ANSI/AWWA C507-05
(Revision of ANSI/AWWA C507-99)

American Water Works Association

The Authoritative Resource on Safe Water[SM]

AWWA Standard

Ball Valves, 6 In. Through 48 In. (150 mm Through 1,200 mm)

American National Standards Institute

Effective date: April 1, 2005.
First edition approved by AWWA Board of Directors Sept. 14, 1973.
This edition approved Jan. 16, 2005.
Approved by American National Standards Institute Feb. 1, 2005.

6666 West Quincy Avenue
Denver, CO 80235-3098
T 800.926.7337
www.awwa.org

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AWWA Standard

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Committee Personnel

The AWWA Standards Committee on Ball Valves, which revised and approved this standard, had the following personnel at the time of approval:

Bayard E. Bosserman, *Chair*

Consumer Members

V.Q. Le, Los Angeles Water and Power, Los Angeles, Calif.	(AWWA)
W.F. Reeves, Cincinnati, Ohio	(AWWA)
I.M. Schuraytz, Detroit, Mich.	(AWWA)
D.C. Stone, Denver Water Department, Denver, Colo.	(AWWA)
L.D. Thomas, The Metropolitan District, Hartford, Conn.	(AWWA)

General Interest Members

B.E. Bosserman, Mission Viejo, Calif.	(AWWA)
Tom Chadwick, Earth Tech, San Diego, Calif.	(AWWA)
W.D. Ensor, Ringwood, N.J.	(AWWA)
R.E. Herriott, Malcolm Pirnie Inc., Columbus, Ohio	(AWWA)
J.R. Holstrom, Naperville, Ill.	(AWWA)
M.B. Horsley, Overland Park, Kan.	(AWWA)
W.A. Hunt, Bozeman, Mont.	(AWWA)
T.J. McCandless,* Standards Engineer Liaison, AWWA, Denver, Colo.	(AWWA)
H.E. Spindler, Nodaway Valley Engineering, Barnard, Mo.	(AWWA)

Producer Members

J.V. Ballun, Val-Matic Valve & Manufacturing Corporation, Elmhurst, Ill.	(AWWA)
Malcolm Dixon, Henry Pratt Company, Aurora, Ill.	(AWWA)
Keith Hall, APCO Willamette Valve & Primer, San Clemente, Calif.	(AWWA)
T.A. Hartman, Hartman Valve Corporation, St. Louis, Mo.	(AWWA)

*Liaison, nonvoting

T.J. McAndrew, Rodney Hunt Company, Orange, Mass. (AWWA)

F.W. Peirce,* G.A. Industries Inc., Mars, Pa. (AWWA)

W.B. Scobie,* Mueller Company, Smithfield, R.I. (AWWA)

C.M. Stutsman, NIBCO Inc., Elkhart, Ind. (AWWA)

*Alternate

Contents

All AWWA standards follow the general format indicated subsequently. Some variations from this format may be found in a particular standard.

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Foreword

This foreword is for information only and is not a part of ANSI/AWWA C507.

I. Introduction.

I.A. *Background.* Ball valves have been used in pipelines carrying water for at least 45 years. Manufacturers of ball valves have developed tight-seating ball valves using metal-to-metal seats and also metal-to-resilient seats.

I.B. *History.* The first edition of ANSI/AWWA C507, Standard for Ball Valves, Shaft- or Trunnion-Mounted—6 In. Through 48 In.—for Water Pressures up to 300 psi, was approved on Sept. 14, 1973. The second edition of ANSI/AWWA C507, Standard for Ball Valves, 6 In. Through 48 In., was approved by the AWWA Board of Directors on June 23, 1985. The fourth edition was approved by the AWWA Board on Jan. 24, 1999. This fifth edition was approved by the AWWA Board on Jan. 16, 2005.

I.C. *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 original consortium included the American Water Works Association Research Foundation (AwwaRF) and the Conference of State Health and Environmental Managers (COSHEM). The American Water Works Association (AWWA) and the Association of State Drinking Water Administrators (ASDWA) joined later.

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 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.

*Persons outside the US should contact the appropriate authority having jurisdiction.

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

Annex A, "Toxicology Review and Evaluation Procedures," to NSF/ANSI 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 Annex A procedures may not always be identical, depending on the certifier.

ANSI/AWWA C507 does not address additives requirements. 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 parties offering to certify products for contact with, or treatment of, drinking water.

3. Determine current information on product certification.

II. Special Issues.

II.A. *General.* This standard covers only ball valves of the shaft- or trunnion-supported type. Generally, the valves are of cast construction in 150-psi (1,050-kPa), 250-psi (1,750-kPa), and 300-psi (2,100-kPa) pressure classes, with bodies having flanged ends. The actuating forces required to operate a ball valve of a given size vary considerably and depend on the size of the valve, the differential operating pressure, the quantity of water flow, the configuration of waterway passages, and the seal

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* NSF International, 789 N. Dixboro Rd., Ann Arbor, MI 48105.

† American National Standards Institute, 25 West 43rd Street, 4th Floor, New York, NY 10036.

‡ Both publications available from National Academy of Sciences, 2101 Constitution Ave. N.W., Washington, DC 20418.

design used. This standard covers the design of these valves and their actuators operating at a maximum differential pressure equal to or less than the design pressure and a maximum port fluid velocity of 35 ft/sec (10.7 m/sec). Ball valves capable of operating under pressure–velocity conditions exceeding these ratings are available but are outside the scope of this standard.

This standard uses the terms *differential pressure* and *design pressure*. These terms are defined in Sec. 3, Definitions. As an example, a valve could be in a service in which the design pressure is 100 psi (690 kPa), but the differential pressure is only 50 psi (345 kPa). That is, the pipeline pressure could be 100 psi (690 kPa), but with the valve closed, the differential pressure between the two sides of the closed ball is 50 psi (345 kPa).

