ANSI/AWWA C516-14
(Revision of ANSI/AWWA C516-10)

American Water Works Association
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AWWA Standard

Large-Diameter Rubber-Seated Butterfly Valves, Sizes 78 In. (2,000 mm) and Larger

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AWWA Standard

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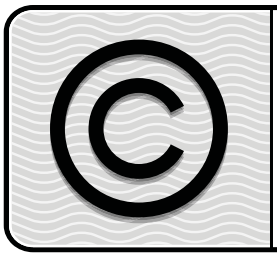

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Contents

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 C516.*

I. Introduction.

I.A. *Background.* Large-diameter butterfly valves are generally used for pipelines carrying water and gases in power generation facilities, water treatment plants, and major water supply and distribution lines. Butterfly valves are isolation and flow-control devices that provide tight shutoff; are relatively easy to operate, even with moderate pressure drops across the valves; and 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) with the adoption of AWWA C504 for Rubber-Seated Butterfly Valves in 1954. This companion standard was developed by the AWWA Standards Committee on Feb. 12, 2006, to meet the need for large-diameter valves in the waterworks industry. This second edition of ANSI/AWWA C516 was approved by the AWWA Board of Directors on June 8, 2014.

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. 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.

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* 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.

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 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 C516 does not address additives requirements. Thus, users of this standard should consult the appropriate state or local agency having jurisdiction in order to

1. Determine additives requirements, including applicable standards.
2. Determine the status of certifications by all parties offering to certify products for contact with, or treatment of, drinking water.
3. Determine current information on product certification.

In an alternative approach to 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 National Academy of Sciences, 500 Fifth Street, NW, 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.* 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 (open–close or throttling), including (1) the maximum transient pressure 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. Torque coefficients should be determined by the manufacturer using the methodology given in AWWA Manual M49, which recommends the use of scale models for predicting dynamic torques for large valves.

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, which do not have identical surface configurations on each side. Many butterfly valves have different sealing characteristics on one side versus 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 or in surge relief applications. The effects of high fluid 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.* Valves in this standard 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 from the adjacent pipe flanges. Many types of buried pipes are designed to deflect 2 to 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 Applications.* 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 4, 5, 6, and 26 of Sec. III.A in this foreword.

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 24 of Sec. III.A in this foreword.

2. This standard does not require a minimum waterway area nor does it limit head loss across the valve. If this is of concern, limitations should be provided. Refer to item 14 of Sec. III.A of this foreword.

3. There is no standard for valve laying lengths for large butterfly valves, only a range of laying lengths. Laying lengths should be provided by the supplier on outline drawings.

4. This standard does not require the valve manufacturer to mount the actuator to the valve and perform tests when the actuator is not direct-mounted, such as when an extended bonnet is provided. Special factory tests and actuator field installation requirements should be provided to ensure the actuator is properly adjusted and the valve leak tested before placing the valve and line in service.

5. Some actuators may produce sufficient torque to damage the valve if the valve is prevented from closing because of an obstruction in the pipeline. Protective measures such as torque-limiting devices or shear pins and keys are beyond the scope of this standard.

6. The selection of materials may be critical for water service and distribution piping in locations where there is the likelihood that elastomers will be in contact with specific water treatment disinfection agents. Documented research has shown that elastomers such as pipe gaskets, valve stem seals, and valve seats may degrade

when exposed to certain disinfection agents. This standard does not include elastomer test requirements for chemical resistance to water treatment disinfection agents such as, but not limited to, chlorine and chloramines. If resistance to such agents is required, careful selection of and specifications for elastomeric materials should be considered to provide long-term usefulness and minimal degradation (e.g., swelling, loss of elasticity, softening, etc.) of each elastomeric valve component. The AWWA Research Foundation (now known as the Water Research Foundation) and USEPA sponsored the 2007 publication *Performance of Elastomeric Components in Contact With Potable Water*, which presents data on commonly used elastomeric materials and may serve as a reference for reviewing alternative materials in specific applications. System designers, valve manufacturers, and material producers may also have knowledge and experience with elastomeric materials in specific applications that could provide the purchaser with additional information.

