



Designation: D 3296–98

Standard Specification for Designation: D 3296 – 03 (Reapproved 2008)

Standard Specification for FEP-Fluorocarbon Tube¹

This standard is issued under the fixed designation D 3296; 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 The tubing is intended for electrical, mechanical, chemical, and medical applications manufactured from extrusion resins made from the copolymer of tetrafluoroethylene and hexafluoropropylene (FEP-fluorocarbon). This specification is for virgin material only and does not address recycled material as it is not appropriate for FEP 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 parentheses are for information only.

1.3 The following safety hazards caveat pertains only to the test methods portion, Section 7–8 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 limitations prior to use.*

2. Referenced Documents

2.1 ASTM Standards:²

D 149 Test Method for Dielectric Breakdown Voltage and Dielectric Strength of Solid Electrical Insulating Materials at Commercial Power Frequencies

D 618 Practice for Conditioning Plastics and Electrical Insulating Materials for Testing—Practice for Conditioning Plastics for Testing

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

D 1457 Specification for PTFE Molding and Extrusion Materials—883 Terminology Relating to Plastics

D 1600 Terminology for Abbreviated Terms Relating to Plastics

D 1675 Test Method for Polytetrafluoroethylene Tubing³

D 1898 Practice for Sampling of Plastics³—Test Methods for Polytetrafluoroethylene Tubing

D 2116 Specification for FEP-Fluorocarbon Molding and Extrusion Materials³

E 691 Practice for Conducting an Interlaboratory Test Program to Determine the Precision of a Test Method—Specification for FEP-Fluorocarbon Molding and Extrusion Materials

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

IEEE/ASTM SI 10 American National Standard for Use of the International System of Units (SI): The Modern Metric System

3. Classification

3.1 This specification provides for three types of FEP-fluorocarbon tubing differentiated by size schedules as follows:

3.1.1 Type I Terminology

3.1.1 Definitions—Definitions of terms used in this specification shall be in accordance with Terminology D 883.

¹ This specification is under the jurisdiction of ASTM Committee D 20 on Plastics and is the direct responsibility of Subcommittee D 20.15 on Thermoplastic Materials (Section 20.15.12).

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² Annual Book of ASTM Standards, Vol 10.01.

³ 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.

*A Summary of Changes section appears at the end of this standard.

3.2 Definitions of Terms Specific to This Standard:

3.2.1 *lot, n*—one production run or uniform blend of two or more production runs.

4. Classification

4.1 This specification provides for three types of FEP-fluorocarbon tubing differentiated by size schedules as follows:

4.1.1 *Type I*—Tubing based upon the American Wire Gage (AWG) sizes.

3.1.2 *Type H*

4.1.2 *Type II*—Tubing based upon fractional inch sizes (see Note 2).

3.1.3 *Type III*

4.1.3 *Type III*—Tubing of all other sizes, as agreed by buyer and seller. This type shall conform to the Dimensional Tolerances for FEP Tubing, as listed in Table 3.

3.2The4.2 The types are further differentiated in accordance with increasing wall thicknesses as follows:

3.2.14.2.1 *Class A*—Tubing having walls tabulated in Table 1 listed as light-weight wall.

3.2.2Class C

4.2.2 *Class C*—Tubing having walls tabulated in Table 1 listed as standard wall (see Note 3).

3.2.3Class D

4.2.3 *Class D*—Tubing having walls tabulated in Table 2 listed as chemical tubing.

3.2.4Class E

4.2.4 *Class E*—Tubing having walls listed as heavy or conforming to the Dimensional Tolerances for FEP Tubing as listed in Table 3.

NOTE 3—Tubing having electrical internal diameters and wall thickness dimensions were deleted because of lack of demand.

NOTE 4—Class B has been deleted because of lack of demand.

