



Designation: D6779 – 17

Standard Classification System for and Basis of Specification for Polyamide Molding and Extrusion Materials (PA)¹

This standard is issued under the fixed designation D6779; 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 polyamide materials suitable for molding and extrusion. Some of these compositions are also suitable for application from solution.

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 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 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 values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

1.5 The following precautionary caveat pertains only to the test methods 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 1874-1/-2, although the technical content is significantly different.

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. Referenced Documents

2.1 ASTM Standards:²

D257 Test Methods for DC Resistance or Conductance of Insulating Materials

D789 Test Methods for Determination of Solution Viscosities of Polyamide (PA)

D792 Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement

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

D5740 Guide for Writing Material Standards in the Classification Format

D6260 Test Method for Gravimetric Determination of Carbon Black in Nylon Materials (PA) (Withdrawn 2004)³

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

2.2 IEC/ISO Standards:⁴

IEC 60243-1 Electrical Strength of Insulating Materials—Test Methods—Part 1: Tests at Power Frequencies

IEC 60250 Recommended Methods for the Determination of the Permittivity and Dielectric Dissipation Factor of Electrical Insulating Materials at Power, Audio and Radio Frequencies Including Metre Wavelengths

ISO 75-1 Plastics—Determination of Temperature of Deflection Under Load—Part 1: General Test Methods

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.

⁴ 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 75-2 Plastics—Determination of Temperature of Deflection Under Load—Part 2: Plastic and Ebonite
- ISO 179-1 Plastics—Determination of Charpy Impact Strength—Part 1: Non-instrumented Impact Test
- ISO 294-1 Plastics—Injection Moulding of Test Specimens of Thermoplastic Materials—Part 1: General Principles, Multipurpose-Test Specimens and Bars
- ISO 307 Determination of Viscosity Number of Polyamides In Dilute Solutions
- ISO 527-1 Plastics—Determination of Tensile Properties—Part 1: General Principles
- ISO 527-2 Plastics—Determination of Tensile Properties—Part 2: Testing Conditions
- ISO 1183 Plastics—Methods for Determining the Density and Relative Density of Non-Cellular Plastics
- ISO 1874-1 Plastics—Polyamide (PA) Homopolymers and Copolymers for Moulding and Extrusion—Part 1: Designation
- ISO 1874-2.2 Plastics—Polyamide (PA) Homopolymers and Copolymers for Moulding and Extrusion—Part 2: Preparation of Test Specimens and Determination of Properties
- ISO 3167 Plastics, Multipurpose Test Specimens
- ISO 3451-4 Plastics—Determination of Ash—Part 4: Polyamides
- ISO 11357-1 Plastics—Differential Scanning Calorimetry—Part 1: General Principles
- ISO 11357-3 Plastics—Differential Scanning Calorimetry—Part 3: Determination of Temperature and Enthalpy of Melting and Crystallization
- ISO 15512 Plastics—Determination of Water Content

3. Terminology

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

4. Classification

4.1 Polyamide materials are classified into groups in accordance with their composition. These groups are subdivided into classes and grades as shown in the Basic Property Table (Table PA).

NOTE 2—An example of this classification system for unreinforced polyamide is given as follows: The designation PA0123 indicates the following:

- PA = polyamide as found in Terminology **D1600**,
- 01 (group) = polyamide 66,
- 2 (class) = heat stabilized, and
- 3 (grade) = with a minimum viscosity number of 210 and the requirements given in Table PA.

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 5, 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 follows:

Symbol	Material	Tolerance (Based on the Total Mass)
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 %

NOTE 3—An example of this classification system for reinforced polyamide is given as follows: The designation PA012G35 indicates the following:

- PA = polyamide as found in Terminology **D1600**,
- 01 (group) = polyamide 66,
- 2 (class) = heat stabilized, and
- G35 (grade) = nominal 35 % glass with the requirements given in Table PA.

NOTE 4—This part of the classification system uses 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 control 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 5 are included in the nearest PA grade designation. For example, a material with a nominal glass fiber level of 33 % is included with Grade G35 as shown in **Note 4**.

NOTE 6—Ash content of filled or reinforced materials is determined using Test Method ISO 3451-4.

4.2 Variations of polyamide materials that are not in Table PA are classified in accordance with Tables PA and A or B. Table PA is used to specify the group of polyamide and Table A or B is used to specify property requirements.

4.2.1 Specific requirements for variations of polyamide materials shall be shown 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 Tables A and B.

4.2.1.1 Although the values listed are necessary to include the range of properties available in existing materials, 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, is not important or does not meet the Table PA requirements, the use of “0” grade classification shall be used for reinforced materials in this classification system.

NOTE 7—An example of this classification system for a reinforced polyamide material is given as follows. The designation PA0110G30A42270 would indicate the following material requirements:

- PA0110 = Polyamide 66, from Table PA,
- G30 = Glass reinforced at 30 % nominal,
- A = Table A property requirements,
- 4 = Tensile strength, 140 MPa, min,
- 2 = Tensile modulus, 4500 MPa, min,
- 2 = Charpy impact, 5.0 kJ/m², min,
- 7 = Deflection temperature at 1.8 MPa, 200°C, min, and
- 0 = Unspecified.

If no properties are specified, the designation would be PA0110G30A00000.

NOTE 8—When a grade of polyamide is not fully identified by a standard callout, it is possible to specify all table properties by the use of an addition of Classification **D4000** suffixes. Suffix values will override the PA table values. An example of an unreinforced polyamide material is given as follows: PA0212KN023. This example is a general purpose, low viscosity PA6 material where K denotes tensile properties, N denotes tensile modulus with ISO 527 as the test method, and 023 denotes a value of 2300 MPa. This value for tensile modulus overrides the normal table value. This example can be applied to replace all table values, that is, tensile stress, notched Charpy impact, and heat deflection temperature.

4.3 To facilitate the specification of special materials where the basic property table does not reflect the properties required, Table B has been incorporated into this classification system. This table will be used in a manner similar to Table A.

NOTE 9—Pigmented or colored polyamides can differ significantly from

the natural polymers in mechanical properties depending on the choice of colorants and concentrations. The main property affected is ductility, as illustrated by a reduction in Charpy impact and elongation values. In a typical white pigmented polyamide, elongation losses of up to 50 % and Charpy impact losses of up to 30 % are common. To specify property requirements of pigmented materials, use Table B.

NOTE 10—An example of a special material using this classification system is as follows: The designation PA0220B54220 would indicate the following material requirements from Table B:

- PA0220 = Polyamide 6, heat stabilized, from Table PA,
- B = Table B property requirements,
- 5 = Tensile strength, 70 MPa, min,
- 4 = Tensile modulus, 2400 MPa, min,
- 2 = Charpy impact, 4.0 kJ/m², min,
- 2 = Deflection temperature at 1.8 MPa, 55°C, min, and
- 0 = unspecified.

