ANSI/AWWA **C900-22**

(Revision of ANSI/AWWA C900-16)

AWWA Standard

Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 In. Through 60 In. (100 mm Through 1,500 mm)

Effective date: Oct. 1, 2022
First edition approved by Board of Directors June 8, 1975.
This edition approved June 10, 2022.
Approved by American National Standards Institute May 23, 2022.

American Water Works Association

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 codes 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 in the Official Notice 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 ANSI approval. 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 e-mailing info@ansi.org.

ISBN-13, print: 978-1-64717-097-4

ISBN-13, electronic: 978-1-61300-630-6

DOI: http://dx.doi.org/10.12999/AWWA.C900.22

All rights reserved. No part of this publication may be reproduced or transmitted in any form or by any means, electronic or mechanical, including scanning, recording, or any information or retrieval system. Reproduction and commercial use of this material is prohibited, except with written permission from the publisher. Please send any requests or questions to permissions@awwa.org.

Committee Personnel

The C900 Standard Subcommittee that developed this standard had the following personnel at the time of approval:

Robert Walker, *Chair*

L.M. Bowles, Bureau of Reclamation, Denver, Colo.
B. Clark, JM Manufacturing Co. Inc., DBA JM Eagle, Los Angeles, Calif.
D.L. Eckstein, EBAA Iron Sales Inc., Williamston, S.C.
W. Fassler, Uni-Bell PVC Pipe Association, Ripon, Calif.
S. Ferry, PSILab Inc., Longmont, Colo.
C.A. Fisher, Star Pipe Products, Houston, Tex.
M. Glasgow, North American Pipe Corporation, Ashland City, Tenn.
J.F. Houle, Houle Plastic Pipe Consulting, Livingston, Tex.
J. Hrdlicka (*liaison, nonvoting*), Standards Engineer Liaison, AWWA, Denver, Colo.
M. Huynh, JM Manufacturing Co. Inc., DBA JM Eagle, Bakersfield, Calif.
K.S. Jeng-Bulloch, City of Huntsville, Huntsville, Tex.
T.E. Layton, Orange County Utilities, Orlando, Fla.
T. Marti, Underground Solutions Inc., Warrendale, Pa.
S.K. Rajah, Bellevue, Wash.
E.E. Schmidt, Diamond Plastics Corporation, Grand Island, Neb.
G. Scoby, Palo Alto Utilities Department, Los Gatos, Calif.
S. Scott, NAPCO Pipe & Fittings, Houston, Tex.
B. Sukolsky, Harco, Bellingham, Wash.
J.A. Volpe, North American Pipe Corporation, Wayne, Pa.
R.P. Walker, Underground Solutions Inc., Southlake, Tex.
W.R. Whidden, Woolpert, Orlando, Fla.

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

Bill Whidden, *Chair*
Robert P. Walker, *Vice-Chair*

General Interest Members

S.D. Adams, Jacobs, Corvallis, Ore.
M.L. Busby, Lockwood, Andrews, & Newnam, Inc., Dallas, Tex.

A.J. Ciechanowski, NSF International, Ann Arbor, Mich.
A. Chastain-Howley (*liaison, nonvoting*), Standards Council Liaison, Black & Veatch, Arlington, Tex.
S.J. Cook, Black & Veatch, Virginia Beach, Va.
S. Ferry, PSILab, Inc., Longmont, Colo.
J. Hebenstreit, Underwriters Laboratories LLC, Northbrook, Ill.
J.F. Houle, Houle Plastic Pipe Consulting, Livingston, Tex.
S.C. Macleod (*alternate*), Underwriters Laboratories Inc., Melville, N.Y.
J.A. Hrdlicka (*liaison, nonvoting*), Standards Engineer Liaison, AWWA, Denver, Colo.
J.R. Paschal, Aquatherm, Lindon, Utah
J.K. Snyder, Snyder Environmental Engineering Associates, Audubon, Pa.
W.R. Whidden, Woolpert, Winter Park, Fla.

