



Standard Specification for PTFE Resin Skived Tape¹

This standard is issued under the fixed designation D 3308; 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.

This standard has been approved for use by agencies of the Department of Defense.

1. Scope

1.1 This specification covers skived tape in thicknesses from 0.013 to 6.35 mm (0.0005 to 0.250 in.) manufactured by skiving (Note 1) from PTFE resin molding and extrusion materials.

NOTE 1—Skiving is the process of continuously shaving a film on a lathe from the outer surface to the core of a molded cylindrical tube of material.

NOTE 2—Abbreviations have been approved from Terminology D 1600.

1.2 The values stated in inch-pound units are to be regarded as the standard. The values given in parentheses are for information only.

1.3 The following hazard caveat pertains only to the test method 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 limitations prior to use.*

NOTE 3—This specification and ISO/FDIS 13000-1 and ISO/FDIS 13000-2 differ in approach or detail, and data obtained using either may not be technically equivalent.

2. Referenced Documents

2.1 ASTM Standards:

- D 149 Test Methods for Dielectric Breakdown Voltage and Dielectric Strength of Solid Electrical Insulating Materials at Commercial Power Frequencies²
- D 374 Test Methods for Thickness of Solid Electrical Insulation²
- D 618 Practice for Conditioning Plastics and Electrical Insulating Materials for Testing³
- D 638 Test Method for Tensile Properties of Plastics³
- D 792 Test Method for Specific Gravity (Relative Density) and Density of Plastics by Displacement³

¹ This specification is under the jurisdiction of ASTM Committee D-20 on Plastics and is the direct responsibility of Subcommittee D20.15 on Thermoplastic Materials (Section D20.15.12).

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² Annual Book of ASTM Standards, Vol 10.02.

³ Annual Book of ASTM Standards, Vol 08.01.

D 882 Test Methods for Tensile Properties of Thin Plastic Sheeting²

D 1389 Methods for Dielectric Proof-Voltage Testing of Thin Solid Electrical Insulating Materials²

D 1505 Test Method for Density of Plastics by the Density-Gradient Technique³

D 1600 Terminology for Abbreviated Terms Relating to Plastics⁴ Microtensile Specimens³

D 1898 Practice for Sampling of Plastics³

D 3892 Practice for Packaging/Packing of Plastics⁵

D 4894 Specification for Polytetrafluoroethylene (PTFE) Granular Molding and Ram Extrusion Materials⁴

E 691 Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method⁶

2.2 ISO Standards:

ISO/FDIS 13000-1 Plastics—Polytetrafluorethylene (PTFE) Semi-Finished Products Part 1: Requirements and Designation⁷

ISO/FDIS 13000-2 Plastics—Polytetrafluorethylene (PTFE) Semi-Finished Products Part 2: Preparation of Specimens and Determination of Properties⁷

3. Classification

3.1 This specification covers four types of PTFE resin skived tape:

3.1.1 *Type I*—Premium; normally used for exacting electrical, mechanical, or chemical applications.

3.1.2 *Type II*—General purpose; for electrical, mechanical, and chemical applications not requiring premium material.

3.1.3 *Type III*—Commercial; for non-critical chemical, electrical, and mechanical applications.

3.1.4 *Type IV*—Utility; having no electrical requirements, and with mechanical properties at lower level.

3.2 Types I, II, III, and IV may be subdivided into two grades according to the base resin used as follows:

3.2.1 *Grade 1*—Made only from virgin resin.

3.2.2 *Grade 2*—May be made using reprocessed resin, or a mixture of virgin and reprocessed resin.

⁴ Annual Book of ASTM Standards, Vols 08.01 and 08.04.

⁵ Annual Book of ASTM Standards, Vol 08.02.

⁶ Annual Book of ASTM Standards, Vol 14.02.

⁷ Available from American National Standards Institute, 11 W. 42nd St., 13th Floor, New York, NY 10036.

