American Water Works Association
ANSI/AWWA C504-94
(Revision of ANSI/AWWA C504-87)

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AWWA STANDARD

FOR

RUBBER-SEATED BUTTERFLY VALVES

AMERICAN NATIONAL STANDARD

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AMERICAN WATER WORKS ASSOCIATION

6666 West Quincy Avenue, Denver, Colorado 80235

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AWWA Standard

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Contents

Foreword

This foreword is for information only and is not a part of AWWA C504.

I. History of Standard. Rubber-seated butterfly valves have been in use for at least 50 years in pipelines carrying liquids and gases. Manufacturers of butterfly valves developed tight-closing, rubber-seated types for cooling water systems and power stations. Since 1940, most new valves installed for this type of service have been rubber-seated butterfly valves.

Since the late 1940s, rubber-seated butterfly valves have gained increased acceptance for use in water treatment plants and water supply and distribution lines because (1) they provide tight shutoff, (2) are relatively easy to operate, even with large pressure drops across the valves, and (3) require relatively little space for installation. The need for standardization of butterfly valves was recognized by the American Water Works Association (AWWA) in June 1953.

The committee appointed for the task of standardization developed AWWA C504, which was approved as tentative and published in September 1954. Four years later, in 1958, the tentative standard was accepted as standard.

The 1954 tentative standard was written to describe the then-available types of standard rubber-seated butterfly valves that had been in successful operation for at least five years prior to 1954. The standard established three pressure and two velocity classifications, standards for materials, laying lengths, minimum body and disc designs, and actuator sizes for valves having rubber seats in the valve body.

Since the publication of AWWA C504 in 1954, butterfly-valve designs have been improved and refined. In September 1962 a new committee was charged with the task of reviewing AWWA C504 and recommending revisions to the standard in order to make it compatible with then-current valve designs.

Generally, modern butterfly-valve designs for water service include cast-body construction in 25-psi (172-kPa), 75-psi (517-kPa), and 150-psi (1,034-kPa) pressure classes; flanged, mechanical-joint, and wafer bodies; rubber seats in valve bodies as well as on the valve discs; and operating conditions (limited by the design shutoff pressure and velocities of water flow) that produce torques considered maximum for the shaft size used. These modern practices were the basis for the revisions included in the 1966 edition of AWWA C504.

Revisions in the 1970 edition were initiated to minimize the corrosion of seating surfaces, to provide more adequate requirements for stainless steel, and to provide for painting of all valve interiors with asphalt varnish.

Revisions in 1974 and 1980 provided, for the most part, fine-tuning of the provisions of the standard. Major changes included the addition of provisions concerning the connection between shaft and disc and the use of carbon-steel shafts with stainless-steel journals.

Revisions in 1987 included using the word "actuator" rather than "operator" and providing definitions of valve classifications. Major changes included the addition of certain sprayed-metal seat surfaces and nonmetallic cylinder components as acceptable materials. Appendix B (now appendix A), Installation, Operation, and Maintenance of Rubber-Seated Butterfly Valves, was added.

II. General Information. Torque requirements for valve operation vary considerably with differential pressure across the valve, fluid velocity, and fluid temperature. Conditions under which a valve is to be operated must be evaluated carefully by the purchaser. The evaluations must include the determination of the hydraulic characteristics of the system in which the valve will be installed, including (1) the maximum transient and static combinations of differential pressure across the valve disc and (2) flow through the valve under the most adverse operating conditions.

The following discussion on applications of control valves is for general information. It is neither a part nor a requirement of the standard. Its purpose is to alert users of control valves to the many considerations and limitations of installing and using control valves. The following considerations apply to butterfly valves as well as many of the different types of control valves.

Flow direction is important in the installation and use of a valve. Some valves' performance and sealing characteristics vary with direction of flow. It is important that the user be aware of any flow preference.

Hydraulic testing, flow and sealing capacities, and valve torques are based on the flow upstream of a valve being uniform and undisturbed, like the flow produced by a long length of constant-diameter, straight pipe. Piping configurations in which upstream components affect and disturb the flow approaching a valve can have an adverse effect on the valve. Users should be aware of this possibility for upstream piping to affect the valve performance and operation.

Some flow systems are capable of producing higher flow velocities than are covered in this standard. The user of the butterfly valve should recognize that the valve may not operate properly at these higher velocities.

III. Advisory Information on Product Application. This standard does not cover all possible applications or manufacturing technologies. The purchaser should identify special requirements and required deviations from this standard and include appropriate language in purchase specifications. Refer to Sec. IV in this foreword. Other advisory information is provided below.

1. The maximum anticipated flow velocity through the valve, maximum nonshock shutoff pressure, water temperature range, and valve classification are used by manufacturers to calculate torque requirements, which then may determine valve operating-component design and actuator sizing. This information should be provided under items 5, 6, 7, and 27 of Sec. IV in this foreword. IF THIS INFORMATION IS NOT PROVIDED, VALVE CLASSIFICATION 150B WILL BE PROVIDED AND ACTUATORS WILL BE SIZED FOR THE MOST SEVERE CONDITIONS LISTED IN THIS STANDARD. THIS MAY RESULT IN A SIGNIFICANT UNWARRANTED EXPENSE.

Turbulence is also a factor that may affect torque requirements. Turbulence will be considered only if information on piping conditions is provided under item 31 of Sec. IV in this foreword.

2. This standard limits handwheel rim pull, but not handwheel diameter. A smaller handwheel may require a more expensive actuator requiring more turns. If a large-diameter handwheel is of concern, due to clearance or other limitations, then the diameter should be limited to an acceptable dimension under item 14 of Sec. IV in this foreword.

3. This standard recognizes nonmetallic water-hydraulic and pneumatic cylinder actuators, but does not specify materials or design details for such actuators. The suitability for the application depends, to a large extent, on the quality of the manufactured product. The purchaser should be aware of the manufacturer's previous experience with similar applications. The purchaser may limit acceptability to a specific product or application under item 17 of Sec. IV in this foreword.

4. This standard permits the use of some plated components in metallic water-hydraulic cylinder actuators. The purchaser should be aware of the possibility of plating failure, particularly when the operating water is aggressive. The purchaser may limit acceptability to cylinders having components that do not depend on platings to resist corrosion under item 17 of Sec. IV in this foreword.

5. This standard permits several metallic seating-surface materials. This standard recommends seating surfaces of stainless steel or nickel–copper alloy in cases where valves are to be operated more frequently than once a month. The purchaser may require these alloys for specific applications under item 12 of Sec. IV in this foreword.

6. This standard also accepts sprayed mating-seat surfaces when the surfaces are applied under certain conditions. The suitability of this type of surface depends, to a large extent, on the quality of the manufactured product. The purchaser should be aware of the manufacturer's previous experience with similar applications. The purchaser may limit acceptability to a specific product or application under item 12 of Sec. IV in this foreword.

7. The material references for metals in Sec. 2 and Sec. 3 of this standard are based on successful experience. There may be instances where the water is very aggressive and the listed materials, particularly the bronzes, may not be suitable for surfaces in both the valve and, if applicable, the hydraulic cylinder actuators wetted by the line content. In these cases, such alternative materials as low zinc and low aluminum (7 percent maximum zinc, 2 percent maximum aluminum) should be specified. The purchaser should recognize that alternative materials may increase costs and delivery time. Refer to item 12 of Sec. IV of the foreword.

8. The requirements for rubbers are included in Sec. 3 of this standard. This standard does not require rubber parts to be specifically tested or to be specifically suitable for service with line content containing chlorine or chloramines. Standardized tests measuring resistance to chlorine- or chloramine-bearing waters were not available at the date of revision of this standard. If these or other chemical constituents are of concern, special requirements may be included in the specifications. Refer to item 32 of Sec. IV in the foreword.

9. This standard does not require a minimum waterway area nor does it limit head loss across the valve. If this is of concern, limitations should be provided. Refer to item 30 of Sec. IV of this foreword.

IV. Information Regarding Use of This Standard. When placing orders for valves to be manufactured in accordance with this standard, the purchaser's specifications should include the following:

1. Standard to be used — that is, AWWA C504, Standard for Rubber-Seated Butterfly Valves.
2. Size of valve.
3. Quantity required.
4. Type of body: flanged (short body or long body), wafer, or mechanical-joint ends.
5. Minimum acceptable valve classification.
6. Maximum nonshock shutoff pressure and maximum nonshock line pressure.
7. Flow-through valve:
   a. Under normal conditions.
   b. Under maximum-flow conditions.
      — When opening (consider such factors as fire flow).
      — When closing (consider such factors as line break).

8. The furnishing of test records that are specified under Sec. 2.3, Sec. 3.8.5.8, Sec. 3.8.5.9, Sec. 5.2.1, Sec. 5.2.2, Sec. 5.2.3, and Sec. 5.2.4 of this standard. Test records required for power actuators under ANSI/AWWA C540, Standard for Power-Actuating Devices for Valves and Sluice Gates, may also be requested. The purchaser may require all records or may stipulate a breakdown of production test records and/or proof-of-design test records.

9. Description of connecting piping: material, outside diameter (OD) and inside diameter (ID), and flanged or plain end.

10. Detailed description of nonstandard end connections (Sec. 3.1 and Sec. 3.2).

11. Type of shaft seal (Sec. 3.7).

12. Materials.

a. If one or more of the materials included in this standard are unacceptable, specify the acceptable materials that are included in this standard.

b. If materials included in the standard are not suitable for exposure to line content or are otherwise unacceptable, specify materials that are suitable and acceptable. (Refer to item 7, Sec. III of this foreword.)

c. Metallic mating seats: Specify any limitations on the acceptability of seat materials or sprayed seats for specific applications or specific products.

