



Designation: **D4675 – 09<sup>ε1</sup> D4675 – 14**

## Standard Guide for Selection and Use of Flat Strapping Materials<sup>1</sup>

This standard is issued under the fixed designation D4675; 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.

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

---

<sup>ε1</sup> NOTE—The layout of Table 2 was adjusted editorially in November 2010.

---

### INTRODUCTION

This guide covers two common categories of flat strapping materials: ~~flat carbon-steel and nonmetallic strapping, nonmetallic.~~ Within each of these two broad categories, categories there are distinct types that lend themselves in differing degrees to particular applications to differing degrees, applications.

The goal of this guide is to help the user focus on the desired elements of performance or service, and the unique properties of each strapping material in order to judge which of these strapping materials/products is best suited for the application. ~~Contact your supplier for further information intended strapping application.~~ For further information, consult with your strapping supplier, your carrier, and any packaging and loading regulations applicable to your products. It is of particular importance, for both safety and satisfactory performance, that the user informs the strapping supplier of all intended uses and usage conditions that may differ from industry custom and practice or from intended strapping applications. Likewise, the user needs to inform the strapping supplier of any practice of the user's carrier that the user believes may differ from any requirement or recommendation of the carrier's association or of any applicable ASTM or regulatory provisions. The user also should inform the strapping supplier of the following expected conditions: load, unit, or package characteristics (rigid, expanding, shrinking, or combination); severity of handling; nature of transport equipment; storage conditions (stacking height and weight); exposure to environmental conditions; extreme temperatures (particularly if prolonged outdoor exposure is anticipated); exposure to chemicals; exposure to abrasive surfaces; and exposure to sharp or pointed objects that can cause nicks, scratches, or holes in the strapping. There are other materials not covered by this guide, which may also offer acceptable solutions or may be used in conjunction with flat strapping to provide acceptable solutions for the user's intended application. Examples of accessories, such as, edge protectors, seal protectors, etc. are shown in Fig. 1.

~~It is recognized that there are other materials (not covered) that may also offer acceptable solutions or may be used in conjunction with flat strapping. Also, examples of ancillary materials are shown in Fig. 1.~~

Strapping may be ~~recyclable~~ recyclable but must never be reused. Contact your supplier for further information.

### 1. Scope

1.1 This guide covers information on flat strapping materials (steel ~~or~~ and nonmetallic) for the prospective user wanting initial guidance in selecting a strapping material and ~~applied configuration information on suggested application methods~~ for use in packaging (closing, reinforcing, baling, bundling, unitizing, or palletizing) and loading applications (load unitization and securement to transport vehicle) applications, vehicle). The use applies to handling, securement, storage, and distribution systems.

---

<sup>1</sup> This guide 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 March 1, 2009 April 1, 2014. Published March 2009 May 2014. Originally approved in 1987. Last previous edition approved in 2006 2009 as D4675 – 06 D4675 – 09 <sup>ε2-ε1</sup>. DOI: 10.1520/D4675-09E01-10.1520/D4675-14.

