.

4.2 Valve Information

4.2.1 It is the Owner's responsibility to communicate to the Reconditioner any known problem with the valve. Any tag placed on the valve by the Owner should be of a type and material that resists damage, fading, and inadvertent removal.

4.2.2 A safety data sheet shall be provided for each service media that may have been contained in the valves sent for reconditioning, materials used to clean the valve, or a combination thereof.

4.2.3 Large valves that operate with the stems in the horizontal position should be noted in the purchase order.

4.3 Preparation for Shipment to Reconditioner

Valves to be shipped to the Reconditioner shall:

1) be in the open or partial open position;

2) have all residual product drained or flushed out of the body;

3) be decontaminated sufficiently so that it can be disassembled and handled safely;

4) have end flange gaskets removed;

5) contain packaging requirements approved by the Owner and the Reconditioner.

5 Inspection, Identification, and Disassembly of Valves

5.1 General

5.1.1 As soon as practical, valves shall be marked to identify the Owner (see 5.2.1).

5.1.2 Valves shall be visually inspected and classified as valves capable of being reconditioned, or scrap.

5.1.3 For valves that cannot be economically repaired, consideration shall be given to salvaging as many usable parts as possible for use only in valves of the same manufacturer, type, and material.

5.1.4 Scrapped valves and scrapped valve parts shall be disposed of in accordance with Owner instructions.

5.2 Identification Number

5.2.1 Each valve shall be assigned a unique identification number that is traceable back to its Owner's shipping documentation or other pertinent information such as special instructions or records of previous reconditioning. If the Owner provides an equipment identification number for the valve, it shall be recorded in the traveler documents.

5.2.2 Salvaged usable parts (excluding handwheels) shall be identified as such to the Owner, and the identification shall include the name of the valve manufacturer, the model/figure number, size, type, pressure class, and material of the valve if available.

5.3 Traveler Documents

5.3.1 If requested by the Owner, the traveler document shall be approved by the Owner, otherwise the traveler document or electronic record shall follow the Reconditioner's standard practice. A traveler document or electronic record shall be developed and maintained for each valve and shall reference the valve identification number.

5.3.2 Traveler information shall be accumulated through the reconditioning process and include as a minimum:

a) the valve identification number

b) the status of repair, parts replaced, and work still to be performed;

c) dimensional changes as a result of the reconditioning process;

d) weld repair traceability [welder qualifications, welding procedure specifications (WPSs), procedure qualification records (PQRs), weld material certification, weld map with welder's ID stamp];

e) applicable inspection and testing reports;

f) additional information as specified by the Owner.

5.3.3 Unless otherwise specified, traveler information shall be archived by the Reconditioner for a minimum of 10 years.

5.4 Disassembly and Cleaning of Valves

5.4.1 Valves to be reconditioned shall be completely disassembled.

5.4.2 Old packing, gaskets, and bonnet bolting shall be removed and disposed of in accordance with Reconditioner's standard practice and applicable regulations. If nonstandard materials (such as packing, gaskets, and bolting) are identified by the Reconditioner, they shall be verified with the Owner.

5.4.3 Tags from previous reconditioning shall be removed and the tag, or data from the tag, shall be placed in the reconditioned valve record document. OEM tags shall not be removed and shall be protected during the reconditioning process.

5.4.4 During the disassembly process, the valve's newly assigned identification number shall be metal stamped onto the valve's closure element, stem/shaft, seat rings if removed, and any other major part. Stamped markings shall remain on the individual valve components after the reconditioning process is completed and the valve is returned to the Owner.

a) Stamping shall be on non-functional surfaces and shall be made with low stress stamps.

b) If stamping is not practical, parts shall be segregated and traceable to the identification number. However, all stems and closure elements for valves DN 50 (NPS 2) and larger shall be marked by stamping.

5.4.5 Unless a specific cleaning method is specified by the Owner, valve parts shall be thoroughly cleaned by any usual method, such as steam, chemical, sand/bead, or steel shot blasting. Finished surfaces that may be damaged during the cleaning process shall be protected.

5.4.6 The cleaning process shall remove all or nearly all paint, grease, rust, and product from both internal and external surfaces.

6 Repair of Valve Parts

6.1 General

6.1.1 Welding

6.1.1.1 Welding procedures and welders shall be qualified in accordance with Section IX of the ASME *Boiler and Pressure Vessel Code*.

6.1.1.2 When required by the Owner, welding procedures and PQRs shall be submitted to the Owner for approval prior to the start of welding.

6.1.1.3 Weld metal buildup and weld metal repairs, including any required postweld heat treatment, shall be performed in accordance with the approved procedures.

6.1.2 Nondestructive Examination (NDE)

6.1.2.1 Welds, other than tack welds, shall be examined by the liquid penetrant method or by the NDE method specified by the Owner.

6.1.2.2 NDE of parts and weld repairs shall be done in accordance with Owner-approved NDE procedures and acceptance criteria.

6.1.2.3 SNT-TC-1A Level II technicians certified for the procedures per ASME Section V shall evaluate NDE results.

6.1.3 Replacement Parts and Material

6.1.3.1 Sources of replacement parts shall be one or more of the following in preferential order:

a) parts purchased from the OEM or other OEM-approved source;

b) identical parts salvaged from scrapped valves from the same valve manufacturer and with matching identification (see 5.2.2), when approved by the Owner;

c) parts manufactured in the reconditioning facility, when approved by the Owner.

6.1.3.2 Material used to manufacture replacement parts in the reconditioning facility shall be as specified by the Owner or the following in preferential order.

a) If the Owner does not specify material, the material used (including heat treatment if applicable) shall be the material used by the original valve manufacturer and shall comply with the requirements of the referenced standard.

b) Changes in material group, such as 13CR to austenitic stainless steel, require approval of the Owner.

c) Verification of the specific material used and its source shall be part of the required documentation.

6.1.3.3 As a minimum, the following components shall be replaced:

a) soft seats;

b) body/bonnet/cover bolting;

c) packing;

d) gaskets;

e) grease fittings.

6.2 Inspection of Valve Parts

6.2.1 General

6.2.1.1 Valve parts shall be inspected to determine their acceptability for re-use and extent of required repair.

6.2.1.2 Criteria for acceptability and extent of repair shall be the component's ability to meet the Owner's expectation for continued service in the Owner's facility.

6.2.2 Threaded Parts

6.2.2.1 Threaded parts shall be visually inspected for gross defects, such as burrs, chatter, missing or incomplete threads, defective thread profile, torn or ruptured surfaces, and cracks.

6.2.2.2 Acceptable surface finish of threaded parts shall be determined by visual or tactile methods or the use of a thread gauge as required.

6.3 Handwheel Nut

6.3.1 Handwheel nut shall be visually inspected for wear or excessive corrosion of the threads or contact area.

6.3.2 If the handwheel nut is defective, it shall be repaired or replaced.

6.3.3 If the handwheel nut is locked into place with a setscrew or some other device, the locking mechanism shall be in place and fully functional.

6.4 Handwheel

6.4.1 Handwheel shall be visually inspected for worn, bent, or broken spokes and rim.

6.4.2 Handwheel shall be inspected to verify proper engagement to the stem yoke nut. If the valve does not have a yoke nut, the handwheel shall be inspected to verify proper engagement to the stem.

6.4.3 A defective handwheel shall be repaired by the appropriate repair method for the defect: bent spokes, hub, or rim may be straightened by pressing. Broken spokes or rim (if made of a weldable grade material) may be weld repaired.

6.4.4 If the defect(s) cannot be repaired, the handwheel shall be scrapped and replaced with one of similar size and material.

6.4.5 All parts of the handwheel and any repairs shall be free of burrs, metal splinters, and sharp metal edges.

6.5 Yoke

6.5.1 Yoke shall be visually inspected for defects and for proper alignment of the stem through the stem nut, packing chamber, backseat bushing, and wedge connection.

6.5.2 Defects shall be repaired by generally accepted repair procedures, such as welding or machining.

6.6 Stem Nut and Stem Nut Housing

6.6.1 Stem nut and stem nut housing shall be visually inspected for corrosion, galling, or wear of bearing surfaces.

6.6.2 Defects shall be repaired by welding (if of a weldable material), machining, or other appropriate methods. If the defects cannot be repaired, the nut/housing shall be replaced.

6.6.3 If a thrust bearing was used by the OEM in the design of the valve, the thrust bearing must be in place and free of excessive corrosion or wear. If necessary for smooth operation of the stem nut, the thrust bearing shall be replaced.

6.6.4 Internal threads of a tapped hole in the stem nut housing shall be visually inspected and defective threads shall be repaired or re-tapped.

6.6.5 If applicable, external threads on the stem nut shall be visually inspected for proper engagement to the handwheel nut.

6.6.6 Internal ACME threads of the stem nut shall be visually inspected for condition and proper engagement with the external threads of the stem in accordance with ASME B1.5 or ASME B1.8.

6.7 Stem Nut Retainer

6.7.1 If applicable, stem nut retainer shall be visually inspected for excessive corrosion and wear. Threads shall be inspected for general condition and proper engagement to the valve bonnet or yoke.

6.7.2 Defective stem nut retainer shall be repaired by welding, machining, or a combination thereof. If defects cannot be repaired, stem nut retainer shall be replaced.

6.7.3 After assembly and before shipping, the stem nut retainer shall be tack welded, or otherwise locked, to the yoke.

6.8 Packing Gland Flange

6.8.1 Packing gland flange shall be visually inspected for excessive corrosion, cracks, and straightness. If the packing gland flange to nut seating surface cannot be repaired, hardened washers may be installed if approved by Owner.

6.8.2 Defective packing gland flange shall be repaired or replaced.

6.9 Packing Gland (Packing Follower)

6.9.1 Packing gland shall be visually inspected for excessive corrosion or wear and checked dimensionally for proper fit to the stuffing box and to the stem in accordance with OEM dimensions and tolerances. When OEM dimensions and tolerances are not available, the clearances specified in Figure B.1 may be used.

6.9.2 A damaged or broken packing gland shall be repaired or replaced.

6.9.3 No chamfer or radius > 0.1 mm (0.005 in.) is permitted on the gland ID and OD.

6.10 Backseat Bushing

6.10.1 A backseat bushing's ability to seal against the opposing angle of the stem shall be assessed by visually inspecting for corrosion, wear, and cracks. Sealing surface shall have a finish Ra of 0.8 μm (32 μin.) or smoother.

6.10.2 A defective backseat bushing shall be repaired or replaced as required.

6.10.3 The backseat bushing shall be positively secured (e.g. not secured by friction).

6.11 Body and Bonnet

6.11.1 Bonnet Stuffing Box

6.11.1.1 The stuffing box shall be visually inspected for corrosion, wear, or scoring of the bore wall.

6.11.1.2 Bottom of stuffing box shall be perpendicular to the stuffing box wall with a maximum tolerance of 5°.

6.11.1.3 The stuffing box bore sealing area (the area of the stuffing box that contacts the top packing ring) may have some pitting provided that the pitting does not extend for more than one quarter of the height of any individual compressed packing ring. The stuffing box bore non-sealing area is not required to be inspected for surface finish. Any deleterious area that may cause damage to the packing during installation shall be dressed.

6.11.1.4 A defective stuffing box shall be repaired by machining or welding and re-machining. Unless otherwise specified by the Owner, sleeving of the stuffing box is prohibited.

6.11.1.5 The stuffing box surface finish shall be as specified by the packing manufacturer with a maximum surface finish Ra of 3.2 μm (125 μin.).

6.11.1.6 For linear valves, the stuffing box depth should be sufficient to house a minimum of 5 packing rings, unless otherwise recommended by the packing manufacturer. For quarter turn valves, the packing gland dimensions should match the valve manufacturer's recommendation.

6.11.2 Bellows Sealed Valves (BSV)

CAUTION — Bellows can be easily damaged and must be handled carefully.

6.11.2.1 Bellows should be visually inspected for damage (such as cracks, bulges, dents, or rupture). The overall free length, convolution spacing, and angular torsion of the bellows should be reviewed to meet the guidelines from the manufacturer, if available.