TABLE PA Requirements for Polyamides Dry-as-Molded^{A,B}

Group	Description	Class	Description	Grade	Description ^C	Viscosity Number, ISO 307, min, mL/g	Density, ^D ISO 1183 g/cm ³	Tensile Strength, ISO 527-1 and ISO 527-2, MPa, min	Tensile Modulus, ^E ISO 527-1 and ISO 527-2, MPa, min	Charpy Impact Resistance, ISO 179/1eA, kJ/m ² , min	Deflection Temperature, ^F ISO 75-1 and ISO 75-2, at 1.8 MPa, °C, min				
01	PA66	1	General-purpose	1		135	1.13 to 1.15	70	2300	3.3	60				
				2		165	1.13 to 1.15	70	2300	3.3	60				
				3		210	1.13 to 1.15	70	2300	3.3	60				
				4		270	1.13 to 1.15	70	2300	3.3	60				
				5	recycled	115	1.13 to 1.15	70	2300	3.3	60				
				6	recycled	135	1.13 to 1.15	70	2300	3.3	60				
				7		115	1.13 to 1.15	70	2300	3.3	60				
				G15	15 % glass	...	1.20 to 1.26	100	4000	3.0	215				
				G20	20 % glass	...	1.25 to 1.33	115	5000	4.0	220				
				G25	25 % glass	...	1.29 to 1.37	140	6000	5.0	225				
		G35	35 % glass	...	1.35 to 1.45	170	8000	7.0	235						
		G40	40 % glass	...	1.42 to 1.52	175	9000	8.0	235						
		G45	45 % glass	...	1.45 to 1.55	180	10 000	9.0	240						
		G50	50 % glass	...	1.51 to 1.61	190	11 000	10.0	245						
		M40	40 % mineral	...	1.45 to 1.55	80	5000	2.0	100						
		0	other												
		2	Heat-stabilized	1		1		135	1.13 to 1.15	70	2300	3.0	60		
						2		165	1.13 to 1.15	70	2300	3.0	60		
						3		210	1.13 to 1.15	70	2300	3.0	60		
						4		270	1.13 to 1.15	70	2300	3.0	60		
						5	recycled	115	1.13 to 1.15	70	2300	3.0	60		
						6	recycled	135	1.13 to 1.15	70	2300	3.0	60		
						G15	15 % glass	...	1.20 to 1.26	100	4000	3.0	220		
						G25	25 % glass	...	1.29 to 1.37	140	6000	5.0	225		
						G30	30 % glass	...	1.32 to 1.42	160	7000	6.0	230		
						G35	35 % glass	...	1.35 to 1.45	170	8000	7.0	235		
				G40	40 % glass	...	1.43 to 1.53	175	9000	8.0	235				
				G45	45 % glass	...	1.45 to 1.55	180	10 000	9.0	240				
				G50	50 % glass	...	1.51 to 1.61	190	11 000	10.0	245				
				M40	40 % mineral	...	1.45 to 1.55	80	5000	2.0	100				
				R20	20 % filler	...	1.23 to 1.31	70	3200	1.5	...				
				R40	40 % filler	...	1.43 to 1.53	100	5500	2.5	200				
				0	other										
				3	Nucleated	1		1		135	1.13 to 1.15	80	2500	2.8	60
								2		165	1.13 to 1.15	80	2500	2.8	60
								3		210	1.13 to 1.15	80	2500	2.8	60
		4						270	1.13 to 1.15	80	2500	2.8	60		
		5	recycled					115	1.13 to 1.15	80	2500	2.8	60		
		6	recycled					135	1.13 to 1.15	80	2500	2.8	60		
		0	other												
4	Nucleated, heat-stabilized	1						1		Requirements the same as corresponding grades under Group 01, Class 3					
								2							
								3							
				4											
				5											
				0	other										

TABLE PA Requirements for Polyamides Dry-as-Molded^{A,B}

Group	Description	Class	Description	Grade	Description ^C	Viscosity Number, ISO 307, min, mL/g	Density, ^D ISO 1183 g/cm ³	Tensile Strength, ISO 527-1 and ISO 527-2, MPa, min	Tensile Modulus, ^E ISO 527-1 and ISO 527-2, MPa, min	Charpy Impact Resistance, ISO 179/1eA, kJ/m ² , min	Deflection Temperature, ^F ISO 75-1 and ISO 75-2, at 1.8 MPa, °C, min		
02	PA6	5	Impact-modified	1		...	1.06 to 1.12	52	1700	9.0	50		
				2	recycled	...	1.06 to 1.12	50	1600	8.0	50		
				G15	15 % glass	...	1.15 to 1.23	85	3000	6.0	210		
				G35	35 % glass	...	1.31 to 1.41	110	5500	6.0	225		
				0	other								
				6	Impact-modified, heat-stabilized	1		...	1.08 to 1.12	52	1700	9.0	50
						2	recycled	...	1.08 to 1.12	50	1600	8.0	50
						G15	15 % glass	...	1.15 to 1.23	85	3000	6.0	210
						G35	35 % glass	...	1.31 to 1.41	110	5500	6.0	225
						M40	40 % mineral	...	1.45 to 1.55	75	4500	4.0	...
						R35	35 % filler	...	1.38 to 1.48	80	5500	3.0	200
				0	other								
		7	Toughened	1		...	1.06 to 1.10	42	1500	40	45		
				2	recycled	...	1.05 to 1.11	40	1300	35	45		
				G15	15 % glass	...	1.15 to 1.23	70	2800	9.0	180		
				G35	35 % glass	...	1.28 to 1.38	110	5500	11	220		
		0	other										
		8	Toughened, heat-stabilized	1		...	1.06 to 1.10	42	1500	40	45		
				2	recycled	...	1.05 to 1.11	40	1300	35	45		
				G15	15 % glass	...	1.15 to 1.23	70	2800	9.0	180		
				G35	35 % glass	...	1.28 to 1.38	110	5500	11	220		
				G45	45 % glass	...	1.39 to 1.49	130	8000	10	230		
				M35	35 % mineral	...	1.37 to 1.47	70	3800	6.0	...		
		0	other										
		9	Weather-stabilized ^G	1		135	1.13 to 1.17	80	2400	2.5	60		
				2	recycled	115	1.13 to 1.17	65	2200	2.0	60		
				0	other								
		0	Other	1	General-purpose	1		100	1.12 to 1.14	75	2400	4.0	50
						2		135	1.12 to 1.14	70	2200	3.0	50
						3		150	1.12 to 1.15	70	2200	3.0	50
				4		200	1.12 to 1.15	70	2200	3.0	50		
				G15	15 % glass		1.20 to 1.28	110	4200	4.0	170		
				G25	25 % glass		1.28 to 1.36	135	5000	6.5	180		
				G30	30 % glass		1.32 to 1.40	150	7000	7.5	180		
				G35	35 % glass		1.38 to 1.44	155	7500	8.0	180		
				G40	40 % glass		1.41 to 1.48	175	10 000	9.0	190		
				M30	30 % mineral		1.30 to 1.40	70	3200	2.4	50		
				M40	40 % mineral		1.44 to 1.52	75	4500	4.0	70		
				R40	40 % glass/mineral		1.42 to 1.50	100	6000	3.0	180		
				0	other								
				2	Heat-stabilized	1		100	1.12 to 1.14	75	2400	4.0	50
						2		135	1.12 to 1.14	70	2200	3.0	50
3						150	1.12 to 1.15	70	2200	3.0	50		
4						200	1.12 to 1.15	70	2200	3.0	50		
5	recycled					135	1.12 to 1.14	70	2000	3.0	50		
G5	5 % glass						1.16 to 1.22	85	2500	2.5	110		
G15	15 % glass						1.20 to 1.28	110	4200	4.0	180		
G25	25 % glass						1.28 to 1.36	135	5000	6.5	190		
G30	30 % glass						1.32 to 1.40	150	7000	7.5	190		
G35	35 % glass						1.38 to 1.44	155	7500	8.0	190		
G40	40 % glass						1.41 to 1.48	175	10 000	9.0	190		
G45	45 % glass						1.46 to 1.54	175	10 000	10	190		
G50	50 % glass						1.52 to 1.60	175	10 000	10	190		
G60	60 % glass						1.66 to 1.74	175	10 000	10	190		
G65	65 % glass						1.70 to 1.78	175	13 000	10	200		
M30	30 % mineral						1.30 to 1.40	70	3200	2.4	50		
M35	35 % mineral						1.39 to 1.47	70	3500	3.0	60		
M40	40 % mineral						1.44 to 1.52	75	4500	4.0	70		
R20	20 % glass/mineral						1.25 to 1.33	80	3200	2.5	120		
R40	40 % glass/mineral						1.42 to 1.50	100	6000	3.0	180		
0	other												
3	Nucleated and lubricated	1		100	1.12 to 1.14	70	2300	2.5	50				
		2		135	1.12 to 1.14	70	2300	2.5	50				
		3		150	1.12 to 1.15	75	2300	2.5	50				
		4		200	1.12 to 1.15	80	2300	2.5	50				
		0	other										