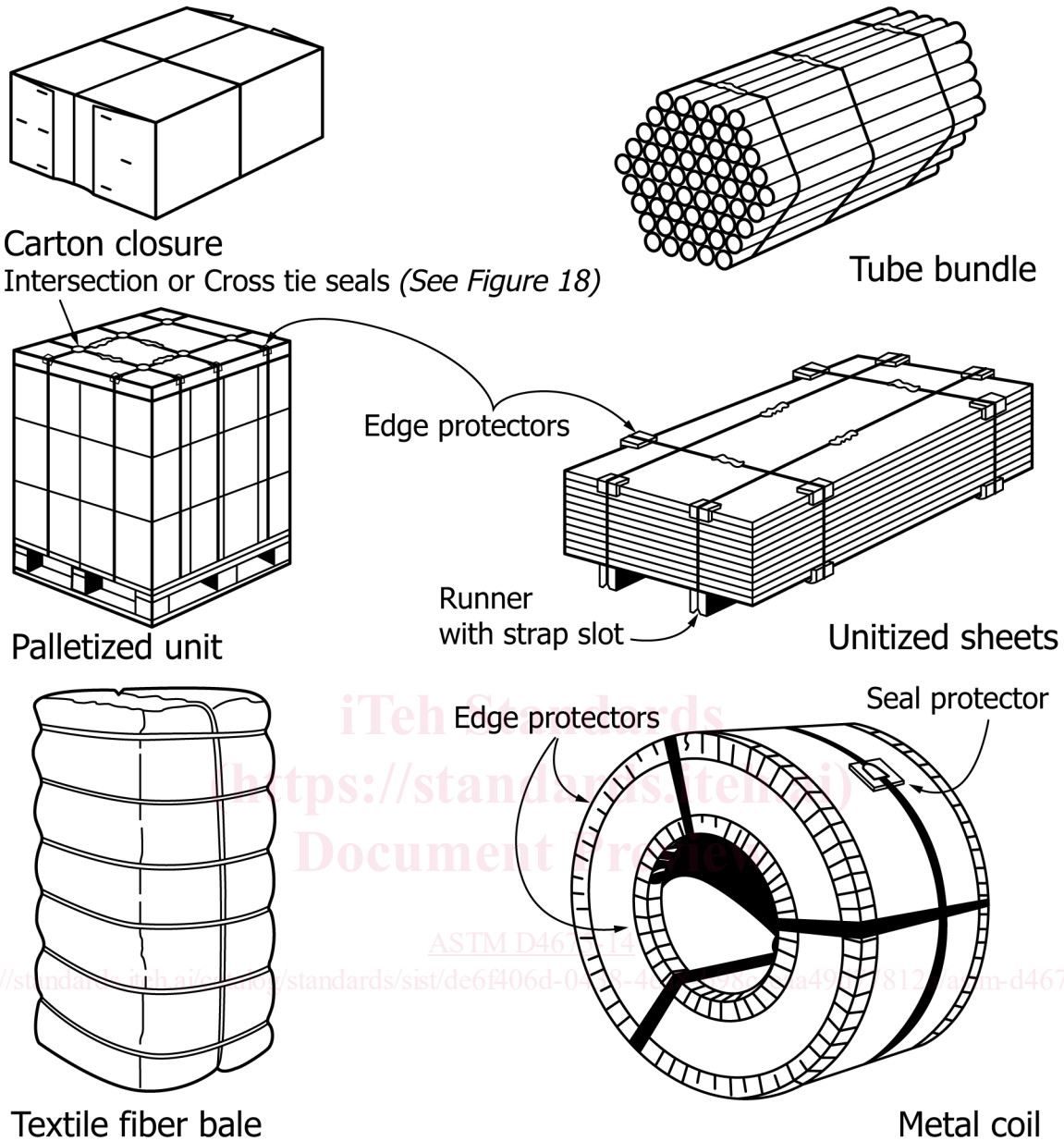


FIG. 1 Applications for Steel and Nonmetallic Strapping Various Strapping Applications

1.2 Carrier associations have established certain packaging and loading requirements that in (in some cases) specify the type of strap, the minimum size or strength, or both, and the type of joint or seal, or both, and the number of straps, seals, and joints that must be used for certain particular types of shipments or under certain conditions. Users should consult with their carriers initially to determine if there are applicable, applicable published requirements. Individual carriers may establish their own requirements (see requirements. (See 2.2).)

1.3 *Limitations*—This guide is not intended to give specific information as to how strapping must be used in any particular packaging or loading situation. Rather, it is intended to be informational in nature and is offered as a starting point for testing. The need for thorough testing of strapping being considered by the user. Thorough user testing is to be emphasized essential, as is a review of pertinent regulations that can influence the selection of sizes, types, and possibly, strap selection (size and type), and application methods.

1.4 The sections in this guide appear in the following order:

- Scope
- Referenced Documents
- Terminology

- Section
- 1
- 2
- 3

**TABLE 1 Strapping Preference as a Function of Handling Severity of Elements**

Type	Regular-Duty Steel		Heavy-Duty Steel	Banded or Woven Polyester Cord		Polypropylene-Plastic	Nylon Plastic	Polyester Plastic
	Regular-Duty Steel	Duty High Strength Steel		Heavy-Duty Steel	Rayon Cord			
Ultra-violet <sup>A</sup>	x	x	x	...	x	...	...	...
Moisture	x	x	x	...	x	x	...	x
Elevated temperatures	x	x	x	x	x	...	x	x
Low temperatures	...	...	...	x	x	x	x	x
Exposure to corrosives	...	...	...	x	x	x	x	x
Concern for damage to unit surface	...	...	...	x	x	x	x	x

**TABLE 1 Table of Contents**

Section	Page No.
Introduction	1
List of Figures	3
List of Tables	3
1. Scope	1
2. Referenced Documents	2
3. Terminology	3
4. Significance and Use	4
5. Safety Hazard Guidelines	4
6. General Considerations	7
7. General Uses	8
8. Strap Tension	9
9. Packaging Design	9
10. Load, Unit, and Package Securement Configuration	9
11. Strap Selection	9
12.	10
Joining Methods and Properties	
13. Coatings, Finishes, and Resistance to Deterioration of Physical Properties	14
14. Environmental Considerations	14
15. Lubrication	15
16. Equipment for Strapping Application	15
17. Strap Application	15
18. Testing and Evaluation	16
19. Evaluation of Strap Failure	16
20. Keywords	16
S. Supplementary Requirements	18
Disclaimer and Contact Information	19

<sup>A</sup>UV inhibitors are available for polypropylene, nylon, and polyester plastics.

