



Designation: D5990 – 20a

Standard Classification System and Basis for Polyketone Injection Molding and Extrusion Materials (PK)¹

This standard is issued under the fixed designation D5990; 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 reappraisal. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reappraisal.

1. Scope*

1.1 This classification system covers polyketone materials suitable for injection molding and extrusion. This classification system does not address recycled polyketone materials.

1.2 The properties included in this classification system 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 suffixes as given in Section 5.

1.3 This classification system and subsequent line call out (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 the performance required of the part, the environment to which it will be exposed, the fabrication process to be employed, the costs involved, and the inherent properties of the material other than those covered by this classification system.

1.4 The following precautionary caveat pertains only to the test method portion, Section 11, of this classification system: *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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

NOTE 1—This classification system and ISO 21970-1 and ISO 21970-2 address the same subject matter, but differ in technical content.

1.5 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

¹ These test methods are under the jurisdiction of ASTM Committee D20 on Plastics and are the direct responsibility of Subcommittee D20.15 on Thermoplastic Materials.

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2. Referenced Documents

2.1 ASTM Standards:²

- D256 Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics
- D618 Practice for Conditioning Plastics for Testing
- D638 Test Method for Tensile Properties of Plastics
- D648 Test Method for Deflection Temperature of Plastics Under Flexural Load in the Edgewise Position
- 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
- D3418 Test Method for Transition Temperatures and Enthalpies of Fusion and Crystallization of Polymers by Differential Scanning Calorimetry
- D3641 Practice for Injection Molding Test Specimens of Thermoplastic Molding and Extrusion Materials
- 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

2.2 ISO Standards:³

- ISO 21970-1 Plastics—Polyketone (PK) moulding and extrusion materials—Part 1: Designation system and basis for specifications
- ISO 21970-2 Plastics—Polyketone (PK) moulding and extrusion materials—Part 2: Preparation of test specimens and determination of properties

3. Terminology

3.1 Except for the term defined as follows, the terminology used in this classification system is in accordance with Terminologies D883 and D1600.

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

3.2 Definitions:

3.2.1 *polyketone (PK), n*—a linear alternating polymer of carbon monoxide and at least one ethylenically unsaturated hydrocarbon.

4. Classification

4.1 Unreinforced polyketone materials are classified into groups according to their composition. These groups are subdivided into classes and grades as shown in Table PK.

NOTE 2—An example of this classification system is given as follows. The designation PK0112 indicates the following:

PK	=	Polyketone as found in Terminology D1600 ,
01	=	Carbon monoxide olefin (Ethylene-propylene),
1	=	General purpose (class), and
2	=	Requirements given in Table PK (grade).

4.1.1 To facilitate incorporation of future or special materials the “other” category for group (00), class (0), and grade (0) is shown in Table PK. The basic properties of these materials can be obtained from Table A as they apply.

4.2 Reinforced, filled, and lubricated versions of polyketone materials that are not in Table PK are classified in accordance with Tables PK and A. Table PK is used to specify the group of polyketone materials and Table A is used to specify the property requirements after the addition of reinforcements, pigments, fillers, or lubricants at the nominal level indicated (see 4.2.1).

4.2.1 Reinforced versions of the basic materials are identified by a single letter that indicates the reinforcement used and two digits that indicate the nominal quantity in percent by weight. Thus, a letter designation G for glass fiber reinforced and 33 for percent of reinforcement, G33, specifies a filled material with a nominal glass level of 33 %. The reinforcement letter designations and associated tolerance levels are tabulated as follows:

Symbol	Material	Tolerance
C	Carbon and graphite fiber reinforced	±3 %
G	Glass fiber reinforced	±3 %
L	Lubricants (such as PTFE and silicone)	Depends upon material and process—to be specified.
M	Mineral-reinforced	±3 %
R	Combinations of reinforcements or fillers, or both	±3 %

NOTE 3—This part of the classification system uses the percent of reinforcements or additives or both in the call-out of the modified basic material. The types and percentages of reinforcements and additives should be shown on the supplier’s technical data sheet unless they are proprietary in nature. If necessary, additional call-out of these reinforcements and additives can be accomplished by use of the suffix part of the system (see Section 3). Ash content of filled or reinforced materials may be determined using Test Method **D5630** where applicable.

4.2.2 Specific requirements for reinforced, filled, or lubricated polyketone materials shall be shown by a six-character designation. The designation consists of the letter “A” and the five digits comprising the cell numbers for the property requirements in the order as they appear in Table A.

