Standard Specification for
PTFE Tubing, Miniature Beading and Spiral Cut Tubing

This standard is issued under the fixed designation D 3295; 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 (e) indicates an editorial change since the last revision or reapproval.

1. Scope *

1.1 This specification covers PTFE tubing, miniature beading and spiral cut tubing—manufactured from PTFE resin produced from dispersion specified in Specification D 4895.

NOTE 1—PTFE tube and rod manufactured from resin specified in Specification D 4894 are covered in Specification D 1710.

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

1.3 The following hazard caveat pertains only to the test method portion, Section 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.

1.4 As PTFE resin produced from dispersion is not a true thermoplastic material, any reuse for the specification referenced above is impossible. However, markets do exist for non-virgin PTFE as additives and fillers.

NOTE 2—There is currently no published ISO standard relating to this specification.

2. Referenced Documents

2.1 ASTM Standards:

D 618 Practice for Conditioning Plastics for Testing
D 792 Test Methods for Specific Gravity (Relative Density) and Density of Plastics by Displacement
D 883 Terminology Relating to Plastics
D 1600 Terminology for Abbreviated Terms Relating to Plastics
D 1675 Test Method for Polytetrafluoroethylene Tubing
D 1710 Specification for Extruded and Compression Molded Polytetrafluoroethylene PTFE Rod and Heavy Walled Tubing
D 1898 Practice for Sampling of Plastics
D 3892 Practice for Packaging/Packing of Plastics
D 4894 Specification for Polytetrafluoroethylene (PTFE) Granular Molding and Ram Extrusion Materials
D 4895 Specification for Polytetrafluoroethylene (PTFE) Resin Produced from Dispersion
E 691 Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method

3. Terminology

3.1 Definitions:
3.1.1 The terminology given in Terminology D 883 is applicable to this specification.

3.2 Description of Term Specific to This Standard:
3.2.1 lot—a single production run, or a uniform blend of two or more production runs.

4. Classification

4.1 This specification provides for five groups of PTFE tubing, miniature beading and spiral cut tubing, differentiated by size and type. The groups are further subdivided into classes based on wall thickness.

4.1.1 Group 01—Tubing based upon the American Wire Gage (AWG) sizes.
4.1.2 Group 02—Tubing based upon fractional inch sizes.
4.1.3 Group 03—Tubing specified by inner diameter and wall thickness in Table 6 referred to as “Custom or Metric.”
4.1.4 Group 04—Tubing cut to form spiral wrap as in Table 7.
4.1.5 Group 05—Miniature beading having diameters as listed in Table 8.

4.2 The types are further differentiated in accordance with increasing wall thickness as follows:
4.2.1 Class 1—Tubing having walls tabulated in Table 1 listed as light wall.
4.2.2 Class 2—Tubing having walls of greater thickness than Class 1 listed as thin wall.

* A Summary of Changes section appears at the end of this standard.
4.2.3 Class 3—Tubing having walls tabulated in Table 2 listed as standard wall.

4.2.4 Class 4—Tubing having walls tabulated in Table 3 listed as chemical tubing.

4.2.5 Class 5—Tubing having walls tabulated in Table 2 and Table 3 listed as heavy wall.

4.3 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.
For this example, the line callout would be Specification D 3295 – 01, 01124 and would specify tubing having walls listed as light wall that has all the properties listed for that group, class and grade in the specification identified. These shall be based on AWG size within the group and class. Grade will be the AWG size designation. Only Groups 01 and 02 shall have requirements for Class and no separator is needed.

5. Physical Properties

5.1 The tubing and miniature beading shall be made of PTFE meeting the requirements of Specification D 4895 and may contain a maximum of two mass percentage of additive.

5.2 The melting point for all Groups of tubing, and miniature beading shall be 327 ± 10°C (621 ± 18°F) when measured in accordance with 8.1.4.
### Table 3: Dimensions and Tolerances for Group 02 PTFE Tubing, mm (in.)

