



**Summary of Substantive Changes
between the 2006 and 2016 editions of
AWWA C904, Crosslinked Polyethylene (PEX) Pressure Tubing, ½ In. (13 mm)
Through 3 In. (76 mm), for Water Service**

Presented to the IAPMO Standards Review Committee on September 9, 2019

General: The changes to this standard might have an impact on currently listed products. The significant changes are:

- Clarified the standard scope by replacing piping with tubing throughout the Standard and also stated the product application in the scope (see Section 1.1)
- Added the requirements of NSF 61 for potable water applications (see Section 4.2.3)
- Added Chlorine resistance and UV resistance requirements for PEX materials (see Sections 4.3.9, and 4.3.10)
- Added informational Annex A for Design and Installation of Crosslinked Polyethylene (PEX) Tubing (see Annex A)
- Removed 5/8" nominal tubing size from multiple tables in the Standard (see Tables 2, 3, and 4)
- Revised footnote of Table 4 to change the fiber stress used to derive the test pressures from 1,300 psi to 1,900 psi (see Table 4)

Title, Crosslinked Polyethylene (PEX) Pressure Tubing, 1/2 In. (12 mm) Through 3 In. (76 mm), for Water Service: Title was changed as follows:

Cross-linked Polyethylene (PEX) Pressure ~~Pipe Tubing~~, 1/2 In. (~~1213~~ mm) Through 3 In. (76 mm), for Water Service

Section 1, General: Clarified the standard scope by replacing piping with tubing throughout the Standard and also specified the product application in the scope as follows:

Sec. 1.1 Scope

This standard describes crosslinked polyethylene (PEX) pressure ~~pipe tubing~~ made from material having a standard PEX material designation code of PEX ~~1006~~ 1306, or higher, according to ASTM F876 and intended for use as underground potable water, reclaimed water, and waste water service lines in sizes 1/2 in. (~~1213~~ mm) through 3 in. (76 mm) that conform to a standard dimension ratio of SDR9. Tubing may incorporate an optional polymeric outer layer.*

Included in this standard are criteria for classifying PEX plastic ~~pipe tubing~~ materials, and a system of nomenclature, requirements, and test methods for materials and ~~pipe tubing~~. Methods of marking are given. Design, installation, and application considerations are discussed in the foreword of this standard.

Sec. 1.3 Application

This standard can be referenced for purchasing and receiving PEX pressure ~~pipe tubing~~ for use as service lines in the construction of underground water distribution systems. This standard can be used as a guide for manufacturing PEX ~~pipe tubing~~. The stipulations of this standard apply when this document has been referenced and only to PEX ~~pipe tubing~~.



Section 2, References: The following references were added, revised or deleted as follows:

[ASTM D2122—Standard Test Method for Determining Dimensions of Thermoplastic Pipe and Fittings.](#)

~~[ASTM D3350—Standard Specification for Polyethylene Plastics Pipe and Fitting Materials.](#)~~

~~[ASTM F412—Standard Terminology Relating to Plastic Piping Systems.](#)~~

[ASTM F2023-13—Standard Test Method for Evaluating the Oxidative Resistance of Crosslinked Polyethylene \(PEX\) Tubing and Systems to Hot Chlorinated Water.](#)

[ASTM F2657-07—Standard Test Method for Outdoor Weathering Exposure of Crosslinked Polyethylene \(PEX\) Tubing.](#)

~~[CSA B137.5—Crosslinked Polyethylene \(PEX\) Tubing Systems for Pressure Applications.](#)~~

~~[ISO R161—Pipe of Plastic Materials for the transport of Fluids, Part 1 Metric Series.](#)~~

NSF*/ANSI ~~No.~~ 14—Plastics Piping System Components and Related Materials.