- Significance and Use -4
- Safety Hazards -5
- General Considerations:
- Properties of Strap Types -6
- General Uses -7
- Strap Tension -8
- Packaging Design:
- Distribution -9
- Package Configuration -10
- Strap Selection -11

**TABLE 4 Minimum Sizes of Steel and Plastic Strapping for Fiberboard Boxes**

Gross Weight of Container and Contents, lb	Specification	Nonmetallic Specification	
		Type II, in.	Type III, in.
0 to 35	5/8 by 0.010	3/8 by 0.015 1/4 by 0.025	7/16 by 0.017 1/2 by 0.015
35 to 70, incl	3/4 by 0.015	3/8 by 0.015 1/4 by 0.025 7/16 by 0.025	7/16 by 0.017 1/2 by 0.015
70 to 110, incl	3/4 by 0.020 1/2 by 0.015	1/2 by 0.015 3/8 by 0.020 7/16 by 0.025	1/2 by 0.015 7/16 by 0.017
Over 110 to 225, incl	1/2 by 0.020 5/8 <sup>A</sup> by 0.015	1/2 by 0.020 5/8 by 0.015 7/16 by 0.025	7/16 by 0.023 1/2 by 0.020

**TABLE 2 List of Figures**

Title	Figure No.	Page No.
Various Strapping Applications	1	2
Strap Cutting Techniques	2	7
Crimp Joint with Seals	3	8
Correct and Incorrect Applied Strapping	4	9
Notch Joint with Seals	5	10
Sealless Interlocking Joints	6	11
Loop Joint Secured to Stake Pocket	7	11
Loop Joint Replacement	8	11
Buckle Styles	9	12
Crimp Joint Seals	10	12
Overlap Sealless Joints	11	12
Feedwheel Hand Tool Tensioning Application	12	12
Snap-On (Open) / Semi-Open Seals	13	12
Windlass Type Hand Tool Application	14	13
Thread-On (Closed) and Push Type (Overlap) Seals	15	13
Push Type Hand Tool Application	16	13
Nested Stack (Magazine Feed Seal)	17	13
Combination Tension and Seal-Feed Hand Tool Application	18	13
Intersection Seal	19	13
Various Strapping Take-Up and Tensioning Methods	20	15
Corrugated Fiberboard Box Strap Placement	21	17
Fiberboard Panel Box	S1.1	18
Cleated-Panel Box	S1.2	18
Nailed Wooden Boxes	S1.3	19
Wire Bound Box	S1.4	19

<sup>A</sup> Other type and sizes may be applicable.

**TABLE 2 Strapping Applications Commonly Used for Packaging, Unitization, and Load Securement**

Industry	ASTM D3953 Standard Specification for Strapping Flat Steel and Seals				ASTM D3950 Standard Specification for Strapping Nonmetallic (and Joining Methods)			
	Hand or Machine Applied		Hand Applied		Hand Applied		Hand or Machine Applied	
Product	Type I Steel Regular Duty High Strength	Type I Steel Regular Duty Heavy Duty	Type IA Bonded, Woven or Composite Polyester Cord	Type I Bonded Rayon Cord	Type II Polypropylene (Plastic)	Type III Nylon (Plastic)	Type IV Polyester (Plastic)	
General	Moderate Tensile Strength Low Elongation High Retained Tension	High Tensile Strength Moderate Elongation High Retained Tension	Good Tensile Strength Moderate Elongation Good Retained Tension High Energy-to-Break Good Notch Sensitivity	Moderate Tensile Strength Moderate Elongation Good Notch Sensitivity	Low Tensile Strength High Elongation Low Retained Tension Good Tension Recovery	Moderate Tensile Strength Good Elongation Good Retained Tension Good Tension Recovery	Good Tensile Strength Moderate Elongation Good Retained Tension High Energy-to-Break	
	3/8" & 1/2"	5/8" & 3/4"	5/8" & 3/4"	3/16", 1/4" & 3/8"	7/16"	7/16"	5/8"	
	3/4"	5/8" & 3/4"	1/2" to 3/4"		1/4" & 3/8"	3/8"	5/8" & 3/4"	
Agriculture			5/8" & 3/4"		7/16"	7/16"	5/8"	
Beverage								
Packaging								

TABLE 3 List of Tables

Title

Industry	ASTM D3953 Standard Specification for Strapping Flat Steel and Seals				ASTM D3950 Standard Specification for Strapping Nonmetallic (and Joining Methods)				Page No.
	Hand or Machine Applied		Hand Applied		Hand or Machine Applied		Hand or Machine Applied		
Product	Type I Steel Regular Duty	Type I Steel Regular Duty High Strength	Type I Steel Heavy Duty	Type IA Bonded, Woven or Composite Polyester Cord	Type I Bonded Rayon Cord	Type II Polypropylene (Plastic)	Type III Nylon (Plastic)	Type IV Polyester (Plastic)	
General	Moderate Tensile Strength Low Elongation High Retained Tension	High Tensile Strength Low Elongation High Retained Tension	High Tensile Strength Moderate Elongation High Retained Tension	Good Tensile Strength Moderate Elongation Good Retained Tension High Energy-to-Break Good Notch Sensitivity	Moderate Tensile Strength Moderate Elongation Good Retained Tension Good Notch Sensitivity	Low Tensile Strength High Elongation Low Retained Tension Good Tension Recovery	Moderate Tensile Strength Good Elongation Good Retained Tension Good Tension Recovery	Good Tensile Strength Moderate Elongation Good Retained Tension High Energy-to-Break	
	3/8" & 1/2"				3/16", 1/4" & 3/8"	7/16"	7/16"	5/8"	
		5/8" & 3/4"		5/8" & 3/4"			1/4" & 3/8"	3/8"	5/8" & 3/4"
Agriculture	3/4"	5/8" & 3/4"		1/2" to 3/4"		7/16"	7/16"	1/2", 5/8" & 3/4"	
			3/4"	5/8" & 3/4"				5/8"	
			3/4"			1/2"		1/2"	
						1/2"		3/4"	
	5/8" & 3/4"	5/8" & 3/4"	1/2", 5/8" & 3/4"					5/8" & 3/4"	
PET Bottles			1/2", 5/8" & 3/4"					3/8"	