Producer Members

H. Connors (*alternate*), North American Pipe Corporation, Wayne, Pa.
G.A. Garcia, JM Eagle, Inc., Los Angeles, Calif.
L.J. Gill, IPEX Inc., Mississauga, Ont., Canada
T. Marti (*alternate*), Underground Solutions, Warrendale, Pa.
R. Nichols, Uni-Bell PVC Pipe Association, Irving, Tex.
J. Parvez (*alternate*), Uni-Bell PVC Pipe Association, Irving, Tex.
S.R. Piper, Galaxy Plastic Industries, Inc., Barrie, Ont., Canada
M. Rennau (*alternate*), Diamond Plastic Corporation, Grand Island, Neb.
J. Riordan (*alternate*), HARCO Fittings, Lynchburg, Va.
L.D. Schmidt, Diamond Plastics Corporation, Grand Island, Neb.
S. Scott, North American Pipe Corporation, Woodbridge, Ont., Canada
B. Sukolsky, HARCO Fittings, Bellingham, Wash.
R.P. Walker, Underground Solutions Inc., Southlake, Tex.

User Members

J.R. Barbier, Denver Water, Denver, Colo.
S. DuChez, WSSC Water, Laurel, Md.
K.S. Jeng-Bulloch, City of Huntsville, Huntsville, Tex.
J. Jimenez, Region of Peel, Etobicoke, Ont., Canada
A. Korell, City of North Bay, North Bay, Ont., Canada

J. Larson, Marshall Municipal Utilities, Marshall, Minn.
T.E. Layton, Orange County Utilities, Orlando, Fla.
A. Marner, United States Bureau of Reclamation, Denver, Colo.
V.B. Sandoval, Natural Resource Conservation Service, Boise, Idaho

This page intentionally blank.

Contents

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

SEC. PAGE

Foreword

I Introduction ix
I.A Background ix
I.B History ix
II Special Issues xi
II.A Selection of Pressure Class xi
II.B UV Light Effects xi
II.C Chlorine and Chloramine Degradation of Elastomers xi
II.D PVC Oxidative Resistance xii
III Use of This Standard xii
III.A Purchaser Options and Alternatives xii
III.B Modification to Standard xiii
IV Major Revisions xiii
V Comments. xiii

Standard

1 General

1.1 Scope 1
1.2 Purpose 1
1.3 Application 2

2 References 2

3 Definitions 3

4 Requirements

4.1 Permeation 7
4.2 Materials. 8
4.3 Pipe Requirements 9
4.4 Machined Coupling Requirements 16
4.5 Fabricated Fitting Requirements 16
4.6 Joint Design Performance Qualification Requirements 18
4.7 Pressure Class Designation Requirements and Pressure Design Recommendations 19

5 Verification

5.1 Quality Control and Qualification Test Requirements 22
5.2 Quality Control Records 26
5.3 Plant Inspection 26
5.4 Basis for Rejection 26

6 Marking and Delivery

6.1 Marking Requirements 26
6.2 Shipping 28
6.3 Affidavit of Compliance 28

Appendixes

A Bibliography 29
B Recurring (Cyclic) Surge Figures and Design Example 31
B.1 Discussion 31
B.2 Design Examples 33

Figures

1 Lap Shear Test 18
B.1 Illustration of Stress Terms 32

SEC. PAGE

Tables

1A Pipe Barrel Dimensions, Pressure Classes, and Dimension Ratios for PVC Pipe with Cast Iron Outside Diameter (CIOD) 10

1B Pipe Barrel Dimensions, Pressure Classes, and Dimension Ratios for PVC Pipe with IPS Outside Diameters..... 13

2 Pressure Test Requirements..... 14

SEC. PAGE

3 Temperature Coefficients, F_T..... 15

4 Allowable Maximum Occasional Surge Pressure Capacity and Allowable Sudden Changes in Water Velocity (V) for Pipe Operating at 73.4°F (23°C) at Working Pressures (WP) Expressed as Percent of Nominal Pressure Class (PC) 21

B.2 The Cyclic Life of other PVC Pipe DRs for Force Main Example.... 35

Foreword

This foreword is for information only and is not a part of ANSI/AWWA C900.*

I. Introduction.

I.A. *Background.* This standard pertains to 4-in. through 60-in. (100-mm through 1,500-mm) polyvinyl chloride (PVC) pressure pipe† and fabricated fittings with outside diameter (OD) dimensions that conform with either those of ductile and cast iron pipe (CIOD) or steel pipe (IPS). Outside diameter to wall thickness (OD/*t*) dimension ratios (DRs) of 14, 17, 18, 21, 25, 26, 27.5, 32.5, 41, and 51 are included and correspond with pressure classes (PCs) of 305, 250, 235, 200, 165, 160, 150, 125, 100, and 80 psi. Design considerations are provided in AWWA Manual M23, *PVC Pipe—Design and Installation*. The manual includes chapters on general properties of PVC pipe; manufacturing, testing, and inspection; pressure capacity; design factors for external forces; hydraulics; receiving, storage, and handling; testing and maintenance; and service connections (tapping). Recommended installation guidance is provided in ANSI/AWWA C605, Underground Installation of Polyvinyl Chloride (PVC) and Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe and Fittings.