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03 ^H	PA11	4	Nucleated and heat-stabilized	1		100	1.12 to 1.14	70	2300	2.5	50						
				2		135	1.12 to 1.14	70	2300	2.5	50						
				3		150	1.12 to 1.15	75	2300	2.5	50						
				4		200	1.12 to 1.15	80	2300	2.5	50						
				5	recycled other	135	1.12 to 1.14	70	2100	2.5	50						
		5	Impact-modified	1				1.05 to 1.12	45	1700	30	45					
				2				1.05 to 1.18	55	2000	6.0	45					
				3				1.05 to 1.18	40	1000	6.0	35					
				G15	15 % glass			1.15 to 1.24	75	3300	9.0	130					
				G30	30 % glass			1.30 to 1.40	135	6500	15	180					
				G35	35 % glass			1.32 to 1.42	135	6800	15	190					
				G40	40 % glass			1.39 to 1.47	135	8000	10	200					
				0	other												
				6	Impact-modified, heat-stabilized	1				1.05 to 1.12	45	1700	30	45			
						2				1.05 to 1.18	55	2000	6.0	45			
		3						1.05 to 1.18	40	1000	6.0	35					
		4						1.05 to 1.18	25	1000	30	30					
		G15	15 % glass					1.15 to 1.24	75	3300	9.0	130					
		G30	30 % glass					1.30 to 1.40	135	6500	15	180					
		G35	35 % glass					1.32 to 1.42	135	6800	10	190					
		G40	40 % glass					1.39 to 1.47	135	8000	10	200					
		M35	35 % mineral					1.35 to 1.45	65	3200	3.0	50					
		M40	40 % mineral					1.39 to 1.47	65	3200	3.0	50					
		0	other														
		7	Flexural-modified, heat-stabilized	1	injection molding			1.05 to 1.16	55	2375 max	10	45					
				2	extrusion			1.05 to 1.16	30	2000 max	7.0	25					
				3	blends			1.05 to 1.10	35	1700 max	4.5	35					
				0	other												
				0	other												
				0	Other	1	General purpose	1		115 to 140	1.01 to 1.06	35	900	4.0	36		
						2		2		160 to 190	1.01 to 1.06	35	900	6.0	36		
						0	other										
						2	Heat-stabilized	1				115 to 140	1.01 to 1.06	35	900	4.0	36
								2				160 to 190	1.01 to 1.06	35	900	6.0	36
		3	UV Stabilized							160 to 190	1.01 to 1.06	35	900	4.0	36		
		4								210 to 255	1.01 to 1.06	35	900	6.0	36		
		0	other														
		3	Plasticized			1				170 to 200	1.01 to 1.06	30	370	25	36		
						0	other										
		4	Plasticized, Heat Stabilized	1				180 to 240	1.01 to 1.06	35	500	25	36				
				2				170 to 200	1.01 to 1.06	35	400	25	36				
				3				115 to 140	1.01 to 1.06	30	350	25	36				
				4	UV Stabilized			175 to 240	1.01 to 1.06	35	400	25	36				
				5				170 to 190	1.01 to 1.06	30	370	25	36				
				6				200 to 230	1.01 to 1.06	35	370	25	36				
				7	UV Stabilized			160 to 240	1.01 to 1.06	35	340	25	36				
				0	other												
0	other																
04	PA12			1	General purpose	1		100 to 210	1.00 to 1.06	30	800	2.5	35				
		2				100 to 210	1.00 to 1.06	35	1000	2.5	35						
		3				211 to 270	1.00 to 1.06	35	1000	2.5	35						
		4				271 to 340	1.00 to 1.06	35	1000	2.5	35						
		0	other														
		2	Heat-stabilized	1				100 to 150	1.00 to 1.06	35	800	2.5	35				
				2				151 to 210	1.00 to 1.06	35	800	2.5	35				
				3				211 to 280	1.00 to 1.06	35	1000	2.5	35				
				G15	15 % glass			1.10 to 1.20	75	3000	10	160					
				G25	25 % glass			1.10 to 1.25	90	3000	15	160					
				G30	30 % glass			1.15 to 1.30	95	4000	15	160					
				G40	40 % glass			1.30 to 1.45	100	4500	15	160					
				R30	30 % filler			1.18 to 1.32	55	3500	5.0	100					
				0	other												
				3	Nucleated	1				100 to 180	1.00 to 1.06	35	800	1.0	35		
		2						181 to 250	1.00 to 1.06	35	800	1.0	35				
		0	other														