Strapping Applications Commonly Used for Packaging, Unitization, and Load Securement

4

5

Examples of Different Package Types	5	9
Appropriate Strapping Use as a Function of Environmental Conditions	6	14
Potential Causes for Strap Failure	7	16
Suggested Minimum Size of Steel and Plastic Strapping for Fiberboard Boxes	S1.1	18
Suggested Sizes of Flat Metal Bands for Cleated-Panel Boxes	S1.2	19
Suggested Minimum Sizes of Flat Metal Straps for Wooden Boxes	S1.3	19
Weight of Contents Versus Length of Cleat	S1.4	19

TABLE 2 Strapping Applications Commonly Used for Packaging, Unitization, and Load Securement (continued)

Industry	ASTM D3953 Standard Specification for Strapping Flat Steel and Seals						ASTM D3950 Standard Specification for Strapping Nonmetallic (and Joining Methods)			
	Hand or Machine Applied			Hand Applied			Hand or Machine Applied			
	Type I Steel Regular Duty	Type I Steel Regular Duty High Strength	Type I Steel Heavy Duty	Type IA Bonded, Woven or Composite Polyester Cord	Type I Bonded Rayon Cord	Type II Polypropylene (Plastic)	Type III Nylon (Plastic)	Type IV Polyester (Plastic)		
Forest Products	Lumber	5/8" & 3/4"	1/2", 5/8" & 3/4"	5/8" & 3/4"	5/8", 3/4", 1" & 1-1/4"				5/8" & 3/4"	
	Hardwoods	3/4"		3/4"	5/8" & 3/4"				3/4" & 1"	
	Hardboard Siding	5/8" & 3/4"		5/8" & 3/4"	5/8" & 3/4"				5/8"	
	Pressure Treated Lumber	5/8" & 3/4"	5/8" & 3/4"	5/8" & 3/4"	5/8" & 3/4"				5/8"	
Panel Products	Landscape Timbers	3/4"		3/4"	5/8", 3/4" & 1"				5/8"	
	Flakeboard, MDF, OSB, Particleboard & Plywood		5/8"	5/8"	5/8" & 3/4"				5/8" & 3/4"	
Engineered Wood Products	I-Joists, LVL, PSL & LSL			3/4" & 1-1/4"	5/8", 3/4", 1" & 1-1/4"				5/8" & 3/4"	
	Paper Rolls	3/8" & 1/2"							7/16"	
Paper	Copy Paper in Cartons								1/4" & 3/8"	3/8"
	Aluminum Ingots			3/4" & 1-1/4"						5/8", 3/4", 1" & 1-1/4"
	Aluminum Billets			3/4"						3/4", 1" & 1-1/4"
	Aluminum Extrusions			5/8" & 3/4"	1/2", 5/8" & 3/4"					5/8"



Joining Methods and Properties	
— Joint Methods and Properties (except loop joint)	12
— Loop Joint and Seal Properties	13
Coatings:	
— Strap Coatings and Purposes	14
Application:	
— Equipment for Strap Application	15
— Strap Application	16
Testing and Evaluation:	
— Testing and Developing Final Package Design	17
— Evaluation of Strap Failure	18
— Keywords	19
Supplementary Guideline	S1

1.4 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 (metric) units.

1.5 *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.* Specific safety hazard statements guidelines, however, are given provided in Section 5 and ~~Note 13.1 and 15.3.~~

## 2. Referenced Documents

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

D996 Terminology of Packaging and Distribution Environments

D3950 Specification for Strapping, Nonmetallic (and Joining Methods)

D3953 Specification for Strapping, Flat Steel and Seals

D4169 Practice for Performance Testing of Shipping Containers and Systems

### 2.2 ~~Other Standards:~~ Standards (most current revisions):

Uniform Freight Classification Code, Rule 41, Section 9<sup>3</sup>

National Motor Freight Classification 100-L, Item 222, Section 7<sup>4</sup>

ISTA, International Safe Transit Association, Pre-Shipment Test Procedures Procedure<sup>5</sup>

Association of American Railroads—Railroads (AAR/TTCI)—Railing Closed Car Loading Methods and Open Top Loading Rules<sup>6</sup>

IMO/ILO/UN ECE Guidelines for Packing or Cargo Transport Units (CTUs)<sup>7</sup>

Driver's Handbook on Cargo Securement<sup>8</sup>

## 3. Terminology

3.1 *Definitions*—For general definitions of packaging and distribution environments, see environments. (See Terminology D996.)