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

Specification				
Standard Number Block	Type	Grade	Class	Special Notes
:	:	:	:	:
:	:	:	:	:

Example: Specification D 3308 – 97 I 2 ... "Oil"

For this example, the line callout would be: Specification D 3308 – 97,I,2, Oil and would specify a skived tape that has all of the properties listed for that Type and Grade, in the appropriate specified properties, tables, 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 and Grade, because they are, in turn, Roman numerals and Arabic digits.⁸ Provision for "Special Notes" is included so that other information can be provided when required. This example would be premium PTFE tape noting that the dielectric strength is to be done in oil. When Special Notes are used, they should be preceded by a comma.

4. Physical Requirements

- 4.1 The tape shall be made from unpigmented PTFE resin.
- 4.2 The length and width of the roll shall be as agreed upon between the purchaser and the seller. Width tolerances shall be in accordance with Table 1.
- 4.3 The melting point for all types of tape shall be 327 ± 10°C (621 ± 18°F).
- 4.4 The thickness tolerances for skived tape shall be as shown in Table 2.
- 4.5 Tensile strength and elongation shall meet the requirements shown in Table 3.
- 4.6 The requirements for specific gravity shall be as shown in Table 3.
- 4.7 The minimum required values for dielectric strength *S* (V/mil), shall be computed for applicable thicknesses of materials in accordance with the following formulas, where *t* is the thickness of the tape in mils.

$$\text{Type I: } S = 1000 \sqrt{20/t}$$

$$\text{Type II: } S = 840 \sqrt{20/t}$$

$$\text{Type III: } S = 500 \sqrt{20/t}$$

Type IV: No requirement for dielectric strength

- 4.8 The number of permissible electrical flaws shall be as agreed between the purchaser and the seller.

5. Sampling

5.1 Unless agreed upon between the purchaser and the seller, the materials shall be sampled in accordance with the sampling procedure prescribed in Practice D 1898. Adequate statistical sampling shall be considered an acceptable alternative. A lot shall consist of all tape that is part of one manufacturer's production made from the same nominal raw material under the same conditions, and designed to meet the same specifications. A lot shall not exceed 24 h.

TABLE 1 Width Tolerances for Skived Tape

Width		Tolerance	
mm	in.	mm	in.
12.7	0.5	-0, +0.51	-0, +0.020
25.4	1	-0, +0.64	-0, +0.025
50.8	2	-0, +0.89	-0, +0.035
76.2	3	-0, +0.89	-0, +0.075
152.4	6	-0, +1.91	-0, +0.125
304.8	12	-0, +3.18	-0, +0.250
609.6	24	-0, +6.35	-0, +0.250

6. Number of Tests and Retests

6.1 One set of test specimens as prescribed in Section 7 shall be considered sufficient for testing each batch. The average result of the specimens shall conform to the requirements of this specification.

TABLE 2 Thickness Tolerances for Skived Tape

Thickness		Tolerance	
mm	in.	mm	in.
0.013 to 0.025	0.0005 to 0.001	±0.0025	±0.0001
0.028 to 0.048	0.0011 to 0.0019	±0.008	±0.0003
0.051 to 0.076	0.002 to 0.003	±0.008	±0.0003
0.089 to 0.25	0.0035 to 0.010	±0.013	±0.0005
0.28 to 0.38	0.011 to 0.015	±0.026	±0.0010
0.41 to 1.02	0.016 to 0.040	±0.038	±0.0015
1.04 to 1.55	0.041 to 0.061	±0.127	±0.0050
1.58 to 3.18	0.062 to 0.125	±0.13	±0.0050
>3.18	>0.125	±0.254	±0.010

7. Test Methods

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

7.1.1 *Conditioning*—For those tests where conditioning is required, condition the test specimens in accordance with Procedure A of Practice D 618 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.

TABLE 3 Mechanical Requirements for Skived Tape

Type	Tensile Strength, ^A min		Elongation, min,%	Specific Gravity
	MPa	psi		
I	27.58	4000	300	2.14 to 2.19
II	19.31	2800	200	2.14 to 2.19
III	11.00	1600	75	2.14 min
IV	9.66	1400	50	2.14 min

^A Tape 6.35 mm (¼ in.) or wider.