3.3A4.3 A one-line system may be is used to specify materials covered by in this specification. The system uses predefined cells to refer to specific aspects of this specification, as illustrated as follows:

Standard Number Block	Specification Type	Class	Special Notes
Example: Specification D 3296 – 98,	I	A	

For this example, the line callout would be Specification D 3296 – 98, 3296 – 03, IA, and would specify form of FEP-Fluoro ethylenepropylene that has all of the properties listed for that type, grade, and class in the appropriate specified properties or tables,

<https://standards.iteh.ai/catalog/standards/sist/ab320119-1ea7-4c9d-a24f-f6e7537dc1d0/astm-d3296-032008>

TABLE 1 Dimensions and Tolerances for Type I FEP-Fluorocarbon Tubing—Dimensions, mm (in.)

AWG Size	Inside Diameter		Wall Thickness					
			Class A			Class C		
			Lightweight Wall			Standard Wall		
min	max	nom	min	max	nom	min	max	
24	0.51 (0.020)	0.69 (0.027)	0.152 (0.006)	0.102 (0.004)	0.203 (0.008)	0.305 (0.012)	0.254 (0.010)	0.356 (0.014)
22	0.64 (0.025)	0.81 (0.032)	0.152 (0.006)	0.102 (0.004)	0.203 (0.008)	0.305 (0.012)	0.254 (0.010)	0.356 (0.014)
20	0.81 (0.032)	1.02 (0.040)	0.152 (0.006)	0.102 (0.004)	0.203 (0.008)	0.406 (0.016)	0.330 (0.013)	0.483 (0.019)
19	0.91 (0.036)	1.12 (0.044)	0.152 (0.006)	0.102 (0.004)	0.203 (0.008)	0.406 (0.016)	0.330 (0.013)	0.483 (0.019)
18	1.01 (0.040)	1.25 (0.049)	0.152 (0.006)	0.102 (0.004)	0.203 (0.008)	0.406 (0.016)	0.330 (0.013)	0.483 (0.019)
17	1.14 (0.045)	1.37 (0.054)	0.152 (0.006)	0.102 (0.004)	0.203 (0.008)	0.406 (0.016)	0.330 (0.013)	0.483 (0.019)
16	1.30 (0.051)	1.55 (0.061)	0.152 (0.006)	0.102 (0.004)	0.203 (0.008)	0.406 (0.016)	0.330 (0.013)	0.483 (0.019)
15	1.45 (0.057)	1.70 (0.067)	0.152 (0.006)	0.102 (0.004)	0.203 (0.008)	0.406 (0.016)	0.330 (0.013)	0.483 (0.019)
14	1.63 (0.064)	1.88 (0.074)	0.203 (0.008)	0.152 (0.006)	0.254 (0.010)	0.406 (0.016)	0.330 (0.013)	0.483 (0.019)
13	1.83 (0.072)	2.08 (0.082)	0.203 (0.008)	0.152 (0.006)	0.254 (0.010)	0.406 (0.016)	0.330 (0.013)	0.483 (0.019)
12	2.06 (0.081)	2.31 (0.091)	0.203 (0.008)	0.152 (0.006)	0.254 (0.010)	0.406 (0.016)	0.330 (0.013)	0.483 (0.019)
11	2.31 (0.091)	2.57 (0.101)	0.203 (0.008)	0.152 (0.006)	0.254 (0.010)	0.406 (0.016)	0.330 (0.013)	0.483 (0.019)
10	2.59 (0.102)	2.85 (0.112)	0.203 (0.008)	0.152 (0.006)	0.254 (0.010)	0.406 (0.016)	0.330 (0.013)	0.483 (0.019)
9	2.90 (0.114)	3.15 (0.124)	0.203 (0.008)	0.152 (0.006)	0.254 (0.010)	0.508 (0.020)	0.406 (0.016)	0.610 (0.024)
8	3.28 (0.129)	3.58 (0.141)	0.203 (0.008)	0.152 (0.006)	0.254 (0.010)	0.508 (0.020)	0.406 (0.016)	0.610 (0.024)
7	3.66 (0.144)	4.01 (0.158)	0.203 (0.008)	0.152 (0.006)	0.254 (0.010)	0.508 (0.020)	0.406 (0.016)	0.610 (0.024)
6	4.12 (0.162)	4.52 (0.178)	0.254 (0.010)	0.178 (0.007)	0.330 (0.013)	0.508 (0.020)	0.406 (0.016)	0.610 (0.024)
5	4.62 (0.182)	5.03 (0.192)	0.254 (0.010)	0.178 (0.007)	0.330 (0.013)	0.508 (0.020)	0.406 (0.016)	0.610 (0.024)
4	5.18 (0.204)	5.69 (0.224)	0.254 (0.010)	0.178 (0.007)	0.330 (0.013)	0.508 (0.020)	0.406 (0.016)	0.610 (0.024)
3	5.82 (0.229)	6.33 (0.249)	0.254 (0.010)	0.178 (0.007)	0.330 (0.013)	0.508 (0.020)	0.406 (0.016)	0.610 (0.024)
2	6.55 (0.258)	7.06 (0.278)	0.254 (0.010)	0.178 (0.007)	0.330 (0.013)	0.508 (0.020)	0.406 (0.016)	0.610 (0.024)
1	7.34 (0.289)	7.90 (0.311)	0.254 (0.010)	0.178 (0.007)	0.330 (0.013)	0.508 (0.020)	0.406 (0.016)	0.610 (0.024)
0	8.26 (0.325)	8.81 (0.347)	0.254 (0.012)	0.229 (0.007)	0.330 (0.013)	0.508 (0.020)	0.406 (0.016)	0.610 (0.024)

