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Designation: D4675 – 09^{ε1} D4675 – 14

Standard Guide for Selection and Use of Flat Strapping Materials¹

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 (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.

e¹ NOTE—The layout of Table 2 was adjusted editorially in November 2010.

INTRODUCTION

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

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 <u>materialsproducts</u> is best suited for the <u>application.</u> 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 <u>orand</u> nonmetallic) for the prospective user wanting initial guidance in selecting a strapping material and <u>applied configuration information on suggested application methods</u> for use in packaging (closing, reinforcing, baling, <u>bundling</u>, <u>unitizing</u>, or palletizing) and loading <u>applications</u> (load unitization and securement to transport vehicle) applications. vehicle). The use applies to handling, securement, storage, and distribution systems.

¹ This guide is under the jurisdiction of ASTM Committee D10 on Packagingand is the direct responsibility of Subcommittee D10.25 on Palletizing and Unitizing of Loads. Current edition approved March 1, 2009April 1, 2014. Published March 2009May 2014. Originally approved in 1987. Last previous edition approved in 20062009 as D4675 - 06D4675 - 09

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FIG. 1 -Applications for Steel and Nonmetallic StrappingVarious Strapping Applications

1.2 Carrier associations have established certain packaging and loading requirements that in(in some easescases) specify athe 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 eertain 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.

Section

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



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

COLVI	Ciffication D3953	70111 >CC	mame		د - col ج	becification	.40111 03950	~
Type	Regular- Duty Steel	Regular- Duty High Strength Steel	Heavyl Duty Steel	Bonded Rayon Cord	Bondec or Wo- ven Polyes- ter Cord	l Polypropyl- ene Plastic	Nylon Plastic	Polyester Plastic
Ultra- violet ^A	*	*	×		×			
Mois- ture	×	×	×		×	×		×
El- evated — tem	*	×	×	×	×		×	×
pera- tures Low tem-	*	×	*	*	×		*	*
tures Expo- sure to_cor-				×	×	×	×	×
rosives Con- cern for dor				×	×	×	×	×
to ua to u surface	nit e							
		TAE	BLE 1 <u>T</u>	able c	of Cont	tents	S	
Sectior	1					Page	No.	• `
Introdu List of List of	ction Figures Tables					$dS\frac{1}{3}$		
1. Scop 2. Refe	erenced Do	ocuments						
4. Sign 5. Safe 6. Gen	ificance a ty Hazard eral Consi	nd Use Guidelines derations				$4 \frac{5}{4}$		
7. Gen 8. Stra	eral Uses p Tension	urds/sist				8-4et 98-b		
10. Loa	ad, Unit, a	nd Package	e Secure	ment C	Configura	ation 9		

9

<u>14</u>

 $\frac{14}{15} \frac{15}{15} \frac{16}{16} \frac{16}{18}$

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11. Strap Selection

15. Lubrication

20. Keywords

Strap Application
 Testing and Evaluation
 Evaluation of Strap Failure

of Physical Properties 14. Environmental Considerations

S. Supplementary Requirements Disclaimer and Contact Information

16. Equipment for Strapping Application

12.

^A UV inhibitors are available for polypropylene, nylon, and polyester plastics.

Joining Methods and Properties 13. Coatings, Finishes, and Resistance to Deterioration

