



**American Water Works
Association**

The Authoritative Resource on Safe WaterSM

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(Revision of ANSI/AWWA C903-02)

AWWA Standard

Polyethylene–Aluminum– Polyethylene & Cross-linked Polyethylene–Aluminum– Cross-linked Polyethylene Composite Pressure Pipes, ½ In. (12 mm) Through 2 In. (50 mm), for Water Service



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

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Committee Personnel

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:

Michael G. Boyle, *Chair*

General Interest Members

J.P. Castronovo, CH2M Hill, Gainesville, Fla.	(AWWA)
K.C. Choquette, Iowa Department of Public Health, Des Moines, Iowa	(AWWA)
D.E. Duvall, Engineering Systems Inc., Aurora, Ill.	(AWWA)
M.L. Magnant, Iowa Department of Public Health, Des Moines, Iowa	(AWWA)
S.A. Mruk, New Providence, N.J.	(PPI)
J.R. Paschal, Bodycote Polymer-Broutman Laboratory, Ypsilanti, Mich.	(AWWA)
J.R. Peters, M.D. Wessler & Associates Inc., Indianapolis, Ind.	(AWWA)
J.M. Stubbart,* Standards Engineer Liaison, AWWA, Denver, Colo.	(AWWA)
Stanley Ziobro, FM Approvals, West Gloucester, R.I.	(AWWA)

Producer Members

J.M. Craig, McElroy Manufacturing Inc., Tulsa, Okla.	(AWWA)
L.J. Gill, Ipex Inc., Mississauga, Ont.	(AWWA)
W.J. McGlinchy, W.J. McGlinchy & Associates, Guerneville, Calif.	(AWWA)
S.C. Rademacher, Uponor Wirsbo Company, Apple Valley, Minn.	(AWWA)
C.G. Rubeiz, Plastics Pipe Institute, Washington, D.C.	(AWWA)
Harvey Svetlik, Independent Pipe Products Inc., Grand Prairie, Texas	(AWWA)

User Members

M.G. Boyle, Pfluerville, Texas	(AWWA)
J.D. Cox, Stockton, Calif.	(AWWA)
M.R. Falarski, East Bay Municipal Utility District, Oakland, Calif.	(AWWA)
R.P. Fuerst, Bureau of Reclamation, Denver, Colo.	(AWWA)
W.F. Guillaume, Orlando, Fla.	(AWWA)

*Liaison, nonvoting

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Foreword

This Foreword is for information only and is not a part of ANSI/AWWA C903.

I. Introduction.

I.A. *Background.* This standard describes polyethylene–aluminum–polyethylene and cross-linked polyethylene–aluminum–cross-linked polyethylene composite pressure pipes for use primarily as water service lines in the construction of underground water distribution systems.

These composite pipes consist of a welded aluminum tube reinforcement between the inner and outer layers of polyethylene. The inner and outer polyethylene layers are bonded to the aluminum tube by a polymeric melt adhesive. This standard describes both linear polyethylene–aluminum–polyethylene configurations, defined as PE–AL–PE pipes, and cross-linked polyethylene–aluminum–cross-linked polyethylene configurations, defined as PEX–AL–PEX pipes. Pipes described by this standard are made from Grade PE20, PE23, PE30, or PE33, Class A, B, or C polyethylene material in combination with polymeric melt adhesive and aluminum tube, as defined further in this standard and in ASTM F1281 and ASTM F1282. This standard describes pipe conforming to outside diameter dimensions in nominal size from ½ in. (12 mm) through 2 in. (50 mm).

I.B. *History.* In the summer of 1997, the American Water Works Association (AWWA) Committee on Polyolefin Pressure Pipe and Fittings was approached to develop a standard describing polyethylene–aluminum–polyethylene and cross-linked polyethylene–aluminum–cross-linked polyethylene composite pressure pipes for water service. Formal application was made to the AWWA Standards Council for the creation of a new standard. The application was accompanied by a letter of endorsement from the Polyolefin Committee stating that it was willing to manage the creation of the standard.