6.11.2.2 Bellows-seal attachment welds should be examined visually and via surface NDT (PT). Generally, damaged bellows should be replaced instead of repaired due to complexities of welding the thin bellows. Repair of the bellows welds is outside the scope of this document.

6.11.2.3 For testing of bellows assemblies, see C.2.

6.11.3 Castings

6.11.3.1 Pressure containing castings shall be visually inspected for defects in accordance with MSS SP 55.

6.11.3.2 Some pitting or areas of localized corrosion are allowed provided the requirements of Table 1 are met.

6.11.3.3 If requested by the Owner, castings may be inspected with NDE (radiography or other method) to determine extent of defects.

6.11.3.4 WC6, WC9, C5, C12, nickel alloys, and austenitic stainless casting metallurgy shall be verified by positive material identification (PMI) or as specified by the Owner.

6.11.3.5 Minimum wall thickness of bonnet castings shall be measured at a minimum of two locations, and minimum wall thickness of body castings shall be measured at a minimum of three locations. Typical thickness measurement locations are shown in Figure 1, Figure 2, and Figure 3. Care should be taken so that measurements are not taken on the thickest area of the wall, such as at a boss. Wall thickness shall be measured at additional locations if visual inspection identifies specific areas that require additional wall thickness verification.

a) Acceptable wall thickness shall conform to Table 2 for heavy wall valves (API Standard 600, API Standard 623, and API Standard 594). For all other valves see the product standard, unless otherwise approved by the Owner.

b) Location of measurements and thickness measured shall be recorded in the data file (traveler documents) of each valve.

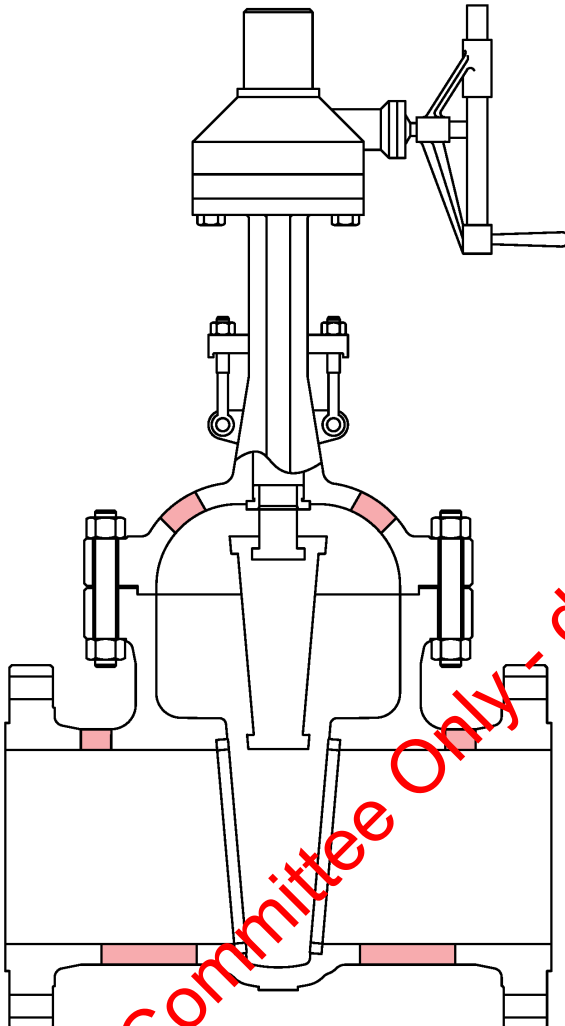


Figure 1—Gate Valve Typical Thickness Measurement Locations

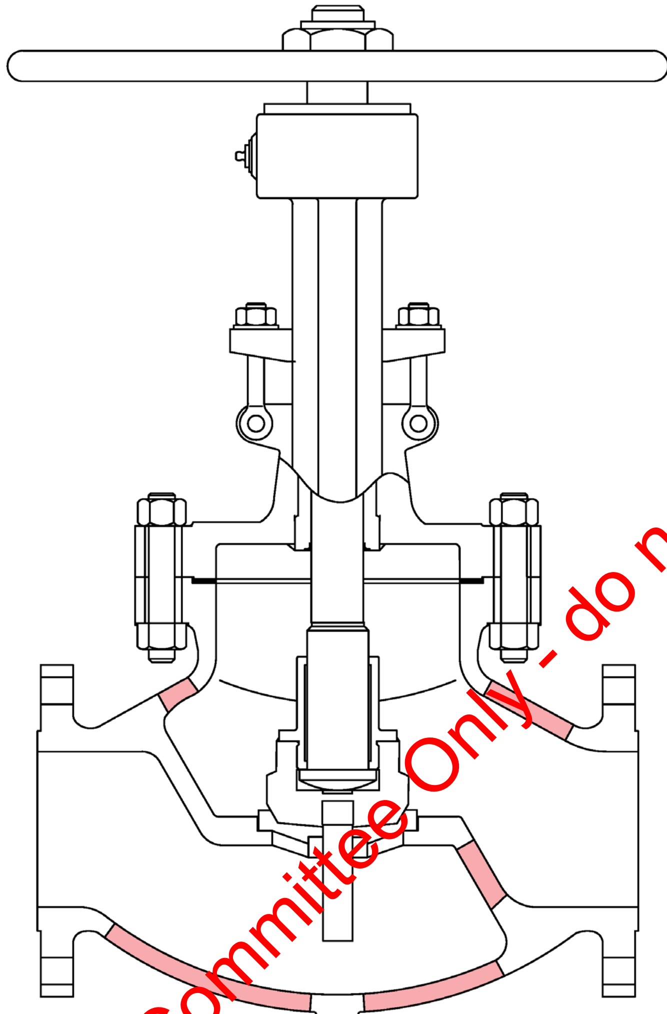


Figure 2—Globe Valve Typical Thickness Measurement Locations

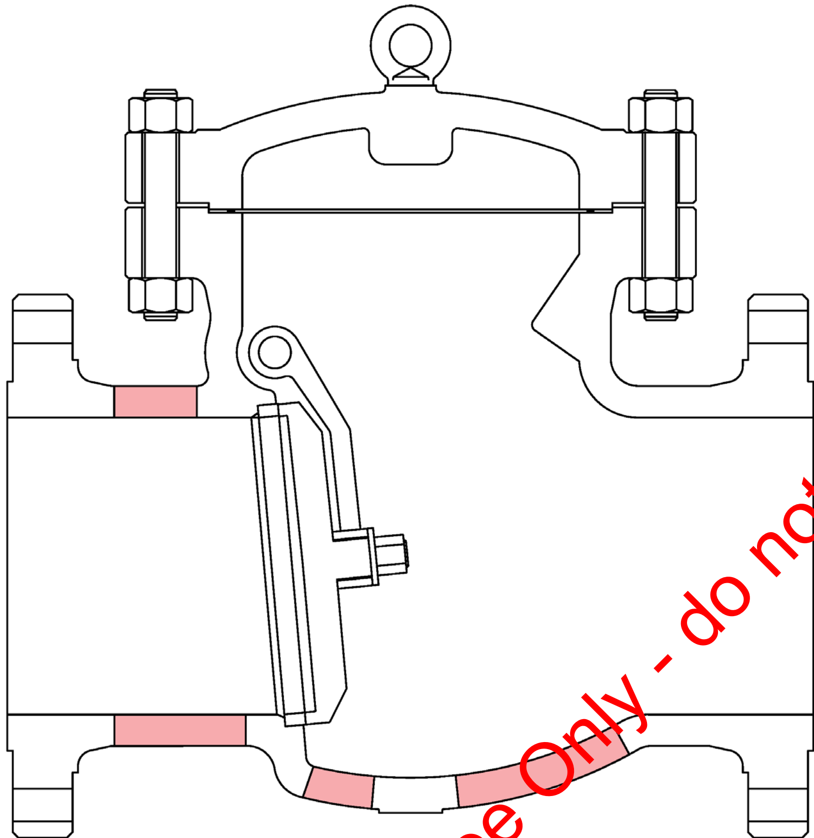


Figure 3—Check Valve Typical Thickness Measurement Locations

6.11.3.6 Pitting or localized corrosion that reduces valve wall thickness below the minimum allowable wall thickness specified in Table 2 or applicable product standard shall be acceptable with Owner's approval if all of the following are met:

a) maximum diameter of a circle that can enclose the pitting/corrosion conforms to Table 1;

b) minimum edge-to-edge distance between circles that enclose adjacent areas of pitting/corrosion conforms to Table 1;

c) wall thickness at location of pitting/corrosion is a minimum of 75 % of the minimum wall thickness specified in Table 2 or applicable product standard.

6.11.3.7 Casting defects deemed unacceptable per 6.11.3 shall be removed and repaired with Owner's approval. If the defect cannot be repaired, the casting shall be scrapped. For repairs:

a) area of defect and areas of inadequate wall thickness shall be repaired by welding;

b) weld metal surfaces shall be ground or machined smooth;

c) postweld heat treatment shall be performed as required by the ASTM, ASME, Owner's requirements, or other specification governing the casting requirements.

6.11.3.8 Weld repairs for low and intermediate alloy steel castings shall comply with requirements specified in the ASTM, ASME, Owner's requirements, or other specification governing the casting requirements. In the absence of specified requirements, the requirements of the applicable ASTM standard and the approved procedures shall apply. Owner shall specify the required NDE procedures.

6.11.3.9 Weld repairs for all stainless steel castings shall comply with the requirements specified in the ASTM, ASME, or other specification governing the casting requirements. In the absence of specified requirements, the requirements of the applicable ASTM standard and the approved procedures shall apply. Owner shall specify the required NDE procedures.

6.11.3.10 Nipples, pipe plugs, or hinge pin plugs screwed into tapped openings in the body, bonnet, cover, or stuffing box shall be removed and the threads shall be inspected and repaired if necessary. If required by the Owner, the threaded connections shall be converted to socket welded or threaded and seal welded.

a) Pipe plug material shall be solid and of an equivalent strength and corrosion resistance to that of the body material.

b) Unless otherwise specified, plugs shall be screwed and seal welded into place and visually inspected. Additional NDE may be specified.

c) Unless otherwise specified, replacement nipples shall be made from material of equivalent chemical composition and strength as the body or bonnet material.

d) Welded replacement plugs or nipples shall be subject to heat treatment as required by the approved procedures.

e) PMI of all alloy materials is required.

f) Existing seal welds shall be visually inspected. Additional NDE may be specified.

