Designation: D 6261 – 98

Standard Specification for Extruded and Compression Molded Basic Shapes Made from Thermoplastic Polyester (TPES)[1]

This standard is issued under the fixed designation D 6261; 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.

INTRODUCTION

This specification is intended to be a means of calling out mechanical grade plastic product used in the fabrication of end items or parts.

1. Scope

1.1 This specification covers requirements and test methods for the material, dimensions, and workmanship, and the properties of extruded and compression molded plate, rod and tubular bar manufactured from thermoplastic polyester.

1.2 The properties included in this specification are those required for the compositions covered Requirements necessary to identify particular characteristics important to specialized applications may be described by using the classification system given in Section 4.

1.3 This specification allows the use of recycled plastics[2] (see Section 4).

1.4 The values are stated in inch-pound units and are regarded as the standard in all property and dimensional tables. For reference purposes, SI units are also included in Table 1 and Table S-TPES only.

1.5 The following precautionary caveat pertains only to the test method portions sections 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 1—There is no similar or equivalent ISO Standard.

2. Referenced Documents

2.1 *ASTM Standards:*

D 256 Test Method for Determining the Pendulum Impact Resistance of Notched Specimens of Plastics[3]

D 618 Practice for Conditioning Plastics and Electrical Insulating Materials[3]

D 638 Test Method for Tensile Properties of Plastics[3]

D 790 Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Materials[3]

D 883 Terminology Relating to Plastics[3]

D 3892 Practice for Packaging/Packing of Plastics[4]

D 4507 Specification for Thermoplastic Polyester (TPES) Unfilled and Reinforced Material[4]

D 4000 Classification System for Specifying Plastics Materials[4]

D 5033 Guide for the Development of Standards Relating to the Proper Use of Recycled Plastics[5]

D 5927 Specification for Thermoplastic Polyester (TPES) Injection and Extrusion Materials Based on ISO Test Methods[4]

2.2 *ANSI Standard:*

Z1.4-1993 Sampling Procedures and Tables for Inspection by Attributes[6]

3. Terminology

3.1 *Definitions*:

3.1.1 For definitions of other technical terms pertaining to plastics used in this specification, see Terminology D 883 or Guide D 5033.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *plate, n*—flat stock ¼ in. (6.4 mm) or greater.

3.2.2 *recycled-plastic shape, n*—a product made from up to 100 % recycled plastic.

3.2.3 *rod, n*—an extruded solid cylindrical shape with a minimum diameter of ⅛in. (3.2 mm).

3.2.4 *tubular bar, n*—an extruded annular shape with minimum inside diameter of ⅜in. (9.6 mm) and minimum wall

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[2] As defined in Guide D 5033.

[3] *Annual Book of ASTM Standards*, Vol 08.01.

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

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

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

thickness of 1⁄16 in. (1.6 mm).

4. Classification and Material

4.1 Product shape and size as defined in the applicable purchase order.

4.2 This specification covers product extruded and compression molded as listed in Table S-TPES. Products included in the designations reference Specification D 4507 or Specification D 5927 callouts where applicable.

4.2.1 The type of thermoplastic polyester shape product may be categorized by type, grade and class depending on resin and filler compositions as defined in Table S-TPES.

4.2.2 Each type of thermoplastic polyester shape may be categorized into one of several grades as follows:

4.2.2.1 *Grade 1—General Purpose*—Extruded or compression molded product made using only 100 % virgin thermoplastic polyester resin.

4.2.2.2 *Grade 2—Recycled*—Extruded or compression molded product made using any amount up to 100 % recycled thermoplastic polyester plastics.

4.3 The type, class and grade is further differentiated based on dimensional stability (elevated temperature excursion test), Table S-TPES, and dimensional requirements, Tables A and B.

4.4 *Property Tables*:

4.4.1 Table S-TPES may be used to describe both extruded or compression molded products.

4.4.2 Table 1 may also be used to describe extruded or compression molded products not included in Table S-TPES via a cell callout that includes the applicable Table S-TPES thermoplastic polyester type and specific properties (Designations 1 through 7).

4.4.3 To facilitate the incorporation of future or special materials not covered by the Table S-TPES, the “as specified” category (00) for type, class and grade is shown in the table with the basic properties to be obtained from Table 1, as they apply.

4.4.4 *Reinforcements and Additive Materials*—A symbol (single-letter) will be used for the major reinforcement or combination, or both, along with two numbers that indicate the percentage of addition by mass with the tolerances as tabulated below. This must be included in all Table 1 callouts.