13. Type of installation: buried, submerged, or in-plant.

14. Actuator type and service conditions.

a. Type — manual, electric, cylinder, or other.

b. Service — open/close or modulating.

15. Manual actuator.

a. Type — handwheel, chainwheel, or wrenchnut.

b. Direction to turn operating stem to open valves. (Unless otherwise specified, counterclockwise direction to open the valve will be furnished.)

c. Position indicator:

— If it is required.

— Configuration for buried, submerged, or in-plant service.

d. Special devices or features if required: extension stem, floorstand, handwheel diameter, or position transmitter.

16. Electric actuator (Sec. 3.8.6).

a. Characteristics: operating voltage, control scheme, and time of operation (unless otherwise specified, fully open to fully closed, or the reverse, will be approximately 60 s).

b. Position indicator: configuration.

c. Special considerations: Type of service environment should be stated and appurtenances required.

17. Cylinder actuator.

a. Operating medium: air, water, or oil.

b. Pressure: maximum and minimum.

c. Characteristics: control scheme, opening and closing speed ranges if different than the 30 to 60 s required by ANSI/AWWA C540.

d. Position indicator:

— If it is required.

— Configuration.

e. Special requirements:

— Specify any limitations on acceptability or any special construction required.

18. Other actuators: Actuators other than those covered by this standard or ANSI/AWWA C540 shall be specified by the purchaser in detail.

19. Valve and actuator arrangement and position.

20. Protective coatings if other than specified in Sec. 4.2 of this standard.

21. If an affidavit of compliance is to be furnished (Sec. 1.7).

22. If the manufacturer shall furnish dimensions of the clearance required for the valve discs (Sec. 1.5).

23. If certified drawings are to be furnished by the manufacturer (Sec. 1.4 and Sec. 1.5).

24. If valve-torque data are to be furnished.

25. If shop inspection by the purchaser is required.

26. Maximum transient pressure and its characteristics if known.

27. Water temperature range.

28. If a leakage test in both directions is required.

29. If a leakage test with the actuator attached is required. NOTE: This may not be a standard practice for some manufacturers and, therefore, may result in increased cost and delivery time.

30. If a maximum head loss is required. This information should be provided for each size and class of valve. NOTE: Not all manufacturers may use the same test methods in measuring head loss; this should be discussed by the purchaser and the manufacturer.

31. A drawing or description of the piping arrangement sufficient to describe significant turbulent line flow conditions to which the valve disc may be subjected.

32. Considerations relating to anticipated problems with rubber components exposed to line content containing chlorine, chloramines, or other chemicals. If such problems are anticipated, the purchaser should identify the maximum expected concentrations of these chemicals and other factors, such as pH and temperature ranges, which may affect the corrosivity of these chemicals. The purchaser should consult with the manufacturers and, if appropriate, specify special requirements for these components.

V. Acceptance. In May 1985, the US Environmental Protection Agency (USEPA) entered into a cooperative agreement with a consortium led by NSF International (NSF) to develop voluntary third-party consensus standards and a certification program for all direct and indirect drinking water additives. Other members of the consortium included the American Water Works Association Research Foundation (AWWARF), the Conference of State Health and Environmental Managers (COSHEM), the American Water Works Association (AWWA), and the Association of State Drinking Water Administrators (ASDWA). The consortium is responsible for the cooperative effort of manufacturers, regulators, product users, and other interested parties that develop and maintain the NSF standards.

In the United States, authority to regulate products for use in, or in contact with, drinking water rests with individual states.* Local agencies may choose to impose requirements more stringent than those required by the state. To evaluate

*Persons in Canada, Mexico, and non-North American countries should contact the appropriate authority having jurisdiction.

the health effects of products and drinking water additives from such products, state and local agencies may use various references, including

1. An advisory program formerly administered by USEPA, Office of Drinking Water, discontinued on Apr. 7, 1990.

2. Specific policies of the state or local agency.

3. Two standards developed under the direction of NSF, ANSI*/NSF† 60, Drinking Water Treatment Chemicals — Health Effects, and ANSI/NSF 61, Drinking Water System Components — Health Effects.

4. Other references, including AWWA standards, *Food Chemicals Codex, Water Chemicals Codex,*‡ and other standards considered appropriate by the state or local agency.

Various certification organizations may be involved in certifying products in accordance with ANSI/NSF 61. Individual states or local agencies have authority to accept or accredit certification organizations within their jurisdiction. Accreditation of certification organizations may vary from jurisdiction to jurisdiction.

Appendix A, "Toxicology Review and Evaluation Procedures," to ANSI/NSF 61 does not stipulate a maximum allowable level (MAL) of a contaminant for substances not regulated by a USEPA final maximum contaminant level (MCL). The MALs of an unspecified list of "unregulated contaminants" are based on toxicity testing guidelines (noncarcinogens) and risk characterization methodology (carcinogens). Use of Appendix A procedures may not always be identical, depending on the certifier.

AWWA C504-94 does not address additives requirements. Thus, users of this standard should consult the appropriate state or local agency having jurisdiction in order to

1. Determine additives requirements, including applicable standards.

2. Determine the status of certifications by all parties offering to certify products for contact with, or treatment of, drinking water.

3. Determine current information on product certification.

VI. Modification to Standard. Any modification of the provisions, definitions, or terminology in this standard must be provided in the purchaser's specifications.

VII. Major Revisions. Major revisions included in this edition of AWWA C504 consist of the following:

1. Appendix A, Suggested Method for Calculating Torques Required to Operate Butterfly Valves, was deleted.
2. Soft metrification was implemented.
3. Scope — temperature and pH ranges were added.
4. Section 2, Materials:
    a. Lead content of wetted parts was limited.
    b. 70-50-05 ductile iron was added.
    c. Corrosion-resistant metals were defined.
5. Section 3, General Design:
    a. Connection requirements were clarified and expanded.

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*American National Standards Institute, 11 W. 42nd St., New York, NY 10036.

†NSF International, 3475 Plymouth Rd., Ann Arbor, MI 48106.

‡Both publications available from National Academy of Sciences, 2102 Constitution Ave. N.W., Washington, DC 20418.

b. Section 3.5.3.1 was expanded to allow a nickel-alloy seat and to require a minimum metal seat width.

c. Section 3.5.3.3 was expanded to include a welding process to attach a mating seat.

d. Section 3.7.4.2 was expanded to permit the use of engineered plastic materials.

e. Section 3.8.1 was expanded to include the basis for actuator sizing.

f. Section 3.8.6: Requirements for electric actuators are now included in AWWA C540.

g. Section 3.8.7: Requirements for cylinder actuators are now included in AWWA C540.

6. Former appendix B is now appendix A.

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(Revision of ANSI/AWWA C504-87)

AWWA STANDARD FOR

RUBBER-SEATED BUTTERFLY VALVES

SECTION 1: GENERAL

Sec. 1.1 Scope

This standard covers rubber-seated butterfly valves, 3 in. (75 mm) through 72 in. (1,800 mm) in diameter, with various body and end types, for fresh water having a pH range from 6 to 10 and a temperature range from 33° to 125°F (0.6° to 52°C). This standard covers rubber-seated butterfly valves suitable for a maximum steady-state fluid working pressure of 150 psig (1,034 kPa [gauge]), a maximum steady-state differential pressure of 150 psi (1,034 kPa), and a maximum velocity of 16 ft/s (4.9 m/s).

1.1.1 *Body types, classes, and sizes.* Valves covered by this standard are furnished in four body types and in classes as follows:

1.1.1.1 Wafer valves. Class 150B, in sizes 3–20 in. (75–500 mm).

1.1.1.2 Short-body flanged valves. All classes, in sizes 3–72 in. (75–1,800 mm).

1.1.1.3 Long-body flanged valves. Class 75A, class 75B, class 150A, and class 150B, in sizes 3–72 in. (75–1,800 mm).

1.1.1.4 Mechanical-joint-end valves. Class 150B, in sizes 3–24 in. (75–600 mm), and all classes in sizes 30–48 in. (750–1,200 mm).

1.1.2 *Definition of classification.* In each case, the numeric designation represents the pressure rating (the maximum steady-state fluid working pressure, in pounds-per-square-inch gauge) and also the maximum steady-state differential pressure, in pounds per square inch, for which the valve is designed. The designations "A" and "B" define the flow-rate capabilities with the valve in the fully open position. "A" valves are rated for a maximum velocity of 8 ft/s (2.4 m/s), and "B" valves are rated for a maximum velocity of 16 ft/s (4.9 m/s) in the piping section upstream of the valve.

Sec. 1.2 Definitions

In this standard, the following definitions shall apply:

1.2.1 *Actuator:* A device attached to the valve for the purpose of rotating the valve disc to an open, closed, or intermediate position; preventing disc overtravel; and maintaining the disc in any position.

1.2.2 *Bearing:* The cylindrical journal located in the body hubs that is used to support the valve shaft(s) and transmit disc forces to the valve body while minimizing friction and wear.

1.2.3 *Body:* The primary pressure-retaining structure of the valve that forms a portion of the pipeline and that has ends adapted for connection to the piping.

1.2.4 *Butterfly valve:* A valve that uses a disc rotatable through an angle of approximately 90° as a closure member. The valve is closed when the disc is perpendicular to the flow way, open when parallel to the flow way, or used for throttling when positioned between open and closed.

1.2.5 *Chainwheel:* A chain-driven wheel with a closed loop of chain draped over it to facilitate the actuation of an overhead-mounted valve.

1.2.6 *Cylinder actuator:* An actuator that employs fluid power and mechanically converts hydraulic or pneumatic pressure acting on a piston within a cylinder.

