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ANSI/AWWA C519-18
(First Edition)

AWWA Standard

High-Performance Waterworks Butterfly Valves—3 In. (75 mm) Through 60 In. (1,500 mm)

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Approved American National Standard ANSI

AWWA Standard

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Committee Personnel

The AWWA Standards Sub-Committee for High-Performance Waterworks Butterfly Valves, which prepared and reviewed this standard, had the following personnel at the time of approval:

Albert W. Libke, *Chair*

General Interest Members

A. Ali, ADA Consulting Ltd., Surrey, B.C.
F.L. Hinker, Santa Rosa, N.M.
M.C. Johnson, Utah State University, Water Research Lab., Logan, Utah
M. MacConnell, Burnaby, B.C.
T.J. McCandless,* Standards Engineer Liaison, AWWA, Denver, Colo.

Producer Members

A. Abouelleil, Henry Pratt Company, Aurora, Ill.
S. Allen, Bray Controls, Houston, Tex.
H. Herold, VAG, Mannheim, Germany
J. Holstrom, Val-Matic Valve & Manufacturing Corp., Elmhurst, Ill.
A.W. Libke, DeZURIK, Inc., Sartell, Minn.
J.H. Wilber, American AVK, Littleton, Colo.
D. Woollums,† Mueller Group, Chattanooga, Tenn.

User Members

S. Carpenter, San Diego County Water Authority, San Diego, Calif.
S. Hattan, Tarrant Regional Water Dist., Fort Worth, Tex.
P.J. Ries, Denver Water, Denver, Colo.

* Liaison, nonvoting
† Alternate

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

Mark MacConnell, *Chair*

General Interest Members

A. Ali, ADA Consulting Ltd., Surrey, B.C.
M.D. Bennett, Stantec, Cleveland, Ohio
B.E. Bosserman, Consultant, Mission Viejo, Calif.
J. Hebenstreit, Underwriters Laboratories Inc., Northbrook, Ill.
F.L. Hinker, Consultant, Santa Rosa, N.M.
M.C. Johnson, Utah State University, Water Research Lab., Logan, Utah
T. Jordan, HDR Inc., Denver, Colo.
T.J. McCandless,* Standards Engineer Liaison, AWWA, Denver, Colo.
D. Middleton,† Stantec, Burlington, Mass.
J.N. Nakashima, Lockwood, Andrews, & Newnam, Oakbrook Terrace, Ill.
W. Rahmeyer,† Dept. of Civil & Environmental Engineering, Utah State, Logan, Utah
U. Sant, AECOM, Dallas, Tex.
L. Thomas,* Standards Council Liaison, Stanley Consultants, Crystal Lake, Ill.
R.A. Ward, Tighe & Bond, Westfield, Mass.

Producer Members

A. Abouelleil, Henry Pratt Company, Aurora, Ill.
S. Allen, Bray International, Jonesboro, Ark.
D.E. Burczynski,† Kennedy Valve, Elmira, N.Y.
S. D. Dalton,† Val-Matic Valve & Manufacturing Corp., Elmhurst, Ill.
A.C. Granzow, NIBCO Inc., Elkhart, Ind.
T.A. Hartman, Hartman Valve Corp., Saint Louis, Mo.
H. Herold, VAG, Mannheim, Germany
J.R. Holstrom, Val-Matic Valve & Manufacturing Corp., Elmhurst, Ill.
K. Johnson, M&H Valve Company, Anniston, Ala.
A.W. Libke, DeZURIK, Sartell, Minn.
R. Tschida,† DeZURIK, Sartell, Minn.
D. Woollums,† Mueller Group, Chattanooga, Tenn.
J.H. Wilber, American AVK, Littleton, Colo.

* Liaison, nonvoting
† Alternate

User Members

S. Carpenter, San Diego County Water Authority, Escondido, Calif.
D.W. Coppes, Mass. Water Resources Authority, Chelsea, Mass.
S. Hattan, Tarrant Regional Water Dist., Fort Worth, Tex.
R. Kilborn, City of Chandler, Chandler, Ariz.
V.Q. Le, Los Angeles Water & Power, Los Angeles, Calif.
M. MacConnell, Burnaby, B.C.
P.J. Ries, Denver Water, Denver, Colo.
S.Y. Tung, City of Houston, Houston, Tex.

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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 C519.*

I. Introduction.

I.A. *Background.* Butterfly valves are generally used for pipelines carrying liquids and gases. Manufacturers of steel butterfly valves developed tight-closing, polymeric-seated and metal-seated valve options for cooling water systems and power stations and other industrial applications.