Symbol	Material	Tolerance (Based on the Total Mass)
C	Carbon and graphite fiber reinforced	± 2 %
G	Glass-reinforced	
	< 15 % glass content	± 2 %
	> 15 % glass content	± 3 %
L	Lubricants (for example, PTFE, graphite and silicone	by agreement between the supplier and the user
M	Mineral	± 2 %
R	Combinations of reinforcements or fillers, or both	± 3 % for the total reinforcement

4.5 *Callout Designation*—A one-line system shall be used to specify thermoplastic polyester materials covered by this specification. The system uses pre-defined cells to refer to specific aspects of this specification as illustrated below:

4.5.1 *Examples*:

4.5.1.1 *Example 1*—Product made from general purpose PBT

CELL CALLOUT: S-TPES0111

S-TPES01 = Product made from PBT in accordance with Table S-TPES
1 = Unfilled class
1 = General purpose grade product

4.5.1.2 *Example 2*—Product made from general purpose PET

CELL CALLOUT: S-TPES0211

S-TPES02 = Product made from PET in accordance with Table S-TPES
1 = Unfilled class
1 = General purpose grade product

4.5.2 These two examples illustrate how a one-line, alphanumeric sequence can identify the product composition, commercial parameters and physical characteristics of extruded or compression molded product. A space must be used as a separator between the specification number and the type designation. No separators are needed between type, class and grade. When special notes are to be included, such information should be preceded by a comma. Special tolerances must be noted at time of order and are inserted after the grade in parentheses and preceded by a comma.

5. Ordering Information

5.1 All shapes covered by this specification shall be ordered using the proper callout designation (see 4.5).

6. Physical Property Requirements

6.1 The physical property values listed within this specification’s tables are to be considered minimum specification values. Any requirement for specific test data for a given production lot should be specified at the time of order. Physical properties for products not yet included in Table S-TPES may be specified using Table 1 for extruded or compression molded products.

7. Dimensional Requirements

7.1 The type, class and grade is differentiated based on dimensional stability (elevated temperature excursion test), as indicated in Table S-TPES.

7.2 Products shall be produced within commercial tolerances and with the lowest stress levels for machined parts as delineated in Tables A and B.

7.3 Tubular bar dimensions shall be supplied in the unfinished condition, unless otherwise specified at time of order, sufficient to finish to the nominal dimension ordered.

7.4 The maximum allowable camber or bow or both, shall be within the limits referenced in Tables A and B.

8. Workmanship, Finish and Appearance

8.1 *Appearance*—The resin material color is white to off-white. The product color shall be as published by the shapes manufacturer. They shall be uniform in color throughout the thickness. Specific colors and color matching only as agreed to by order. Physical properties may be affected by other colors.

8.2 *Finish*—All products shall be free of blisters, wrinkles, cracks, gouges and defects that restrict commercial use of the

product. Special surface finish shall be supplied only when specified in the purchase order or contract.

8.3 *Defects*—All products shall be free of voids, dirt, foreign material and embedded particles exceeding 1/32 in. (0.8 mm) maximum diameter as defined in 8.3.1.

8.3.1 The criteria for determining the internal cleanliness shall be external visual inspection. A maximum number of two internal defects per square foot of plate and one foot length of rod and tubular bar are allowed. Clusters of defects less than 1/32in. (0.8 mm) diameter are to be counted as a single defect.

9. Sampling

9.1 Sampling shall be statistically adequate to satisfy the requirements of this specification as applicable (see ANSI Z1.4-1993).

9.2 For purposes of sampling, an inspection lot for examination and tests shall consist of all material of the same type, class, grade and nominal size submitted for inspection at one time.

10. Number of Tests

10.1 Routine lot inspection shall consist of all the criteria specified in the applicable product tables.

10.2 The criteria listed in these product tables and definitions are sufficient to establish conformity of the sheet, plate, rod or tubular bars to this specification. When the number of test specimens is not stated in the test method, a single determination may be made. If more than single determinations and separate portions of the same sample are made, the results shall be averaged. The final result shall conform to the requirements prescribed in this specification.

11. Test Conditions

11.1 *Conditioning of Specimens*—The specification values and dimensions are based on conditioning techniques outlined in Procedure A of Practice D 618.

11.2 *Standard Temperature*—The tests shall be conducted at the standard laboratory temperature of 73.4 ± 3.6°F (23 ± 2°C) and 50 ± 5 % relative humidity.

12. Test Methods

12.1 Tensile stress break, elongation at break, and tensile modulus (tangent) are in accordance with Test Method D 638, at the rate of 0.2 in. (5 mm)/min.

12.1.1 All plate specimens are in accordance with Test Method D 638, Type I.

12.1.2 All rod specimens are in accordance with Test Method D 638.

12.1.3 All tubular bar specimens are in accordance with Test Method D 638.

12.2 *Dimensional Stability*:

12.2.1 *Specimen Preparation (a Minimum of Three Test Samples Required)*:

12.2.1.1 *Rods and Tubular Bar*—Prepare each specimen by cutting a 1.5 in. (35 mm) long slice from the shape to be tested. Machine the slice using a coolant and good machining practices to a length of 1 000 ± 0.005 in. (25 ± 0.13 mm). Each end of the specimen shall have a machined surface.