II.B. *Considerations for Throttling Service.* If a valve is to be installed for throttling service, the purchaser must carefully evaluate the full range of differential pressures across the valve versus the downstream pressures in order to avoid damage by cavitation. Differential pressures across the valve versus downstream pressures for all angles of the ball, together with the hydraulic characteristics of the valve, must be determined and evaluated to ensure a successful installation.

Although fluid port velocities greater than 35 ft/sec (10.7 m/sec) have a higher probability of causing cavitation in piping systems, especially if valves are used to throttle flows, the 35-ft/sec (10.7-m/sec) port velocity is not an upper limit to the flow that can be satisfactorily handled by ball valves. Piping systems capable of producing higher velocities should be studied by the purchaser and manufacturer to ensure the most appropriate valve selection.

II.C. *Valve and Piping Supports.* According to Sec. 4.3.2.1.4 in this standard, valve bodies are required to have support legs or pads. These body support legs or pads should also rest on foundations, piers, or plate bearings without being anchored to the supports. The purpose of the body support legs or pads is to support the weight of the valve and actuator assembly when the valve is installed in a horizontal pipeline. These support legs or pads are not intended to be anchored to foundations that would require the valve to withstand loads caused by thermal expansion of piping or to support piping loads with the valve body. It is recommended that the purchaser take the responsibility of providing adequate supports for the piping. Ball valves installed in vertical pipelines may be supported by the flanged connections between the body and the pipeline.

Valves should be handled, stored, and installed in accordance with the manufacturer's instructions. It is strongly recommended that instruction manuals supplied by the valve manufacturer be reviewed before installing the ball valve.

To maintain the integrity of the valve, it is important to avoid subjecting the valve to pipe loads or external loads that drive the valve out of round, such as the use of valve foundations or supports without proper pipe supports. The valve should be supported independently of the adjacent piping, and the adjacent piping should be supported independently of the valve. Piping to and from the valve should be adequately supported and controlled. Valve inlet and outlet piping should be supported as near to the valve as practical. This removes most of the static load and allows identification of piping fit problems during installation and easier removal of the valve for maintenance. Design considerations should include allowable flange loadings, thermal expansion and contraction, and differential settlement.

Many types of buried pipes are designed to deflect 2 percent to 5 percent of pipe diameter, which is harmful to valve integrity. Adjacent piping should be supported or stiffened to provide a round mating connection to the valve in service.

II.D. *Effects of Pressure on Seat Performance.* Some ball valve seat designs are pressure sensitive, and the ability of these designs to meet the shop seat-leakage test requirements, as outlined in Sec. 5.1.1, depends on the specified differential pressure. The ball valves described in this standard do not have leakage requirements other than at the described differential pressure range. Operation of a valve at differential pressures less than the specified differential pressure range may result in increased seat-leakage rates. If operation at differential pressures lower than the specified differential pressure range is critical, the user should consult with the manufacturers and specify allowable leakage rates at the lower pressures. Operation of a valve at differential pressures greater than the specified differential pressure may result in accelerated seat wear or the inability of the valve to seat or unseat properly, or both. The purchaser should provide the manufacturer with the actual operating differential pressure or range of differential pressures to ensure optimum seat performance.

Sec. 5.1.1.4 through 5.1.1.6 describe allowable leakage rates at various differential pressure ranges. These leakage rates vary from 1–3 oz/hr/in. (1.2–3.6 mL/hr/mm) diameter of the valve. Valves having a leakage rate as low as 1 oz/hr/in. (1.2 mL/hr/mm) diameter over the entire differential pressure range are available. The purchaser should specify whether valves having these lower leakage rates are desired.

III. Use of This Standard. It is the responsibility of the user of an AWWA standard to determine that the products described in that standard are suitable for use in the particular application being considered.

III.A. *Purchaser Options and Alternatives.* The following items should be considered in the purchase documents:

1. Standard used—that is, ANSI/AWWA C507, Standard for Ball Valves, 6 In. Through 48 In. (150 mm Through 1,200 mm), latest edition.
2. Requirement (see Sec. 4.1) that the manufacturer submit drawings showing the principal dimensions, general construction, and materials used for all parts of each valve, and that all work to be done and all valves to be provided are in accordance with such drawings.
3. Whether the manufacturer is to provide instructions, parts manuals, recommended spare parts lists, and maintenance procedures.
4. Size of the valve, pressure class, and quantity required (Sec. 1).
5. Type of installation—buried, submerged, in-plant, in-vault, or outdoor.
6. Valve and actuator arrangement and position.
7. Body materials, if there is a preference (Sec. 4.3.2.1.1).
8. Type of valve support, if different from the standard (Sec. 4.3.2.1.4).
9. Ball material, if there is a preference (Sec. 4.3.2.2.1).
10. Whether a double- or single-seated valve is desired and preference of seat materials, if any (Sec. 4.3.2.3).
11. Resilient seat location (body or ball), if there is a preference (Sec. 4.3.2.3).
12. Bearing material, if there is a preference (Sec. 4.3.2.4.6).
13. Shaft material, if there is a preference (Sec. 4.3.2.5.2).
14. Type of shaft seals, if there is a preference (Sec. 4.3.2.6.2). This standard does not require that seal materials be resistant to permeation by organic compounds such as organic solvents and vapors that are petroleum-based products. If the purchaser's application involves such service conditions (usually in buried applications), the purchaser should consult with valve manufacturers to specify the proper shaft seals.
15. Whether or not shaft seals shall be designed for replacement under line pressure (Sec. 4.3.2.6.4).
16. Direction to open manual actuators—clockwise or counterclockwise rotation of handwheel, chainwheel, crank, or key (Sec. 4.3.2.7.13).