- 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

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

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

colwidth="	1.42in">	Nonmotollicol	name="col3
colwidth="	blain">colname="col4"	CORMENCIAL CORMENCE	27in">
and Contents	Turne 1 in	D3950	
and coments,	- type - 1, III.	Tune II in	- Turne III in
		type II, In.	type III, In.
0 to 35	5∕∞ by 0.010	¾ by 0.015	7∕16 by 0.017
		<u>1∕₄ by 0.025</u>	<u>1∕₂ by 0.015</u>
35 to 70, incl	¾ by 0.015	¾ by 0.015	7∕16 by 0.017
		1⁄4 by 0.025	1⁄2 by 0.015
		7∕16 by 0.025	
70 to 110, incl	¾ by 0.020	<u>½ by 0.015</u>	<u>½ by 0.015</u>
	1/2 by 0.015	⅔ by 0.020	7∕16 by 0.017
		7∕16 by 0.025	
Over 110 to	<u>½ by 0.020</u>	½ by 0.020	7∕16 by 0.023
225, incl			
	5∕8^A by 0.015	5∕a by 0.015	1/2 by 0.020
		7∕16 by 0.025	
	TABLE 2 LIST OF F	igures	
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Strap Cutting	lechniques	2	7
Crimp Joint wi	th Seals	3	8
Correct and In	correct Applied Strapping	4	9
Notch Joint wi	th Seals	5	$\frac{10}{11}$
Sealles Interlo	cking Joints	6	$\frac{11}{11}$
Loop Joint Sec	cured to Stake Pocket	$\frac{7}{2}$	$\frac{11}{11}$
Loop Joint Re	placement	8	$\frac{11}{12}$
Buckle Styles		9	12
Crimp Joint Se	eals	<u>10</u>	$\frac{12}{12}$
Overlap Sealle	ess Joints	11	$e^{\frac{12}{12}}$
Feedwheel Ha	nd lool lensioning Application	$\frac{12}{12}$	$\frac{12}{12}$
Snap-On (Ope	n) / Semi-Open Seals	<u>13</u>	12
Windlass Type	Hand Tool Application	$\frac{14}{12}$	$-\frac{13}{12}$
Thread-On (Cl	osed) and Push Type (Overlap)	<u>15</u>	<u>13</u>
Seals			10
Push Type Ha	nd Tool Application	$\frac{16}{47}$	$\frac{13}{12}$
Nested Stack	(Magazine Feed Seal)	17	13
Combination I	ension and Seal-Feed Hand Tool	18	<u>13</u>
Application	1	10	10
Intersection Se		19	
various Strapp	oing take-Up and tensioning	20	<u>A 15</u> I V
Nethods	//standarda iteb ai/catak	on/statedard	e/ejet/d=6f
Corrugated Fit	perboard Box Strap Placement	0 g Stal <u>21</u> al U	5/515/ <u>47</u> 01
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Cleated-Panel	Box	<u>S1.2</u>	<u>18</u>
Nailed Woode	n Boxes	<u>S1.3</u>	<u>19</u>
Wire Round Br	<u>nv</u>	S1 /	10

^A Other type and sizes may be applicable.

				D4(6d	a d nt				
		ASTM D3953 S	tandard Specificatio Flat Steel and Seals	n for Strapping	nd ar P	ASTM D3950 Star Nonmetal	ndard Specification f llic (and Joining Metl	for Strapping hods)	-
		На	ind or Machine Appli	14 8-	Hand App	olied	Ĥ	and or Machine Appl	ied
ada setas		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)
(neppill		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 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
	Appliances	3/8" & 1/2"		a49	ai		7/16"		5/8"
eral	Carton Closure			d7		3/16", 1/4" & 3/8"	1/4" & 3/8"	3/8"	
uəĐ	Flat Glass		5/8" & 3/4"	78:	5/8" & 3/4"				5/8" & 3/4"
	PVC Pipe	3/4"	5/8" & 3/4"	l2a	1/2" to 3/4"		7/16"		1/2", 5/8" & 3/4"
	Food Products in Wood Bins				5/8" & 3/4"				5/8"
nre	Hay Baling			m-d			1/2"		1/2"
) Incult	Cotton			3/4"					3/4"
ġΑ	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"
əf	PET Bottles							3/8"	3/8"
everag	Cans							3/8"	3/8"
B	Glass Bottles							7/16" & 1/2"	7/16" & 1/2"
bəted	KD Boxes	3/8"					7/16"		7/16"

