ANSI/AWWA C522-22

(First Edition)

AWWA Standard

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

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American Water Works Association

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STANDARD Since 1881

AWWA Standard

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Foreword

This foreword is for information only and is not a part of ANSI/AWWA C522-22*

I. Introduction.

I.A. *Background.* A type of quarter turn plug valve, rotary cone valves have been used in pipelines carrying water for more than 95 years. Manufacturers of rotary cone valves have developed rotary cone valves using metal-to-metal seats. This standard covers only full-ported rotary cone valves of the trunnion-supported type. Generally, the valves are installed in interior or protected spaces and are of cast or weld fabricated construction with bodies having flanged ends. Buried installations of flanged joints should be avoided.

I.B. *History.* This first edition of ANSI/AWWA C522-22, Rotary Cone Valves, 6 In. Through 60 In. (150 mm Through 1,500 mm), was approved on October 24, 2022.

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.
2. Two standards developed under the direction of NSF[‡]: NSF/ANSI/CAN 60, Drinking Water Treatment Chemicals—Health Effects, and NSF/ANSI/CAN 61, Drinking Water System Components—Health Effects.

* 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.

[‡] NSF International, 789 North Dixboro Road, Ann Arbor, MI 48105.

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/CAN 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 C522-22 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 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 2020.

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 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 rotary cone valve of a given size vary considerably and depend on the size of the valve, the differential

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

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/sec (10.7 m/sec). Rotary cone 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/sec (10.7 m/sec) have a higher probability of causing cavitation in piping systems, especially if valves are used to throttle flows. The 35-ft/sec (10.7-m/sec) port fluid velocity is not an upper limit to the flow that can be satisfactorily handled by rotary cone 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 and thrust restraint.

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 conical plug, 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.

Cavitation resistant trim may be optional or included in the manufacturer's product offering.

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 axial and shear loadings, thermal expansion and contraction, and differential settlement.

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 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.E. *Valve Installation and Piping Design.* The installation of rotary cone valves downstream of turbulence-inducing devices or pieces of equipment, such as pumps and piping fittings, 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 conical plugs with associated increase in torque loadings on valve actuators, unanticipated higher loadings and stresses on shaft and trunnion bearings with resulting decrease in bearing longevity, and higher stresses on the valve shafts. These issues can be especially significant with rotary cone valves installed directly on the discharge flanges of pumps. Piping system designers should review with the rotary cone 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 as determined by designer and owner coordination with manufacturer. 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 rotary cone valves upstream of certain items of equipment requires some consideration to avoid various mechanical and hydraulic issues, especially if the conical plug is partially open. A partially open rotary cone valve installed a short distance upstream can result in issues such as increased wear on a downstream valve's bushings and/or shafts and supports and oscillation ("chattering") of the valve closure member. The turbulence caused by a partially open rotary cone valve can also affect the performance and accuracy of other downstream devices such as flowmeters and pressure indicating devices. Sufficient pipe spacing between the rotary cone valve and the downstream piece of equipment should be provided to accommodate these issues. Note that the situation of a partially open conical plug can occur with valves in throttling or modulating service. Disturbances upstream of the rotary cone valve should be avoided for the same reasons. See AWWA Manual of Standard Practice M49 for further installation cautions.

II.F. *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 substantially varies from 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.G. *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 as well as 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.H. *Valve Body/Conical Plug Taper Angle*. Since the first rotary cone valve introduced in 1926, there have been multiple taper angles employed in their design/construction including 9 degrees, 1-½ inches/12 inches (1 mm/8 mm), 7 degrees, 5 degrees, 1 inch/12 inches (1 mm/12 mm), and 8 percent. It is incumbent on the system owner, system designer, or purchaser to determine which taper suits their needs, intended usage, and life cycle expectancy. Narrower taper angles can be problematic if lift prior to rotation is not properly coordinated with body/head cover and conical plug trunnion bushing running clearances. Conical plug lift must be sufficient such that seat clearances are a minimum of two times that of body/head cover and conical plug trunnion bushing running clearances prior to initiation of rotation. This is directly related to the use of multi-start ACME power screw threads (female) in the bronze axial motion nut which interfaces with like kind multi-start ACME power screw threads (male) on the valve operating mechanism shaft.