TABLE 2 Dimensions and Tolerances for Type II FEP-Fluorocarbon Tubing—Dimensions, mm (in.)

ID Size Fractions	Class D			Class D	
	Inside Diameter			Wall Dimensions	
	nom	max	min	Thickness	Tolerances
0.79 (1/32)		0.89 (0.035)	0.69 (0.027)	0.41 (0.016)	±0.076 (±0.003)
0.79 (1/32)	0.79 (0.031)	0.89 (0.035)	0.69 (0.027)	0.41 (0.016)	±0.076 (±0.003)
1.59 (1/16)		1.70 (0.067)	1.45 (0.057)	0.76 (0.030)	±0.127 (±0.005)
1.59 (1/16)	1.59 (0.062)	1.70 (0.067)	1.45 (0.057)	0.76 (0.030)	±0.127 (±0.005)
2.38 (3/32)		2.49 (0.098)	2.24 (0.088)	0.76 (0.030)	±0.127 (±0.005)
2.38 (3/32)	2.38 (0.094)	2.49 (0.098)	2.24 (0.088)	0.76 (0.030)	±0.127 (±0.005)
3.18 (1/8)		3.30 (0.130)	3.05 (0.120)	0.76 (0.030)	±0.127 (±0.005)
3.18 (1/8)	3.18 (0.125)	3.30 (0.130)	3.05 (0.120)	0.76 (0.030)	±0.127 (±0.005)
4.76 (3/16)		4.90 (0.193)	4.65 (0.183)	0.76 (0.030)	±0.127 (±0.005)
4.76 (3/16)	4.76 (0.188)	4.90 (0.193)	4.65 (0.183)	0.76 (0.030)	±0.127 (±0.005)
6.35 (1/4)		6.53 (0.257)	6.17 (0.243)	0.76 (0.030)	±0.127 (±0.005)
6.35 (1/4)	6.35 (0.250)	6.53 (0.257)	6.17 (0.243)	0.76 (0.030)	±0.127 (±0.005)
7.94 (5/16)		8.13 (0.320)	7.72 (0.304)	0.76 (0.030)	±0.127 (±0.005)
7.94 (5/16)	7.94 (0.312)	8.13 (0.320)	7.72 (0.304)	0.76 (0.030)	±0.127 (±0.005)
9.52 (3/8)		9.73 (0.383)	9.32 (0.367)	0.76 (0.030)	±0.127 (±0.005)
9.52 (3/8)	9.52 (0.375)	9.73 (0.383)	9.32 (0.367)	0.76 (0.030)	±0.127 (±0.005)
11.11 (7/16)		11.38 (0.448)	10.87 (0.428)	0.76 (0.030)	±0.152 (±0.006)
11.11 (7/16)	11.11 (0.438)	11.38 (0.448)	10.87 (0.428)	0.76 (0.030)	±0.152 (±0.006)
12.70 (1/2)		12.95 (0.510)	12.45 (0.490)	0.76 (0.030)	±0.152 (±0.006)
12.70 (1/2)	12.70 (0.500)	12.95 (0.510)	12.45 (0.490)	0.76 (0.030)	±0.152 (±0.006)
14.29 (9/16)		14.53 (0.572)	14.02 (0.552)	0.76 (0.030)	±0.152 (±0.006)
14.29 (9/16)	14.29 (0.563)	14.53 (0.572)	14.02 (0.552)	0.76 (0.030)	±0.152 (±0.006)
15.88 (5/8)		16.18 (0.637)	15.57 (0.613)	0.76 (0.030)	±0.152 (±0.006)
15.88 (5/8)	15.88 (0.625)	16.18 (0.637)	15.57 (0.613)	0.76 (0.030)	±0.152 (±0.006)
17.46 (1 1/16)		17.78 (0.700)	17.17 (0.676)	0.81 (0.032)	±0.152 (±0.006)
