



Designation: D 5927 – 99a

# Standard Specification for Thermoplastic Polyester (TPES) Injection and Extrusion Materials Based on ISO Test Methods<sup>1</sup>

This standard is issued under the fixed designation D 5927; 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 ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

## INTRODUCTION

This material specification is intended to provide a callout system for thermoplastic polyester materials based on ISO test methods.

### 1. Scope \*

1.1 This specification covers thermoplastic polyester materials suitable for molding or extrusion.

1.2 This specification allows for the use of recycled thermoplastic polyester materials provided that the requirements as stated in this specification are met. The proportions of recycled material used, as well as the nature and amount of any contaminant, however, cannot be covered practically in this specification.

1.3 The properties included in this specification are those required to identify the compositions covered. There may be other requirements necessary to identify particular characteristics important to specialized applications. These may be specified by using the suffixes as given in Section 5.

1.4 This classification system and subsequent line callout (specification) are intended to provide a means of calling out plastic materials used in the fabrication of end items or parts. It is not intended for the selection of materials. Material selection should be made by those having expertise in the plastic field after careful consideration of the design and performance required of the part, the environment to which it will be exposed, the fabrication process to be used, the costs involved, and the inherent properties of the material other than those covered by this specification.

1.5 The values stated in SI units are to be regarded as the standard. The values given in parentheses are for information only.

1.6 The following hazard caveat pertains only to the test methods portion, Section 11, 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—This specification is similar to ISO 7792-1:1995 and ISO 7792-2:1988, although the technical content is significantly different.

### 2. Referenced Documents

#### 2.1 ASTM Standards:

D 883 Terminology Relating to Plastics<sup>2</sup>

D 1600 Terminology for Abbreviated Terms Relating to Plastics<sup>2</sup>

D 3892 Practice for Packaging/Packing of Plastics<sup>3</sup>

D 4000 Classification System for Specifying Plastic Materials<sup>3</sup>

E 29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications<sup>4</sup>

#### 2.2 IEC and ISO Standards:<sup>5</sup>

IEC 112 Recommended Method for Determining the Comparative Tracking Index of Solid Insulation Materials

IEC 243 Recommended Methods of Test for Electrical Strength of Solid Insulating Materials at Power Frequencies

ISO 62 Plastics—Determination of Water Absorption

ISO 75-1:1993 Plastics—Determination of Temperature of Deflection Under Load—Part 1: General Test Methods

ISO 75-2:1993 Plastics—Determination of Temperature of Deflection Under Load—Part 2: Plastics and Ebonite

ISO 178:1993 Plastics—Determination of Flexural Properties

ISO 180:1993 Plastics—Determination of Izod Impact Strength

ISO 291:1977 Plastics—Standard Atmospheres for Conditioning and Testing

ISO 294-1:1996 Plastics—Injection Moulding of Test Specimens of Thermoplastic Materials—Part 1: General Principles, Multipurpose-Test Specimens (ISO Mould Type A) and Bars (ISO Mould Type B)

<sup>1</sup> 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.

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<sup>2</sup> Annual Book of ASTM Standards, Vol 08.01.

<sup>3</sup> Annual Book of ASTM Standards, Vol 08.02.

<sup>4</sup> Annual Book of ASTM Standards, Vol 14.02.

<sup>5</sup> Available from American National Standards Institute, 11 W. 42nd St., 13th Floor, New York, NY 10036.

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

ISO 527-1:1993 Plastics—Determination of Tensile Properties—Part 1: General Principles

ISO 527-2:1993 Plastics—Determination of Tensile Properties—Part 2: Testing Conditions

ISO 604 Plastics—Determination of Compressive Properties

ISO/DIS 1133:1995 Plastics—Determination of the Melt Mass-Flow Rate (MFR) and the Melt Volume-Flow Rate (MVR) of Thermoplastics

ISO 1183:1987 Plastics—Methods for Determining the Density and Relative Density of Non-Cellular Plastics

ISO 3451-2:1984 Plastics—Determination of Ash—Part 2: Polyalkylene Terephthalates