### 3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 The following refer to the characteristics and properties of strapping materials. These can be objectively measured to some extent and are used to rank the relative effectiveness of different strapping materials in different applications. The definitions given here are for the purposes of this guide only and do not necessarily reflect general usage or ASTM standard definitions. Some properties are common to both steel and nonmetallic strapping. Other properties are peculiar to nonmetallic only, or to steel only. The following refers to the characteristics and properties of strapping materials. These can be objectively measured to some extent and are used to rank the relative effectiveness of different strapping materials in different applications. The definitions given here are for the purposes of this guide only and do not necessarily reflect general usage or ASTM standard definitions. Some properties are common to both steel and nonmetallic strapping. Other properties pertain to just nonmetallic strapping or to steel strapping only.

3.2.1 *break strength, n*—the longitudinal tensile force that ~~must be~~ is applied to cause a strap to rupture. (See Specifications D3950 and D3953.)

3.2.2 *chemical contamination, n*—exposure to chemicals which may degrade the strap's physical properties. (See Section 13).

<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 National Railroad Freight Classification, available from Uniform Classification Committee, 222 South Riverside Plaze, Chicago, IL 60606.

<sup>4</sup> Available from National Motor Freight Traffic Association (NMFTA), 1001 N. Fairfax St., Alexandria, VA 22314, http://www.nmfta.org.

<sup>5</sup> Available from International Safe Transit Association (ISTA), 1400 Abbot Road, Suite 160, East Lansing, MI 48823-1900, http://www.ista.org.

<sup>6</sup> Available from Association of American Railroads—Railing, Association of American Railroads—Railing Highwoods Center, 7001 Weston Parkway, Suite 200, Cary, NC 27513.

<sup>7</sup> Available from International Maritime Organization, Publishing Service, 4 Albert Embankment, London, SE1 7SR, United Kingdom, http://www.imo.org.

<sup>8</sup> Available from Driver's Handbook on Cargo Securement, 1200 New Jersey Avenue, SE, Suite W60-300, Washington, DC 20590, http://www.fmcsa.dot.gov/documents/cargo/cargosecurement-16-04.pdf.

3.2.3 *corner break strength, n*—the reduced break strength due to the strap/strapping being bent around an a corner or edge. (See Specification [D3953](#).)

3.2.4 *dead stretch (creep), n*—permanent deformation, strain (elongation) resulting from the application of tension constant tensional stresses over time.

3.2.5 *ductility in bending (resistance to “work hardening”), n*—ductility is the opposite of “brittleness”. This quality is related to corner break strength and closely allied with strength and elongation in determining impact resistance. It is also important in tensioning applications requiring the strap to be bent double, and in loop joint applications. (Specification refers to the ability of steel strapping to deform without rupture under the tensile stress resulting from bending, or its resistance to work hardening; it is the opposite of “brittleness.” Ductility is related to corner break strength and closely related to strength and elongation. (See Specification [D3953](#) contains test procedures and specifications.)

3.2.6 *elongation at break, n*—the increase in strapping length due to tensile load at the time of break. (strain) when the tensional loading (stress) gets high enough to cause strap failure. (See Specifications [D3950](#) and [D3953](#).)

3.2.7 *energy to break, energy-to-break, n*—the maximum force required to break a strap as measured by the area under the stress-strain curve. energy/force (total area under the stress-strain curve), resulting from strength and elongation properties required to break a strap.

3.2.8 *environmental resistant properties (see [Table 1](#)):*

3.2.8 *atmospheric contamination, environmental resistant properties, n*—the presence of chemicals in the atmosphere which degrades strap properties. (See Section [14](#), ability of steel or nonmetallic strapping to withstand degradation from (but not [14](#).) limited to) exposure to sunlight, low and high humidity, and caustic chemicals.

3.2.9 *mechanism, initial applied tensions (IAT), n*—includes application, tool, tooling, tensioner, sealer, and power strap equipment. highest amount of stress induced into the strap while the tensioning mechanism is still engaged.

3.2.11 *moisture sensitivity, n*—the degradation of properties caused by presence of moisture or moisture vapor.

3.2.10 *temperature sensitivity, initial retained tension (IRT), n*—the deterioration of properties caused by high or low temperatures. stress that remains in the strap immediately after completion of the joint and removal of the tensioning equipment.

3.2.13 *ultraviolet light sensitivity, n*—the degradation of strapping caused by ultraviolet rays from sunlight or electric lamps.

3.2.11 *joint efficiencies, n*—joint strength divided by the minimum acceptable breaking strength of the strap, expressed as a percentage. (See [percentage](#) (For minimum acceptable percentage values, see Section [12](#), Specifications [D3950](#) and [D3953](#) for minimum acceptable percentage values.)

