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Standard Classification System for and Basis for Specifications for Thermoplastic Polyester (TPES) Injection and Extrusion Materials Based on ISO Test Methods¹

This standard is issued under the fixed designation D5927; 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 material classification system is intended to provide a callout system for thermoplastic polyester materials based on ISO test methods.

1. Scope*

- 1.1 This classification system covers thermoplastic polyester materials suitable for molding or extrusion.
- 1.2 This classification system allows for the use of recycled thermoplastic polyester materials provided that the requirements as stated in this classification system and subsequent line callout (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 standard are those required to identify the compositions covered. Other requirements necessary to identify particular characteristics important to specialized applications are to 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 can be made by those having expertise in the plastic field only 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 hazards 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 standard and ISO 7792-1:2012 and ISO 7792-2:2012 address the same subject matter, but differ in technical content.

2. Referenced Documents

2.1 ASTM Standards:²

- [D883 Terminology Relating to Plastics](#)
- [D1600 Terminology for Abbreviated Terms Relating to Plastics](#)
- [D3892 Practice for Packaging/Packing of Plastics](#)
- [D4000 Classification System for Specifying Plastic Materials](#)
- [D7209 Guide for Waste Reduction, Resource Recovery, and Use of Recycled Polymeric Materials and Products \(Withdrawn 2015\)³](#)
- [E29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications](#)

¹ This specification is under the jurisdiction of ASTM Committee D20 on Plastics and is the direct responsibility of Subcommittee D20.15 on Thermoplastic Materials. Current edition approved Dec. 1, 2014/March 1, 2017. Published December 2014/March 2017. Originally approved in 1996. Last previous edition approved in 2009/2014 as ~~D5927 – 09~~D5927 – 14. DOI: 10.1520/D5927-14.10.1520/D5927-17.

² 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.

³ The last approved version of this historical standard is referenced on www.astm.org.

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

2.2 IEC and ISO Standards:⁴

- 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 75-1:2013 Plastics—Determination of Temperature of Deflection Under Load—Part 1: General Test Methods
- ISO 75-2:2013 Plastics—Determination of Temperature of Deflection Under Load—Part 2: Plastics and Ebonite
- ISO 179-1:2010 Plastics—Determination of Charpy Impact Strength
- ISO 291:2008 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)
- ISO 527-1:2012 Plastics—Determination of Tensile Properties—Part 1: General Principles
- ISO 527-2:2012 Plastics—Determination of Tensile Properties—Part 2: Testing Conditions
- ISO 604 Plastics—Determination of Compressive Properties
- ISO 1133-2:2011 Plastics—Determination of the Melt Mass-Flow Rate (MFR) and the Melt Volume-Flow Rate (MVR) of Thermoplastics—Part 2: Method for Materials Sensitive to Time-Temperature History and/or Moisture
- ISO 1183-1:2012 Plastics—Methods for Determining the Density of Non-Cellular Plastics—Part 1: Immersion Method, Liquid Pyknometer Method, and Titration Method
- ISO 1183-2:2012 Plastics—Methods for Determining the Density of Non-Cellular Plastics—Part 2: Density Gradient Column Method
- ISO 1183-3:2012 Plastics—Methods for Determining the Density of Non-Cellular Plastics—Part 3: Gas Pyknometer Method
- ISO 3451-2 Plastics—Determination of Ash—Part 2: Polyalkylene Terephthalates
- ISO 7792-1:2012 Plastics—Saturated Polyester (SP) Moulding and Extrusion Materials—Part 1: Designation System and Basis for Specification
- ISO 7792-2:2012 Plastics—Polyalkylene Terephthalates—Part 2: Preparation of Test Specimens and Determination of Properties

2.3 Underwriters Laboratories (UL):⁵

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

2.4 National Technical Information Service (NTIS):⁶

- 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 **D883** and **D1600**.

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 D1600 ,
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:

TABLE Reinforcement-Filler^A Symbols^B and Tolerances

Symbol	Material	Tolerance
C	Carbon and graphite	±2 %
E	Clay	±2 %
G	Glass	±2 %
K	Calcium carbonate	±2 %
L	Lubricants (such as PTFE, graphite, silicone, and molybdenum disulfide)	depends on material and process—to be specified
M	Mineral	±2 %

⁴ Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, <http://www.ansi.org>.

⁵ Available from Underwriters Laboratories (UL), 333 Pfingsten Rd., Northbrook, IL 60062-2096, <http://www.ul.com>.

⁶ Available from National Technical Information Service (NTIS), 5285 Port Royal Rd., Springfield, VA 22161, <http://www.ntis.gov>.