Table 1—Allowable Pitting and Localized Corrosion

Valve Size		Maximum Diameter of Circle That Can Enclose Pitting/Corrosion	Minimum Edge-to-edge Distance Between Adjacent Enclosure Circles
DN (mm)	NPS (in.)		
25	1	4.0 (0.16)	19.0 (0.75)
40	1 1/2	5.0 (0.20)	23.0 (0.91)
50	2	6.0 (0.24)	29.0 (1.14)
65	2 1/2	6.0 (0.24)	32.0 (1.26)
80	3	7.0 (0.28)	36.0 (1.42)
100	4	9.0 (0.35)	45.0 (1.77)
150	6	11.0 (0.43)	58.0 (2.28)
200	6	14.0 (0.55)	70.0 (2.76)
250	10	16.0 (0.63)	81.0 (3.19)
300	12	19.0 (0.75)	94.0 (3.70)
350	14	22.0 (0.87)	108 (4.25)
400	16	24.0 (0.94)	118.0 (4.65)
450	18	26.0 (1.02)	130.0 (5.12)
500	20	28.0 (1.10)	141.0 (5.55)
600	24	33.0 (1.30)	165.0 (6.49)
650	26	37.0 (1.46)	170 (6.69)
700	28	40.0 (1.57)	180 (7.09)
750	30	43.0 (1.69)	195 (7.68)
800	32	46.0 (1.81)	205 (8.07)
850	34	49.0 (1.93)	220 (8.66)
900	36	52.0 (2.05)	235 (9.25)
950	38	55.0 (2.17)	250 (9.84)
1000	40	58.0 (2.28)	265 (10.43)
1050	42	60.0 (2.36)	280 (11.02)

Table 2—Minimum Thickness of Shell Wall (API Standard 600, API Standard 623, and API Standard 594)

DN (mm)	NPS (in.)	150	300	400	600	900	1500	2500
25	1	5.0 (0.20)	5.0 (0.20)	—	7.0 (0.28)	—	11.0 (0.43)	14.0 (0.55)
40	1 1/2	5.0 (0.20)	6.0 (0.24)	—	8.0 (0.31)	—	14.0 (0.55)	18.0 (0.71)
50	2	7.0 (0.28)	8.0 (0.31)	—	10.0 (0.39)	—	18.0 (0.71)	21.0 (0.83)
65	2 1/2	8.0 (0.31)	10.0 (0.39)	—	10.0 (0.39)	—	21.0 (0.83)	24.0 (0.94)
80	3	9.0 (0.35)	10.0 (0.39)	—	11.0 (0.43)	18.0 (0.71)	22.0 (0.87)	28.0 (1.10)
100	4	10.0 (0.39)	11.0 (0.43)	11.0 (0.43)	14.0 (0.55)	20.0 (0.79)	28.0 (1.10)	34.0 (1.34)
150	6	10.0 (0.39)	15.0 (0.59)	15.0 (0.59)	18.0 (0.71)	25.0 (0.98)	35.0 (1.38)	47.0 (1.85)
200	8	11.0 (0.43)	16.0 (0.63)	18.0 (0.71)	22.0 (0.87)	29.0 (1.14)	45.0 (1.77)	61.0 (2.40)
250	10	13.0 (0.51)	18.0 (0.71)	20.0 (0.79)	26.0 (1.02)	34.0 (1.34)	54.0 (2.13)	66.0 (2.60)
300	12	14.0 (0.55)	19.0 (0.75)	22.0 (0.87)	29.0 (1.14)	39.0 (1.54)	64.0 (2.52)	85.0 (3.35)
350	14	15.0 (0.59)	21.0 (0.83)	25.0 (0.98)	32.0 (1.26)	43.0 (1.69)	67.0 (2.64)	—
400	16	16.0 (0.63)	22.0 (0.87)	27.0 (1.06)	35.0 (1.38)	49.0 (1.93)	77.0 (3.03)	—
450	18	17.0 (0.67)	24.0 (0.94)	29.0 (1.14)	38.0 (1.50)	54.0 (2.13)	86.0 (3.39)	—
500	20	18.0 (0.71)	25.0 (0.98)	32.0 (1.26)	41.0 (1.61)	61.0 (2.40)	96.0 (3.78)	—
600	24	19.0 (0.75)	29.0 (1.14)	35.0 (1.38)	48.0 (1.89)	71.0 (2.80)	111.0 (4.37)	—
650	26	20.0 (0.79)	30.0 (1.18)					
700	28	21.0 (0.83)	31.0 (1.22)					
750	30	22.0 (0.87)	33.0 (1.30)					
800	32	22.0 (0.87)	34.0 (1.34)					
850	34	23.0 (0.91)	36.0 (1.42)					
900	36	24.0 (0.94)	37.0 (1.46)					
950	38	25.0 (0.98)	39.0 (1.54)					
1000	40	25.0 (0.98)	41.0 (1.61)					
1050	42	26.0 (1.02)	42.0 (1.65)					

NOTE 1 The shell comprises the body and the bonnet.
NOTE 2 When using this table, linear interpolation may be used for values intermediate to those not listed. Minimum wall thickness does not include liners, linings, or cartridges.
NOTE 3 For all other valves see the product standard, unless otherwise approved by the Owner.

6.11.4 Body-to-bonnet Flanges and Gasket Surfaces

6.11.4.1 Body-to-bonnet flanges shall be inspected for corrosion and overall condition.

6.11.4.2 Unless otherwise specified by the Owner, the minimum flange thickness after machining, or any required weld repair and subsequent re-machining, shall not be less than 0.8 mm (0.032 in.) below the original thickness.

6.11.4.3 Both body-to-bonnet gasket sealing surfaces shall be visually inspected for corrosion, wear, cuts, or scoring. Defects shall be repaired to achieve surface finish in accordance with OEM requirements. Alternatively, surface finish may be per Table 3. Repairs to gasket sealing surfaces shall not alter the body-to-bonnet joint design dimensions that provide the inherent gasket compression control.

Table 3—Surface Finish Required per Gasket Type

Gasket Type	Surface Finish
Flexible graphite with metal insert	3.2 µm to 6.4 µm (125 µin. to 250 µin.)
Polytetrafluroethylene (PTFE) with or without reinforcing fillers	3.2 µm to 6.4 µm (125 µin. to 250 µin.)
Corrugated metal with or without graphite or PTFE overlay	1.6 µm (63 µin.), without overlay 3.2 µm to 6.4 µm (125 µin. to 250 µin.), with overlay
Spiral wound	3.2 µm to 6.4 µm (125 µin. to 250 µin.)
Oval/octagonal ring type joint	Ring joint groove with a 0.8 µm to 1.6 µm (32 µin. to 64 µin.) finish
Pressure seal gasket	Approximately 0.8 µm (32 µin.)
Grooved Metal Gasket with Covering Layer	3.2 µm to 6.4 µm (125 µin. to 250 µin.)

6.11.5 Body End Flanges and Face-to-Face Dimensions

6.11.5.1 Face-to-Face dimensions shall be checked for compliance with Table 4.

Table 4—Face-to-Face Dimensions

Valve Size		Face-to-Face Dimension Allowable Variation from ASME B16.10 mm (in.)
NPS (in.)	DN (mm)	
1 to 3	25 to 80	±1.6 (±0.0625)
4 to 14	100 to 350	±3.4 (±0.120)
16 and larger	400 and larger	±4.8 (±0.187)

6.11.5.2 Dimensional nonconformances shall be corrected by weld metal buildup, machining, or a combination thereof.

6.11.5.3 "Defective surfaces around the bolt holes shall be repaired as necessary. Weld repairs shall be machined, ground, or a combination thereof, and if required, bolt holes shall be spot faced per MSS SP-9 to provide smooth nut bearing surfaces that are parallel to the flange gasket face within ±1° and unrestricted bolt holes. Spot facing shall not reduce the flange thickness below the minimum flange thickness requirements of ASME B16.5, ASME B16.47, or minimum flange thickness requirements as specified by the Owner.

6.11.5.4 Reduction of flange thickness below the minimum thickness requirements of ASME B16.5 and ASME B16.47 is allowed with approval by the Owner stating the thickness permitted.

6.12 Body Guides

6.12.1 Body guides shall be visually inspected. Corrosion or damage that will interfere with smooth operation of the obturator in any orientation shall be repaired. Large valves installed with the stem in the horizontal position can create issues with stem, disc, body guide alignment, potentially resulting in the disc locking in the valve body or disengagement of the stem from the disc, unless proper clearances are maintained.

6.12.2 Body guides may be repaired by grinding or machining or by weld metal buildup and grinding or machining.

6.13 Body Seat Ring(s)

6.13.1 Body seat ring(s) shall be visually inspected for corrosion, wear, or cuts, and for any apparent leakage between the seat ring and the valve body. Unless otherwise specified, all non-welded seat rings, in class 600 and higher pressure class and valves larger than NPS 2, shall be seal welded.

6.13.2 If the condition of the valve body and seat ring(s) permit, the seat ring(s) shall be repaired by machining or lapping of the sealing surface(s) to achieve chamfered edges and a flat surface a minimum of 1.6 mm ($^{1}/_{16}$ in.), wide but not less than the width of the original seating surface with a Ra of 0.8 μm (32 μin.) or smoother finish.

6.13.3 If the condition of the seat ring(s) requires more extensive repairs than specified above, one or more of the following repair procedures shall be used.

a) When approved by the Owner, the seat ring sealing surface(s) may be replaced or repaired with a weld metal deposit of a material type appropriate for the required trim. The repaired seating surface(s) shall meet the hardness minimum of the original design specification. The Owner shall specify the need and extent of any required hardness testing of the seat ring sealing surface(s). If hardness testing is required, the procedure used shall be approved by the Owner.

b) Install new seat ring(s) that meet the requirements of the original design specification.

c) If leakage between the seat ring(s) and body is suspected, seal weld the seat ring(s) into the body using an approved weld procedure compatible with both the body and seat ring base material. Unless otherwise specified, all non-welded seat rings in class 600 and higher pressure class valves shall be seal welded.

6.13.4 Use of bushings, shims, epoxy, glue, grease, or thread sealant between the body and seat ring(s) is prohibited.

6.13.5 If applicable, springs used for seat energization shall be replaced, unless otherwise approved by the Owner.

6.14 Obturator (Wedge, Globe, Disc, and Plate)

6.14.1 Wedge, globe, disc, or plate (including the arm, hinge pin, disc retainer, and cap) assembly shall be visually inspected for corrosion, wear, or pitting.

6.14.2 Defective wedge, globe, disc, or plate (including the arm, hinge pin, disc retainer, and cap) shall be replaced or shall be repaired by weld metal buildup, machining, grinding, lapping, or a combination thereof after completion of repairs. Seating surface finish shall be a maximum Ra of 0.8 μm (32 μin.) Some valve designs (e.g. dual plate check valves) may require a maximum surface finish of Ra of 0.4 μm (16 μin.).

6.14.3 Seating design for a wedge gate valve shall provide adequate seating both before and after the wear of the seating surfaces. When fully closed, the wedge seating surface shall provide an additional closing travel of not less than indicated in Table 5 and Figure 4.

Table 5—Minimum Wear Travel and Maximum Stem Projection (from API Standard 600)

Valve Size Range DN (NPS)	Wear Travel *h* mm (in.)	Maximum Stem Projection mm (in.)
DN ≤ 50 (NPS ≤ 2)	2.3 (0.09)	11.5 (0.45)
65 ≤ DN ≤ 150 (2 1/2 ≤ NPS ≤ 6)	3.3 (0.13)	16.5 (0.65)
200 ≤ DN ≤ 300 (8 ≤ NPS ≤ 12)	6.4 (0.25)	19.2 (0.75)
350 ≤ DN ≤ 450 (14 ≤ NPS ≤ 18)	9.7 (0.38)	29.1 (1.14)
500 ≤ DN ≤ 600 (20 ≤ NPS ≤ 24)	12.7 (0.50)	38.1 (1.5)
650 ≤ DN ≤ 700 (26 ≤ NPS ≤ 28)	16.0 (0.62)	48.0 (1.86)
750 ≤ DN ≤ 900 (30 ≤ NPS ≤ 36)	19.1 (0.75)	57.3 (2.25)
950 ≤ DN ≤ 1050 (38 ≤ NPS ≤ 42)	25.4 (1.00)	76.2 (3.00)

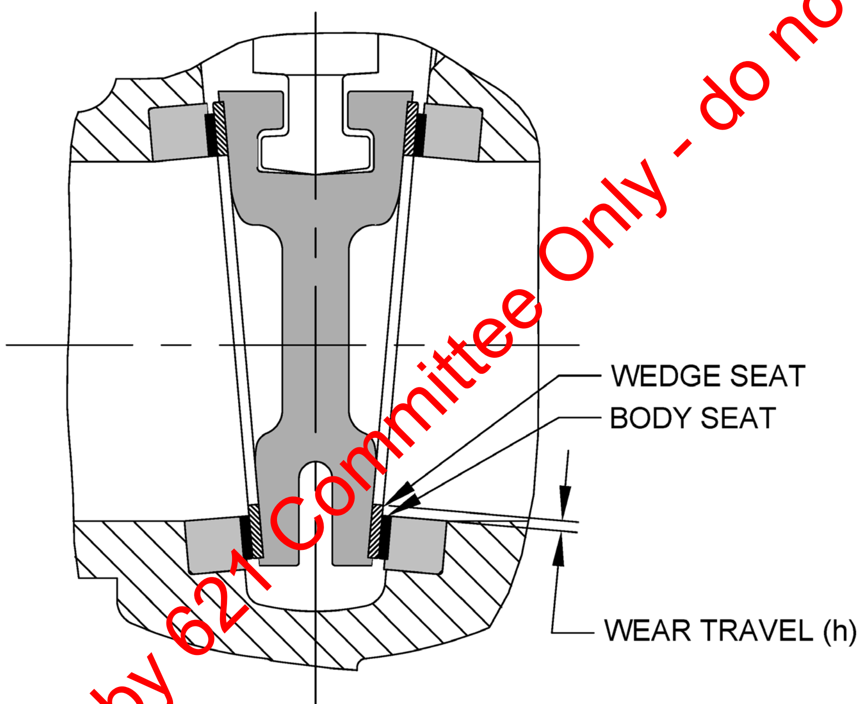


Figure 4—Wear Travel

6.14.4 If the final fitting of a wedge to the seat rings results in an additional closing travel less than that specified in Table 5, the wedge sealing surfaces may be built-up with weld metal to ensure an adequate distance from the area of seat ring contact and the edge of the wedge sealing surface.

