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Standard Specification for Strapping, Nonmetallic (and Joining Methods)[1]

This standard is issued under the fixed designation D 3950; 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.

1. Scope

1.1 This specification covers nonmetallic strapping and joining methods intended for use in closing, reinforcing, and bundling articles for shipment, unitizing, palletizing, and bracing for car loading and truck loading.

1.2 The values stated in inch-pound units are to be regarded as standard.

1.3 The following safety hazards caveat pertains only to the test method portion, Section 12, 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.*

2. Referenced Documents

2.1 *ASTM Standards:*

D 996 Terminology of Packaging and Distribution Environments[2]

D 3951 Practice for Commercial Packaging[2]

D 4332 Practice for Conditioning Containers, Packages, or Packaging Components for Testing[2]

2.2 *Other Standards:*

ANSI/ASQC Z 1.4 Sampling Procedures and Tables for Inspection by Attributes[3]

ANSI/ASQC Z 1.9 Sampling Procedures and Tables for Inspection by Variables for Percent Nonconforming[3]

3. Terminology

3.1 For general definitions of packaging and distribution environments, see Terminology D 996.

4. Classification

4.1 *Types and Grades*:

Type I —Strapping, bonded rayon cord.
- *Grade 1*—Light duty.
- *Grade 2*—Regular duty.
- *Grade 3*—Heavy duty.

Type IA —Strapping, bonded, or woven polyester cord.
- *Grade 1*—Light duty.
- *Grade 2*—Regular duty.
- *Grade 3*—Heavy duty.
- *Grade 4*—Extra heavy duty.
- *Grade 5*—Special duty.

Type II — Strapping, polyolefin plastic.

Type III — Strapping, nylon plastic.

Type IV — Strapping, polyester plastic.

5. Ordering Information

5.1 The inquiry and order shall indicate the following:

5.1.1 Type, grade, and dimensions required (see 4.1 and 7.1),

5.1.2 Length per coil (see 8.1),

5.1.3 Joining method (see 6.2), type and size required (if needed),

5.1.4 If an embossed finish on strapping is desired or allowed (see Footnote in Table 1),

5.1.5 Make and model of strapping equipment that the strapping and joining method must work in, if applicable,

5.1.6 Coil dimensions (see 8.1),

5.1.7 Level of packaging and packing if other than commercial (see Section 15), and

5.1.8 ASTM designation and date of issue.

6. Materials and Manufacture

6.1 Materials shall be of the quality necessary to meet the physical requirements within the allowable dimensions.

6.1.1 *Type I*—Strapping shall consist of longitudinal rayon cords bonded with a plastic binder so that a nonwoven material is formed.

6.1.1.1 *Type IA*—Strapping shall consist of longitudinal polyester cords bonded with a plastic binder to form a nonwoven material or longitudinal polyester cords woven with a weft thread and treated with a plastic binder to form a woven material.

6.1.2 *Type II*—Strapping shall be an extruded, oriented polyolefin.

6.1.3 *Type III*—Strapping shall be an extruded, oriented nylon.

6.1.4 *Type IV*—Strapping shall be an extruded, oriented polyester.

6.2 *Joining Methods*— If seals or buckles are to be used, they shall be steel and have a coating of zinc, black iron oxide,

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[2] *Annual Book of ASTM Standards*, Vol 15.09.

[3] Available from American National Standards Institute, 11 W. 42nd St., 13th Floor, New York, NY 10036.

TABLE 1 Breaking Strengths of Type II Strapping (PP)

