Designation: D 5989 – 03

Standard Specification for Extruded and Monomer Cast Shapes Made from Nylon (PA)[1]

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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 manufactured from nylon or monomers.

1.2 The properties included in this specification are those required for the compositions covered. Requirements necessary to identify particular characteristics important to specialized applications may be described by using the classification system given in Section 4.

1.3 This specification allows for the use of recycled plastics (as defined in Guide D 5033).

1.4 The values are stated in English units and are regarded as the standard in all property and dimensional tables. For reference purposes, SI units are also included in Table 1 and S-PA 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 similar or equivalent ISO standard.

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

2. Referenced Documents

2.1 *ASTM Standards:*

D 256 Test Method for Determining the Pendulum Impact Resistance of Notched Specimens of Plastics[2]

D 638 Test Method for Tensile Properties of Plastics[2]

D 790 Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Materials[2]

D 883 Terminology Relating to Plastics[2]

D 3892 Practice for Packaging/Packing of Plastics[2]

D 4000 Classification System for Specifying Plastics Materials[2]

D 5033 Guide for the Development of Standards Relating to the Proper Use of Recycled Plastics[3]

D 6779 Classification System for Polyamide Molding and Extrusion Materials (PA)[3]

2.2 *ANSI Standard:*[4]

Z1.4-1993 Sampling Procedures and Tables for Inspection by Attributes

2.3 *Federal Standard:*[5]

LP-410A Nylon Stock Shapes

3. Terminology

3.1 *Definitions:*

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 D 883 or Guide D 5033.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *finished product (F)*, *n*—product that meets the dimensional criteria of Tables 2-5 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 3 and Table 5 only.

3.2.4 *plate*, *n*—flat stock greater than ⅜ in.

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

[1] This specification is under the jurisdiction of ASTM Committee D20 on Plastics and is the direct responsibility of Subcommittee D20.20 on Plastic Products.

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[2] *Annual Book of ASTM Standards*, Vol 08.02.

[3] *Annual Book of ASTM Standards*, Vol 08.03.

[4] Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036.

[5] Available from U.S. Government Printing Office Superintendent of Documents, 732 N. Capitol St., NW, Mail Stop: SDE, Washington, DC 20401.

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

TABLE 1 Additional Detail Requirements—Reinforced/Unreinforced Extruded and Cast Nylons[A]

Designation Order Number	Property	0	1	2	3	4	5	6	7	8	9
1	Tensile strength, Test Method D 638, min, psi [MPa]	Unspecified	6000 [41]	8000 [55]	10 000 [69]	12 000 [83]	14 000 [97]	16 000 [110]	20 000 [138]	25 000 [172]	Specify value
2	Elongation at break, Test Method D 638, %, min	Unspecified	1	3	5	10	20	50	100	200	Specify value
3	Tensile modulus min, Test Method D 638, min, psi [MPa]	Unspecified	100 000 [690]	200 000 [1379]	300 000 [2073]	400 000 [2760]	500 000 [3448]	600 000 [4137]	800 000 [5516]	1 000 000 [6895]	Specify value
4	Dimensional stability, % max, per 11.2	Unspecified	0.1	0.2	0.3	0.4	0.6	0.8	1.0	1.5	Specify value
5	Flexural modulus, Test Methods for D 790, min, psi [MPa]	Unspecified	250 000 [1649]	350 000 [2400]	450 000 [3100]	550 000 [3792]	650 000 [4482]	750 000 [5171]	1 000 000 [6895]	1 500 000 [10 343]	Specify value
6	Izod impact, Test Method for D 256, min, ft lbs/in. [J/m] of notch	Unspecified	0.4 [21]	0.6 [32]	0.8 [43]	1.0 [53]	2.0 [107]	3.0 [160]	4.5 [240]	6.0 [320]	Specify value
7	To be determined	Unspecified	...	...	...	...	...	...	...	...	

[A]The applicable Table 4 nylon type (including fillers per 4.4.4) must precede this table designation.

TABLE 2 Dimensional Requirements for Extruded Nylon Rod[A]

Size, in.[B]	Length Tolerance, in.	Diameter Tolerance, in.	Roundness TIR, in.	Camber, in./ft
1/16	+1 –0	+0.002 –0.001	0.002	2½ /8
1/8	+1 –0	+0.002 –0.001	0.002	2½ /8
3/16	+1 –0	+0.002 –0.001	0.002	2½ /8
1/4	+1 –0	+0.002 –0.001	0.002	2½ /8
3/8	+1 –0	+0.002 –0.001	0.002	2½ /8
1/2	+1 –0	+0.002 –0.001	0.002	2½ /8
5/8	+1 –0	+0.002 –0.001	0.002	2½ /8
3/4	+1 –0	+0.002 –0.001	0.002	2½ /8
7/8	+1 –0	+0.002 –0.001	0.002	2½ /8
1	+1 –0	+0.004 –0.001	0.002	1¼ /8
1⅛	+1 –0	+0.005 –0	0.005	1¼ /8
1¼	+1 –0	+0.005 –0	0.005	1¼ /8
1⅜	+1 –0	+0.005 –0	0.005	1¼ /8
1½	+1 –0	+0.005 –0	0.005	1¼ /8
1⅝	+1 –0	+0.008 –0	0.005	1¼ /8
1¾	+1 –0	+0.008 –0	0.005	1¼ /8
1⅞	+1 –0	+0.008 –0	0.005	1¼ /8
2	+1 –0	+0.010 –0	0.010	1¼ /8
2⅛ –2¾	+1 –0	+0.030 –0	0.030	1¼ /8
3–5	+1 –0	+0.250 –0	0.060	¼ /4
Over 5	+1 –0	+0.250 –0	0.060	¼ /4

[A]Based on dry-as-manufactured condition and proper product storage and handling.