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TABLE 3 List of Tables

TABLE 3 List of Tables				_										
<u>Title</u>		ied	Type IV Polyester (Plastic)	Good Tensile Strength Moderate Elongation Good Retained Tension High Energy-to-Break	5/8"		5/8" & 3/4"	1/2", 5/8" & 3/4"	5/8"	1/2"	3/4"		5/8" & 3/4"	3/R"
	for Strapping thods)	and or Machine Appl	Type III Nylon (Plastic)	Moderate Tensile Strength Good Elongation Good Retained Tension Good Tension Recovery	7/16"	3/8"		7/16"						3/8"
	ndard Specification Ilic (and Joining Met		Type II Polypropylene (Plastic)	Low Tensile Strength High Elongation Low Retained Tension Good Tension Recovery	7/16"	1/4" & 3/8"		7/16"		1/2"		1/2"		
	ASTM D3950 Sta Nonmeta	olied	Type I Bonded Rayon Cord	Moderate Tensile Strength Moderate Elongation Good Notch Sensitivity		3/16", 1/4" & 3/8"								
iTeh Standar (https://standards.	ds ite	Hand App	Type IA Bonded, Woven or Composite Polyester Cord	Good Tensile Strength Moderate Elongation Good Retained Tension High Energy-to-Break Good Notch Sensitivity			5/8" & 3/4"	1/2" to 3/4"	5/8" & 3/4"					
Document Prev <u>ASTM D4675-14</u> eh ai/catalog/standards/sist/de6f406d-0438-4ea	1 for Strapping	pa	- Type I Steel Heavy Duty	High Tensile Strength Moderate Elongation High Retained Tension	la/a	.stn	n-d	46'	3/ 4 "	4	3/4"	1/2" , 5/8" & 3/4"	1/2" , 5/8" & 3/4"	
	andard Specification Flat Steel and Seals	nd or Machine Appli	Type I Steel Regular Duty High Strength	High Tensile Strength Low Elongation High Retained Tension			5/8" & 3/4"	5/8" & 3/4"					5/8" & 3/4"	
	ASTM D3953 Si	На	Type I Steel Regular Duty	Moderate Tensile Strength Low Elongation High Retained Tension	3/8" & 1/2"			3/4"					5/8" & 3/4"	
			400 PP		Appliances	Carton Closure	Flat Glass	PVC Pipe	Food Products in Wood Bins	Hay Baling	Cotton	Торассо	Fibers (Manmade & Natural)	PET Bottlee
Strapping Applications Commonly Used for Packaging	Table 4	No.	5	Industry		eral	nəĐ			ure	gricult	۶A		
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Weight of Contents Versus Length of Cleat	S1.4	19

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

1/4"

ASTM D3953 Standard Specification for Strapping Flat Steel and Seals	Hand or Machine Applied 🚿 🔽 🔂 Hand A	Type I Steel Bonded, Woven or Regular Duty High Strength Heavy Duty Polyester Cord	High Tensile Strength High Tensile Strength High Tensile Strength Tensile	Lumber 5/8" & 3/4" 1/2", 5/8" & 3/4" 5/8" & 3/4" 5/8", 3/4", 7" & 1-1/4"	A Hardwoods 3/4" 5/8" & 3/4" 5/8" & 3/4"	특히 전 Hardboard Siding 5/8" & 3/4" 5/8" & 3/4" 5/8" & 3/4" 5/8" & 3/4"	Pressure Treated Lumber 5/8" & 3/4" 5/8" & 3/4" 5/8" & 3/4" 5/8" & 3/4"	Landscape Timbers 3/4" 3/4" & 1" 5/8", 3/4" & 1"	Elakeboard, MDF, OSB, 5/8" 5/8" 5/8" 5/8" 5/8" 5/8" 5/8" 5/8"	edd Soducts, LVL, PSL & LSL B/4" & 1-1/4" 5/8", 3/4", 1" & 1-1/4" 5/8", 3/4", 1" & 1-1/4" 5/8", 3/4", 1" & 1-1/4"	De Paper Rolls 3/8" & 1/2"	Copy Paper in Cartons	Aluminum Ingots 3/4" & 1-1/4"	Aluminum Billets 3/4"	-
ation for Strapping als	pplied 8-	Type I Steel Heavy Duty	th High Tensile Strength Moderate Elongation High Retained Tension	" 5/8" & 3/4"	3/4"	5/8" & 3/4"	5/8" & 3/4"	3/4" 3/4"	"8/5 ttm-d4	3/4" & 1-1/4"	4		3/4" & 1-1/4"	3/4"	
nd ar P	Hand Apr	Type IA Bonded, Woven or Composite Polyester Cord	Good Tensile Strength Moderate Elongation Good Retained Tension High Energy-to-Break Good Notch Sensitivity	5/8", 3/4", 1" & 1-1/4"	5/8" & 3/4"	5/8" & 3/4"	5/8" & 3/4"	5/8", 3/4" & 1"	5/8" & 3/4"	5/8", 3/4", 1" & 1-1/4"					
ASTM D3950 Sta Nonmetal	olied	Type I Bonded Rayon Cord	Moderate Tensile Strength Moderate Elongation Good Notch Sensitivity									3/16", 1/4" & 3/8"			
ndard Specification	Ĭ	Type II Polypropylene (Plastic)	Low Tensile Strength High Elongation Low Retained Tension Good Tension Recovery									1/4" & 3/8"			
for Strapping thods)	and or Machine App	Type III Nylon (Plastic)	Moderate Tensile Strength Good Elongation Good Retained Tension Good Tension Recovery									3/8"			
	lied	Type IV Polyester (Plastic)	Good Tensile Strength Moderate Elongation Good Retained Tension High Energy-to-Break	5/8" & 3/4"	3/4" & 1"	5/8"	5/8"	5/8"	5/8" & 3/4"	5/8" & 3/4"	7/16"		5/8", 3/4", 1" & 1-1/4"	3/4", 1" & 1-1/4"	

