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Standard Classification System and Basis for Specification for Polyoxymethylene Molding and Extrusion Materials (POM)[1]

This standard is issued under the fixed designation D6778; 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 classification system covers polyoxymethylene materials suitable for molding and extrusion. This classification system allows for the use of polyoxymethylene plastic materials that are recycled, reconstituted, recycled-regrind, recovered, or reprocessed, or combination thereof, provided that the requirements as stated in this specification are met. It is the responsibility of the supplier and the buyer of recycled, reconstituted, recycled-regrind, recovered, or reprocessed polyoxymethylene plastic materials, or combination thereof, to ensure compliance. (See Guide D7209).

1.2 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 suffixes as given in Section 5.

1.3 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 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 standard.

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

1.5 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 requirements prior to use.*

NOTE 1—This classification system is similar to ISO 9988-1/-2, although the technical content is significantly different.

2. Referenced Documents

2.1 *ASTM Standards:*[2]
D618 Practice for Conditioning Plastics for Testing
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
D5630 Test Method for Ash Content in Plastics
D7209 Guide for Waste Reduction, Resource Recovery, and Use of Recycled Polymeric Materials and Products
D6100 Specification for Extruded, Compression Molded and Injection Molded Polyoxymethylene Shapes (POM)
E29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications
2.2 *ISO Standards:*[3]
ISO 75-1 Plastics—Determination of Temperature of Deflection under Load—Part 1: General Test Method
ISO 75-2 Plastics—Determination of Temperature of Deflection under Load—Part 2: Plastics and Ebonite

[1] This classification 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**

ISO 179-1 Plastics—Determination of Charpy Impact Properties—Part 1: Non-instrumented Impact Test
ISO 294-1 Plastics—Injection Moulding of Test Specimens of Thermoplastic Materials—Part 1: General Principles, and Moulding of Multipurpose and Bar Test Specimens
ISO 527-1 Plastics—Determination of Tensile Properties—Part 1: General Principals
ISO 527-2 Plastics—Determination of Tensile Properties—Part 2: Test Conditions for Moulding and Extrusion Plastics
ISO 1133 Plastics—Determination of the Melt-Mass Flow Rate (MFR) and the Melt Volume-Flow Rate (MVR) of Thermoplastics
ISO 11357-3 Plastics—Differential Scanning Calorimetry (DSC)—Part 3: Determination of Temperature and Enthalpy of Melting and Crystallization
ISO 1183 Plastics—Methods for Determining the Density of Non-Cellular Plastics—Part 1: Immersion Method, Liquid Pyknometer and Titration Method
ISO 3167 Plastics—Multipurpose Test Specimens
ISO 3451-1 Plastics—Determination of Ash—Part 1: General Methods
ISO 9988-1 Plastics—Polyoxymethylene (POM) Moulding and Extrusion Materials—Part 1: Designation System and Basis for Specifications
ISO 9988-2 Plastics—Polyoxymethylene (POM) Moulding and Extrusion Materials—Part 2: Preparation of Test Specimens and Determination of Properties
ISO 20753 Plastics—Test Specimens

3. Terminology

3.1 The terminology used in this classification system is in accordance with Terminologies D883 and D1600.

4. Classification

4.1 Polyoxymethylene materials are classified into groups according to their composition. These groups are subdivided into classes and grades, as shown in the Basic Property Table (Table POM).

TABLE POM Polyoxymethylene Materials, Detail Requirements (Natural and Black Color Only)[A,B,C]

Group	Description	Class	Description	Grade	Description	Flow Rate ISO 1133,[D,E] G/10 min	Melting Point, ISO 11357-3[F] °C, min	Density, ISO 1183, g/cm³	Tensile Strength, ISO 527,[G] MPa, min	Tensile Modulus, ISO 527[H] MPa, min	Charpy Impact Resistance, ISO 179[I] / 1eA, kJ/m², min	Deflection Temperature, ISO 75/ Method A_f[J] 1.82 MPa, °C, min
01	Homopolymer	1	general purpose and high flow	1		<4	170	1.39 to 1.44	65	2400	7.0	80
				2		4 to 10	170	1.39 to 1.44	65	2500	6.0	80
				3		8 to 19	170	1.39 to 1.44	65	2700	4.5	80
				4		19 to 30	170	1.39 to 1.44	65	2700	4.5	85
				5		30 to 55	170	1.39 to 1.44	65	2700	4.0	85
				G10	10 % glass		170	1.45 to 1.53	80	3500	3.0	150
				G25	25 % glass		170	1.55 to 1.63	125	7000	6.0	160
				0	other							
		3	UV stabilized	1		<8	170	1.39 to 1.44	65	2400	7.0	75
				2		8 to 19	170	1.39 to 1.44	65	2700	4.5	75
				3		19 to 30	170	1.39 to 1.44	65	2700	4.5	75
				4		30 to 55	170	1.39 to 1.44	65	2700	4.5	75
				0	other							
		4	impact modified	1		<4	170	1.31 to 1.37	35	800	50.0	50
				2		8 to 17	170	1.36 to 1.42	45	1800	8.0	65
				3			170	1.32 to 1.38	35	1100	12.0	55
		0	other	0	other							
02	Copolymer	1	general purpose and high flow	1		<4	160	1.38 to 1.43	58	2000	4.0	80
				2		4 to 7	160	1.38 to 1.43	58	2200	3.5	80
				3		7 to 11	160	1.38 to 1.43	58	2200	3.5	80
				4		11 to 16	160	1.38 to 1.43	58	2000	3.0	80
				5		16 to 35	160	1.38 to 1.43	60	2300	3.0	80
				6		35 to 60	160	1.38 to 1.43	60	2500	2.5	80
				7		60+	160	1.38 to 1.43	60	2500	2.0	80
				G10	10 % glass		160	1.40 to 1.52	70	4000	3.0	150
				G15	15 % glass		160	1.45 to 1.55	80	5500	3.0	150
				G20	20 % glass		160	1.50 to 1.60	80	6500	3.0	150
				G25	25 % glass		160	1.54 to 1.65	80	7300	3.0	150
				GE25	25 % glass beads		160	1.50 to 1.70	36	3000	1.0	80
				M30	30 % Mineral		160	1.55 to 1.65	40	3500	2.5	80
				0	other							
		2	UV stabilized	1		<4	160	1.38 to 1.43	56	2000	4.0	80
				2		4 to 7	160	1.38 to 1.43	56	2000	3.5	80