3.2.12 *joint strength, n*—the highest longitudinal tensile force/tension (strain) that must be applied to cause a strap joint to fail. A failure at the gripper marks (outside of the joint) made by the hand tool or strapping head, is not to be considered the strength of the joint.

3.2.13 *lubrication, n*—a substance on the strap surface that lowers the lower coefficient of friction.

3.2.14 *mechanism, n*—devices used in application of strapping, such as tensioner, sealer, combination tools, and power strapping equipment.

3.2.15 *moisture sensitivity, n*—the degree to which mechanical properties degrade due to the presence of moisture or moisture vapor. (See Section [13](#).)

3.2.16 *notch sensitivity, n*—the measure of the ability of a strapping material material’s ability to resist “nick or cut” propagation-tearing or breaking due to a nick or cut.

3.2.17 *settling tolerance, n*—the ability of a strap to remain taut when used to confine a settling unit load. dimensionally shrinking load, unit, or package.

3.2.18 *shear plane, n*—a shear plane is the the contact surface area between two contiguous items that will allow items at which they move relative to one another when parallel and opposing forces are applied to these areas. The parallel application of forces causes the items to slide relative to each other when a force is applied against one another.

3.2.19 *system strength, n*—the strength of an applied strap (closed loop) including both the strap and joining method.

3.2.20 *temperature sensitivity, n*—the degree to which the mechanical properties degrade due to extreme low or high temperatures.

3.2.21 *tension transmission, n*—the ability of strapping to transmit tension around an edge. slide around a corner/edge during tensioning.

3.2.22 *ultraviolet (U.V.) light resistance, n*—the degree to which the mechanical properties degrade due to ultraviolet ray exposure. U.V. inhibitors are available for all types of nonmetallic strapping.

3.2.23 *unit strap lifting method (USLM), n*—a specialized application for overhead lifting and transport of large and heavy loads, units, or packages primarily at port facilities. (See [Table 4](#).)



**TABLE 4 Strapping Applications Commonly Used for Packaging, Unitization, and Load Securement**

NOTE 1—For guidance purposes only. The strapping types and sizes indicated for specific applications are typical. The table is not intended to recommend or specify.

		ASTM D3953 Standard Specification for Strapping Flat Steel and Seals			ASTM D3950 Standard Specification for Strapping Nonmetallic (and Joining Methods)				
		Hand or Machine Applied			Hand Applied		Hand or Machine Applied		
Industry	Product	Type I Steel Regular Duty	Type I Steel Regular Duty High Strength	Type I Steel Heavy Duty	Type IA Bonded, Woven, or Composite Polyester Cord	Type I Bonded Rayon Cord	Type II Polypropylene	Type III Nylon	Type IV Polyester
		Moderate Tensile Strength Low Elongation High Retained Tension Well suited for rigid and moderate expanding units Not well suited for shrinking units.	High Tensile Strength Low Elongation High Retained Tension Well suited for rigid and moderate expanding units Not well suited for shrinking units.	High Tensile Strength Moderate Elongation High Retained Tension Well suited for rigid and moderate expanding units Not well suited for shrinking units.	Good Tensile Strength Moderate Elongation Good Retained Tension High Energy-to-Break Good Notch Sensitivity Well suited for shrinking, rigid, and expanding units	Moderate Tensile Strength Moderate Elongation Good Notch Sensitivity Well suited for shrinking, rigid, and moderate expanding units	Low Tensile Strength High Elongation Low Retained Tension Good Tension Recovery Well suited for shrinking and expanding units	Moderate Tensile Strength Good Elongation Good Retained Tension Good Tension Recovery Well suited for shrinking, rigid, and expanding units	Good Tensile Strength Moderate Elongation Good Retained Tension High Energy-to-Break Well suited for shrinking, rigid, and expanding units
General	Appliances	3/8" & 1/2"					7/16"	7/16"	5/8"
	Carton Closure					3/16", 1/4" & 3/8"	1/4" & 3/8"	3/8"	
	Flat Glass		5/8" & 3/4"		5/8" & 3/4"				5/8" & 3/4"
	PVC Pipe	3/4"	5/8" & 3/4"		1/2", 5/8" & 3/4"		7/16"	7/16"	1/2", 5/8" & 3/4"
Agriculture	Food Products in Wood Bins			3/4"	5/8" & 3/4"				5/8"
	Hay Bailing						1/2"		1/2"
	Cotton			3/4"					3/4"
	Tobacco			1/2", 5/8" & 3/4"			1/2"		
	Fibers (Manmade & Natural)	5/8" & 3/4"	5/8" & 3/4"	1/2", 5/8" & 3/4"					5/8" & 3/4"
Beverage	PET Bottles							3/8"	3/8"
	Cans							3/8"	3/8"
Corrugated	Glass Bottles							7/16" & 1/2"	7/16" & 1/2"
	KD Boxes		3/8"				7/16"		7/16"
	Corrugated Sheet Bundles	3/8", 5/8" & 3/4"					7/16"		7/16"
Graphic Arts	Signature Logs						7/16" & 1/2"		7/16" & 1/2"
	Magazines						5 mm, 3/16" & 1/4"		
	Newspapers						"		
	Palletized Printed Loads		1/2" & 5/8"		1/2" & 5/8"				7/16", 1/2" & 5/8"
Masonry	Brick		1/2"	1/2"					5/8"
	Block/Pavers		1/2" & 3/8"	1/2" & 5/8"					5/8" & 3/4"
	Roof Tiles						7/16"		
Forest Products	Lumber	5/8" & 3/4"	1/2", 5/8" & 3/4"	5/8" & 3/4"	5/8", 3/4", 1" & 1 1/4"				5/8" & 3/4"
	Hardwoods	3/4"		3/4"	5/8" & 3/4"				3/4" & 1"
	Hardboard Siding	5/8" & 3/4"		5/8" & 3/4"	5/8" & 3/4"				5/8"
	Pressure Treated Lumber	5/8" & 3/4"	5/8" & 3/4"	5/8" & 3/4"	5/8" & 3/4"				5/8"
	Landscape Timbers	3/4"		3/4"	5/8", 3/4" & 1"				5/8"

