



**American Water Works
Association**

ANSI/AWWA C301-07
(Revision of ANSI/AWWA C301-99)

The Authoritative Resource on Safe Water®

AWWA Standard

Prestressed Concrete Pressure Pipe, Steel-Cylinder Type



Effective date: June 1, 2007.

First edition approved by AWWA Board of Directors Nov. 21, 1949.

This edition approved Jan. 21, 2007.

Approved by American National Standards Institute Jan. 11, 2007.

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

Advocacy
Communications
Conferences
Education and Training
► **Science and Technology**
Section



Documents

Document Sharing Hub

AWWA Standard

This document is an American Water Works Association (AWWA) standard. It is not a specification. AWWA standards describe minimum requirements and do not contain all of the engineering and administrative information normally contained in specifications. The AWWA standards usually contain options that must be evaluated by the user of the standard. Until each optional feature is specified by the user, the product or service is not fully defined. AWWA publication of a standard does not constitute endorsement of any product or product type, nor does AWWA test, certify, or approve any product. The use of AWWA standards is entirely voluntary. AWWA standards are intended to represent a consensus of the water supply industry that the product described will provide satisfactory service. When AWWA revises or withdraws this standard, an official notice of action will be placed on the first page of the classified advertising section of *Journal AWWA*. The action becomes effective on the first day of the month following the month of *Journal AWWA* publication of the official notice.

American National Standard

An American National Standard implies a consensus of those substantially concerned with its scope and provisions. An American National Standard is intended as a guide to aid the manufacturer, the consumer, and the general public. The existence of an American National Standard does not in any respect preclude anyone, whether that person has approved the standard or not, from manufacturing, marketing, purchasing, or using products, processes, or procedures not conforming to the standard. American National Standards are subject to periodic review, and users are cautioned to obtain the latest editions. Producers of goods made in conformity with an American National Standard are encouraged to state on their own responsibility in advertising and promotional materials or on tags or labels that the goods are produced in conformity with particular American National Standards.

CAUTION NOTICE: The American National Standards Institute (ANSI) approval date on the front cover of this standard indicates completion of the ANSI approval process. This American National Standard may be revised or withdrawn at any time. ANSI procedures require that action be taken to reaffirm, revise, or withdraw this standard no later than five years from the date of publication. Purchasers of American National Standards may receive current information on all standards by calling or writing the American National Standards Institute, 25 West 43rd Street, Fourth Floor, New York, NY 10036; (212) 642-4900.

Science and Technology

AWWA unites the entire water community by developing and distributing authoritative scientific and technological knowledge. Through its members, AWWA develops industry standards for products and processes that advance public health and safety. AWWA also provides quality improvement programs for water and wastewater utilities.

All rights reserved. No part of this publication may be reproduced or transmitted in any form or by any means, electronic or mechanical, including photocopy, recording, or any information or retrieval system, except in the form of brief excerpts or quotations for review purposes, without the written permission of the publisher.

Copyright © 2007 by American Water Works Association
Printed in USA

Committee Personnel

The AWWA standards subcommittee that revised this standard had the following personnel at the time of approval:

Michael M. Hicks, *Chair*

General Interest

M.M. Hicks, MWH Americas Inc., Walnut Creek, Calif.	(AWWA)
A.E. Romer, Boyle Engineering Corporation, Newport Beach, Calif.	(AWWA)
C.C. Sundberg, CH2M Hill, Issaquah, Wash.	(AWWA)
M.S. Zarghamee, Simpson Gumpertz & Heger Inc., Waltham, Mass.	(AWWA)

Producer

S.A. Arnaout, Hanson Pipe & Products Inc., Dallas, Texas	(AWWA)
H.H. Bardakjian, Ameron International, Rancho Cucamonga, Calif.	(AWWA)
G. Bizien, Hyprescon Inc., St. Eustache, Que.	(AWWA)
A.W. Tremblay, Price Brothers Company, Dayton, Ohio	(AWWA)

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

Wayne R. Brunzell, *Chair*

David P. Prosser, *Secretary*

General Interest Members

W.R. Brunzell, Brunzell Associates Ltd., Skokie, Ill.	(AWWA)
R.C. Edmunds, Jones Edmunds & Associates, Gainesville, Fla.	(AWWA)
L.B. Freese, Freese and Nichols Inc., Fort Worth, Texas	(AWWA)
J.K. Haney, HDR Engineering Inc., Austin, Texas	(AWWA)
M.M. Hicks, MWH Americas Inc., Walnut Creek, Calif.	(AWWA)
R.Y. Konyalian, Consultant, Huntington Beach, Calif.	(AWWA)
S.A. McKelvie, Parsons Brinckerhoff Quade & Douglas Inc., Boston, Mass.	(NEWWA)
T. Niemann, Elizabeth Niemann & Associates, Louisville, Ky.	(AWWA)

