ANSI/AWWA C301-14
(Revision of ANSI/AWWA C301-07)

American Water Works Association

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AWWA Standard

Prestressed Concrete Pressure Pipe, Steel-Cylinder Type

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American Water Works Association STANDARD Since 1881

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AWWA Standard

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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.

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Foreword

This foreword is for information only and is not a part of ANSI/AWWA C301.*

I. Introduction.

I.A. *Background.* There are two types of prestressed concrete steel-cylinder pipe: (1) the lined-cylinder type, with a core composed of a steel cylinder lined with concrete and subsequently wire-wrapped directly on the steel cylinder and coated with mortar; and (2) the embedded-cylinder type, with a core composed of a steel cylinder encased in concrete and subsequently wire-wrapped on the exterior concrete surface and coated with cement mortar. The lined-cylinder type, which was first used in the United States in 1942, is provided in sizes from 16 in. (410 mm) to 60 in. (1,520 mm). The embedded-cylinder type, which was developed later and first installed in 1953, is most commonly manufactured in sizes 48 in. (1,220 mm) and larger.

Both types are designed for the specific combination of internal pressure and external load required for the project in accordance with the procedures outlined in ANSI*/AWWA C304, Standard for Design of Prestressed Concrete Cylinder Pipe.

Prestressed concrete steel-cylinder pipe is used for transmission mains, distribution feeder mains, pressure siphons (including river crossings), penstocks, industrial pressure lines, water intake lines, and other applications.

In the manufacture of lined-cylinder pipe, the first step is to fabricate and hydrostatically test the steel cylinder with joint rings attached. The cylinder is then lined with concrete to form the core. The concrete is placed either centrifugally, by vertical casting, or by a radial compaction method. The concrete lining is cured and high-tensile wire is wrapped around the core directly on the steel cylinder. For a selected wire size, the tension and spacing of the wire are controlled to produce a predetermined residual compression in the core to meet design requirements. The wrapped core is then covered with a dense premixed mortar coating applied by a mechanical impact method.

In the manufacture of embedded-cylinder pipe, the cylinder and joint rings are constructed and tested in the same manner as lined-cylinder pipe. The cylinder is encased in concrete by vertical casting and mechanical vibration to form the core. After curing, the wire reinforcement is wound under tension in one or more layers around the outside of the core with embedded steel cylinder, instead of directly on

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

the cylinder. Each layer of prestressed wire is covered with a dense premixed coating applied by a mechanical impact method.

Installation of this pipe is described in AWWA Manual M9, *Concrete Pressure Pipe*.

I.B. *History.* The first edition of this standard was approved as tentative on Nov. 21, 1949. It was revised and made standard June 13, 1952. The second edition was approved as tentative June 17, 1955, and made standard June 26, 1958.

Substantial changes, including the addition of combined loading procedures, were included in the third edition, which was made standard Jan. 27, 1964. The standard was revised again on Jan. 31, 1972; June 24, 1979; Jan. 30, 1984; June 22, 1992; Jan. 24, 1999; and Jan. 21, 2007. This edition was approved by the AWWA Board of Directors on Jan. 19, 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.
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.

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

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

‡ Both publications available from National Academy of Sciences, 500 Fifth Street, N.W., Washington, DC 20001.

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 C301 does not address additives requirements. Thus, users of this standard should consult the appropriate state, local, or provincial 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. This standard has no applicable information for this section.

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.* Purchasers are advised that, while this standard presents information on materials and procedures for manufacture of the pipe, it does not contain all of the engineering information needed to prepare a complete specification for a particular pipeline installation. A specific installation may require provisions more restrictive than those in the standard and most certainly will require additional design and installation features.

Reference to AWWA Manual M9, *Concrete Pressure Pipe*, should be considered as a supplement to the use of this standard, and information in the manual should not be regarded as superseding any portion of this standard. The purpose of Manual M9 is to provide information concerning some of the various subjects to be considered in, and the minimum standard of practice for, the design and installation of concrete pressure pipelines.

When purchasing pipe under the provisions of this standard, the purchaser's specifications shall include specific details, where applicable, regarding the following:

1. Standard used—that is, ANSI/AWWA C301, Prestressed Concrete Pressure Pipe, Steel-Cylinder Type, of latest revision.

2. Whether compliance with NSF/ANSI 61, Drinking Water System Components—Health Effects, is required.

3. Manner of storage and delivery, if required of the manufacturer.

4. Working pressure, surge pressure, field-test pressure, external loading conditions, and method of bedding and backfilling (Sec. 4.2.1).