Since the 1990s, high-performance butterfly valves have gained increased acceptance for use in water treatment plants, water reuse, and water supply and distribution lines because they (1) provide higher pressure and fluid velocity ratings than rubber-seated butterfly valves; (2) provide tight shutoff; (3) are relatively easy to operate, even with large pressure differentials across the valves; and (4) require relatively little space for installation.

I.B. *History.* The need for standardization of high-performance butterfly valves for waterworks service was recognized by AWWA in 2010.

The 2018 standard was written to describe the then-available types of standard high-performance butterfly valves that had been in successful operation for at least ten years. The standard established three pressure classifications, three fluid velocity classifications, standards for materials, laying lengths, minimum body and disc designs, and actuator requirements for high-performance butterfly valves.

Generally, modern high-performance butterfly-valve designs for water service include cast or welded body construction in 150 psi (1,034 kPa), 275 psi (1,896 kPa), and 500 psi (3,447 kPa) pressure ratings; flanged, lugged-wafer, and wafer bodies; seats in valve bodies or on the valve discs; and operating conditions (limited by the materials, design shutoff pressure, and velocities of water flow) that may produce torques considered maximum for the shaft size used.

This edition of ANSI/AWWA C519 was approved by the AWWA Board of Directors on June 9, 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

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

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 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 or local agency.

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, provinces, or local agencies have authority to accept or accredit certification organizations within their jurisdiction. Accreditation of certification organizations may vary from jurisdiction to jurisdiction.

ANSI/AWWA C519 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.* The purchaser should carefully evaluate conditions under which a valve is to be operated. The evaluations must include the determination of the hydraulic characteristics of the system in which the valve will be installed and the

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

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

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

§ Both publications available from National Academy of Sciences, 500 Fifth Street, NW, Washington, DC 20001.

operation of the valve (open-closed, throttling, or modulating service), including (1) the maximum transient 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 the seat design or type, 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. Performance and sealing characteristics of some valves 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 offset seat-type 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, such as 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 higher than the maximum of 35 ft/s (10.7 m/s) described in this standard. These design conditions should be clearly specified by the purchaser so that the valve supplier can address materials and actuator issues. Typically, high fluid velocities can result from flow control and pressure-reducing applications, pipeline breaks, during firefighting, or in surge-relief applications. The effects of high fluid velocities and asymmetrical turbulent-flow conditions can result in high component stresses, and high torque requirements, such that the actuator(s) may not be able to hold valve position or control valve opening and closing. These flow conditions are not within the scope of this standard.

II.B. *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 as follows:

1. The maximum anticipated fluid velocity through the valve, maximum nonshock shutoff and differential pressure, water temperature range, and valve classification are used by manufacturers to calculate torque requirements through methods found in AWWA Manual M49—Quarter-Turn Valves: Head Loss, Torque,

and Cavitation Analysis, which then may determine valve operating-component design and actuator sizing. This information should be provided according to items 5, 6, 7, 23, and 24 of Sec. III.A in this foreword. If this information is not provided, a maximum fluid velocity of 35 ft/s (10.7 m/s) and maximum pressure classification of 500 psi (3,447 kPa) will be provided with actuators 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 27 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—Hydraulic and Pneumatic Cylinder and Vane-Type Actuators for Valves and Slide Gates, 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 unusually corrosive, resulting in the promotion of material degradation. The purchaser may limit acceptability to cylinders having components that do not depend on plating to resist corrosion according to item 15 of Sec. III.A in this foreword.

4. This standard permits polymer and metal seating-surface materials. This standard recommends seating surfaces of reinforced polymer or 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 materials 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 Secs. 4.2 and 4.3 of this standard are based on successful experience. There may be instances where the water is corrosive, resulting in the promotion of material degradation, and the listed materials may not be suitable for both the valve and, if applicable, the hydraulic cylinder. If the materials

are not appropriate for the application, the purchaser should identify in the purchase documents which materials are acceptable and identify any other allowable materials.

7. High-performance butterfly valves were developed as steel products, and typically mate with steel and ductile-iron flanges. They generally do not mate to cast iron flanges. Flanges conforming to standards tables noted in Sec. 4.2.2.1 mate with valves described in this standard and are dimensionally interchangeable. The purchaser should review pressure ratings of the valves and mating flanges, and dimensional compatibility of mating pipeline flanges.

8. 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 26 of Sec. III.A of this foreword.