Nominal Width of Strapping, in. (mm)	Nominal Thickness of Strapping, in. (mm)[A]	Minimum Breaking Strength, lbf (N)[B]
¼ (6.4)	0.0135 (0.34)	134 (600)
0.236 (6.0)	0.0130 (0.33)	135 (600)
¼ (6.4)	0.015 (0.38)	180 (810)
¼ (6.4)	0.018 (0.46)	190 (850)
0.236 (6.0)	0.0173 (0.44)	190 (850)
¼ (6.4)	0.025 (0.64)	200 (900)
0.354 (9.0)	0.0142 (0.36)	225 (1 000)
0.354 (9.0)	0.0173 (0.44)	270 (1 200)
0.354 (9.0)	0.0181 (0.46)	270 (1 200)
⅜ (9.5)	0.018 (0.46)	250 (1 120)
⅜ (9.5)	0.015 (0.36)	290 (1 300)
0.413 (10.5)	0.0201 (0.51)	360 (1 600)
⅜ (9.5)	0.020 (0.51)	390 (1 750)
⅜ (9.5)	0.025 (0.64)	400 (1 790)
0.413 (10.5)	0.0248 (0.63)	460 (2 050)
0.413 (10.5)	0.0295 (0.75)	550 (2 450)l
7⁄16 (11.1)	0.014 (0.36)	300 (1 340)
7⁄16 (11.1)	0.019 (0.48)	350 (1 570)
0.472 (12.0)	0.0169 (0.43)	360 (1 600)
7⁄16 (11.1)	0.023 (0.58)	420 (1 880)
7⁄16 (11.1)	0.025 (0.64)	450 (2 020)
0.472 (12.0)	0.0212 (0.54)	460 (2 050)
0.472 (12.0)	0.0252 (0.64)	550 (2 450)
7⁄16 (11.1)	0.030 (0.76)	550 (2 460)
½ (12.7)	0.017 (0.43)	350 (1 570)
½ (12.7)	0.015 (0.38)	390 (1 750)
½ (12.7)	0.022 (0.56)	450 (2 020)
½ (12.7)	0.020 (0.51)	530 (2 370)
½ (12.7)	0.026 (0.66)	550 (2 460)
½ (12.7)	0.025 (0.64)	660 (2 960)
½ (12.7)	0.030 (0.76)	810 (3 630)
⅝ (15.9)	0.015 (0.38)	500 (2 240)
⅝ (15.9)	0.020 (0.51)	680 (3 050)
⅝ (15.9)	0.030 (0.76)	950 (4 260)
¾ (19.1)	0.020 (0.51)	725 (3 250)
1¼ (31.8)	0.035 (0.89)	2 200 (9 860)
1¼ (31.8)	0.050 (1.27)	3 100 (13 900)

[A] When specified (see 5.1.4), the strapping as measured by a flat anvil micrometer shall have an embossed finish which yields an overall nominal thickness no greater than twice the nominal thickness of smooth-surfaced strapping of the same width and breaking strength.

[B] Range of elongation at break is from 10 to 35 %.

or equivalent protection from corrosion, or buckles may be made of plastic.

7. Mechanical Properties

7.1 *Breaking Strength and Elongation* (see 12.2):

7.1.1 Type I and Type IA strapping shall conform to the breaking strengths and elongations prescribed in Table 2 and Table 3.

7.1.2 Type II strapping shall conform to the breaking strengths and elongations prescribed in Table 1.

7.1.3 Type III strapping shall conform to the breaking strengths and elongations prescribed in Table 4.

7.1.4 Type IV strapping shall conform to the breaking strengths and elongations prescribed in Table 5.

7.2 Transverse strength of Types I and IA strapping shall be a minimum of 2.75 lbf (12.2 N) and 2.25 lbf (10 N), respectively, when tested in accordance with 12.4.

7.3 *Joint Strength* (see 12.3).

TABLE 2 Breaking Strengths[A] of Type I Bonded Rayon Cord Strapping

Nominal Width of Strapping, in. (mm)	Grade	Minimum Breaking Strength, lbf (N)
¼ (6.4)	2	235 (1045)
⅜ (9.5)	1	290 (1290)
	2	350 (1555)
½ (12.7)	1	410 (1820)
	2	465 (2070)
⅝ (15.9)	1	525 (2335)
	2	585 (2600)
	3	765 (3400)
¾ (19.1)	1	640 (2845)
	2	700 (3110)
	3	900 (4000)
1¼ (31.8)	3	1575 (7005)

[A] Range of elongation at break is from 10 to 15 %.

