



Standard Specification for Perfluoroalkoxy (PFA)-Fluoropolymer Tubing¹

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1. Scope

1.1 This specification covers tubing produced from PFA Fluoropolymer resins which are cited in Specification D 3307. This document specifies tubing dimensional tolerances, tensile properties and related electrical properties as noted in the appropriate tables when tested in accordance with the methods cited in this specification. This specification is for virgin material only and does not address recycled material, as it is not appropriate for PFA tubing.

NOTE 1—Abbreviations are in accordance with Terminology D 1600.

NOTE 2—There is no similar ISO standard.

1.2 The values stated in SI units are to be regarded as the standard. The values given in brackets are for information only.

1.3 The following safety hazards caveat pertains only to the test methods portion, Section 7, of this specification. *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory requirements prior to use.*

2. Referenced Documents

2.1 ASTM Standards:

D 618 Practice for Conditioning Plastics for Testing²

D 792 Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement²

D 883 Terminology Relating to Plastics²

D 1600 Terminology for Abbreviated Terms Relating to Plastics²

D 1675 Test Method for Polytetrafluoroethylene Tubing³

D 3307 Specification for Perfluoroalkoxy (PFA)-Fluorocarbon Molding and Extrusion Materials⁴

D 4894 Specification for Polytetrafluoroethylene (PTFE) Granular Molding and Ram Extrusion Materials⁵

IEEE/ASTM SI 10 Standard for Use of the International

System of Units (SI): The Modern Metric System⁶

3. Terminology

3.1 *Definitions*—Definitions are in accordance with Terminology D 883 unless otherwise specified.

3.1.1 *lot, n*—one continuous production run or a uniform blend of two or more production runs of one size sheet or molded basic shape.

4. Physical Requirements

4.1 The tubing shall be made of PFA-fluoropolymer resin meeting the requirements of Specification D 3307.

4.2 The inside diameter and wall thickness and tolerances of the tubing shall be as shown in Table 1, when determined in accordance with 7.1.3.1 and 7.1.3.2.

4.3 The specific gravity of the tubing shall be between 2.12 and 2.17 inclusive when determined in accordance with 7.1.4.

4.4 The tubing shall have a minimum tensile strength of 10.0 MPa [1500 psi] and a minimum elongation of 200 % when determined in accordance with 7.1.5.

4.5 The tubing shall remain free from cracks and exhibit no splitting when tested for dimensional stability in accordance with 7.1.6.

5. Sampling

5.1 Sampling shall be statistically adequate to satisfy the requirements of 8.2.

6. Number of Tests and Retests

6.1 One set of five test specimens shall be considered sufficient for testing each batch. The average result of the specimens tested shall conform to the requirements of this specification.

7. Test Methods

7.1 The properties enumerated in this specification shall be determined in accordance with the following methods.

7.1.1 *Conditioning*—Condition the test specimens at $23 \pm 2^\circ\text{C}$ [$73.4 \pm 3.6^\circ\text{F}$] for a period of at least 4 h prior to test. If the test material has been exposed to temperatures below 20°C within 24 h prior to test, the conditioning shall be for at least 24 h and as outlined in Practice D 618.

⁶ Available from ASTM International Headquarters, 100 Barr Harbor Drive, PO Box C700, West Conshohocken, PA 19428-2959.

¹ This specification is under the jurisdiction of ASTM Committee D20 on Plastics and is the direct responsibility of Subcommittee D20.15 on Thermoplastic Materials.

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² *Annual Book of ASTM Standards*, Vol 08.01.

³ *Annual Book of ASTM Standards*, Vol 10.01.

⁴ *Annual Book of ASTM Standards*, Vol 08.02.

⁵ *Annual Book of ASTM Standards*, Vol 08.03.

TABLE 1 Dimensions and Tolerances for PFA-Fluorocarbon Tubing-Dimensions, mm [in.]

Inside Diameter		Wall Thickness	
Nominal Inside Diameter, mm [in.]	Inside Diameter Tolerance, mm [in.]	Nominal Thickness, mm [in.]	Thickness Tolerance, mm [in.]
0 to 0.25 [0.000 to 0.010]	±0.03 [0.001]	0 to 0.13 [0.000 to 0.005]	±0.030 [0.001]
0.26 to 0.50 [0.011 to 0.020]	±0.05 [0.002]	0.14 to 0.30 [0.006 to 0.012]	±0.050 [0.002]
0.51 to 0.75 [0.021 to 0.030]	±0.08 [0.003]	0.31 to 0.48 [0.013 to 0.019]	±0.080 [0.003]
0.76 to 2.54 [0.031 to 0.100]	±0.10 [0.004]	0.49 to 0.74 [0.020 to 0.029]	±0.100 [0.004]
2.55 to 4.32 [0.101 to 0.170]	±0.13 [0.005]	0.75 and >[0.030 and >]	±0.130 [0.005]
4.33 to 6.35 [0.171 to 0.250]	±0.15 [0.006]		
6.36 to 19.05 [0.251 to 0.750]	±0.18 [0.007]		
19.06 to 25.39 [0.751 to 0.999]	±0.25 [0.010]		
25.4 and [1.000 and >]	±0.38 [0.015]		

7.1.2 *Test Conditions*—Conduct tests at the standard laboratory temperature of $23 \pm 2^\circ\text{C}$ [$73.4 \pm 3.6^\circ\text{F}$], in referee cases the standard laboratory atmosphere including $50 \pm 5\%$ RH shall apply.