9. This standard allows a party other than the valve manufacturer to mount an actuator to a valve. Sections 5.1.1 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.

10. Electric actuators meeting the requirements of ANSI/AWWA C542—Electric Motor Actuators for Valves and Slide Gates 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—Rubber-Seated Butterfly Valves.

11. High-performance butterfly valves can vary in their seat design, and typically are of single-, double-, and triple-offset seat configurations. The purchaser should be aware that not all high-performance butterfly valve seat designs are required to create a positive drop-tight seal between the valve disc and seat, and that these seat designs can also vary in their leakage rates. Should the purchaser specify a high-performance butterfly valve, an associated acceptable leakage rate should also be specified. This information can be obtained from the manufacturer or supplier. Acceptable leakage rates may vary considerably depending on application, operational requirements, and applicable safety standards. Valve testing standards such as ISO 5208—Industrial Valves—Pressure Testing of Metallic Valves or API 598—Valve Inspection and Testing have permissible leakage rates that would be applicable for these seat designs and could assist the purchaser in determining an appropriate leakage rate.

II.C *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 be an issue especially with adjacent pipe interior linings, polyethylene transmission pipe, and mating flanges. The piping system designer should check the valve manufacturers' recommendations for minimum pipe internal diameter for disc clearance and be sure that the adjacent pipe internal diameters are sufficient to accommodate the fully open valve discs.

The installation of butterfly valves downstream of turbulence-inducing devices or pieces of equipment, such as pumps, check valves, and pipe fittings, requires some consideration to avoid various mechanical and hydraulic issues. Turbulence can cause premature wearing of seats, unequal hydrodynamic loads on the discs 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 can be especially significant issues 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 previously described valve mechanical and hydraulic issues. Piping system designers should review with the butterfly valve manufacturers the requirements or recommendations for minimum upstream pipe runs to provide reasonably smooth flow patterns approaching the valve discs, as well as the recommendations regarding shaft orientation. Such recommendations regarding minimum upstream pipe runs should be the result 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. If such installation is considered, the user should consult with the valve manufacturer regarding recommendations for minimum upstream straight pipe length and shaft orientation to reduce or eliminate such hydraulic or mechanical issues.

The installation of butterfly valves upstream of certain 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), then 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 of equipment, 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 flowmeters and pressure measuring devices. Sufficient pipe spacing between the butterfly valve and the downstream piece of equipment should be provided to address these issues. Note that the situation of a partially open disc can occur with valves in throttling or modulating service. If any such conditions exist in the piping system, the user should consult the valve manufacturer for recommendations.

II.D *Flange Bolt Patterns.* The ASME and AWWA flange bolt patterns in sizes 42 in. (1,050 mm) through 60 in. (1,500 mm) are not compatible. Additionally, the ASME B16.47 flanges are generally designed for outside nominal diameter pipe and may not be compatible with inside nominal diameter pipe or cement mortar-lined pipe. System designers should review the compatibility and mating conditions of the flanges in this size range.

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

II.F. *Chloramines.* 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) of each elastomeric valve component. The 2007 publication, "Performance of Elastomeric Components in Contact with Potable Water," sponsored by the former AWWA Research Foundation (now Water Research Foundation) and USEPA, presents data on commonly used elastomeric materials and may serve as a reference for reviewing alternate 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.

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 C519, High-Performance Waterworks Butterfly Valves—3 In. (75 mm) Through 60 In. (1,500 mm), of latest edition.
2. Whether compliance or certification with NSF/ANSI 61, Drinking Water System Components—Health Effects, is required.
3. Size of valve.
4. Quantity required.
5. Type of body:
   a. Wafer or lugged-wafer (Type 1 or Type 2) or flanged.
   b. Wafer or flange facing, either flat or raised face.
6. Minimum acceptable valve classification.
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 or opening (consider factors such as pipeline break).
9. Description of connecting pipe: material, outside diameter (OD), inside diameter (ID), and flange type, classification, and dimensions.
10. Information or data required 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. Seating/unseating torque and dynamic torque at specified flow and pressure.
    d. The number of turns to open and close for manual actuators.
    e. Assembled weight.
    f. Preferred-flow direction, if applicable (Foreword, Sec. II. Special Issues).
    g. Valve component materials (Sec. 4.2).
    h. Principal dimensions, including laying length (Tables 1-A thru 1-E).

i. Actuator manufacturer, model, and torque capability (Sec. 4.2.8).

j. Interior and exterior coating materials (Sec. 4.3.2).

k. Clearance beyond the valve body required for the valve disc to open fully (Sec. A.5.7).

l. Other materials used for the tested and certified valve.