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- Testing and Developing Final Package Design	17
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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 153

2. Referenced Documents

2.1 ASTM Standards:²

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 9³ National Motor Freight Classification 100-L, Item 222, Section 7⁴ ISTA, International Safe Transit Association

ISTA, International Safe Transit Association, Pre-Shipment Test Procedures⁵

Association of American Railroads—Railroads (AAR/TTCI)—RailingClosed Car Loading Methods and Open Top Loading Rules⁶

IMO/ILO/UN ECE Guidelines for Packing or Cargo Transport Units (CTUs)⁷ Driver's Handbook on Cargo Securement⁸

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).

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

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

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.

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

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

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

⁸ 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 strapstrapping being bent around an <u>a corner or edge</u>. (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. (Specificationrefers 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 Sectionability 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 forcetension (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—athe 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.<u>dimensionally</u> shrinking load, unit, or package.

3.2.18 *shear plane, n*—a shear plane is the <u>the contact</u> surface area between two contiguous items that will allow-<u>items at which</u> they move relative to one another when parallel and opposing forces are applied to these areas. The parallel application of forces <u>causes</u> 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.<u>slide around a corner/edge during</u> 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.

<u>3.2.23</u> 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.)

ASTM D09503 Standard Specification for Stragging Normetalis (and John Appled and Seale) Hand Appled Hand or Machine Appled Prote View Internet Prote View Internet Modernet Dony Hand Appled Hand or Machine Appled Prote View Internet Prote Prote Proteo Prote Prote Prote Prote Proteo Prote Prote Prote Prote Proteo Prote Prote Prot Prote Prot Prote Prot Prote Prote Prote Prote Prote Prote Pro	NOTE 1—For g	guidance purposes on	ly. The strapping ty	pes and sizes indi-	cated for specific app	olications are typical	l. The table is not in	tended to recomme	nd or specify.		
Industry Product Hand or Machine Applied Program Hand or Machine Applied Program Hand or Machine Applied Program Hand or Machine Applied Program Hand or Machine Applied Industry Product Type I Bype I			ASTM D3953 Stand	dard Specification for	r Strapping Flat Steel	ASTM D3	950 Standard Specific	ation for Strapping No	onmetallic (and Joining	g Methods)	
Industry Trans Applies Trans Applies <thtrans applies<<="" td=""><td></td><td></td><td></td><td>and Seals</td><td></td><td></td><td>A 1' 1</td><td></td><td></td><td></td></thtrans>				and Seals			A 1' 1				
