



**American Water Works
Association**

The Authoritative Resource on Safe Water®

ANSI/AWWA C504-10
(Revision of ANSI/AWWA C504-06)

AWWA Standard

Rubber-Seated Butterfly Valves, 3 In. (75 mm) Through 72 In. (1,800 mm)



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AWWA Standard

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Foreword

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

I. Introduction.

I.A. *Background.* Butterfly valves are generally used for 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 they (1) provide tight shutoff; (2) are relatively easy to operate, even with large pressure differentials across the valves; and (3) require relatively little space for installation.

I.B. *History.* 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 a 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), 150-psi (1,034-kPa), and 250-psi (1,723-kPa) pressure classes; flanged, mechanical-joint, and wafer bodies; rubber seats in valve bodies or 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.

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

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 valve interiors with asphalt varnish.

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

Revisions to the 1987 edition included using the word “actuator” rather than “operator” and provided 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.

Revisions to the 1994 edition included the deletion of appendix A for calculating torques, the addition of soft metrication, reference to actuator requirements given in ANSI/AWWA C540, Power-Actuating Devices for Valves and Hydrants, introduction of Class 250 valves, and adoption of additional materials and material requirements.

Revisions to the 2000 edition included revision of material references to use the Unified Numbering System (UNS) designations; addition of ductile iron as an acceptable material for actuator worm gears in buried service; allowance for the use of the valves from the proof-of-design tests to be rebuilt and used as production valves; and addition of advisory text on valve and adjacent pipe installation.

The eighth edition of ANSI/AWWA C504 was approved by the AWWA Board of Directors on Feb. 12, 2006. This ninth edition of ANSI/AWWA C504 was approved on June 20, 2010.

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 American Water Works Association Research Foundation (AwwaRF, now Water Research Foundation*) 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

* Water Research Foundation, 6666 West Quincy Avenue, Denver, CO 80235.

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

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.
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 C504 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 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.* 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 and the operation of the valve (on–off or throttling), including (1) the maximum transient

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

† Both publications available from National Academy of Sciences, 550 Fifth Street NW, Washington, DC 20418.

and static differential pressure across the valve disc and (2) flow through the valve under the most adverse operating conditions.

Torque requirements for valve operation vary considerably with differential pressure across the valve, fluid velocity, fluid temperature, and upstream piping conditions.

Flow direction is important in the installation and use of a butterfly valve. Some valves' performance and sealing characteristics vary with direction of flow. Flow direction can affect the torque requirements and throttling characteristics of valves with offset discs or discs that do not have identical surface configurations on each side. Many butterfly valves have different sealing characteristics on one side vs. the other. A manufacturer may have a recommended high-pressure sealing side for long-term reliability.

Hydraulic testing, flow 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 that produce a nonuniform or turbulent flow pattern upstream of the valve can increase torque requirements, create damaging vibrations, increase head loss, and increase stresses in valve components.

Some hydraulic systems can produce fluid velocities much higher than the maximum of 16 ft/sec (4.9 m/sec) described in this standard. Typically high fluid velocities can result from line breaks, during fire fighting or in surge relief applications. The effects of high velocities and asymmetrical turbulent flow conditions can result in high loads and torque requirements, which are unaccounted for in this standard. These design conditions should be clearly specified by the purchaser.

II.B. *Buried Valves Larger Than 48 In.* When valves are provided with flanged ends in buried applications, the purchaser is advised to consider providing means to accommodate issues such as differential settlement, capability to remove the valve or actuator for maintenance access to the valve interior for inspection, support of the valve, and controlling the shear loading on the adjacent pipe flanges. Many types of large buried pipes are designed to deflect 2–5 percent of pipe diameter, which is harmful to the valve integrity. Adjacent pipe must be supported or stiffened to provide a round mating connection for the valve in service.

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

1. The maximum anticipated fluid velocity through the valve, maximum non-shock 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 according to items 6, 7, 8, and 23 of Sec. III.A in this foreword. NOTE: If this information is not provided, Class B valve classifications 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 according to item 26 of Sec. III.A 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 because of clearance or other limitations, the diameter should be limited to an acceptable dimension according to item 14 of Sec. III.A in this foreword.

3. This standard refers to ANSI/AWWA C541, which 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 according to item 15 of Sec. III.A in this foreword.

4. This standard permits several metallic seating-surface materials. It 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 according to item 11 of Sec. III.A in this foreword.

5. 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 according to item 11 of Sec. III.A in this foreword.

6. The material references for metals in Sec. 4.1 of this standard are based on successful experience. There may be instances where the water is very corrosive, and the listed materials, particularly the bronzes, may not be suitable for surfaces in both the valve and, if applicable, the hydraulic cylinder actuator's wetted parts. The requirements for elastomers are included in Sec. 4.2.5 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 purchase documents. Refer to item 27 of Sec. III.A of this foreword.

