Designation: D6867 – 03 (Reapproved 2014)

Standard Specification for Perfluoroalkoxy (PFA)-Fluoropolymer Tubing[1]

This standard is issued under the fixed designation D6867; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This specification covers tubing produced from PFA Fluoropolymer resins which are cited in Specification D3307. 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 D1600.

NOTE 2—There is no known ISO equivalent to this standard.

1.2 The values stated in SI units are to be regarded as standard. The values given in parentheses 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:*[2]

D618 Practice for Conditioning Plastics for Testing

D792 Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement

D883 Terminology Relating to Plastics

D1600 Terminology for Abbreviated Terms Relating to Plastics

D1675 Test Methods for Polytetrafluoroethylene Tubing

D3307 Specification for Perfluoroalkoxy (PFA)-Fluorocarbon Resin Molding and Extrusion Materials

D4894 Specification for Polytetrafluoroethylene (PTFE) Granular Molding and Ram Extrusion Materials

IEEE/ASTM SI 10 Standard for Use of the International System of Units (SI): The Modern Metric System[3]

3. Terminology

3.1 *Definitions:*

3.1.1 Definitions are in accordance with Terminology D883 unless otherwise specified.

3.1.2 *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 D3307.

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.

[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.

Current edition approved Oct. 1, 2014. Published October 2014. Originally approved in 2003. Last previous edition approved in 2009 as D6867 - 03(2014). DOI: 10.1520/D6867-03R14.

[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

[3] Available from ASTM International Headquarters, 100 Barr Harbor Drive, PO Box C700, West Conshohocken, PA 19428–2959.

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. 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 ± 2°C (73.4 ± 3.6°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 D618.

7.1.2 *Test Conditions*—Conduct tests at the standard laboratory temperature of 23 ± 2°C (73.4 ± 3.6°F), in referee cases the standard laboratory atmosphere including 50 ± 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 D1675, 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 D1675, 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 D792. 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 D4894.

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 D4894. For longitudinal specimens, 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 (1⅜ 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 (1⁄16 in.). Place the specimens in a circulating-air oven at 200 ± 2°C for 3 h. Then remove the specimens from the oven and allow to cool to 23 ± 2°C (73.4 ± 3.6°F). Again measure the length to the nearest 1.6 mm (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

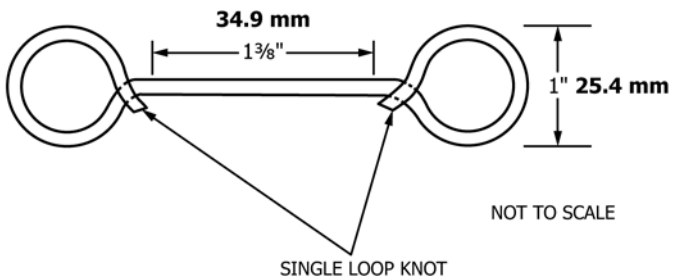

FIG. 1 Tension Specimen for Tubing Less Than 2.29 mm (0.090 in.)

have been met. When specified in the purchase order or contract, a report of the test results shall be furnished.

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.

10. Keywords

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