Industry Product Steel Regular Duty Hole Type I Steel Regular Duty Hole Hole Regular Duty Ho			<u> </u>	and or Machine App	blied	Hand	Applied	H	land or Machine Appli	ed	
Regular Duty Industry Regular Duty High Strangth Strangth Low Elengation (Low Elengation (Low Elengation) (Low Elengati			Type I Steel	Type I Steel	Type I Steel	Type IA Bonded,	Type I Bonded	Type II Polypro-	Type III Nylon	Type IV Polyester	
Industry Product Moderate Transition Strength (ove Eiorophic Transition Terristion Ter			Regular Duty	Regular Duty	Heavy Duty	Woven, or Com-	Rayon Cord	pylene			
Industry Product Moderate Tensile Strength High Tensile High				High Strength		posite Polyester					
Industry Moderate Tensile Strength Low Tensile Figh Tensile Low Tensile Low Tensile Low Tensile Low Tensile Strength Low Tensile Low T						Cord					
Industry Product Strongth High Relatined Tension well auride for well auride for shrinking, indi, and expanding units Strongth Benalt Strongth Benalt Auride for shrinking, indi, and expanding units Strongth Benalt Strongth Benalt Auride for Strong for Strong fo			Moderate Tensile	High Tensile	High Tensile	Good Tensile	Moderate Tensile	Low Tensile	Moderate Tensile	Good Tensile	
Industry Product Low Ebrigation (high Relating Tension well suited for ingle accuration in the second or relating in the second in the second			Strength	Strength	Strength	Strength	Strength	Strength	Strength	Strength	
Industry Product High Retained Transion well suited for rigid and moder are expanding and expanding			Low Elongation	Low Elongation	Moderate Elonga-	Moderate Elonga-	Moderate Elonga-	High Elongation	Good Elongation	Moderate Elonga-	
Applances 3** 8 3** <t< td=""><td>Industry</td><td>Product</td><td>High Retained</td><td>High Retained</td><td>tion</td><td>tion</td><td>tion</td><td>Low Retained</td><td>Good Retained</td><td>tion</td></t<>	Industry	Product	High Retained	High Retained	tion	tion	tion	Low Retained	Good Retained	tion	
Appliances Appliances Statute for rigid and moder- rigid and moder-			Tension	Tension	High Retained	Good Retained	Good Notch Sen-	Tension	Tension	Good Retained	
Applances Sin 2 Sin			Well suited for	Well suited for	Tension	Tension	sitivity	Good Tension	Good Tension	Tension	
Applanoes Baile expanding note Baile expanding units for shrinking units Optical and moders and moder units for shrinking units Optical and moder and moder units for shrinking units Optical and moder units Optical and units Optical and units Optic			rigid and moder-	rigid and moder-	Well suited for	High Energy-to-	Well suited for	Becovery	Becovery	High Energy-to-	
Applances Solutions Solutions <t< td=""><td></td><td></td><td>ate expanding</td><td>ate expanding</td><td>rigid and moder-</td><td>Break</td><td>shrinking rigid</td><td>Well suited for</td><td>Well suited for</td><td>Break</td></t<>			ate expanding	ate expanding	rigid and moder-	Break	shrinking rigid	Well suited for	Well suited for	Break	
Not will suited units Not will suited ior shrinking units Not will suited ior shrit suited ior shrinking units Not wi			units	units	ate expanding	Good Notch Sen-	and moderate	shrinking and ex-	shrinking rigid	Well suited for	