<table>
<thead>
<tr>
<th>Fractional Sizes</th>
<th>Inside Diameter</th>
<th>Wall Thickness</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Class 1, 2, 3</td>
<td>Class 1</td>
</tr>
<tr>
<td></td>
<td>min</td>
<td>max</td>
</tr>
<tr>
<td>0.79 (1/8)</td>
<td>0.79 (0.031)</td>
<td>0.84 (0.033)</td>
</tr>
<tr>
<td>1.6 (5/32)</td>
<td>1.7 (0.063)</td>
<td>1.85 (0.066)</td>
</tr>
<tr>
<td>2.4 (¼)</td>
<td>2.4 (0.094)</td>
<td>2.3 (0.099)</td>
</tr>
<tr>
<td>3.2 (5/32)</td>
<td>3.2 (0.125)</td>
<td>3.1 (0.130)</td>
</tr>
<tr>
<td>4.8 (5/32)</td>
<td>4.7 (0.192)</td>
<td>5.0 (0.198)</td>
</tr>
<tr>
<td>6.4 (¼)</td>
<td>6.5 (0.255)</td>
<td>6.4 (0.260)</td>
</tr>
<tr>
<td>7.9 (5/32)</td>
<td>8.1 (0.312)</td>
<td>8.0 (0.313)</td>
</tr>
<tr>
<td>9.5 (5/32)</td>
<td>9.7 (0.381)</td>
<td>9.5 (0.385)</td>
</tr>
<tr>
<td>11.1 (5/32)</td>
<td>11.3 (0.451)</td>
<td>11.1 (0.458)</td>
</tr>
<tr>
<td>12.7 (5/32)</td>
<td>12.9 (0.515)</td>
<td>12.7 (0.520)</td>
</tr>
<tr>
<td>15.9 (5/32)</td>
<td>15.2 (0.643)</td>
<td>15.9 (0.650)</td>
</tr>
<tr>
<td>19.0 (5/32)</td>
<td>19.3 (0.750)</td>
<td>19.0 (0.775)</td>
</tr>
<tr>
<td>22.2 (6/32)</td>
<td>22.4 (0.902)</td>
<td>22.2 (0.927)</td>
</tr>
<tr>
<td>25.4 (1)</td>
<td>25.6 (1.000)</td>
<td>25.4 (1.060)</td>
</tr>
<tr>
<td>31.8 (11/32)</td>
<td>32.1 (1.265)</td>
<td>31.8 (1.250)</td>
</tr>
<tr>
<td>38.1 (1)</td>
<td>38.6 (1.550)</td>
<td>38.1 (1.580)</td>
</tr>
</tbody>
</table>

5.3 The inside diameter, wall thickness, pitch and tolerances of the tubing, miniature beading and spiral cut tubing shall be as shown in Tables 1-3 and Tables 6-8 when determined in accordance with 8.1.3.1 and 8.1.3.2.
8. Test Methods

8.1 Determine the properties enumerated in this specification in accordance with the following test methods.

8.1.1 Conditioning—Conditioning is not required except in referee cases. When conditioning is required, condition the test specimens at 23°C 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.

8.1.2 Test Conditions—Conduct tests at the standard laboratory temperature of 23 ± 2°C (73.4 ± 3.6°F). The maintenance of constant humidity is not necessary; in referee cases the standard laboratory atmosphere including 50 ± 5% relative humidity shall apply.

8.1.3 Dimensions and Tolerances:

8.1.3.1 Inside Diameter—Determine the inside diameter in accordance with Test Method D 1675.

8.1.3.2 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 Tables 1-3, Tables 6 and 7.

8.1.3.3 Pitch—Determine the pitch by measuring across the cut as depicted in Fig. 2.

8.1.3.4 Outer Diameter of Miniature Beading—Determine the outer diameter in accordance with the procedures described in Test Method D 1675.

8.1.4 Melting Point—The melting point shall be determined in accordance with Specification D 4895, using a shaving from the tubing rather than a molded disk.

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

8.1.6 Weight Loss—Determine the loss in weight in accordance with Test Method D 1675, except that the minimum weight of the test specimens shall be 50 g and they shall be heated in a forced-draft oven for 3 h at 300 ± 5°C (572 ± 9°F).

8.1.7 Tensile Strength and Elongation—Determine the tensile strength and elongation as specified in 8.1.7.1-8.1.7.3 in 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.

8.1.7.1 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 4895. To prepare specimens, slit the tubing parallel to the axis and flatten out, prior to punching out specimens.

8.1.7.2 Tubing Having an Inside Diameter Less Than 15.9 mm (0.625 in.) to 4.8 mm (0.090 in.) Inclusive—Determine the tensile strength and elongation in the longitudinal direction in accordance with Specification D 4895. For longitudinal specimens, slit the tubing parallel to the axis and flatten out, prior to punching out specimens.
8.1.7.3 Tubing Having an Inside Diameter Less Than 4.8 mm (0.090 in.)—Test specimens as filaments. Make nonslip-type loop knots in each end of the specimen so that there are 34.9 mm (1%/ 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.

8.1.8 Dielectric Breakdown Voltage—Determine the dielectric breakdown voltage of the tubing in accordance with Test Method D 1675. Testing may be in air or oil, the latter being the referee method.