I.B. *History.* In 1966, the American Water Works Association (AWWA) appointed Committee 8350-D to study and report on the adaptability of plastic pipe for use within the water industry. The committee presented its report on June 6, 1967, at AWWA's annual conference. The report included a recommendation that a task group be appointed to prepare standards for the use of plastic materials. The AWWA Standards Committee on Thermoplastic Pressure Pipe Standards Committee was established in 1968.

In June 1988, the Thermoplastic Pressure Pipe Committee was divided into two separate committees: The Polyvinyl Chloride Pressure Pipe and Fittings Standards Committee and the Polyolefin Pressure Pipe and Fittings Standards Committee.

ANSI/AWWA C900 was the first thermoplastic pipe standard approved by the AWWA Board of Directors in June of 1975. This is the seventh edition of ANSI/AWWA C900. Previous revisions to ANSI/AWWA C900 were prepared by the AWWA Standards Committee and approved in Jan. 1981, Jan. 1989, June 1997, June 2007, and on Jan. 16, 2016. This edition of ANSI/AWWA C900 was approved on June 10, 2022.

---

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

† Including requirements for pipe couplings.

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. Specific policies of the state or local agency.

2. Two standards developed under the direction of NSF[§], NSF/ANSI[¶]/CAN[**] 60, Drinking Water Treatment Chemicals—Health Effects, and NSF/ANSI/CAN 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/CAN 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/CAN 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.

[‡] Persons outside the United States should contact the appropriate authority having jurisdiction.

[§] NSF International, 789 N. Dixboro Road, Ann Arbor, MI 48105.

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

[**] Standards Council of Canada, 55 Metcalfe Street, Suite 600, Ottawa, ON K1P 6L5 Canada.

[††] Both publications available from National Academy of Sciences, 500 Fifth Street, NW, Washington, DC 20001.

ANSI/AWWA C900 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 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. *Selection of Pressure Class*. This standard does not include information about PVC pipe design and installation. AWWA Manual M23, PVC Pipe—Design and Installation, provides detailed information to assist in the proper selection, handling, installation, operation, and acceptance testing of PVC pressure pipe. The minimum pressure class of the pipe selected should be equal to or greater than the system working pressure. The sum of the system working pressure and occasional surge pressure should not exceed 1.60 times the pressure class of the pipe. The system working pressure and recurring surge pressure should be analyzed using the method in Sec. 4.7. If surge pressures govern the selection of the pressure class, consideration should be given to removal of the cause of surge pressures or to the incorporation of surge suppressors in the system.

II.B. *UV Light Effects*. Ultraviolet (UV) radiation from sunlight can affect the outer surface coloration of PVC pipe. A UV inhibitor, usually titanium dioxide, is included in the pipe compound to absorb UV radiation. Even after prolonged exposure, PVC pipe's performance characteristics are not significantly altered. Outdoor storage recommendations are included in AWWA M23 and AWWA C605.

II.C. *Chlorine and Chloramine Degradation of Elastomers.* The selection of materials is critical for water service and distribution piping in locations where there is a possibility that elastomers will be in contact with chlorine or chloramines. Documented research has shown that elastomers such as gaskets, seals, valve seats, and encapsulations may be degraded when exposed to chlorine or chloramines. The impact of degradation is a function of the type of elastomeric material, chemical concentration, contact surface area, elastomer cross section, environmental conditions as well as temperature. Careful selection of and specifications for elastomeric materials and the specifics of their application for each water system component should be considered to provide long-term usefulness and minimum degradation (swelling, loss of elasticity or softening) of the elastomer specified.

NOTE: A pipe gasket having the compressed hardness of an elastomer with a large mass relative to the exposed surface area experiences minimal degradation. This was validated in a research paper reported in Journal AWWA (Volume 96, Number 4, April 2004, pp. 153–160) where the pipe gasket degradation in a 110-mg/L chloramine solution was found to be negligible.