Indiana Indiana Not well suited for shrinking units. Not well suited shrinking units. View shrinking units. View shrinking shrinking units. View shrinking units. View shrinking units. View shrinking units. View shrinking units. View shrinking shrinking shrinking shrinking units. View shrinking shrinking shrinking shrinking shrinking units. View shrinking shrinki			Not well suited	Not well suited	units	sitivity	expanding units	nanding units	and expanding	shrinking rigid	
$ \frac{1}{10000000000000000000000000000000000$			for shrinking	for shrinking	Not well suited	Well suited for	<u>onpariaing armo</u>	partaing armo	units	and expanding	
Line Differ Differ Differ Differ Differ Differ General Part 8.1/2 Star 8.2/2 Vin *			units	units	for shrinking	shrinking rigid			dinto	units	
Applances %s * & %s * %s *<			dinto.	<u>unito.</u>	units	and expanding				dinto	
Applances Mplances						units					
General Betrand Cation Cleare PVC Pipe 10 <td></td> <td>Appliances</td> <td>3/8 " & 1/2 "</td> <td></td> <td></td> <td></td> <td></td> <td>7/16 "</td> <td>7/16 "</td> <td>5/8 "</td>		Appliances	3/8 " & 1/2 "					7/16 "	7/16 "	5/8 "	
General Point Class 56 * 8 30 * 56 * 8 30 * 70 * <th70 *<="" th=""> 70 * 70 * <t< td=""><td></td><td>Carton Closure</td><td><u>78 0 72</u></td><td></td><td></td><td></td><td>3/1c " 1/4 " 2 3/6 "</td><td>1/4 " & 3/6 "</td><td>3/6 "</td><td>78</td></t<></th70>		Carton Closure	<u>78 0 72</u>				3/1c " 1/4 " 2 3/6 "	1/4 " & 3/6 "	3/6 "	78	
PVC Pipe 94" 94	General	Flat Glass		5% " & 3/4 "		5/0 " & 3/4 "	<u>/10</u> , /4 C /8	74 Q 78	78	5% " & 3/4 "	
Food Products in Wood Bins Hard Baling Oction Doe under the state of the state State of the state Reverse Doe under the state Preview 10 <t< td=""><td></td><td>PVC Pine</td><td>3/4 "</td><td>5% " & 3/4"</td><td></td><td>1/2 " 5/2 " & 3/4 "</td><td></td><td>7/16 "</td><td>7/16 "</td><td>1/2 " 5/2 " & 3/4 "</td></t<>		PVC Pine	3/4 "	5% " & 3/4"		1/2 " 5/2 " & 3/4 "		7/16 "	7/16 "	1/2 " 5/2 " & 3/4 "	
Agriculture Model Bins Hary Bailing Oction Tobacco Document Preview 24: 34: 34: 34: 34: 34: 34: 34: 34: 34: 3		Food Products in	/4	78 Q 74	3/4 "	5% " & 3/4 "		/10	/10	<u></u>	
Agriculture Hey Balling Cotton Document Preview ½ "		Wood Bins			74	<u>78 0 74</u>				78	
AgricultureIn claims Tobacco $\frac{44.^{\circ}}{10000000000000000000000000000000000$		Hay Bailing						1/2 "		1/2 "	
Instruction Description V/2 ** 56 ** 8 34 ** V/2 ** 56 ** V/2 ** V	Agriculture	Cotton			3/4 "			12		3/4 "	
Fibers (Manmade % * & % *	Agriculture	Tobacco			1/2 " 5/6 " & 3/4 "			1/2 "			
Index Index <thindex< th=""> Index <thi< td=""><td></td><td>Fibers (Manmade</td><td>5/6 " & 3/4 "</td><td>5/6 " & 3/4 "</td><td>$\frac{72}{1/2}$, 78 C 74</td><td></td><td></td><td>12</td><td></td><td>5% " 2 3/4 "</td></thi<></thindex<>		Fibers (Manmade	5/6 " & 3/4 "	5/6 " & 3/4 "	$\frac{72}{1/2}$, 78 C 74			12		5% " 2 3/4 "	
$\begin{array}{c c c c c c c c c c c c c c c c c c c $		& Natural)	<u>78 0 74</u>	<u>78 0 74</u>	<u>72 , 78 Q 74</u>					<u>78 0 74</u>	
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $		PET Bottles			<u>ADTIVI</u>	<u>DTU/J-1T</u>			3/8 "	3/8 "	
ContrageContraction<	Revarage	Cans							3/6 "	3/2 "	
Consugated Corrugated Sheet 36 mm 7/6 mm	Devalage	Glass Bottles							7/16 " & 1/2 "	7/16 " & 1/2 "	
Corrugated Corruga		KD Boyes	3/6 "	38-4	ca8-b98c-caa4 5)d77812a/astm	-d4675	7/10 "	/16 0 /2	7/10 00 /2	