12.2.1.2 *Plate*—Each specimen shall consist of a 2 in. (50 mm) diameter disc machined from the flat (diameter shall equal test specimen thickness with a minimum of 2.0 in. (50 mm)). The same care shall be used in the machining as described in 12.1.1. The thickness of the specimen shall be that of the original flat from which it was cut, no machining being done on the top or bottom faces.

12.2.2 *Testing Procedure*—Measure the outside diameter and thickness or length of the specimen as applicable at 73.4 ± 1.8°F (23 ± 1°C) to the nearest 0.0001 in. (0.0025 mm). All measurements shall be done on the centerline and 90° from the center line for plate. Also take measurements for thickness halfway to center, and for diameter at mid-point. Place the specimen in a bath consisting of polyalkylene glycol or an air circulating oven heated to the temperatures shown below. After 6 hrs, allow the specimen to slowly cool to room temperature at a rate not to exceed 40°F (22°C)/h. Measure the specimen at 73.4 ± 1.8°F (23 ± 1°C) and calculate the percent change in each dimension:

$$300 \pm 5°F\ (149 \pm 3°C) \quad (1)$$

12.2.3 *Reproducibility*—Inter-laboratory reproducibility is being determined and will be added within one year. Precision Statement will be finalized and included within two years.

12.3 *Lengthwise Camber and Widthwise Bow*:

12.3.1 Make all measurements for camber and bow using the maximum distance rod, sheet or plate deviates from the straight line extended from edge to edge when measured in accordance with 12.3.2. The shape shall be oriented such that the weight of the product doesn't influence the results.

12.3.2 *Rod and Plate*:

12.3.2.1 *Rod*—Lay each rod on its side and measure it with concave side facing a straight edge. Measure camber from the straight edge to the maximum concave point on the rod. Camber may not exceed the values of Table A.

12.3.2.2 *Plate*—Plate shall not exceed the requirements of Table B on the lengthwise ends and widthwise edges when laid on a flat surface (crown side up).

12.3.3 *Reproducibility*—Inter-laboratory reproducibility is being determined and will be added within one year. Precision statement will be finalized and included within two years.

12.4 *Squareness (Based on a 4 ft Nominal Length)*:

12.4.1 Measure and compare diagonal lengths (corner to corner). Accept the product if the difference is 1/16 in. (0.4 mm) or less and the measured minimums diagonal meets the following requirements

12.4.1.1 1 ft wide is 49-1/2 in. (125.5 cm) minimum.

12.4.1.2 2 ft wide is 53-3/4 in. (136.5 cm) minimum.

12.4.1.3 4 ft wide is 68 in. (1463.0 cm) minimum.

12.4.2 If the diagonal difference exceeds 1/16 in. (0.4 mm), proceed to measure the gap (which is the deviation from a 2 ft square). The maximum allowable gap shall not exceed 1/8 in. (0.7 mm) except for the 1 ft (25.4 cm) wide sizes of sheet and plate which should not exceed 1/16 in. (0.4 mm).

12.4.3 *Reproducibility*—Inter-laboratory reproducibility is being determined and will be added within one year. Precision statement will be finalized and included within two years.

12.5 Flexural modulus are in accordance with Test Method D 790, specimen 1/4 in. (1.4 mm) thick maximum, testing speed 0.11 in. (2.9 mm)/min.

12.6 Izod impact, are in accordance with Test Method

D 256, Method A, Fig. 4, notched, ¼ in. (1.4 mm) thick maximum specimen.

13. Certification

13.1 When requested at the time of order, the purchaser shall be furnished a certification that the lot is made from the required thermoplastic polyester plastic (percent recycle, if applicable) and meets the requirements of this specification.

14. Packing, Packaging and Marking

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

15. Keywords

15.1 thermoplastic polyester; thermoplastic polyester—PBT; thermoplastic polyester—PET; thermoplastic polyester—plates; thermoplastic polyester—recycled plastic; thermoplastic polyester—plates; thermoplastic polyester—rod; thermoplastic polyester—shapes; thermoplastic polyester—tubular bar

