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ANSI/AWWA C507-18
(Revision of ANSI/AWWA C507-15)

AWWA Standard

Ball Valves, 6 In. Through 60 In. (150 mm Through 1,500 mm)

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AWWA Standard

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Contents

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

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 more than 50 years. Manufacturers of ball valves have developed ball valves using metal-to-metal seats and also metal-to-resilient seats. This standard covers only full-ported ball valves of the shaft- or trunnion-supported type. Generally, the valves are installed in interior or protected spaces and are of cast construction with bodies having flanged ends. Buried installations of flanged joints should be avoided.

I.B. *History.* The first edition of ANSI/AWWA C507, Ball Valves, Shaft- or Trunnion-Mounted—6 In. Through 48 In.—for Water Pressures Up to 300 psi, was approved on Sept. 14, 1973. Subsequent revisions to ANSI/AWWA C507 were prepared by the AWWA Standards Committee and approved by the AWWA Board of Directors on June 23, 1985; Jan. 24, 1999; Jan. 16, 2005; and Jan. 23, 2011. The 2015 edition of ANSI/AWWA C507 added updated actuator requirements and was approved on Jan. 24, 2015. This edition was approved on Jan. 20, 2018.

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 direct and indirect drinking water additives. Other members of the original consortium included the Water Research Foundation (formerly 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. Specific policies of the state, provincial, or local agency.

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

† Persons outside the United States should contact the appropriate authority having jurisdiction.

2. 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.

3. 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 jurisdictions. 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, provincial, 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.

To minimize inadvertent drinking water additives, some jurisdictions (including California, Maryland, Vermont, and Louisiana, at the time of this writing) are calling for reduced lead limits for materials in contact with potable water. Various third-party certifiers have been assessing products against these lead content criteria, and a new ANSI-approved national standard, NSF/ANSI 372, Drinking Water System Components—Lead Content, was published in 2010.

On Jan. 4, 2011, legislation was signed revising the definition for "lead free" within the Safe Drinking Water Act (SDWA) as it pertains to "pipe, pipe fittings, plumbing fittings, and fixtures." The changes went into effect on Jan. 4, 2014. In brief, the new

* NSF International, 789 North Dixboro Road, Ann Arbor, MI 48105.

† Both publications available from The National Academies Press, 500 Fifth Street NW, Keck 360, Washington, DC 20001.

provisions to the SDWA require that these products meet a weighted average lead content of not more than 0.25 percent.

II. Special Issues.

II.A. *General.* 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 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 full-open port fluid velocity of 35 ft/s (10.7 m/s). Ball valves capable of operating under pressure–velocity conditions exceeding those found in this standard are available but are outside the scope of this standard. Fluid port velocities greater than 35 ft/s (10.7 m/s) have a higher probability of causing cavitation in piping systems, especially if valves are used to throttle flows. The 35-ft/s (10.7-m/s) port fluid 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 system owner, system designer, or purchaser and manufacturer to ensure the most appropriate valve selection.

II.B. *Considerations for Throttling Service.* If a valve is to be installed for throttling service, the system owner, system designer, or 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. See AWWA Manual M49 for further explanation and information.

II.C. *Valve and Piping Supports.* 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 arrangement 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. 5.1.2.2, 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. Operation of a valve at differential pressures greater than the specified differential pressure may result in accelerated seat wear, the inability of the valve to seat or unseat properly, or both.

Section 5.1.2.3 describes allowable leakage rates at various differential pressure ranges. These leakage rates vary from 1 to 18 fl oz/h/in. (1.2–21.64 mL/h/mm) diameter of the valve. Valves with resilient seats having a leakage rate as low as 1–3 fl oz/h/in. (1.2–3.6 mL/h/mm) diameter over the entire differential pressure range are available. The system owner, system designer, or purchaser should specify whether valves having these lower leakage rates are desired.

II.E. *Permeation.* The selection of materials is critical for water service and distribution piping in locations where there is likelihood that the pipe will be exposed to significant concentrations of pollutants composed 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, are 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 body walls, jointing materials, etc., *before* selecting materials for use in that area.

II.F. *Valve Installation and Piping Design.* The installation of ball valves downstream of turbulence-inducing devices or pieces of equipment, such as pumps and piping elbows, requires some consideration to avoid various mechanical and hydraulic issues. The turbulence can cause premature wearing of seats, unequal or uneven hydrodynamic loads on the balls with associated increase in torque loadings on valve actuators, unanticipated higher loadings and stresses on shaft bearings with resulting decrease in bearing longevity, and higher stresses on the valve shafts. These issues can be especially significant with ball valves installed directly on the discharge flanges of pumps. Piping system designers should review with the ball valve manufacturers the requirements or recommendations for minimum upstream pipe runs to provide reasonably smooth flow patterns approaching the valves. Such recommendations regarding minimum upstream pipe runs should preferably be the results of hydraulic tests or based on relevant experience. If no test data or results are available, or if no relevant experience is available, refer to the section "Effects of Pipe Installation" in AWWA Manual M49.

