

ANSI/AWWA

C903-21

(Revision of *ANSI/AWWA C903-16*)

AWWA Standard

Polyethylene– Aluminum–Polyethylene (PE–AL–PE) Composite Pressure Pipe, 12 mm ($\frac{1}{2}$ In.) Through 51 mm (2 In.), for Water Service

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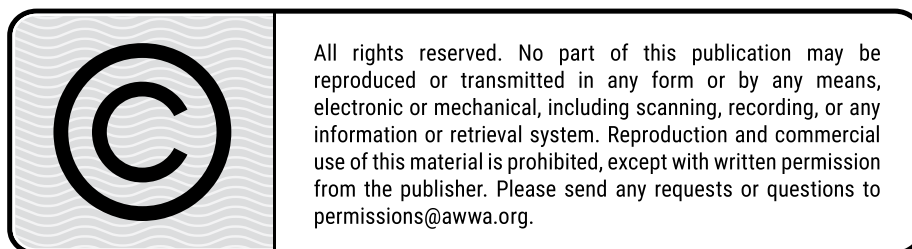
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Foreword

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

I. Introduction.

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

The pipe consists of a welded aluminum tube jacketed by protective inner and outer layers of polyethylene (PE). The inner and outer PE layers are adhesively bonded to the aluminum tube by a polymeric hot-melt adhesive. This standard describes pipe conforming to inside diameter nominal pipe size from 12 mm (½ in.) through 51 mm (2 in.).

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 PE–AL–PE and PEX–AL–PEX 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. Subsequent editions were approved on June 12, 2005 and June 19, 2016. This edition was approved on Oct. 25, 2021.

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). AWWA and the Association of State Drinking Water Administrators (ASDWA) joined later.

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

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 jurisdictions. Accreditation of certification organizations may vary from jurisdiction to jurisdiction.

Annex A to NSF/ANSI/CAN 61, “Toxicology Review and Evaluation Procedures,” 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 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. Information on product selection and installation is provided in this foreword for the benefit of the users of this standard.

[†] 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 The National Academies Press, 500 Fifth Street NW, Keck 360, Washington, DC 20001.

II.A. Pipe Selection.

II.A.1. Pressure rating. The pipe pressure rating for a specific application should be based on a detailed evaluation of the operating pressure, the installation configuration, joining methods and fitting types, use of coiled or straight products, installed bend radii, working temperature, disinfection type and concentration, and surge pressure.

NOTE: The designer should consider the frequency of surge events and the magnitude of the surge pressure.

The pressure rating of the pipe selected should be equal to or greater than the sum of the maximum expected system operating pressure and maximum surge pressure not to exceed 200 psi (1380 kPa). If the maximum expected system operating pressure and maximum surge pressure exceed 200 psi (1380 kPa), consideration should be given to the removal of the cause of surge pressures, reduction of the surge pressure to an acceptable value, or the incorporation of surge suppressors in the system.

Pressure rating (PR), operating pressure ($P_{operating}$), and surge pressure (PS), are related by the following equation:

$$PR \geq P_{operating} + PS \quad (\text{Eq F-1})$$

The pressure rating for pipe specified in ANSI/AWWA C903 is given in Table 4 for use with water at 73.4°F (23°C). Consult the manufacturer for ratings at additional temperatures.

II.A.2. Calculation of surge pressure. Surge pressure generated by velocity changes in PE–AL–PE service lines may be estimated using the equations 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 equations:

$$a = \sqrt{\frac{\left(\frac{K}{\rho}\right)}{\left(1 + \frac{Kd}{E_{PE}(t_{PEi} + t_{PEo}) + E_{AL}(t_{AL})}\right)}} \quad (\text{Eq F-2})$$

$$P_s = \rho V_O a \quad (\text{Eq F-3})$$

where:

- a = wave velocity, ft/sec (m/sec)
- K = bulk modulus of water 294,000 lb/in.² (2,100 MPa)
- ρ = density of water 0.036 lb/in.³ (1,000 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} = dynamic modulus of 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 (MPa)
- v_o = change in flow velocity, 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]).

Table F-1 Surge pressures and maximum allowable instantaneous change in velocity in PE–AL–PE (PR 200 psi) pipe

Nominal ID Size <i>mm</i>	Surge Pressure		Maximum Allowable Instantaneous Change in Velocity*	
	<i>psig</i>	<i>(kPa)</i>	<i>ft/sec</i>	<i>(m/sec)</i>
12	29.6	(205.4)	3.4	(1.0)
16	29.0	(201.7)	3.4	(1.0)
20	26.5	(184.3)	3.8	(1.2)
25	25.0	(173.8)	4.0	(1.2)
32	23.3	(161.8)	4.3	(1.3)
41	22.2	(154.2)	4.5	(1.4)
51	19.5	(135.4)	5.1	(1.6)

* Maximum allowable instantaneous change in velocity is based on a 100-psi maximum surge pressure determined at 1 ft/sec (0.3048m/sec) velocity change.

NOTE: This is a metric-sized pipe product; therefore, the nominal pipe size is metric only.