



**American Water Works
Association**

Dedicated to the World's Most Important Resource®

ANSI/AWWA C901-17
(Revision of ANSI/AWWA C901-08)

AWWA Standard

**Polyethylene (PE) Pressure
Pipe and Tubing, 3/4 In.
(19 mm) Through 3 In.
(76 mm), for Water Service**

Effective date: Nov. 1, 2017.

First edition approved by AWWA Board of Directors Jan. 28, 1978.

This edition approved June 11, 2017.

Approved by American National Standards Institute May 11, 2017.



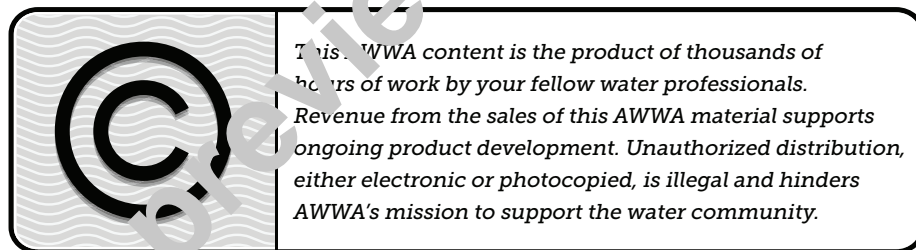
AWWA Standard

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. This standard does not supersede or take precedence over or displace any applicable law, regulation, or code of any governmental authority. AWWA standards are intended to represent a consensus of the water 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 Official Notice section of *Journal – American Water Works Association*. The action becomes effective on the first day of the month following the month of *Journal – American Water Works Association* 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 mark 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; or emailing info@ansi.org.



ISBN-13, print: 978-1-62576-260-3

eISBN-13, electronic: 978-1-61300-446-3

DOI:<http://dx.doi.org/10.12999/AWWA C901>

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 © 2017 by American Water Works Association
Printed in USA

Committee Personnel

The AWWA Standards Subcommittee on C901, which reviewed and developed this revision, included the following personnel at the time:

Camille G. Rubeiz, *Chair*

S. Boros, Pipeline Plastics, Westlake, Texas (AWWA)
A. J. Ciechanowski, NSF International, Ann Arbor, Mich. (NSF)
D. Keller, LyondellBasell, Cincinnati, Ohio (AWWA)
D. Langston, WL Plastics, Cedar City, Utah (AWWA)
H. Link, Colorado Springs Utilities, Colorado Springs, Colo. (AWWA)

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

John F. Fishburne, *Chair*

Camille G. Rubeiz, *Secretary*

General Interest Members

W.I. Adams, WSS Consulting, Terre Haute, Ind. (AWWA)
J.L. Beaver, Simpson Gumpertz & Heger, Waltham, Mass. (AWWA)
J.P. Castronovo, Consultant, Blue Ridge, Ga. (AWWA)
A. Chastain-Howley,* Standard Council Liaison, Black & Veatch, Arlington, Texas (AWWA)
K.C. Choquette, Consultant, Des Moines, Iowa (AWWA)
A.J. Ciechanowski, NSF International, Ann Arbor, Mich. (NSF)
D.E. Duvall, Engineering Systems Inc., Aurora, Ill. (AWWA)
D.L. McPherson, PDK Inc., Charlotte, N.C. (AWWA)
P.J. Olson,* Standards Engineer Liaison, AWWA, Denver, Colo. (AWWA)
J.R. Paschal, Paschal Engineering LLC, Ypsilanti, Mich. (AWWA)
S.C. Williams, CH2M, Atlanta, Ga. (AWWA)

Producer Members

L.J. Gill, Ipex Management Inc., Mississauga, Ont., Canada (AWWA)
R. Houle, Reliance Worldwide, Atlanta, Ga. (AWWA)

* Nonvoting liaison

M. Huynh, JM Manufacturing Company, Los Angeles, Calif.	(AWWA)
L. MacNevin,* Plastics Pipe Institute, Leesburg, Va.	(AWWA)
C.G. Rubeiz, Plastics Pipe Institute, Fairfax, Va.	(PPI)
S.D. Sandstrum, ISCO Industries, Louisville, Ky.	(AWWA)
H. Svetlik, Georg Fischer Central Plastics, Dallas, Texas	(AWWA)