7.1.2 *Test Conditions*—Conduct tests at the standard laboratory temperature of 23 ± 2°C (70 to 77°F). The maintenance of constant humidity is not necessary. In reference cases, the standard atmosphere, 50 ± 5 % relative humidity, shall apply.

7.1.3 *Thickness*—Measure thickness in accordance with Method A of Test Methods D 374.

7.1.4 *Melting Point*—Determine the melting point on one specimen in accordance with the test method stated in Specification D 4894.

⁸ See the ASTM *Form and Style Manual*. Available from ASTM Headquarters.

7.1.5 *Tensile Properties*—Determine the tensile strength and percentage elongation at break in accordance with Test Method D 638, for tapes or films 1.0 mm (0.04 in.) thick or greater. For tapes or films less than 1.0 mm (0.04 in.) thick, determine the tensile strength and percentage elongation at break in accordance with Test Method D 882.

7.1.6 *Dielectric Strength*—Determine the dielectric strength in accordance with Test Methods D 149 using the short time test. Use air as the medium for tapes up to and including 0.254 mm (0.010 in.) in thickness. For thicker tapes, test in oil. Oil can be used as the medium for tapes less than 0.24 mm (0.010 in.) when agreed upon between the purchaser and the seller. Use ten specimens in determining the dielectric strength of each thickness of tape.

NOTE 4—Dielectric values obtained in oil is a requirement for the laminate industry. Therefore, it is necessary to test dielectric strength in oil when requested by these customers. Values obtained when testing thin skived tape in oil are significantly different than those obtained using the air method.

7.1.7 *Specific Gravity*—Determine the specific gravity on two specimens in accordance with Method A of Test Methods D 792. Add 2 drops of a wetting agent⁹ (liquid detergent) to the water in order to reduce the surface tension and ensure complete wetting of the sample. The gradient tube method in Test Method D 1505 may be used as an alternative, with three specimens used for testing.

7.1.8 *Electrical Flaws*—Methods D 1389.

8. Inspection

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

9. Packaging and Marking

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

9.2 *Marking*—Shipping containers shall be marked with the name of the material, type, size, and quantity contained therein. Each roll of tape shall be marked to designate type, grade, and lot number. The marking will be, preferably, on the core.

9.3 All packing, packaging, and marking provisions of Practice D 3892 shall apply to this specification.

10. Precision and Bias¹⁰

10.1 Table 4 is based on a round robin conducted in 1985–1986 according to Practice E 691, involving seven materials tested by six laboratories. For each material, the sheeting from which the test specimens were to be cut was obtained from one source. Using a steel rule die, one set of test specimens for each laboratory was cut by one of the laboratories. Sheeting and a duplicate die were furnished each partici-

TABLE 4 Precision Summary, Tensile Strength and Elongation at Break

NOTE 1— $I_r = 2.8 \times CV_r$; $I_R = 2.8 \times CV_R$.

Material	Tensile Strength				
	Mean psi	CV _r %	CV _R %	I _r %	I _R %
Granular PTFE	4801	2.79	8.85	7.81	24.78
Coagulated Dispersion PTFE	4807	2.71	3.37	7.59	9.46
PFA	4164	3.11	9.03	8.71	25.28
FEP	4144	2.98	7.98	8.34	22.34
Material	Percentage Elongation at Break				
	Mean % E	CV _r %	CV _R %	I _r %	I _R %
Granular PTFE	337	2.83	16.43	7.92	46.00
Coagulated Dispersion PTFE	300	2.17	13.74	6.08	38.47
PFA	336	3.27	9.66	9.16	27.05
FEP	319	2.21	7.60	6.19	21.28

pating laboratory and used to cut a second set of test specimens. Each test result was the average of five individual determinations. Each lab obtained four test results on each material, two test results each on the specimens furnished and two on the specimens cut by the laboratory doing the testing.