7. 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 items 25 and 26 of Sec. III.A of this foreword.

8. This standard allows a party other than the valve manufacturer to mount an actuator to a valve. Sec. 5.1.2 and 5.1.2.1 require that the valve and actuator assembly be performance- and leak-tested as an assembly. The purchaser is cautioned that the valve manufacturer cannot assume responsibility for the valve's sealing and operating performance if the actuator is mounted by a party other than the valve manufacturer. If this is a concern, requirements on actuator mounting should be included in the purchase documents.

9. Electric actuators meeting the requirements of ANSI/AWWA C542 can be supplied with or without an intermediate quarter-turn mechanism. If desired, the purchaser should specify a multi-turn actuator coupled to an intermediate mechanism according to ANSI/AWWA C504.

10. When specifying manual and power actuators in Sec. III.A 13, 14, 16, and 36, consideration should be given to the effects of speed of valve closure on pipeline hydraulic transients (surges), especially on long pipelines.

II.D. *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 that are 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, 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.

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 information should be provided by the purchaser.

1. Standard to be used—that is, ANSI/AWWA C504, Rubber-Seated Butterfly Valves, of latest revision.

2. Whether compliance with NSF/ANSI 61, Drinking Water System Components—Health Effects, is required.
3. Size of valve.
4. Quantity required.
5. Type of body: flanged (short body or long body), wafer, or mechanical-joint ends.
6. Minimum acceptable valve classification (Sec. 1.1.2).
7. Maximum nonshock shutoff pressure and maximum nonshock line pressure.
8. Required flow rate through valve.
 - a. Under normal conditions.
 - b. Under maximum-flow conditions.
 - When opening (consider factors such as fire flow).
 - When closing (consider factors such as line break).
9. Description of connecting piping: material, outside diameter (OD) and inside diameter (ID), and flanged or plain end.
10. Information or data from the valve manufacturer or supplier. This information can include the following:
 - a. Valve port diameter.
 - b. Clearances required for the actuator and clearances required to remove the actuator.
 - c. The number of turns to open and close for manual actuators.
 - d. Assembled weight.
 - e. Valve-torque data.
 - f. Cavitation coefficients.
 - g. Preferred-flow direction, if applicable (foreword Section II, Special Issues).
 - h. Valve component materials (Sec. 4.2.1.6).
 - i. Principal dimensions, including laying length (Table 1).
 - j. Actuator manufacturer, model, and torque capability (Sec. 4.2.8).
 - k. Interior and exterior coating materials (Sec. 4.4.1).
 - l. Clearance beyond the valve body required for the valve disc to open fully (Sec. A.5.8).
11. Materials.
 - a. If the purchaser specifies a wetted component that was not part of the tested and certified valve, the certification may not be valid.
 - b. If one or more of the materials included in this standard are unacceptable, specify the acceptable materials that are included in this standard.

c. 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 6, Sec. II.B of this foreword.)

d. Metallic mating seats: Specify any limitations on acceptability of seat materials or sprayed seats for specific applications or specific products. Refer to Sec. II.C of this foreword.

12. Type of installation: buried, submerged, or nonburied.

13. Actuator type and service conditions.

a. Type—handwheel, chainwheel, or wrench nut.

b. Service—open-close or modulating.

14. Manual actuator.

a. Type—handwheel, chainwheel, or wrench nut.

b. Direction to turn the handwheel, chainwheel, or wrench nut to open valves. (Unless otherwise specified, the valve will open by turning counterclockwise.)

c. Position indicator:

— If required.

— Configuration for buried, submerged, or nonburied service.

d. Special devices or features if required: extension shaft, floor stand, handwheel diameter, or position transmitter.

e. Actuator handwheel or chainwheel pull requirements. Maximum pull requirements have been found by some operator staff to be a high exertion of effort, and lesser pulls of 40 to 60 lb (18.1 to 24.2 kg) on handwheels and chainwheels have sometimes been found to be beneficial (Sec. 4.2.8.6.2). This may require more turns or larger handwheels and perhaps more expensive actuators.

15. Cylinder actuator.

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

b. Medium pressure: maximum and minimum.

c. Characteristics: control scheme, opening and closing speed ranges, if different from the 30 to 60 sec required by ANSI/AWWA C541.

d. Position indicator:

— If required.

— Configuration.

e. Special requirements:

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

16. Other actuators: actuators other than those described in this standard or ANSI/AWWA C541 or C542 shall be specified by the purchaser in detail.