17. Valve operating mechanism or actuator housing material, if there is a preference (Sec. 4.3.2.7.2).

18. If valves with custom-designed actuators (Sec. 4.3.2.7.6) operate the valve at differential pressures less than the design pressure or at a maximum port velocity less than 35 ft/sec (10.7 m/sec), or both, are desired, the purchaser shall designate.

a. Maximum differential pressure (pounds per square inch [kilopascals]) (Sec. 3[9]).

b. Maximum port fluid velocity (feet [meters] per second) (Sec. 3[11]).

19. If the valve is to be used for regulating or throttling service, a complete description of maximum and minimum flow conditions with related upstream versus downstream pressures shall be provided. The range of regulating or throttling conditions shall be supplied by the purchaser, if required by the manufacturer.

20. Type of actuator required—handwheel, chainwheel, lever, crank, key operating nut, electric motor, air cylinder, water cylinder, or oil cylinder. Complete information for motor or cylinder actuators, including available electric power characteristics for the actuator; maximum and minimum air, water, or oil pressure for the cylinders; any control scheme; special devices, such as positioners, position indicators, or adjustable cushions; and complete information for any extension stems, floor stands, or similar appurtenances (Sec. 4.3.2.8). Requirements for power actuators are covered in ANSI/AWWA C540, Standard for Power-Actuating Devices for Valves and Sluice Gates.

21. Time of operation for the power actuators (Sec. 4.3.2.8.5).

22. Special protective coatings, if other than specified as standard in Sec. 4.4.3.

23. Whether or not records of certified tests are required (Sec. 5.1 and 5.2).

24. Sec. 5.1.2 requires the manufacturer to leak test the valve at the specified differential pressure of the valve. It is important to specify the operating differential pressure for the valve. Some ball valves rely on line pressure to seal and may have a higher leak rate at lower pressures if adjusted to seal at the rated pressure of the valve. Sec. 5.1.1.7 requires the manufacturer to test the valve for leakage at 100% of the specified differential pressure. The purchaser should specify any other required differential pressures at which the valves are to be tested for leakage.

25. Affidavit of compliance, if required (Sec. 6.3).

26. Warranty provisions, if they are required. AWWA standards do not cover warranties.

27. If shop inspection is required, the extent of such inspection should be defined.

III.B. *Modification to Standard.* Any modification to the provisions, definitions, or terminology in this standard must be provided in the purchase documents.

IV. Major Revisions. The major changes made in this revision of the standard include the following:

1. Added paragraph to Part II.C, Special Issues, in the Foreword, concerning the need for adequate valve and pipe supports.
2. Revised the allowable leakage rates in Sec. 5.
3. Revised material references to use the Unified Numbering System (UNS) designations.
4. Changed the allowable materials of construction for Classes 250 and 300 valves (Sec. 4.3).

V. Comments. If you have any comments or questions about this standard, please call the AWWA Volunteer and Technical Support Group at (303) 794-7711, FAX (303) 795-7603, or write to the group at 6666 West Quincy Avenue, Denver, CO 80235-3098, or e-mail at standards@awwa.org.

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American Water Works
Association

AWWA Standard

Ball Valves, 6 In. Through 48 In. (150 mm Through 1,200 mm)

SECTION 1: GENERAL

Sec. 1.1 Scope

This standard covers gray-iron, ductile-iron, and cast-steel, flanged-end, tight-shutoff, shaft- or trunnion-mounted, full-port, double- and single-seated ball valves for pressures up to 300 psi (2,100 kPa) in sizes from 6-in. through 48-in. (150-mm through 1,200-mm) diameter for use in water systems having fresh water with a pH greater than 6 and less than 12 and with temperatures greater than 32° F (0° C) and less than 125° F (52° C).

1.1.1 *Design fluid velocity.* The valve assembly and components shall be structurally suitable for a port fluid velocity of 35 ft/sec (10.7 m/sec) at design pressure and shall be within the allowable stresses noted in Sec. 4.3.1.1.

1.1.2 *Pressure class and rated/design pressure.* The classes of valves discussed in this standard shall be designed for the following maximum rated pressure. Rated pressure is defined as the design pressure at 100° F (38° C).

Pressure Class	Rated/Design Pressure
150	150 psi (1,050 kPa)
250	250 psi (1,750 kPa)
300	300 psi (2,100 kPa)

Sec. 1.2 Purpose

The purpose of this standard is to provide purchasers, manufacturers, and constructors with the minimum requirements for 6-in. through 48-in. (150-mm through 1,200-mm) ball valves for water supply service, including material, design, inspection, testing, marking, handling, and packaging for shipment.

Sec. 1.3 Application

This standard can be referenced in specifications for purchasing and receiving ball valves and can be used as a guide for fabricating and assembling ball valves, 6 in. through 48 in. (150 mm through 1,200 mm). The stipulations of this standard apply when this document has been referenced and then only to ball valves, 6 in. through 48 in. (150 mm through 1,200 mm) for water supply service applications.

SECTION 2: REFERENCES

This standard references the following documents. In their latest editions, these references form a part of this standard to the extent indicated within the standard. In any case of conflict, the requirements of this standard shall prevail.

ASME* B16.1—Cast Iron Pipe Flanges and Flanged Fittings.

ASME B16.42—Ductile Iron Pipe Flanges and Flanged Fittings, Class 150 and 300.

ASME B46.1—Surface Texture, Surface Roughness, Waviness, and Lay.

ANSI†/AWS‡ A5.4—Specification for Stainless Steel Electrodes for Shielded Metal Arc Welding.