P.J. Olson,* Standards Engineer Liaison, AWWA, Denver, Colo.	(AWWA)
J.J. Roller, CTL Group, Skokie, Ill.	(AWWA)
A.E. Romer, Boyle Engineering Corporation, Newport Beach, Calif.	(AWWA)
C.C. Sundberg, CH2M Hill, Issaquah, Wash.	(AWWA)
M.S. Zarghamee, Simpson Gumpertz & Heger Inc., Waltham, Mass.	(AWWA)

Producer Members

J.O. Alayon, Atlantic Pipe Corporation, San Juan, Puerto Rico	(AWWA)
S.A. Arnaout, Hanson Pipe & Products Inc., Dallas, Texas	(AWWA)
H.H. Bardakjian, Ameron International, Rancho Cucamonga, Calif.	(AWWA)
G. Bizien, Hyprescon Inc., St. Eustache, Que.	(AWWA)
D. Dechant, Northwest Pipe Company, Denver, Colo.	(AWWA)
S.R. Malcolm, Vianini Pipe Inc., Somerville, N.J.	(AWWA)
D.P. Prosser, American Concrete Pressure Pipe Association, Reston, Va.	(ACPPA)
A.W. Tremblay, Price Brothers Company, Dayton, Ohio	(AWWA)

User Members

B.M. Bradish, City of Portsmouth, Portsmouth, Va.	(AWWA)
J. Galleher, San Diego County Water Authority, San Diego, Calif.	(AWWA)
J.W. Keith, Bureau of Reclamation, Denver, Colo. (abstained)	(AWWA)
D. Marshall, Tarrant Regional Water District, Fort Worth, Texas	(AWWA)
V.B. Soto, Los Angeles Department of Water & Power, Los Angeles, Calif.	(AWWA)
D.A. Wiedyke, Consultant, Clinton Township, Mich.	(AWWA)

*Liaison, nonvoting

Contents

All AWWA standards follow the general format indicated subsequently. Some variations from this format may be found in a particular standard.

SEC.	PAGE	SEC.	PAGE
Foreword		4	Requirements
I	Introduction..... vii	4.1	Permeation..... 7
I.A	Background..... vii	4.2	Plans and Data to Be Provided by Purchaser 7
I.B	History..... viii	4.3	Data to Be Submitted by Manufacturer 8
I.C	Acceptance viii	4.4	Materials 8
II	Special Issues..... ix	4.5	Design..... 13
III	Use of This Standard ix	4.6	Fabrication..... 16
III.A	Purchaser Options and Alternatives ... x	4.7	Fittings and Special Pipe..... 28
III.B	Modification to Standard..... xi	5	Verification
IV	Major Revisions xi	5.1	Inspection and Testing by Purchaser.. 30
V	Comments xi	5.2	Tests 31
Standard		5.3	Quality Assurance 32
1	General	6	Delivery
1.1	Scope 1	6.1	Marking..... 32
1.2	Purpose 2	6.2	Transportation 33
1.3	Application 2	6.3	Affidavit of Compliance..... 33
2	References 2		
3	Definitions 6		

Table

1	Minimum Thickness of Sheet or Plate for Fittings of Various Diameters..... 29
---	---

This page intentionally blank.

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 constitute the core. After curing, the wire reinforcement is wound under tension in one or more layers around the outside of the concrete core containing the cylinder, instead of

directly on the cylinder. The exterior coating of premixed mortar is placed by impaction.

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; and Jan. 24, 1999. This edition was approved by the AWWA Board of Directors on Jan. 21, 2007.

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 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 US, 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,

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

†NSF International, 789 N. Dixboro Road, Ann Arbor, MI 48113.

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

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 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

^{*}Both publications available from National Academy of Sciences, 500 Fifth Street, NW, Washington, DC 20001.

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. Manner of storage and delivery, if required of the manufacturer.
3. Working pressure, surge pressure, field test pressure, external loading conditions, and method of bedding and backfilling (Sec. 4.2.1).
4. If detailed drawings and schedules are to be submitted for review (Sec. 4.3.1 and 4.7.1).
5. If the manufacturer is not permitted to supply pipe from inventory (Sec. 4.3.1).
6. If a tabulated layout schedule will be required (Sec. 4.3.2).
7. If any material or manufacturing test reports will be required (Sec. 4.4, 5.1.2, and 5.2).
8. Type of cement required, if there is a preference (Sec. 4.4.1.1).
9. If the manufacturer is not permitted to use pozzolanic materials as a cement replacement (Sec. 4.4.1.1).
10. If aggregate samples will be required (Sec. 4.4.4).
11. If the manufacturer is not permitted to use admixtures (Sec. 4.4.6).
12. If submission of manufacturer's verification of design will be required (Sec. 4.5.2.1).
13. If submission for approval of welder qualification (Sec. 4.6.2) and welding procedure specifications (Sec. 4.6.3) will be required.
14. If details of specials and fittings are to be provided by the manufacturer (Sec. 4.7.1).