[NSF/ANSI 61—Drinking Water System Components—Health Effects.](#)

Section 3, Definitions: Definitions have been added, deleted or revised as follows:

[1. Crosslinked polyethylene: A polyethylene material that has undergone a change in molecular structure using a chemical or a physical process where most of the polymer chains are chemically linked.](#)

~~42.~~ Hydrostatic design basis (HDB): The categorized long-term hydrostatic stress in the circumferential or hoop direction established ~~from long-term pressure tests performed~~ in accordance with ASTM D2837.

~~53.~~ Hydrostatic design stress (HDS): The maximum allowable hoop stress in the ~~pipe tubing~~ wall ~~when for pipe tubing that~~ is subjected to sustained long-term hydrostatic pressure. For use in this standard, the hydrostatic design stress is determined by multiplying the hydrostatic design basis by a design factor ~~for water service~~.

~~37.~~ Standard dimension ratio (SDR): [A specific ratio of the average specified outside diameter to the minimum wall thickness. For PEX tubing, the SDR is calculated by dividing the average outside diameter of the pipe tubing by the minimum wall thickness \(OD/t\). If the wall thickness calculated by this formula is less than 0.070 in. \(1.78 mm\), it shall be increased to 0.070 in. The SDR values shall be rounded to the nearest 0.5.](#)

[9. Surge pressure: Surge pressure is the maximum positive transient increase \(commonly called water hammer\) that is anticipated in the system as the result of a change in velocity of the water column.](#)

[10. Working pressure: Working pressure \(WP\) is the maximum anticipated sustained operating pressure applied to the tubing exclusive of transient pressures.](#)

Section 4, Requirements: Added the requirements of NSF 61 for potable water applications as follows:

Sec. 4.1 Permeation

The selection of materials is critical for water service and distribution ~~pipe tubing~~ in locations where ~~there is likelihood~~ the ~~pipe tubing~~ will be exposed to significant concentrations of pollutants comprised of low-molecular-weight petroleum products ~~or~~ organic solvents or their vapors. Research has documented that ~~pipe tubing~~ materials, such as polyethylene, polybutylene, polyvinyl chloride, PEX, ~~and~~ asbestos cement, and elastomers used in joining gaskets and packing glands are subject to permeation by ~~lower low-~~ low-molecular weight organic solvents or petroleum products. If ~~potable~~ water ~~pipe tubing~~ must pass through such a contaminated area or an area subject to contamination, consult with the manufacturer regarding permeation of ~~pipe tubing~~ walls, jointing materials, and so forth before selecting materials for use in that area.



[Additional resources about permeation of elastomeric joint gaskets and plastic tubing are provided in appendix B.](#)

Sec. 4.2 Materials

4.2.1 General. Materials shall comply with the requirements of the Safe Drinking Water Act and other federal ~~requirements~~ [regulations for potable water, wastewater, and reclaimed water systems as applicable.](#)

4.2.1.1 [Pipe Tubing](#) covered by this standard shall conform, as a minimum, with the requirements of PEX ~~1006~~ [1306](#) as classified in ASTM F876. PEX classified with a material designation code of PEX ~~1008~~ [3306](#) and PEX 5306 also meets this requirement.

4.2.1.2 The material shall be crosslinked by peroxides, ~~azo compounds,~~ or silane compounds [in extrusion](#) or by electron beam [after extrusion](#) so the ~~pipe tubing~~ meets [or exceeds](#) the performance requirements in ~~ASTM F876~~ [this standard](#). The minimum percent of crosslinking shall be 70 percent for peroxides, ~~65 percent for azo compounds,~~ 65 percent for silane compounds, and 65 percent for electron beam [when tested in accordance with ASTM D2765, Method B, as defined in ASTM F876. Tubing may incorporate an optional polymeric outer layer. Tubing with outer layers must meet technical requirements as per established policies defined within ASTM F876 and PPI TR-3.](#)

4.2.1.3 PEX ~~pipe tubing~~ shall have a long-term HDS ([hydrostatic design stress](#)) equal to or better than given in Table 1, when the HDB ([hydrostatic design basis](#)) is determined in accordance with [ASTM D2837. HDS and HDB ratings shall be listed in accordance](#) with procedures no less restrictive than those of PPI TR-3.