AWS A5.9—Specification for Bare Stainless Steel Welding Electrodes and Rods.

AWS A5.11—Specification for Nickel and Nickel Alloy Welding Electrodes for Shielded Metal Arc Welding.

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

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

AWWA C550—Protective Interior Coatings for Valves and Hydrants.

*ASME, Three Park Avenue, New York, NY 10016.

†American National Standards Institute, 25 West 43rd Street, Fourth Floor, New York, NY 10036

‡American Welding Society, 550 N.W. LeJeune Rd., Miami, FL 33126.

ASTM* A27/A27M—Standard Specification for Steel Castings, Carbon, for General Application.

ASTM A48—Standard Specification for Gray Iron Castings.

ASTM A108—Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished.

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

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

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

ASTM A322—Standard Specification for Steel Bars, Alloy, Standard Grades.

ASTM A351/A351M—Standard Specification for Castings, Austenitic, Austenitic-Ferritic (Duplex) for Pressure-Containing Parts.

ASTM A395/A395M—Standard Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures.

ASTM A536—Standard Specification for Ductile Iron Castings.

ASTM A564/A564M—Standard Specification for Hot-Rolled and Cold-Finished Age-Hardening Stainless Steel Bars and Shapes.

ASTM A743/A743M—Standard Specification for Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion Resistant, for General Application.

ASTM B62—Standard Specification for Composition Bronze or Ounce Metal Castings.

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 B164—Standard Specification for Nickel-Copper Alloy Rod, Bar, and Wire.

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

ASTM D570—Standard Test Method for Water Absorption of Plastics.

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

ASTM E10—Standard Test Method for Brinell Hardness of Metallic Materials.

*ASTM International, 100 Barr Harbor Dr., West Conshohocken, PA 19428.

UNS[*] C83600—Cast Leaded Red Brass.

UNS S20161—Austenitic Cr-Mn-Ni-Si Stainless Steel.

UNS S21800—Austenitic Cr-Ni-Mn Stainless Steel (Nitronic 60).

SECTION 3: DEFINITIONS

The following definitions shall apply in this standard:

1. *Actuator:* A device or mechanism used to restrain or move the ball. A *power actuator* requires fluid or electrical power to restrain or move the ball.

2. *Ball:* The rotating, internal structural member of the valve that forms a structural obstruction to flow through the pipeline when the valve is in the closed position.

3. *Ball seat:* Seating surface located on the ball.

4. *Bearings:* The bearings that support the ball and operating shaft.

5. *Body seat:* Seating surface located in the body.

6. *Constructor:* The party that furnishes the work and materials for placement or installation.

7. *Cosmetic defect:* A blemish that has no effect on the ability of the component to meet the structural design and production test requirements of the standard. Should the blemish or the plugging, welding, grinding, or repairing of the blemish cause the component to fail these requirements, then the blemish shall be considered a structural defect.

8. *Design or rated pressure:* The maximum internal, steady-state pressure, at the specified operating temperatures, which the valve is designed to withstand when the ball is in any position.

9. *Differential pressure:* The maximum steady-state pressure differential, at the specified operating temperatures, across a closed valve at which pressure the valve is designed to seal and operate.

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

11. *Maximum port fluid velocity:* The maximum fluid velocity (feet [meters] per second) that the system can deliver through the ball in the wide-open position.

*Unified Numbering System.

12. *Operating shaft:* The shaft that connects the ball to the operating mechanism and transmits operating torque to rotate the ball.

13. *Port fluid velocity:* The fluid velocity of water (feet [meters] per second) through the full-open, nominal valve port, which is calculated as follows:

$$V = \frac{4Q}{\pi D^2} \tag{Eq 1}$$

Where:

V = port velocity, feet (meters) per second

Q = quantity of water flowing through valve, cubic feet (meters) per second

D = nominal diameter of valve, feet (meters)

π = 3.1416

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

15. *Shaft seal:* A system that contains the fluid at the shaft or stem penetration through the valve body.

16. *Shaft-mounted ball:* A valve ball whose shafts are supported within the valve body by bearings.

17. *Structural defect:* A flaw that causes the component to fail the structural design or test requirements of this standard. This includes, but is not limited to, imperfections that result in leakage through the walls of a casting; failure to meet the minimum wall thickness requirement; or failure to meet production tests.

18. *Thrust bearings:* The bearings that support axial shaft loads.

19. *Trunnion-mounted ball:* A valve ball whose trunnions are supported within the valve body by bearings.

20. *Valve body:* The pressure-containing shell or part of the shell of the valve.

SECTION 4: REQUIREMENTS

Sec. 4.1 Data to Be Provided by the Manufacturer or Supplier

The following data are to be provided by the manufacturer or supplier:

1. Principal dimensions, including laying length.
2. Valve component materials.

3. Actuator component materials.
4. Interior and exterior coating materials.
5. Assembled weight.
6. Valve port diameter.

Sec. 4.2 Materials

4.2.1 *General.* Materials designated in this standard, when used in valves produced according to the stipulations of this standard, shall conform to the requirements designated for each material listed.

4.2.2 *Physical and chemical requirements.* Materials shall conform to the physical and chemical requirements of this subsection.

4.2.2.1 Gray iron. ASTM A126, Class B; ASTM A48, Class 35.

4.2.2.2 Ductile iron. ASTM A536, grade 65-45-12; ASTM A395/A395M.

4.2.2.3 Stainless steel. ASTM A276, Grade S30400 or S31600; ASTM A351/A351M, grade CF8 or grade CF8M; ASTM A743/A743M, ASTM A564/A564M, grade S17400; UNS 21800; UNS 20161.