The installation of ball valves upstream of certain items of equipment requires some consideration to avoid various mechanical and hydraulic issues, especially if the ball is partially open. A partially open ball valve installed a short distance upstream can result in issues such as increased wear on valve hinges and/or shafts and supports and oscillation ("chattering") of the valve closure member. The turbulence caused by a partially open ball valve can also affect the performance and accuracy of other downstream devices such as flowmeters and pressure-indicating devices. Sufficient pipe spacing between the ball valve and the downstream piece of equipment should be provided to accommodate these issues. Note that the situation of a partially open ball can occur with valves in throttling or modulating service.

II.G. *Effects of Manual or Power Actuation Stroke Time.* When specifying manual and power actuators in Sec. III.A, Items 4, 23, 25, 26, and 27, consideration should be given to the effects of speed of valve *operation* on the pipeline hydraulic transients (surges), especially on long pipelines. The power actuator stroke time default values in this standard are based on broad system assumptions and reasonable induced transient pressures in an attached piping system of lengths up to approximately 4,000 diameters of the valve's nominal size. The user is cautioned to evaluate the need for other stroke times (longer or shorter) based on operational requirements and/or when piping length approaches or exceeds this assumption. Installed stroke times may vary based on an actual valve's operating fluid conditions (pressure and flow) as well as the actuator's power source capacity (i.e., terminal voltage, current, and wire size; or pressure, flow, and pipe size).

II.H. *Chlorine and Chloramine Degradation of Elastomers.* The selection of materials is critical for water service and distribution piping in locations where there is a possibility that elastomers will be in contact with chlorine or chloramines. Documented research has shown that elastomers such as gaskets, seals, valve seats, and encapsulations may be degraded when exposed to chlorine or chloramines. The impact of degradation is a function of the type of elastomeric material, chemical concentration, contact surface area, elastomer cross section, environmental conditions, and temperature. Careful selection of and specifications for elastomeric materials and the specifics of their application for each water system component should be considered to provide long-term usefulness and minimum degradation (swelling, loss of elasticity, or softening) of the elastomer specified.

II.I. *Bolting Gray Cast Iron Flanges to Steel Flanges.* The following recommendations are made for the use of high-strength bolting used with either ASME or AWWA steel flanges when bolting to low-ductility gray cast iron valve flanges. The ASME B16.1 standard gray iron flange is intended to be used with ASTM A307 Grade B bolting. This low-strength bolting has Unified National Coarse (UNC) series threads and heavy hex heads. AWWA C207 and ASME B16.5 steel flanges allow or require the use of higher-strength bolting such as ASTM A193 grade B bolts and ASTM A194 grade 2H nuts. These higher-strength materials employ eight threads per inch (8UN) in sizes 1⅛ in. and larger. When an iron flange is to be coupled with a steel flange using higher-strength bolting, the following precautions are recommended.

1. The information provided by the system owner, system designer, or purchaser to the manufacturer should include the need for tapped flange holes of 1⅛ in. and larger bolts to be tapped with the 8-thread series (8UN) tap.
2. The steel flanges should have flat faces.
3. Properly align flange faces before tensioning the bolts.
4. The gaskets should be ring gaskets extending to the bolt holes per ASME B16.5 Nonmandatory Appendix B, Table B-1, Group No. Ia materials. Use of Ib, IIa, IIb, IIIa, and IIIb gasket materials should be avoided.
5. Use only heavy hex nuts and heavy hex bolts.
6. Tension the bolts in a crossover pattern similar to ASME PCC-1-2013, “Guidelines for Pressure Boundary Bolted Flange Joint Assembly” using the three or more–round torque increment approach to the target torque.
7. Control of the bolt target torque should be based on the gasket material load requirements for the system maximum operating pressure so as not to overstress the cast iron flanges.
8. Care should also be exercised to ensure that piping loads transmitted to the cast iron valve and flanges are controlled and minimized.

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. *System Owner, System Designer, or Purchaser Options and Alternatives.* The following items or information should be provided by the system owner, system designer, or purchaser:

1. Standard used—that is, ANSI/AWWA C507, Ball Valves, 6 In. Through 60 In. (150 mm Through 1,500 mm), of latest revision.

2. Type of installation—buried, submerged, or nonburied and any permeation requirements (Sec. II.E).

3. Size of the valve, pressure class, and quantity required.

4. Valve and actuator arrangement and position.

5. Type of valve support, if different from the standard.

6. The system owner, system designer, or purchaser may indicate a desired shaft orientation. Typically, ball valves are constructed and installed such that the shaft is horizontal in horizontal piping. However, valves can be constructed with the shaft orientation vertical when installed in horizontal piping. The system owner, system designer, or purchaser should also consider the application or service conditions of the valve. For example, valves used in wastewater and reclaimed water service should be installed with the shafts horizontal so that solids do not accumulate in the shaft sealing areas.

7. Actuator requirements shall be provided by the system owner, system designer, or purchaser. Requirements may include handwheel, chainwheel, lever, crank, key operating nut, electric motor, air cylinder, water cylinder, or oil cylinder. Complete information for motor or cylinder actuators shall be in accordance with ANSI/AWWA C541 (Hydraulic and Pneumatic Cylinder and Vane-Type Actuators for Valves and Slide Gates) or ANSI/AWWA C542 (Electric Motor Actuators for Valves and Slide Gates).