11. Materials.

a. For valves certified to the requirements of NSF Standard 61, if the purchaser specifies a wetted component that is not part of the certification, the certification of the valve is no longer valid. Note: As of the publication date of this first edition, no manufacturers are known to have obtained an NSF certification for this type of valve.

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 pipeline contents 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 items 4 and 5, Sec. II.B of this foreword.

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

13. Actuator type and service conditions.

a. Type: manual, pneumatic, hydraulic, or electric.

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 in-plant 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 operators to be a high exertion of effort, and lesser pulls of 40–60 lb. (18.1–27.2 kg) on handwheels and chainwheels have sometimes been found to be beneficial (Sec. 4.2.8.8.2).

15. Pneumatic or hydraulic actuator (cylinder or vane).

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

b. Operating medium pressure: maximum and minimum.

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

d. Position indicator:

- If required.
- Configuration.

e. Special requirements:

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

16. Electric actuator (Sec. 4.2.8.10).

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

b. Characteristics: operating voltage, control scheme, requirements, and time of operation (i.e., fully open to fully closed from 0° to 90°).

c. Position indicator: configuration.

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

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

18. Valve and actuator arrangement and position. The purchaser may indicate a desired shaft orientation. Typically, butterfly valves are constructed so that the shaft may be horizontal or vertical 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 of valves installed upstream of pump suction intake can affect the performance of some types of pumps. Shaft orientation can affect valve head loss and dynamic torque when the valve is installed downstream of pumps and pipe fittings which create an asymmetric approach velocity pattern at the valve. The user should consider the installation and orientation limitations given in Appendix Sec. A.5 and in AWWA Manual M49. Horizontal shaft orientation in horizontal piping will increase opening or closing torque due to hydrostatic torque if the pipe on one side of a closed valve is allowed to empty.

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

20. If the flow resistance coefficient for a fully open valve calculated in accordance with AWWA Manual M49 is required.

21. If valve position versus flow resistance or coefficient curves are required, they should be referenced to procedures described in AWWA Manual M49.

22. If shop inspection and performance witness testing by the purchaser is required.

23. Maximum transient pressure and characteristics, if known.

24. Water temperature range.

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

26. 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.

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

28. Considerations relating to anticipated issues with components exposed to pipeline content containing chlorine, chloramines, chloride, or other chemicals. If these conditions 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.

29. Type of flange facing: This standard requires raised-face or flat-face flanges. Facings must be defined by the purchaser.

30. 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.

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

32. The provision of test records that are specified according to Secs. 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.

33. Detailed description of nonstandard end connections (Sec. 4.2.2).

34. 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 the valve manufacturer to require the proper shaft seals.

35. Protective coatings, if other than specified in Sec. 4.3.2 of this standard.

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

37. If a material certification is required identifying the origin of materials, and that they comply with the material standards outlined in this standard.

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. This is the first edition of this standard.

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

American Water Works Association
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AWWA Standard

High-Performance Waterworks Butterfly Valves—3 In. (75 mm) through 60 In. (1,500 mm)

SECTION 1: GENERAL

Sec. 1.1 Scope

This standard establishes minimum requirements for high-performance butterfly valves, 3 in. (75 mm) through 60 in. (1,500 mm) in diameter, with various body and end types, for raw, potable, and reclaimed water having a pH range from 6 to 12 and a temperature range from 33°–125°F (0.6°–51.6°C). This standard covers three pressure ratings for high-performance butterfly valves suitable for maximum steady-state fluid working and differential pressures of 150 psig (1,034 kPa), 275 psig (1,896 kPa), and 500 psig (3,447 kPa), and maximum pipeline fluid velocity ranges of 16 ft/s (4.9 m/s), 24 ft/s (7.3 m/s), and 35 ft/s (10.7 m/s). The scope of carbon steel and stainless-steel valves includes all sizes, classes, and body styles. The scope of ductile-iron valves includes all sizes in wafer and lugged-wafer bodies. The flanged ductile-iron body scope includes 3 in. (75 mm) through 60 in. (1,500) for classes 150B, 150C, and 150D; 3 in. (75 mm) through 48 in. (1,200) for classes 275B, 275C, and 275D; and 3 in. (75 mm) through 24 in. (600 mm) for classes 500B, 500C, and 500D.

1.1.1 *Body types.* Valves described in this standard are provided in wafer, lugged-wafer, and double-flanged body patterns.