



Designation: ~~D5989~~—~~11~~ D5989 – 14

## Standard Specification for Extruded and Monomer Cast Shapes Made from Nylon (PA)<sup>1</sup>

This standard is issued under the fixed designation D5989; 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 ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

### INTRODUCTION

This specification is intended to be a means of calling out plastic products used in the fabrication of end items or parts.

#### 1. Scope\*

1.1 This specification covers requirements and test methods for the material, dimensions, and workmanship, and the properties of extruded and cast sheet, plate, rod and tubular bar, excluding pipe and fittings, manufactured from nylon or monomers.

1.2 The properties included in this specification are those required for the compositions covered. Section 4 presents a classification system for defining requirements for particular characteristics important to specialized applications.

1.3 This specification allows for the use of recycled plastics (as defined in Guide D7209).

1.4 The values stated in inch-pound units are regarded as standard. The values in parentheses are for information only.

1.5 The following precautionary caveat pertains only to the test method portions of this specification. *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 known ISO equivalent to this standard.

NOTE 2—This specification is intended to replace Federal Standard LP-410A and PS 50.

#### 2. Referenced Documents

2.1 *ASTM Standards:*<sup>2</sup>

D256 Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics

D638 Test Method for Tensile Properties of Plastics

D790 Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials<sup>4</sup>

D883 Terminology Relating to Plastics

D3892 Practice for Packaging/Packing of Plastics

D6779 Classification System for and Basis of Specification for Polyamide Molding and Extrusion Materials (PA)

D7209 Guide for Waste Reduction, Resource Recovery, and Use of Recycled Polymeric Materials and Products

2.2 *ANSI Standard:*<sup>3</sup>

Z1.9–2008 Sampling Procedures for Inspection by Variables

2.2 *Federal Standard:*<sup>3</sup>

LP-410A Nylon Stock Shapes

#### 3. Terminology

3.1 *Definitions:*

<sup>1</sup> This specification is under the jurisdiction of ASTM Committee D20 on Plastics and is the direct responsibility of Subcommittee D20.15 on Thermoplastic Materials. Current edition approved April 1, 2011/May 1, 2014. Published April 2011/May 2014. Originally approved in 1998. Last previous edition approved in 2005/2011 as D5989–05-D5989–11. DOI: 10.1520/D5989-11.10.1520/D5989-14.

<sup>2</sup> 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.

<sup>3</sup> Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, http://www.ansi.org.

<sup>3</sup> Available from U.S. Government Printing Office Superintendent of Documents, 732 N. Capitol St., NW, Mail Stop: SDE, Washington, DC 20401, http://www.access.gpo.gov.

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

3.1.1 *regrind (plastic), n*—a product or scrap such as sprues, runners and edge trim that have been reclaimed by shredding and granulating for use in-house.

3.1.2 For definitions of other technical terms pertaining to plastics used in this specification, see Terminology D883 or Guide D7209.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *finished product (F), n*—product that meets the dimensional criteria of Tables 1-4 of this specification.

3.2.2 *monomer-cast nylon, n*—nylon polymer prepared by polymerization of epsilon-caprolactam or lauryllactam monomer.

3.2.3 *oversize product (O), n*—product that meets the designated dimensional criteria of Table 2 and Table 4 only.

3.2.4 *plate, n*—flat stock greater than 3/8 in. (9.5 mm).

3.2.5 *recycled-plastic shape, n*—a product made from up to 100 % post-consumer material.

3.2.6 *rod, n*—an extruded solid cylindrical shape with a minimum diameter of 1/16 in., or cast solid cylindrical shapes with a minimum diameter of 1 in. (25.4 mm).

3.2.7 *sheet, n*—flat stock less than and including 3/8 in. thickness.

3.2.8 *tubular bar, n*—extruded annular shapes with minimum inside diameter of 3/8 in. (9.5 mm) and minimum wall thickness of 1/16 in. (1.6 mm), or cast shapes with minimum inside diameter of 1/2 in. (12.7 mm), and minimum wall of 1/4 in. (6.4 mm).

3.2.9 *unmodified virgin plastic shape, n*—a product produced from virgin plastic, as furnished by a manufacturer, with no additives or processing aids.

3.2.10 *virgin-plastic shape, n*—product that is produced from 100 % plastic resin that has not been subjected to subsequent melt processing.

