



**American Water Works  
Association**

AWWA D103a-14  
Addenda to  
ANSI/AWWA D103-09  
Standard  
for

## **Factory-Coated Bolted Carbon Steel Tanks for Water Storage**

Effective Date: Nov. 1, 2014.

Approved by AWWA Board of Directors June 8, 2014.

Approved by American National Standards Institute July 17, 2014.

### **Section 2, References, add the following reference item:**

ANSI/AWWA D108—Aluminum Dome Roofs For Water Storage Facilities.

### **Section 2, References, delete the following reference items:**

AA ASD—*Aluminum Standards and Data, 2006.*

AAMA 2604-05—Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels.

ASTM C509—Standard Specification for Elastomeric Cellular Preformed Gasket and Sealing Material.

ASTM C1115—Standard Specification for Dense Elastomeric Silicone Rubber Gaskets and Accessories.

ASTM D2244—Standard Practice for Calculation of Color Tolerances and Color Differences from Instrumentally Measured Color Coordinates.

Fed. Spec. A-A-59588—Rubber, Silicone.

**Sec. 5.3, Design Criteria, add the following subsections:**

5.3.2 *Effect of Glass-fused Coatings Firing Process on Steel Strength.* The design of structural components with glass-fused-to-steel coatings shall take into account the reduction in strength properties of the steel due to the firing process of the glass coatings, and details of such effects shall be submitted when specified. The effect of the glass-fused-to-steel coating process shall be assessed and monitored over a period of time using a regular and documented testing program from which steel strength properties can be predicted with a 95 percent confidence level. The 95 percent confidence level refers to the 95 percent confidence interval, which is the statistically calculated range within which there is a 95 percent probability that the true value of a parameter will fall.

5.3.2.1 *Reduced Strength Properties for Components with Glass-Fused-to-Steel Coatings.* The modified steel properties,  $F'_y$  and  $F'_u$ , shall be the minimum values established for the particular specification and grade of steel through the regular and documented testing program as identified in Sec. 5.3.2 or, alternatively, where regular and documented testing is not carried out, the values  $F'_y$  and  $F'_u$  shall be taken as 70 percent of the minimum published yield strength,  $F_y$ , and 70 percent of the minimum published tensile strength,  $F_u$ , respectively, of the selected material.

5.3.2.2 *Application of Reduced Strength Properties.* For components with glass-fused-to-steel coatings, design of the components shall utilize the lesser of the applicable modified steel properties  $F'_y$  and  $F'_u$  and the minimum published yield strength and minimum published tensile strength,  $F_y$  and  $F_u$ , respectively. Reduced strength properties only apply to structural elements of the tank that have undergone the glass-fused-to-steel coating process.

**Sec. 5.7, Roof Supports, add the following new item #7 to the end of that section:**

7. Self-supporting dome roofs constructed of aluminum shall comply with the requirements of ANSI/AWWA D108.

**Sec. 15.4.1, Top Girder, add the following subsection:**

15.4.1.2 Where glass-fused-to-steel coated wind girders are used, the required minimum section modulus,  $S$ , in Eq 15-4 shall be multiplied by the greater of  $30,000 \text{ psi}/F'_y$  ( $206 \text{ MPa}/F'_y$ ) and 1.0.

**Delete the entire Section 16, Structurally Supported Aluminum Dome Roofs.**

**Appendix Section A.5, General Design, add the following subsections:**

**Sec. A.5.3 Design Criteria**

A.5.3.2 The modified steel properties,  $F'_y$  and  $F'_u$ , specified in Sec. 5.3.2.1 shall apply to the following sections and equations where applicable: Sec. 5.5.1, Eq 5-3, Sec. 5.5.3, Eq 5-4, Eq 5-5, Sec. 5.5.4, Sec. 5.7 (AISC designs), Eq 5-9, Sec. 5.9.5, Sec. 14.3.4.1.1, Eq 14-33, Sec. 14.3.4.1.2, Eq 14-34, Sec. 15.4.1, Eq 15-4, Sec. A.14.4.1, and Eq A14-5.