P	Mica	±2 %
R	Combinations of reinforcements and/or fillers	±3 %
S	Synthetic organic	±2 %
T	Talcum	±2 %
X	Not specified	To be specified

^AAsh content of filled and/or reinforced materials can be determined using ISO 3451-2 where applicable.

^BAdditional symbols can be added to this table as required.

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 D1600 ,
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 are sometimes shown on the supplier’s technical data sheet. 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 is determined using ISO 3451-4.

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, not 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).

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TABLE A Detailed Requirements:^A 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 527-1:2012 and ISO 527-2:2012, min, MPa ^B	unspecified	35	50	70	95	115	140	175	210	specify value ^C
2	Tensile modulus, ISO 527-1:2012 and ISO 527-2:2012, min, MPa ^D	unspecified	1 400	2 700	4 100	5 500	6 900	8 000	10 000	12 500	specify value ^C
3	Charpy impact, ISO 179-1:2010, min, kJ/m ^{2E}	unspecified	1.5	3.0	4.5	6.0	8.5	11.0	13.5	17.5	specify value ^C
4	Deflection temperature under load at 1.8 MPa, ISO 75-1:2013 and ISO 75-2:2013, min, °C ^F	unspecified	50	100	120	150	185	205	220	235	specify value ^C
5	To be determined	...	...	...	...	...	...	...	...	...	...

^A It is recognized that detailed test values, particularly Charpy impact, do not necessarily predict nor even correlate with the performance of parts molded of these materials.

^B Tensile strength shall be determined using a Type 1AA1 tensile specimen as described in ISO 527-2:2012. Crosshead speed shall be 5 mm/min ± 20 %.

^C If a specific value is required, it must appear on the drawing or contract, or both.

^D Tensile modulus shall be determined using a Type 1AA1 tensile specimen as described in ISO 527-2:2012 at a test speed of 1 mm/min ± 20 %.

^E The test specimen shall be 80 ± 2 by 10 ± 0.2 by 4 ± 0.2 mm, cut from the center of the Type 1AA1 tensile specimen and tested as described in ISO 179:2010, Method 1eA.

^F The test specimen size shall be 80 ± 2 by 10 ± 0.2 by 4 ± 0.2 mm, cut from the center of the Type 1AA1 tensile specimen. The requirements are based on unannealed test specimens.

TABLE B Detailed Requirements:^A Special Thermoplastic Polyesters

Designation Order Number	Property	Cell Limits									
		0	1	2	3	4	5	6	7	8	9
1	Tensile strength, ISO 527-1:2012 and ISO 527-2:2012, min, MPa ^B	unspecified	10	30	35	40	45	50	60	80	specify value ^C
2	Tensile modulus, ISO 527-1:2012 and ISO 527-2:2012, min, MPa ^D	unspecified	100	350	1000	1500	2000	2500	3000	4000	specify value ^C
3	Charpy impact, ISO 179:2010, min, kJ/m ^{2E}	unspecified	2.0	3.5	5.0	8.0	13.0	18.0	25.0	50.0	specify value ^C
4	Deflection temperature under load at 1.8 MPa, ISO 75-1:2013 and ISO 75-2:2013, min, [°]	unspecified	30	45	60	70	80	90	100	115	specify value ^C
5	To be determined	...	...	...	...	...	...	...	...	...	...

^AIt is recognized that detailed test values, particularly Charpy impact, do not necessarily predict nor even correlate with the performance of parts molded of these materials.

^BTensile strength shall be determined using a Type ~~4AA1~~ tensile specimen as described in ISO 527-2:2012. Crosshead speed shall be 50 mm/min ± 10 %.

^CIf a specific value is required, it must appear on the drawing or contract, or both.

^DTensile modulus shall be determined using a Type ~~4AA1~~ tensile specimen as described in ISO 527-2:2012 at a test speed of 1 mm/min ± 20 %.

^EThe test specimen shall be 80 ± 2 by 10 ± 0.2 by 4 ± 0.2 mm, cut from the center of the Type ~~4AA1~~ tensile specimen and tested as described in ISO 179:2010, Method 1eA.

^FThe test specimen size shall be 80 ± 2 by 10 ± 0.2 by 4 ± 0.2 mm, cut from the center of the Type ~~4AA1~~ tensile specimen. The requirements are based on unannealed test specimens.

TABLE 1 Recommended Processing Conditions

Material	Melt Temperature, °C	Mold Temperature, °C	Average Injection Velocity, 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

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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	=	tensile modulus, 2700 MPa, min,
4	=	Charpy impact, 6.0 kJ/m ² , min,
5	=	deflection temperature, 185°C, at 1.8 MPa, min,
0	=	and unspecified.

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

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, thus requiring the use of Table A or B as appropriate to specify the material.

NOTE 9—An example of a special material using this classification system is as follows. The designation TPES0210B54220 would indicate the following material requirements from Table B:

TPES0210	=	PET, unmodified, from Table TPES,
B	=	Table B for property requirements,
5	=	tensile strength, 45 MPa, min,
4	=	tensile modulus, 1500 MPa, min,
2	=	Charpy impact, 3.5 kJ/m ² , min,
2	=	deflection temperature, 45°C, at 1.8 MPa, min,
		and
0	=	unspecified.

TABLE TPES Detail Requirements for Thermoplastic Polyesters^A

Group	Description	Class	Description	Grade	Description ^B	Flow Rate, ISO 1133-2:2011, g/10 min	Density, ISO 1183-1/-2/- 3:2012, g/cm ³	Tensile Strength, ISO 527-1:2012 and ISO 527-2: 2012, ^C min, MPa	Tensile Modulus, ISO 527-1:2012 and ISO 527-2:2012, ^D min, MPa	Charpy Impact ISO 179:2010, ^E min, kJ/m ²	Deflection Temperature at 1.8 MPa, ISO 75-1: 2013 and ISO 75-2:2013, ^F min, °C		
01	Polybutylene terephthalate (PBT)	1	general purpose	1		<6 250/2.16 ^G	1.28 to 1.34	45	1 800	3.0	...		
				2		<12 250/2.16 ^G	1.28 to 1.34	45	1 800	3.0	...		
				3		<20 250/2.16 ^G	1.28 to 1.34	45	1 800	3.0	...		
				4		<35 250/2.16 ^G	1.28 to 1.34	45	1 800	3.0	...		
				5		<60 250/2.16 ^G	1.28 to 1.34	45	1 800	3.0	...		
				6		<100 250/2.16 ^G	1.28 to 1.34	45	1 800	3.0	...		
				G10	10 % glass	...	1.34 to 1.38	70	4 000	3.0	145		
				G15	15 % glass	...	1.36 to 1.47	75	4 500	3.0	160		
				G20	20 % glass	...	...	80	6 000	4.5	...
				G30	30 % glass	...	1.50 to 1.59	85	7 000	6.0	190		
				G40	40 % glass	...	1.58 to 1.65	115	10 000	6.0	190		
				R40	40 % filler	...	1.54 to 1.64	85	9 000	3.0	180		
				0	other								
				2	impact modified	1		<20 250/5.0 ^G	1.16 to 1.32	20	1 000	45	...
		G05	5 % glass			...	1.26 to 1.36	35	2 300	7.0	55		
		G10	10 % glass			...	1.25 to 1.35	35	3 500	3.3	85		
		G15	15 % glass			...	1.31 to 1.37	45	3 000	7.0	130		
		G30	30 % glass			...	1.42 to 1.53	70	7 000	7.0	145		
		R40	40 % filler			...	1.49 to 1.59	60	5 000	7.0	150		
		0	other										
		3	flame- retarded			1	unfilled		1.38 to 1.52	40	2 000	0.7	40
						G10	10 % glass	...	1.45 to 1.55	60			130
						G15	15 % glass	...	1.48 to 1.60	62	5 000	3.0	180
						G30	30 % glass	...	1.58 to 1.75	85	7 000	4.0	165
						R30	30 % filler	...	1.71 to 1.77	80	8 000	4.0	185
						R35	35 % filler	...	1.60 to 1.77	60	8 000	2.0	175
						0	other						
		4	flame- retarded, impact- modified	1		...	1.26 to 1.36	25	1 200	20	45		
0	other	0	other										
02	Polyethylene terephthalate (PET)	1	unmodified	1		<20.0 285/2.16 ^H	1.26 to 1.43	50			60		
				G15	15 % glass	...	1.26 to 1.52	75	4 000	3.0	160		
				G20	20 % glass	...	1.43 to 1.60	80			190		
				G30	30 % glass	...	1.46 to 1.65	115	7 500	7.0	200		
				G40	40 % glass	...	1.59 to 1.75	120	11 000	5.0	200		
				G45	45 % glass	...	1.64 to 1.85	120	12 000	7.0	210		
				G55	55 % glass	...	1.76 to 1.86	160	15 000	5.0	220		
				R15	15 % filler	...	1.35 to 1.45	70	4 000	1.0	90		
				R35	35 % filler	...	1.53 to 1.65	70	8 500	3.0	165		
				R40	40 % filler	...	1.54 to 1.70	85	10 000	4.0	185		
				R45	45 % filler	...	1.65 to 1.76	90	12 000	3.0	200		
				0	other								
				2	impact- modified	G15	15 % glass	...	1.35 to 1.45	60	3 000	5.0	170
						G30	30 % glass	...	1.46 to 1.56	100	7 000	9.0	205
		G35	35 % glass			...	1.49 to 1.59	85	6 000	15.0	200		
		0	other										
		3	flame- retarded			G15	15 % glass	...	1.50 to 1.67	70	5 000	3.5	175
						G20	20 % glass	...	1.56 to 1.70	80			190
						G30	30 % glass	...	1.62 to 1.78	95	8 000	4.0	200
				G40	40 % glass	...	1.71 to 1.83	100			200		
				G45	45 % glass	...	1.75 to 1.85	140	12 000	8.0	215		
R45	45 % filler	...	1.70 to 1.91	80	11 000	3.0	180						