6.14.5 Split wedge gate valves shall have all the weld metal buildup on the face of the wedge. Weld metal buildup on the backside of the wedge halves to compensate for wear or machining of the sealing surface of the wedge and seat rings is prohibited.

6.14.6 When specified by the Owner, check valves that do not have an anti-rotation device shall be retrofitted with an anti-rotation device by the Reconditioner. Rotation shall be limited to less than 360 degrees or as specified by the manufacturer.

6.14.7 The components of the check valve arm and clapper assembly (including the hinge pin, lever arm, clapper, clapper stud, and nut) should be evaluated individually and as an assembly. Contact surfaces of each component should receive additional attention to verify that the clapper will be centered with the seat and able to properly contact the seat. Welding and machining may be performed to repair areas that are worn or damaged. After final machining, the check valve arm and clapper assembly should be evaluated again for proper alignment and that it moves freely for the full range of motion prior to final assembly.

6.14.8 Springs for check valves shall be visually inspected and functionally checked to ensure the springs are keeping the closure element in contact with the seat. Defective springs shall be replaced.

6.14.9 Guides (Wedge, Globe, and Disc)

6.14.9.1 Guides shall be visually inspected for cracking, corrosion, or excessive wear.

6.14.9.2 Guides shall also be visually inspected to ensure proper engagement with the body guides.

6.14.9.3 Guides shall be functionally checked for proper operation and alignment.

6.14.9.4 Defects shall be repaired by weld buildup, machining, grinding, milling, or a combination thereof.

6.15 Stem

6.15.1 Stem shall be inspected for straightness and damage to the threads, backseat, and tee-head.

6.15.2 Portion of stem that slides through the packing shall be inspected for corrosion, pitting, wear, and taper. If the stem is coated or hardened, perform a liquid penetrant test to check for cracking.

6.15.3 Stem shall have surface finish Ra of 0.8 μm (32 μin.) or smoother in the stem area contacting the packing during stroking. Out-of-straightness of the entire length of the stem shall not exceed 0.001 mm/mm (0.001 in./in.).

6.15.4 Stem threads shall properly engage the internal threads of the stem nut in accordance with ASME B1.5 and ASME B1.8.

6.15.5 Stem backseat shall have a surface finish Ra of 0.8 μm (32 μin.) or smoother and shall ensure proper seating against the sealing surface of the bonnet backseat.

6.15.6 Tee-head shall be visually inspected to verify proper engagement to the wedge. Additional NDE may be specified.

6.15.7 Minimum stem diameter shall be in accordance with the original design standard. Permitted undertolerance for gate and globe valves shall be per Table 6. If necessary, defective stems shall be replaced or, if feasible and approved by the Owner, may be repaired with a qualified procedure appropriate for the type of defect, including welding and machining. Stem weld repairs and weld qualification procedures shall conform to Annex A.

NOTE The stem diameter undertolerance values in this table are based on the lesser of 150 % of that given by Section 5.8.1 of API Standard 600 current edition or 0.8 mm ($^1/_{32}$ in.) below the manufacturer's original stem diameter.

Table 6—Permitted Stem Undertolerance (Gate and Globe)

Diameter (mm)	Undertolerance (mm)	Diameter (in.)	Undertolerance (in.)
≤ 15.9	0.47	≤ $^{5}/_{8}$	0.018
>15.0 to 22.2	0.50	>$^{5}/_{8}$ to $^{7}/_{8}$	0.020
>22.2 to 25.4	0.54	>$^{7}/_{8}$ to 1	0.021
>25.4 to 28.6	0.57	>1 to 1$^{1}/_{8}$	0.023
>28.6 to 31.8	0.62	>1 $^{1}/_{8}$ to 1 $^{1}/_{4}$	0.024
>31.8 to 34.9	0.65	>1 $^{1}/_{4}$ to 1$^{3}/_{8}$	00.26
>34.9 to 38.1	0.72	>1$^{3}/_{8}$ to 1 $^{1}/_{2}$	0.029
>38.1 to 41.3	0.80	>1 $^{1}/_{2}$ to 1 $^{5}/8$	0.031
>41.3 to 50.8	0.80	>1 $^{5}/_{8}$ to 2	0.031
>50.8 to 82.6	0.80	>2 to 3$^{1}/_{4}$	0.031
>82.6 to 101.6	0.80	>3 $^{1}/_{4}$ to 4	0.031

6.15.8 Repaired stems shall be inspected with liquid penetrant examination or an alternative method when approved by the Owner. Stem packing area shall have:

a) no relevant Penetrant Test (PT) indications;

b) a surface finish Ra of 0.8 μm (32 μin.) or smoother;

c) a maximum taper or cylindrical variation of 0.08 mm (0.003 in.) across the entire stem packing area.

6.16 Body-to-Bonnet Joint Bolting

6.16.1 Unless otherwise specified, body-to-bonnet bolting shall be new bolts and nuts as specified by the original design specification or as specified by the Owner. If the original design specification does not specify the bolting materials, they shall be in accordance with ASME B16.34 Installed bolting shall have readily visible marking imprinted into all bolts and nuts.

6.16.2 Special or other bolting requirements shall be in accordance with the Owner's engineering piping specification as supplied on the Owner's purchase order or as instructed by the Owner's representative.

6.17 Packing Gland Eye Bolts

6.17.1 Packing eyebolts shall be visually inspected for corrosion or other damage. Damaged eyebolts shall be replaced. Assure the packing gland eye bolts allow for sufficient bolt stress to allow for potentially higher loads required for API Standard 622 packing as required in 6.18.2.

6.17.2 Packing gland bolting shall be tightened per the packing manufacturer's recommended practice prior to API Standard 598 testing.

6.17.3 Unless otherwise specified, nuts shall be replaced as specified by the original design specification. Heavy hex nuts shall be used for repair.

6.17.4 Special or other bolting requirements shall be in accordance with the Owner's engineering piping specification as supplied on the Owner's purchase order or as instructed by the Owner's representative.

6.17.5 Guidance for live loaded valve stem packing systems is provided in MSS SP-143.

6.18 Packing

6.18.1 Packing dimensions shall be in accordance with Table 7 and the applicable API standard.

6.18.2 For packing materials refer to Annex B.

6.18.3 Packing cross section shall be consistent with the final dimensions of the reconditioned stuffing box and stem.

NOTE For quarter turn valves, refer to manufacturer standards.

Table 7—Nominal Radial Width of Packing (from API Standard 600 and API Standard 623)

Nominal Stem Diameter d_n mm (in.)	Nominal Radial Width of the Packing w mm (in.)	Packing Box Clearance Factor y mm (in.)
15 < d ≤ 27 ($^1/_4$ < d ≤ 1)	6.4 ($^1/_4$)	0.4 ($^1/_{64}$)
27 < d ≤ 37 (1 < d ≤ 1$^3/_8$)	7.9 ($^5/_{16}$)	0.4 ($^1/_{64}$)
37 < d ≤ 49 (1$^3/_8$ < d ≤ 1$^7/_8$)	9.5 ($^3/_8$)	0.4 ($^1/_{64}$)
49 < d ≤ 56 (1 $^7/_8$ < d ≤ 2$^1/_8$)	11.1 ($^7/_{16}$)	0.8 ($^1/_{32}$)
56 < d ≤ 74 (2 $^1/_8$ < d ≤ 2$^7/_8$)	12.7 ($^1/_2$)	0.8 ($^1/_{32}$)
74 < d ≤ 102 (2 $^7/_8$ < d ≤ 4)	14.3 ($^9/_{16}$)	0.8 ($^1/_{32}$)

6.19 Body-to-Bonnet Joint Gasket

Body-to-Bonnet joint gasket shall conform to Table 3 unless other requirements are specified by the Owner.

6.20 Grease Injectors

Grease injection ports shall be verified to be clear, that the double ball check valves are operating correctly, and replaced as required.

7 Post-repair Assembly

7.1 General

7.1.1 Before assembly of valve parts, internal surfaces (excluding body and bonnet gasket surfaces, seating surfaces, and stem) shall be coated with an Owner-approved rust preventative. Austenitic stainless steel and corrosion resistant nickel alloy materials are excluded from this requirement.

7.1.2 Stem threads shall be lubricated with an Owner-approved dry film lubricant. Lubricant shall be injected into the stem nut housing. Care must be taken to not overlubricate, as petroleum-based lubricants may contaminate the packing area of the stuffing box and adversely affect volatile organic compound (VOC) monitoring readings caused by off-gassing of the lubrication.

7.1.3 After testing, stem packing shall have a minimum of one-and-one half times the packing width available for field adjustment of the stem packing.

7.1.4 Body-to-Bonnet joint bolting shall be torqued in accordance per Manufacturer's specifications, Reconditioner's documented procedure, or as specified by the Owner. The procedure shall specify lubrication requirements, and incremental torquing and torquing sequences consistent with the recommendations of ASME PCC-1, latest edition to the valve manufacturer's specified values. Caution is advised when austenitic stainless steel bolting or uncontained PTFE gaskets are used.

7.1.5 In the fully closed position, the end of the stem on gate valves shall be flush with the top of the stem nut, as a minimum, and shall not exceed the maximum allowable projection above the stem nut permitted by API Standard 600, as a maximum. Globe valves open and closed positions shall be set per the current edition of API Standard 623, Section 5.8.

7.2 Actuated Valves

7.2.1 Upon receipt of the valve, closure settings, either torque or position shall be verified with the Owner.

7.2.2 Actuated valves should be assembled with the stem in the vertical position if possible. When mounting the actuator, it is critical to ensure alignment of the stem, packing gland, and actuator mounting plate.

7.2.3 If alignment bushings are required to prevent stem deflection, they should be constructed of a material with a 50 Brinell hardness differential between the stem and bushing to prevent galling. The ends of the bushing should be radiused or chamfered.

7.2.4 The actuator should be cycled after assembly to confirm that the stem and obturator moves freely without damage and visually maintains concentricity with the packing.

7.2.5 If an actuator is added, or the actuation is changed, this may result in a change to the maximum torque that the valve is subjected to. Further, if the materials of the valve are changed (such as a change of stem material), this may alter the maximum allowed torque of the valve. If the valve experiences excessive torque due to the changes, the Owner and Reconditioner shall agree on the responsibility to validate actuator sizing, preferably as part of the contractual agreement presented in 4.3.

7.2.6 Care should be taken to confirm that actuators are set correctly on either torque or position as confirmed in 7.2.1.

8 Pressure Test

8.1 Unless a more restrictive test is required by the Owner, the pressure test of assembled valves shall be in accordance with Annex C of this RP. Additional testing shall be done at the request of the Owner as stated in the Owner's purchase order or as instructed by the Owner's representative.

8.2 A copy of the test results shall be included in the reconditioning work documentation.

9 Preparation for Shipment to Owner

9.1 Carbon steel and ferritic alloy steel valves shall be cleaned and externally coated with a general purpose aluminum or silver color paint, unless otherwise specified by the Owner.

9.2 Machined and flange gasket surfaces, butt weld ends, and stems shall be left completely paint free.

9.3 Machined surfaces (excluding stem threads) exposed to the atmosphere shall be coated with an Owner-approved rust preventative. Austenitic stainless steel and corrosion resistant nickel alloy materials are excluded from this requirement.

9.4 Valves shall have the end port openings covered and protected.

9.5 Gate and globe valves shall be shipped in the closed position. Swing check valves shall be shipped with the disc secured or supported during transport. A warning tag is to be attached to the swing check valve with instructions to remove the material used to secure the disc before installation. Ball and plug valves shall be shipped in the full-open position. Butterfly valves shall be shipped in the full-closed position. Valves with fail action operators shall be shipped in the failed (failed open or failed closed) position.