**Add the following Appendix Section A.16, Structurally Supported Aluminum Dome Roofs:**

**SECTION A.16: STRUCTURALLY SUPPORTED ALUMINUM DOME ROOFS**

Section 16, Structurally Supported Aluminum Dome Roofs, has been deleted as requirements are covered in ANSI/AWWA D108, Aluminum Dome Roofs for Water Storage Facilities. See Sec. 5.7, Roof Supports, note 7, for direction to ANSI/AWWA D108.



**American Water Works  
Association**

ANSI/AWWA D103-09  
(Revision of AWWA D103-97)

The Authoritative Resource on Safe Water®

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*AWWA Standard*

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# Factory-Coated Bolted Carbon Steel Tanks for Water Storage



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6666 West Quincy Avenue  
Denver, CO 80235-3098  
T 800.926.7337  
www.awwa.org

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## Committee Personnel

The D103 Revision Task Force, which developed this standard, had the following personnel at the time:

Keith McGuire, *Chair*

### *General Interest Members*

D.B. Harrison, Associated Engineering (B.C.) Ltd., Comox, B.C. (AWWA)  
S.W. Meier, Tank Industry Consultants, Indianapolis, Ind. (AWWA)

### *Producer Members*

R.V.D. Field, Engineered Storage Products Company, DeKalb, Ill. (AWWA)  
C. Margolf, TEMCOR, Gardena, Calif. (AWWA)  
J.E. Marquez, Superior Tank Company Inc., Rancho Cucamonga, Calif. (AWWA)  
K. McGuire, Columbian TecTank Inc., Parsons, Kan. (AWWA)  
B. Rumble, Columbian TecTank Inc., Kansas City, Kan. (AWWA)  
L.D. Scott, CB&I Constructors Inc., Atascadero, Calif. (AWWA)  
J. Staat, Conservatek Industries, Conroe, Texas (AWWA)

The AWWA Standards Committee on Steel Elevated Tanks, Standpipes, and Reservoirs, which reviewed and approved this standard, had the following personnel at the time of approval:

Stephen W. Meier, *Chair*

### *General Interest Members*

E. Darrimon, Bay Area Coating Consultant Service Inc., Denair, Calif. (AWWA)  
W.J. Dixon, Dixon Engineering Inc., Lake Odessa, Mich. (AWWA)  
F.S. Kurtz,\* Standards Engineer Liaison, AWWA, Denver, Colo. (AWWA)  
S.W. Meier, Tank Industry Consultants, Indianapolis, Ind. (AWWA)  
B.M. Shepherd,\* Standards Council Liaison, Metro Water District of  
Southern California, La Verne, Calif. (AWWA)  
J.I. Strand, Short Elliott Hendrickson Inc., Chippewa Falls, Wis. (AWWA)  
C.C. Sundberg, CH2M HILL Inc., Issaquah, Wash. (AWWA)

---

\* Liaison, nonvoting

J.H. Wilber, American AVK, Littleton, Colo. (AWWA)

R.S. Wozniak, Bow Tech Ltd., Batavia, Ill. (AWWA)

*Producer Members*

J.W. Davis, TNEMEC Company, Kansas City, Mo. (AWWA)

B.E. Kromer, Tank Builders Inc., Euless, Texas (AWWA)

S. Lamb, Nickel Development Institute, Huntington, W.V. (AWWA)

G.A. Larson, CB&I Constructors Inc., Clive, Iowa (AWWA)

K. McGuire, Columbian TecTank Inc., Parsons, Kan. (AWWA)

L.D. Scott,\* CB&I Constructors Inc., Atascadero, Calif. (AWWA)

D.L. Stilger, Caldwell Tanks Inc., Louisville, Ky. (AWWA)

*User Members*

C.P. Harder, City of Fort Worth, Fort Worth, Texas (AWWA)