ISO 7792-1:1995 Plastics—Saturated Polyester (SP) Moulding and Extrusion Materials—Part 1: Designation System and Basis for Specification

ISO 7792-2:1988 Plastics—Polyalkylene Terephthalates—Part 2: Preparation of Test Specimens and Determination of Properties

2.3 *Underwriters Laboratories (UL):*<sup>6</sup>

UL 94 Test for Flammability of Plastic Materials for Parts in Devices and Appliances

2.4 *National Technical Information Service (NTIS):*<sup>7</sup>

AD297457 Procedure and Analytical Method for Determining Toxic Gases Produced by Synthetic Compounds

### 3. Terminology

3.1 *Definitions*—The terminology used in this specification is in accordance with Terminologies D 883 and D 1600.

### 4. Classification

4.1 Thermoplastic polyester materials are classified into groups according to their composition. These groups are subdivided into classes and grades, as indicated in the basic property table (Table TPES).

NOTE 2—An example of this classification system is as follows. The designation TPES 0113 would indicate:

TPES	=	thermoplastic polyester as found in Terminology D 1600,
01 (group)	=	PBT,
1 (class)	=	general purpose, and
3 (grade)	=	requirements given in Table TPES.

4.1.1 Grades of reinforced or filled versions, or both, of the basic materials are identified by a single letter that indicates the reinforcement or filler used and two digits, in multiples of five, that indicate the nominal quantity in percent by weight. Thus, a letter designation G for glass reinforced and 35 for percent or reinforcement, G35, specifies a material with a nominal glass level of 35 %. The reinforcement letter designations and associated tolerance levels are shown as tabulated as follows:

Symbol	Material	Tolerance
C	carbon- and graphite-fiber-reinforced	±2 %
G	glass-reinforced	±2 %
L	lubricants (such as PTFE, graphite, silicone, and molybdenum disulfide)	depends on material and process—to be specified
M	mineral-reinforced	±2 %
R	combinations of reinforcements or fillers, or both	±3 %

NOTE 3—An example of this classification system for reinforced thermoplastic polyester is given as follows. The designation TPES 021G30 indicates the following:

TPES	=	thermoplastic polyester as found in Terminology D 1600,
02 (group)	=	PET,
1 (class)	=	unmodified, and
G30 (grade)	=	nominal 30 % glass with the requirements given in Table TPES.

NOTE 4—This part of the classification system uses the percent of reinforcements or fillers, or both, in the callout of the modified base material. The types and percentages of reinforcements and fillers should be shown on the supplier's technical data sheet unless they are proprietary in nature. If necessary, additional callout of these reinforcements and additives can be accomplished by use of the suffix part of the system (see Section 5).

NOTE 5—Materials containing reinforcements or fillers, or both, at nominal levels not in multiples of five are included in the nearest TPES designation. For example, a material with a nominal glass content of 28 % is included with Grade G30.

NOTE 6—The ash content of filled or reinforced materials may be determined using ISO 3451-2:1984.

4.2 Variations of thermoplastic polyester materials that are not included in Table TPES are classified in accordance with Table TPES and Table A or B. Table TPES is used to specify the group of thermoplastic polyester, and Table A or B is used to specify property requirements.

4.2.1 Specific requirements for variations of thermoplastic polyester materials shall be indicated by a six-character designator. The designation will consist of the letter "A" or "B" and the five digits comprising the cell numbers for the property requirements in the order as they appear in Table A or B.

4.2.1.1 Although the values listed are necessary to include the range of properties available in existing material, users should not infer that every possible combination of the properties exists or can be obtained.

4.2.2 When the grade of the basic material is not known or is not important, the use of "0" grade classification shall be used for materials in this system (see Note 7).

NOTE 7—An example of a reinforced thermoplastic polyester of this classification system is as follows. The designation TPES 0310G30A22450 would indicate the following material requirements from Table A:

TPES0310	=	PET copolymer, from Table TPES,
G30	=	glass-reinforced at 30 % nominal glass content,
A	=	Table A for property requirements,
2	=	tensile strength, 50 MPa, min,
2	=	flexural modulus, 2700 MPa, min,
4	=	Izod impact, 6.0 kJ/m <sup>2</sup> , min,
5	=	deflection temperature, 185°C, at 1.8 MPa, min,
	=	and
0	=	unspecified.