8.1.9 Dimensional Stability—Cut three specimens each 305 mm (12 in.) long, measured to the nearest 1.6 mm (1/16 in.). Place the specimen on steel mandrels having a diameter 5 to 10 % less than the inside diameter of the specimen, then in a circulating-air oven at 260 ± 5°C (500 ± 9°F) for 3 h.

Determine the inner diameter and maximum and minimum wall thickness in accordance with 7.1.3.1 and 7.1.3.2. 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.) and the diameter and wall thickness. Calculate the change in length as a percentage of the original length and the change in diameter and wall thickness as a percentage of the original length and the change in diameter and wall thickness as a percentage of the original.

8.1.10 Heat Resistance—Place three specimens, each 305 mm (12 in.) long, in a circulating-air oven at 260 ± 5°C (500 ± 9°F) for 5 h.

9. Inspection and Certification

9.1 Inspection and certification of the material supplied with reference to a specification based on this specification shall be for conformance to the requirements specified herein.

9.2 Lot-acceptance shall be based on acceptance or rejection of the lot as a whole.

9.3 Lot-acceptance inspection shall consist of measurements for inside diameter and wall thickness.

9.4 Certification shall be that the material was manufactured by a process in statistical control, sampled, tested, and inspected in accordance with this specification, and that the average values for the lot meet the requirements of the specification (line callout).

9.5 A report of test results shall be furnished when requested. The report shall consist of results of the lot-acceptance inspection for the shipment and the results of the most recent periodic-check inspection.

10. Packaging and Package Marking

10.1 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.

10.2 Marking—Shipping containers can be marked with the name of the material, type, class, size, and quantity contained therein.

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

11. Keywords

11.1 coagulated dispersion PTFE; fluorocarbon polymer; fluoropolymers; miniature beading; polytetrafluoroethylene; PTFE; PTFE extruded tubing; spiral cut tubing; thin-walled tubing

SUMMARY OF CHANGES

This section identifies the location of selected changes to this specification. For the convenience of the user, Committee D20 has highlighted those changes that may impact the use of this specification. This section may also include descriptions of the changes or reasons for the changes, or both.

D 3295 – 01:

(1) Changed title to include miniature beading and spiral cut tubing.
(2) Revised 1.1 to reflect change in title.
(3) Added reference to IEEE/ASTM SI 10 in 1.2.
(4) Changed old 1.4 into Note 2.
(5) Added a new 1.4.
(6) Removed Test Method D 1505 from Referenced Documents and 8.1.5.
(7) Changed definition of lot in 3.2.1.
(8) Revised Section 4.
(9) Revised Example for Specification to match changes found in Section 4.
(10) Added “and miniature beading” to 5.1, 5.2, 5.3, 5.4, 5.5, and 5.6.
(11) Changed “both types” to “all groups” in 5.2.
(12) Deleted 5.9. 5.10 becomes 5.9 as a result.
(13) Revised 6.1.
(14) Changed “batch” to “lot” in 7.1.
(15) Added 8.1.3.3 and 8.1.3.4.
(16) Added new Tables 6 and 7.
(17) Changed .190 to .090 in 8.1.7.3.
(18) Deleted 8.1.11.
(19) Changed Section 9 heading to “Inspection and Certification.”
(20) Deleted old Section 9 with new paragraphs (9.1–9.5).
(21) Deleted Section 11 “Precision and Bias.”
(22) Added keywords: miniature beading; spiral cut tubing.
(23) All existing tables changed to reflect new groups and classes.
(24) Added Figure 2.
(25) Added Table 8.
(26) Fixed errors in existing tables.
(27) Made miscellaneous editorial corrections throughout.

ASTM International takes no position respecting the validity of any patent rights asserted in connection with any item mentioned in this standard. Users of this standard are expressly advised that determination of the validity of any such patent rights, and the risk of infringement of such rights, are entirely their own responsibility.

This standard is subject to revision at any time by the responsible technical committee and must be reviewed every five years and if not revised, either reapproved or withdrawn. Your comments are invited either for revision of this standard or for additional standards and should be addressed to ASTM International Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee, which you may attend. If you feel that your comments have not received a fair hearing you should make your views known to the ASTM Committee on Standards, at the address shown below.

This standard is copyrighted by ASTM International, 100 Barr Harbor Drive, PO Box C700, West Conshohocken, PA 19428-2959, United States. Individual reprints (single or multiple copies) of this standard may be obtained by contacting ASTM at the above address or at 610-832-9585 (phone), 610-832-9555 (fax), or service@astm.org (e-mail); or through the ASTM website (www.astm.org).