II.I. *Integrally Cast or Welded Trunnions vs Bolted Trunnions.* Rotary cone valves were first introduced in 1926 incorporating bolted-on trunnions in lower body and upper plug design. This resulted in too many degrees of freedom and concentricity issues resulting in diminished critical rigidity for long term successful metal-to-metal seating. Subsequent rotary cone valve designs have all incorporated integrally cast or welded trunnion designs offering required rigidity and concentricity for long term successful metal-to-metal seating.

II.J *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 flanges are intended to be used with ASTM* A307 Grade B bolting. This low strength bolting has coarse unified series threads (UNC) and heavy hex heads. AWWA C207, AWWA C228, and ASME B16.5 steel and stainless-steel flanges allow or require the use of higher strength bolting such as ASTM A193 bolts and ASTM A194 nuts. These higher strength materials employ eight threads per inch (8UN) in sizes 1-⅛ inch 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 1-⅛ inch 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 Non-mandatory 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, "Guidelines for Pressure Boundary Bolted Flange Joint Assembly" using the 3 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.

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* ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959.

II.K *Finite Element Analysis (FEA). Advisory Information on Valve Design*. Calculation tools like FEA software can be used as a supplement to the equations, wall thickness tables, and size tables when listed in this standard for stress design. These calculation tools are able to show detailed stress concentrations on valve components for a given load scenario, which is not indicative of the allowable stress determinations in this standard. Other standards may be used to separately evaluate the localized stress concentrations and combinations.

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 C522-22, Standard for Rotary Cone Valves, 6 In. Through 60 In. (150 mm Through 1,500 mm), of latest revision.
2. Type of installation—non-buried—indoors, outdoors, and in vaults and any permeation requirements (Sec. II.D).
3. Size of the valve, pressure class, and quantity required.
4. Valve and actuator arrangement and position.
5. Type of valve support.
6. The system owner, system designer, or purchaser may indicate a desired shaft orientation. Typically, rotary cone 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 should 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 should 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 pressure class, at a maximum port velocity less than 35 ft/sec (10.7 m/sec), or both, the system owner, system designer, or purchaser shall specify the maximum differential pressure (pounds per square inch [kilopascals]) and the maximum port fluid velocity (feet [meters] per second) (Sec. 3, item 14).

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 or provincial, 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. Materials—bodies, conical plugs, and head covers, if there is a preference (Sec. 4.3.5).

15. Flange requirements (Sec. 4.3.13.1).

16. Whether a two seated (closed position seats only on conical plug) or four seated (closed position and open position seats on conical plug) is preferred (Sec. 4.3.7).

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

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

19. Shaft material, if there is a preference (Sec. 4.3.18.1).

20. Type of shaft seals, if there is a preference (Sec. 4.3.18.6).

21. 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. 4.3.18.3.1).

22. Direction to open manual actuators (Sec. 4.3.18.3.4)—Unless otherwise specified, open counter clockwise (CCW) will be provided.

23. Time of operation (stroke time) for the power actuators, if other than the default values (Sec. 4.3.18.4.2 and Sec. 4.3.18.5.4).

24. 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.

25. Whether records of certified tests are required (Sec. 5.1.1, 5.2.3).

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

27. Whether affidavit of compliance is 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. This is the first edition of this standard.

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 303.795.7603; or write to the department at 6666 West Quincy Avenue, Denver, CO 80235-3098; or email at standards@awwa.org.

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American Water Works Association
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AWWA Standard

Rotary Cone 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 or weld fabricated-steel or stainless steel flanged-end, low-leakage trunnion-mounted, full-port, two(2)- and four(4)-seated rotary cone valves for pressures up to 300 psi (2,100 kPa) in sizes from 6-in. through 60-in. (150-mm through 1,500-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 full-open port fluid velocity (Class D) of 35 ft/sec (10.7 m/sec) at design pressure and shall be within the allowable stresses noted in Sec. 4.3.1.

1.1.2 *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).

Table 1 Pressure classes and rated/design pressure and fluid velocity

Pressure Class	Rated/Design Pressure	Rated/Design Fluid Velocity
150D	150 psi (1,050 kPa)	35 ft/sec (10.7 m/sec)
250D	250 psi (1,750 kPa)	35 ft/sec (10.7 m/sec)
300D	300 psi (2,100 kPa)	35 ft/sec (10.7 m/sec)