If no properties are specified, the designation would be TPES 0310G30A00000.

<sup>6</sup> Available from Underwriters Laboratories, 333 Pfingsten Rd., Northbrook, IL 60062–2096.

<sup>7</sup> Available from NTIS, 5285 Port Royal Rd., Springfield, VA 22161.

**TABLE A Detailed Requirements:<sup>A</sup> Reinforced or Filled Thermoplastic Polyesters**

Designation Order Number	Property	Cell Limits									
		0	1	2	3	4	5	6	7	8	9
1	Tensile strength, ISO 527-1:1993 and ISO 527-2:1993, min, MPa <sup>B</sup>	unspecified	35	50	70	95	115	140	175	210	specify value <sup>C</sup>
2	Flexural modulus, ISO 178:1993, min, MPa <sup>D</sup>	unspecified	1 400	2 700	4 100	5 500	6 900	8 000	10 000	12 500	specify value <sup>C</sup>
3	Izod impact, ISO 180:1993, min, kJ/m <sup>2E</sup>	unspecified	1.5	3.0	4.5	6.0	8.5	11.0	13.5	17.5	specify value <sup>C</sup>
4	Deflection temperature under load at 1.8 MPa, ISO 75-1:1993 and ISO 75-2:1993, min, °C <sup>F</sup>	unspecified	50	100	120	150	185	205	220	235	specify value <sup>C</sup>
5	To be determined	...	...	...	...	...	...	...	...	...	...

<sup>A</sup> It is recognized that detailed test values, particularly Izod impact, may not predict nor even correlate with the performance of parts molded of these materials.

<sup>B</sup> Tensile strength shall be determined using a Type 1A tensile specimen as described in ISO 527-1:1993 and ISO 527-2:1993. Crosshead speed shall be 5 mm/min ± 25 %.

<sup>C</sup> If a specific value is required, it must appear on the drawing or contract, or both.

<sup>D</sup> The test specimen size shall be 80 by 10 by 4 mm, with a crosshead speed of 2 mm/min ± 20 %.

<sup>E</sup> The test specimen size shall be 80 by 10 by 4 mm, tested as described in ISO 180:1993, Method 1A.

<sup>F</sup> The test specimen size shall be 80 by 10 by 4 mm. The requirements are based on unannealed test specimens.

**TABLE B Detailed Requirements:<sup>A</sup> Special Thermoplastic Polyesters**

Designation Order Number	Property	Cell Limits									
		0	1	2	3	4	5	6	7	8	9
1	Tensile strength, ISO 527-1:1993 and ISO 527-2:1993, min, MPa <sup>B</sup>	unspecified	10	30	35	40	45	50	60	80	specify value <sup>C</sup>
2	Flexural modulus, ISO 178:1993, min, MPa <sup>D</sup>	unspecified	100	350	1000	1500	2000	2500	3000	4000	specify value <sup>C</sup>
3	Izod impact, ISO 180:1993, min, kJ/m <sup>2E</sup>	unspecified	2.0	3.5	5.0	8.0	13.0	18.0	25.0	50.0	specify value <sup>C</sup>
4	Deflection temperature under load at 1.8 MPa, ISO 75-1:1993 and ISO 75-2:1993, min, °C <sup>F</sup>	unspecified	30	45	60	70	80	90	100	115	specify value <sup>C</sup>
5	To be determined	...	...	...	...	...	...	...	...	...	...

<sup>A</sup> It is recognized that detailed test values, particularly Izod impact, may not predict nor even correlate with the performance of parts molded of these materials.

<sup>B</sup> Tensile strength shall be determined using a Type 1A tensile specimen, as described in ISO 527-1:1993 and ISO 527-2:1993. Crosshead speed shall be 50 mm/min ± 25 %.

<sup>C</sup> If a specific value is required, it must appear on the drawing or contract, or both.