TABLE S-TPES Requirements for Thermoplastic Polyester (TPES) Shapes

Type	Description	Class	Description	Grade	Resin Type	Description	Ultimate Tensile Strength, min, psi (MPa)	Tensile Elongation, % at break (min.)	Tensile Modulus, min, psi (MPa)	Dimen. Stability, max, %
01	PBT	1	Unfilled	1	TPES0111[A] TPES0111[B]	General Purpose	8,500 (58)	40	350,000 (2,470)	0.4
				2	As Specified[B]	Recycled	. . .	. . .	. . .	. . .
				0	As Specified[B]	As Specified	. . .	. . .	. . .	. . .
		2	Modified	1	As Specified[B]	General Purpose	. . .	. . .	. . .	. . .
				0	As Specified[B]	As Specified	. . .	. . .	. . .	. . .
		0	As Specified	0	As Specified[B]	As Specified	. . .	. . .	. . .	. . .
02	PET	1	Unfilled	1	TPES211[B]	General Purpose	11 500 (79)	15	450 000 (3103)	0.4
				2	As Specified[B]	Recycled	. . .	. . .	. . .	. . .
				0	As specified[B]	As Specified	. . .	. . .	. . .	. . .
		2	Modified	1	As Specified[B]	General Purpose	. . .	. . .	. . .	. . .
				0	As Specified[B]	As Specified	. . .	. . .	. . .	. . .
		0		0	As Specified[B]	As Specified	. . .	. . .	. . .	. . .
00	Other Polyesters	0	As Specified	1	As Specified[B]	General Purpose	. . .	. . .	. . .	. . .
				2	As Specified[B]	Recycled	. . .	. . .	. . .	. . .
				0	As Specified[B]	As Specified	. . .	. . .	. . .	. . .

[A]In accordance with Specification D 4507.
[B]In accordance with Specification D 5927.

TABLE A Dimensional Requirements for Thermoplastic Polyester Rod[A]

Size, in.[A]	Diameter Tolerance, in.[A]	Roundness TIR, in.[A]	Camber, in.[A]
⅛ to ⅞ in.	+0.003/–0.001	0.002	2⅝ in./8 ft
1 in.	+0.005/–0	0.004	1⅜in./8 ft
1⅛ to 1-¼ in.	+0.005/–0	0.004	1⅜ in./8 ft
1⅜ to 1-⅞ in.	+0.005/–0	0.005	1⅜ in./8 ft
2 in.	+0.008/–0	0.010	1⅜in./8 ft
2⅛ to 2-½ in.	+0.030/–0	0.025	1⅛ in./8 ft
2⅝ to 6 in.	+0.250/–0	0.050	⅜ in./4 ft

[A]To convert inches to millimetres, multiply by 25.40.

TABLE B Dimensional Requirements for Extruded Thermoplastic Polyester Plates (Grade 1)[A,B]

Size[A]	Thickness Tolerances[A]	Length Camber[A]	Width Bow[A]
¼ to 2 in.	+0.025/–0	¾ in./4 ft	¼ in./2 ft.
2⅛ to 3 in.	+0.050/–0	¼ in./4 ft	⅛ in./2 ft
3⅛ in. and over	+0.350/–0	¼ in./4 ft	5⁄16 in./1 ft

[A]To convert inches to millimetres multiply by 25.40.
[B]Compression molded plate is supplied sufficiently oversize to finish to nominal dimension listed.

TABLE 1 Additional Detail Requirements—Reinforced/Unreinforced Extruded and Compression Molded Thermoplastic Polyester (The applicable Table S-TPES thermoplastic polyester type (including fillers, see 4.4.4) must precede this table designation.)

Designation Order Number	Property	0	1	2	3	4	5	6	7	8	9
1	Tensile stress Test Method D 638, min, psi (MPa)	Unspecified	5000 (34)	8000 (55)	10 000 (69)	12 000 (83)	14 000 (97)	16 000 (110)	20 000 (138)	25 000 (172)	Specify Value
2	Elongation at break Test Method D 638, %, min	Unspecified	1	3	5	10	20	50	100	200	Specify Value
3	Tensile modulus min. Test Method D 638, min, psi (MPa)	Unspecified	100 000 (690)	300 000 (2073)	400 000 (2760)	500 000 (3448)	600 000 (4137)	800 000 (5516)	1 00 000 (6895)	1 200 000 (8276)	Specify Value
4	Dimensional stability, % max per 12.2	Unspecified	0.1	0.2	0.3	0.4	0.6	0.8	1.0	1.5	Specify Value
5	Flexural modulus, Test Method D 790, min, psi (MPa)	Unspecified	200 000 (1379)	300 000 (2073)	400 000 (2760)	500 000 (3448)	600 000 (4137)	700 000 (4827)	800 000 (5516)	1 500 000 (10 343)	Specify Value
6	Izod impact, Test Method D 256, min ft.lbs./in. of notch (J/M of notch)	Unspecified	0.2 (11)	0.4 (21)	0.6 (32)	1.0 (53)	1.5 (80)	3.0 (160)	4.0 (213)	5.0 (267)	Specify Value
7	To be determined	Unspecified	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .