Designation: D 3950 – 06

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.

This standard has been approved for use by agencies of the Department of Defense.

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:* [2]

D 996 Terminology of Packaging and Distribution Environments

D 3951 Practice for Commercial Packaging

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

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.
- *Grade 6*—Special duty.
- *Grade 7*—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.

[1] This specification is under the jurisdiction of ASTM Committee D10 on Packaging and is the direct responsibility of Subcommittee D10.25 on Palletizing and Unitizing of Loads.

Current edition approved Oct. 1, 2006. Published October 2006. Originally approved in 1980. Last previous edition approved in 2005 as D 3950 – 05.

[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, 25 W. 43rd St., 4th Floor, New York, NY 10036.

TABLE 1 Breaking Strengths of Type II Strapping (PP)

Nominal Width of Strapping		Nominal Thickness of Strapping		Minimum Breaking Strength	
in.	(mm)	in.	(mm)[A]	lb	(N)[B]
0.197	(5.0)	0.0120	(0.30)	80	(360)
0.197	(5.0)	0.0145	(0.37)	100	(440)
0.234	(5.9)	0.0135	(0.34)	130	(580)
0.234	(5.9)	0.0140	(0.36)	155	(690)
0.236	(6.0)	0.0130	(0.33)	135	(600)
0.234	(5.9)	0.0160	(0.41)	180	(800)
0.236	(6.0)	0.0173	(0.44)	190	(850)
¼	(6.4)	0.0135	(0.34)	134	(600)
¼	(6.4)	0.0150	(0.38)	180	(800)
¼	(6.4)	0.0250	(0.64)	200	(890)
0.351	(8.9)	0.0130	(0.33)	200	(899)
0.354	(9.0)	0.0142	(0.36)	225	(1 000)
0.351	(8.9)	0.0160	(0.41)	270	(1 200)
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)	0.0180	(0.46)	250	(1 110)
⅜	(9.5)	0.0150	(0.38)	290	(1 290)
⅜	(9.5)	0.0200	(0.51)	390	(1 730)
⅜	(9.5)	0.0250	(0.64)	400	(1 780)
0.413	(10.5)	0.0190	(0.48)	360	(1 600)
0.413	(10.5)	0.0201	(0.51)	360	(1 600)
0.413	(10.5)	0.0248	(0.63)	460	(2 050)
0.413	(10.5)	0.0295	(0.75)	550	(2 450)
0.413	(10.5)	0.0295	(0.75)	540	(2 400)
0.413	(10.5)	0.0230	(0.58)	450	(2 000)
7/16	(11.1)	0.0140	(0.36)	300	(1 330)
7/16	(11.1)	0.0190	(0.48)	350	(1 560)
7/16	(11.1)	0.0230	(0.58)	420	(1 870)
7/16	(11.1)	0.0250	(0.64)	450	(2 000)
7/16	(11.1)	0.0300	(0.76)	550	(2 450)
0.468	(11.9)	0.0215	(0.55)	450	(2 000)
0.472	(12.0)	0.0169	(0.43)	360	(1 600)
0.472	(12.0)	0.0212	(0.54)	460	(2 050)
0.472	(12.0)	0.0252	(0.64)	550	(2 450)
0.480	(12.2)	0.0190	(0.48)	400	(1.780)
½	(12.7)	0.0150	(0.38)	390	(1.750)
½	(12.7)	0.0170	(0.43)	350	(1 570)
½	(12.7)	0.0220	(0.56)	450	(2 020)
½	(12.7)	0.0200	(0.51)	530	(2 360)
½	(12.7)	0.0250	(0.64)	660	(2 940)
½	(12.7)	0.0260	(0.66)	550	(2 450)
½	(12.7)	0.0300	(0.76)	810	(3 600)
0.468	(12.0)	0.0255	(0.65)	540	(2 400)
0.591	(15.0)	0.0410	(1.04)	1 050	(4 660)
⅝	(15.9)	0.0150	(0.38)	500	(2 200)
⅝	(15.9)	0.0200	(0.51)	680	(3 020)
⅝	(15.9)	0.0300	(0.76)	950	(4 220)
0.728	(18.5)	0.0410	(1.04)	1 300	(5 770)
¾	(19.1)	0.0200	(0.51)	725	(3 220)
1¼	(31.8)	0.0350	(0.89)	2 200	(9 790)
1¼	(31.8)	0.0500	(1.27)	3 100	(13 790)

[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 7 to 35 %.

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, 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).

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, Grade 5, Grade 6, and Grade 7 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.

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	157 (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)	4	4 400 (19 570)
1½ (38.0)	5	5 400 (24 030)
1⅝ (40.0)	6	7 700 (34 265)
1⅝ (40.0)	7	11 000 (48 950)

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

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)
½ (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 %.

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.

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.

TABLE 5 Breaking Strengths of Type IV Strapping (PET)

Nominal Width of Strapping in.	(mm)	Nominal Thickness of Strapping in.	(mm)	Minimum Breaking Strength lb	(N)[A]
0.351	(8.9)	0.0190	(0.48)	390	(1 730)
0.354	(9.0)	0.0205	(0.52)	400	(1 780)
⅜	(9.5)	0.0150	(0.38)	310	(1 380)
⅜	(9.5)	0.0200	(0.51)	420	(1 870)
0.413	(10.5)	0.0195	(0.50)	430	(1 910)
0.413	(10.5)	0.0205	(0.52)	460	(2 050)
0.413	(10.5)	0.0220	(0.56)	500	(2 220)
0.413	(10.5)	0.0240	(0.61)	560	(2 490)
0.413	(10.5)	0.0255	(0.65)	575	(2.550)
0.413	(10.5)	0.0265	(0.67)	600	(2 660)
7/16	(11.1)	0.0160	(0.41)	360	(1 600)
7/16	(11.1)	0.0200	(0.51)	460	(2 050)
7/16	(11.1)	0.0220	(0.56)	500	(2 220)
7/16	(11.1)	0.0240	(0.61)	560	(2 490)
0.468	(11.9)	0.0168	(0.43)	470	(2 090)
0.468	(11.9)	0.0175	(0.44)	470	(2 090)
0.468	(11.9)	0.0205	(0.52)	560	(2 490)
0.468	(11.9)	0.0275	(0.70)	750	(3 340)
0.468	(11.9)	0.0280	(0.71)	750	(3 340)
0.472	(12.0)	0.0175	(0.44)	470	(2 090)
0.472	(12.0)	0.0205	(0.52)	560	(2 490)
0.472	(12.0)	0.0280	(0.71)	750	(3 340)
½	(12.7)	0.0150	(0.38)	420	(1 870)
½	(12.7)	0.0170	(0.43)	470	(2 090)
½	(12.7)	0.0200	(0.51)	560	(2 490)
½	(12.7)	0.0250	(0.64)	700	(3 110)
½	(12.7)	0.0280	(0.71)	750	(3 340)
½	(12.7)	0.0300	(0.76)	850	(3 780)
0.615	(15.6)	0.0300	(0.76)	1 000	(4 440)
0.615	(15.6)	0.0350	(0.89)	1 100	(4 890)
0.615	(15.6)	0.0360	(0.91)	1 150	(5 120)
0.615	(15.6)	0.0380	(0.97)	1 200	(5 328)
0.615	(15.6)	0.0400	(1.02)	1 200	(5 328)
0.615	(15.6)	0.0400	(1.02)	1 500	(6 670)
0.615	(15.6)	0.0410	(1.04)	1 200	(5 328)
0.615	(15.6)	0.0450	(1.14)	1 600	(7 120)
⅝	(15.9)	0.0200	(0.51)	700	(3 110)
⅝	(15.9)	0.0250	(0.64)	870	(3 870)
⅝	(15.9)	0.0300	(0.76)	1 000	(4 450)
⅝	(15.9)	0.0350	(0.89)	1 200	(5 340)
⅝	(15.9)	0.0350	(0.89)	1 300	(5 780)
¾	(19.1)	0.0400	(1.02)	1 750	(7 780)
¾	(19.1)	0.0500	(1.27)	2 250	(10 010)
¾	(19.1)	0.0550	(1.40)	2 400	(10 680)
¾	(19.1)	0.0600	(1.52)	2 500	(11 120)
¾	(19.1)	0.0600	(1.52)	2 600	(11 550)
0.985	(25.0)	0.0400	(1.02)	2 300	(10 210)
0.985	(25.0)	0.0500	(1.27)	2 800	(12 460)
1¼	(32.0)	0.0320	(0.82)	2 250	(10 010)
1¼	(32.0)	0.0400	(1.02)	2 800	(12 460)

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

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.

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.