4.2.2 Reworked material. The use of reclaimed, recycled, or reworked materials is not permitted.

4.2.3 Certification. PEX ~~pipe tubing~~ covered by [ANSI/AWWA C904](#) shall be tested and certified for use with potable water by an accredited testing agency. ~~The p~~Product testing shall be no less stringent than required by [NSF/ANSI 61](#) or the health effects portion of NSF/ANSI 14. [This applies to applications for potable water, wastewater, and reclaimed water systems as described in Sec. 4.2.1.](#)

Section 4.3, Tubing: Added Chlorine resistance and UV resistance requirements for PEX materials as follows:

Sec. 4.3 [Pipe Tubing](#)

4.3.1 Workmanship. [Pipe Tubing](#) shall be homogeneous throughout; free from voids, cracks, inclusions, and other defects; and uniform in color, opacity, density, and other physical properties. Surfaces of the products shall be free from scratches, gouges, bloom, and other imperfections.

4.3.2 Dimensions and tolerances. [Pipe Tubing](#) shall conform to the dimensions specified in Table 2 when measured in accordance with ASTM ~~F876~~ [D2122](#).

4.3.3 Density. PEX ~~pipe tubing~~ material shall have a minimum density as determined in accordance with ASTM F876.

4.3.4 Sustained-pressure test. PEX ~~pipe tubing~~ shall not fail, balloon, burst, or weep in accordance with ASTM D1598 at the test pressures given in Table 3 when tested in accordance with ASTM F876.

4.3.5 Burst pressure. The minimum burst pressure for PEX ~~pipe tubing~~ shall be as given in Table 4 when determined in accordance with ASTM F876.

4.3.6 Environmental stress cracking. There shall be no loss of pressure in the tubing, when tested in accordance with [the environmental stress cracking test of](#) ASTM F876.

4.3.7 Degree of crosslinking. When tested in accordance with ASTM F876, the degree of crosslinking for PEX ~~pipe tubing~~ material shall be from 65 percent to 89 percent inclusive.

~~4.3.7.1~~ [4.3.8](#) Stabilizer functionality. Stabilizer functionality shall be tested in accordance with ASTM F876.



[4.3.9 Chlorine resistance. PEX materials covered by this standard shall have a minimum extrapolated time-to-failure of 50 years when tested in accordance with ASTM F2023 and evaluated in accordance with ASTM F876.](#)

[4.3.10 UV resistance. The minimum UV resistance for PEX materials covered by this standard is 6 months. PEX tubing shall be tested for UV resistance in accordance with ASTM F2657 with results analyzed in accordance with ASTM F876.](#)

[4.3.7.2 4.3.11 Pipe Tubing ends and lengths. ~~Pipe shall~~ Tubing may be furnished with ~~plain~~ uncapped or capped ends, and in straight lengths or ~~coiled~~ coils unless otherwise specified by purchaser.](#)

Section 5, Verification:

Sec. 5.1 General

The manufacturer shall take adequate measures to check incoming material and the ~~pipe tubing~~ produced to ensure product compliance with the requirements of this standard. The following tests for qualification of compounds, manufacturing processes, and quality assurance shall be conducted no less frequently than indicated unless otherwise specified by the purchaser. The manufacturer is solely responsible for designing a quality control program with a testing frequency that ensures product conformance with this standard.

Sec. 5.2 Tests for Qualification of Materials and Processes

5.2.1 Sustained-pressure test. Test [per Sec. 4.3.4](#) at the beginning of the first production run of a ~~pipe~~ tubing diameter and [at least](#) annually thereafter. Sustained pressure tests shall be completed in accordance with ASTM D1598 on one size of ~~pipe tubing~~ in the range of 1/2 in. (~~12~~ 13 mm) through 1-1/2 in. (38 mm) and on one size of tubing larger than 1-1/2 in. (38 mm).