5. If detailed drawings and schedules are to be submitted for review (Sec. 4.3.1 and 4.7.1).

6. If the manufacturer is not permitted to supply pipe from inventory (Sec. 4.3.1).

7. If a tabulated layout schedule will be required (Sec. 4.3.2).

8. Details of other federal, state or provincial, and local requirements (Sec. 4.4).

9. If any material or manufacturing test reports will be required (Sec. 4.4, 5.1.2, and 5.2).

10. Type of cement required, if there is a preference (Sec. 4.4.1.1).

11. If the manufacturer is not permitted to use pozzolanic materials as a cement replacement (Sec. 4.4.1.1).

12. If aggregate samples will be required (Sec. 4.4.4).

13. If the manufacturer is not permitted to use admixtures (Sec. 4.4.6).

14. If submission of manufacturer's verification of design will be required (Sec. 4.5.2.1).

15. If submission for approval of welder qualification (Sec. 4.6.2) and welding procedure specifications (Sec. 4.6.3) will be required.

16. If details of specials and fittings are to be provided by the manufacturer (Sec. 4.7.1).

17. If the purchaser desires to inspect the material, pipe, and fittings at the manufacturer's plant (Sec. 5.1.1).

18. If steel test specimens will be required (Sec. 5.2.6).

19. If an affidavit of compliance will be required (Sec. 6.3).

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. Major changes made to the standard in this revision include the following:

1. The minimum yield strength requirement of steel used in the manufacture of cylinders for pipe has increased from 33,000 psi to 36,000 psi (227 MPa to 248 MPa) (Sec. 4.4.7.1).

2. In the requirements for steel bar reinforcement, the conformance standard for the 0.55 percent maximum carbon equivalency has changed from ASTM A706 to AWS D1.4 (Sec. 4.4.8.2).

3. In the material requirements for flat steel bars, the option of conformance to ASTM A575 grade M1020 has been removed (Sec. 4.4.7.4).

4. A requirement has been added that, if specified by the purchaser, the manufacturer shall submit test reports showing the physical properties of the rubber compound used in the manufacture of gaskets (Sec. 4.4.11.8).

5. A tolerance of +½ in. (+13 mm) has been added to the minimum cover requirement of mortar coating over wire (Sec. 4.5.1.5).

6. A requirement in the testing of concrete strength for the pipe core has been added that in no case shall any cylinder tested fall below 80 percent of the required strength (Sec. 4.6.5.8).

7. For placement of prestressing wire reinforcement, the required action to be taken in case of wire breakage has changed to include verification of the required tension level (Sec. 4.6.7.1).

8. Provisions for multiple layers of prestressing wire have been added, including a requirement for a smooth and even surface to minimize bridging of the prestressing wire and criteria for mortar voids and offsets to be repaired before adding subsequent wire layers (Sec. 4.6.7.2).

9. Requirements for linings and coatings for fittings have been modified extensively (Sec. 4.7.2.4).

10. Numerous editorial improvements have been made throughout the standard.

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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Prestressed Concrete Pressure Pipe, Steel-Cylinder Type

SECTION 1: GENERAL

Sec. 1.1 Scope

This standard describes the manufacture of circumferentially prestressed concrete pressure pipe in diameter sizes 16 in. (410 mm) through 144 in. (3,660 mm) manufactured with a steel cylinder and wire reinforcement. Larger sizes have been manufactured based on the concepts presented in this standard. The standard describes two types of prestressed pipe: (1) lined-cylinder pipe with a core composed of a steel cylinder lined with concrete and subsequently wire-wrapped and coated with premixed cement mortar, and (2) embedded-cylinder pipe with a core composed of a steel cylinder encased in concrete and subsequently wire wrapped and coated with premixed cement mortar. The structural design of prestressed concrete pipe for internal pressure and external load is not presented in this standard but is the subject of ANSI/AWWA C304, Design of Prestressed Concrete Cylinder Pipe. ANSI/AWWA C301 also does not include requirements for handling, delivering, laying, field testing, or disinfection of pipe. See AWWA Manual M9, *Concrete Pressure Pipe*, for this information, as well as for certain supplementary design considerations related to thrust restraint, subaqueous installations, and installation in corrosive environments.