Designation: D3950 – 23

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

This standard is issued under the fixed designation D3950; 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 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. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered 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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.4 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D996 Terminology of Packaging and Distribution Environments

D3951 Practice for Commercial Packaging

D4332 Practice for Conditioning Containers, Packages, or Packaging Components for Testing

2.2 *Other Standards:*

ANSI/ASQC Z1.4 Sampling Procedures and Tables for Inspection by Attributes[3]

ANSI/ASQC Z1.9 Sampling Procedures and Tables for Inspection by Variables for Percent Nonconforming[3]

3. Terminology

3.1 *breaking strength, n*—the maximum load a sample of strap will bear when tested as described in Section 12, **Test Methods**, and by the procedure described in 12.6.1, *Breaking Strength*, expressed in units of force.

3.2 For general definitions of packaging and distribution environments, see Terminology D996.

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, Composite 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, polypropylene 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 and Note 1), type and size required (if needed),

5.1.4 If an embossed finish on strapping is desired or allowed (see Footnote in Table 1, Table 2, and Table 3),

[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 July 1, 2023. Published October 2023. Originally approved in 1980. Last previous edition approved in 2017 as D3950 – 17. DOI: 10.1520/D3950-23.

[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 (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, http://www.ansi.org.

TABLE 1 Breaking Strength of Type II Strapping (PP)

Nominal Width		Nominal Thickness		Minimum Breaking Strength	
±0.030 in. (±0.76 mm)		0.0250 in. (0.635 mm) thick or less, ±0.0025 in. (±0.06 mm)			
		>0.0250 in. thick, ±0.0030 in. (±0.08 mm)			
in.	(mm)	in.	(mm)[A]	lbf	(N)[B]
3/16	(5)	0.0120	(0.30)	80	(355)
		0.0145	(0.37)	100	(445)
1/4	(6)	0.0130	(0.033)	135	(600)
		0.0135	(0.34)	130	(580)
		0.0140	(0.36)	155	(690)
		0.0150 and 0.0160	(0.38 and 0.41)	180	(800)
		0.0173	(0.44)	190	(845)
		0.0250	(0.64)	200	(890)
3/8	(9)	0.0130	(0.33)	200	(890)
		0.0142	(0.36)	225	(1 000)
		0.0150	(0.38)	290	(1 290)
		0.0160 and 0.0173 and 0.0181	(0.41 and 0.44 and 0.46)	270	(1 200)
		0.0180	(0.46)	250	(1 110)
		0.0200	(0.51)	390	(1 735)
		0.0230	(0.58)	450	(2 000)
		0.0248	(0.63)	460	(2 045)
		0.0250	(0.64)	400	(1 780)
		0.0295	(0.75)	540	(2 400)
7/16	(11)	0.0140	(0.036)	300	(1 335)
		0.0190 and 0.0201	(0.48 and 0.51)	350	(1 555)
		0.0215	(0.55)	450	(2 000)
		0.0230	(0.58)	420	(1 870)
		0.0250	(0.64)	450	(2 000)
1/2	(12)	0.0150	(0.38)	390	(1 735)
		0.0170	(0.43)	350	(1 555)
		0.0190	(0.48)	400	(1 780)
		0.0200	(0.51)	530	(2 360)
		0.0220	(0.56)	450	(2 000)
		0.0250	(0.64)	660	(2 935)
		0.0255	(0.65)	540	(2 400)
		0.0260	(0.66)	550	(2 445)
		0.0300	(0.76)	810	(3 600)
5/8	(16)	0.0150	(0.38)	500	(2 225)
		0.0200	(0.51)	680	(3 025)
		0.030	(0.76)	950	(4 225)
		0.0410	(1.04)	1050	(4 670)
3/4	(19)	0.0200	(0.51)	725	(3 225)
		0.0410	(1.04)	1 300	(5 785)
1 1/4	(32)	0.0350	(0.89)	2 200	(9 785)
		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 %.

TABLE 2 Breaking Strengths of Type III Strapping (Nylon)

Nominal Width of Strapping, in. (mm)	Nominal Thickness of Strapping, in. (mm)[A]	Minimum Breaking Strength, lbf (N)[B]
7/16 (11.1)	0.017 (0.43)	420 (1870)
	0.023 (0.58)	560 (2490)
1/2 (12.7)	0.029 (0.74)	700 (3110)
	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] 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 12 to 25 %.

5.1.5 Make and model of strapping equipment that the strapping and joining method must work in, if applicable (see Note 1),

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 either bonded with a plastic binder to form a nonwoven material (Bonded); or encased in a polypropylene extrusion (Composite); or woven with a weft thread and treated with a plastic binder to form a woven material (Woven).

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

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

TABLE 3 Breaking Strength of Type IV Strapping (PET)

Nominal Width		Nominal Thickness		Minimum Breaking Strength	
±0.030 in. (±0.76 mm)		±0.0025 in. (±0.06 mm)			
in.	(mm)	in.	(mm)[A]	lbf	(N)[B]
⅜	(9)	0.0150	(0.38)	310	(1 380)
		0.0190	(0.48)	390	(1 735)
		0.0200	(0.51)	420	(1 870)
		0.0205	(0.52)	400	(1 780)
7/16	(11)	0.0160	(0.41)	360	(1 600)
		0.0195	(0.50)	430	(1 910)
		0.0200 and 0.0205	(0.51 and 0.52)	460	(2 045)
		0.0220	(0.56)	500	(2 225)
		0.0240	(0.61)	560	(2 490)
		0.0255	(0.65)	575	(2 560)
		0.0265	(0.67)	600	(2 670)
½	(12)	0.0150	(0.38)	420	(1 870)
		0.0168 and 0.0170	(0.43)	470	(2 090)
		0.0175	(0.44)	470	(2 090)
		0.0200 and 0.0205	(0.51 and 0.52)	560	(2 490)
		0.0250	(0.64)	700	(3 115)
		0.0275 and 0.0280	(0.70 and 0.71)	750	(3 435)
		0.0300	(0.76)	850	(3 780)
⅝	(16)	0.0200	(0.51)	700	(3 115)
		0.0250	(0.64)	870	(3 870)
		0.0300	(0.76)	1 000	(4 450)
		0.0350	(0.89)	1 300	(5 780)
		0.0360	(0.91)	1 150	(5 115)
		0.0400	(1.02)	1 500	(6 670)
		0.0450	(1.14)	1 600	(7 120)
⅝ [C]	(16)	0.0350 and 0.0400 and 0.0410	(0.89 and 1.02 and 1.04)	1 200	(5 340)
		0.0360	(0.91)	1 150	(5 115)
		0.0380	(0.097)	1 200	(5 340)
¾	(19)	0.0400	(1.02)	1 750	(7 785)
		0.0500	(1.27)	2 250	(10 010)
		0.0550	(1.40)	2 400	(10 680)
		0.0600	(1.52)	2 500	(11 120)
1	(25)	0.0400	(1.02)	2 300	(10 230)
		0.0500	(1.27)	2 800	(12 455)
1¼	(32)	0.0320	(0.82)	2 250	(10 010)
		0.0400	(1.02)	2 800	(12 455)
		0.0500	(1.27)	3 750	(16 680)

[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] *Ultimate Elongation Range:* 5 to 20% (Standard Elongation PET), 10 to 25% (High Elongation PET).
[C] Denotes High Elongation (H.E.) PET strapping.

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.

NOTE 1—Bonded, woven and composite Type 1A strappings each may require different joining methods (buckles), tensioning tools and dispensers.

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 4 and Table 5.

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 2.

7.1.4 Type IV strapping shall conform to the breaking strengths and elongations prescribed in Table 3.

TABLE 4 Breaking Strengths of Type I Bonded Rayon Cord Strapping

Nominal Width of Strapping, in. (mm)	Grade	Minimum Breaking Strength, lbf (N)[A]
¼ (6.4)	2	235 (1 045)
⅜ (9.0)	1	290 (1 290)
	2	350 (1 555)
½ (12.7)	1	410 (1 820)
	2	465 (2 070)
⅝ (16.0)	1	525 (2 335)
	2	585 (2 600)
	3	765 (3 400)
¾ (19.0)	1	640 (2 845)
	2	700 (3 110)
	3	900 (4 000)
1¼ (32.0)	3	1 575 (7 005)

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

7.2 *Joint Strength* (see 12.3).