4.2.2.4 Carbon steel. ASTM A108.

4.2.2.5 Cast steel. ASTM A216, grade WCB; ASTM A27/A27M, grade 65-35.

4.2.2.6 Monel. ASTM B127, ASTM B164.

4.2.2.7 Brass or bronze. Components of brass or bronze shall be made to ASTM or the Unified Numbering System (UNS) and shall have a minimum yield strength of 14,000 psi (96,500 kPa).

4.2.2.7.1 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.

4.2.2.7.2 Bronze parts subject to wetting by line contents shall not contain more than 7 percent zinc, 8 percent lead, and 2 percent aluminum.

4.2.2.7.3 If aluminum bronze is used, the alloy shall be inhibited against dealuminization by receiving a temper anneal at 1,200° F (650° C) ± 50° F (28° C) for 1 hr/in. (1 hr/25 mm) of section thickness followed by cooling in moving air or by water quenching.

Sec. 4.3 General Design and Detailed Design

4.3.1 *General design.*

4.3.1.1 Allowable stress. The allowable stresses at design pressure shall not exceed one third of the yield strength or one fifth of the ultimate strength of materials used.

4.3.1.2 Differential pressure loading. Valves shall be designed so that at least 80 percent of the total differential pressure loading on the ball is carried by the shaft and trunnions.

4.3.1.3 Port fluid velocity. The valves shall be capable of operating at a maximum port fluid velocity of 35 ft/sec (10.7 m/sec).

4.3.2 *Detailed design.*

4.3.2.1 Body.

4.3.2.1.1 Bodies for Class 150 valves shall be of gray iron (ASTM A126, Class B, or ASTM A48, Class 35); ductile iron (ASTM A395/A395M or ASTM A536, grade 65-45-12); or cast steel (ASTM A27/A27M, grade 65-35, or ASTM A216, grade WCB); and, unless otherwise specified by the purchaser, shall have two flanges. Bodies for Classes 250 and 300 shall be the same as for Class 150, except that gray iron is not permitted.

4.3.2.1.2 Flanges shall conform to the dimensions and drilling of ANSI/ASME B16.1 or B16.42, Class 125, for Class 150 valves; flanges for Class 250 and Class 300 valves shall conform to the dimensions and drilling of ANSI/ASME B16.1 or B16.42, Class 250, except gray-iron flanges shall be flat-faced.

4.3.2.1.3 The body shall have a full, unobstructed, circular inlet and outlet port diameter as shown in Table 1.

4.3.2.1.4 Bodies shall have support legs or pads to support the valve and actuator weight when installed in a horizontal pipeline.

4.3.2.1.5 Bodies shall have a minimum shell thickness as shown in Table 2.

4.3.2.2 Valve ball.

4.3.2.2.1 The ball shall be made of gray iron (ASTM A126, Class B, or ASTM A48, Class 35); ductile iron (ASTM A536, grade 65-45-12); or cast steel (ASTM A27/A27M, grade 65-35, or ASTM A216, grade WCB).

4.3.2.2.2 The ball shall have a full, unobstructed, circular port of diameter as shown in Table 1.

Table 1 Port diameter for body inlet, body outlet, and ball

Valve Size		Nominal Port Diameter		Tolerance (±)	
in.	*(mm)*	*in.*	*(mm)*	*in.*	*(mm)*
6	(150)	6	(150)	1/8	(3.18)
8	(200)	8	(200)	1/8	(3.18)
10	(250)	10	(250)	1/8	(3.18)
12	(300)	12	(300)	3/16	(4.76)
14	(350)	14	(350)	3/16	(4.76)
16	(400)	16	(400)	3/16	(4.76)
18	(450)	18	(450)	3/16	(4.76)
20	(500)	20	(500)	1/4	(6.35)
24	(600)	24	(600)	1/4	(6.35)
30	(750)	30	(750)	1/4	(6.35)
36	(900)	36	(900)	1/4	(6.35)
42	(1,050)	42	(1,050)	1/4	(6.35)
48	(1,200)	48	(1,200)	1/4	(6.35)

Table 2 Minimum shell thickness for bodies

		Gray Iron and Ductile Iron				Cast Steel	
Size		Class 150		Class 250 and 300		Class 150, 250, and 300	
in.	*(mm)*	*in.*	*(mm)*	*in.*	*(mm)*	*in.*	*(mm)*
6	(150)	5/16	(7.94)	5/8	(15.9)	5/16	(7.94)
8	(200)	3/8	(9.53)	5/8	(15.9)	3/8	(9.53)
10	(250)	1/2	(12.7)	11/16	(17.5)	1/2	(12.7)
12	(300)	1/2	(12.7)	3/4	(19.1)	1/2	(12.7)
14	(350)	9/16	(14.3)	7/8	(22.2)	9/16	(14.3)
16	(400)	11/16	(17.5)	1	(25.4)	11/16	(17.5)
18	(450)	3/4	(19.1)	1 1/8	(28.6)	3/4	(19.1)
20	(500)	3/4	(19.1)	1 1/8	(28.6)	3/4	(19.1)
24	(600)	3/4	(19.1)	1 1/4	(31.8)	3/4	(19.1)
30	(750)	1	(25.4)	1 3/4	(44.5)	1	(25.4)
36	(900)	1 1/4	(31.8)	1 7/8	(47.6)	1 1/4	(31.8)
42	(1,050)	1 1/2	(38.1)	2 1/4	(57.2)	1 1/2	(38.1)
48	(1,200)	1 1/2	(38.1)	2 1/2	(63.5)	1 1/2	(38.1)

4.3.2.2.3 The ball port shall align with the body inlet and outlet ports within $^1/_8$ in. (3.18 mm) at the end of the ball port when the valve is in the full open position.