[B]To convert inches to millimetres, multiply by 25.40.

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.

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. and minimum wall thickness of 1/16 in., or cast shapes with minimum inside diameter of ½ in., and minimum wall of ¼ in.

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.

4. Classification and Material

4.1 Product shape and size as defined in the applicable purchase order.

4.2 This specification covers product extruded and cast as listed in Table S-PA. Products included in the designations reference Classification System D 6779 callouts where applicable.

4.2.1 The type of nylon extruded product may be categorized by type, grade and class depending on resin and filler compositions as defined in Table S-PA.

4.2.2 Each type of nylon shape may be categorized into one of several grades as follows:

4.2.2.1 *Grade 1—General Purpose*:

(1) Extruded product made using virgin plastic plus up to 15 % maximum of an alternate virgin-nylon as a processing aid.

(2) Up to 20 % nylon regrind plastic developed during the internal processing steps; may be reused for sheet products.

(3) Monomer-cast nylon made from epsilon-caprolactam or lauryllactam monomer.

4.2.2.2 *Grade 2—Recycled*:

(1) Extruded product made using any amount up to 100 % recycled nylon plastic.

(2) Does not apply to cast product.

4.2.2.3 *Grade 3—Unmodified Virgin*:

(1) Extruded product made using 100 % unmodified virgin plastic.

(2) Does not apply to cast product.

4.3 The type, class, and grade is further differentiated based on dimensional stability (elevated temperature excursion test), Table S-PA, and dimensional requirements, Tables 2-5.

4.4 *Property Tables*:

4.4.1 Table S-PA may be used to describe both extruded or cast products.

4.4.2 Table 1 may also be used to describe extruded or cast products not included in Table S-PA via a cell callout which includes the applicable Table S-PA nylon type and specific properties (Table 1, Designations 1–7).

TABLE 3 Dimensional Requirements for Monomer Cast Nylon Rod[A]

Size, in.[B]	Length Tolerance, in.	Diameter Tolerance, in.		Roundness TIR, in.		Camber, in./ft	
		Finished[C]	Oversize[D]	Finished[C]	Oversize[D]	Finished[C]	Oversize[D]
1	+1 -0	+0.015 –0	...	0.015	N/A[E]	¼ /4	N/A
1⅛	+1 -0	+0.015 –0	...	0.015	N/A	¼ /4	N/A
1¼	+1 -0	+0.015 –0	...	0.015	N/A	¼ /4	N/A
1⅜	+1 -0	+0.015 –0	+0.100 –0	0.015	N/A	¼ /4	N/A
1½	+1 -0	+0.015 –0	+0.100 –0	0.015	N/A	¼ /4	N/A
1⅝	+1 -0	+0.015 –0	+0.100 –0	0.015	N/A	¼ /4	N/A
1¾	+1 -0	+0.015 –0	+0.100 –0	0.015	N/A	¼ /4	N/A
1⅞	+1 -0	+0.015 –0	+0.100 –0	0.015	N/A	¼ /4	N/A
2–2¾	+1 -0	+0.030 –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

[A]Based on dry-as-manufactured condition and proper product storage and handling.
[B]To convert inches to millimetres, multiply by 25.40.
[C]Finished product as defined in 3.2.1.
[D]Oversize product as defined in 3.2.3; roundness and camber not applicable.
[E]Not applicable.

4.4.3 To facilitate the incorporation of future or special materials not covered by Table S-PA, the "as specified" category (00) for type, class and grade is shown in the table with the basic properties to be obtained from Table 1, as they apply (see 4.5, Example 5).

TABLE 4 Dimensional Requirements for Extruded Nylon Sheets and Plates[A] (Squareness Requirement Listed in 11.4)

Size, in.[B]	Width Tolerance, in.	Thickness Tolerances, in.	Length Camber, in./ft	Width Bow, in./ft
1/16	+0.5 -0	±0.005	¾ /4	3/16 /2
3/32	+0.5 -0	±0.005	¾ /4	3/16 /2
⅛	+0.5 -0	±0.010	¾ /4	3/16 /2
3/16	+0.5 -0	+0.025 –0	¾ /4	3/16 /2
¼	+0.5 -0	+0.025 –0	¾ /4	3/16 /2
5/16	+0.5 -0	+0.025 –0	¾ /4	3/16 /2
⅜	+0.5 -0	+0.025 –0	¾ /4	3/16 /2
7/16	+0.5 -0	+0.025 –0	¾ /4	3/16 /2
½	+0.5 -0	+0.025 –0	¾ /4	3/16 /2
⅝	+0.5 -0	+0.025 –0	¾ /4	3/16 /2
¾	+0.5 -0	+0.025 –0	¾ /4	3/16 /2
⅞	+0.5 -0	+0.025 –0	¾ /4	3/16 /2
1	+0.5 -0	+0.050 –0	¼ /4	1/16 /2
1⅛	+0.5 -0	+0.050 –0	¼ /4	1/16 /2
1¼	+0.5 -0	+0.050 –0	¼ /4	1/16 /2
1⅜	+0.5 -0	+0.050 –0	¼ /4	1/16 /2
1½	+0.5 -0	+0.050 –0	¼ /4	1/16 /2
1⅝	+0.5 -0	+0.050 –0	¼ /4	1/16 /2
1¾	+0.5 -0	+0.050 –0	¼ /4	1/16 /2
1⅞	+0.5 -0	+0.050 –0	¼ /4	1/16 /2
2	+0.5 -0	+0.050 –0	¼ /4	1/16 /2
Over 2	+0.5 -0	+0.125 –0	¼ /4	1/16 /2

[A]Based on dry-as-manufactured condition and proper product storage and handling.
[B]To convert inches to millimetres, multiply by 25.40.