10.1.1 The properties used in the analysis are tensile strength and elongation at break. The stress-strain curves of the fluorocarbon polymers (but not the fluoropolymers: modified ETFE and poly(vinylidene fluoride), PVDF) are similar in shape. Data on ETFE and PVDF, therefore, were excluded from the analysis used for this precision and bias statement but are available for use in precision and bias statements and are to be included in the research report at ASTM. Based on advice from experts in statistical analysis of round robin data, and since use of fillers is excluded in the applicable standards, information from the testing on glass-fiber filled PTFE also is not included in Table 4. In addition, the experts advised that information from the samples cut in one laboratory and tested by all the laboratories should not be included in Table 4. The data are available in the report.

NOTE 5—**Caution:** The following explanations of I_r and I_R (10.3-10.3.3) are intended only to present a meaningful way of considering the approximate precision of this test method. The data in Table 4 should not be applied rigorously to acceptance or rejection of material, as those data are specific to the round robin and may not be representative of other lots, conditions, materials, or laboratories.

10.2 Users of this test method should apply the principles outlined in Practice E 691 to generate data specific to their laboratory and materials, or between specific laboratories. The principles of 10.3-10.3.3 would then be valid for such data.

10.3 *Concept of I_r and I_R* —IF CV_r and CV_R have been calculated from a large enough body of data, and for test results that were averages from testing five specimens:

10.3.1 I_r : *Repeatability*—(Comparing two test results for the same material, obtained by the same operator using the same equipment on the same day.) The two test results should be judged not equivalent if they differ by more than the I_r value for that material.

10.3.2 I_R : *Reproducibility*—(Comparing two test results for the same material, obtained by different operators using different equipment on different days.) The two test results should be judged not equivalent if they differ by more than the I_R value for that material.

⁹ “Joy”, “Glim”, or “Triton” X-100, available from Rohm and Haas, Independence Square, Philadelphia, PA 19105, have been found satisfactory for the purpose.

¹⁰ Supporting data are available from ASTM Headquarters.

10.3.3 Any judgment in accordance with 10.3.1 and 10.3.2 would have an approximate 95 % (0.95) probability of being correct.

10.4 Bias is systematic error that contributes to the difference between a test result and a true (or reference) value. There are no recognized standards on which to base an estimate of bias for this test procedure.

11. Keywords

11.1 fluorocarbon polymer; fluropolymers; granular PTFE; polytetrafluoroethylene; PTFE; PTFE basic shapes; PTFE film; PTFE skived tape

SUMMARY OF CHANGES

This section identifies the location of selected changes to this test method. For the convenience of the user, Committee D-20 has highlighted those changes that may impact the use of this test method. This section may also include descriptions of the changes or reasons for the changes, or both.

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- (1) 1.1—Changed thickness range from 0.05 mm minimum to 0.013 mm minimum and from 3.18 mm maximum to 6.35 mm maximum.
- (2) 1.2—Changed values to metric versus inch-pound.
- (3) Added ISO equivalency statement.
- (4) 2.1—Deleted Specification D 1457 (discontinued) and added Specification D 4894 in its place.
- (5) 2.1—Added Test Methods D 882 to referenced documents.
- (6) 2.1—Took out reference to Test Method D 1708, which will be eliminated with proposed tensile change.
- (7) 2.2—Removed reference to MIL-STD 105 and replaced with ISO standards.
- (8) Added 3.3.
- (9) 5.1—Changed definition of *lot*.
- (10) Table 2, Thickness—Changed minimum from 0.051 to 0.013 and from 3.18 to 6.35 maximum.

- (11) Table 1, Width—Changed table for widths over 609.6 mm to read equal to or greater than because data from this point on is redundant and tolerances will remain the same from this point on. This also eliminates a maximum width requirement.
- (12) Table 1—Fixed tolerances (inches did not agree with mm).
- (13) Table 3—Changed minimum elongation on Type II material to 200 % versus 270 %.
- (14) 7.1.5—Changed tensile to include Test Method D 882 or Test Method D 638 and eliminated special testing using micro-tensile specimen.
- (15) 7.1.6—Added statement allowing the use of an oil medium for thin tapes when requested by purchaser.
- (16) 7.1.4—Changed section to eliminate Specification D 1457 and replace it with Specification D 4894.
- (17) 9.1—Removed statement for retests.

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