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

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

17. 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. References for steel sheets, coils, and strips have been updated to reflect new and discontinued ASTM standards (Sec. 2, Sec. 4.4.7.2, and Sec. 4.4.9.2).

2. The maximum root opening for the cylinder to joint ring weld assembly and the weld repair procedure have been added (Sec. 4.6.4.2.1).

3. The radial compaction method has been added for concrete placement for the pipe core (Sec. 4.6.5.1).

4. A statement on retensioning of the wire during placing of wire reinforcement has been added (Sec. 4.6.7.1).

5. The allowable maximum individual mortar coating absorption value has been reduced (Sec. 4.6.8.3).

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 at 303.795.7603, write to the group at 6666 West Quincy Avenue, Denver, CO 80235-3098, or e-mail at standards@awwa.org.

This page intentionally blank.

AWWA Standard

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 with a steel cylinder and wire reinforcement in sizes 16 in. (410 mm) through 144 in. (3,660 mm). 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 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 design of prestressed concrete pipe 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 disinfecting of pipe. See AWWA Manual M9, *Concrete Pressure Pipe*, for this information.

1.1.1 *Essential requirements.* The pipe shall have the following principal features: a welded steel cylinder with steel joint rings welded to its ends; for lined-

cylinder pipe, a core consisting of a lining of concrete within the steel cylinder, or for embedded-cylinder pipe, a core consisting of the steel cylinder encased in concrete; reinforcement consisting of high-tensile wire wound around the outside of the core in one or more layers at a predetermined stress and fastened securely at its ends; a coating of dense mortar covering the core and wire, except for the necessarily exposed surfaces of the joint rings; and a self-centering joint with a preformed gasket of rubber, designed so that the joint will be watertight under all conditions of service. Lined-cylinder pipe shall be used for pipe sizes up to and including 20 in. (510 mm) and may be used for pipe sizes up to and including 60 in. (1,520 mm). Embedded-cylinder pipe may be used for pipe sizes 24 in. (610 mm) through 60 in. (1,520 mm) and shall be used for larger pipe. For embedded-cylinder pipe, at least one third of the total core thickness shall be outside the cylinder.

Sec. 1.2 Purpose

The purpose of this standard is to provide the minimum requirements for steel-cylinder, prestressed concrete pressure pipe.

Sec. 1.3 Application

This standard can be referenced in specifications for purchasing and receiving prestressed concrete pressure pipe, steel-cylinder type, and can be used as a guide for manufacturing this type of concrete pressure pipe. The stipulations of this standard apply when this document has been referenced and then only to prestressed concrete pressure pipe, steel-cylinder type.

SECTION 2: REFERENCES

This standard references the following documents. In their latest editions, they form a part of this standard to the extent specified within the standard. In any case of conflict, the requirements of this standard shall prevail.

ACI*—Committee 305 report—Hot Weather Concreting.

*ACI International, 38800 Country Club Drive, Farmington Hills, MI 48331.

ANSI/AWS[†] D1.1—Structural Welding Code—Steel.

ANSI/AWS D1.3—Structural Welding Code—Sheet Steel.

ANSI/AWWA C304—Design of Prestressed Concrete-Cylinder Pipe.

ASME[‡] SEC IX—Boiler and Pressure Vessel Code, Sec. IX, Qualification Standard for Welding and Brazing Procedures, Welders, Brazers, and Welding and Brazing Operators.

ASTM[§] A27/A27M—Standard Specification for Steel Castings, Carbon, for General Application.

ASTM A36/A36M—Standard Specification for Carbon Structural Steel.

ASTM A185—Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete.

ASTM A283/A283M—Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates.

ASTM A285/A285M—Standard Specification for Pressure Vessel Plates, Carbon Steel, Low- and Intermediate-Tensile Strengths.

ASTM A370—Standard Test Methods and Definitions for Mechanical Testing of Steel Products.

ASTM A497/A497M—Standard Specification for Steel Welded Wire Reinforcement, Deformed, for Concrete.

ASTM A568/A568M—Standard Specification for Steel, Sheet, Carbon and High-Strength, Low-Alloy, Hot Rolled and Cold Rolled, General Requirements for.

ASTM A575—Standard Specification for Steel Bars, Carbon, Merchant Quality, M-Grades.

ASTM A576—Standard Specification for Steel Bars, Carbon, Hot-Wrought, Special Quality.

ASTM A615/A615M—Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.

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

†American Welding Society Inc., 550 N.W. LeJeune Road, Miami, FL 33126.

‡ASME International, Three Park Avenue New York, NY 10016.

§ASTM International, 100 Barr Harbor Drive, West Conshohocken, PA 19428.