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

4.2.3 When the grade of the basis material is not known, or is not important, the use of the “0”-grade classification shall be used for the reinforced materials in this system.

NOTE 4—An example of this classification for a reinforced polyketone material is given as follows: The designation PK0120G30A76360 would indicate the following material requirements:

PK0120	=	High flow ethylene-propylene copolymer polyketone from Table PK,
G 30	=	Glass reinforcement at 30 % nominal level,
A	=	Table A property requirements,
7	=	Tensile strength 170 MPa min,
6	=	Tensile modulus 10 GPa min,
3	=	Izod impact strength 120 J/m min,
6	=	Deflection temperature 220°C min, and
0	=	Unspecified.

5. Suffixes

5.1 When additional requirements are needed that are not covered by the basic requirements or cell-table requirements, they shall be indicated through the use of suffixes.

5.2 A list of suffixes can be found in Classification **D4000** (Table 3) and may be used for additional requirements as appropriate. Additional suffixes will be added to that standard as test methods and requirements are developed and requested.

TABLE PK Requirements for Unreinforced Polyketone Plastics

Group	Description	Class	Description	Grade	Description	Flow Rate, D1238, ^A min, g/10	Melt Point, D3418, ^B °C	Specific Gravity, D792	Tensile Strength at Yield, D638, ^C min, MPa	Elongation at Yield, D638, ^C min, %	Tensile Modulus, ^D D638 min, GPa	Izod Impact Resistance ^E at 23°C, D256, min, J/m	Deflection Temperature at 1.82 MPa, D648, min, °C
01	Carbon monoxide olefin (Ethylene-propylene copolymer)	1	general purpose	1		<4	215–225	1.20–1.26	55	20	1.4	180	85
2					4 to 8	215–225	1.20–1.26	55	20	1.4	180	85	
30				other	>8	215–225	1.20–1.26	55	20	1.4	170	85	
2		high flow	1		>60	215–225	1.20–1.26	55	18	1.4	80	85	
			0	other									
			1		<4	195–205	1.20–1.26	45	20	1.2	160	65	
3	low melting point	0	other										
		1											
00	Other	0	other	0	other								

^ATest conditions: 240°C/2.16 kg, Charging time: 30 s, Preheat time: 240 s, Degas time: 60 s, Melt flow measurement: <7 min.

For group/class PK013 low melting point, test conditions are: 220°C/2.16 kg; Charging time: 30s, Preheat time: 240 s, Degas time: 60s, Melt flow temperature: <7 min.

^BMeasured by DSC. Heating rate 20°C/min.

^CTest specimens are Test Method D638, Type I tensile bars and shall be tested at 50 mm/min.

^DTest specimens are Test Method D638, Type I tensile bars tested at 50 mm/min, using an extensometer (gage length: 50 mm).

^ETest specimens are nominal 3.2 by 12.7-mm cross section.

TABLE A Detail Requirements:^A Special and Reinforced Polyketone Plastics

Designation Order Number	Property	0	1	2	3	4	5	6	7	8
1	Tensile strength at yield, ^B D638, min, MPa	unspecified	30	50	70	90	110	140	170	specify value ^C
2	Tensile modulus, ^D D638, min, GPa	unspecified	1.0	2.0	3.0	5.0	7.0	10.0	14.0	specify value ^C
3	Izod impact resistance ^E at 23°C, D256, min, J/m	unspecified	80	100	120	150	200	260	320	specify value ^C
4	Deflection temperature at 1.82 MPa, D648, min, °C	unspecified	70	100	130	160	190	220	250	specify value ^C
5	To be determined	unspecified								specify value ^C

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

^BTest specimens are Test Method D638, Type I tensile bars and shall be tested at 5 mm/min.

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

^DTest specimens are Test Method D638, Type I tensile bars tested at 50 mm/min, using an extensometer (gage length: 50 mm).

^ETest specimens are nominal 3.2 by 12.7-mm cross section.

6. General Requirements

6.1 Basic requirements from the property Tables PK and A are always in effect unless superseded by specific suffix requirements, which always take precedence.

6.2 The plastics composition shall be uniform and shall conform to the requirements specified herein.

7. Detail Requirements

7.1 The materials shall conform to the requirements in Tables PK, A, and suffix requirements as they apply.

7.2 For purposes of determining conformance, all specified limits for a specification (line callout) based on this classification system are absolute limits, as defined in Practice E29.