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StandardSpecification for Polycarbonate (PC) Unfilled and Reinforced Material[1]

This standard is issued under the fixed designation D3935; 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 U.S. Department of Defense.

1. Scope*

1.1 This specification covers unfilled and reinforced polycarbonate and polycarbonate copolymer materials suitable for injection molding, blow molding, and extrusion. Some of these compositions may also find use for compression molding or application from solution.

1.2 The properties in this specification are those required for identifying the compositions covered. There may be other requirements necessary for identifying particular characteristics important to specific applications. Those may be specified by using the suffixes in accordance with Section 5.

1.3 The values stated in SI units are to be regarded as the standard.

NOTE 1—This specification and ISO 7391-1 and ISO 7391-2 address the same subject matter, but differ in technical content.

1.4 The following hazards caveat pertains only to the test methods portion, Section 12, of this specification. *This standard does not purport to address all 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 or regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D256 Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics
D638 Test Method for Tensile Properties of Plastics
D648 Test Method for Deflection Temperature of Plastics Under Flexural Load in the Edgewise Position
D790 Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials
D792 Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement
D883 Terminology Relating to Plastics
D1238 Test Method for Melt Flow Rates of Thermoplastics by Extrusion Plastometer
D1600 Terminology for Abbreviated Terms Relating to Plastics
D2584 Test Method for Ignition Loss of Cured Reinforced Resins
D3892 Practice for Packaging/Packing of Plastics
D4000 Classification System for Specifying Plastic Materials
D5630 Test Method for Ash Content in Plastics
E29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications
E169 Practices for General Techniques of Ultraviolet-Visible Quantitative Analysis

2.2 *ISO Standard:*[3]

ISO 7391-1 Plastics—Polycarbonate Molding and Extrusion Materials (Part 1: Designation—2006)
ISO 7391-2 Plastics—Polycarbonate Molding and Extrusion Materials (Part 2: Preparation of Test Specimens and Determination of Properties)

3. Terminology

3.1 *Definitions*—The terminology used in this specification is in accordance with Terminologies D883 and D1600. The polycarbonate materials will be designated PC as specified in Terminology D1600.

4. Classification

4.1 Unfilled polycarbonate materials are classified into groups according to their composition. These groups are subdivided into classes and grades as shown in Table PC

[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.

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

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

TABLE PC Polycarbonate Materials and Detail Requirements

NOTE 1— The values are for naturals; colors may be different.