TABLE 3 Breaking Strengths[A] of Type IA Bonded or Woven Polyester Cord Strapping

Nominal Width of Strapping, in. (mm)	Grade	Minimum Breaking Strength, lbf (N)
¼ (6.4)	2	300 (1 335)
(6.0)	3	540 (2 400)
⅜ (9.5)	2	450 (2 000)
(9.0)	3	780 (3 480)
½ (12.7)	1	400 (1 780)
(12.7)	2	600 (2 670)
(13.0)	3	1 050 (4 670)
(13.0)	4	1 360 (6 050)
⅝ (15.9)	1	500 (2 225)
(15.9)	2	725 (3 225)
(16.0)	3	1 310 (5 830)
(16.0)	4	1 650 (7 340)
¾ (19.1)	2	900 (4 000)
(19.0)	3	1 585 (7 060)
(19.0)	4	1 830 (8 150)
(19.0)	5	2 600 (11 570)
1¼ (32.0)	2	1 830 (8 150)
(32.0)	3	2 105 (9 370)
(32.0)	4	3 285 (14 620)
(32.0)	5	4 200 (18 680)
1½ (38.0)	5	5 400 (24 030)

[A] Range of elongation at break is from 9 to 15 %.

7.3.1 Type I and Type IA Grade 1 and Grade 2 joined strapping shall have a strength of not less than 45% of the minimum breaking strength of the strapping grade and size listed in Table 2 and Table 3.

7.3.2 Type IA Grade 3, Grade 4, and Grade 5 joined strapping shall have a strength of not less than 55 % of the minimum breaking strength of the strapping grade and size listed in Table 3. Test data are available to substantiate this conclusion.

7.3.3 Types II, III, and IV joined strapping shall have a strength of not less than 45 % of the minimum breaking strength corresponding to the dimensions of the strap listed in Table 1, Table 4, or Table 5.

TABLE 4 Breaking Strengths of Type III Strapping (Nylon)

Nominal Width of Strapping, in. (mm)	Nominal Thickness of Strapping, in. (mm)	Minimum Breaking Strength, lbf (N)[A]
7/16 (11.1)	0.017 (0.43)	420 (1870)
	0.023 (0.58)	560 (2490)
	0.029 (0.74)	700 (3110)
1/2 (12.7)	0.015 (0.38)	420 (1870)
	0.020 (0.51)	560 (2490)
	0.025 (0.64)	700 (3110)
	0.030 (0.76)	900 (4000)

[A]Range of elongation at break is from 12 to 25 %.

TABLE 5 Breaking Strengths of Type IV Strapping (PET)

Nominal Width of Strapping, in. (mm)	Nominal Thickness of Strapping, in. (mm)	Minimum Breaking Strength, lbf (N)[A]
3/8 (9.5)	0.015 (0.38)	310 (1380)
0.354 (9.0)	0.0205 (0.52)	400 (1780)
3/8 (9.5)	0.020 (0.51)	420 (1870)
0.413 (10.5)	0.0205 (0.52)	460 (2050)
0.413 (10.5)	0.024 (0.61)	560 (2490)
7/16 (11.1)	0.016 (0.41)	360 (1600)
7/16 (11.1)	0.020 (0.51)	460 (2050)
0.472 (12.0)	0.0175 (0.44)	470 (2090)
7/16 (11.1)	0.022 (0.56)	500 (2220)
0.472 (12.0)	0.0205 (0.52)	560 (2490)
7/16 (11.1)	0.024 (0.61)	560 (2490)
0.472 (12.0)	0.0280 (0.71)	750 (3340)
1/2 (12.7)	0.015 (0.38)	420 (1870)
1/2 (12.7)	0.017 (0.43)	470 (2090)
1/2 (12.7)	0.020 (0.51)	560 (2490)
1/2 (12.7)	0.025 (0.64)	700 (3110)
1/2 (12.7)	0.028 (0.71)	750 (3340)
1/2 (12.7)	0.030 (0.76)	850 (3780)
5/8 (15.9)	0.020 (0.51)	700 (3110)
5/8 (15.9)	0.025 (0.64)	870 (3870)
5/8 (15.9)	0.030 (0.76)	1060 (4720)
5/8 (15.9)	0.035 (0.89)	1200 (5328)
5/8 (15.9)	0.035 (0.89)	1300 (5770)
5/8 (19.1)	0.040 (1.02)	1500 (6660)
3/4 (19.1)	0.040 (1.02)	1750 (7770)
3/4 (19.1)	0.050 (1.27)	2250 (9990)
3/4 (19.1)	0.055 (1.40)	2400 (10 660)
3/4 (19.1)	0.060 (1.53)	2500 (11 100)

[A] Range of elongation at break is from 5 to 25 %.