<sup>D</sup> The test specimen size shall be 80 by 10 by 4 mm, with a crosshead speed of 2 mm/min ± 20 %.

<sup>E</sup> The test specimen size shall be 80 by 10 by 4 mm, tested as described in ISO 180:1993, Method 1A.

<sup>F</sup> The test specimen size shall be 80 by 10 by 4 mm. The requirements are based on unannealed test specimens.

**TABLE 1 Recommended Processing Conditions**

Material	Melt Temperature, °C	Mold Temperature, °C	Average Injection Veloc- ity, mm/s	Hold Pressure Time, s	Total Cycle Time, s
PBT, unfilled semicrystalline	260 ± 3	80 ± 5	200 ± 100	20 ± 5	40 ± 5
PBT, filled semicrystalline	260 ± 3	80 ± 5	200 ± 100	20 ± 5	40 ± 5
PET, unfilled amorphous	285 ± 3	20 ± 5	200 ± 100	20 ± 5	40 ± 5
PET, unfilled semicrystalline	275 ± 3	135 ± 5	200 ± 100	20 ± 5	40 ± 5
PET, filled semicrystalline	285 ± 3	135 ± 5	200 ± 100	20 ± 5	40 ± 5
PET, filled semicrystalline, nucleated	285 ± 3	110 ± 5	200 ± 100	20 ± 5	40 ± 5
PET, filled semicrystalline, flame-retarded	275 ± 3	135 ± 5	200 ± 100	20 ± 5	40 ± 5
PET, filled semicrystalline, flame-retarded, nucleated	275 ± 3	110 ± 5	200 ± 100	20 ± 5	40 ± 5
PCT, unfilled amorphous	300 ± 3	20 ± 3	200 ± 100	20 ± 5	40 ± 5
PCT, unfilled semicrystalline	300 ± 3	120 ± 5	200 ± 100	20 ± 5	40 ± 5
PCT, filled semicrystalline	300 ± 3	120 ± 5	200 ± 100	20 ± 5	40 ± 5
PEN, unfilled amorphous	300 ± 3	20 ± 3	200 ± 100	20 ± 5	40 ± 5

4.3 Table B has been incorporated into this specification to facilitate the classification of special materials for which Table TPES or Table A do not reflect the required properties. Table B shall be used in the same manner as Table A.

NOTE 8—The mechanical properties of pigmented or colored thermoplastic polyester materials can differ from the mechanical properties of natural thermoplastic polyester material, depending on the choice of

colorants and the concentration. The main property affected is ductility, as illustrated by a reduction in Izod impact strength and tensile elongation values. If specific properties of pigmented thermoplastic polyester materials are necessary, prior testing between the materials supplier and end user should be initiated. Once these agreements are reached, a classification using Table B should be used to ensure proper property compliance.

NOTE 9—An example of a special material using this classification system is as follows. The designation TPES0210B54220 would indicate