1.2.7 *Disc:* The closure member that is positioned in the flow stream to permit flow or to obstruct flow (depending on closure position) and that rotates through an angle of 90° from full open to full shutoff.

1.2.8 *Electric actuator:* An electromechanical actuator that employs the power of an electric motor converted through a gear-reduction unit.

1.2.9 *Fluid working pressure:* The internal hydrostatic pressure for which the valve body is designed without regard to disc position or actuator capacity.

1.2.10 *Handwheel:* A circular-rimmed component connected to the input shaft of an actuator to facilitate the manual actuation of a valve.

1.2.11 *Hub:* Structural raised-area (boss) member cast integrally on the valve body used to support the valve-shaft bearing and valve shaft.

1.2.12 *Long-body flanged valve:* A flanged valve designed to be installed between and attached to pipe flanges and that has a laying length as shown in Table 2 on page 8.

1.2.13 *Manual actuator:* An actuator that can be operated by a person without the need for an external energy source, such as electrical power or fluid pressure.

1.2.14 *Manufacturer:* The party that manufactures, fabricates, or produces materials or products.

1.2.15 *Mating surface:* The metal ring around the inside of the valve body or the outside edge of the valve disc that seals with the rubber seat when the disc is closed.

1.2.16 *Mechanical-joint valve:* A valve with mechanical-joint-type ends conforming to ANSI/AWWA C111/A21.11.

1.2.17 *O-ring seal:* A type of seal consisting of an elastomer in the shape of a torus, i.e., a circular shape with a circular cross section.

1.2.18 *Outboard thrust bearing:* A bearing that is provided on the shaft outboard of the shaft seal or in the actuator housing to protect the shaft seal from side-thrust forces induced by the actuator.

1.2.19 *Pull-down, packing-gland sealing system:* An adjustable-type shaft seal in which the deformable sealing material is composed of one or more ring-shaped seals that have square or rectangular cross sections or are V-shaped (Chevron).

1.2.20 *Purchaser:* The person, company, or organization that purchases any materials or work to be performed.

1.2.21 *Rated differential pressure:* Pressure classes as defined in Sec. 3.5.1.

1.2.22 *Required actuator torque:* The value of torque that must be overcome by the actuator. Required actuator torque depends on the values of water temperature, pressure, and flow specified by the purchaser and on the hydraulic characteristics of the system in which the valve will be installed. Required actuator torque will vary depending on the geometrics of the valve disc and hydraulic characteristics, and can be influenced by the choice of materials for the valve seat and valve-shaft bearings. For these reasons, required actuator torque will vary among valves offered under this standard and must be determined by proof-of-design testing.

1.2.23 *Rubber seat:* A rubber ring around the outside edge of the valve disc or the inside of the valve body to effect a seal against the metal seating surface when the disc is closed.

1.2.24 *Shaft:* A bar extending through the body hubs and into the disc to support the disc and transmit operating torque to the disc closure member.

1.2.25 *Shaft seal:* A circular seal between the valve shaft and the inside cylindrical surface of the body hub that prevents the pressurized water from exiting and outside contaminants from entering the valve body in the area where the shaft protrudes through the body.

1.2.26 *Short-body flanged valve:* A flanged valve designed to be installed between and attached to pipe flanges and that has a laying length as shown in Table 2 on page 8.

1.2.27 *Shutoff pressure:* Actual differential pressure against which the valve is closed.

1.2.28 *Standard V-type packing:* An adjustable type of packing shaft seal in which the deformable sealing material is composed of one or more ring-shaped seals that have V-shaped cross sections.

1.2.29 *Supplier:* The party who supplies materials or services. A supplier may or may not be the manufacturer.

1.2.30 *Thrust bearing:* A device that supports the axial forces of the shaft and is used to center the disc in the valve body.

1.2.31 *Wafer valve:* A flangeless valve having a laying length as shown in Table 2 on page 8 and designed to be installed between pipe flanges.

Sec. 1.3 References

This standard references the following documents in their latest editions. The references form a part of this standard to the extent specified herein. In any case of conflict, the requirements of this standard shall prevail.

ASME*/ANSI† B16.1 — Cast-Iron Pipe Flanges and Flanged Fittings.

ASME Boiler and Pressure Vessel Codes.

ASTM A36‡ — Standard Specification for Structural Steel.

ASTM A48 — Standard Specification for Gray Iron Castings.

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*American Society of Mechanical Engineers, 345 E. 47th St., New York, NY 10017.

†American National Standards Institute, 11 W. 42nd St., New York, NY 10036.

‡American Society for Testing and Materials, 1916 Race St., Philadelphia, PA 19103.

ASTM A108 — Standard Specification for Steel Bars, Carbon, Cold-Finished, Standard Quality.

ASTM A126 — Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.

ASTM A167 — Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.

ASTM A216 — Standard Specification for Steel Castings, Carbon, Suitable for Fusion Welding, for High Temperature Service.

ASTM A240 — Standard Specification for Heat-Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet and Strip for Pressure Vessels.

ASTM A276 — Standard Specification for Stainless and Heat-Resisting Steel Bars and Shapes.

ASTM A436 — Standard Specification for Austenitic Gray Iron Castings.

ASTM A439 — Standard Specification for Austenitic Ductile Iron Castings.

ASTM A516 — Standard Specification for Pressure Vessel Plates, Carbon Steel, for Moderate- and Lower-Temperature Service.

ASTM A536 — Standard Specification for Ductile Iron Castings.

ASTM A564 — Standard Specification for Hot-Rolled and Cold-Finished Age-Hardening Stainless and Heat-Resisting Steel Bars, Wire, and Shapes.

ASTM A743 — Standard Specification for Castings, Iron-Chromium, Iron-Chromium-Nickel, and Nickel-Base Corrosion-Resistant for General Applications.

ASTM B117 — Standard Test Method of Salt Spray (Fog) Testing.

ASTM B127 — Standard Specification for Nickel–Copper Alloy (UNS N04400) Plate, Sheet, and Strip.

ASTM B154 — Standard Test Method for Mercurous Nitrate Test for Copper and Copper Alloys.

ASTM B160 — Standard Specification for Nickel Rod and Bar.

ASTM C633 — Standard Test Method for Adhesion or Cohesive Strength of Flame-Sprayed Coatings.

ASTM D429 — Standard Test Methods for Rubber Property — Adhesion to Rigid Substrates.

ASTM D471 — Standard Test Method for Rubber Property — Effect of Liquids.

ASTM D1141 — Standard Specification for Substitute Ocean Water.

ASTM D1149 — Standard Test Method for Rubber Deterioration — Surface Ozone Cracking in a Chamber.

ANSI/AWS* A5.14 — Specification for Nickel and Nickel Alloy Bare Welding Rods and Electrodes.

ANSI/AWWA C110/A21.10 — American National Standard for Ductile-Iron and Gray-Iron Fittings, 3 In. Through 48 In., for Water and Other Liquids.

ANSI/AWWA C111/A21.11 — American National Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.

ANSI/AWWA C540 — Standard for Power-Actuating Devices for Valves and Sluice Gates.

ANSI/AWWA C550 — Standard for Protective Epoxy Interior Coatings for Valves and Hydrants.

Fed. Spec.† TT-C-494B — Coating Compound — Bituminous Solvent Type, Acid Resistant.

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*American Welding Society, 550 N.W. LeJeune Road, P.O. Box 351040, Miami, FL 33135.

Sec. 1.4 Data to Be Furnished by the Bidder

When required, certified drawings and material specifications for the equipment to be supplied under this standard shall be provided. The drawings shall show valve-port diameter and shall be sufficiently detailed to show that the proposed equipment meets the purchaser's specifications. The submittal shall include a statement of the total net assembled weight of each valve.

Sec. 1.5 Data to Be Furnished by the Manufacturer or Supplier

Most butterfly-valve discs extend beyond the laying length of the valve body when in the open position. On request, the manufacturer or supplier shall furnish the dimensions of the clearance required for the valve disc. When required, the manufacturer or supplier shall submit, for acceptance by the purchaser, certified drawings showing the principal dimensions, construction, and materials used for all parts of the valve and actuator. All work shall be performed and all valves shall be furnished in accordance with the certified drawings after they have been accepted by the purchaser.

Sec. 1.6 Assembly

For valves having direct-mounted actuators, except those furnished with extension shafts, torque tubes, or floorstands, the valve and actuator shall be assembled and performance tested in accordance with Sec. 5.2.1 of this standard by the manufacturer or supplier.

Sec. 1.7 Affidavit of Compliance

Whether the purchaser has an agent at the plant or not, the purchaser may require an affidavit that the valves furnished comply with all applicable provisions of this standard.

Sec. 1.8 Permeation

The selection of materials is critical for water service and distribution piping in locations where there is likelihood the pipe will be exposed to significant concentrations of pollutants comprised of low-molecular-weight petroleum products or organic solvents or their vapors. Research has documented that pipe materials such as polyethylene, polybutylene, polyvinyl chloride, and asbestos cement; and elastomers, such as used in jointing gaskets and packing glands, may be subject to permeation by lower-molecular-weight organic solvents or petroleum products. If a water pipe must pass through such a contaminated area or an area subject to contamination, consult with the manufacturer regarding permeation of pipe walls, jointing materials, etc., *before* selecting materials for use in that area.

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§Federal Specifications are available from Naval Publications and Form Center, 5801 Tabor Ave., Philadelphia, PA 19120.