TABLE 4 Continued

Panel Products	Flakeboard, MDF, OSB< Particle-board & Plywood	$\frac{5}{8}$ "	$\frac{5}{8}$ "	$\frac{5}{8}$ " & $\frac{3}{4}$ "		$\frac{5}{8}$ " & $\frac{3}{4}$ "
Engineered Wood Products	I-Joists, LVL, PSL & LSL		$\frac{3}{4}$ " & $1\frac{1}{4}$ "	$\frac{5}{8}$ ", $\frac{3}{4}$ ", 1" & $1\frac{1}{4}$ "		$\frac{5}{8}$ " & $\frac{3}{4}$ "
Paper	Paper Rolls Copy Paper in Cartons	$\frac{3}{8}$ " & $\frac{1}{2}$ "			$\frac{3}{16}$ ", $\frac{1}{4}$ " & $\frac{3}{8}$ "	$\frac{1}{4}$ " & $\frac{3}{8}$ "
	Aluminum Ingots		$\frac{3}{4}$ " & $1\frac{1}{4}$ "			$\frac{7}{16}$ "
	Aluminum Billets		$\frac{3}{4}$ "			$\frac{5}{8}$ ", $\frac{3}{4}$ ", 1" & $1\frac{1}{4}$ "
	Aluminum Extrusions		$\frac{5}{8}$ " & $\frac{3}{4}$ "	$\frac{1}{2}$ ", $\frac{5}{8}$ " & $\frac{3}{4}$ "		$\frac{3}{4}$ ", 1" & $1\frac{1}{4}$ "
	Scrap Aluminum		$\frac{5}{8}$ " & $\frac{3}{4}$ "			$\frac{5}{8}$ " & $\frac{3}{4}$ "
	Aluminum Rod		$\frac{3}{4}$ " & $1\frac{1}{4}$ "	$\frac{5}{8}$ ", $\frac{3}{4}$ " & 1"		$\frac{3}{4}$ " & 1"
	Coiled Cooper Rod		$1\frac{1}{4}$ "	$\frac{3}{4}$ ", 1" & $1\frac{1}{4}$ "		$\frac{3}{4}$ " & 1"
	Steel Wire		$1\frac{1}{4}$ "	$\frac{3}{4}$ ", 1" & $1\frac{1}{4}$ "		$\frac{5}{8}$ " & $\frac{3}{4}$ "
	Steel Structural Shapes		$\frac{3}{4}$ " & $1\frac{1}{4}$ "	$\frac{5}{8}$ ", $\frac{3}{4}$ ", 1", & $1\frac{1}{4}$ "		$\frac{3}{4}$ " & 1"
	Cut-to-Length Flat Sheet Stock		$\frac{5}{8}$ ", $\frac{3}{4}$ " & $1\frac{1}{4}$ "	$\frac{5}{8}$ ", $\frac{3}{4}$ ", 1" & $1\frac{1}{4}$ "		$\frac{5}{8}$ ", $\frac{3}{4}$ ", 1" & $1\frac{1}{4}$ "
	Steel Tubing		$\frac{5}{8}$ ", $\frac{3}{4}$ " & $1\frac{1}{4}$ "	$\frac{5}{8}$ ", $\frac{3}{4}$ ", 1" & $1\frac{1}{4}$ "		$\frac{3}{4}$ " & 1"
	Steel Coils	$\frac{1}{2}$ ", $\frac{5}{8}$ " & $\frac{3}{4}$ "	$\frac{5}{8}$ ", $\frac{3}{4}$ " & $1\frac{1}{4}$ "	$\frac{3}{4}$ ", 1", & $1\frac{1}{4}$ "		$\frac{5}{8}$ ", $\frac{3}{4}$ " & 1"
Load Securement	Truck & Railcar Unitization		$\frac{3}{4}$ " & $1\frac{1}{4}$ "	$\frac{3}{4}$ ", 1" & $1\frac{1}{4}$ "		
	Truck Tie Down		$1\frac{1}{4}$ "			
	Railcar Doorway Protection		$\frac{3}{4}$ " & $1\frac{1}{4}$ "	$1\frac{1}{4}$ " & $1\frac{1}{2}$ "		
	Open Top Railcar Tie Down		$\frac{3}{4}$ ", $1\frac{1}{4}$ " & 2"			
	Unit Strap Lifting Method		$1\frac{1}{4}$ " USLM			