E.J. King, Connecticut Water Co., Clinton, Conn. (AWWA)

J.L. Ortiz, San Francisco Public Utilities Commission, San Francisco, Calif. (AWWA)

J.P. Scott, New Jersey–American Water Company, Delran, N.J. (AWWA)

D.T. Wagner, EBMUD, Oakland, Calif. (AWWA)

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\* Alternate

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# Foreword

*This foreword is for information only and is not a part of ANSI/AWWA D103.*

## **I. Introduction.**

I.A. *Background.* This standard covers factory-coated bolted steel tanks for water storage and is based on the accumulated knowledge and experience of manufacturers of bolted steel tanks.\*

I.B. *History.* The first version of this standard was prepared in cooperation with the Bolted Tank Manufacturer's Association and was issued in 1980. It was prepared in response to the increasing use of bolted tanks for water storage. AWWA D103-80 was later updated and approved as AWWA D103-87 on June 14, 1987.

The third edition of ANSI/AWWA D103-97 was approved by the AWWA Board of Directors on June 15, 1997. The fourth and current edition of ANSI/AWWA D103 was approved on Jan. 25, 2009.

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 all direct and indirect drinking water additives. Other members of the original consortium included the American Water Works Association Research Foundation (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 the following:

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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\* The word *tanks* is used hereinafter broadly in place of the lengthy phrase *standpipes or reservoirs for water storage*.

† 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 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 D103 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.

## II. Special Issues.

II.A. *Purchase.* When tanks are purchased using this standard, the purchaser must specify certain basic requirements. The purchaser may desire to modify, delete, or amplify sections of this standard to suit special conditions. It is strongly recommended that such modifications, deletions, or amplifications be made by supplementing this standard rather than by rewriting or incorporating sections from this standard into a separate specification.

II.B. *Design and Construction.* The details of design and construction covered by this standard are minimum requirements. A tank cannot be represented as adhering

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\* NSF International, 789 North Dixboro Road, Ann Arbor, MI 48113.

† 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.

to the provisions of ANSI/AWWA D103 if it does not meet the minimum requirements of this standard.

**II.C. Coatings.** Tanks covered by this standard shall be supplied with factory-applied coatings. Field coating is limited to repair of damaged coatings.

Tanks with factory-applied coatings and bolted construction have a long life expectancy. Regular inspection and repair of damaged or deteriorated areas may be the determining factors in the length of tank life.

**II.D. Foundations.** Tank foundations are one of the more important aspects of tank design. Detailed requirements for tank foundations are covered in Section 13 of this standard. This standard does not require the manufacturer or constructor to be responsible for the design of the tank foundation unless specified. An adequate soil investigation at the tank site, including recommendations of the type of foundation to be used, the depth of foundation required, specification and compaction of sub-base materials, and the design soil-bearing pressure should be obtained. This information, as well as specifications for an adequate soil investigation, should be established by a qualified geotechnical engineer. A drainage inlet structure or suitable erosion protection should be provided to receive the discharge from the tank overflow. The overflow should not be connected directly to a sewer or a storm drain without an air break.

**II.E. Annual Inspection, Maintenance, and Operation.** Annual inspection and maintenance is important if maximum tank life is to be attained. Complete interior and exterior inspections should occur at least every 3 to 5 years. In particular, accumulations of dirt and weeds from around the outside base of the tank, which may trap moisture and accelerate corrosion, as well as accumulated silt inside on the floor, should be removed. Refer to AWWA Manual M42, *Steel Water-Storage Tanks*, for guidance concerning inspection and maintenance.

Sufficient water replacement and circulation is necessary to prevent freezing in the tank and piping. Where low usage may result in the possibility of freezing, the water may need to be wasted or heat provided to prevent freezing. The purchaser is referred to National Fire Protection Association (NFPA)\* document NFPA 22, *Water Tanks for Private Fire Protection*, for heater sizing. Purchasers are cautioned against allowing ice to build up for use as insulation because the ice may break loose and damage the tank.