TABLE S-PA Requirements for Nylon (Polyamide) Shapes, Dry-as-Manufactured (<0.2 % Moisture)

Type	Description	Class	Description	Grade	Applicable Classification System D6779 Callout <sup>A</sup>	Description	Ultimate Tensile Strength, min, psi (MPa)	Tensile Elongation, % at Break, min	Tensile Modulus, min, psi (MPa)	Dimensional Stability, %, max
01	Nylon 66	1	Unfilled	1	...	General purpose	10 000 (69)	25	350 000 (2400)	0.4
				2	...	Recycled	9000 (62)	15	350 000 (2400)	0.7
				3	PA 0114 <sup>B</sup>	Unmodified virgin	10 000 (69)	25	350 000 (2400)	0.4
		2	MoS <sub>2</sub> filled	1	PA 0110L01	General purpose	11 000 (76)	15	450 000 (3100)	0.4
				2	...	Recycled	9000 (62)	5	350 000 (2400)	0.7
				3	PA 0124	General purpose	10 000 (69)	25	350 000 (2400)	0.4
				4	PA 0180	General purpose	10 000 (69)	5	350 000 (2400)	0.4
		0	As specified	1	See Table 1	General purpose	...	...	...	...
				2	See Table 1	Recycled	...	...	...	...

TABLE 1 Dimensional Requirements for Extruded Nylon Rod<sup>A</sup>

Size, in. <sup>B</sup>	Length Tolerance, in.	Diameter Tolerance, in.	Roundness TIR, in.	Camber, in./ft
1/16	+1 -0	+0.003 -0	0.002	2 1/2 /8
1/8	+1 -0	+0.003 -0	0.002	2 1/2 /8
3/16	+1 -0	+0.003 -0	0.002	2 1/2 /8
1/4	+1 -0	+0.003 -0	0.002	2 1/2 /8
3/8	+1 -0	+0.003 -0	0.002	2 1/2 /8
1/2	+1 -0	+0.003 -0	0.002	2 1/2 /8
5/8	+1 -0	+0.003 -0	0.002	2 1/2 /8
3/4	+1 -0	+0.003 -0	0.002	2 1/2 /8
7/8	+1 -0	+0.003 -0	0.002	2 1/2 /8
1	+1 -0	+0.003 -0	0.002	1 1/4 /8
1 1/8	+1 -0	+0.005 -0	0.005	1 1/4 /8
1 1/4	+1 -0	+0.005 -0	0.005	1 1/4 /8
1 3/8	+1 -0	+0.005 -0	0.005	1 1/4 /8
1 1/2	+1 -0	+0.005 -0	0.005	1 1/4 /8
1 5/8	+1 -0	+0.005 -0	0.005	1 1/4 /8
1 3/4	+1 -0	+0.005 -0	0.005	1 1/4 /8
1 7/8	+1 -0	+0.005 -0	0.005	1 1/4 /8
2	+1 -0	+0.005 -0	0.010	1 1/4 /8
2 1/8 -2 3/4	+1 -0	+0.015 -0	0.030	1 1/4 /8
3-5	+1 -0	+0.250 -0	0.060	1/4 /4
Over 5	+1 -0	+0.250 -0	0.060	1/4 /4

<sup>A</sup>Based on dry-as-manufactured condition and proper product storage and handling.

<sup>B</sup>To convert inches to millimetres, multiply by 25.40.

**TABLE 2 Dimensional Requirements for Monomer Cast Nylon Rod<sup>A</sup>**

Size, in. <sup>B</sup>	Length Tolerance, in.	Diameter Tolerance, in.		Roundness TIR, in.		Camber, in./ft	
		Finished <sup>C</sup>	Oversize <sup>D</sup>	Finished <sup>C</sup>	Oversize <sup>D</sup>	Finished <sup>C</sup>	Oversize <sup>D</sup>
1	+1 -0	+0.015 -0	...	0.015	N/A <sup>E</sup>	¼ /4	N/A
1 ⅛	+1 -0	+0.015 -0	...	0.015	N/A	¼ /4	N/A
1 ¼	+1 -0	+0.015 -0	...	0.015	N/A	¼ /4	N/A
1 ⅜	+1 -0	+0.015 -0	+0.100 -0	0.015	N/A	¼ /4	N/A
1 ½	+1 -0	+0.015 -0	+0.100 -0	0.015	N/A	¼ /4	N/A
1 ⅝	+1 -0	+0.015 -0	+0.100 -0	0.015	N/A	¼ /4	N/A
1 ¾	+1 -0	+0.015 -0	+0.100 -0	0.015	N/A	¼ /4	N/A
1 ⅞	+1 -0	+0.015 -0	+0.100 -0	0.015	N/A	¼ /4	N/A
2-2 ¾	+1 -0	+0.015 -0	+0.125 -0	0.015	N/A	¼ /4	N/A
3-5	+1 -0	+0.250 -0	+0.250 -0	0.060	N/A	¼ /4	N/A
Over 5	+1 -0	+0.250 -0	+0.500 -0	N/A	N/A	N/A	N/A

<sup>A</sup>Based on dry-as-manufactured condition and proper product storage and handling.