NOTE: If the ratio of cylinder maximum supply pressure to minimum supply pressure is greater than 1.8, a pressure regulator or pressure-reducing valve is recommended for safety and stroke time consistency.

8. 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 may be provided by the system owner, system designer, or purchaser.

9. If actuators are used to operate the valve at differential pressures less than the design pressure, at a maximum port velocity less than 35 ft/s (10.7 m/s), or both, the system owner, system designer, or purchaser shall specify the maximum differential pressure (pounds per square inch [kilopascals]) (Sec. 3 [Item 11]) and the maximum port fluid velocity (feet [meters] per second).

10. Whether the manufacturer is required to provide instructions, parts manuals, recommended spare parts lists, operation and maintenance procedures (Sec. 4.1).

11. Details of federal, state, and local requirements (Sec. 4.2.1).

12. For potable water applications, whether compliance with NSF/ANSI 61, Drinking Water System Components—Health Effects, is required (Sec. 4.2.2).

13. Physical and chemical requirements (Sec. 4.2.3).

14. Body materials, if there is a preference (Sec. 4.3.5).

15. Flange requirements (Sec. 4.3.5.1).

16. Valve ball material, if there is a preference (Sec. 4.3.6).

17. Whether a single- or double-seated valve is preferred (Sec. 4.3.7).

18. Metal seat material requirements (Sec. 4.3.7.3).

19. Resilient seat material requirements (Sec. 4.3.7.4).

20. Resilient seat location (body or ball), if there is a preference (Sec. 4.3.7.4.1).

21. Bearing material, if there is a preference (Sec. 4.3.8.7.1).

22. Shaft material, if there is a preference (Sec. 4.3.9.1).

23. Type of shaft seals, if there is a preference (Sec. 4.3.9.5).

24. O-ring containment requirements (Sec. 4.3.9.5.2).

25. Actuator handwheel or chainwheel pull requirements. Maximum pull requirements have been found by some operations staff to be a high exertion of effort, and lesser pulls of 40 to 60 lb (178 to 267 N) on handwheels and chainwheels have sometimes been found to be beneficial (Sec. 4.3.10.3.1).

26. Direction to open manual actuators (Sec. 4.3.10.3.5).

27. Time of operation for the power actuators, if other than the default values (Sec. 4.3.10.4.3 and Sec. 4.3.10.5.5).

28. Whether certified copies of actuator proof-of-design tests are required (Sec. 4.3.10.5.2).

29. Special protective coatings, if other than specified (Sec. 4.4.3). If the user desires a particular valve coating to match that for the plant piping, it should be described clearly in the purchase documents.

30. Whether records of certified tests are required (Sec. 5.1.1).

31. The required differential pressure at which the valve is to be tested (Sec. 5.1.2).

32. Whether proof-of-design affidavit of compliance is not required (Sec. 5.2.2).

33. Whether affidavit of compliance is not required (Sec. 6.5).

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. Chlorine and chloramine degradation of elastomers advisory statement was added to the Foreword (Sec. II.H).

2. Bolting gray cast iron flanges to steel flanges advisory statement was added to the Foreword (Sec. II.I).

3. Body port diameter tolerances were defined (Sec. 4.3.5.2).

4. Seat surface treatment requirements were modified (Sec. 4.3.7.6).

5. Valve bearing stress was expanded to include bearing length requirements and trunnion-mounted ball valve requirements (Sec. 4.3.8.1).

6. Shaft shear stress requirements were added (Sec. 4.3.9.4.5).

7. Coating section was revised (Sec. 4.4.3).

8. Purchaser option to request production test records was added (Sec. 5.1.1).

9. Purchaser option to request proof-of-design test results was added (Sec. 5.2.2).

10. Rehabilitation of the proof-of-design test valve is allowed (Sec. 5.2.3.9).

V. Comments. If you have any comments or questions about this standard, please contact the AWWA Engineering and Technical Services at 303.794.7711, FAX at 303.795.7603, write to the department at 6666 West Quincy Avenue, Denver, CO 80235-3098, or email at standards@awwa.org.

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AWWA Standard

Ball Valves, 6 In. Through 60 In. (150 mm Through 1,500 mm)

SECTION 1: GENERAL

Sec. 1.1 Scope

This standard covers gray-iron, ductile-iron, and cast-steel flanged-end, low-leakage, shaft- or trunnion-mounted, full-port, and double- and single-seated ball valves for pressures up to 150 psi (1,050 kPa) in sizes 6 in. through 60 in. (150 mm through 1,500 mm) diameter and 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, wastewater, and reclaimed water systems having 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 shall be structurally suitable for a port fluid velocity (class D) of 35 ft/s (10.7 m/s) at design pressure and shall be within the allowable stresses noted in Sec. 4.3.1.

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 (Table 1). Rated pressure is defined as the design pressure at 100°F (38°C).