SECTION 2: MATERIALS

Sec. 2.1 General

All materials designated hereinafter, when used in valves produced under this standard, shall conform to the requirements designated in Sec. 2.2 for each material listed. Unless a more stringent standard applies (refer to foreword, Sec. V), surfaces in contact with the line content shall not contain more than 8 percent lead. Refer to ANSI/AWWA C540 and ANSI/AWWA C550 for materials required for power actuators and epoxy interior coatings.

Sec. 2.2 Physical and Chemical Properties

Materials shall be in conformance with the physical and chemical requirements of this subsection.

2.2.1 *Cast iron.* ASTM A126, class B or ASTM A48, class 40.

2.2.2 *Ductile iron.* ASTM A536, grade 65-45-12 or 70-50-05.

2.2.3 *Alloy cast iron.* ASTM A436, type 1 or 2, or ASTM A439, type D2, with a maximum lead content of 0.003 percent.

2.2.4 *Stainless steel.* ASTM A167, type 304 or 316; ASTM A240, type 304 or 316; ASTM A276, type 304 or 316; ASTM A743, grade CF8 or CF-8M; or ASTM A564, grade 630.

2.2.5 *Nickel–copper alloy.* ASTM B127.

2.2.6 *Carbon steel.* ASTM A108.

2.2.7 *Cast steel.* ASTM A216, grade WCB.

2.2.8 *Fabricated steel.* ASTM A36, ASTM A516, or better.

2.2.9 *Nickel rod.* ASTM B160.

2.2.10 *Rubber seats.* See Sec. 3.5.2.

2.2.11 *Brass or bronze.* Components made of brass or bronze shall be to ASTM or Copper Development Association (CDA)* recognized alloy specifications. The chemical and physical requirements shown in Table 1 shall apply.

2.2.11.1 Any bronze alloy used in the cold-worked condition shall be capable of passing the mercurous-nitrate test in accordance with ASTM B154 to minimize susceptibility to stress corrosion.

2.2.11.2 Because of dezincification considerations, grades B and C bronze may be used only for those parts not wetted by line content, such as actuator components. All bronze parts subject to wetting by line content shall be of grade A, D, or E. If aluminum–bronze is used, the alloy shall be inhibited against dealuminization by receiving a temper anneal at 1,200°F ± 50°F (650°C ± 28°C) for 1 h per inch of section thickness, followed by cooling in moving air or by water quenching.

2.2.12 *Corrosion-resistant metals.* Corrosion-resistant metals used for clamping and retaining rubber seats, shaft and disc connection hardware, glands or gland assemblies, thrust bearings, and O-ring removable recesses that are wetted by line content shall be stainless steel, nickel–copper alloy, or grade A, D, or E bronze, all conforming to the above requirements.

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*Copper Development Association, 405 Lexington Ave., New York, NY 10017.

Table 1 Chemical and physical requirements for bronze

Grade of Bronze	Minimum Yield Strength psi	(kPa)	Minimum Elongation in 2 in.* percent	Copper Minimum percent	Zinc Maximum percent
A	14,000	(96,530)	15	79	16
B	20,000	(137,900)	15	57	—
C	32,000	(220,640)	10	57	—
D	20,000	(137,900)	15	79	16
E	32,000	(220,640)	10	79	16

*Gauge length of sample.

Sec. 2.3 Tests

Whenever valve components are to be made in conformance with ASTM or other standards that include test requirements or testing procedures, such requirements or procedures shall be met by the valve manufacturer. The records of such tests shall be made available if required by the purchaser.

SECTION 3: GENERAL DESIGN

Sec. 3.1 Valve Bodies

3.1.1 *Laying length.* Laying lengths for flanged-end and wafer valves shall be as specified in Table 2. There is no standard laying length for valve bodies with mechanical-joint ends.

3.1.2 *Shaft-bearing hubs.* The bodies of all valves shall have two shaft-bearing hubs cast integrally with the valve bodies.

3.1.3 *Wafer-valve bodies.* Wafer-valve bodies shall be designed for installation between ASME/ANSI B16.1, class 125 cast-iron flanges. No part of the valve internals shall extend beyond the body ends when the disc is in the closed position.

3.1.4 *Mechanical joints.* Mechanical-joint bell dimensions shall conform to ANSI/AWWA C111/A21.11. Slots with the same width as the diameter of the bolt holes may be provided instead of holes in the bell flange only at those places where the valve body interferes with the insertion of bolts.

3.1.5 *Shell thickness.* Minimum body shell thicknesses shall conform to the requirements listed in Table 2.

3.1.6 *Materials.* Unless otherwise specifically requested by the purchaser, bodies of all valves shall be of cast iron, ductile iron, or alloy cast iron.

Sec. 3.2 End Flanges

3.2.1 *Dimensions.* Unless otherwise specified, the dimensions and drilling of end flanges shall conform to ASME/ANSI B16.1, class 125 or ANSI/AWWA C110/A21.10 for cast-iron flanges.

3.2.2 *Holes.* All flanges shall have full-sized bolt holes through the body flanges, except that drilled and tapped holes in wafer valves and in flanges of short-body valves will be acceptable in locations in which the valve body will not permit a through-hole.

Table 2 Laying lengths for flanged and wafer valves and minimum body shell thicknesses for all body types

Valve Size		Laying Length*						Minimum Body Shell Thicknesses†					
		Short Body		Long Body		Wafer		Class 25A Class 25B		Class 75A Class 75B		Class 150A Class 150B	
in.	*(mm)*	*in.*	*(mm)*	*in.*	*(mm)*	*in.*	*(mm)*	*in.*	*(mm)*	*in.*	*(mm)*	*in.*	*(mm)*
3	(75)	5	(127)	5	(127)	2	(50.8)	0.37	(9.40)	0.37	(9.40)	0.37	(9.40)
4	(100)	5	(127)	7	(178)	2 ¼	(57.2)	0.40	(10.2)	0.40	(10.2)	0.40	(10.2)
6	(150)	5	(127)	8	(203)	2 13⁄16	(71.4)	0.43	(10.9)	0.43	(10.9)	0.43	(10.9)
8	(200)	6	(152)	8 ½	(216)	2 15⁄16	(74.6)	0.46	(11.7)	0.46	(11.7)	0.46	(11.7)
10	(250)	8	(203)	15	(381)	3 ⅛	(79.4)	0.50	(12.7)	0.50	(12.7)	0.54	(13.7)
12	(300)	8	(203)	15	(381)	3 ⅜	(85.7)	0.54	(13.7)	0.54	(13.7)	0.58	(14.7)
14	(350)	8	(203)	16	(406)	3 ¾	(96.3)	0.54	(13.7)	0.58	(14.7)	0.63	(16.0)
16	(400)	8	(203)	16	(406)	4 ⅛	(105)	0.58	(14.7)	0.63	(16.0)	0.68	(17.3)
18	(450)	8	(203)	16	(406)	4 ⅝	(117)	0.63	(16.0)	0.68	(17.3)	0.79	(20.1)
20	(500)	8	(203)	18	(457)	5 ⅛	(130)	0.66	(16.8)	0.71	(18.0)	0.83	(21.1)
24	(600)	8	(203)	18	(457)			0.74	(18.8)	0.80	(20.3)	0.93	(23.6)
30	(750)	12	(305)	22	(559)			0.87	(22.1)	0.94	(23.9)	1.10	(27.9)
36	(900)	12	(305)	22	(559)			0.97	(24.6)	1.13	(28.7)	1.22	(31.0)
42	(1,050)	12	(305)	24	(610)			1.07	(27.2)	1.16	(29.5)	1.35	(34.3)
48	(1,200)	15	(381)	26	(660)			1.18	(29.9)	1.37	(34.8)	1.48	(37.6)
54	(1,350)	15	(381)	28	(711)			1.30	(33.0)	1.51	(38.4)	1.63	(41.4)
60	(1,500)	15	(381)	30	(762)			1.39	(35.3)	1.62	(41.1)	1.89	(48.0)
66	(1,650)	18	(457)	34	(864)			1.625	(41.3)	1.80	(45.7)	2.00	(50.8)
72	(1,800)	18	(457)	36	(914)			1.75	(44.5)	2.00	(50.8)	2.375	(60.3)

*Includes rubber if rubber extends over the flange face. Tolerance for valves 10 in. (250 mm) and smaller is ± 1⁄16 in. (1.58 mm). Tolerance for valves 12 in. (300 mm) and larger is ± ⅛ in. (3.17 mm).

†At no point shall the shell thickness be more than 12.5 percent below the metal thickness shown in this table.

Sec. 3.3 Valve Shafts

3.3.1 *Shafts.* Each valve shaft shall be either a one-piece unit extending completely through the valve disc or the stub-shaft type.

3.3.1.1 A stub shaft comprises two separate shafts inserted into the valve-disc hubs. Each stub shaft shall be inserted into the valve-disc hubs a distance of at least 1½ shaft diameters.

3.3.1.2 Valve shafts shall have a minimum diameter extending through the valve bearings and into the valve disc as specified in Table 3.

3.3.1.3 Valve-shaft torque capability for the full-diameter portion of the shaft for valves produced in accordance with this standard shall meet or exceed the values in Table 4.

3.3.2 *Connection.* The connection between the shaft and the disc shall be designed to transmit shaft torque equivalent to at least 75 percent of the torsional strength of the minimum required shaft diameters. Rigid shaft restraint shall be provided. Hardware used in connecting the shaft to the disc shall be made of corrosion-resistant metals. The disc shall be mechanically secured to the shaft by a process such as bolting, riveting, threading, upsetting, or cross-pinning, and shall not rely solely on chemical bonding, adhesives, or welding. The shaft and disc shall be capable of nondestructive removal.