9.6 Valves shall be secured on wooden pallets, or other suitable means, for shipment.

9.7 Moving parts on valves shall be lubricated with an approved lubricant specific to the design and function of the part.

9.8 If special preparations, cleaning, or packaging are required prior to shipping, they shall be performed in accordance with the Owner's instructions.

10 Tagging and Reconditioning Facility Identification

10.1 A stainless steel plate (valve tag) shall be permanently attached to the valve body or bonnet of each reconditioned valve. Tag shall have the following metal-stamped or imprinted information:

a) statement that valve has been reconditioned in accordance with API Standard 621;

b) name of reconditioning facility;

c) date of reconditioning;

d) size and type valve;

e) body/bonnet material;

f) stem material;

g) body and closure element seating surface material;

h) packing material;

i) gasket material;

j) valve identification number;

k) valve pressure rating at 100 °F (38 °C) and pressure class;

l) any reduction in maximum pressure/temperature rating to reflect packing, bolting, or gasket material changes.

10.2 Tag shall have rounded corners.

10.3 Valves that are too small to have the tag directly attached shall have the tag attached to the valve body/bonnet with 0.9 mm (0.035 in.) minimum stainless steel wire.

10.4 If reconditioning included any special cleaning or other preparations for a specific service, an additional tag shall be wired to the valve identifying the special preparations performed.

10.5 Each reconditioned valve shall have the name of the reconditioning company and date of reconditioning (month and year) stamped on the valve, using 9.52 mm (0.375 in.) to 12.7 mm ($^1/_2$ in.) low stress characters. Stamping shall be located on a nonfunctional surface as follows.

a) For flanged valves, stamping shall be located on the outside diameter surface of a body or end flange.

b) For other valves, stamping shall be in the bonnet area.

c) For small valves where stamping per the above is not practical, the stamping method and location shall be approved by the Owner.

10.6 Keep OEM nameplate attached to the valve.

Annex A
(normative)

Weld Overlay of Stems

A.1 Scope

This annex covers requirements for weld overlay of stems for valves being reconditioned in accordance with this RP.

A.2 General

A.2.1 Weld overlay of stems shall be done by undercutting the defective stem packing area and rebuilding with a weld metal overlay. Undercutting shall be done by machining.

A.2.2 Reconditioner shall weld overlay only those stems for which a stem base material/filler metal combination has been specifically qualified and approved.

A.2.3 Maximum allowable undercutting shall be to the minimum thread root diameter.

A.2.4 Weld overlay is not allowed on stems with a diameter of 19.05 mm (0.750 in.) or smaller in the packing area.

A.2.5 After welding, the stem packing area shall be machined and inspected to the requirements of 6.18.

A.2.6 Areas of defective weld may be repaired using this stem weld procedure provided the area of pitting or defective weld is undercut by machining and the entire area of undercut is welded in accordance with this procedure. Spot welding over individual defects or pits without undercutting is prohibited.

A.2.7 Repair of stem T-head by weld buildup is not permitted.

A.2.8 All 300 series high carbon (C > 0.040) stainless steel stems, after weld repair is completed, shall be solution annealed and subjected to PT examination after final machining.

A.3 Procedure Qualification and Sample Preparation

A.3.1 Weld procedures shall be qualified in accordance with Section IX of the ASME *Boiler and Pressure Vessel Code* (QW-450 for weld metal buildup and corrosion resistant or hardfacing overlay).

A.3.2 Weld overlay by shielded metal arc welding (SMAW) is prohibited.

A.3.3 A weld procedure shall be qualified for each stem material and filler metal combination to be used for repair.

A.3.4 Reconditioner shall provide to the Owner written notification of the stem material/filler metal combinations to be qualified.

A.3.5 Reconditioner shall prepare two samples from either 31.8 mm (1.250 in.) or 34.9 mm (1.375 in.) diameter API Standard 600 valve stems for each stem material/filler metal combination to be qualified in accordance with the laboratory tests in A.4.

A.3.6 Owner shall be notified when the preparation of the samples will commence.

A.3.7 Reconditioner shall provide to the Owner a copy of the procedures to be qualified.

A.4 Laboratory Tests

A.4.1 One stem sample shall be subjected to a stem pull test in accordance with API Recommended Practice 591 for each stem material and filler metal combination that is being qualified.

A.4.2 Except for a stem with a hardfacing overlay, a 9.52 mm ($^3/_8$ in.) wide specimen containing the overlay shall be taken from the center of the second sample stem longitudinally and a side bend test shall be performed in accordance with ASME Section IX, QW-453. Any sign of disbonding of the weld metal shall disqualify the repair procedure.

A.4.3 A specimen from the second stem sample shall be microetched and photomicrographed to determine proper fusion.

A.4.4 A hardness profile shall be made across the centerline of the stem.

a) 410 stainless steel with a 410 stainless steel overlay:

1) unless otherwise specified, a hardness between 200 HB and 275 HB shall be maintained, both before and after welding;

2) hardness of the heat-affected zone shall be within 80 HB of the base metal hardness.

b) 300 series stainless steel with a 300 series stainless steel overlay:

1) hardness of the weld overlay shall be within 50 HB of the base metal hardness.

c) 410 stainless steel base with a corrosion resistant overlay:

1) preheat and postweld heat treatment is required;

2) a maximum allowable reduction of hardness shall be a maximum of 30 HB;

3) unless otherwise specified, final base metal hardness shall be between 200 HB and 275 HB;

4) after heat treatment, hardness of the heat-affected zone shall be within 50 HB of the base metal;

5) PMI shall be done on the weld overlay using an analyzer approved by the Owner;

6) chemical analyses shall be done for procedure qualifications and laboratory tests.

d) 300 stainless steel base with a hardfacing overlay:

1) postweld heat treatment is required;

2) a maximum allowable reduction of hardness shall be a maximum of 30 HB;

3) unless otherwise specified, final base metal hardness shall be per manufacturer's standard;

4) after heat treatment, hardness of the heat-affected zone shall be within 50 HB of the base metal hardness.

Annex B
(normative)

Stem Packing

B.1 Scope

This annex covers requirements for materials, design, and installation for stem packing for valves being reconditioned in accordance with this RP.

B.2 Materials

B.2.1 General Service

B.2.1.1 Packing material shall be asbestos free, and unless otherwise specified by the Owner, *Graphitic Low Emissions*—packing qualified to API Standard 622 shall be used.

B.2.2 High Temperature Service

B.2.2.1 Packing materials for high temperature service above 800 °F shall be approved by the Owner.

B.2.3 Non-Graphitic Materials

B.2.3.1 Non graphitic packing materials (e.g. PTFE) should be replaced in kind. Material substitutions shall be approved by the Owner.

B.3 Spacers or Bushings

Spacers or bushings used in stuffing boxes of valves shall:

a) be compatible with the stem material;

b) be made of carbon, or a material approved by the Owner, that is equivalent to the valve bonnet material or of a material with a greater corrosion and temperature resistance than the bonnet material and with a hardness at least 50 HB different than the stem hardness except for 300 series stainless. The use of carbon bushings shall be limited to packing chambers that have a flat bottom;

c) conform to the dimensional clearances in Figure B.1.

B.4 Lantern Rings

B.4.1 If a lantern ring is specified in the stuffing box for an external connection, it shall be aligned with the external connection or placed in accordance with the Owner's instructions.

B.4.2 Figure B.2 shows this diagrammatically.

B.5 Typical Packing Arrangements

For typical packing arrangements, refer to Figure B.3, Figure B.4, and Figure B.5.

NOTE 1 Configuration of the stuffing box and spacer location may vary (Figure B.1).

NOTE 2 For quarter turn valves, refer to the stuffing box clearances provided by the manufacturer (Figure B.1).

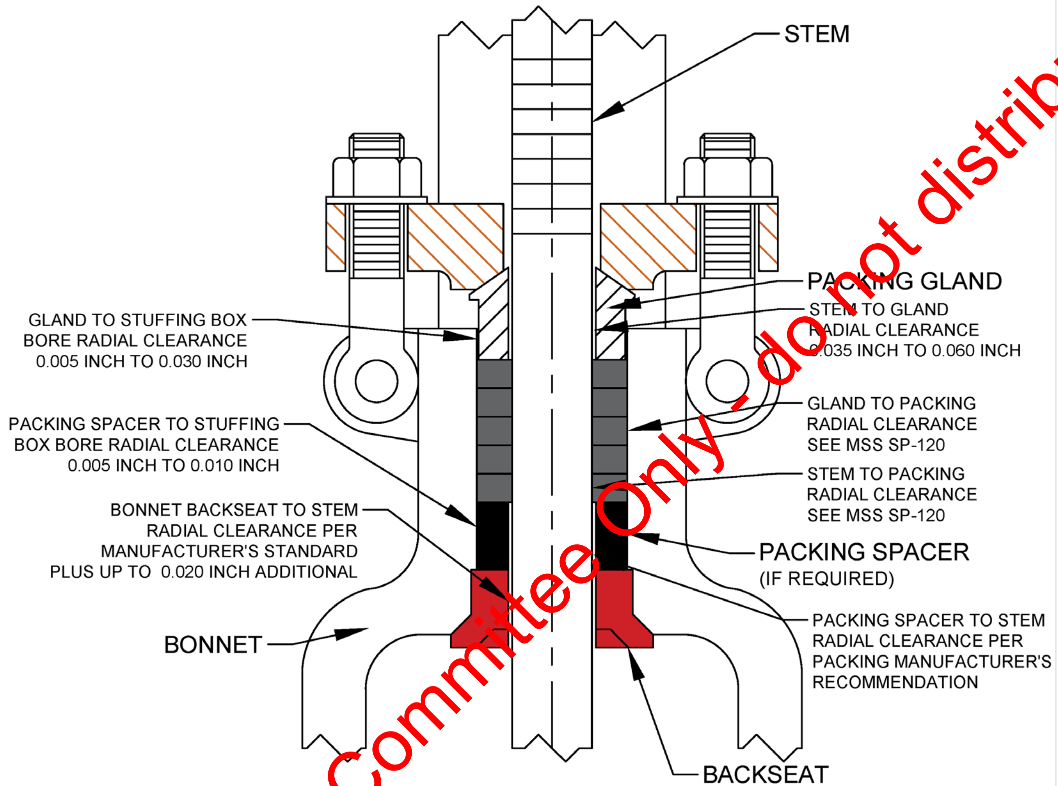
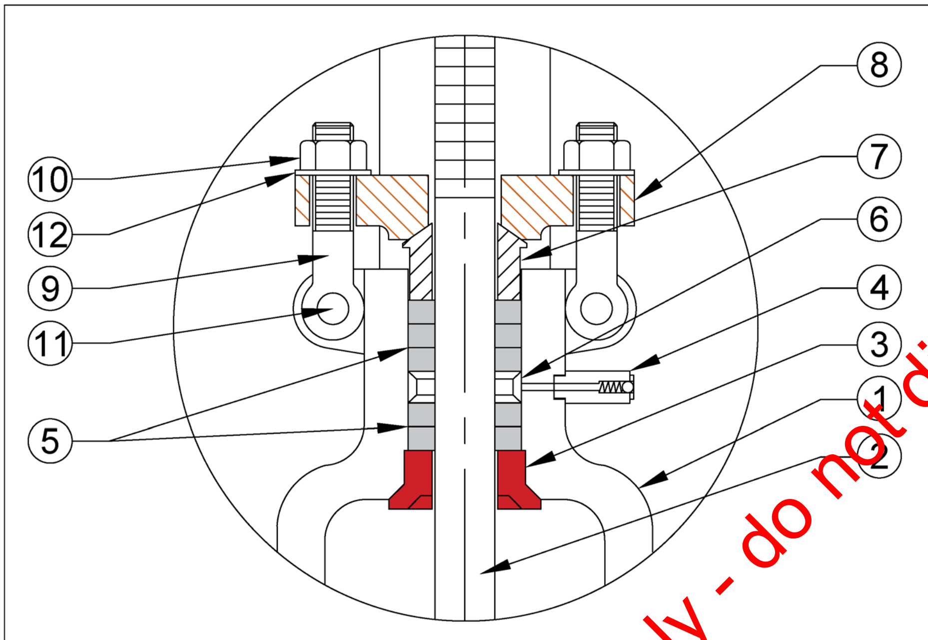
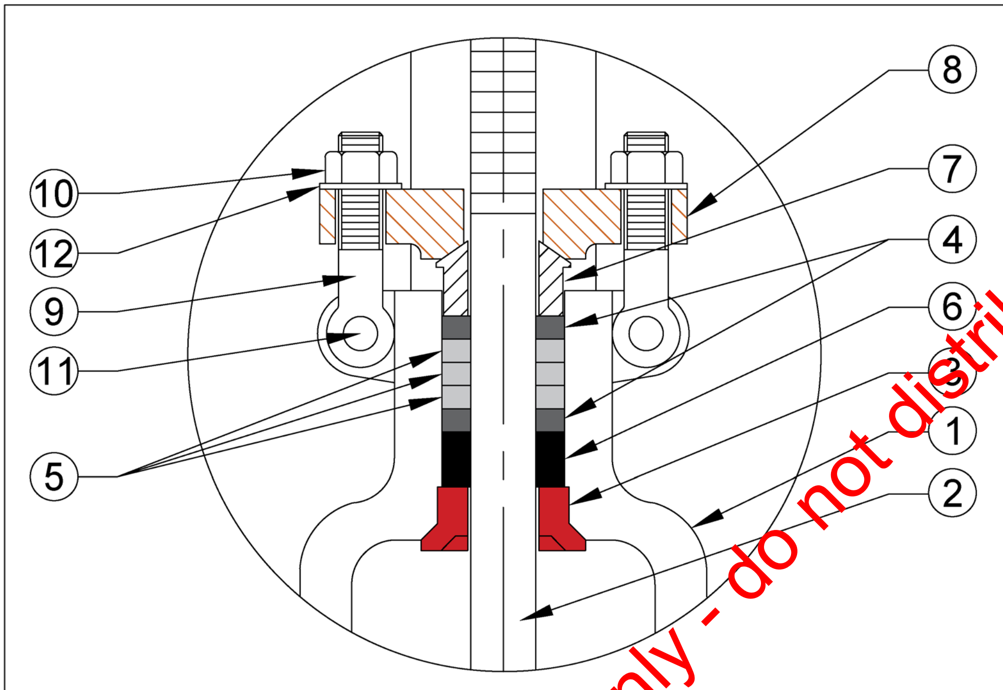