4.3.2.3 Valve seats.

4.3.2.3.1 Valves shall have a flexible metal or resilient seat located either in the valve body mating with a metal seating surface located on the valve ball or in the valve ball mating with a metal seating surface located in the valve body.

4.3.2.3.2 In single-seated valves, there shall be one set of ball and body seats that shall provide tight shutoff in one direction.

4.3.2.3.3 In double-seated valves, there shall be two sets of ball and body seats that shall provide tight shutoff in two directions.

4.3.2.3.4 Metal body or ball seats shall be made of bronze, stainless steel, Monel, or nickel-chromium alloy. The following materials are generally acceptable as metal seats: bronze per Sec. 4.2.2.7.2 (castings conforming to ASTM B62/UNS C83600); 18-8 stainless steel (wrought materials conforming to ASTM A276, Grade S30400 or S31600); gall-resistant stainless steel conforming to UNS S21800 or UNS S20161; wrought and cast Monel (conforming to ASTM B127); nickel-chromium alloy or weld overlay having a minimum total thickness of at least $^1/_4$ in. (6.35 mm), including an approximate $^1/_8$-in. (3.18-mm) thickness of base-weld material of rod or wire having greater than 50 percent nickel, overlaid with stainless steel rod or wire conforming to ANSI/AWS A5.4, E308L, or ANSI/AWS A5.9, ER308L for use with gray-iron, ductile-iron, or cast-steel valves; or weld overlay with a minimum thickness of $^1/_8$ in. (3.18 mm) of Monel rod conforming to ANSI/AWS A5.11, ENicu-1, ENicu-2, or ANSI/AWS A5.14/A5.14M, ERNicu-5 for use with gray-iron, ductile-iron, or cast-steel valves.

4.3.2.3.5 Resilient body or ball seats shall be of new, natural or synthetic rubber, or new plastic, and may be reinforced.

4.3.2.3.5.1 Resilient seats shall be of a design that permits removal and replacement at the site of the installation.

4.3.2.3.5.2 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. 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 hr at 104° F (40° C) without visible cracking in the surfaces of the test samples after the tests conclude. 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. Rubber compounds shall have less than a 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 hr.

4.3.2.3.5.3 Plastic compounds shall be of virgin resin. Compounds shall be resistant to microbiological attack and chemical degradation and shall have a maximum water adsorption of 2 percent in accordance with ASTM D570.

4.3.2.3.6 Plated surfaces, sprayed surfaces, or surface-coating treatments applied directly to the gray-iron, ductile-iron, or cast-steel valve body or ball are not acceptable as seating surfaces.

4.3.2.4 Bearings.

4.3.2.4.1 Valves shall be fitted with sleeve-type bearings contained in the hubs of the body.

4.3.2.4.2 Bearings shall be designed not to exceed a stress of one fifth of the compressive strength of the material used, but the stress shall not exceed 2,000 psi (14 MPa).

4.3.2.4.3 A bearing shall be provided on the valve shaft outboard of the valve-shaft seal or in the actuator housing to protect the valve-shaft seal from side thrust forces developed in the operating mechanism. See Sec. 4.3.2.5 for shaft design.

4.3.2.4.4 Each valve shall be equipped with at least one thrust-bearing set to hold the ball securely in the center of the valve seat.

4.3.2.4.5 Bearings shall be made of self-lubricated, corrosion-resistant materials.

4.3.2.4.6 Bearings that are exposed to the line contents shall be made of bronze per Sec. 4.2.2.7.2, stainless steel, Monel, or nonmetallic materials.

4.3.2.4.7 There shall be a hardness difference of at least 50 points on the Brinell Hardness Scale per ASTM E10 between mating stainless-steel bearing surfaces. Methods of obtaining an acceptable hardness difference include the use of different stainless-steel alloys having a minimum hardness difference of 50 points Brinell or forming a hardened surface on one or both mating surfaces by plating, nitriding, welding, or plasma spraying.

4.3.2.4.7.1 The use of stainless-steel alloys with gall-resistant characteristics for mating bearing surfaces shall be exempt from hardness requirements stated in

Sec. 4.3.2.4.7. The following materials are generally acceptable as nongalling stainless-steel bearing materials: UNS S21800 or UNS S20161.

4.3.2.5 Shafts.

4.3.2.5.1 The valve shall be provided with an operating shaft that connects the ball to the actuator. This shaft shall be of ample size to transmit the torque required for operation.

4.3.2.5.2 Shafts shall be made of stainless steel (ASTM A276 or ASTM A564/A564M, Grade S17400, age hardened); ferritic stainless steel (ASTM A276, Grade S41000); chrome molybdenum steel ([ASTM A322, grades G41400 or G41420], or [ASTM A108, grade G41400]).

4.3.2.5.3 Chrome molybdenum-steel or ferritic stainless-steel shafts shall be provided with hard chrome plating at least 0.003 in. (0.076 mm) minimum thickness where they contact the shaft seal system.

4.3.2.5.4 Shaft surfaces bearing against shaft seals shall have a finish that is 50 µin. (1.27 µm) (ANSI/ASME B46.1) or smoother. If made of chrome molybdenum steel or ferritic stainless steel, the surface shall be provided with a minimum of 0.003-in. (76.2-µm) thickness of chromium plating.

4.3.2.5.5 The valve shafts shall be rigidly connected to the ball by a positive means, such as by dowels or keys. When taper pins, dowel pins, or other such devices are used, they must be mechanically secured to ensure they are retained. The connection shall be designed to transmit shaft torque equivalent to at least 75 percent of the torsional strength of the shaft.