**TABLE TPES Detail Requirements for Thermoplastic Polyesters<sup>A</sup>**

Group	Description	Class	Description	Grade	Description <sup>B</sup>	Flow Rate, ISO/DIS, 1133, g/10 min	Density, ISO 1183:1987, g/cm <sup>3</sup>	Tensile Strength, ISO 527-1:1993 and ISO 527-2: 1993, <sup>C</sup> min, MPa	Flexural Modulus, ISO 178:1993, <sup>D</sup> min, GPa	Izod Impact Resistance, ISO 180: 1993, <sup>E</sup> min, kJ/m <sup>2</sup>	Deflection Temperature at 1.8 MPa, ISO 75-1: 1993 and ISO 75-2:1993, <sup>F</sup> min, °C			
01	Polybutylene terephthalate (PBT)	1	general purpose	1		<6 250/2.16 <sup>G</sup>	1.28 to 1.34	45	1.9	1.4	...			
				2		<12 250/2.16 <sup>G</sup>	1.28 to 1.34	45	1.9	1.4	...			
				3		<20 250/2.16 <sup>G</sup>	1.28 to 1.34	45	1.9	1.4	...			
				4		<35 250/2.16 <sup>G</sup>	1.28 to 1.34	45	1.9	1.4	...			
				5		<60 250/2.16 <sup>G</sup>	1.28 to 1.34	45	1.9	1.4	...			
				6		<100 250/2.16 <sup>G</sup>	1.28 to 1.34	45	1.9	1.4	...			
				0	other									
				G10	10 % glass	...	1.34 to 1.38	70	3.5	2.0	...			
				G15	15 % glass	...	1.36 to 1.44	80	4.5	2.5	170			
				G20	20 % glass	...	...	80	5.5	4.0	...			
				G30	30 % glass	...	1.50 to 1.56	85	6.0	3.5	190			
				G40	40 % glass	...	1.58 to 1.64	115	7.0	7.0	190			
				G00	other	...								
				R35	35 % filler	...	...	75	6.5	2.5	...			
				R40	40 % filler	...	1.58 to 1.64	85	6.0	2.8	180			
		R00	other	...										
		2	impact modified	1		<20 250/5.0 <sup>G</sup>	1.2 to 1.3	25	1.2	NB	...			
				0	other	...								
				G10	10 % glass	...	1.25 to 1.35	35	2.4	9.0	85			
				G15	15 % glass	...	1.31 to 1.37	50	3.5	12.0	140			
				G30	30 % glass	...	1.42 to 1.52	70	5.0	8.0	170			
				G00	other	...								
				R40	40 % filler	...	1.49 to 1.59	65	6.5	6.0	150			
				R00	other	...								
				3	flame-retarded	1	unfilled	...	1.38 to 1.48	45	2.0	1.5	60	
						0	other	...						
						G10	10 % glass	...	1.45 to 1.55	60	4.0	2.0	130	
						G15	15 % glass	...	1.48 to 1.58	62	3.0	2.0	180	
						G30	30 % glass	...	1.58 to 1.70	85	3.5	3.0	190	
						G00	other	...						
R30	30 % filler					...	1.71 to 1.77	80	9.0	2.0	185			
R00	other	...												
4	flame-retarded, impact-modified	1				...	1.26 to 1.36	25	1.4	NB	45			
		0	other			...								
0	other	0	other	...										
02	Polyethylene terephthalate (PET)	1	unmodified	1		<20.0 285/2.16 <sup>H</sup>	1.26 to 1.43	50	2.0	2.8	60			
				0										
				G15	15 % glass	...	1.26 to 1.52	75	4.0	4.0	180			
				G20	20 % glass	...	1.43 to 1.60	80	6.0	5.0	190			
				G30	30 % glass	...	1.46 to 1.65	115	8.0	5.0	200			
				G40	40 % glass	...	1.59 to 1.73	120	11.0	5.0	200			
				G45	45 % glass	...	1.64 to 1.85	120	12.0	5.0	210			
				G55	55 % glass	...	1.76 to 1.86	160	12.0	5.0	220			
				G00	other	...	...	...	...	...	...			
				R15	15 % filler	...	1.35 to 1.45	85	3.5	3.0	150			
				R35	35 % filler	...	1.53 to 1.65	75	7.5	4.0	165			
				R40	40 % filler	...	1.54 to 1.70	90	7.0	4.0	195			
				R45	45 % filler	...	1.65 to 1.75	145	12.0	8.0	225			
				R00	other	...	...	...	...	...	...			
				2	impact-modified	G15	15 % glass	...	1.35 to 1.45	60	3.0	5	170	
		G30	30 % glass			...	1.46 to 1.56	100	7.0	10	205			
		G35	35 % glass			...	1.49 to 1.59	85	6.0	15	200			
		G00	other			...	...	...	...	...	...			
		G00	other			...	...	...	...	...	...			
		3	flame-retarded	G15	15 % glass	...	1.50 to 1.67	70	4.5	3.5	175			
G20	20 % glass			...	1.56 to 1.70	80	5.5	4.5	190					
G30	30 % glass			...	1.62 to 1.78	95	9.0	4.0	200					