<sup>B</sup>To convert inches to millimetres, multiply by 25.40.

<sup>C</sup>Finished product as defined in 3.2.1.

<sup>D</sup>Oversize product as defined in 3.2.3; roundness and camber not applicable.

<sup>E</sup>Not applicable.

**TABLE 3 Dimensional Requirements for Extruded Nylon Sheets and Plates<sup>A</sup> (Squareness Requirement Listed in 11.4)**

Size, in. <sup>B</sup>	Width Tolerance, in.	Thickness Tolerances, in. <sup>C</sup>	Length Camber, in./ft	Width Bow, in./ft
1/16	+0.5 -0	±0.005	¾ /4	¾/16 /2
3/32	+0.5 -0	±0.005	¾ /4	¾/16 /2
1/8	+0.5 -0	±0.005	¾ /4	¾/16 /2
3/16	+0.5 -0	+0.025 -0	¾ /4	¾/16 /2
1/4	+0.5 -0	+0.025 -0	¾ /4	¾/16 /2
5/16	+0.5 -0	+0.025 -0	¾ /4	¾/16 /2
3/8	+0.5 -0	+0.025 -0	¾ /4	¾/16 /2
7/16	+0.5 -0	+0.025 -0	¾ /4	¾/16 /2
1/2	+0.5 -0	+0.025 -0	¾ /4	¾/16 /2
5/8	+0.5 -0	+0.025 -0	¾ /4	¾/16 /2
3/4	+0.5 -0	+0.025 -0	¾ /4	¾/16 /2
7/8	+0.5 -0	+0.025 -0	¾ /4	¾/16 /2
1	+0.5 -0	+0.025 -0	¾ /4	¾/16 /2
1 1/8	+0.5 -0	+0.025 -0	¾ /4	¾/16 /2
1 1/4	+0.5 -0	+0.025 -0	¾ /4	¾/16 /2
1 3/8	+0.5 -0	+0.025 -0	¾ /4	¾/16 /2
1 1/2	+0.5 -0	+0.025 -0	¾ /4	¾/16 /2
1 5/8	+0.5 -0	+0.025 -0	¾ /4	¾/16 /2
1 3/4	+0.5 -0	+0.025 -0	¾ /4	¾/16 /2
1 7/8	+0.5 -0	+0.025 -0	¾ /4	¾/16 /2
2	+0.5 -0	+0.025 -0	¾ /4	¾/16 /2
Over 2	+0.5 -0	+0.050 -0	¾ /4	¾/16 /2

<sup>A</sup>Based on dry-as-manufactured condition and proper product storage and handling.

<sup>B</sup>To convert inches to millimetres, multiply by 25.40.

<sup>C</sup>Length tolerance in inches for all sizes at 48-in. length is +1.001 -0 and at 144-in. length is +1.001 -0.

Type	Description	Class	Description	Grade	Applicable Classification System D6779 Callout <sup>A</sup>	Description	Ultimate Tensile Strength, min, psi (MPa)	Tensile Elongation, % at Break, min	Tensile Modulus, min, psi (MPa)	Dimensional Stability, %, max
02	Monomer Cast Nylon 6	1	Unfilled	3	See Table 1	Unmodified virgin	...	...	...	...
		2	MoS <sub>2</sub> filled, 0.5-1.5 %	1	...	General purpose	10 000 (69)	25	350 000 (2400)	0.4
		3	Heat stabilized <sup>C</sup>	1	...	General purpose	10 000 (69)	25	350 000 (2400)	0.4
		4	Internally lubricated	1	...	General purpose	9000 (62)	25	320 000 (2100)	0.4
		5	Oil-filled	1	...	General purpose	9000 (62)	25	350 000 (2400)	0.4
		6	Highly plasticized	1	...	General purpose	8000 (53)	100	275 000 (1845)	0.4
03	Monomer Cast Nylon 612	0	As specified	1	See Table 1	General purpose	...	...	...	...
		1	Unfilled	1	...	General purpose	8000 (53)	40	300 000 (2000)	0.4
04	Nylon 6	1	Unfilled	1	...	General purpose	10 000 (69)	25	328 000 (2260)	0.4
		0	As specified	1	See Table 1	General purpose	...	...	...	...