4.3.2.6 Shaft seals.

4.3.2.6.1 Where shafts or integral ball shafts project through the body, a shaft seal shall be provided.

4.3.2.6.2 Shaft seals shall be designed for V-type packing; for O-ring seals; or for nongraphited, lubricated compression packing.

4.3.2.6.3 If O-rings or the equivalent are used as shaft seals, they shall be contained in a removable stainless-steel, bronze, or nonmetallic cartridge, and at least two seal rings shall be used.

4.3.2.6.4 If required by the purchaser, shaft seals shall be designed for replacement with the line pressurized at the design pressure with the ball in either the open or closed position.

4.3.2.7 Manual valve operating mechanisms or actuators.

4.3.2.7.1 The valve operating-mechanism housing shall be securely attached and doweled or keyed to the valve body to prevent shift during operation of the valve.

4.3.2.7.2 The actuator housing shall be made of gray iron (ASTM A126, Class B, or ASTM A48, Class 35); ductile iron (ASTM A395/A395M or A536, grade 65-45-12); cast steel (ASTM A27/A27M or better); or forged or plate steel; and shall provide a complete enclosure for the operating mechanisms that use gears or threaded rods.

4.3.2.7.3 If the actuator requires lubrication, the enclosure shall retain the lubricant used. If actuator housings are buried, submerged, or in vaults, the enclosure shall be fully gasketed, grease-packed, and designed to withstand submersion and be droptight in water to 20 ft (6.1 m).

4.3.2.7.4 The actuator housing shall be fitted with a removable cover for maintenance and inspection of the operating mechanism.

4.3.2.7.5 The valve and actuator design shall prevent shaft-seal leakage from entering the housing.

4.3.2.7.6 The valve actuator shall be designed to open and close the valve under the operating conditions specified by the purchaser. If these conditions are not stipulated by the purchaser, the operating mechanism shall be designed to operate the valve at the design pressure and a maximum port velocity of 35 ft/sec (10.7 m/sec).

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

4.3.2.7.8 Actuators of the traveling-nut type shall be enclosed; shall have threaded reach rods of steel; and shall have a bronze or ductile-iron nut with internal threads. The lead screw shall be used as a tension and compression device and shall be properly supported so that it is not subjected to, or required to transmit, side loads.

4.3.2.7.9 Geared or traveling-nut type 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.

4.3.2.7.10 Proof of design shall be proven by subjecting one prototype actuator of each model and torque rating to a shop torque test equal to or greater than twice the required torque. After being tested, the actuator shall be completely dismantled and carefully examined for any evidence of damage.

4.3.2.7.11 On request, the manufacturer shall provide the purchaser with certified copies of reports describing the procedures and results of these tests for each model and torque rating of the actuator to be supplied.

4.3.2.7.12 Each manual actuator shall have all gearing totally enclosed.

4.3.2.7.13 The purchaser shall indicate the direction that the operating nut is turned to open the valve.

4.3.2.7.14 Actuators shall be designed to produce the indicated torque with a maximum pull of 80 lb (36.3 kg) on the handwheel or chainwheel and a maximum torque input of 150 ft-lb (203 J) on operating nuts (see Sec. 4.3.2.7.6).

4.3.2.7.15 Stop-limiting devices shall be provided in the actuators for the open and closed positions.

4.3.2.7.16 Actuator components between the input and the stop-limiting devices shall be designed to withstand, without damage, a pull of 200 lb (90.7 kg) for handwheel or chainwheel actuators and an input torque of 300 ft-lb (407 J) for operating nuts when operating against the stop-limiting devices.

4.3.2.8 Power actuators. Power actuators shall be designed and manufactured in accordance with applicable requirements of ANSI/AWWA C540.

4.3.2.8.1 Electric actuators shall be rated to produce not less than the required operating torque with motors sized for 1.5 times the required operating torque. Actuators used for modulating service shall also be rated to produce not less than 2.0 times the modulating torque.

4.3.2.8.2 Cylinder actuators shall be rated to produce not less than 1.25 times the required operating thrust at the minimum cylinder supply pressure. Air-powered cylinder actuators used for modulating service shall also be rated to produce not less than 2.0 times the modulating torque at the minimum cylinder supply pressure.

4.3.2.8.3 The intermediate mechanisms shall meet the requirements of Sec. 4.3.2.7.

4.3.2.8.4 A valve bearing a friction factor no lower than 0.30 shall be used in calculating the operating torques.

4.3.2.8.5 The purchaser should specify the required opening and closure times based on system or process requirements. There is more discussion on this subject in ANSI/AWWA C540, which users of ANSI/AWWA C507 should read if they are going to specify power actuators with these valves.

Sec. 4.4 Workmanship and Coatings

4.4.1 *General.* When assembled, valves manufactured in accordance with this standard shall be well-fitted and shall operate smoothly. The body and shaft seal shall meet the test requirements set forth in Sec. 5.2.

4.4.2 *Castings.* Castings shall be clean, sound, and without defects that will weaken their structure or impair their service. Cosmetic defects may be plugged, welded, or repaired. Structural defects may not be repaired unless the purchaser agrees. Repaired valves shall comply with the testing requirements of this standard after repairs have been made. Repairs within the bolt circle of any flange face are not allowed.

4.4.3 *Coating.*

4.4.3.1 Internal surfaces. Unless otherwise required by the purchaser, internal steel or iron surfaces of each valve, except stainless steel, machined, or bearing surfaces, shall be shop-coated with asphalt varnish or shall be coated in conformance with ANSI/AWWA C550.

4.4.3.2 External surfaces. Unless otherwise required by the purchaser, exterior steel or iron surfaces of each valve, except machined or bearing surfaces, shall be shop-coated with an alkyd primer or, in the case of valves for buried service, with asphalt varnish.