In the fall of 1997, the AWWA Standards Committee authorized the project and a subcommittee was created under the Polyolefin Pressure Pipe and Fittings Committee to handle the task. The first edition of ANSI/AWWA C903 was approved by the AWWA Board of Directors on Jan. 20, 2002. This second edition of C903 was approved by the AWWA Board of Directors on June 12, 2005.

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 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.

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

*Persons outside the US 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.

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

guidelines (noncarcinogens) and risk characterization methodology (carcinogens). Use of Annex A procedures may not always be identical, depending on the certifier.

ANSI/AWWA C903 does not address additives requirements. 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. Although the topics of design and installation are being addressed in a new AWWA Manual on Design and Installation of Polyethylene Pipe currently under development, information is provided in this Foreword for the benefit of users of this standard. After publication of the new AWWA manual, it is expected that these sections will be removed from the Foreword of this standard.

II.A. Pipe selection.

II.A.1. Calculation of maximum allowable operating pressure or pressure rating. A minimum pressure rating (PR) of 160 psig (1,118 kPa) is recommended for general durability in handling and for use in typical water service installations. Lesser pressure ratings may be appropriate for specific applications, but selection should be based on a detailed evaluation of factors, such as installation configuration, fitting type, joining methods, use of coiled or straight products, working temperature, and potential for significant surge pressures.

The minimum pressure rating of the pipe selected should be equal to or greater than the maximum expected system operating pressure. The surge pressure should not exceed 50 percent of the maximum operating pressure. If the surge pressure exceeds 50 percent of the maximum operating pressure, consideration should be given to the removal of the cause of surge pressures or the incorporation of surge suppressors in the system.

II.A.2. Calculation of surge pressure. Surge pressure generated by velocity changes in PE–AL–PE or PEX–AL–PEX service lines may be estimated using the formulas provided in this section. In addition, surges occurring either upstream in mains or downstream in a user's plumbing system should be considered for their effect on the service line. Surge (water hammer) problems are complex; their solutions require specialized knowledge.

The wave velocity and surge pressure that result from abrupt changes in the velocity of a column of water moving through a restrained pipe may be calculated using the following formulas:

$$a = \sqrt{\frac{K/\rho}{1 + [(Kd)/(tE_{PE})]}}$$

$$t = t_{PEi} + (E_{AL}/E_{PE}) + t_{AL} + t_{PEo}$$

$$P_s = \rho v_o a$$

Where:

- a = wave velocity, in ft/sec (m/sec)
- K = bulk modulus of water 294,000 lb/in.² (2,100 MPa)
- ρ = density of water 1,000 lb/in.³ (kg/m³)
- d = internal diameter, in. (mm)
- t = equivalent thickness of polyethylene, in. (mm)
- t_{PEi} = inner polyethylene layer thickness, in. (mm)
- E_{AL} = elastic modulus of aluminum, 4.20×10^6 psi (30,000 MPa)
- E_{PE} = elastic modulus of polyethylene, 150,000 psi (1,047 MPa)
- E_{PEX} = elastic modulus of cross-linked polyethylene, 150,000 psi*
(1,047 MPa)
- t_{AL} = aluminum layer thickness, in. (mm)
- t_{PEo} = outer polyethylene layer thickness, in. (mm)
- P_s = surge pressure, psig (kPa)
- v_o = change in flow velocity, in ft/sec (m/sec)

Table F.1 shows surge pressures resulting from an instantaneous change in velocity of 1 ft/sec (0.3048 m/sec), as calculated from the earlier equations. The anticipated surge and the instantaneous change in velocity are directly related; therefore, the surge resulting from higher velocity changes is a multiple of the values given in this table (i.e., the surge anticipated at a velocity of 5 ft/sec [1.524 m/sec] is five times the value at 1 ft/sec [0.3048 m/sec]).

*If calculating surge pressure in PEX-AL-PEX service lines, use E_{PEX} instead of E_{PE} .