Group	Description	Class	Description	Grade	Description[A]	Flow Rate,[B] Test Method D1238, g/10 min	Specific Gravity, Test Method D792	Izod Impact,[C] Test Methods D256, J/m, min	Tensile Yield Strength[D] Test Method D638, MPa, min	Elongation at Break[D] Test Method D638, %, min	Flexural Modulus,[E] Test Methods D790, MPa, min	Deflection Temperature, Test Method D648,[F] °C, min
01	PC	1	general purpose	1		>24	1.19–1.22			use Table B		
				2		15 to 30	1.19–1.22			use Table B		
				3		12 to 20	1.19–1.22	640	55	100	2000	126
				4		9 to 18	1.19–1.22	750	60	105	2100	126
				5		6 to 13	1.19–1.22	750	60	110	2200	128
				6		4 to 8	1.19–1.22	750	60	110	2200	128
				7		<5	1.19–1.22	780	60	110	2200	130
				0	other	...	...	...	...	...	...	...
		2	flame-retarded[G]	1		>24	1.19–1.22			use Table B		
				2		15 to 30	1.19–1.22			use Table B		
				3		12 to 20	1.19–1.22	640	55	100	2000	126
				4		9 to 18	1.19–1.22	640	60	100	2100	126
				5		6 to 13	1.19–1.22	640	60	105	2200	128
				6		4 to 8	1.19–1.22	640	60	110	2200	128
				7		<5	1.19–1.22	640	60	110	2200	130
				0	other	...	...	...	...	...	...	...
		3	UV[H] stabilized	1		>24	1.19–1.22			use Table B		
				2		15 to 30	1.19–1.22			use Table B		
				3		12 to 20	1.19–1.22	640	55	100	2000	124
				4		9 to 18	1.19–1.22	750	60	105	2100	124
				5		6 to 13	1.19–1.22	750	60	110	2100	126
				6		4 to 8	1.19–1.22	750	60	110	2200	126
				7		<5	1.19–1.22	750	60	110	2200	128
				0	other	...	...	...	...	...	...	...
		4	impact-modified	1		6 to 15	1.18–1.22	375[I]	50	90	1900	121
				0	other	...	...	...	...	...	...	...
		5	FDA[J] compliant formulations	1		>24	1.19–1.22			use Table B		
				2		15 to 30	1.19–1.22			use Table B		
				3		12 to 20	1.19–1.22	640	55	100	2000	126
				4		9 to 18	1.19–1.22	750	60	105	2100	126
				5		6 to 13	1.19–1.22	750	60	110	2200	128
				6		4 to 8	1.19–1.22	750	60	110	2200	128
				7		<5	1.19–1.22	780	60	110	2200	130
				0	other	...	...	...	...	...	...	...
		0	other	0	other	...	...	...	...	...	...	...
02	PC copolymer-flame retarded	1	general purpose	1		>24	1.22–1.26			use Table B		
				2		15 to 30	1.22–1.26			use Table B		
				3		12 to 20	1.22–1.26	80	60	100	2100	128
				4		9 to 18	1.22–1.26	80	60	110	2200	128
				5		6 to 13	1.22–1.26	90	60	110	2200	130
				6		4 to 8	1.22–1.26	90	60	110	2200	130
				7		<5	1.22–1.26	90	60	110	2200	132
				0	other	...	...	...	...	...	...	...
		2	UV[H] stabilized	1		>24	1.22–1.26			use Table B		
				2		15 to 30	1.22–1.26			use Table B		
				3		12 to 20	1.22–1.26	80	60	100	2100	126
				4		9 to 18	1.22–1.26	80	60	110	2200	126
				5		6 to 13	1.22–1.26	90	60	110	2200	128
				6		4 to 8	1.22–1.26	90	60	110	2200	130
				7		<5	1.22–1.26	90	60	110	2200	130
				0	other	...	...	...	...	...	...	...
		0	other	0	other	...	...	...	...	...	...	...
03	PC copolymer high-heat resin	1	general purpose	1		TBD	1.18–1.22	80	63	40	1700	150
				0	other	...	...	...	...	...	...	...
		2	UV[H] stabilized	1		TBD	1.18–1.22	80	63	40	1700	148
				0	other	...	...	...	...	...	...	...
		3	impact-modified	1		TBD				use Table B		
				0	other	...	...	...	...	...	...	...
		4	FDA[J] compliant formulation	1		TBD	1.18–1.22	80	63	40	1700	150
				0	other	...	...	...	...	...	...	...
		0	other	0	other	...	...	...	...	...	...	...
04	PC copolymer homopolymer intermediate heat blends	1	general purpose	1		TBD	1.18–1.22	480	65	60	1900	138
				0	other	...	...	...	...	...	...	...
		2	UV[H] stabilized	1		TBD	1.18–1.22	480	65	60	1900	136
				0	other	...	...	...	...	...	...	...
		3	impact-modified	1		TBD				use Table B		

TABLE *Continued*

NOTE 1— The values are for naturals; colors may be different.