**II.F. Disinfection Procedures and Cathodic Protection.** This standard does not cover disinfecting procedures<sup>†</sup> (see Sec. 11.3) or cathodic protection.

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\* National Fire Protection Association, One Batterymarch Park, Quincy, MA 02169-7471.

† Various disinfection procedures are presented in ANSI/AWWA C652, *Disinfection of Water-Storage Facilities*.



1. If the disinfecting is to be performed by the tank constructor, the purchaser must specify the disinfecting procedure to be used (see ANSI/AWWA C652).

2. If cathodic protection is desired, the criteria for the design and the installation must be specified (see ANSI/AWWA D104). On completion of tank construction, electrical continuity among all tank components in contact with water should be verified.

**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. Whether compliance with NSF/ANSI 61, Drinking Water System Components—Health Effects, is required, in addition to the requirements of the Safe Drinking Water Act.

2. Details of other federal, state or provincial, and local requirements (Sec. 1.1.3).

3. Tank geometry.

a. Dimensions, capacity, and top capacity level (TCL) above top of foundation.

b. The bottom capacity level (BCL) of the tank when empty if different from the level when the tank would be emptied through the specified discharge piping.

c. Type of roof. Steel roof or aluminum dome.

d. Type of bottom. Steel tank bottom or concrete bottom with embedded steel base setting ring (Sec. 13.4.6).

e. Vertical distance from finished ground level to the crown of inlet and outlet pipes (pipe cover) at tank foundation (Sec. 13.7.2).

4. Tank accessories and requirements.

a. The type of pipe and fittings for fluid conductors and the type of pipe joint if different from that permitted in Sec. 4.9.

b. Locations of manholes, ladders, and accessories (Section 7). NOTE: Only one shell manhole will be provided unless the purchaser otherwise specifies (Sec. 7.1).

c. The number and location of pipe connections, and type and size of pipe to be accommodated.

d. If a removable silt stop is required (Sec. 7.2.1).

e. Overflow type, whether stub or to ground; size of pipe; pumping and discharge rates (Sec. 7.3).

f. If the exterior ladder or access to roof hatches and vents is to be omitted (Sec. 7.4).

g. If safety cages, rest platforms, ladder locks, roof-ladder handrails, or other safety devices in excess of OSHA are required (Sec. 7.5).

h. If a special screen is required for tank vent (Sec. 7.7).

i. If shop inspection is required, and whether certified mill-test reports are required (Sec. 11.1).

5. Tank design criteria.

a. Snow load. If snow loading is to be reduced (Sec. 5.2.3).

b. Wind load. Specific wind-load requirements, including whether a sliding check for self-anchored tanks is required (Sec. 5.2.4 and 15.3).

c. Seismic load. Seismic Use Group for the tank, or if the seismic design is to be omitted (Sec. 5.2.5 and Sec. 14.2.1).

If seismic design of roof framing and columns is required and the amount of live loads to be used (Sec. 14.3.4.5).

Whether the site-specific seismic design procedure is required (Sec. 14.2.8).

d. Other loads. Equipment, platforms, walkways, and all additional loads including live, dead, static, and dynamic loads.

6. Foundation.

a. Geotechnical report. Summary of soil investigation, including foundation-design criteria (Sec. 13.2), type of foundation (Sec. 13.4), depth of foundation below existing grade, site class for seismic areas, and design soil-bearing pressure, including appropriate factor of safety.

b. When a pile-supported foundation is required, the pile type and the depth below existing grade (Sec. 13.5.4).

c. The elevation of concrete foundations above the finish grade (Sec. 13.5.1).

7. Field construction.

a. The prepared site location.

b. Type of road available for access to the site and whether the road is public or private.

c. Name of and distance to the nearest town.

d. Name of and distance to the nearest railroad siding.

e. Availability of electric power; who furnishes it and at what fee, if any; what voltage is available; whether direct or alternating current; and, if alternating current, what cycle and phase.