**TABLE 4 Dimensional Requirements for Monomer Cast Nylon Sheets and Plates<sup>A</sup> (Squareness Requirement Listed in 11.4)**

Size, in. <sup>B</sup>	Width Tolerance, in.	Thickness Tolerances, in.		Length Camber, in./ft		Width Bow, in./ft	
		Finished <sup>C</sup>	Oversize <sup>D</sup>	Finished <sup>C</sup>	Oversize <sup>D</sup>	Finished <sup>C</sup>	Oversize <sup>D</sup>
3/16	+0.5 -0	+0.025 -0	...	1/4 /4	N/A <sup>E</sup>	1/16 /2	N/A
1/4	+0.5 -0	+0.025 -0	...	1/4 /4	N/A	1/16 /2	N/A
5/16	+0.5 -0	+0.025 -0	...	1/4 /4	N/A	1/16 /2	N/A
3/8	+0.5 -0	+0.025 -0	+0.080 -0	1/4 /4	N/A	1/16 /2	N/A
7/16	+0.5 -0	+0.025 -0	+0.080 -0	1/4 /4	N/A	1/16 /2	N/A
1/2	+0.5 -0	+0.025 -0	+0.080 -0	1/4 /4	N/A	1/16 /2	N/A
5/8	+0.5 -0	+0.025 -0	+0.080 -0	1/4 /4	N/A	1/16 /2	N/A
3/4	+0.5 -0	+0.025 -0	+0.080 -0	1/4 /4	N/A	1/16 /2	N/A
7/8	+0.5 -0	+0.025 -0	+0.080 -0	1/4 /4	N/A	1/16 /2	N/A
1	+0.5 -0	+0.025 -0	+0.100 -0	1/4 /4	N/A	1/16 /2	N/A
1 1/8	+0.5 -0	+0.025 -0	+0.100 -0	1/4 /4	N/A	1/16 /2	N/A
1 1/4	+0.5 -0	+0.025 -0	+0.100 -0	1/4 /4	N/A	1/16 /2	N/A
1 3/8	+0.5 -0	+0.025 -0	+0.100 -0	1/4 /4	N/A	1/16 /2	N/A
1 1/2	+0.5 -0	+0.025 -0	+0.100 -0	1/4 /4	N/A	1/16 /2	N/A
1 5/8	+0.5 -0	+0.025 -0	+0.100 -0	1/4 /4	N/A	1/16 /2	N/A
1 3/4	+0.5 -0	+0.025 -0	+0.100 -0	1/4 /4	N/A	1/16 /2	N/A
1 7/8	+0.5 -0	+0.025 -0	+0.100 -0	1/4 /4	N/A	1/16 /2	N/A
2-3 3/4	+0.5 -0	+0.025 -0	+0.200 -0	1/4 /4	N/A	1/16 /2	N/A
Over 3 3/4	+0.5 -0	+0.025 -0	N/A	1/4 /4	N/A	1/16 /2	N/A

<sup>A</sup>Based on dry-as-manufactured condition and proper product storage and handling.

<sup>B</sup>To convert inches to millimetres, multiply by 25.40.

<sup>C</sup>Finished product as defined in 3.2.1.

<sup>D</sup>Oversize product as defined in 3.2.3; roundness and camber not applicable.

<sup>E</sup>Not applicable.

Type	Description	Class	Description	Grade	Applicable Classification System D6779 Callout <sup>A</sup>	Description	Ultimate Tensile Strength, min, psi (MPa)	Tensile Elongation, % at Break, min	Tensile Modulus, min, psi (MPa)	Dimensional Stability, %, max
05	Nylon 6/12	1	Unfilled	1	PA 0612/0613	General purpose	8000 (53)	20	300 000 (2000)	0.4
00	Other	0	...	0	...	...	...	...	...	...

<sup>A</sup> Applicable Classification System D6779 resin type to be specified on purchase order.

<sup>B</sup>In accordance with Classification System D6779.

<sup>C</sup>Heat resistance requirement is 75 % retention of original tensile strength after aging 100 h at 300 ± 3.5°F. After heat aging, use Test Method D638 procedure.

[ASTM D5989-14](https://standards.iteh.ai)
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