Figure B.1—Typical Linear Valve Stuffing Box Clearances



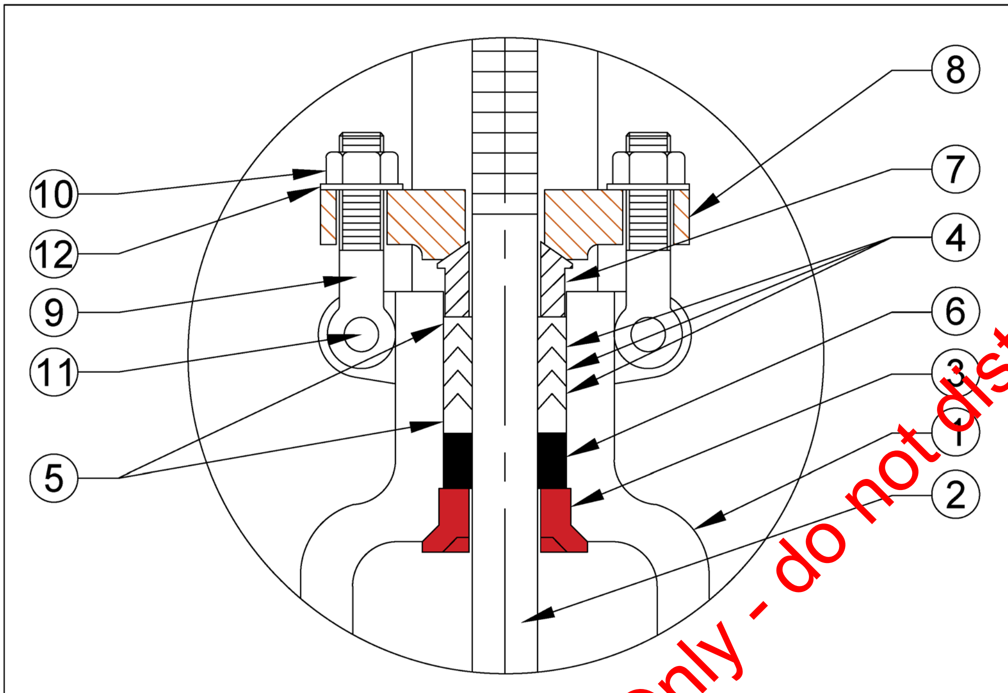
1) Bonnet
2) Stem
3) Backseat
4) Grease Injector
5) Packing
6) Lantern Ring
7) Gland
8) Gland Flange
9) Packing Bolt (Eye Bolt)
10) Nut (Eye Bolt)
11) Pin (Eye Bolt)
12) Washer

Figure B.2—Lantern Ring Arrangement



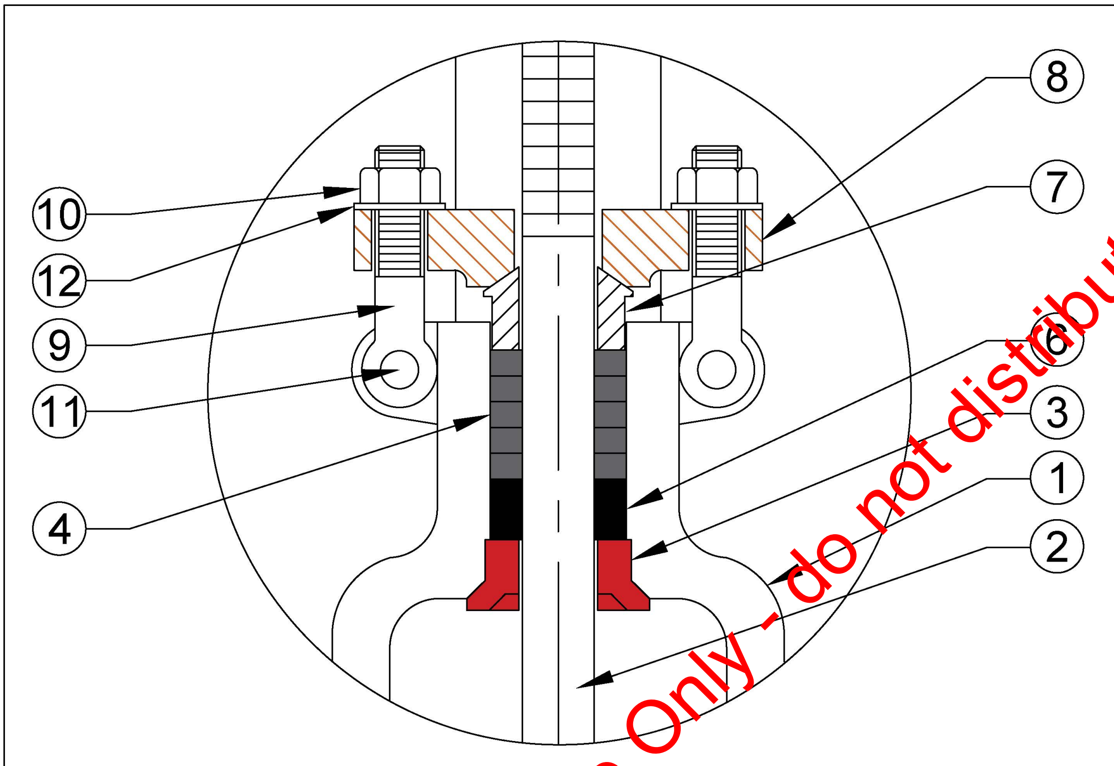
1)	Bonnet	7)	Gland
2)	Stem	8)	Gland Flange
3)	Backseat	9)	Packing Bolt (Eye Bolt)
4)	Braided Graphite Rings	10)	Nut (Eye Bolt)
5)	Die Formed Graphite Rings	11)	Pin (Eye Bolt)
6)	Packing Spacer (as required)	12)	Washer (optional)

Figure B.3—Graphite Packing Ring Arrangement



1) Bonnet
2) Stem
3) Backseat
4) PTFE V-Ring Rings
5) Male (Bottom), Female (Top) V-Ring Adapter
6) Packing Spacer (as required)
7) Gland
8) Gland Flange
9) Packing Bolt (Eye Bolt)
10) Nut (Eye Bolt)
11) Pin (Eye Bolt)
12) Washer (optional)

Figure B.4—PTFE V-ring Packing Arrangement



1)	Bonnet	7)	Gland
2)	Stem	8)	Gland Flange
3)	Backseat	9)	Packing Bolt (Eye Bolt)
4)	Braided Packing	10)	Nut (Eye Bolt)
5)	(Not Used)	11)	Pin (Eye Bolt)
6)	Packing Spacer (as required)	12)	Washer (optional)

Figure B.5—Braided Packing Arrangement

Annex C
(normative)

Tests

C.1 Scope

This annex covers requirements for testing of valves being reconditioned in accordance with this RP.

C.2 General

C.2.1 Unless a more restrictive test is specified by the Owner, test pressures, test durations, test fluids, and leakage rates shall conform to API Standard 598 to verify the pressure integrity of the valve body and the valve seat(s).

C.2.1.1 During seat testing, the valve body cavity shall be pressurized by allowing the test medium to flow through the valve as the obturator is being closed onto the seats.

C.2.1.2 Preferably, the seat test shall be performed with the valve stem in the horizontal position, the valve bore in the vertical position, and one side of the valve open.

C.2.1.3 If a valve must be tested with the stem in the vertical position, double flanging both sides of the valve and using a pipe stand is permitted for the high-pressure seat tests. Double flanging both sides of the valve and using a bubbler is permitted for the low-pressure air seat test when approved by the Owner.

C.2.1.4 Stop-check valves shall be tested in accordance with the requirements of API Standard 598 for both globe and check valves and shall meet the acceptance criteria of both types of tests.

C.2.1.5 Shell testing of bellows sealed valves shall be completed with the packing loose.

C.2.1.6 For quarter turn valves, verify and document that the operating torque is within the manufacturer's or Owners acceptable torque range.

C.3 Test Equipment

C.3.1 Test equipment that may conceal or reduce disqualifying conditions from being easily detected shall not be used.

C.3.2 Gauges used for pressure tests shall have been calibrated to the National Bureau of Standards within the previous year and shall be functioning properly at the time of the test.

C.3.3 Equipment used for pressure tests shall not apply external forces that affect seat or shell leakage. If an end-clamping test fixture is used, the Reconditioner shall demonstrate that the fixture does not affect the seat-sealing capability of the valve being tested.

C.3.4 Handwheel wrenches shall be limited to a length of approximately twice the size (NPS or DN) of the valve being tested. Extensions on the wrenches shall not be used. Handwheel wrenches shall not be used on valves with gear operators.

EXAMPLE A 457 mm (18 in.) to 610 mm (24 in.) handwheel wrench may be used on a NPS 10 (DN 250) valve.

C.3.5 Hammers shall not be used on the valve body, flanges, or handwheel wrench to help seat the wedge.

Annex D
(normative)

Low Emissions Verification

D.1 Scope

This annex covers requirements for repacking of repaired valves for low-emissions applications

D.2 General

D.2.1 All steps listed in the base document concerning stem and stuffing box geometry, finishes and dimensions must be followed, and data recorded.

D.2.2 Low-emissions verified packing shall be installed in the valve per the packing manufacturer's instructions. If graphitic packing is used, it shall be per API Standard 622.

D.3 Testing and Documentation

D.3.1 Following LE packing installation, the valve shall be stroked from open to closed.

D.3.2 The valve ends shall be sealed or mounted in a valve test stand.

D.3.3 The test temperature shall be between 5 °C (41 °F) and 50 °C (122 °F).

D.3.4 With the obturator in the partially open position, the valve shall be pressurized with 100 psi test fluid. The test fluid shall be either helium or methane, as specified by the Owner.