17. Valve and actuator arrangement and position. The purchaser may indicate a desired shaft orientation. Typically, butterfly valves are constructed and installed such that the shaft is horizontal in horizontal piping. However, valves can be constructed and installed with the shaft orientation vertical when installed in horizontal piping. The purchaser should also consider the application or service conditions of the valve. For example, valves used in raw (untreated) water and reuse water service should generally be installed with the shafts horizontal so that solids do not accumulate in the shaft sealing areas. Shaft orientation on valves installed upstream of pump suction nozzles can affect the performance of some types of pumps. Shaft orientation can affect valve head loss when the valve is installed downstream of elbow and tee branch fittings.

18. If an affidavit of compliance is required with the provisions of ANSI/AWWA C541 or C542 signed by the actuator manufacturer.

19. If the flow resistance coefficient for a fully open valve calculated in accordance with AWWA Manual M49, *Butterfly Valves: Torque, Head Loss, and Cavitation Analysis*, is required.

20. If valve position vs. flow resistance curves are required, they should be referenced to procedures described in AWWA Manual M49.

21. If shop inspection by the purchaser is required.

22. Maximum transient pressure and characteristics, if known.

23. Water temperature range.

24. If a leakage test in both directions is required (Sec. 5.1.2.5.3).

25. 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 for measuring head loss. This should be discussed by the purchaser and the manufacturer. It is recommended that the purchaser reference AWWA Manual M49 if a maximum head loss is specified.

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

27. Considerations relating to anticipated problems with rubber components exposed to line content containing chlorine, chloramines, or other chemicals (Sec. 4.2.5.2). If these 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.

28. This standard requires flat-faced flanges. If other facings are desired, they must be specified by the purchaser (Sec. 4.2.2.1).

29. If purchase documents require shop inspection or test observations to be performed by the purchaser, the extent of such inspections and observations should be defined.

30. Details of other federal, state or provincial, and local requirements (Sec. 4.1.1).

31. The provision of records for tests that are specified according to Sec. 4.1.3, 4.2.8.6.12, 5.1.1, 5.1.2, 5.1.3, and 5.1.4 of this standard. Test records required for power actuators under ANSI/AWWA C541 or C542 may also be requested. The purchaser may require all records or may stipulate a breakdown of production test records or proof-of-design test records.

32. Detailed description of nonstandard end connections (Sec. 4.2.1 and 4.2.2).

33. If valves are intended for operation more than once a month (Sec. 4.2.5.3.3).

34. Whether the shaft seals should use a stuffing box with pull-down glands (Sec. 4.2.7.5).

35. Type of shaft seal (Sec. 4.2.7). This standard does not require that seal materials be resistant to permeation by organic compounds such as organic solvents or petroleum-based products. If the purchaser's application involves such source conditions (usually in buried applications), then the purchaser should consult with valve manufacturers to specify the proper shaft seals.

36. Electric actuator (Sec. 4.2.8.7).

a. Type: multiturn actuator coupled to an intermediate mechanism or integral quarter-turn unit.

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

c. Position indicator: configuration.

d. Special considerations: type of service environment should be stated and appurtenances required.

37. Special protective coatings, if other than specified (Sec. 4.4). If the user desires a particular valve coating to match that for the plant piping, it should be described clearly in the purchase documents. Specify in the purchase documents if interior or exterior surface coating is required to be NSF 61 certified and if the interior or exterior surfaces of the valve shall be holiday tested and shall be holiday free (Sec. 4.4.1 and 4.4.5).

38. If an affidavit of compliance is required with the provisions of this standard signed by the valve manufacturer (Sec. 6.3).

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

IV. Major Revisions. The major revisions made to the standard in this edition include the following:

1. Permeation language was moved to the foreword under Special Issues, Sec. II.C.
2. New requirements were provided for mechanical-joint-end valves.

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

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**American Water Works
Association**

AWWA Standard

Rubber-Seated Butterfly Valves, 3 In. (75 mm) Through 72 In. (1,800 mm)

SECTION 1: GENERAL

Sec. 1.1 Scope

This standard establishes minimum requirements for 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 6–12 and a temperature range from 33°–125°F (0.6°–52°C). This standard covers rubber-seated butterfly valves suitable for a maximum steady-state fluid working pressure of 250 psig (1,723 kPa), a maximum steady-state differential pressure of 250 psi (1,723 kPa), and a maximum fully open fluid velocity of 16 ft/sec (4.9 m/sec) based on nominal valve size.

1.1.1 *Body types, classes, and sizes.* Valves described in this standard are provided 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 and long-body flanged valves. Class 25A, Class 25B, Class 75A, Class 75B, Class 150A, and Class 150B, in sizes 3–72 in. (75–1,800 mm), and Class 250B in sizes 3–48 in. (75–1,200 mm).

1.1.1.3 Mechanical-joint-end valves. Class 150B and Class 250B, in sizes 3–24 in. (75–600 mm), and Class 25A, Class 25B, Class 75A, Class 75B, Class 150A, Class 150B, and Class 250B, in sizes 30–48 in. (750–1,200 mm).