7.1.3 *Dimensions and Tolerances:*

7.1.3.1 *Inside Diameter*—Determine the inside diameter in accordance with Test Method D 1675, except that no individual measurements shall be allowed to exceed the tolerances specified in Table 1.

7.1.3.2 *Wall Thickness*—Determine the wall thickness in accordance with the procedures described in Test Method D 1675, except that no individual measurements shall be allowed to exceed the tolerances specified in Table 1.

7.1.4 *Specific Gravity*—Determine the specific gravity in accordance with Method A of Test Methods D 792. Add 2 drops of wetting agent (liquid detergent) to the water in order to reduce the surface tension and ensure complete wetting of the specimen.

7.1.5 *Tensile Strength and Elongation*—Determine the tensile strength and elongation as specified in 7.1.5.1-7.1.5.3 on five transverse specimens, using a testing speed of 50.8 mm [2 in.]/min. Average the test results for the longitudinal and the transverse specimens separately. Discard specimens that break in the jaws of the tension tester, and make new tests.

7.1.5.1 *Tubing Having an Inside Diameter of 15.9 mm [0.625 in.] and Over*—Determine the tensile strength and elongation in both the longitudinal and transverse directions in accordance with Specification D 4894.

7.1.5.2 *Tubing Having an Inside Diameter less than 15.9 mm [0.625 in.] to 2.3 mm [0.090 in.] Inclusive*—Determine the tensile strength and elongation in the longitudinal direction in accordance with Specification D 4894. For longitudinal speci-

mens, slit the tubing parallel to the axis and flatten out, prior to punching out specimens.

7.1.5.3 *Tubing Having an Inside Diameter less than 2.3 mm [0.090 in.]*—Test specimens as filaments. Make nonsliptype loop knots in each end of the specimen so that there are 34.9 mm [$1\frac{3}{8}$ in.] between the knots of the loops (see Fig. 1). Place loops over the drum of a standard wire specimen holder in the tension-testing machine and pull in this position.

7.1.6 *Dimensional Stability*—Cut three specimens each 305 mm [12 in.] long, measured to the nearest 1.6 mm [$\frac{1}{16}$ in.]. Place the specimens in a circulating-air oven at $200 \pm 2^\circ\text{C}$ for 3 h. Then remove the specimens from the oven and allow to cool to $23 \pm 2^\circ\text{C}$ [$73.4 \pm 3.6^\circ\text{F}$]. Again measure the length to the nearest 1.6 mm [$\frac{1}{16}$ in.]. Calculate the change in length as a percentage of the original length.

8. Inspection and Certification

8.1 The tubing shall be visually and dimensionally inspected to verify compliance with the requirements of this specification.

8.2 For all products, the purchaser shall be furnished a certification that this lot is made from only virgin PFA and that the sample representing each lot has been either tested or inspected as directed in this specification and the requirements have been met. When specified in the purchase order or contract, a report of the test results shall be furnished.

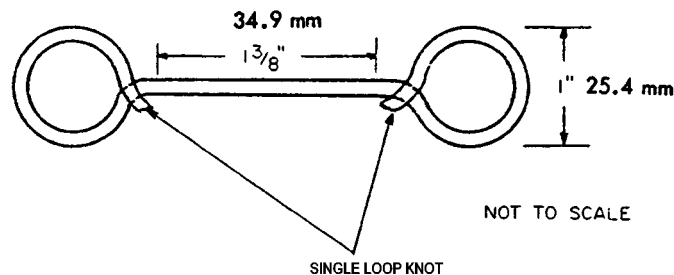


FIG. 1 Tension Specimen for Tubing Less Than 2.29 mm [0.090 in.]

9. Packaging and Package Marking

9.1 *Packaging*—The material shall be packaged in standard commercial containers so constructed as to ensure acceptance by common or other carrier for safe transportation at the lowest rate to the point of delivery, unless otherwise specified in the contract or order.

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10. Keywords

10.1 extruded material; fluoropolymers; fluoropolymer tubing; melt-processible fluorocarbon polymer; PFA extruded tubing; polytetrafluoroethylene (TFE) copolymers