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(Revision of ANSI/AWWA D100-11)

AWWA Standard

Welded Carbon Steel Tanks for Water Storage

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American Water Works Association

AWWA Standard

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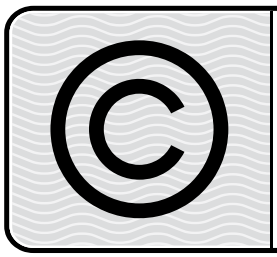

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Contents

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 D100.*

I. Introduction.

I.A. *Background.* In 1931, American Water Works Association (AWWA) Subcommittee 7H, whose members were L.R. Howson, H.C. Boardman, and James O. Jackson, prepared "Standard Specifications for Riveted Steel Elevated Tanks and Standpipes." The specifications were published in the November 1935 edition of *Journal AWWA.* In 1940, the scope of the standard specifications was expanded to include welded construction. The American Welding Society (AWS)† cooperated in the revision and became a joint sponsor of the standard. Since its original publication, the standard has gained wide acceptance in the United States and abroad.

I.B. *History.* In 1965, Appendix C was added to provide for the alternative use of higher-strength steels for standpipes and reservoirs. Other changes included the addition of requirements for the use of steel pipe as tubular columns and a wind–pressure formula for winds in excess of 100 mph (45 m/s). The requirements for loads on balconies and ladders and unit stresses for combinations of wind, seismic, and other loads were clarified. The rules for the minimum thickness of shell plates for standpipes and reservoirs were revised to apply only to cylindrical shells and not to roof knuckles or toroidal or elliptical roof plates containing water. The swivel ladder for standpipes and reservoirs, which was found to be impractical, was eliminated, and a fixed ladder was required. The rules for welding and for weld qualification were rewritten completely. The qualification procedure of the American Society of Mechanical Engineers (ASME)‡ Boiler and Pressure Vessel Code, Sec. IX, was adopted, and the sizes of fillet welds in the shell-to-bottom joints of standpipes and reservoirs were revised, as were the sections on sand cushions and grouting for standpipe and reservoir bottoms. Rules for inspection of welds were rewritten completely. An isothermal map showing the lowest one-day mean temperature in various parts of the continental United States and parts of Canada was included. Concrete foundation design was brought into conformity with American Concrete Institute (ACI)§ Standard No. 318, Building Code Requirements for Reinforced Concrete.

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

† American Welding Society, 8669 NW 36 Street, Suite 130, Miami, FL 33166.

‡ The American Society of Mechanical Engineers, Two Park Avenue, New York, NY 10016.

§ American Concrete Institute, 38800 Country Club Drive, Farmington Hills, MI 48331.

In 1973, the use of rivets for joints in tank shells was eliminated. Specifications for tank steels were revised to include low-alloy steels. The design of foundations for elevated tanks and standpipes was changed extensively, making foundation design a part of the requirements. Procedures for soil investigation were recommended.

In 1979, Appendix A, Non-Mandatory Seismic Design of Water Storage Tanks, and Appendix B, Diagrams for Checking Overturning of Elevated Tanks, were added. The sections from the former Appendix B, covering information to be provided, were incorporated into Sec. II of the foreword, and the sections dealing with foundations were incorporated into Sec. 12. Sec. 11 was revised to include inspection and testing requirements that were formerly in Sec. 11 and Sec. 12 and appendixes A and B. Other additions included requirements for additional acceptable steels, design requirements for seismic resistance, a formula for cylindrical shell design, requirements for backfill within ringwall foundations, and requirements for depth-of-pipe cover. The out-of-date porosity charts in former Appendix A were eliminated and reference made to the charts in the ASME Boiler and Pressure Vessel Code, Sec. VIII, or to the identical charts in American Petroleum Institute (API)[¶] Standard 650, Welded Tanks for Oil Storage. A section covering permissible inspection by air carbon arc gouging was added to Sec. 11. Materials for shell plates and intermediate stiffeners were classified into three categories in Appendix C, and the requirements for impact testing were expanded.

In 1984, revisions included new sections pertaining to single-pedestal tanks incorporating design rules for this type of tank. New design rules were included for columns of elevated tanks having eccentric work-point connections. A section covering the design considerations for struts was added. For combined stresses, the unit stresses for wind and seismic forces were increased from 25 percent to 33⅓ percent. Shell plates thicker than 2 in. (51 mm), conforming to ASTM** A36, Specification for Structural Steel, were allowed to be used, provided that their usage was in compliance with certain stipulated conditions and requirements. Ground-supported tanks not greater than 50 ft (15.2 m) in diameter were allowed to have a minimum shell thickness of 3⁄16 in. (4.8 mm). A minimum size and maximum spacing were added for foundation bolts. The previous Appendix A, on seismic design, was incorporated into the standard as Sec. 13. In addition, a new section was added to Sec. 13 to permit scaling down to specific site response spectra when local seismic data are available.

[¶] American Petroleum Institute, 1220 L Street NW, Washington, DC 20005.

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

Appendix C, Alternative Rules and Design Stresses for the Use of Steel Plates and Shapes with Suitable Toughness and Ductility for Use in Welded Standpipes and Reservoirs at Specified Minimum Ambient Temperatures, was made a part of the standard while retaining its title designation as Appendix C.

For Appendix C tanks with a height-to-diameter (*H/D*) ratio of 0.50 or less, the shell design was allowed to be by the Variable Design Point Method, in compliance with API 650. Also, for Appendix C tanks, inspection of certain members is not required when the material has a tensile strength less than 75,000 psi (517.1 MPa).

In 1996, revisions included new requirements for high-strength anchor bolts. Table 1 was added to clarify thickness limitations and special material requirements. Requirements for wind escalation for heights greater than 125 ft (38.1 m) and wind loads on shrouds were added. Fixed-percentage seismic design loads were eliminated. Design requirements for handrails and guardrails were added. Allowable-unit stresses were stated as a function of material class, which is a function of material yield strength. Width-to-thickness limitations were added for compression elements, and compression requirements for shells were clarified. Design rules for tension and compression rings were added. Anchorage requirements were expanded, and a wind overturning check for ground-supported tanks was added. Weld inspection for tension bracing for cross-braced, column-supported elevated tanks was expanded to include ultrasonic testing and tensile tests. Requirements for flush-type cleanout fittings for ground-supported flat-bottom tanks were added. Design rules and limits for openings in support pedestals were added. Criteria for accessories including safety grills, overflows, and vents were updated. Seal welds were defined and usage clarified. Temperature requirements for welding and weld reinforcement limits were added. Tolerances were added for ground-supported tanks and shells designed by stability formulas. Responsibilities of the certified welding inspector were defined. Inspection requirements for primary and secondary stressed joints and tubular support columns were clarified. Inspection requirements were added for single-pedestal columns and large-diameter dry risers. The penetrometer techniques and details were revised to conform to ASME criteria.

The load factor to be applied to water load for foundation design was clarified, and requirements for material under bottom plates of ground-supported tanks were added.

Seismic design load equations were revised to follow the Uniform Building Code[††] format. A new seismic map of the United States was included along with new and revised equations for calculating such things as hydrodynamic seismic hoop tensile

[††] Uniform Building Code, International Conference of Building Officials, 5360 Workman Mill Road, Whittier, CA 90601.