TABLE PA Requirements for Polyamides Dry-as-Molded^{A,B}

Group	Description	Class	Description	Grade	Description ^C	Viscosity Number, ISO 307, min, mL/g	Density, ^D ISO 1183 g/cm ³	Tensile Strength, ISO 527-1 and ISO 527-2, MPa, min	Tensile Modulus, ^E ISO 527-1 and ISO 527-2, MPa, min	Charpy Impact Resistance, ISO 179/1eA, kJ/m ² , min	Deflection Temperature, ^F ISO 75-1 and ISO 75-2, at 1.8 MPa, °C, min		
05	PA612	4	Plasticized	1		100 to 280	1.00 to 1.06	30	300 to 550	15			
				2		100 to 280	1.00 to 1.06	30	450 to 750	10			
				0	other								
		5	Plasticized, heat-stabilized	1		100 to 280	1.00 to 1.06	20	200 to 350	20			
				2		100 to 280	1.00 to 1.06	30	300 to 550	15			
				3		100 to 280	1.00 to 1.06	30	450 to 750	10			
				4		100 to 280	1.00 to 1.06	35	550 to 950	5.0			
		0	Other	0	other								
				0	other								
		1	General purpose	1		100 to 139	1.05 to 1.07	50	1800	2.0	45		
				2		140 to 199	1.05 to 1.07	50	1800	2.5	45		
				3		200	1.05 to 1.07	50	1800	3.0	45		
				G35	35 % glass		1.28 to 1.38	140	7000	9.0	175		
				G45	45 % glass		1.38 to 1.48	150	8500	11	180		
				0	other								
2	Heat-stabilized			1		140	1.05 to 1.07	50	1800	2.0	45		
				G20	20 % glass		1.17 to 1.25	105	4500	5.0	170		
				G30	30 % glass		1.25 to 1.33	120	5500	5.0	170		
				G35	35 % glass		1.28 to 1.38	140	7000	9.0	175		
0	other												
3	Weather-stabilized ^G	1		140	1.05 to 1.07	50	1800	1.5	45				
06	PA46	0	Other	0	other								
				0	other								
		1	General-purpose	1		170	1.16 to 1.20	85	2300	6.0			
				2		195	1.16 to 1.20	85	2300	6.0	140		
				0	other								
		2	Heat-stabilized	1		165	1.16 to 1.20	85	2300	6.0	140		
				2		195	1.16 to 1.20	85	2300	6.0	140		
				G15	15 % glass		1.25 to 1.31	125	5000	3.6	240		
				G30	30 % glass		1.38 to 1.42	175	8000	7.5	280		
				G40	40 % glass		1.48 to 1.53	195	10 000	10.0	280		
				G50	50 % glass		1.58 to 1.63	210	12 000	12.0	280		
				G60	60 % glass		1.70 to 1.77	215	16 000	10.0	280		
				R50	50 % filler		1.60 to 1.67	140	9000	4.0	280		
		0	other										
		3	Flame-retardant ^I , heat-stabilized	1			1.32 to 1.36	45	2250	4.0	140		
G15	15 % glass				1.55 to 1.59	115	6000	4.5	270				
G30	30 % glass				1.63 to 1.69	155	10 000	7.5	280				
G40	40 % glass				1.76 to 1.80	145	11 000	8.0	280				
G45	45 % glass				1.75 to 1.79	165	12 000	8.0	280				
0	other												
4	Impact-modified, heat-stabilized	1			1.08 to 1.12	40	1500	50	70				
		0	other										
5	Wear-resistant, heat-stabilized	1			1.16 to 1.20	75	2200	3.0	140				
		0	other										
07	PA6T/MPMDT	0	Other	0	other								
				1	Heat-stabilized	G35	35 % glass		1.42 to 1.52	200	10 000	8.0	250
						G45	45 % glass		1.53 to 1.63	210	12 000	8.0	250
08	PA66 copolymers + blends	0	Other	0	other								
				1	PA66/6 General purpose	G15	15 % glass		1.20 to 1.26	90	3500	3.0	180
						G35	35 % glass		1.35 to 1.45	160	7500	8.0	190
		G45	45 % glass				1.45 to 1.55	180	8500	10	200		
		2	66/6 heat-stabilized	0	other								
				G15	15 % glass		1.20 to 1.26	90	3500	3.0	180		
				G25	25 % glass		1.29 to 1.37	115	4500	6.5	190		
				G35	35 % glass		1.35 to 1.45	160	7500	8.0	190		
				G45	45 % glass		1.45 to 1.55	180	8500	10	200		
				M20	20 % mineral		1.25 to 1.33	70	3000	4.0			
				M30	30 % mineral		1.35 to 1.45	75	4000	3.0			
		M40	40 % mineral		1.45 to 1.55	75	4000	3.0					
0	other												

