



Designation: D 5990 – 00

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

This standard is issued under the fixed designation D 5990; 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 approval. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reapproval.

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. There may be other requirements necessary to identify particular characteristics important to specialized applications. These will be agreed upon between the user and the supplier.

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 and health practices and determine the applicability of regulatory limitations prior to use.*

NOTE 1—There is no similar or equivalent ISO standard available.

2. Referenced Documents

2.1 ASTM Standards:

- D 256 Test Method for Determining the Pendulum Impact Resistance of Notched Specimens of Plastics²
- D 618 Practice for Conditioning Plastics and Electrical Insulating Materials for Testing²
- D 638 Test Method for Tensile Properties of Plastics²
- D 648 Test Method for Deflection Temperature of Plastics Under Flexural Load²

¹ This classification system 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 Annual Book of ASTM Standards, Vol 08.01.

- D 790 Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials²
- D 792 Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement²
- D 883 Terminology Relating to Plastics²
- D 1238 Test Method for Flow Rates of Thermoplastics by Extrusion Plastometer²
- D 1600 Terminology for Abbreviated Terms Relating to Plastics²
- D 3418 Test Method for Transition Temperatures of Polymers by Thermal Analysis³
- D 3641 Practice for Injection Molding Test Specimens of Thermoplastic Molding and Extrusion Materials³
- D 3892 Practice for Packaging/Packing of Plastics³
- D 4000 Classification System for Specifying Plastic Materials³
- D 5630 Test Method for Ash Content in Thermoplastics⁴
- E 29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications⁵

3. Terminology

3.1 Except for the term defined as follows, the terminology used in this classification system is in accordance with Terminologies D 883 and D 1600.

3.2 Definition:

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 D 1600, |
| 01 | = | Ethylene-propylene copolymer (group), |
| 1 | = | General purpose (class), and |
| 2 | = | Requirements given in Table PK (grade). |

³ Annual Book of ASTM Standards, Vol 08.02.

⁴ Annual Book of ASTM Standards, Vol 08.03.

⁵ Annual Book of ASTM Standards, Vol 14.02.

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

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 D 5630 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 | = Flexural modulus 7.5 GPa min |
| 3 | = Izod impact strength 120 J/m min |
| 6 | = Deflection temperature 220°C min, and |
| 0 | = Unspecified. |

If no properties are specified, the designation would be PK0120-G30A00000.

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 D 4000 (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, D 1238, ^A min, g/10 | Melt Point, D 3418, ^B °C | Specific Gravity, D 792 | Tensile Strength at Yield, D 638, ^C min, MPa | Elongation at Yield, ^C D 638, min, % | Tensile Modulus, ^D D 638 min, GPa | Izod Impact ^E Resistance at 23°C, D 256, min, J/m | Deflection Temperature at 1.82 MPa, D 648, min, °C | |
|-------|------------------------------|-------------------|-------------------|---|-------------------------------------|-------------------------|---|---|--|--|--|--|
| 01 | 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 | |
| | | | 3 | >8 | 215–225 | 1.20–1.26 | 55 | 20 | 1.4 | 170 | 85 | |
| | | 2 high flow | 0 other | | | | | | | | | |
| | | | 1 | >60 | 215–225 | 1.20–1.26 | 55 | 18 | 1.4 | 80 | 85 | |
| | | | 0 other | | | | | | | | | |
| 00 | 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.

^BMeasured by DSC. Heating rate 10°C/min.

^CTest specimens are Test Method D 638 Type I tensile bars and shall be tested at 50 mm/min.

^DTest specimens are Test Method D 638 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.