3.3.3 *Size.* The portion of the valve shaft that extends through the valve bearings shall be full size. If the valve-shaft diameter is reduced to fit connections to the valve operating mechanism, the smaller portion shall have fillets with radii equal to the offset to minimize the possibility of stress concentration at the junction of the two different shaft diameters. The smallest diameter of the shaft shall be capable of transmitting the maximum calculated valve-operating torque without the torsional shear stress exceeding 40 percent of the tensile yield strength of the shaft material.

3.3.4 *Valve-shaft material.* All valve shafts shall be wrought stainless steel, nickel–copper alloy, or carbon steel with stainless-steel journals. Static seals shall be provided to isolate the interior of the disc and the shaft from line contents when carbon–steel shafts and stainless-steel journals are used.

Sec. 3.4 Valve Discs

3.4.1 *Disc material.* Valve discs shall be made of cast iron; cast steel; fabricated steel; grade A, D, or E bronze, as referenced in Sec. 2.2.11; alloy cast iron; ductile iron; or stainless steel.

3.4.2 *Disc design.* The design shall withstand full differential pressures across the closed valve disc without exceeding a working stress equivalent to one fifth of the tensile strength of the material used.

3.4.3 *Disc thickness.* The thickness of the valve disc shall not be more than 2¼ times the shaft diameter listed in Table 3.

3.4.4 *External ribs.* Valve discs shall be of a cast or fabricated design with no external ribs transverse to the flow.

Sec. 3.5 Valve Seats

3.5.1 *Pressure classes.* Valve seats shall be designed to be leak tight in both directions at the following pressure differentials:

3.5.1.1 Class 25A and class 25B: 25 psi (172 kPa) upstream; 0 psi (0 kPa) downstream.

Table 3 Minimum shaft diameters for all allowable materials

Valve Diameter in.	(mm)	Shaft Diameter — in. (mm) Class 25A*		Class 25B*		Class 75A*		Class 75B*		Class 150A*		Class 150B*	
3	(75)	½	(12.7)	½	(12.7)	½	(12.7)	½	(12.7)	½	(12.7)	½	(12.7)
4	(100)	⅝	(15.9)	⅝	(15.9)	⅝	(15.9)	⅝	(15.9)	⅝	(15.9)	⅝	(15.9)
6	(150)	¾	(19.1)	¾	(19.1)	¾	(19.1)	¾	(19.1)	1	(25.4)	1	(25.4)
8	(200)	⅞	(22.2)	⅞	(22.2)	⅞	(22.2)	⅞	(22.2)	1 ⅛	(28.6)	1 ⅛	(28.6)
10	(250)	1	(25.4)	1	(25.4)	1 ⅛	(28.6)	1 ⅛	(28.6)	1 ⅜	(34.9)	1 ⅜	(34.9)
12	(300)	1 ⅛	(28.6)	1 ⅛	(28.6)	1 ¼	(31.8)	1 ¼	(31.8)	1 ½	(38.1)	1 ½	(38.1)
14	(350)	1 ¼	(31.8)	1 ⅜	(34.9)	1 ⅜	(34.9)	1 ½	(38.1)	1 ¾	(44.5)	1 ¾	(44.5)
16	(400)	1 ⅜	(34.9)	1 ½	(38.1)	1 ½	(38.1)	1 ⅝	(41.3)	2	(50.8)	2	(50.8)
18	(450)	1 ½	(38.1)	1 ⅝	(41.3)	1 ⅝	(41.3)	1 ⅞	(47.6)	2 ⅛	(54.0)	2 ¼	(57.2)
20	(500)	1 ½	(38.1)	1 ⅞	(47.6)	1 ¾	(44.5)	2 ⅛	(54.0)	2 ⅜	(60.3)	2 ½	(63.5)
24	(600)	1 ¾	(44.5)	2 ¼	(57.2)	2	(50.8)	2 ½	(63.5)	2 ¾	(69.9)	3	(76.2)
30	(750)	2	(50.8)	2 ¾	(69.9)	2 ½	(63.5)	3	(76.2)	3 ½	(88.9)	3 ⅝	(92.1)
36	(900)	2 ½	(63.5)	3 ½	(88.9)	3	(76.2)	3 ⅝	(92.1)	4	(102)	4 ⅜	(111)
42	(1,050)	2 ⅞	(73.0)	3 ¾	(95.3)	3 ⅜	(85.7)	4 ¼	(108)	4 ½	(114)	5	(127)
48	(1,200)	3 ¼	(82.6)	4 ¼	(108)	3 ⅞	(98.4)	4 ⅞	(124)	5 ⅛	(130)	5 ⅝	(143)
54	(1,350)	3 ⅝	(92.1)	4 ⅞	(124)	4 ¼	(108)	5 ½	(140)	5 ¾	(146)	6 ¾	(171)
60	(1,500)	4	(102)	5 ½	(140)	4 ¾	(121)	6	(152)	6 ¼	(159)	7 ¼	(184)
66	(1,650)	4 ½	(114)	6	(152)	5	(127)	6 ¾	(171)	7	(178)	7 ¾	(197)
72	(1,800)	4 ⅞	(124)	6 ½	(165)	5 ¾	(146)	7 ½	(191)	7 ½	(191)	8 ½	(216)

*For an explanation of classification, see Sec. 1.1.2.

Table 4 Shaft torque capabilities — *ft-lb (N·m)**

Valve Diameter in.	(mm)	Shaft Torque — *ft-lb (N·m)* Class 25A†		Class 25B†		Class 75A†		Class 75B†		Class 150A†		Class 150B†	
3	(75)	18	(24)	18	(24)	18	(24)	18	(24)	18	(24)	18	(24)
4	(100)	36	(49)	36	(49)	36	(49)	36	(49)	36	(49)	36	(49)
6	(150)	62	(84)	62	(84)	62	(84)	62	(84)	147	(199)	147	(199)
8	(200)	99	(134)	99	(134)	99	(134)	99	(134)	210	(285)	210	(285)
10	(250)	147	(199)	147	(199)	210	(285)	210	(285)	383	(519)	383	(519)
12	(300)	210	(285)	210	(285)	288	(390)	288	(390)	497	(674)	497	(674)
14	(350)	288	(390)	383	(519)	383	(519)	497	(674)	789	(1,070)	789	(1,070)
16	(400)	383	(519)	497	(674)	497	(674)	632	(857)	1,180	(1,600)	1,180	(1,600)
18	(450)	497	(674)	632	(857)	632	(857)	971	(1,320)	1,410	(1,910)	1,680	(2,280)
20	(500)	497	(674)	971	(1,320)	789	(1,070)	1,410	(1,910)	1,970	(2,670)	2300	(3,120)
24	(600)	789	(1,070)	1,680	(2,280)	1,180	(1,600)	2,300	(3,120)	3,060	(4,150)	3,980	(5,400)
30	(750)	1,180	(1,600)	3,060	(4,150)	2,300	(3,120)	3,980	(5,400)	6,310	(8,560)	7,020	(9,520)
36	(900)	2,300	(3,120)	6,310	(8,560)	3,980	(5,400)	7,020	(9,520)	9,430	(12,800)	12,300	(16,700)
42	(1,050)	3,500	(4,750)	7,770	(10,400)	5,660	(7,670)	11,300	(15,300)	13,400	(18,200)	18,400	(24,900)
48	(1,200)	5,060	(6,860)	11,300	(15,300)	8,570	(11,600)	17,100	(23,200)	19,800	(26,800)	26,200	(35,500)
54	(1,350)	7,020	(9,520)	17,100	(23,200)	11,300	(15,300)	24,500	(33,200)	28,000	(38,000)	45,300	(61,400)
60	(1,500)	9,430	(12,800)	24,500	(33,200)	15,800	(21,400)	31,800	(43,100)	36,000	(48,800)	56,100	(76,100)
66	(1,650)	13,400	(18,200)	31,800	(43,100)	18,400	(24,900)	45,300	(61,400)	50,500	(68,500)	68,500	(92,900)
72	(1,800)	17,100	(23,200)	40,400	(54,800)	28,000	(38,000)	62,100	(84,200)	62,100	(84,200)	90,400	(123,000)

*Calculated with 9,000 psi (62 MPa) torsional shear stress as allowable for 18-8 stainless steel and shaft diameters as shown in Table 3.

†For an explanation of classification, see Sec. 1.1.2.

3.5.1.2 Class 75A and class 75B: 75 psi (517 kPa) upstream; 0 psi (0 kPa) downstream.

3.5.1.3 Class 150A and class 150B: 150 psi (1,034 kPa) upstream; 0 psi (0 kPa) downstream.

3.5.2 *Rubber seats.* Rubber seats of valves 30 in. (750 mm) and larger shall be of a design that permits removal and replacement at the site of the installation.

3.5.2.1 Rubber seats shall be applied to either the body or the disc, shall be of new natural or synthetic rubber, and may be reinforced.

3.5.2.2 Rubber seats shall be clamped, mechanically secured, or bonded to the body or disc. The method used for bonding shall be tested in accordance with ASTM D429, method A or B. For method A, the minimum strength shall be not less than 250 psi (1,725 kPa). When method B is used, the peel strength shall not be less than 75 lb/in. (1.33 kg/mm). Rubber seats applied to the valve body and penetrated by the valve shaft shall be adequately reinforced to prevent the seat from becoming inflated by pressure behind the seat. Circumferential joints of rubber seats shall be bonded together. The design of the seat shall provide tight shutoff with flow in either direction under the tests required by Sec. 5.

3.5.2.3 Rubber compounds shall contain no more than 8 ppm of copper ion and shall include copper inhibitors to prevent copper degradation of the rubber material.