**TABLE TPES<sup>A</sup> Continued**

Group	Description	Class	Description	Grade	Description <sup>B</sup>	Flow Rate, ISO/DIS, 1133, g/10 min	Density, ISO 1183:1987, g/cm <sup>3</sup>	Tensile Strength, ISO 527-1:1993 and ISO 527-2: 1993, <sup>C</sup> min, MPa	Flexural Modulus, ISO 178:1993, <sup>D</sup> min, GPa	Izod Impact Resistance, ISO 180: 1993, <sup>E</sup> min, kJ/m <sup>2</sup>	Deflection Temperature at 1.8 MPa, ISO 75-1: 1993 and ISO 75-2:1993, <sup>F</sup> min, °C
				G40	40 % glass	...	1.71 to 1.83	100	11.5	6.0	200
				G45	45 % glass	...	1.75 to 1.85	140	12.0	10	215
				G00	other	...	...	...	...	...	...
				R45	45 % filler	...	1.70 to 1.91	100	11.0	4.0	205
				R00	other	...	...	...	...	...	...
		0	other	0	other						
03	Polyethylene terephthalate copolymer (PET)	1	PETG <sup>I</sup>	1	other	...	1.20 to 1.35	40	1.7	5.0	50
				0	other						
		0	other	0	other						
04	Polybutylene terephthalate copolymer (PBT)	1	general purpose	1	other	<20 250/2.16 <sup>G</sup>	1.24 to 1.34	...	...	...	...
				0	other	<20 250/2.16 <sup>G</sup>	...	...	...	...	...
		2		1		<65 250/2.16 <sup>G</sup>	1.19 to 1.31	...	...	...	...
				2			1.24 to 1.32	...	...	...	...
				0	other		...	...	...	...	...
		0	other	0	other	...					
05	Blend polybutylene terephthalate and polycarbonate (PBT + PC)	1		1	other	...	...	...	...	...	...
				0	other	...	...	...	...	...	...
		0		0	other	...	...	...	...	...	...
06	Blend polybutylene terephthalate + polyethylene terephthalate (PBT + PET)	1	general purpose	1	other						
				0	other						
				G15	15 % glass	...	1.36 to 1.48	60	4.0	2.5	170
				G30	30 % glass	...	1.47 to 1.60	70	6.0	3.0	180
				G40	40 % glass	...	1.58 to 1.70	80	9.0	3.5	200
				G00	other	...	...	...	...	...	...
				R30	30 % filler	...	1.50 to 1.60	90	7.0	1.0	190
				R40	40 % filler	...	1.52 to 1.64	65	8.0	1.0	180
				R00	other	...	...	...	...	...	...
		2	impact-modified	R40	40 % filler	...	1.49 to 1.59	60	5.5	6.0	150
				R00	other						
		0	other	0	other						
08	Blend polybutylene terephthalate + thermoplastic elastomer ether ester (PBT + TETE)	1	general purpose	1		<25 240/2.16 <sup>J</sup>	1.18 to 1.24	10	0.7	NB	...
				2		<25 250/2.16 <sup>J</sup>	1.1 to 1.2	7	0.2	NB	...
				0	other	...	...	...	...	...	...
				R25	25 % filler	...	1.36 to 1.46	20	0.9	13	...
				R00	other	...	...	...	...	...	...