4.4.3.3 Coatings for severe conditions. The coatings required in paragraphs 4.4.3.1 and 4.4.3.2 are for usual conditions. The purchaser should specify other painting, coatings, or special protection systems for severe conditions, such as exposure to corrosive soils, corrosive water, fumes, or abrasion.

SECTION 5: VERIFICATION

Sec. 5.1 Production (Shop) Testing

Whenever valve components are made to conform with standards that include test requirements or testing procedures, these requirements or procedures shall be met by the valve manufacturer. If required by the purchaser, the records of the tests shall be made available to the purchaser.

5.1.1 *Production hydrostatic and seat tests.*

5.1.1.1 Body hydrostatic. With the ball in an open position, hydraulic pressure twice the design pressure shall be applied to the inside of the body of each valve for at least 30 min.

At this test pressure, there shall be no leakage to the exterior of the valve, nor shall any part be permanently deformed.

5.1.1.2 Ball and seat hydrostatic. With the ball in the closed position, hydraulic pressure 1.5 times the design pressure shall be applied between the flange on the side opposite the seat being tested and the seat being tested. The duration of this test shall be 15 min.

If the valve is double seated, this test will be performed in the same manner on the second seat. At this test pressure, no part shall be permanently deformed.

5.1.1.3 Production seat testing and proof of design tests. Each valve, with the actuator mounted on the valve, shall be closed, pressurized internally to the differential pressure, with the design pressure between the flange on the side opposite of the seat to be tested, and the seat being tested.

The valve shall then be opened against this differential pressure to the fully opened position. This test shall be repeated three times.

After the third test, the valve shall be pressurized as in the previous three tests, and the leakage shall be measured for 15 min and recorded at the differential pressure.

5.1.1.4 Leakage at 50 to 100 percent of differential pressure. The leakage past the closed seat being tested, over the range of 50 percent to 100 percent of the differential pressure, shall not exceed 1 fl oz/hr/in. (1.2 mL/hr/mm) of nominal port diameter. This leakage rate is applicable only for differential pressures greater than 10 psi.

5.1.1.5 Leakage at 25 to less than 50 percent of differential pressure. The leakage past the closed seat being tested, over the range of 25 percent to less than 50 percent of the differential pressure, shall not exceed 3 fl oz/hr/in. (3.6 mL/hr/mm) of nominal port diameter. This leakage rate is applicable only for differential pressures greater than 10 psi.

5.1.1.6 Leakage at less than 25 percent of differential pressure. For differential pressures less than or equal to 10 psi, and for pressures less than 25 percent of any differential pressure, higher leakage rates are allowable.

5.1.1.7 Leakage test. Unless otherwise specified, the leakage test shall be performed at 100 percent of the differential pressure.

5.1.2 *Performance tests.* Each valve, with the actuator mounted on the valve, shall be opened from its seated position under the differential pressure without exceeding the limitations of Sec. 4.3.2.7.14.

5.1.2.1 Shop operation of valves. Each valve shall be operated in the shop three times from the fully closed to the fully opened position and vice versa under no-flow conditions in order to demonstrate that the assembly operates properly.

Sec. 5.2 Proof-of-Design Tests

5.2.1 *Affidavit.* On request, the manufacturer shall provide an affidavit of compliance stating that the proof-of-design tests were carried out as described in this standard and that all requirements were successfully met.

5.2.2 *Procedure.* This section demonstrates the adequacy of each type of valve offered by a manufacturer to perform under design pressures within the applicable valve rating for a sufficient number of operations simulating a full service life. The adequacy is to be demonstrated by testing valves selected to represent each type of seat design in each applicable size group, in a pressure class or classes equal to or greater than the valves being purchased. The valves shall be subjected to cycling consisting of applying the differential pressure equal to the design pressure to the inside of the body and against the ball in the closed position, then opening the valve against the differential pressure equal to the design pressure, to the wide open position, and then closing the valve. Once the cycle test is completed, leakage of metal-to-metal seat valves and resilient seat valves shall not exceed the rate set forth in Sec. 5.1.1 The number of cycles shall be 5,000 for 6-in. through 18-in. (150-mm through 450-mm) valves and 1,000 for 20-in. through 48-in. (500-mm through 1,200-mm) valves.

Valves with upstream and downstream seats shall meet the above leakage evaluation in both directions. However, the specified number of cycles need only be run in one flow direction. Valves intended to seat in only one direction shall meet the stipulated leakage allowance for the indicated flow direction.

SECTION 6: DELIVERY

Sec. 6.1 Marking

6.1.1 *Body marking.* Bodies shall be marked with the size, design pressure, and manufacturer's name. Single-seated valves shall also be marked with an arrow showing the flow direction.

6.1.2 *Nameplate.* A corrosion-resistant nameplate containing the following data shall be mounted on the actuator housing:

1. Manufacturer's name.
2. Year of manufacture.
3. Identifying serial number.
4. Size of valve.
5. Design pressure.
6. Differential pressure.

Sec. 6.2 Preparation for Shipment

Valves shall be complete in all details when shipped. The manufacturer shall carefully prepare valves for shipment to minimize the likelihood of damage during shipment. Cavities shall be drained of water for protection against freezing. Valves larger than 16 in. (400 mm) shall be bolted or otherwise securely fastened to skids. Full-face flange protectors of exterior-grade plywood or weather-resistant pressboard, at least equal in size to 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 to permit correct field assembly.

Sec. 6.3 Affidavit of Compliance

The purchaser may require an affidavit from the manufacturer stating that the valve, actuator, and material used in their construction conform to the applicable requirements of this standard and the purchase documents and that all required tests have been performed and test requirements have been met.

1P-3.6M-43507-03/05-CM

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