D.3.5 Under pressure, the valve shall be fully cycled open-to-close, five times and leave in the partially open position.

D.3.6 After a minimum duration of 5 min, measure the bonnet and stem seal leakage. Scanning probe distance to not exceed $^{1}/_{8}$ in. (3 mm) during bonnet and stem seal leakage measurement. Monitor leakage for a minimum of 1 min or until leakage stabilizes.

D.3.7 A reading above 100 ppmv (methane) or 3.0e-3 atm cc/sec (helium), shall require the valve to be repacked or repaired as required and re-tested.

D.3.8 While the valve body is still pressurized, the periphery of the gasket area shall be sniffed. Any reading above 50 ppmv (methane) or 1.5 × 10–3 atm cc/sec (helium) shall require additional repair or remediation and re-testing.

D.3.9 Valves having passed the above test procedure shall have a low-emissions tag attached to the valve body or stuffing box area. The valve packing manufacturer and style, as well as the recommended packing torque shall be noted on this tag or on an additional tag attached to the stuffing box area.

Annex E
(informative)

Service Specific Requirements

E.1 Scope

This annex covers additional repair recommendations and safety precautions that should be considered when repairing valves in selected specific service applications. Valves in these applications often require precautions or procedures exceeding those listed in the base document. The Owner should identify the service to the Reconditioner to aid in providing an adequate inspection, repair, and testing of the valve.

For more information on the damage mechanisms listed below refer to API 571.

E.2 Services

E.2.1 High Temperature Hydrogen Service

E.2.1.1 Overview

Due to the small molecule size of hydrogen and its inflammability, pressure containing valve components must be sound and free of internal defects (see E.2.1.5 for acceptance criteria).

E.2.1.2 Safety

Hydrogen may be trapped in the metal, caution should be used during cutting, grinding, burning, or welding activities.

E.2.1.3 Damage Mechanism

The following damage mechanisms can apply to valves in high temperature hydrogen service.

a) High Temperature H_2/H_2S Corrosion—Corrosion will appear as uniform loss in thickness from the process side and is accompanied by the formation of an iron sulfide scale. Carbon steel and low-alloy steels are more susceptible to this damage.

b) High Temperature Hydrogen Attack—At elevated temperatures and pressures, dissociated hydrogen atoms react with elements in steel and form CH_4 which can become trapped in the steel. As the pressure of the CH_4 builds up, it can form cavities in the steel that eventually leads to the formation of cracks. Carbon steel and low-alloy steels are more susceptible to this damage.

c) Hydrogen Embrittlement—Diffusion of atomic hydrogen into the metal resulting in a loss of strength, ductility, fracture toughness, or a combination thereof, which can lead to brittle cracking. Low-alloy steels, high strength steels, 400 series SS, precipitation hardenable SS, duplex SS, and some high strength nickel-based alloys are susceptible to this damage. Carbon steel that has been hardened by cold work or welding may also be susceptible to this damage.

E.2.1.4 Material/Welding Concerns

The following material and welding concerns can apply to valves in high temperature hydrogen service.

a) Applying a hydrogen bake out can improve weld quality by removing any traces of molecular hydrogen trapped in the steel. If a hydrogen bake out is performed and detailed requirements are not provided by the Owner, it should be in a temperature controlled oven at 600 °F for 1 hr. per inch of thickness for a minimum of 1 hr.

b) Repair of valve castings shall be in accordance with the casting specification, construction code, and the Owner's instructions.

E.2.1.5 Inspection/Testing

For valve castings in hydrogen service, it is recommended that additional NDE is performed. See ASME B16.34, Section 8 for additional inspection methods and Mandatory Appendix I through III for acceptance criteria for RT/MT/PT. The Reconditioner should seek guidance on which NDE method to use from the Owner.

E.2.2 Coker Valves

E.2.2.1 Overview

Valves in coker applications are cycled often and operate at high temperatures. This operation can result in fatigue cracking and damage to components. Additionally, coke deposits may foul the valve body, restrict proper operation, and cause incidental damage.

E.2.2.2 Safety

Valves may contain coke buildup that requires removal.

E.2.2.3 Damage Mechanism

The following damage mechanisms can apply to valves in coker service.

a) Mechanical Fatigue—Occurs when a component is exposed to cyclical stresses over an extended period, often resulting in thru-wall cracking. All materials are susceptible to this damage. Cracks typically originate from a point of high stress concentration or discontinuity.

b) Thermal Fatigue—Result of cyclic stresses caused by variations in temperature. Damage is in the form of cracking that may occur anywhere in a metallic component where relative movement or differential expansion is constrained during repeated thermal cycling. All materials are susceptible to this damage. Cracks initiate from the ID or OD surface and are generally filled with oxides due to the elevated temperature exposure.

c) Sulfidation (Sulfidic Corrosion)—Corrosion of carbon steel and other alloys resulting from their reaction with sulfur compounds in high temperature environments. The presence of hydrogen accelerates corrosion. Because of the smooth, large, relatively uniformly corroded surface, it can lead to rupture failure rather than a localized or pinhole leak. Carbon steel and low-alloy steels are the most susceptible to this damage.

E.2.2.4 Materials/Welding Concerns

No additional concerns.

E.2.2.5 Inspection/Testing

The following additional inspection and testing apply to valves in coker service.

a) Surface examination should be completed to check for cracking.

b) Ensure that the purge systems are clear and operating properly and that any auxiliary valves are functioning properly.

c) For a lift type plug valve, verify that it properly seats in both the open and closed positions.

E.2.3 HF Alkylation

E.2.3.1 Overview

Repair of HF Alky valves should be generally governed by API Recommended Practice 751, and the Owner's specifications for welding, metallurgy, and inspection requirements.

E.2.3.2 Safety

The following safety concerns apply to valves in HF Alkylation service.

a) Valves and other equipment to be taken outside the battery limits of the alkylation unit should be tagged, opened, the packing removed, and the bonnet bolting loosened. Other areas where pockets of HF may have accumulated should be disassembled to ensure complete neutralization. The valve should be neutralized and identified with a caution tag indicating that the valve has been in HF service and has been neutralized. If neutralization inside the battery limits is impracticable, appropriate handling procedures should be developed. Personal protective equipment requirements should be specified for personnel who disassemble neutralized equipment in the unit or in the shop.

b) The Reconditioner shall note that remnants of HF acid may still be contained in the valve and that suitable safety precautions should be taken until the individual valve components have been again neutralized by the Reconditioner.

c) Hydrofluoric acid is a corrosive, fuming liquid that can form a vapor cloud if released to the atmosphere. It is completely soluble in water. Contact with HF liquid or vapor can cause severe burns, sometimes with delayed onset. Exposure can lead to serious health effects or even death.

d) Iron Fluoride scale and Acid Soluble Oil (ASO) may also be present in valves. These materials should be completely removed prior to welding, and appropriate PPE should be used as long as they are present.

E.2.3.3 Damage Mechanism

The following material and welding concerns can apply to valves in HF Alkylation service.

a) Hydrofluoric Acid Corrosion—Services containing both water and hydrofluoric acid can result in general or localized corrosion and may also be accompanied by hydrogen cracking, blistering, or HIC/SOHIC (cracking). Significant fouling due to iron fluoride scales may also be present on carbon steel.

b) Hydrofluoric Acid Stress Corrosion Cracking of Nickel Alloys—Surface initiated cracking that may occur in nickel alloys due to the presence of oxygen with hydrofluoric acid. Alloy K-500 and Alloy 400 are more susceptible to this damage.

c) Hydrogen Stress Cracking in Hydrofluoric Acid—Environmental cracking that can occur in carbon steel and low alloy steels with localized zones of high hardness in the weld metal or HAZ when exposed to hydrofluoric acid.

E.2.3.4 Materials/Welding Concerns

The following material and welding concerns can apply to valves in HF Alkylation service.

a) Low Residual Elements (RE) and Carbon Equivalent (CE) requirements for carbon steel may be specified by the Owner.

b) Specific PWHT requirements are normally provided for carbon steel and Ni-Cu alloy materials in API Recommended Practice 751 or provided by the Owner.

E.2.3.5 Inspection/Testing

The following inspection and testing apply to valves in HF Alkylation service.

a) The test medium should typically be kerosene, nitrogen, or helium, water should not be used.

b) Additional NDE is recommended for valves that have been in HF Acid service and should be specified by the Owner. Additional NDE may include surface examination per ASME B16.34, Helium Leak Testing per ASME BPVC Section V, Article 10, Radiography per ASME B16.34, or a combination of thereof.

E.2.4 Amine, Caustic, or Carbonate Service

E.2.4.1 Overview

Valves in Amine, Caustic, or Carbonate service are subjected to a corrosive environment and require specific materials and welding/heat treatment procedures.

E.2.4.2 Safety

The repair facility should assume that Amine, Caustic, or Carbonate service valves still may contain traces of Amine, Caustic, or Carbonate and should be treated as potentially hazardous upon receipt.

E.2.4.3 Damage Mechanism

The following damage mechanisms can apply to valves in amine, caustic, or carbonate service.

a) Amine Corrosion—Uniform thinning in localized (isolated) locations or localized under-deposit attack. May be worse in areas of higher velocity and at welds. Primarily occurs on carbon steel in amine treating processes.

b) Amine Stress Corrosion Cracking—Cracking of steels under tensile stress and aqueous amine solution. Typically found at or adjacent to non-PWHT carbon steel welds or in highly cold worked parts. Carbon steel and low-alloy steels are susceptible to this damage.

c) Amine Hydrochloride Corrosion—Localized corrosion, often pitting, normally occurring under amine salt deposits. Carbon steel and low-alloy steels are the most susceptible, but higher alloys can also be susceptible to this damage.

d) Carbonate Stress Corrosion Cracking—Cracking that occurs in processes containing free water phase with carbonate ions and where some amount of H2S is also present. Carbon steel and low-alloy steels with welds or cold worked areas are susceptible to this damage. Cracking generally occurs in weld, HAZ, or adjacent base metal within 2 in. of the weld.

e) Caustic Corrosion—Localized corrosion due to the concentration of caustic solutions and corrosive salts from those solutions. General thinning may also occur. Carbon steel is the most susceptible, but low-alloy steels and 400 series SS can be susceptible at elevated temperatures. Localized corrosion may appear as gouging or grooving.

f) Caustic Stress Corrosion Cracking—Surface-initiated cracks that occur when exposed to caustic at elevated temperature, primarily adjacent to non-PWHT welds. Carbon steel, low-alloy steel, and 300 series SS are more susceptible to this damage. Cracking generally occurs in the base metal adjacent to the weld but can occur in the weld deposit or HAZ.

E.2.4.4 Materials/Welding Concerns

The following materials and welding concerns can apply to valves in amine, caustic, or carbonate service.

a) A neutralization wash step may be appropriate prior to welding on valves previously in amine or caustic service.

b) All welding shall be in accordance with NACE MR0103 and NACE SP0472, or the Owner's specification.

c) PWHT shall be in accordance with NACE SP0472 or the Owner's specification.

E.2.4.5 Inspection/Testing

All accessible wetted components shall be hardness tested with acceptance criteria in accordance with NACE MR0103.

Annex F
(informative)

Quarter Turn Valve Specific Requirements

F.1 Purpose

The purpose of this annex is to provide additional inspection, repair, and testing requirements that are common for quarter turn valves that are not covered in the base document. Specialty engineered quarter turn valves are outside of the scope of this annex.

F.2 Ball Valves

F.2.1 Scope

The following ball valves are covered in the scope of this annex, API Standard 608 metal seated and soft seated ball valves. Severe service metal seated ball valves are not covered in the scope since they are typically highly engineered valves with too many details to cover in this RP.

F.2.2 Disassembly

F.2.2.1 Ensure the body and ball cavity is clear, including behind the seats.

F.2.2.2 Examine and document the configuration of the seals and packing.

F.2.3 Inspection

F.2.3.1 Body

Refer to API Standard 608, Section 5.3 for minimum thickness requirements of the valve body.