**TABLE TPES<sup>A</sup> Continued**

Group	Description	Class	Description	Grade	Description <sup>B</sup>	Flow Rate, ISO/DIS, 1133, g/10 min	Density, ISO 1183:1987, g/cm <sup>3</sup>	Tensile Strength, ISO 527-1:1993 and ISO 527-2: 1993, <sup>C</sup> min, MPa	Flexural Modulus, ISO 178:1993, <sup>D</sup> min, GPa	Izod Impact Resistance, ISO 180: 1993, <sup>E</sup> min, kJ/m <sup>2</sup>	Deflection Temperature at 1.8 MPa, ISO 75-1: 1993 and ISO 75-2:1993, <sup>F</sup> min, °C		
		0	other	0	other						<i>GHU</i>		
09	Blend (PCTG + PC)	1	unmodified	1	chemical and medium heat resistance	...	1.17 to 1.23	48	1.9	NB	75		
				2	chemical and low heat resistance	...	1.18 to 1.24	45	1.7	NB	65		
				0	other								
		0	other	0	other								
10	Poly(1,4-cyclohexylene-dimethylene terephthalate) (PCT)	1	unmodified	1	unfilled	...	1.18 to 1.33	55	2.0	2.5	60		
				0	other								
				G15	15 % glass	...	1.25 to 1.40	70	4.5	3.0	210		
				G20	20 % glass	...	1.30 to 1.45	85	5.0	4.0	235		
				G30	30 % glass	...	1.37 to 1.52	100	7.5	4.5	240		
				G40	40 % glass	...	1.46 to 1.60	115	9.5	5.5	240		
				G00	other								
				R30	30 % filler	...	1.37 to 1.52	80	6.0	3.5	235		
				R40	40 % filler	...	1.49 to 1.63	90	10.0	3.5	240		
				R00	other								
				2	flame-retarded/ filled	G15	15 % glass	...	1.44 to 1.58	70	4.0	3.0	185
				G20	20 % glass	...	1.47 to 1.61	80	6.0	3.5	200		
				G30	30 % glass	...	1.54 to 1.68	95	7.0	3.5	220		
G40	40 % glass	...	1.63 to 1.77	100	10.0	4.5	225						
G00	other												
R40	40 % filler	...	1.65 to 1.80	80	11.0	3.0	210						
R00	other												
		0	other	0	other								
11	PCT copolymer	1	PCTA <sup>K</sup>	1	unfilled	...	1.20 to 1.30	50	1.5	1.0	60		
				0	other								
				G15	15 % glass	...	1.27 to 1.37	55	3.5	2.5	190		
				G20	20 % glass	...	1.37 to 1.41	60	5.5	3.5	220		
				G30	30 % glass	...	1.38 to 1.48	60	7.0	5.0	250		
				G00	other								
				2	PCTG <sup>L</sup>	1	unfilled	...	1.16 to 1.30	40	1.5	NB	60
				G10	10 % glass	...	1.22 to 1.36	65	2.0	4.0	70		
				G20	20 % glass	...	1.28 to 1.42	85	4.5	11.0	70		
				G30	30 % glass	...	1.38 to 1.52	95	6.5	11.5	70		
G00	other												
		0	other	0	other								
12	Blend (PCT + PC)	1	unmodified	1	chemical and high heat resistance	...	1.15 to 1.21	47	1.8	NB	85		
				0	other								
		0	other	0	other								

<sup>A</sup> Data on 4-mm test specimens are limited, and the minimum values may be changed in a later revision after a statistical database of sufficient size is generated.

<sup>B</sup> No descriptions are listed unless needed to describe a special grade under the class. All other grades are listed by requirements.

<sup>C</sup> Tensile strength shall be determined using a Type 1A tensile specimen as described in ISO 527-2:1993. The crosshead speed shall be 50 mm/min ± 10 % for unreinforced materials and 5 mm/min ± 20 % for reinforced grades.

<sup>D</sup> Flexural modulus shall be determined on a specimen 80 ± 2 mm by 10 ± 0.2 mm by 4 ± 0.2 mm at a test speed of 2 mm/min ± 20 %.

<sup>E</sup> Izod shall be determined on a specimen 80 ± 2 mm by 10 ± 0.2 mm by 4 ± 0.2 mm as described in ISO 180:1993, Method 1A.

<sup>F</sup> Deflection temperature shall be determined on an unannealed specimen 80 ± 2 mm by 10 ± 0.2 mm by 4 ± 0.2 mm as described in ISO 75-2:1993, Method Af.

<sup>G</sup> The moisture content of the specimen shall be below 0.02 %.

<sup>H</sup> The moisture content of the specimen shall be below 0.005 %.

<sup>I</sup> Polyethylene terephthalate, glycol modified (PETG).

<sup>J</sup> The moisture content of the specimen shall be below 0.01 %.

<sup>K</sup> Poly(1,4-cyclohexylenedimethylene terephthalate), acid modified (PCTA).

<sup>L</sup> Poly(1,4-cyclohexylenedimethylene terephthalate), glycol modified (PCTG).