Sec. 5.3 Tests for Product Quality Control

5.3.1 Dimensions. Dimensions [in accordance with Sec. 4.3.2 of pipe tubing](#) produced from each extrusion outlet shall be measured at the beginning of production of a particular material or size and thereafter once every hour or once every coil, ~~or once per lot~~ whichever constitutes the less frequent testing.

5.3.2 Burst-pressure tests. Tests [in accordance with Sec. 4.3.5](#) shall be performed in accordance with ASTM D1599 on ~~pipe tubing~~ produced from each extrusion outlet at beginning of production. At least five specimens from each extrusion outlet shall be tested.

Sec. 5.4 Nonconformance

When a product fails to meet a requirement of this standard or a referenced standard, tests on previously manufactured products shall be initiated and continued until failing products from the particular extruder have been identified. [Products that fail to meet any specified requirement shall be rejected. Any purchaser of rejected products shall be notified.](#)

Sec. 5.5 Quality Control Records

The manufacturer shall maintain a record of quality control tests for a period of not less than 2 years and, if requested, shall submit pertinent records to the purchaser ~~if requested~~.

Sec. 5.6 Plant Inspection by the Purchaser

5.6.1 Production notice. When the purchaser specifies a plant inspection, the manufacturer shall provide the purchaser with a 2-week advance notice of when and where production of ordered materials would begin.

5.6.2 Manufacturer's responsibility. Plant inspection by the purchaser or the omission of these inspections shall not relieve the manufacturer of the responsibility for providing materials that comply with the applicable requirements of this standard.



5.6.3 Plant access. Excluding inspection of proprietary manufacturing processes, the purchaser shall have free access to locations within a manufacturer's plant that are necessary to ensure that manufacturing processes and procedures comply with this standard.

Sec. 6.1 Marking

6.1.1 General. Pipe Tubing shall bear permanent identification markings that will remain legible during normal handling, storage, installation, and service life and that have been applied in a manner that will not reduce the strength of or otherwise damage the products.

6.1.2 Marking. Marking on the pipe tubing shall include the following and shall be applied at intervals of not more than 5 ft (1.5 m):

1. Nominal pipe tubing size.
2. Material designation (e.g., PEX ~~1006~~ 1306).
3. Water pressure rating class and rated temperature ~~for which the pressure rating is valid~~ in accordance with Table 1.



4. AWWA designation number for this standard: ANSI/AWWA C904.

Marking the product with this designation affirms that the product was manufactured, inspected, sampled, and tested in accordance with this standard and has been found to meet its requirements.

5. Manufacturer's name or trademark and production code [indicating date of production](#).

6. Seal or mark of the testing agency that certified the tubing, per Sec. 4.2.3.

Sec. 6.2 Shipping and Delivery

6.2.1 Shipping. [Pipe Tubing](#) shall be prepared for standard commercial shipment.

6.2.2 Delivery. [Pipe Tubing](#) that does not comply with the applicable requirements of this standard or that is damaged when received shall be replaced at the agreed-on point of delivery.

Sec. 6.3 Affidavit of Compliance

The purchaser may require an affidavit from the manufacturer [or supplier](#) that the material provided complies with applicable requirements of this standard.

Table 2, Outside diameters and tolerances for SDR9 PEX tubing: Removed 5/8" nominal tubing size from table.

Table 3, Sustained water pressure test condition for SDR9 PEX plastic tubing: Removed 5/8" nominal tubing size from table.

Table 4 Burst-pressure requirements for water at 73°F (23°C) for SDR9 PEX plastic tubing: Removed 5/8" nominal tubing size from table and revised footnote as follows:

*The fiber stress used to derive these test pressures at 73.4°F (23.0°C) is ~~1,300~~ [1,900](#) psi (~~8.96~~ [13.10](#) MPa).