iTel Standards  
<https://standards.itel.com>  
 Document Preview  
 ASTM D4675  
 //standards.catalo.../sis/de6f...  
 38-4ea58...d4675-

3.2.24 *yield point, n*—when a strap is subjected to load beyond its elastic limit, the point the stress at which a strap reaches permanent deformation or continues to deform without an increase in load; material begins to deform physically. Prior to the yield point, the material will deform elastically and will return to its original shape when the applied stress is removed. Once the yield point is passed, some fraction of the deformation will be permanent and non-reversible.

**4. Significance and Use**

4.1 This guide assists is intended to assist the user in selecting a strapping material material(s) and configuration for initial application method(s), for evaluation, when subjected to handling, transit, and storage tests. It describes general load, unit (load) and package types, strapping properties, unit-strapping interaction, strapping performance, weight considerations, unit-shear planes, component frictional characteristics, and unit-geometry.

**5. Safety Hazards Hazard Guidelines**

5.1 Safety guidelines need to be followed to avoid personal injury or death. Examples of safety guidelines are shown below. Users should consider engaging an individual qualified by training to conduct a risk assessment on all strapping applications to determine best safety practices.

5.2 ~~Cutting Strap~~—*Strap Cutting*—All working strapping is under tension when in use. Sudden When straps are under tensional loading, the release of this tension will produce a hazard when the loose ends snap free after being intentionally or accidentally cut, frayed, or otherwise released. Contents under restraint or the strapsnap itself, or both, may spring toward operator or fall upon the operator or a bystander when strap tension is suddenly released. *Cutting tensioned strap is hazardous.* Use caution and follow approved safety procedures. (See Fig. 2.)

5.2.1 When cutting a tensioned strap, always stand to one side of the strap being cut, pressing the strap against the package above the cutter.*Strap Cutting Techniques:*

- (1) Wear safety gloves and eye protection when working with steel or nonmetallic strapping.
- (2) Keep a safe distance away from the danger zone. (See the Gray Area in Fig. 2.) Bystanders need to be in an area where they will not be struck by flying or flailing strap ends when the strapping is being cut. When tensioned straps that secure a load, unit, or package are cut, the contents could shift or fall.
- (3) Never stand under a strapped load, unit, or package, except as necessary to cut a strap. Never stand directly in front of a load, unit, or package secured by a strap being cut.
- (4) Stand to one side of the strap being cut.
- (5) Use one hand to hold the strap firmly against the load, unit, or package. Never place your hand on or near the seal while cutting the strap. (See Fig. 2.)

5.2.2 Always wear proper Personal Protective Equipment (PPE) such as gloves, eye protection, steel toe safety shoes, etc., when working with steel and nonmetallic strapping.

5.3 Excessive tensioning may cause strap breakage. Always position yourself to one side of strap being tensioned. Never stand directly over or in frontline of a strap being tensioned.

5.3 Never operate the tool in such a manner that a hand could slip resulting in a loss of balance.

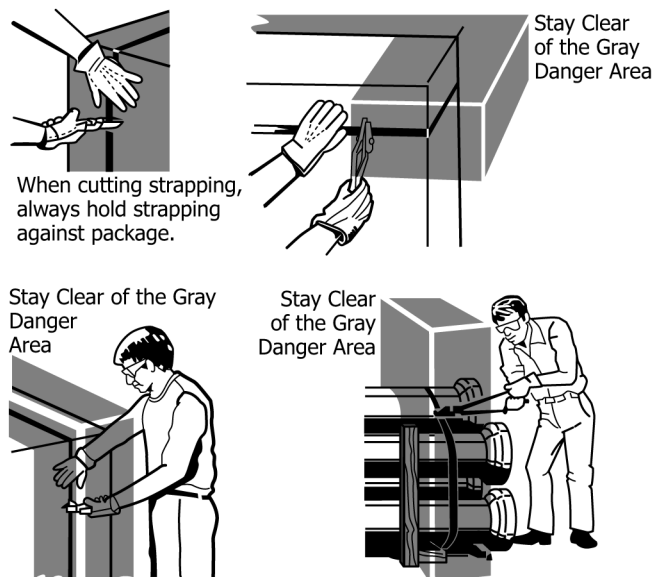


FIG. 2 ~~Joints for Metal Strapping~~ Strap Cutting Techniques