TABLE PA Requirements for Polyamides Dry-as-Molded^{A,B}

Group	Description	Class	Description	Grade	Description ^C	Viscosity Number, ISO 307, min, mL/g	Density, ^D ISO 1183 g/cm ³	Tensile Strength, ISO 527-1 and ISO 527-2, MPa, min	Tensile Modulus, ^E ISO 527-1 and ISO 527-2, MPa, min	Charpy Impact Resistance, ISO 179/1eA, kJ/m ² , min	Deflection Temperature, ^F ISO 75-1 and ISO 75-2, at 1.8 MPa, °C, min		
09	PA6 copolymer + blends	3	66 + 6 general purpose	G15	15 % glass		1.20 to 1.26	100	4000	3.0	200		
				G35	35 % glass		1.35 to 1.45	170	8000	9.0	210		
				G45	45 % glass		1.45 to 1.55	190	10 000	10	220		
				0	other								
		4	66 + 6 heat-stabilized	M20	20 % mineral		1.25 to 1.33	70	3000	3.0			
				M40	40 % mineral		1.45 to 1.55	75	4500	3.0			
				0	Other	0	other						
		1	PA6 + polypropylene blend Heat-stabilized	1	PA6 + polypropylene blend	1		1.00 to 1.05	50	2000	7.0	50	
				G35	35 % glass		1.23 to 1.33	150	8500	9.0	200		
				R35	35 % filler		1.28 to 1.38	53	6000	2.0	135		
		0	other	0	other								
10	PA6T/66	0	Other	0	other								
				1	Heat-stabilized	G35	35 % glass		1.41 to 1.51	175	9000	6.0	270
						G45	45 % glass		1.52 to 1.62	205	12 000	7.5	270
				0	other	0	other						
		2	High heat, heat stabilized	G35	35 % glass		1.39 to 1.49	180	9000	6.0	285		
				G45	45 % glass		1.49 to 1.59	210	12 000	9.0	285		
				G60	60 % glass		1.72 to 1.82	240	19 000	8.0	285		
				0	other	0	other						
		3	Impact-modified	G15	15 % glass		1.17 to 1.27	90	4500	6.5	245		
				G30	30 % glass		1.31 to 1.37	145	8000	10	270		
		0	other	0	other								
4	Flame-retardant	G35	35 % glass		1.63 to 1.73	150	9000	7.0	260				
		G45	45 % glass		1.73 to 1.85	165	12 000	7.0	265				
		0	other	0	other								
5	Lubricated	G35	35 % glass		1.38 to 1.48	165	8500	6.0	285				
		0	other	0	other								
11	PAMXD6	6	General Purpose	1	20 % glass, reflective		1.41 to 1.51	95	7000	5.5	285		
				0	other	0	other						
		0	Other	0	other	0	other						
				1	General purpose	G30	30 % glass		1.43 to 1.47	170	10 000	4.5	225
						G50	50 % glass		1.63 to 1.67	245	17 500	6.5	225
				0	other	0	other						
		2	UV stability improved-exterior	G60	60 % glass		1.75 to 1.79	240	21 000	8.0	225		
				G50	50 % glass		1.59 to 1.63	210	16 500	7.0	210		
				0	other	0	other						
		3	Heat stabilized	G50	50 % glass		1.62 to 1.66	220	17 500	7.0	225		
0	other			0	other								
12	PA6T/6I/66	0	Other	0	other								
				1	Heat-stabilized	G35	35 % glass		1.41 to 1.51	195	9500	7.0	265
						G45	45 % glass		1.52 to 1.62	220	14 000	7.0	265
				0	other	0	other						
		1	Heat-stabilized	G60	60 % glass		1.72 to 1.82	250	20000	7.0	265		
				M40	40 % mineral		1.49 to 1.59	93	6000	2.5	140		
				R40	40 % glass/mineral		1.49 to 1.59	130	8000	3.0	225		
				0	other	0	other						
		2	Heat stabilized, high strength	R65	65 % glass/mineral		1.82 to 1.92	115	13 000	2.0	260		
				R65	65 % glass/mineral		1.76 to 1.86	175	14 500	4.5	265		
		0	other	0	other								

TABLE PA Requirements for Polyamides Dry-as-Molded^{A,B}

Group	Description	Class	Description	Grade	Description ^C	Viscosity Number, ISO 307, min, mL/g	Density, ^D ISO 1183 g/cm ³	Tensile Strength, ISO 527-1 and ISO 527-2, MPa, min	Tensile Modulus, ^E ISO 527-1 and ISO 527-2, MPa, min	Charpy Impact Resistance, ISO 179/1eA, kJ/m ² , min	Deflection Temperature, ^F ISO 75-1 and ISO 75-2, at 1.8 MPa, °C, min		
13	PA 6T/6I	3	Impact-modified	1			1.09 to 1.19	58	1800	12	110		
				2			1.06 to 1.16	43	1700	25	105		
				3			1.05 to 1.15	50	1700	5.0	80		
				4			1.08 to 1.18	62	2000	12	115		
				5			1.11 to 1.18	55	1800	40	100		
				6			1.09 to 1.19	52	1800	2.0	100		
						G15	15 % glass		125	5500	5.5	240	
						G25	25 % glass		160	7500	6.5	255	
						0	other						
				4	Plating	M40	40 % mineral		1.43 to 1.53	55	3000	2.0	115
						0	other						
				5	Flame-retardant	G35	35 % glass		1.64 to 1.74	160	12 000	5.5	250
						G45	45 % glass		1.74 to 1.84	170	14 000	5.5	250
						0	other						
				7	Lubricated	M30	30 % mineral		1.37 to 1.47	85	5700	2.0	170
						M40	40 % mineral		1.49 to 1.59	75	5500	2.5	150
						G45	45 % glass		1.53 to 1.63	220	14 000	7.0	260
						0	other						
				8	General purpose	G35	35 % glass, reflective		1.50 to 1.60	145	8500	5.5	255
						0	other						
				0		0	other						
				1	Heat-stabilized	G30	30 % glass	100	1.42 to 1.46	170	10 000	5	270
						G35	35 % glass		1.46 to 1.52	170	10 500	6	275
						G40	40 % glass	100	1.51 to 1.55	200	12 500	6	275
						G45	45 % glass	100	1.57 to 1.61	215	15 000	7	275
				G50	50 % glass	100	1.63 to 1.67	225	16 500	7	280		
				G60	60 % glass	100	1.76 to 1.80	235	21 000	8	280		
				0	other								
14	PA6/6T	0	Other	0	Other								
		1	High heat, heat-stabilized	1		110	1.11 to 1.21	85	2700	6	85		
				G25	25 % glass	110	1.30 to 1.40	140	7000	6	235		
				G35	35 % glass	110	1.39 to 1.49	160	9000	8	235		
				G50	50 % glass	110	1.57 to 1.67	200	14 000	10	235		
				M5	5 % mineral	100	1.10 to 1.20	50	2400	10	220		
				0	other								
				2	Impact-modified, high heat, heat-stabilized	G30	30 % glass	110	1.32 to 1.42	140	7000	10	220
						0	other						
				3	Flame retardant, high heat, heat-stabilized	G25	25 % glass	105	1.33 to 1.43	120	7000	4	180
		15	PA4T copolymers + blends	1	General purpose	1	other (unfilled)		1.16 to 1.30	50	2500	2	140
						G30	30 % GF		1.38 to 1.48	160	9500	5	295
						0	other						
				2	Heat-stabilized	G30	30 % GF		1.40 to 1.50	150	9500	5	295
						G40	40 % GF		1.50 to 1.60	170	11 500	5	295
						G50	50 % GF		1.60 to 1.70	190	15 500	6	295
						0	other						
				3	Impact modified, Heat-stabilized	G30	30 % GF		1.37 to 1.49	150	9000	6	285
						0	other						
				4	Flame retardant	G30	30 % GF		1.41 to 1.51	125	10 000	5	295
						G40	40 % GF		1.50 to 1.60	145	11 500	4	295
						0	other						
				5	Plating	1	35 % GF		1.48 to 1.62	100	10 000	1	285
				2	30 % GF, impact modified		1.40 to 1.52	90	7000	1.5	270		
				3	30 % GF, flame retardant		1.54 to 1.64	75	9000	1	275		
				0	other								