Group	Description	Class	Description	Grade	Description ^E	Flow Rate, ISO 1133-2:2011, g/10 min	Density, ISO 1183-1/-2/- 3:2012, g/cm ³	Tensile Strength, ISO 527-1:2012 and ISO 527-2: 2012, ^C min, MPa	Tensile Modulus, ISO 527-1:2012 and ISO 527-2:2012, ^D min, MPa	Charpy Impact ISO 179:2010, ^E min, kJ/m ²	Deflection Temperature at 1.8 MPa, ISO 75-1: 2013 and ISO 75-2:2013, ^F min, °C
		0	other	0	other	...					
03	PET copolymer	1	PETG ^I	1	other	...	1.20 to 1.35	40			50
		0	other	0	other						
04	PBT copolymer	1	general purpose	0	other			...			...
		2		G30 0	30 % glass other		1.55 to 1.75	90	9 000	2.0	150
		0	other	0	other	...					
05	Blend PBT and polycarbonate (PBT + PC)	1	general purpose	1 G10 G30 0	10 % glass 30 % glass other	<28 265/5 ^G	1.20-1.24 1.25-1.36 1.46-1.54	58 50 80	2 500 2 700 7 000	13 2.0 6.0	90 90 125
		2	impact- modified	1 2 G10 0	10 % glass other	<17 250/5 ^G <13 265/5 ^G ...	1.17-1.21 1.17-1.21 1.27-1.31	47 45 50	1 500 1 200 2 700	44 35 6.0	73 77 89
		0	other	0	other						
06	Blend (PBT + PET)	1	general purpose	1 G15 G30 G40 R30 R40 0	15 % glass 30 % glass 40 % glass 30 % filler 40 % filler other	... ... ... ... ... ...	1.36 to 1.48 1.47 to 1.60 1.58 to 1.70 1.50 to 1.60 1.52 to 1.67	60 70 80 90 65	8 000 7 000 8 000	7.0 4.0 2.0	170 180 200 190 180
		2	impact- modified	R30 R40 0	30 % filler 40 % filler other	... ... ...	1.49 to 1.67	70 60	6 500	3.0	145 150
		0	other	0	other						
08	Blend PBT and thermoplastic elastomer ether ester (PBT + TEEE)	1	general purpose	1 2 3 0	1 2 3 other	<25 240/2.16 ^J <25 250/2.16 ^J <25 250/2.16 ^J	1.18 to 1.24 1.0 to 1.3 1.16 to 1.32	10 7 20	200 1 000	30 40	... ... 40 ...
		0	other	0	other						...
09	Blend PCTG ^K and PC (PCTG + PC)	1	unmodified	1 2 0	chemical and medium heat resistance chemical and low heat resistance other	... ... ...	1.17 to 1.23 1.18 to 1.24	48 45			75 65
		0	other	0	other						G,H,I,J
10	Poly(1,4-cyclo- hexylene- dimethylene terephthalate) (PCT)	1	unmodified	1 G15 G20 G30 G40 R30 R40 0	unfilled 15 % glass 20 % glass 30 % glass 40 % glass 30 % filler 40 % filler other	... ... ... ... ... ... ...	1.18 to 1.33 1.25 to 1.40 1.30 to 1.45 1.37 to 1.52 1.46 to 1.60 1.37 to 1.52 1.49 to 1.63	55 70 85 100 115 80 90	5 000 7 000	5.5 6.0	60 210 235 240 240 235 240
		2	flame- retarded	G15 G20 G30 G40 R40 0	15 % glass 20 % glass 30 % glass 40 % glass 40 % filler other	... ... ... ... ... ...	1.44 to 1.58 1.47 to 1.61 1.54 to 1.68 1.63 to 1.77 1.65 to 1.80	70 80 95 100 80			185 200 220 225 210
		0	other	0	other						
11	PCT copolymer	1	PCTA ^L	1 G15	unfilled 15 % glass	... ...	1.20 to 1.30 1.27 to 1.37	50 55			60 190