- f. Availability of compressed air and what pressure, volume, and fee are available, if any.
- g. Desired time for completion.
- h. Any materials furnished by the purchaser to be used by the constructor for construction of the tank.
- i. Necessary blinding fittings for leak testing.

III.B. *Information to Be Provided With the Bid.*

- 1. Detailed Submittals.
  - a. Detailed drawing of the tank with dimensions, including the diameter, shell height, height to the top capacity level (TCL), bottom, roof, coatings, details of bolted joints, accessories, ladders, and type and size of plates, members, and anchorage, as applicable.
  - b. Loads imposed on the foundation, including moment and shear under seismic and wind loading.

III.C. *Modification to Standard.* Any modification to the provisions, definitions, or terminology in this standard must be provided in the purchaser's documents.

**IV. Major Revisions.** This edition of the standard includes numerous corrections, updates, revisions, and new material to clarify some of the existing requirements. Sections were rearranged and revisions made to eliminate contractual language. Metric equations and dimensions were added.

- 1. Section 1, General, was revised to clarify that corrugated tanks and tanks constructed of multiple layers of steel were not applicable to the standard.
- 2. Section 2, References, was revised and updated.
- 3. Section 4, Materials, was revised and includes additional grades of plates, sheets, structural shapes, hardware, and other tank construction materials.
- 4. Section 5, General Design, was revised to include maximum thickness of flat panel shell plates of 0.5 in. (12.7 mm), foundation anchor bolt. Sec. 5.9.4 was revised, and reinforcing criteria for diameter of connections was decreased from 4 in. (102 mm) to 2 in. (51 mm). Figure 2, Bolted piping flanges, was eliminated.
- 5. Section 7, Accessories for Tanks, was revised regarding ladder requirements to bring it into compliance with updated OSHA regulations 29 CFR Part 1910.
- 6. Section 8, Welding, was revised and updated regarding qualifications, procedures, and inspection.
- 7. Section 14, Seismic Design, and Section 15, Wind Design, were revised extensively to reflect the requirements of the International Building Code and ASCE 7.

8. Appendix A, Commentary for Factory-Coated Bolted Carbon Steel Tanks for Water Storage, is added to provide background information for many of the requirements contained in the standard.

9. Other general and specific revisions, additions, and corrections were made throughout the standard.

**V. Comments.** If you have any comments or questions about this standard, please call the AWWA Volunteer and Technical Support Group at 303.794.7711, FAX 303.795.7603, write to the group at 6666 West Quincy Avenue, Denver, CO 80235-3098, or e-mail at [standards@awwa.org](mailto:standards@awwa.org).

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**American Water Works  
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*AWWA Standard*

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# Factory-Coated Bolted Carbon Steel Tanks for Water Storage

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## SECTION 1: GENERAL

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### Sec. 1.1 Scope

The purpose of this standard is to provide minimum requirements for the design, construction, inspection, and testing of new cylindrical, factory-coated, bolted carbon steel tanks for the storage of water. This standard is only applicable to tanks with a base elevation substantially at ground level.

1.1.1 *Tank roofs.* All tanks storing potable water shall have roofs. Roofs may be column-supported, self-supported, or aluminum dome. Tanks storing non-potable water may be constructed without roofs.

1.1.2 *Items not described.* This standard does not cover all details of design and construction. Details that are not addressed shall be designed and constructed to be as adequate and as safe as those that would otherwise be provided under this standard. This standard is not applicable to tanks of corrugated construction. This standard is not applicable to tanks constructed of stacked plates or sheets laminated to form multiple layers.

1.1.3 *Local requirements.* This standard is not intended to cover storage tanks erected in areas subject to regulations more stringent than the requirements contained within this standard. In such cases, this standard should be followed where it does not conflict with local requirements. Where more stringent local,