TABLE PA Requirements for Polyamides Dry-as-Molded^{A,B}

Group	Description	Class	Description	Grade	Description ^C	Viscosity Number, ISO 307, min, mL/g	Density, ^D ISO 1183 g/cm ³	Tensile Strength, ISO 527-1 and ISO 527-2, MPa, min	Tensile Modulus, ^E ISO 527-1 and ISO 527-2, MPa, min	Charpy Impact Resistance, ISO 179/1eA, kJ/m ² , min	Deflection Temperature, ^F ISO 75-1 and ISO 75-2, at 1.8 MPa, °C, min			
16	PA410 copolymers + blends	0	Other	0	other									
				1	General purpose	1		120	1.07 to 1.13	65	2500	2.5	65	
						2			130	1.07 to 1.13	65	2500	2.5	65
						3			150	1.07 to 1.13	65	2500	2.5	65
						4			170	1.07 to 1.13	70	2500	3	65
				0										
			2	Heat-stabilized	G20	20 % GF		1.19 to 1.29	130	5500	6	190		
					G25	25 % GF		1.24 to 1.34	140	6000	6.5	190		
					G30	30 % GF		1.29 to 1.39	150	7000	7	200		
					G35	35 % GF		1.34 to 1.43	160	8000	7.5	200		
			G40		40 % GF		1.38 to 1.48	180	10 000	8	200			
			G50		50 % GF		1.47 to 1.57	200	13 500	9	200			
			G60		60 % GF		1.56 to 1.66	210	17 500	10	200			
			R30		30 % GF/MF		1.30 to 1.40	70	6000	2	180			
			0	other										
			3	Impact-modified	1	unfilled	0.9 to 1.1	30	800	8	50			
			G30		30 % GF		1.25 to 1.35	120	6000	15	200			
			G40		40 % GF		1.35 to 1.45	150	9000	15	200			
			0	other										
			4	Flame retardant	1	unfilled	1.05 to 1.25	60	3000	2	70			
		G30	30 % GF			1.35 to 1.45	120	8000	5	200				
		G40	40 % GF			1.45 to 1.55	120	11 000	4	200				
		0	other											
		5	Plating	G35	35 % GF	1.4 to 1.6	80	8000	2	200				
		0		other										
		0	Other	0	other									
00	Other	0	Other	0	other									

^A If data on 4-mm test specimens are limited, the minimum values will be changed in a later revision if a statistical database of sufficient size is generated, which justifies change.

^B Refer to 9.1 for source of test pieces.

^C No descriptions are listed unless needed to describe a special grade under the class. All other grades are listed by requirements.

^D Test Methods D792 is an acceptable alternative method.

^E 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 %.

^F Deflection temperature shall be determined with the specimen in the flatwise position (Method A₁).

^G Weatherable nylon has typically contained about 2 % carbon black. Test Method D6260 - 98 (Withdrawn July 2004), D6260 Federal Specification L-P-419a, and other methods have been used to determine the amount of carbon black. It is possible that materials incorporating other pigments or soluble stabilizers, or both, may prove adequate for particular applications.

^H Relative Viscosities for Group 03 were generated from a correlation with Test Methods D789, utilizing an Ubbelohde viscometer, and m-Cresol as the solvent. Viscosity for groups 03, 04, and 05 (PA11, PA12, and PA6,12) in this classification shall be measured using solvents other than formic acid. Relative viscosities for Groups 03 and 04 shall be measured using 0.5 g of polymer dissolved in 99.5 g of m-cresol at 25.0 ± 0.1 °C in a Cannon-Fenske No. 200 viscometer. Inherent viscosity of Group 05 shall be measured using 0.5 g of polymer dissolved in 100 mL of m-cresol at 25.0 ± 0.1 °C in a Cannon-Fenske No. 200 viscometer. The inherent viscosity is calculated as follows:

$$\text{Inherent viscosity} = \frac{\ln(t_s/t_c)}{C}$$

where:

t_s = average efflux time for sample solution,

t_c = average efflux time for solvent, and

C = concentration in g/100 mL.

^I For specific flammability requirements, use the proper suffix from Classification D4000, for example, FL310 = V0 at 0.8 mm.

TABLE A Detail Requirements: Reinforced Polyamides^{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	35	70	105	140	175	210	245	280	specify value ^D
2	Tensile modulus, ISO 527, min, MPa	unspecified	1500	4500	7500	10 500	13 500	16 500	19 500	22 500	specify value ^D
3	Charpy impact, ISO 179/1eA, min, kJ/m ²	unspecified	2.5	5.0	7.5	10.0	12.5	15.0	22.5	30.0	specify value ^D
4	Deflection temperature, ISO 75, Method A, 1.8 MPa, min, °C ^E	unspecified	50	85	110	135	160	185	200	235	specify value ^D
5	To be determined	unspecified	...	...	...	...	...	...	...	...	...

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

^B Refer to 9.1 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 a specific value is required, it must appear on the drawing or contract, or both.

^E Deflection temperature shall be determined with the specimen in the flatwise position (Method A_f).

TABLE B Detail Requirements: Unreinforced Polyamides^{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	25	40	55	70	85	100	115	specify value ^D
2	Tensile modulus, ISO 527, min, MPa	unspecified	300	1000	1700	2400	3100	3800	4500	5200	specify value ^D
3	Charpy impact, ISO 179/1eA, min, kJ/m ²	unspecified	2.0	4.0	6.0	10.0	14.0	18.0	24.0	30.0	specify value ^D
4	Deflection temperature, ISO 75, Method A, 1.8 MPa, min, °C ^E	unspecified	40	55	70	85	100	115	130	145	specify value ^D
5	To be determined	unspecified	...	...	...	...	...	...	...	...	...

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

^B Refer to 9.1 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 Deflection temperature shall be determined with the specimen in the flatwise position (Method A_f).

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 are to be used for additional requirements, as appropriate. Additional suffixes will be added to that classification system as test methods and requirements are developed and requested.

6. General Requirements

6.1 Basic requirements from the property tables or cell tables 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 material shall conform to the requirements prescribed in Tables PA, A, and B, 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.

7.2.1 With the absolute method, an observed value or a calculated value is not rounded, but is to be compared directly with the specified limiting value. Conformance or nonconformance is based on this comparison.

8. Sampling

8.1 Sampling shall be statistically adequate to satisfy the requirements of 12.4.

8.2 A batch or lot shall be constituted as a unit of manufacture as prepared for shipment, and can consist of a blend of two or more “production runs.”