3.5.2.4 Rubber compounds shall be capable of withstanding an ozone resistance test when tested in accordance with ASTM D1149 using 50 parts per 100 million minimum ozone concentration. The tests shall be conducted on unstressed samples for 70 h at 104°F (40°C) without visible cracking in the surfaces of the test samples after tests.

3.5.2.5 Rubber compounds shall be free of vegetable oils, vegetable-oil derivatives, animal fats, and animal oils. Reclaimed rubber shall not be used. Rubber compounds shall contain no more than 1.5 parts of wax per 100 parts of rubber hydrocarbon.

3.5.2.6 Rubber compounds shall have less than 2 percent volume increase when tested in accordance with ASTM D471 after being immersed in distilled water at 73.4°F ± 2°F (23°C ± 1°C) for 70 h.

3.5.3 *Mating surfaces.*

3.5.3.1 Rubber seats shall mate with the following acceptable seat surfaces: stainless steel; nickel–copper alloy; bronze, grade A, D, or E referenced in Sec. 2.2.11; alloy cast iron; nickel–chromium alloy (72 percent minimum nickel and 14 percent minimum chromium); or nickel alloy (85 percent minimum nickel). The width of the seat surface shall, at a minimum, cover the entire surface wiped by or in contact with the rubber seat.

3.5.3.2 In cases where valves are to be operated frequently (more than once a month), seating surfaces of stainless steel or nickel–copper alloy are recommended.

3.5.3.3 Plated mating surfaces are not acceptable. Sprayed mating-seat surfaces are acceptable only when applied by the plasma nontransferred arc, or sprayed-and-fused process. A welding process may be used to attach the mating surface to the disc or body. Both processes shall be in accordance with the following:

3.5.3.3.1 If the mating seat is applied by the plasma nontransferred arc, sprayed-and-fused, or weld overlay process, the final surface shall have a minimum thickness of 7 mil (0.18 mm) and meet the chemical requirements of Sec. 3.5.3.1.

3.5.3.3.2 The wear resistance of the seating-surface material shall be demonstrated as capable of 100,000 opening and closing cycles under full-rated pressure and in water without damage.

3.5.3.3.3 After the cycle test above, the corrosion resistance and bond integrity of the mating-seat-surface material and base metal combination shall be demonstrated as capable of withstanding immersion in 150°F (65.6°C) ASTM D1141 substitute ocean water for 12 months.

3.5.3.3.4 The application procedure shall be qualified in accordance with the 1983 ASME Boiler and Pressure Vessel Code, Sec. IX, QW-216. The liquid-penetrant examination of the test sample shall show no linear indications or porosity on or adjacent to the seating surface.

3.5.3.3.5 For any overlay, the following performance items are required: diffusion of the overlay into the base metal to a minimum depth of 50 µm; a visually pore-free surface with no cracking in the adjacent base metal; absence of bubbling through of the molten base metal into the surface of the overlay; and bond strength of 1,500 psi (10.4 MPa) minimum, as determined by ASTM C633.

3.5.3.3.6 The manufacturer shall establish and maintain a written quality-assurance program to control the qualified procedure and quality of finished parts.

3.5.3.3.7 Leak tightness shall be demonstrated by mating-seat performance during a 20-min, 150-psig (1,034-kPa [gauge]) proof-of-design gas leakage test. The production seat test shall be in accordance with Sec. 5.2.2.1, except that valves larger than 20 in. (500 mm) in diameter shall be tested for a minimum duration of 10 min. The alternative hydrostatic leakage test per Sec. 5.2.2.2 shall not be applicable. Impregnation of mating-seat surfaces is not permitted.

3.5.4 *Clamps and retaining rings.* Clamps and retaining rings for rubber seats shall be made of corrosion-resistant metallic material as referenced in Sec. 2.2.12. Nuts, screws, and hardware used with clamps and retaining rings shall be of stainless steel or nickel–copper alloy.

Sec. 3.6 Valve Bearings

3.6.1 *Sleeve bearings.* Valves shall be fitted with sleeve-type bearings contained in the hubs of the valve body. The maximum distance from the inside metal surface of the valve body to the inside end of the sleeve bearings shall not exceed ⅛ in. (3.17 mm). Bearings shall be designed for a pressure not to exceed the published design load for the bearing material or one-fifth the compressive strength of the bearing or shaft material. Valve shafts or extensions of the valve shaft shall be designed for connection to actuators, as described in Sec. 3.8.

3.6.2 *Outboard thrust bearing.* A bearing of corrosion-resistant material shall be provided on the shaft outboard of the shaft seal or in the actuator housing to protect the shaft seal from side-thrust forces developed in the operating mechanism.

3.6.3 *Thrust bearings.* Each valve shall be equipped with either one or two thrust bearings, which shall hold the valve disc securely in the center of the valve seat. Valves 20 in. (500 mm) and smaller without hydraulic or external axial shaft loads are excepted.

3.6.4 *Self-lubricating materials.* Sleeve and other bearings fitted into the valve body proper shall be made of self-lubricated materials that do not have a harmful effect on water or rubber and that do not have a coefficient of friction in excess of 0.25 when run at the maximum bearing pressure.

Sec. 3.7 Shaft Seals

A shaft seal shall be provided where shafts project through the valve bodies for actuator connection.

3.7.1 *Seal design.* Shaft seals shall be designed for the use of standard V-type packing; O-ring seals; O-ring-loaded, U-cup seals; or a pull-down packing.

3.7.2 *O-rings.* If O-rings are used, they shall be contained in a removable component constructed of corrosion-resistant metallic materials referenced in Sec. 2.2.12 or suitable nonmetallic materials.

3.7.3 *Seal replacement.* Shaft seals shall be of a design allowing replacement of seals without removing the valve shaft.

3.7.4 *Stuffing box and pull-down packing gland.* When the purchaser specifically requests that the shaft seals be of the type using a stuffing box and pull-down gland, the design of the valve and stuffing box assembly shall permit adjustment or complete replacement of packing without disturbing any part of the valve or actuator assembly except the packing-gland follower.

3.7.4.1 Stuffing-box depth shall be sufficient to accept at least four rings of packing.

3.7.4.2 Gland or gland assemblies shall be made of corrosion-resistant metallic materials referenced in Sec. 2.2.12 or engineered plastic materials recommended by their manufacturers for this service and proven successful by experience in this or similar applications.

3.7.4.3 Packing shall be made of resilient, nonmetallic material suitable for the service.

3.7.4.4 Packing used for potable-water service valves shall not contain asbestos.

Sec. 3.8 Valve Actuators

The actuator is essentially an integral part of a butterfly valve. Intermediate mechanisms used between actuating devices and the valve stem to produce the quarter-turn motion of a butterfly valve shall meet the requirements of this section.

3.8.1 *Torque capability.* The rated torque capability of each actuator shall be sufficient to seat, unseat, and rigidly hold, in any intermediate position, the valve disc it controls under the operating conditions specified by the purchaser. If the purchaser fails to specify a temperature range, differential pressure, flow, or classification, actuator sizing shall be based on the most severe conditions listed in this standard. If the purchaser specifies a valve classification and fails to specify a differential pressure or flow, then actuator sizing shall be based on the pressure or flow requirement of the specified class rather than the most severe pressure and flow conditions listed in this standard.

3.8.2 *Stop limiting devices.* Valve actuators shall be equipped with adjustable, mechanical, stop limiting devices to prevent overtravel of the valve disc in the open and closed positions.

3.8.3 *Safety factor.* Actuator housings, supports, and connections to the valve shall be designed with a minimum safety factor of 5, based on the ultimate strength, or a minimum safety factor of 3, based on the yield strength of materials used.

3.8.4 *Actuator's position-control capability.* The actuator shall be designed to control the valve in all positions from fully open to fully closed and from fully closed to fully open with control in any intermediate position.

3.8.5 *Manual actuators.*

3.8.5.1 Each manual actuator shall have all gearing totally enclosed.

3.8.5.2 Actuators shall be designed to produce the required operating torque with a maximum rim pull of 80 lb (356 N) on the handwheel or chainwheel and a maximum input of 150 ft-lb (203 N·m) on wrench nuts. Adjustable, stop limiting devices shall be provided in the actuators for the open and closed positions. All actuator components between the input and these stops shall be designed to withstand, without damage, a rim pull of 200 lb (890 N) for the handwheel or chainwheel and an input torque of 300 ft-lb (406 N·m) for wrench nuts.

3.8.5.3 Actuators for buried service valves shall be not less than 90 percent grease packed and totally sealed by gaskets, O-rings, or similar means.

3.8.5.4 The manufacturer shall select a representative actuator within each of the torque ranges for proof-of-design testing purposes.

3.8.5.5 Gearing. All gear actuators or traveling-nut actuators shall be self-locking and designed to transmit twice the required actuator torque without damage to the faces of the gear teeth or the contact faces of the screw or nut.

3.8.5.6 Actuators of the traveling-nut type shall have steel drive screws and an internally threaded bronze or ductile-iron nut. Actuators shall be enclosed.

3.8.5.7 Actuators that include worm gearing shall be totally enclosed in a gear case and shall have bronze worm gears and hardened steel worms that operate in a lubricant.

3.8.5.8 The design shall be verified by subjecting one prototype actuator of each model and torque rating to a shop torque test equal to or greater than twice the rated torque. In addition, manual actuators shall be tested while the actuator components are against the open and the closed stop limiting devices referred to in Sec. 3.8.2 by applying a 200-lb (890-N) pull to a handwheel or chainwheel actuator and an input torque of 300 ft-lb (406 N·m) to an actuator nut. After testing, the actuator shall be completely disassembled and carefully examined for evidence of damage. On the purchaser's request, the manufacturer shall furnish the purchaser with certified copies of reports describing the procedures and results of the tests for each model and torque rating of actuator to be furnished. Section 2.2 does not apply to materials specified in Sec. 3.8.5, since actuator materials are not in contact with the line contents.