8. Dimensions and Permissible Variations

8.1 The minimum length per coil of strapping shall be as specified in the following tables according to type, grade, size, and coil width. The coil shall be an oscillating or ribbon wind.

8.1.1 Type I and Type IA strapping shall be furnished with the minimum feet per coil according to size and grade as prescribed in Table 6.

8.1.2 Types II, III, and IV strapping shall be furnished with the minimum feet per coil in accordance with the size and coil width in Table 7.

9. Workmanship, Finish, and Appearance

9.1 Type I and Type IA strapping shall be straight, clean, have good webbing, and be free of cracks and other defects that may affect the serviceability.

9.2 Types II, III, and IV strapping shall be straight, clean, and free of kinks, edge curvature, cracks, and other defects that may affect the serviceability.

TABLE 6 Minimum Feet Per Coil for Type I and Type IA Strapping

Nominal[A] Width of Strapping, in. (mm)	Grade	Minimum Feet (Metres) Per 5½-in. (140-mm) Wide Coil[B]
¼ (6.0)	2	7800 (2380)
(6.0)	3	8250 (2520)
3/8 (9.0)	1 and 2	4950 (1510)
(9.0)	3	4950 (1510)
½ (13.0)	1 and 2	3900 (1190)
(13.0)	3	4170 (1270)
(13.0)	4	3300 (1010)
5/8 (16.0)	1 and 2	3000 (910)
(16.0)	3	3300 (1010)
(16.0)	4	2490 (760)
3/4 (19.0)	2	2100 (640)
(19.0)	3	2490 (760)
(19.0)	4	1655 (500)
1¼ (32.0)	2, 3, and 4	330 (100)
(32.0)	5	450 (140)

[A]The width tolerance shall be + 1/32 in. (+ 0.79 mm) and − 3/32 in. (−2.37 mm).
[B]1¼-in. (32-mm) strapping may be ribbon-wound 1¼-in. (32-mm) wide coil.

9.3 Splices may be made if they do not affect the serviceability of the strapping in strapping equipment and have a break strength equal to at least 50% of the strap break strength. No more than one splice per coil will be permitted.

10. Sampling Plan

10.1 Where it can be demonstrated that a supplier's quality control system provides a similar degree of assurance as that obtained through the use of this specification, the supplier may use that system in place of the system described in this specification. In case of conflict, provisions set forth in ANSI/ASQC Z1.4 shall be used.

10.2 *Lot Size*—The lot size shall be expressed in units of coils or joining methods, or both, and shall consist of all products of one type, grade, and size offered for acceptance at one time.

10.3 *Unit Sample*— One coil or one joining method shall be considered a unit. A minimum of 10 ft (3.05 m) per coil of strapping is required to perform the tests.

10.4 *Rate of Sampling*— The rate of sampling shall be in accordance with ANSI/ASQC Z1.9; Table A-2 reduced inspection level shall be used.

11. Number of Tests

11.1 *Tests*—For the determination of break strength, elongation, transverse strength, and sealed joint strength, an average of three specimens per coil shall be considered a complete test.

11.2 *Retests*—When testing for elongation, if the specimen fails outside of the center third of the gage length or within 1 in. of the jaws, a retest shall be made. If the percentage of elongation or the break strength is less than the specified minimum, a retest is permitted. In this retest, three consecutive specimens must meet the minimum requirements.

12. Test Methods

12.1 The purpose of these test methods is to determine the strength of the strapping and elongation, and the strength when the ends of the strapping are joined together.

12.2 The major properties of strapping used to reinforce packages or bundle objects are the strapping tensile strength,