II.D. *Advisory Information on Scheduling Requirements.* Valves made in accordance with this standard are not "production run" products. They are custom designed and manufactured for the specific application. A consequence of this circumstance is that valve manufacturers may require more time for large-diameter butterfly valves than for "small" valves (i.e., ANSI/AWWA C504) to develop bid prices, prepare valve designs, submit shop drawing data, manufacture the valve, and shop test the valve. For example, manufacturers may typically require several weeks to develop reasonable bid prices. Shop drawings or other submittal preparation may require an additional two to four weeks. Valve manufacture may take over six months. The purchaser should discuss schedule requirements with manufacturers in advance of placing orders or advertising for bids.

II.E. *Valve Discs and Piping Design.* The discs of butterfly valves, when in the fully open position, intrude into the adjacent upstream and downstream piping or other adjacent devices. This can especially be an issue with adjacent pipe having interior linings and with polyethylene transmission pipe. The piping system designer should check the valve manufacturer's recommendations for minimum pipe internal diameter for disc clearance and be sure the adjacent pipe internal diameters are sufficient to accommodate the fully open discs.

The installation of butterfly 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 discs with associated increase in torque loadings on valve actuators, unanticipated higher load-

ings 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 butterfly valves installed directly on the discharge flanges of pumps. In some cases, valve shaft orientation downstream of piping elbows can have a significant effect on the above described valve mechanical and hydraulic issues. Piping system designers should review with butterfly valve manufacturers the requirements or recommendations for minimum upstream pipe runs to provide reasonably smooth flow patterns approaching the valve discs and recommendations regarding shaft orientation. Such recommendations regarding minimum upstream pipe runs should 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 Installations" in AWWA Manual M49.

The installation of butterfly valves upstream of certain items of equipment requires some consideration to avoid various mechanical and hydraulic issues, especially if the butterfly valve disc is partially open. For example, if butterfly valves are installed directly on the upstream or downstream flanges of other valves (such as check valves), the open butterfly valve disc will intrude into the body of the adjacent valve. A partially open butterfly valve disc, or even a partially open butterfly valve installed a short distance upstream, can result in issues such as increased wear on check valves' hinges and shaft supports and oscillation ("chattering") of the check valve discs. The turbulence caused by a partially open butterfly valve disc can also affect the performance and accuracy of other downstream devices such as pitot tubes. Sufficient pipe spacing between the butterfly valve and the downstream piece of equipment should be provided to accommodate these issues. Note that the situation of a partially open disc can occur with valves in throttling or modulating service.

II.F. *Effects of Manual or Power Actuator Stroke Time.* When specifying manual and power actuators in Sec. III.A 6, 7, 8, and 9, 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 actual operating fluid conditions and the power source capacity (i.e., terminal voltage, current, and wire size; pressure, flow, and pipe size).

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 used—that is, ANSI/AWWA C516, Large-Diameter Rubber-Seated Butterfly Valves, Sizes 78 In. (1,950 mm) and Larger, of latest revision.
2. Whether compliance with NSF/ANSI 61, Drinking Water System Components—Health Effects, or NSF/ANSI 372, Drinking Water System Components—Lead Content, or an alternative lead content criterion is required.
3. Size of valve and quantity required.
4. Maximum nonshock shutoff pressure and maximum nonshock line pressure.
5. Actuator type and service conditions.
    a. Type—manual, electric, cylinder, or other.
    b. Service—open/close or modulating.
6. 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 it is required.
        —Configuration for vault, submerged, or in-plant service.
    d. Special devices or features if required: extension shaft, floor stand, handwheel diameter, limit switches, or position transmitter.
7. Electric actuator.
    a. Type: multiturn actuator coupled to an intermediate mechanism or integral quarter-turn unit.
    b. Characteristics: operating voltage, control scheme, and time of operation.
    c. Position indicator: configuration.
    d. Special considerations: type of service environment should be stated and appurtenances required.
8. Cylinder actuator.
    a. Operating medium: air, water, or oil.
    b. Medium pressure: maximum and minimum.
    c. Characteristics: control scheme, opening and closing speed ranges.

d. Position indicator:

—If it is required.

—Configuration.

e. Special requirements:

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

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

10. Valve and actuator arrangement and position.

11. Required flow rate through valve.

a. Under normal conditions.

b. Under maximum-flow conditions.

—When opening under maximum differential pressure.

—When closing under maximum line break velocity.

12. Maximum transient pressure and characteristics, if known.

13. Water temperature range.

14. If a maximum head loss is required, this information shall be provided for each size and class of valve. Manufacturers should use the test methods given in AWWA Manual M49.

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

16. If purchaser requires shop inspection or test observations to be performed by the purchaser or purchaser's agent, the extent of such inspections and observations shall be defined.