3.8.5.9 The design shall also be verified by cycle testing of one prototype actuator of each model through a full 90° cycle with full-rated actuator torque at the point of unseating. The number of cycles shall be in accordance with Table 5. After the cycle testing, the actuator shall be completely disassembled and inspected to determine whether or not excessive wear and/or permanent deformation that would affect its function has occurred. Successful completion of the test will identify the design methods used in a series of actuators within the torque ranges listed as suitable.

Table 5 Prototype-actuator test cycles required

Torque Range *ft-lb*	Torque Range *(N·m)*	Number of Cycles
Up to 3,750	(5,080)	10,000
3,751–6,250	(5,080–8,470)	5,000
6,251 and greater	(8,470 or greater)	1,000

3.8.6 *Electric actuators.*

3.8.6.1 Electric actuators shall meet the requirements of ANSI/AWWA C540 and be rated to produce not less than the required valve seating and dynamic torques. In addition, actuators used for modulating service shall be rated to produce not less than twice the required valve dynamic torque. Motors shall be sized for 1.5 times the actuator torque requirement.

3.8.6.2 Unless otherwise specified, electric-motor-actuated valves shall operate from fully open to fully closed positions, or the reverse, in 60 s ± 10 s.

3.8.6.3 The manufacturer shall apply a warning label in the area of the auxiliary handwheel listing the maximum number of turns from full open to full close and full close to full open (90°).

3.8.6.4 The intermediate mechanism (nonintegral to actuator) between the electric actuator and the valve stem shall meet the requirements of Sec. 3.8.5, except the input testing requirements of Sec. 3.8.5.2 and Sec. 3.8.5.8 do not apply.

3.8.7 *Cylinder actuators.* Cylinder actuators shall be water-hydraulic, oil-hydraulic, or pneumatic cylinders meeting the requirements of ANSI/AWWA C540. Minimum safety factors for cylinder torques shall not be less than those shown in Table 6. Safety factors are the ratio of cylinder torque to required valve operating torque (T_R). Cylinder torque (T_O) is equal to:

$$T_O = (A - a)\,LPE \qquad \text{(Eq 1)}$$

The safety factor (SF) is equal to:

$$\text{SF} = \frac{T_O}{T_R}$$

Where:

A = area of the cylinder based on the inside diameter (ID)

a = area of piston rod in one direction and zero in other direction

L = moment arm (shortest distance between piston-rod axis and valve-disc axis for a given disc position)

P = cylinder operation pressure

E = efficiency factor, taking into account all friction losses in the actuator and the linkages, including the increase in piston and piston-rod seal friction with pressure, and friction of the valve shaft in the outboard bearing caused by cylinder thrust

Table 6 Safety factors for cylinder torques

Type of Service	Operating Fluid	Safety Factor
Open–shut	Water	1.25
Throttling	Water	1.25
Open–shut	Air	1.25
Throttling with positioner	Air	1.5 for cylinders greater than 80 in.^{3} 2.0 for smaller cylinders
Throttling without positioner	Air	10.0

3.8.7.1 Cylinders shall be equipped with adjustable flow-control devices to control the operating media exhausted from the cylinder. For air service, the flow-control devices shall be mounted directly on the cylinder or connected within 6 in. (152 mm) of the cylinder by rigid metal pipe or rigid metal tubing. Opening and closing times shall be field adjustable. Minimum operating time shall be 30 s.

3.8.7.2 Intermediate quarter-turn mechanism. The intermediate mechanism (nonintegral to the actuator) used between the cylinder actuator and the valve stem shall meet the requirements of this section.

3.8.7.2.1 Intermediate rack-and-pinion, quarter-turn mechanisms for torque ratings up to 3,750 ft-lb (5,080 N•m) shall have all gearing totally enclosed.

3.8.7.2.2 The manufacturer shall select a representative mechanism within each of the torque ranges shown in Table 5 for proof-of-design testing purposes.

3.8.7.2.3 Intermediate mechanisms shall be designed to transmit twice the rated torque without damage.

3.8.7.2.4 The design shall be verified by subjecting one prototype actuator of each model and torque range listed in Table 5 to a shop torque test equal to or greater than twice the rated torque. After testing, the actuator shall be completely dismantled and carefully examined for evidence of damage. On the purchaser's request, the manufacturer shall furnish the purchaser with certified copies of reports describing the procedures and results of the tests. Section 2.2 does not apply to materials.

3.8.7.2.5 The design shall be verified by cycle testing of one prototype of each model and torque range listed in Table 5 through a full 90° cycle with full-rated torque at the point of unseating and seating. The number of cycles shall be in accordance with Table 5. After the cycle testing, the actuator shall be completely disassembled and inspected to determine whether or not excessive wear and/or permanent deformation that would affect its function has occurred. Successful completion of the test will identify the design methods used within the torque ranges listed as suitable.

SECTION 4: WORKMANSHIP AND PAINTING

Sec. 4.1 Workmanship

Valve parts shall be designed and manufacturing tolerances set to provide interchangeability of parts between units of the same size and type produced by any one manufacturer. When assembled, valves manufactured in accordance with this standard shall be well-fitted and shall operate smoothly. The body and shaft seal shall be watertight.

Sec. 4.2 Painting

All interior and exterior surfaces, except finished or bearing surfaces, shall be carefully prepared by removing all dirt, grease, and rust and shall be cleaned to the extent that the coating will bond to all surfaces.

4.2.1 *Interior surfaces.* Unless otherwise specified by the purchaser, all steel or cast-iron surfaces, except finished or bearing surfaces, shall be shop coated with two coats of an asphalt coating conforming to Fed. Spec. TT-C-494B. Whenever the purchaser's specification requires a special interior coating, such as an epoxy, and unless otherwise specified, this special coating system shall conform to the requirements of ANSI/AWWA C550.*

4.2.2 *External surfaces.*

4.2.2.1 External surfaces of buried valves shall be shop coated with two coats of an asphalt coating conforming to Fed. Spec. TT-C-494B.

4.2.2.2 When the valves will be installed in an aboveground location to be subsequently field painted, the exterior of each valve, except flange faces, shall be shop coated with a suitable metal primer to a dry film thickness of not less than 3 mil. The primer shall be compatible with the anticipated field coatings when the field coatings are identified by the purchaser. Flange faces shall be protected from atmospheric corrosion.

4.2.2.3 The painting required in Sec. 4.2.2.1 and Sec. 4.2.2.2 is for usual conditions. The purchaser should specify alternative painting systems if required for unusual or severe conditions. The term usual conditions does not include exposure to corrosive soils, water, fumes, or abrasion.

SECTION 5: INSPECTION, TESTING, AND REJECTION

Sec. 5.1 Inspection

All work performed in accordance with this standard shall be subject to inspection and approval by the purchaser's agent.

5.1.1 *Plant inspection.* The purchaser's agent shall at all times have access to all places where materials are being produced or assembled or where tests are being conducted. The purchaser's agent shall be accorded full facilities for inspection and observation of tests.

5.1.2 *Affidavit.* If the purchaser has no agent at the plant, the manufacturer shall, if requested at the time the order is placed, certify that the required tests on the various materials and on the completed valves will be made and that no component or valve shall be furnished that has not been tested and found to conform to the requirements of this standard.

Sec. 5.2 Testing

5.2.1 *Performance tests.* To demonstrate that the complete assembly is workable, each valve (with the actuator mounted directly on the valve) shall be shop operated three times from the fully closed to the fully opened position and the reverse under a no-flow condition.

5.2.2 *Leakage tests.*

5.2.2.1 Each valve shall be shop tested for leaks in the closed position. The test shall be conducted with the disc in a horizontal plane. With the disc in the

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*Asphalt coatings may not be holiday free. Epoxy coatings are more likely to result in a holiday-free surface. If severe service conditions exist, the purchaser should consider an epoxy coating. Special holiday testing, as specified in Sec. 5 of ANSI/AWWA C550, can also be required if conditions justify the added expense.

closed position, air pressure shall be supplied to the lower face of the disc for the full test duration as follows:

class 25A and class 25B: 25 psi (172 kPa)
class 75A and class 75B: 75 psi (517 kPa)
class 150A and class 150B: 150 psi (1,034 kPa)

The upper surface of the valve disc shall be visible and shall be covered with a pool of water at 0 psig (0 kPa) pressure. The duration of the test shall be at least 5 min. There shall be no indication of leakage past the valve disc (visible in the form of bubbles in the water pool on top of the disc) during the test period.

5.2.2.2 As an alternative to the test procedure and disc orientation described in Sec. 5.2.2.1, valves may be given a hydrostatic test at the pressures stated in Sec. 5.2.2.1. During the test, the valves shall be drop-tight. The minimum duration of the test shall be 5 min for valves 20 in. (500 mm) and smaller, and 10 min for valves 24 in. (600 mm) and larger.

5.2.2.3 Unless the purchaser specifies testing in both directions, the valves are required to be tested only in the direction most likely to leak.

5.2.3 *Hydrostatic test.* All valve bodies shall be subjected to an internal hydrostatic pressure equivalent to twice the rated pressure. During the hydrostatic test, there shall be no leakage through the metal, end joints, or shaft seal, nor shall any part be permanently deformed. The duration of the hydrostatic test shall be sufficient to allow visual examination for leakage. Test duration shall be at least 1 min for valves 8 in. (200 mm) and smaller, 3 min for valves 10 in. (250 mm) through 20 in. (500 mm), and 10 min for valves 24 in. (600 mm) and larger.