TABLE POM Polyoxymethylene Materials, Detail Requirements (Natural and Black Color Only)[A,B,C]

Group	Description	Class	Description	Grade	Description	Flow Rate ISO 1133,[D, E] G/10 min	Melting Point, ISO 11357-3[F] °C, min	Density, ISO 1183, g/cm^3	Tensile Strength, ISO 527,[G] MPa, min	Tensile Modulus, ISO 527[H] MPa, min	Charpy Impact Resistance, ISO 179[I] / 1eA, kJ/m^2, min	Deflection Temperature, ISO 75/ Method A$_f$[J] 1.82 MPa, °C, min
				3		7 to 11	160	1.38 to 1.43	57	2000	3.5	80
				4		11 to 16	160	1.38 to 1.43	57	2000	3.0	80
				5		16 to 35	160	1.38 to 1.43	58	2100	3.0	80
				6		35 to 60	160	1.38 to 1.43	58	2100	2.5	80
				7		60+	160	1.38 to 1.43	58	2100	2.0	80
				0	other							
		3	impact modified	1		11 to 28	155	1.34 to 1.40	46	1800	4.5	70
				2		11 to 28	155	1.30 to 1.38	40	1400	4.5	60
				3		12 max	155	1.34 to 1.40	44	1500	5.0	70
				4		12 max	155	1.30 to 1.40	35	1300	5.0	60
				0	other							
		4	high modulus	1		<4	165	1.38 to 1.43	62	2400	5.0	80
				4		11 to 16	165	1.38 to 1.43	64	2700	4.0	80
				0	other							
03	Terpolymer	1	high melt strength	1		<2	160	1.38 to 1.43	56	2250	3.5	80
				0	other							
00	Other	0	other	0	other							

[A] No descriptions are listed unless needed to describe a special grade under the class. All other grades are listed by requirements.
[B] Refer to 9.1 under Specimen Preparation for source of test pieces.
[C] Data on 4 mm test specimens may be limited and the minimum values may be changed in a later revision after a statistical database of sufficient size is generated.
[D] Flow rate: 190/2.16 (T/M).
[E] Flow rate, g/10 min (MFR) can be converted to flow rate, cc/10 min (MVR) by the relationship MVR = (MFR/density of the melt at 190°C).
[F] Melting point rate 10°C/min. T_M second melting curve.
[G] Crosshead speed shall be 50 mm/min ± 10 % unless the specimen exhibits brittle failure (no yield point) and strain at break of <10 % in which case crosshead speed shall be 5 mm/min ± 25 %.
[H] Crosshead speed shall be 1 mm/min.
[I] Notched specimen tested edgewise (method 1eA).
[J] Deflection temperature shall be determined with the specimen in the flatwise position (Method A$_f$).

TABLE A Detail Requirements: Filled or Reinforced Polyoxymethylene[A,B]

Designation Order Number	Property	0	1	2	3	4	5	6	7	8	9
1	Tensile strength, ISO 527, min, MPa[C]	unspecified	20	35	50	65	90	110	130	150	specify value[D]
2	Tensile modulus, ISO 527, min, MPa[E]	unspecified	1500	2500	3500	4500	5500	6500	7500	8500	specify value[D]
3	Charpy impact, ISO 179/1eA, min, kJ/m^2	unspecified	1.0	2.0	3.0	4.0	6.0	10.0	20.0	40.0	specify value[D]
4	Deflection temperature, ISO 75, Method A$_f$, 1.82 MPa, min, °C[F]	unspecified	50	70	90	110	120	130	140	150	specify value[D]
5	To be determined	unspecified	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .

[A] It is recognized that detailed test values, particularly Charpy impact, may not predict nor even correlate with the performance of parts molded of these materials.
[B] Refer to 9.1 under Specimen Preparation for source of test specimens.
[C] Crosshead speed shall be 50 mm/min ± 10 % unless the specimen exhibits brittle failure (no yield point) and a strain at break of <10 % in which case crosshead speed shall be 5 mm/min ± 25 %.
[D] If specific value is required, it must appear on the drawing or contract, or both.
[E] Crosshead speed shall be 1 mm/min.
[F] Deflection temperature shall be determined with the specimen in the flatwise position (Method A$_f$).

TABLE B Detail Requirements: Special Polyoxymethylene[A,B]

Designation Order Number	Property	0	1	2	3	4	5	6	7	8	9
1	Tensile strength, ISO 527, min, MPa[C]	unspecified	10	20	30	40	50	60	70	80	specify value[D]
2	Tensile modulus, ISO 527 min, MPa[E]	unspecified	200	600	1000	1400	1800	2200	2600	3000	specify value[D]
3	Charpy impact, ISO 179/1eA, min, kJ/m^2	unspecified	1.0	2.0	3.0	4.0	6.0	10.0	20.0	50.0	specify value[D]
4	Deflection temperature, ISO 75, Method A$_f$, 1.82 MPa, min, °C[F]	unspecified	40	55	70	80	90	100	110	120	specify value[D]
5	To be determined	unspecified	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .

[A] It is recognized that detailed test values, particularly Charpy impact, may not predict nor even correlate with the performance of parts molded of these materials.
[B] Refer to 9.1 under Specimen Preparation for source of test specimens.

[C] Crosshead speed shall be 50 mm/min ± 10 % unless the specimen exhibits brittle failure (no yield point) and a strain at break of <10 % in which case crosshead speed shall be 5 mm/min ± 25 %.
[D] If specific value is required, it must appear on the drawing or contract, or both.
[E] Crosshead speed shall be 1 mm/min.
[F] Deflection temperature shall be determined with the specimen in the flatwise position (Method A_f).

NOTE 2—An example of this classification system for unreinforced polyoxymethylene is given as follows. The designation POM0112 indicates the following:
POM = polyoxymethylene (acetal) as found in Terminology D1600,
01 = homopolymer (group),
1 = general purpose and high flow (class), and
2 = requirements given in Table POM (grade).

4.1.1 Reinforced, filled, and lubricated versions of polyoxymethylene materials that are found in Table POM are classified according to the reinforcement used and the nominal level, by weight percent, of the reinforcement. The grade is identified by a single letter that indicates the filler or reinforcement used and two digits, in multiples of 5, which indicate the nominal quantity in percent by weight. Thus, a grade containing 25 % glass reinforcement would be indicated by POM021G25. This specification indicates:
POM = polyoxymethylene (acetal) as found in Terminology D1600,
02 = copolymer (group),
1 = general purpose and high flow (class), and
G25 = 25 % glass reinforcement and requirements given in Table POM (grade).
The reinforcement letter designations and associated tolerance levels are shown in Table 1.

TABLE 1 Reinforcement-Filler[A] Symbols[B] and Tolerances

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 upon material and process to be specified
M	mineral-reinforced	±2 %
R	combinations of reinforcements or fillers, or both	±3 %

[A] Ash content of filled, or reinforced materials, or both, is to be determined using either Test Method D5630 or ISO 3451-1 where applicable.
[B] Additional symbols will be added to this table as required.

NOTE 3—This part of the classification system uses the percent of reinforcements or additives, or both, in the callout of the modified basic material. The types and percentages of reinforcements and additives 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 5).

NOTE 4—Materials containing reinforcements or fillers, or both, at nominal levels not in multiples of five are included in the nearest grade designation. For example, material with a nominal glass fiber level falling between 23 % and 27 % are included with Grade G25 as shown in 4.1.1.

4.1.2 To facilitate the incorporation of future or special materials, the "other" category for group (00), class (0), and grade (0) is shown in Table POM. The basic properties can be obtained from Tables A or B, as they apply (see 4.3).

4.2 Reinforced, filled, lubricated and special versions of the polyoxymethylene materials that are not in Table POM are classified in accordance with Table POM and Tables A or B. Table POM is used to specify the Group or the Group and Class of polyoxymethylene and Table A or B is used to specify the property requirements.

4.2.1 Reinforced, filled, and lubricated variations of the basic materials are identified by a single letter from Table 1 that indicates the filler and/or reinforcement used and two digits that indicate the nominal quantity in percent by weight. A second letter from Table ~~1a,~~1A, when desired, is used to indicate the form or structure of the reinforcement and/or filler, but is not used for functional mixtures. Thus, a letter designation G for glass, E for beads or spheres or balls, and 33 for percent by weight, GE33, specifies a reinforced or filled material with 33 percent by weight in the form of glass beads, spheres, or balls. The reinforcement letter designations and associated tolerance levels are shown in Table 1. Form and structure letter designations are shown in Table 1A.