17. This standard requires flat-faced flanges. If other facings are required such as raised face or O-ring grooves, they shall be specified by the purchaser.

18. Minimum acceptable valve classification (Sec. 1.1.1).

19. Data to be provided by the manufacturer or supplier. Sec. 4.1 describes the minimum data to be provided by the supplier. Because these valves are custom designed and manufactured, purchasers may require more detailed or comprehensive data. Such data may include

a. Chemical analysis of materials for body, disc, and shaft.

b. Tensile strength, yield strength, hardness, and impact test data for body, disc, and shaft materials.

c. Data on welding procedures and qualification.

d. Results on welding qualification such as bend tests.

e. Results of weld examinations such as liquid penetrant, hardness, and magnetic particle.

f. Weld procedures and documentation.

g. Center of gravity.

h. Valve torque data.

i. Cavitation coefficients.

j. Valve position versus flow resistance curves.

k. Affidavit of compliance with applicable provisions of this standard, notarized, and signed by the valve and actuators manufacturer's person in responsible charge.

l. Flow resistance coefficient for a fully open valve calculated in accordance with AWWA Manual M49.

m. Copies of the proof-of-design test performed in accordance with Sec. 5.2.

All such requirements shall be clearly defined in the purchase documents. The appropriate submittal requirements per ASTM and ASME material and design standards should be referenced.

20. Details of other federal, state, or provincial requirements, and local requirements (Sec. 4.2.1).

21. Records of materials tests (Sec. 4.2.3).

22. Type of shaft seal (Sec. 4.3.6.1).

23. Description of connecting piping: material, including interior coatings and/or lining, outside diameter (OD) and inside diameter (ID), and flanged end connection (Sec. 4.3.1.6.2).

24. Type of installation: buried (Sec. 4.3.1.6.4, specify depth and loadings), vault, submerged (specify depth and duration), indoors, or outdoors.

25. Considerations relating to anticipated problems with components exposed to water containing chlorine, chlorides, chloramines, or other chemicals. 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 (Sec. 4.3.4.2.1).

26. Materials.

a. If the purchaser specifies a wetted component that was not tested and certified to NSF/ANSI 61 or NSF/ANSI 372 requirements, 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. Required mating surface. In cases where valves are to be opened frequently (more than once a month), seating surfaces of stainless steel are recommended (Sec. 4.3.4.3).

27. Whether shaft seal shall be contained in a stuffing box (Sec. 4.3.6.4).

28. Required welding procedure (Sec. 4.4.1).

29. Protective coatings if other than specified in Sec. 4.5 of this standard.

30. The providing of test records that are specified according to Sec. 5.1.1, 5.1.2, and 5.1.3 of this standard. Test records required for manual actuators under ANSI/AWWA C504, Rubber-Seated Butterfly Valves, and power actuators under ANSI/AWWA C541, Hydraulic and Pneumatic Cylinder and Vane-Type Actuators for Valves and Slide Gates, and ANSI/AWWA C542 Electric Motor Actuators for Valves and Slide Gates, 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.

31. If a leakage test in both directions is required or if the valve shall be tested with the disc in the vertical plane (Sec. 5.1.2).

32. Special markings to be applied to a valve by manufacturer (Sec. 6.1).

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

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

1. AWWA Pressure Class 250B was added.
2. Additional advisory information on installation was added to the foreword.
3. Body shell thickness requirements were revised.
4. Use with reclaimed water was added.
5. Alternate purchaser-specified test requirements were added.

V. Comments. If you have any comments or questions about this standard, please call 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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Large-Diameter Rubber-Seated Butterfly Valves, Sizes 78 In. (2,000 mm) and Larger

SECTION 1: GENERAL

Sec. 1.1 Scope

This standard establishes minimum requirements for rubber-seated butterfly valve assemblies that are 78 in. (2,000 mm) diameter and larger with flanged ends suitable for fresh and reclaimed water having a pH range from 6–12 and a temperature range from 33°–125°F (0.6°–52°C) and suitable for a maximum steady-state fluid working pressure of 250 psig (1,724 kPa [gauge]), a maximum steady-state differential pressure of 250 psi (1,724 kPa), and a maximum full-open fluid velocity of 16 ft/sec (4.9 m/sec) based on nominal valve size.

1.1.1 *Body classes.* Valves described in this standard are provided in classes 25B, 50B, 75B, 150B, and 250B.

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