II.D *PVC Oxidative Resistance*. PVC pipe and fittings are immune to both internal and external galvanic corrosion. PVC pipe and fittings are also resistant to degradation from long-term exposure water that has been treated with disinfectants, such as chlorine, chlorine dioxide, chloramines, bromine, and ozone. There are no issues and no performance evaluation requirements for either galvanic corrosion or water disinfectant oxidation resistance for PVC pipe and fittings.

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 application being considered.

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

1. Standard to be used—that is, ANSI/AWWA C900, Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 In. Through 60 In. (100 mm Through 1,500 mm), of latest revision.

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

3. Pipe and fabricated fittings.*
    a. Nominal size [for example, 14 in. (350 mm) CIOD].
    b. Working, occasional, and recurring surge pressures (Section 3).
    c. Pressure class or dimension ratio (DR) (see Tables 1A and 1B).
    d. Linear feet of each pressure class or DR for each nominal pipe size to be furnished.
    e. Number, nominal size, pressure class, or DR and configuration for fittings and couplings (for example, 17, nominal 24-in. DR 25, 45° bends, IPS).

4. Applicable details of federal, state, provincial, territorial, and local requirements (Sec. 4.2.1).

* Purchase documents may allow or require the use of fittings other than those described in ANSI/AWWA C900. Some examples of compatible fittings include those covered in ANSI/AWWA standards C907, C208, C153, and C110.

5. When desired, requirements such as the following should be specified in the purchase contract:
    a. Standard lengths (Sec. 4.3.2.4).
    b. Shipping (Sec. 6.2).
    c. Affidavit of compliance (Sec. 6.3).

6. Plant inspection. If plant inspections are desired, provisions must be specified in the purchase contract (Sec. 5.3).
    a. Production notice. The manufacturer should be required to give adequate advance notice of when and where production of ordered materials will start.
    b. Inspection aids. The manufacturer should be required to make available, without charge, to the purchaser's inspector such tools and assistance as are necessary for inspection and handling of materials.
    c. Inspection limitations. To exclude inspection of proprietary manufacturing processes, the manufacturer should be required to give adequate advance notice to the purchaser.

III.B. *Modification to Standard.* Any modifications 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 edition include the following:

1. Clarification and update of pipe material requirements in Sec. 4.2.2.
2. Clarification of fabricated fitting material requirements in Sec. 4.2.6.
3. Update to burst pressure test specimen requirements in Sec. 4.3.3.2
4. Clarification of fabricated fitting pressure test requirements in Sec 4.5.5.
5. Clarification of occasional surge pressure allowance in Sec. 4.7.1.2.1.
6. Update to recurring surge pressure allowance in Sec. 4.7.1.2.2.
7. Update to recurring surge design example in Appendix B.

V. Comments. If you have any comments or questions about this standard, please call AWWA Engineering and Technical Services Department, 303.794.7711; write to the Department, 6666 West Quincy Avenue, Denver, CO 80235-3098; or email standards@awwa.org.

This page intentionally blank.

ANSI/AWWA C900-22
(Revision of ANSI/AWWA C900-16)

American Water Works Association
Dedicated to the World's Most Important Resource®

AWWA Standard

Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 In. Through 60 In. (100 mm Through 1,500 mm)

SECTION 1: GENERAL

Sec. 1.1 Scope

This standard covers polyvinyl chloride (PVC) pipe, machined PVC couplings, and fabricated PVC fittings manufactured for conveying potable water, reclaimed water, irrigation water, wastewater, or any fluid compatible with non-plasticized PVC. The standard includes eight-dimension ratios (DRs) and nominal sizes ranging from 4 in. through 60 in. (100 mm through 1,500 mm). Standard pipe outside diameters (ODs) conform to the ductile iron and cast iron sizing system, referred to as *cast iron* or *CIOD*, and steel pipe sizing system, referred to as *IPS* (iron pipe size). Pressure classes range from 80 psi (550 kPa) to 305 psi (2,100 kPa).

This standard does not include injection-molded PVC fittings. Injection-molded PVC fittings are covered in ANSI/AWWA C907.

Sec. 1.2 Purpose

The purpose of this standard is to provide minimum manufacturing, verification, and marking requirements for PVC pressure pipe and fabricated fittings, 4 in. (100 mm) through 60 in. (1,500 mm).