5.2.4 *Proof-of-design tests.*

5.2.4.1 On request by the purchaser, the manufacturer shall furnish a certified statement that proof-of-design tests were carried out as described herein, and all requirements were successfully met.

5.2.4.2 One valve of each size and class shall be hydrostatically tested with twice the rated pressure applied to one side of the disc and zero pressure on the other side. The test is to be made in each direction across the disc and, in the case of flanged valves, the valve body shall be bolted to a flanged test head. Under the hydrostatic test, the manufacturer may make special provisions to prevent leakage past the seats, and no part of the valve or disc shall be permanently deformed by the test.

5.2.4.3 It is the purpose of this section to demonstrate the adequacy of each basic type of valve offered by a manufacturer to perform, under design pressures, within the applicable rating of the valve for a sufficient number of operations to simulate a full service life. The adequacy is to be demonstrated by testing valves selected to represent each basic type of seat design in each applicable size group in Table 7 and in a pressure class or classes equal to or greater than the valves being purchased. The required number of cycles appears in Table 7. Every cycle shall consist of applying the rated differential pressure to the disc in the closed position, then opening the valve (which will relieve the pressure) to the wide-open position, and then closing the disc. On completion of the cycle test, the valve shall be drop-tight in both directions under the rated differential pressure.

5.2.4.4 Actuator proof-of-design test is covered in Sec. 3.8.

Table 7 Valve test cycles required

Size Group in.	(mm)	Number of Cycles
3–20	(75–500)	10,000
24–42	(600–1,050)	5,000
48–72	(1,200–1,800)	1,000

Sec. 5.3 Rejection

Any butterfly valve or part that the purchaser's agent may reject as not conforming to the requirements of this standard shall be made satisfactory or replaced.

SECTION 6: MARKING AND SHIPPING

Sec. 6.1 Marking

Markings for valves other than wafer valves shall be cast on the body or shall be on cast plates with raised letters attached to the valve body. The markings shall show the valve size, manufacturer, class, and year of manufacture. The minimum size of letters shall be ¼ in. (6.35 mm) for 3-in. (75-mm) through 12-in. (300-mm) valves and ½ in. (12.7 mm) for valves larger than 12 in. (300 mm). Corrosion-resistant plates that have ⅛-in. (3.18-mm) etched or engraved letters and that are attached to the body may be used for marking wafer valves.

Sec. 6.2 Shipping

Valves shall be complete in all respects when shipped. The manufacturer shall use care in preparing valves for shipment. All cavities shall be drained of water. Valves larger than 36 in. (900 mm) shall be bolted or otherwise fastened to skids so as to preclude damage in subsequent handling. All unpainted steel and iron-machined surfaces shall be coated with a protective slushing compound. Full-face flange protectors of waterproof plywood or weather-resistant pressboard, of at least the outside diameter of the flange, shall be fastened to each flange to protect both the flange and the valve interior. Small valves may be fully packaged at the manufacturer's option. Components shipped unattached shall be adequately protected and identified for correct field assembly.

APPENDIX A
Installation, Operation, and Maintenance of Rubber-Seated Butterfly Valves

This appendix is for information only and is not a part of AWWA C504.

SECTION A.1: GENERAL

Butterfly valves are a significant component of any water distribution system or treatment plant operation. Valve failure due to faulty installation, improper operation, or maintenance in such systems could result in damage, down time, and costly repairs. In buried or underground installations, problems or malfunctions can result in extensive, costly unearthing operations to correct or eliminate the problem. Many problems with butterfly valves can be traced to improper installation, operation, or maintenance procedures.

SECTION A.2: UNLOADING

Inspect valves on receipt for damage in shipment and conformance with quantity and description on the shipping notice and order. Unload all valves carefully to the ground without dropping. On valves larger than 36 in. (900 mm), use forklifts or slings under skids. On smaller valves, do not lift valves with slings or chains around the operating shaft, actuator, or through waterway. Lift these valves with eye bolts or rods through flange holes or chain hooks at ends of valve parts.

SECTION A.3: STORAGE

If not practical to store the valve indoors, protect the valve and actuators from weather and the accumulation of dirt, rocks, and debris. When valves fitted with power actuators and controls are stored, energize electric actuators or otherwise protect electrical-control equipment to prevent corrosion of electrical contacts due to condensation resulting from temperature variation. Do not expose rubber seats to sunlight or ozone for any extended period. Also see the manufacturer's specific storage instructions.

SECTION A.4: INSPECTION PRIOR TO INSTALLATION

Make sure flange faces, joint sealing surfaces, body seats, and disc seats are clean. Check bolting attaching actuator to valve for loosening in transit and handling. If loose, tighten firmly. Open and close the valve to make sure it operates properly and that stops or limit switches are correctly set so that the valve seats fully. Close the valve before installing.

SECTION A.5: INSTALLATION

It is strongly recommended that all instruction manuals supplied by the valve manufacturer be reviewed in detail before installing butterfly valves. Be sure that inspection, as described in Sec. A.4, is carried out at the jobsite prior to installation.

A.5.1 Handle valves carefully when positioning, avoiding contact or impact with other equipment, vault walls, or trench walls.

A.5.2 Valves are to be installed in accordance with the manufacturer's instructions.

A.5.3 When valves have adjustable seating, install the seat-adjustment side of the valve for access and adjustment in service.

A.5.4 Where practical, valves in buried installations should be located in unpaved areas, unless otherwise indicated in plans and specifications.

A.5.5 Foreign material in a butterfly valve can damage the rubber seat when valves are operated. Be sure valve interiors and adjacent piping are cleaned of foreign material prior to making up the valve to pipe joint connection.

A.5.6 Prepare pipe ends and install valves in accordance with the pipe manufacturer's instructions for the joint used. Do not deflect the pipe–valve joint. Do not use a valve as a jack to pull pipe into alignment. In plant piping, install so as to minimize the bending of the valve connection with pipe loading.

A.5.7 In the case of wafer-type butterfly valves, concentrically center the valve disc between the mating flanges.

A.5.8 Make sure the valve disc, when opened, will not contact the pipe port. This is especially necessary on pipe with linings and when wafer valves are used. Check manufacturer's recommendations for minimum pipe ID required for clearance.

A.5.9 Buried valves installed with valve boxes shall be installed so that the valve box does not transmit shock or stress to the valve actuator as a result of shifting soil or traffic load.

A.5.10 When valves are installed in vaults, the vault design shall provide space for removal of the valve–actuator assembly for purposes of repair. Consideration should be given to the possible entry of groundwater or surface water and to the need to provide for disposal thereof. The valve operating nut should be accessible from the top opening of the vault with a tee wrench.

SECTION A.6: TESTING

When rubber-seated butterfly valves are used to isolate sections of a line for testing, it is important to realize that these valves are designed or factory adjusted to hold rated pressure only. Test pressures above valve rated pressure may cause leakage past the rubber seat and damage to the valve.

A.6.1 In order to prevent time lost searching for leaks, where feasible, it is recommended that excavations for buried valves not be backfilled until after pressure tests have been made.

A.6.2 Seat leakage can occur from foreign material in the line. If this occurs, open the valve 5°–10° to obtain high-velocity flushing action, then close. Repeat several times to clear seats for tight shutoff.

A.6.3 Seat leakage can result from a rotational shift in the position of the disc with relation to the body seat. Readjust the closing stop in accordance with manufacturer's instructions.

SECTION A.7: RECORDS

On completion of installation, the valve location, size, make, type, date of installation, number of turns to open, direction of opening, and any other information deemed pertinent should be entered on the owner's permanent records.

SECTION A.8: OPERATION

A.8.1 Do not permit the use or operation of any valve at pressures above the rated pressure of the valve.

A.8.2 Do not exceed 300 ft-lb (406 N•m) input torque on actuators with wrench nuts and do not exceed 200 lb (890 N) rim pull for handwheels or chainwheels. If portable auxiliary actuators are used, size the actuator or use a torque-limiting device to prevent the application of torque exceeding 300 ft-lb (406 N•m). If an oversize actuator with no means of limiting torque is used, stop the actuator before the valve is fully opened or closed against stops, and complete the operation manually. Be sure to check the actuator directional switch against the direction indicated on wrench nut, handwheel, or records before applying opening or closing torque.

A.8.3 If a valve is stuck in some intermediate position between open and closed, check first for jamming in the actuator. If nothing is found, the interference is inside the valve. In this case, do not attempt to force the disc open or closed, because excessive torque in this position can severely damage internal parts.

SECTION A.9: MAINTENANCE

Maintenance of rubber-seated butterfly valves by the owner is generally limited to actuators and shaft seals. In some instances, valve design permits field adjustment or replacement of rubber seats when leakage occurs past the disc. Unless the owner has skilled personnel and proper equipment, any major internal problem will probably require the removal of the valve from the line and its return to the manufacturer for repair.

A.9.1 Normal maintenance is in the area of shaft seals and actuators. Seal leakage, broken parts, hard operation, and, in some cases, seat leakage should be corrected by a repair crew as soon as possible after a defect is reported.

A.9.2 If repairs are to be made in the field, repair crews should take a full complement of spare parts to the jobsite. Be sure to review the valve-manufacturer's maintenance instructions prior to any repair work.

A.9.3 Provisions should be made to stop line flow and isolate the valve from line pressure prior to performing any corrective maintenance.

A.9.4 After completing repairs, cycle the valve through one complete operating cycle and, after line pressure has been restored, inspect for leakage.

A.9.5 If major repairs require the removal of the valve for repair, be sure to notify all interested parties in the water department and fire department that the valve and line are out of service. On completion of repair and reinstallation, notify the same personnel of the return of the valve and line to service.

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