9. Specimen Preparation

9.1 Test pieces for relevant test methods shall be based on the injection molded ISO 3167 type multipurpose test specimen. All tests shall be conducted on as-molded (not annealed) specimens conditioned dry-as-molded. The following pieces are to be used for the listed relevant test methods:

Test Piece	Relevant Test Method
ISO 3167 Type 1A bar	Tensile strength by ISO 527 Tensile modulus by ISO 527
80 ± 2 mm by 10 ± 0.2 mm by 4 ± 0.2 mm cut from the center portion of ISO 3167 Type 1A bar	Charpy impact resistance by ISO 179/1eA Deflection temperature by ISO 75/Method Ar
Specimen approximately 10 by 10 by 4 mm cut from center of ISO 3167 Type 1A bar	Density by ISO 1183

9.2 The test specimens shall be prepared by an injection molding process as specified in ISO 294. Recommended processing temperatures are shown in **Table 1**.

NOTE 11—Test specimens of PA 6 and PA 66 copolymers and blends prepared at the same process temperatures as specified for their homopolymers, usually show no significant property loss. Selection of process temperature is made based on the major polymer component.

NOTE 12—Consult ISO 1874-2, Table 1, for a more comprehensive listing of the Conditions for Injection Moulding of Test Specimens.

9.3 Molding material-granules of the molding material used in preparation of test specimens shall contain no more than 0.2 % moisture, with the exception of PA 46 which will contain no more than 0.05 % moisture.

NOTE 13—If the moisture content exceeds the limits stated above, the material can be dried by a variety of methods such as raising the temperature of the material to 80 to 100°C in a vacuum or in a stream of dry nitrogen using a desiccant-bed drier. Continue drying until the moisture content is within the stated limits.

10. Conditioning

10.1 *Conditioning*—Test data shall be obtained using dry-as-molded specimens, defined as those specimens that are sealed in containers that are impermeable to water vapor within one hour after removal from the mold. Maximum moisture content of specimens shall be 0.2 %. No moisture shall be intentionally added to reach this level. Condition specimens a minimum of 24 h in sealed containers at 23 ± 2°C.

NOTE 14—Physical properties of most nylon resins are highly dependent upon the moisture content of the molded item. The user is referred to

TABLE 1 Process Temperatures for Injection Molding of Specimens

Polyamide	Viscosity Number		Plastic Melt Temperature, °C	Mold Surface Temperature, °C
PA 6	<200	unfilled	260	80
		unfilled	270	80
		filled	290	80
PA 46	>200	unfilled	305	80
		filled	305	80
PA 66	>200	unfilled	290	80
		filled	290	80
PA11		unfilled	288	38
PA12	<210	unfilled	220	60
		unfilled	240	60
PA612	>210	filled	240	80
		unfilled	250	80
		unfilled	270	80
PA 6T/66	<200	filled	270	80
		filled	335	130
PAMXD6		filled	280	125
PA6T/6I/66		filled	335	130
PA 6T/MPMDT		filled	325	140

the manufacturer's literature for details.

10.2 *Test Conditions*—Conduct tests, other than solution viscosity or those tests conducted at elevated temperature, in the standard laboratory atmosphere of 23 ± 2°C and 50 ± 5 % relative humidity. Individual specimens shall not be removed from sealed containers until immediately before testing.

11. Test Methods

11.1 Determine the properties enumerated in this classification system by means of the test methods referenced in Section 2.

11.1.1 The number of tests shall be consistent with the requirements of Section 8 and 12.4.

12. Inspection and Certification

12.1 Inspection and certification of the material supplied with reference to a specification based on this classification system shall be for conformance to the requirements specified herein.

12.2 Lot-acceptance inspection shall be the basis on which acceptance or rejection of the lot is made. The lot-acceptance inspection shall consist of the tests listed as they apply:

12.2.1 Relative viscosity, or viscosity number, or both,

12.2.2 Moisture content per ISO 15512,

12.2.3 Reinforcement content,

12.2.4 Carbon black content (weather-stabilized materials), and

12.2.5 Heat stabilizer content (heat-stabilized materials, supplier's test showing positive presence).

12.3 Periodic-check inspection with reference to a specification based upon this classification system shall consist of the tests specified for all requirements of the material under this classification system. Inspection frequency shall be adequate to ensure the material is certifiable in accordance with 12.4.

12.4 Certification shall be that the material was manufactured by a process in statistical control, sampled, tested, and inspected in accordance with this classification system and that the average values for the lot meet the requirements of the specification (line callout).

NOTE 15—The ASTM publication, *Manual on Presentation of Data and Control Chart Analysis, 7th Edition*, stock number MNL7A, provides detailed information about statistical process control.

12.5 A report of the test results shall be furnished when requested. The report shall consist of results of the lot-acceptance inspection for the shipment, the percent by weight of recycled plastic, as defined in 3.1.47 of Guide **D7209**, if requested, and the results of the most recent periodic-check inspection.

13. Packing, Packaging, and Marking

13.1 The provisions of Practice **D3892** apply to packaging, packing, and marking of containers for plastic materials.

14. Keywords

14.1 classification; classification system; line callout; polyamide; recycle; specification

SUPPLEMENTARY REQUIREMENTS

The following supplementary requirements shall apply only when specified by the inquiry, contract, or order for agencies of the U. S. Government.

S1. Special End Uses

S1.1 Unless otherwise specified in the contract or purchase order, the supplier is responsible for the performance of all testing and inspections. Except as otherwise specified, the supplier can utilize his own facilities or any commercial laboratory acceptable to the government. The government reserves the right to perform any testing or inspections set forth in the specification requirements. This testing ensures qualification on a one time basis unless the manufacturer makes a significant change in formulation, raw material, or process.

S2. Electrical Requirements

S2.1 The electrical property requirements for initial material qualification of electrical grade materials are given in Table S2.1 and the test methods in Table S2.2.

S3. Quality Assurance

S3.1 *Acceptance Criteria*—Failure to conform to requirements in Table S2.1 shall result in rejection of the material.

S3.2 *Sample Size*—The minimum number of test specimens to be tested shall be as specified in Table S2.2.

S3.3 *Test Method*—Testing shall be in accordance with the methods specified in Table S2.2.

S3.4 *Conditioning*—Standard test specimens shall be conditioned before testing as specified in Table S2.2 and described in Section S4.

S4. Conditioning

S4.1 *Nomenclature*:

S4.1.1 *Condition A*—Dry-as-molded. See Section 10.

S4.1.2 *Condition C*—Humidity conditioning.

S4.1.3 *Condition D*—Immersion conditioning in distilled water.

S4.2 *Designation*—Conditioning procedures shall be designated as follows:

S4.2.1 A capital letter indicating the general conditioning.

S4.2.2 A number indicating, in hours, the duration of conditioning.

S4.2.3 A number indicating, in °C, the conditioning temperature.

S4.2.4 A number indicating the relative humidity when it is controlled.