User Members

L. Aguiar, Miami Dade Water and Sewer Department, Miami, Fla.	(AWWA)
E.A. Ambler, City of Casselberry, Casselberry, Fla.	(AWWA)
L.M. Bowles, Bureau of Reclamation, Denver, Colo.	(USBR)
J.F. Fishburne, Charlotte, N.C.	(AWWA)
H. Link, Colorado Springs Utilities, Colorado Springs, Colo.	(AWWA)
J.R. Peters, City of Carmel Utilities, Carmel, Ind.	(AWWA)
G. Scoby, Scoby & Associates, Los Gatos, Calif.	(AWWA)
D.A. Stewart, City of Lago Vista, Lago Vista, Texas	(AWWA)
M.A. Wirtz, City of Fort Wayne, Fort Wayne, Ind.	(AWWA)

* Alternate, 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		5	Verification
I	Introduction..... vii	5.1	General 13
I.A	Background..... vii	5.2	Tests for Qualification of Materials and Processes 14
I.B	History..... vii	5.3	Tests for Product Quality Control 14
I.C	Acceptance..... vii	5.4	Action After Failure to Meet Requirements 15
II	Special Issues..... ix	5.5	Quality-Control Records..... 15
II.A	Considerations for Oxidative Resistance ix	5.6	Plant Inspection by Purchaser 15
III	Use of This Standard..... ix	6	Delivery
III.A	Purchaser Options and Alternatives ix	6.1	Marking..... 16
III.B	Modification to Standard x	6.2	Shipping..... 17
IV	Major Revisions..... x	6.3	Affidavit of Compliance 17
V	Comments xi		
Standard		Appendixes	
1	General	A	Internal Surge Pressure and Corresponding Sudden Water Flow Velocity Change..... 19
1.1	Scope 1	B	Bibliography of Sources for Additional Information Regarding Permeation of Polyolefin Pipes 21
1.2	Purpose 2	C	Bibliography of Additional Information Regarding Polyolefin Pipe and Tubing..... 23
1.3	Application..... 2		
2	Reference 2		
3	Definitions 4		
4	Requirements		
4.1	Permeation 6		
4.2	Materials 6		
4.3	Pipe and Tubing..... 8		
4.4	Pressure Class..... 13		

SEC.	PAGE	SEC.	PAGE
Figure			
1	12	4	10
1 Bend-Back Test		IPS PE Pipe—OD-Controlled Diameter, SDR, and Wall Thickness	
Tables			
1	7	5	10
1 ASTM D3350 Cell Classification and Property Values for Materials		CTS PE Tubing—OD-Controlled Diameter, SDR, and Wall Thickness	
2	8	6	11
2 Elevated-Temperature Sustained- Pressure Test Requirements		6 Minimum Short-Term Burst Pressure for Pipe and Tubing at 73°F (23°C)	
3	9	7	13
3 ID PE Pipe—ID-Controlled Inside Diameter, SDR, and Wall Thickness		7 PE Pipe and Tubing Pressure Class	

Foreword

This foreword is for information only and is not a part of ANSI/AWWA C901.

I. Introduction.

I.A. *Background.* This standard describes polyethylene (PE) pressure pipe and tubing for use primarily as service lines in the construction of underground water distribution systems.

This standard describes standard dimension ratios (SDRs) and standard inside dimension ratios (SIDRs) for pipe and tubing made from PE material with standard PE code designation PE4710 in a pressure class of 250 psi (1,700 kPa) for water at 80°F (27°C) and lower temperatures. When agreed on between purchaser and manufacturer, special sizes per Sec. 4.3.3 are acceptable. Maximum working pressure ratings are reduced for higher service temperatures; refer to AWWA Manual M55 for information about the use of PE tubes at higher service temperatures. Pipe ranging in nominal size from ¾ in. (19 mm) through 3 in. (76 mm) conforms to the outside-diameter (OD) dimensions of iron pipe size (IPS) or to the inside diameter (ID) dimensions of IPS pipe. Tubing ranging in size from ¾ in. (19 mm) through 2 in. (51 mm) conforms to the outside-diameter dimensions of copper tube size (CTS).