Group	Description	Class	Description	Grade	Description[A]	Flow Rate,[B] Test Method D1238, g/10 min	Specific Gravity, Test Method D792	Izod Impact,[C] Test Methods D256, J/m, min	Tensile Yield Strength[D] Test Method D638, MPa, min	Elongation at Break[D] Test Method D638, %, min	Flexural Modulus,[E] Test Methods D790, MPa, min	Deflection Temperature, Test Method D648,[F] °C, min
				0	other	...	...	...	...	...	...	...
		4	FDA[J] compliant formulation	1		TBD	1.18–1.22	480	65	60	1900	138
				0	other	...	...	...	...	...	...	...
		0	other	0	other	...	...	...	...	...	...	...
05	PC copolymer low-heat standard flow	1	general purpose	1		>50	1.18–1.22			use Table B		
				2		nominal 45	1.18–1.22	570	50	100	2070	104
				3		nominal 29	1.18–1.22	620	50	100	2070	106
				4		nominal 18	1.18–1.22	770	50	100	2160	107
				5		nominal 10	1.18–1.22	810	50	100	2200	108
				0	other	...	...	...	...	...	...	...
		2	UV[H] stabilized	1		>50	1.18–1.22			use Table B		
				2		nominal 45	1.18–1.22	570	50	100	2070	102
				3		nominal 29	1.18–1.22	620	50	100	2070	104
				4		nominal 18	1.18–1.22	770	50	100	2160	105
				5		nominal 10	1.18–1.22	810	50	100	2200	106
				0	other	...	...	...	...	...	...	...
		3	impact-modified	0	other	...	...	...	...	...	...	...
		4	FDA[J] compliant formulations	1		>50	1.18–1.22			use Table B		
				2		nominal 45	1.18–1.22	570	50	100	2070	104
				3		nominal 29	1.18–1.22	620	50	100	2070	106
				4		nominal 18	1.18–1.22	770	50	100	2160	107
				5		nominal 10	1.18–1.22	810	50	100	2200	108
				0	other	...	...	...	...	...	...	...
		5	flame-retarded[G]	1		TBD	1.18–1.22			use Table B		
				0	other	...	...	...	...	...	...	...
		0	other	0	other	...	...	...	...	...	...	...
06	PC copolymer low-heat easy flow	1	general purpose	1		TBD	1.18–1.22			use Table B		
				0	other	...	...	...	...	...	...	...
		2	UV stabilized[H]	1		TBD	1.18–1.22	...	...	use Table B		
				0	other	...	...	...	...	...	...	...
		3	impact-modified	1		TBD	1.17–1.22			use Table B		
				0	other	...	...			...	...	...
		4	FDA[J] compliant formulations	1		TBD	1.18–1.22			use Table B		
				0	other	...	...	...	...	...	...	...
		5	flame-retarded[G]	1		TBD	1.18–1.22			use Table B		
				0	other	...	...	...	...	...	...	...
		0	other	0	other	...	...	...	...	...	...	...
99	PC other[I]	0	other	0	other	...	...	...	...	...	...	...

[A] All grades are listed by performance requirements.
[B] Use condition 300/1.2 for Groups 01, 02, and 05. Define the conditions for other groups in the suffixes as needed.
[C] Test specimens are 3.2 mm thick, with a notch radius of 0.25 mm, tested by Method A.
[D] Test specimens are Type I tensile bars, 3.2 mm thick, tested at a crosshead speed of 50 mm/min.
[E] Test specimens are 3.2 by 12.7 mm, tested by Method I, Procedure A (Tangent), at a crosshead speed of 1.3 mm/min and a span-to-depth ratio of 16 to 1.
[F] Test specimens are 3.2 mm thick, tested at 1820 kPa, and are not annealed before testing.
[G] Use suffix letter F, with the appropriate digits allowed in Classification D4000, to define specific requirements.
[H] Refer to Practices E169 for testing procedure. Specific requirements shall be stated in the purchase order or contract.
[I] Test specimens for Group 1, Class 4, Grade 1 are 6.4 mm thick with a notch radius of 0.25 mm and are tested by Method A.
[J] Manufactured in compliance with Food Additive Regulation 21CFR177.1580 governing polycarbonate resins for food-contact applications..

NOTE 2—An example of this classification system is as follows: the designation PC0214 indicates:

PC = polycarbonate as found in Terminology D1600,
02 = polycarbonate copolymer-flame retarded (group),
1 = general purpose (class), and
4 = requirements given in Table PC.

4.1.1 To facilitate the specification of new, special, or recycled materials, the "other" category (0) for class or grade, or both, may be used as indicated in Table PC. The properties of these materials may be specified using Tables A, B, or R as they apply.

4.2 Reinforced, pigmented, filled, and lubricated versions of polycarbonate materials may be classified in accordance with Tables PC and A, B, or R. Table PC is used to specify basic materials, and Tables A or B are used to specify the property requirements after the addition of reinforcement, pigments, fillers, or lubricants at the nominal level indicated (see 4.2.1). Table R is used for recycled materials.