S4.3 *Tolerances*:

S4.3.1 *Relative Humidity*—Standard tolerance shall be ±5 %.

S4.3.2 *Temperature*— Standard tolerance shall be ±2°C. For water immersion the standard tolerance shall be ±1°C.

NOTE 16—The numbers shall be separated from each other by slant (/) marks, and from the capital letter by a dash (-). A sequence of conditions shall be denoted by the use of a plus (+) sign between successive conditions.

Examples:

C-96/23/50—Humidity condition; 96 h at 23°C and 50 % R.H.

D-48/50—Immersion condition; 48 h at 50°C.

S5. Test Method Modification

S5.1 *Dielectric Strength*:

S5.1.1 The test shall be performed under oil at a frequency not exceeding 100 Hz.

S5.1.2 *Short-Time Test*—The voltage shall be increased uniformly at the rate of 500 V/s.

S5.1.3 *Step-by-Step Test*—Step-by-step testing shall be done after a short-time test. Voltage increments for the step-by-step test shall be determined from short-time results as follows:

Breakdown by short-time test, kV	Increment for step-by-step test, kV
≤12.5	0.5
>12.5 to ≤25	1.0
>25 to ≤50	2.5
>50 to ≤100	5.0
>100	10.0

TABLE S2.1 Property Values for Initial Electrical Qualification Testing

Property	Units	Value Required for Each Type of Compound			Reinforced PA	
		Unreinforced PA			Type I ^A Grade A	Type II ^A Grade A
		Type III ^A Grade E	Type VI ^A Grade E	Type VIA ^A Grade E		
Insulation resistance, min	ohms	5 × 10 ¹²	5 × 10 ¹²	5 × 10 ¹²	...	...
Dielectric strength						
step-by-step test, min	kV/mm	14.8	14.8	14.8	...	...
short-time test, min	kV/mm	...	...	...	14.8	14.8
Dielectric constant @ 1 MHz, max		4.0	4.0	4.0	4.2	4.2
Dissipation factor @ 1 MHz, max		0.11	0.11	0.11	0.025	0.025

^A Types as described in Appendix X3.

TABLE S2.2 Sampling and Conditioning for Initial Qualification

Property	Test Method	Test Method Modified per	Specimens	Number Tested	Conditioning	
					Unreinforced PA	Reinforced PA
Insulation resistance	ASTM D257	S5.1	60 × 60 × 2 mm plaque	3	C-96/23/50	...
Dielectric strength step-by-step test short-time test	IEC 60243		60 × 60 × 2 mm plaque	5	C-96/23/50	...
				5	...	A
Dielectric constant	IEC 60250		60 × 60 × 2 mm plaque	5	C-96/23/50 + D-48/50 + D-0.5/23	A
				5	C-96/23/50 + D-48/50 + D-0.5/23	A

APPENDIXES

(Nonmandatory Information)

X1. VISCOSITY CONVERSION: ASTM TEST METHODS D789 and ISO 307

X1.1 The relation between relative viscosity in 90 % HCOOH (Test Methods D789) and viscosity number in 96 % H₂SO₄ (ISO 307) was developed in an interlaboratory round-robin study by ISO TC-61 Subcommittee 9/Work Group 8 (Plastic Materials/Polyamides). Seven laboratories, including 3 U.S. laboratories (Allied, DuPont, and Monsanto), participated in the work. A95 ± 9 % between-laboratory confidence interval was predicted for the measurements.

X1.2 For convenience, a conversion table and graph (Fig. X1.1) are provided using the following established relationship:

$$VN = A + B \times \ln(RV) \quad (X1.1)$$

where:

- VN = viscosity number (ISO 307),
- RV = relative viscosity (Test Methods D789),
- A = -206.52124, and
- B = 0.002255

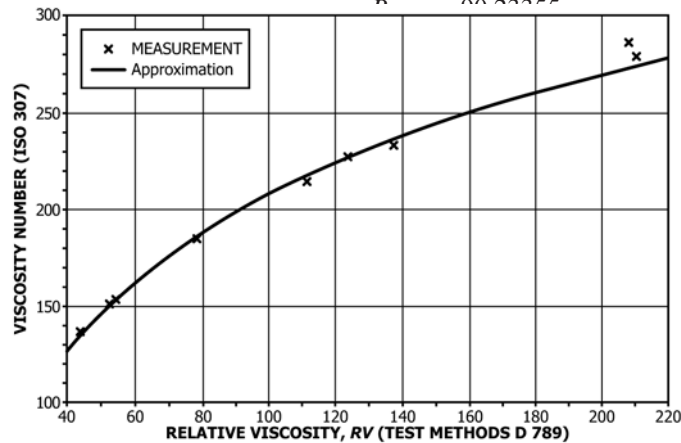


FIG. X1.1 Nylon 6 and Nylon 66 Viscosity Correlation Relative Viscosity in 90 % HCOOH (Test Methods D789) versus Viscosity Number in 96 % H₂SO₄ (ISO 307)

X2. MELTING POINT

X2.1 The nominal melting point of the various polyamide polymers shown in Table PA are listed below. The typical range for melting point determination is $\pm 5^{\circ}\text{C}$.

X2.2 The melting point shall be determined using ISO 11357-3 except the heating rate shall be $10^{\circ}\text{C}/\text{min}$. The melting point, T_m , is obtained from the second melting curve.

Group	Description	T_m , $^{\circ}\text{C}$
01	PA 66	262
02	PA 6	222
03	PA 11	190
04	PA 12	178
05	PA 612	212
06	PA 46	290
07	PA 6T/MPMDT	300
10	PA 6T/66	310

X3. CROSS-REFERENCES TO MIL-M-20693B AND L-P-395C

	ASTM D6779	MIL-M-20693B
PA0111		Type I
PA0121		Type IA
PA0191		Type II
PA0511		Type III
PA0511		Type III, Grade E
PA0211		Type IV
PA0311		Type VI
PA0311		Type VI, Grade E
PA0321		Type VIA
PA0321		Type VIA, Grade E
	ASTM D6779	L-P-395C
PA02G30		Type I, Grade A and Grade B
PA01G40		Type II, Grade A and Grade B

SUMMARY OF CHANGES

Committee D20 has identified the location of selected changes to this standard since the last issue (D6779 - 16) that may impact the use of this standard. (March 1, 2017)

(1) Revised Table PA to add PA6/Class 2/Heat-stabilized/G60, PA46/Class 2/Heat-stabilized/G60, PA4T copolymers and blends as Group 15 and PA410 as Group 16.

Committee D20 has identified the location of selected changes to this standard since the last issue (D6779 - 12a) that may impact the use of this standard. (May 1, 2016)

(1) Revised Table PA to change Group 05, PA612.

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