I.B. *History.* On Jan. 28, 1978, the first edition of ANSI/AWWA C901 was approved by the AWWA Board of Directors. On Aug. 9, 1982, a subcommittee of the AWWA Standards Committee on Thermoplastic Pipe was formed to review and revise the standard based on experience and advances in the state of the art since the adoption of the standard. To this end, AWWA conducted two surveys of its members to ascertain their experience with ANSI/AWWA C901 products. This information was incorporated into the second edition of ANSI/AWWA C901, approved on Jan. 24, 1988.

In June 1980, the Thermoplastic Pressure Pipe Committee was divided into two committees to accommodate both polyolefin and polyvinyl chloride (PVC) pipe. Thus were formed the Polyvinyl Chloride Pressure Pipe and Fittings Committee and the Polyolefin Pressure Pipe and Fittings Committee. Subsequent editions of C901 were approved June 27, 1996, June 16, 2002, and June 8, 2008. This edition was approved on June 11, 2017.

I.C. *Acceptance.* In May 1985, the US Environmental Protection Agency (USEPA) entered into a cooperative agreement with a consortium led by NSF

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

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 or local agency.
2. 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.
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 61 does not stipulate a maximum allowable level (MAL) of a contaminant for substances not regulated by a USEPA and 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 C901 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.

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

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

‡ Both publications available from National Academy of Sciences, 500 Fifth Street, NW, Washington, DC 20418.

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.

II.A. *Considerations for Oxidative Resistance.* Consistent with the practice of other pipe and material standards, strength ratings in this standard are not reduced for potential in-service degradation mechanisms such as internal or external corrosion and oxidation.

ASTM* F2263 assesses long-term internal oxidative stability of PE material in potable water applications based on accelerated testing and modeling. ASTM F2263 was updated in 2014 to reflect how testing is currently being performed. ASTM F2263 results are useful for projecting the relative performance of various PE pipe compounds in chlorinated water applications. ASTM F2263 is a test method and does not include performance criteria for PE tubes. ASTM D3350 was updated in 2014 to provide for the classification of PE resin performance under oxidative conditions. The materials requirements incorporating ASTM F2263 and D3350 have been added in Section 4.

For potable water applications, the standard specifies PE compounds with oxidative resistance classification CC2 or CC3, and limits the pipe size (i.e., dimension ratio) to DR9, which ensures adequate design life under the vast majority of disinfectant applications where chlorine and chloramine are used as secondary disinfectants. (NOTE: This standard does not include consideration of chlorine dioxide as a secondary disinfectant, which is estimated to be used in less than 1 percent of North American utilities. Seek additional guidance from the pipe supplier if chlorine dioxide is the planned disinfectant practice. (See Jana Laboratories, *Usage and Effects of Chlorine Dioxide on PEX Plumbing and Water Distribution Systems in North America*, prepared for the Plastics Pipe Institute, July 2010, <http://plasticpipe.org/pdf/effects-of-chlorine-dioxide-on-pe-x.pdf>.) Future updates to AWWA Manual M55 will incorporate additional design guidance.

II. **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. Refer to AWWA Manual M55 for details.

III.A. *Purchaser Options and Alternatives.* The following items should be covered by the purchaser:

* ASTM International, 100 Barr Harbor Drive, West Conshohocken, PA 19428

1. Standard used—that is, ANSI/AWWA C901, Polyethylene (PE) Pressure Pipe and Tubing, ¾ In. (19 mm) Through 3 In. (76 mm), for Water Service, of latest revision.
2. Whether compliance with NSF/ANSI 61, Drinking Water System Components—Health Effects, is required.
3. Details of other federal, state or provincial, and local requirements (Sec. 4.2).
4. Pipe
 - a. Standard code designation of the PE material.
 - b. Nominal size, pressure class, dimension ratio and diameter basis (SDR or SIDR), form (straight or coiled), length of individual piece, and total linear feet (linear meters) for each different item to be provided.
5. Tubing
 - a. Standard code designation of the PE material.
 - b. Nominal size, pressure class, dimension ratio, form (straight or coiled), length of individual pieces, and total linear feet (linear meters) for each different item to be provided.
6. The following requirements should be specified:
 - a. Special quality-control tests (Section 5).
 - b. Plant inspection (Sec. 5.6).
 - c. Special marking (Sec. 6.1.3).
 - d. Special preparation for shipment (Sec. 6.2).
 - e. Affidavit of compliance (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. Minimum tubing size described in standard has been changed from ½ in. to ¾ in. (Sec. 1.1).
2. Older PE material code designations have been removed (Sec. 1.1, Tables 1, 2, 6, and 7).
3. A section on Considerations for Oxidative Resistance has been added to the Special Issues section of the foreword and other sections (foreword Sec. II.A, Sec. 4.2.1.2, and 6.1.3 item 9).
4. References have been added for the following ASTM standards: A53, B88, D1435, D2565, D2774, F2263, F2620, and G155 (Section 2).

5. Definitions have been added for the terms *Design Factor*, *Lot*, *PE Compound*, *PE 4710*, *Safety Factor*, *Sample*, *Specimen*, and *Virgin PE*. Existing definitions of the terms *Hydrostatic Design Basis* (HDB), *Standard Dimension Ratio* (SDR), and *Standard Inside Dimension Ratio* (SIDR) have been updated (Section 3).

6. AWWA standard language regarding compliance with Safe Drinking Water Act and other federal regulations has been added (Sec. 4.2.1).

7. PE material requirements have been updated (Sec. 4.2.1.1 through Sec. 4.2.1.3).

8. A section on Special Sizes has been added (Sec. 4.3.3) and the former section on Special OD-Controlled Sizes has been deleted.

9. Table 3 has been updated to include only SIDR 7 pipe and tubing for ID-controlled insider-diameter PE pipe.

10. Table 4 has been updated to include only SDR 9 pipe and tubing for IPS OD-controlled PE pipe.

11. Table 5 has been updated to include only SDR 9 pipe and tubing for CTS OD-controlled PE tubing.

12. The 2½ in. size has been removed from Tables 3 and 4.

13. A Pressure Class section has been added (Sec. 4.4).

14. The marking requirements have been updated (Sec. 6.1.3).

15. The Shipping section has been updated to include end caps (Sec. 6.2).

16. Appendix A on Internal Surge Pressure has been updated and a list of additional bibliographic references on the topic has been added to the appendix.

17. An appendix with a bibliography of additional sources regarding permeation of polyolefin pipes has been added (appendix B).

18. A bibliography of additional resources regarding polyolefin pipe and tubing has been added (appendix C).

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.

This page intentionally blank.



**American Water Works
Association**

Dedicated to the World's Most Important Resource®

ANSI/AWWA C901-17
(Revision of ANSI/AWWA C901-08)

AWWA Standard

Polyethylene (PE) Pressure Pipe and Tubing, $\frac{3}{4}$ In. (19 mm) Through 3 In. (76 mm), for Water Service

SECTION 1: GENERAL

Sec. 1.1 Scope

This standard describes polyethylene (PE) pressure pipe and tubing made from material having standard PE code designation PE4710* and intended for use in potable water, reclaimed water, and wastewater service. Polyethylene pipe ranges in nominal size from $\frac{3}{4}$ in. (19 mm)[†] through 3 in. (76 mm) and conforms to the outside-diameter (OD) dimensions of iron pipe size (IPS) or to the inside-diameter (ID) dimensions of IPS pipe. Polyethylene tubing ranges in size from $\frac{3}{4}$ in. (19 mm) through 2 in. (51 mm) and conforms to the OD dimensions of copper tube size (CTS). Included in this standard are criteria for classifying PE plastic pipe materials, a system of nomenclature for PE plastic pipe, and requirements and test methods for materials, pipe, and tubing. Methods of marking are also given.

* Earlier editions of ANSI/AWWA C901 included other PE material designations. For removed designations, refer to previous editions of ANSI/AWWA C901, ASTM D3350, PPI (Plastics Pipe Institute) TR-3, and PPI TR-4.

[†] Metric conversions given in this standard are direct conversions of US customary units and are not those specified in International Organization for Standardization (ISO) standards.