17.46 (1 1/16)	17.46 (0.688)	17.78 (0.700)	17.17 (0.676)	0.81 (0.032)	±0.152 (±0.006)
19.05 (3/4)		19.41 (0.764)	18.69 (0.736)	1.02 (0.040)	±0.178 (±0.007)
19.05 (3/4)	19.05 (0.750)	19.41 (0.764)	18.69 (0.736)	1.02 (0.040)	±0.178 (±0.007)
22.23 (7/8)		22.63 (0.891)	21.82 (0.859)	1.14 (0.045)	±0.178 (±0.007)
22.23 (7/8)	22.23 (0.875)	22.63 (0.891)	21.82 (0.859)	1.14 (0.045)	±0.178 (±0.007)
25.40 (1)		25.91 (1.020)	24.89 (0.980)	1.27 (0.050)	±0.203 (±0.008)
25.40 (1)	25.40 (1.000)	25.91 (1.020)	24.89 (0.980)	1.27 (0.050)	±0.203 (±0.008)
31.75 (1 1/4)		32.26 (1.270)	31.24 (1.230)	1.27 (0.050)	±0.203 (±0.008)
31.75 (1 1/4)	31.75 (1.250)	32.26 (1.270)	31.24 (1.230)	1.27 (0.050)	±0.203 (±0.008)
38.10 (1 1/2)		38.74 (1.525)	37.47 (1.475)	1.27 (0.050)	±0.203 (±0.008)
38.10 (1 1/2)	38.10 (1.500)	38.74 (1.525)	37.47 (1.475)	1.27 (0.050)	±0.203 (±0.008)
50.80 (2)	50.80 (2.000)	51.44 (2.025)	50.17 (1.975)	1.27 (0.050)	±0.203 (±0.008)

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<https://standards.ansi.org/ASTM/standards/D3296-032008> **TABLE 3 Dimensions and Tolerances for Type III FEP-Fluorocarbon Tubing—Dimensions, mm (in.)**

Class E Inside Diameter		Class E 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)		

or both, in the specification identified. A comma is used as the separator between the standard number and the type. Separators are not needed between the type, grade, and class.³ Provision for special notes is included so that other information can be provided when required. An example would be in Specification D 3296-983296-03 where dimensions and tolerances are specified for each AWG size within type and class. When special notes are used, they a comma should be preceded by a comma. precede them.

4.5. Physical Requirements

4.5.1 The tubing shall be made of FEP-fluorocarbon meeting the requirements of Specification D 2116 and may contain a maximum of 2 weight % of additives.

³ Annual Book of ASTM Standards, Vol 08.01.

³ See the ASTM Form and Style Manual. Available from ASTM Headquarters.