F.2.3.2 Ball

The following items are to be included when inspecting the ball.

a) Inspect the surface finish on the ball, and if present, the coating on the ball shall be inspected to ensure adequate integrity (e.g. coating thickness, holiday check). The coating inspection may vary depending on whether the valve has metal or soft seats.

b) Inspect the stem slot for deformation.

c) Measure the diameter of the ball in multiple locations to verify the roundness of the ball. If the ball is machined and lapped, verify that the seat rings snuggly fit the newly machined and lapped ball.

CAUTION — Excessive machining and lapping of the ball may result in the ball not properly fitting with OEM seats.

d) Specially coated balls and seats, with Owner's approval, may be recoated per the original manufacturer's or Owner's specification.

e) The surface finish of the ball shall comply with OEM requirements. If OEM requirements are not available, Ra of 0.4 µm (16 µin.) may be used as the maximum.

F.2.3.3 Seats

The following items are to be included when inspecting the seats.

a) Inspect the surface finish on the seating surfaces.

b) For metal seated valves, inspect the finish of the seating surfaces and contact of the ball to seating surface (e.g. bluing, feeler gages).

c) Confirm if shims are present behind the seats.

d) Visually inspect the seat rings for corrosion, wear or cuts and any apparent leakage between the seat ring and body.

e) If condition and dimensions of the seat rings permit, they may be repaired by coating or machining.

f) If seat rings are not repairable, they shall be replaced.

g) Verify the “stack up” dimension of the seats and ball in metal seated designs, if possible.

F.2.3.4 Stem

The following items are to be included when inspecting the stem.

a) The stem diameter should be no more than 0.015 in. below nominal diameter or as allowed by the valve OEM or Owner.

b) Verify the condition of the stem to ball slot and keyways are not damaged or misaligned (e.g. twisted stem).

c) If the stem is hardened or coated, perform a Penetrant Test to check for cracking.

d) Confirm that the stem is a blowout proof design, unless otherwise approved by the Owner.

F.2.3.5 Anti-static Device

The following items are to be included when inspecting the anti-static device.

a) Confirm the anti-static device, if present, is installed correctly.

b) With agreement from the Owner, an anti-static device may be added if not already present.

c) The anti-static device shall be compatible with the material of the stem.

d) Per API Standard 608, Section 5.4:

“The antistatic feature shall have electrical continuity across the discharge path with a Resistance not exceeding 10 ohms from a power source not exceeding 12 VDC when type tested on a new, dry, as-built valve after open-close position cycling of the valve at least five times.”

F.2.4 Reassembly

F.2.4.1 If the configuration and material of the seals and packing is not clear, verify proper configuration with the manufacturer, if available.

F.2.4.2 Lap the ball and metal seats. Metal and graphite seat rings must be lapped after machining.

F.2.4.3 Replace all soft goods such as packing, O-rings and lip seals.

F.2.4.4 Confirm the motion of the ball and that the actuator/operator stops are set correctly.

F.2.4.5 If the valve utilizes overpressure protection in the form of a vented ball, verify that the vent is located in the high pressure end during assembly.

F.2.4.6 If the valve utilizes overpressure protection in the form of self-relieving seats, verify that the seats are installed in the correct position. Verify that the seats are per OEM requirements.

F.2.4.7 If any machining was completed on the ball, seats, or seat pockets, OEM components may not fit and require custom fabricated components. When nonstandard dimensional components are used, an identification tag stating "Contains Modified Components" shall be attached to the valve.

F.2.4.8 Any flange face interruption dimensions and tolerances shall be in accordance with API Standard 608, Section 5.9.

F.2.4.9 For unidirectional or preferred direction seated valves, confirm the valve is assembled per the marking on the valve body.

F.2.4.10 The following requirements from API Standard 608 shall be applied during reassembly.

a) Light oil or antiseize compound may be applied to facilitate assembly of mating metal components.

b) Light oil, having a viscosity no greater than kerosene, may be used to assemble O-rings (verify chemical compatibility with the lubricant and O-ring material) or other seals required to move during valve assembly.

c) No sealant or grease shall be applied to the ball-seat interface prior to testing.

F.2.5 Testing

For testing requirements for ball valves, refer to Annex C.

F.3 Plug Valves

F.3.1 Scope

The following plug valves are covered in the scope of this annex, and API Standard 599 (lubricated plug, non-lubricated/sleeved plug, and lift plug types).

F.3.2 Disassembly

F.3.2.1 Ensure the cavity between the plug and body, below the plug, and behind the sleeve is clear.

CAUTION — Lubricated plug valves may still contain grease between the plug and body. Sleeve lined or fully lined plug valves may contain product between the lining and valve body.

F.3.2.2 Examine and document the configuration of seals and packing.

F.3.3 Inspection

F.3.3.1 Body

The following items are to be included when inspecting the body.

a) Refer to API 599, Section 5.2 for minimum thickness requirements of the valve body.

b) Clean and inspect the grease injection fitting and the check valve if present.

F.3.3.2 Plug

The following items are to be included when inspecting the plug.

a) Inspect the surface finish on the plug, and if present, the coating on the plug shall be inspected to ensure adequate integrity (e.g. coating thickness, holiday check). The coating inspection may vary depending on plug design.

b) Check for stem slot deformation, if applicable.

c) Specially coated plugs and seats, with Owner's approval, may be recoated per the original manufacturer's specification.

d) The surface finish of the plug for sleeved valves shall be Ra of 0.4 μm (16 μin.) or lower.

F.3.3.3 Seats/Liner

The following items are to be included when inspecting the seat/liner.

a) Inspect the surface finish on the seating surfaces.

b) Inspect the finish of the seating surfaces and contact of the plug to seating surface (e.g. bluing, feeler gages).

c) Visually inspect the seats or liner for corrosion, wear or cuts and any apparent leakage between the seats or liner and the body.

d) If condition and dimensions of the seats permit, metal seats may be repaired by coating, machining, lapping, or grinding as required. Integral metal seats may be repaired by welding then machining, lapping, or grinding as applicable.

e) Liners and sleeves shall not be repaired and should be replaced with OEM components. If OEM liners are not available, consult with the Owner for other options.

f) Verify the port alignment of the plug to body is within ± $^{1}/_{8}$ in. Plugs or seats that have been over machined may allow the ports to drop and require replacement or weld buildup and re-machining.

F.3.3.4 Stem

The following items are to be included when inspecting the stem.

a) The stem diameter should be no more than 0.015 in. below nominal diameter or as allowed by the valve OEM or Owner.

b) Confirm that the condition of the stem to plug connection and keyways are not damaged or misaligned (e.g. is the stem twisted, keyway edges are square).

c) If the stem is hardened or coated, perform a Penetrant Test to check for cracking.

d) Confirm that the stem is a blowout proof design, unless otherwise approved by the Owner.

F.3.3.5 Anti-static Device

The following items are to be included when inspecting the anti-static device.

a) Confirm the anti-static device, if present, is installed correctly.

b) With agreement from the Owner, an anti-static device may be added if not already present.

c) The anti-static device shall be compatible with the material of the stem.

d) Per API Standard 599, Section 5.8:

"The antistatic feature shall have electrical continuity across the discharge path with a resistance not exceeding 10 ohms from a power source not exceeding 12 VDC when type tested on a new, dry, as-built valve after open-close position cycling of the valve at least five times."

F.3.4 Reassembly

F.3.4.1 If the configuration and material of the seals and packing is not clear, verify proper configuration with the manufacturer or Owner, if available.

F.3.4.2 Lap plug and metal seats, if needed.

F.3.4.3 Replace the diaphragm, if applicable.

F.3.4.4 Replace all soft goods (such as packing, O-rings, lip seals, liner, and sleeve)

CAUTION — PTFE sleeves need to have proper equipment and fixtures for installation of new sleeve.

F.3.4.5 Confirm the motion of the plug and that the actuator/operator stops are set correctly.

F.3.4.6 If the valve utilizes a vented body cavity, verify that the vent is clear and properly oriented.

F.3.4.7 If the service allows, a light oil or antiseize compound may be applied to facilitate assembly of mating metal components. Ensure that the lubricant or antiseize compound is compatible with the process.

F.3.4.8 For sleeved plug valves, assemble the valve with proper lubricant as specified by the OEM or as specified by the Owner.

F.3.4.9 For lubricated plug valves, assemble the valve with the proper OEM sealing lubricant or as specified by the Owner. The Owner shall verify that the sealing lubricant is compatible with the process.

F.3.5 Testing

For testing requirements for plug valves, refer to Annex C.

F.4 Butterfly Valves

F.4.1 Scope

The following butterfly valves are covered in the scope of this annex, API Standard 609 (resilient seated, double offset/high performance, and triple offset), and concentric disc and offset disc type butterfly valves.

F.4.2 Disassembly

F.4.2.1 Verify that there is no product in the upper seal/stuffing box cavity or in the lower thrust bearing/bushing area.

F.4.2.2 Examine and document the configuration of seals and packing.

F.4.2.3 If a resilient liner is installed in the valve, remove, and discard the liner, unless otherwise approved by the Owner.

F.4.3 Inspection

F.4.3.1 Body

The following items are to be included when inspecting the body.

a) Refer to API Standard 609, Section 5.2 for minimum thickness requirements of the valve body.

b) Visually inspect the seating surfaces (hard facing, integral seat, seat pockets).

F.4.3.2 Disc

The following items are to be included when inspecting the disc.

a) Specially coated components, with Owner's approval, may be recoated per the original manufacturer's specification.

b) Inspect the seal stack and replace components as required with OEM replacement parts.

c) If equipped with a disc to shaft/stem locking mechanism (keyway or locking pin), inspect for proper alignment and fit.

d) Inspect the alignment and fit of the disc to shaft/stem attachment.

e) Inspect the surface finish on the seating surfaces.

F.4.3.3 Seat

The following items are to be included when inspecting the seat.

a) Inspect the surface finish on the seating surfaces.

b) Visually inspect the seat for corrosion, wear or cuts and any apparent leakage.

c) If condition and dimensions of the seats permit, metal seats may be repaired by coating, machining, lapping, or grinding as required. Integral metal seats may be repaired by welding then coating, machining, lapping, or grinding as applicable.

d) Liners shall not be repaired, and should be replaced with OEM components, if available.

F.4.3.4 Shaft/Stem

The following items are to be included when inspecting the shaft/stem.

a) For shaft/stem minimum diameter (undertolerance), consult with the manufacturer.

b) If the shaft/stem is hardened or coated, perform a Penetrant Test to check for cracking.

c) Confirm that the shaft/stem is a blowout proof design, unless otherwise approved by the Owner.

d) Inspect the stem to actuator attachment connection to verify there is no damage.

e) If not already present, score a line on the top of the shaft/stem to indicate the orientation of the disc.

F.4.3.5 Anti-static Device

The following items are to be included when inspecting the anti-static device.

a) Confirm the anti-static device, if present, is installed correctly.

b) With agreement from the Owner, an anti-static device may be added if not already present.

c) The anti-static device shall be compatible with the material of the stem.

d) Per API Standard 609, Section 7.3:

"To type test for continuity, a dry valve shall be cycled at least five times, and the resistance shall have electrical continuity across the discharge path with a resistance not exceeding 10 ohms as measured using a DC power source not exceeding 12 volts (see 5.10)."

F.4.4 Reassembly

F.4.4.1 If the configuration and material of the seals and packing is not clear, verify proper configuration with the manufacturer, if available.

F.4.4.2 Lap or polish seats, if required. Special jigs and fixtures are required to lap the seats.

F.4.4.3 Replace all soft goods (such as O-rings, lip seals, and liner).

F.4.4.4 Confirm the motion of the disc and that the actuator/operator stops are set correctly.

F.4.4.5 For resilient lined butterfly valves, assemble the valve with proper lubricant as specified by the OEM or by the Owner.

F.4.4.6 Seat retainer or retaining ring should be torqued in accordance with the manufacturer's specification. Refer to API Standard 609 for allowable protrusion of seat retainer plate.

F.4.4.7 Confirm the disc seats correctly.

F.4.4.8 Stroke the actuator to confirm it is operating correctly.

F.4.5 Testing

F.4.5.1 For testing requirements for butterfly valves, refer to Annex C.

F.4.5.2 Adjust stops as required to ensure correct seating performance.

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