Configured Configu	Corrugated	Corrugated Shoot	36 " 56 " 9 3/ "					7/10 "		7/10	
Binder Control of a stature Logs Magazines Control of a stature Logs Magazines Control of a stature masses Con	Contugated	Bundles	<u>78,78 0.74</u>					716		716	
Signative Logs 1/6 & 1/2 Magazines 5 mm, 3/6 * & 1/4 Graphic Arts Newspapers 5 mm, 3/6 * & 1/4 Palletized Printed 1/2 * & 5/6 * 1/2 * & 5/6 * Loads 7/16 * 1/2 * & 5/6 * Biock/Pavers 1/2 * & 5/6 * 1/2 * & 5/6 * Biock/Pavers 1/2 * & 5/6 * 1/2 * & 5/6 * Masonry Biock/Pavers 1/2 * & 5/6 * 1/2 * & 5/6 * Hardwoods 3/4 * 1/2 * 5/6 * & 3/4 * 5/6 * & 3/4 * Forest Products 5/6 * & 3/4 * 5/6 * & 3/4 * 5/6 * & 3/4 * Hardwoods 3/4 * 5/6 * & 3/4 * 5/6 * & 3/4 * Lumber 5/6 * & 3/4 * 5/6 * & 3/4 * 5/6 * & 3/4 * Forest Products 9/6 * & 3/4 * 5/6 * & 3/4 * 5/6 * & 3/4 * Pressure Treated 5/6 * & 3/4 * 5/6 * & 3/4 * 5/6 * & 3/4 * 5/6 * & 3/4 * 5/6 * & 3/4 * 5/6 * & 3/4 * 5/6 * & 3/4 * Forest Products 9/4 * 9/4 * 5/6 * & 3/4 * 5/6 * & 3/4 * Pressure Treated 5/6 * & 3/4 * 5/6 * & 3/4 * 5/6 * & 3/4 * 5/6 * & 3/4 * Press 9/4 * 3/4 * 5/6 * & 3/4 * 5/6 * & 3/4 *		Signature Logs						7/10 " 9 1/0 "		7/10 " & 1/0 "	
Graphic Arts Newspapers 5 mm, $\frac{y_{16}}{y_{16}}$ $\frac{5}{2}$ Palletized Printed $\frac{1/2$ " & $5/6$ " $\frac{1/2$ " & $5/6$ " $\frac{1/2$ " & $5/6$ " $\frac{5}{2}$ " & $5/6$ " $\frac{7}{16}$		Magazinos						$5 \text{ mm} \frac{34}{2} \frac{9}{2} \frac{1}{4}$		/16 04 /2	
Graphic Arts Newspapers <u>5 mm, ŷ, 6 " & 1/4</u> " Palletized Printed Loads <u>1/2 " & 5/6 "</u> <u>1/2 " & 5/6 "</u> <u>7/16 ", 1/2 " & 5/6 "</u> Brick <u>1/2 " & 5/6 "</u> <u>1/2 " & 5/6 "</u> <u>7/16 ", 1/2 " & 5/6 "</u> Masonry Block/Pavers Roof Tiles <u>1/2 " & 5/6 " & 3/4 "</u> <u>1/2 " & 5/6 "</u> <u>5/6 " & 3/4 "</u> Hardwoods <u>3/4 " <u>5/6 " & 3/4 "</u> Forest Products <u>Hardwoods Siding Pressure Treated Lumber <u>5/6 " & 3/4 "</u> Lumber <u>1/4 " <u>5/6 " & 3/4 "</u> Everst Products <u>1/4 " dboard Siding Pressure Treated Lumber <u>5/6 " & 3/4 "</u> Lumber <u>1/4 "'</u> <u>5/6 " & 3/4 "</u> Bers 5/6 " & 3/4 " <u>5/6 " & 3/4 "</u> Hardwoods <u>5/4 " & 3/4 "</u> <u>5/6 " & 3/4 "</u> <u>5/6 " & 3/4 "</u> <u>5/6 " & 3/4 "</u></u></u></u></u>		Iviagazines						<u>5 mm, 716 & 74</u> "			
Chapme Aits Newspapers Simily vis d v/4 Palletized Printed Loads V/2 " & 5/6 " V/2 " & 5/6 " V/2 " & 5/6 " Brick V/2 " & 5/6 " V/2 " & 5/6 " V/2 " & 5/6 " Top of the d v/4 Masonry Block/Pavers Roof Tiles V/2 " & 5/6 " V/2 " & 5/6 " Top of the d v/4 Hardwoods V/2 " & 5/6 " V/2 " & 5/6 " V/2 " & 5/6 " Top of the d v/4 Forest Products Hardwoods S/4 " V/2 " & 5/6 " S/4 " S/6 " & 3/4 " S/6 " & 3/4 " Hardwoods S/4 " S/4 " S/6 " & 3/4 " Lumber S/6 " & 3/4 " Hardwoods S/4 " S/4 " & 3/4 " S/6 " & 3/4 " Lumber S/6 " & 3/4 " Hardwoods S/4 " & 3/4 " S/6 " & 3/4 " S/6 " & 3/4 "	Graphic Arts	Nowspapars						5 mm 340 " & 14			
$ \frac{ Palletized Printed Loads}{ Loads} $ $ \frac{ Palletized Printed Loads}{ Iosephares Palletized Printed Loads} $ $ Palletized Printed Palletized Printedized Prin$		Newspapers						<u>3 mm, 716 & 74</u> "			
IntervalIntervalIntervalBrick $\frac{1/2}{k}$ " $\frac{1/2}{k}$ " $\frac{1}{2}$ "MasonryBlock/Pavers $\frac{1/2}{k}$ " $\frac{1}{2}$ " $\frac{1}{2}$ "Roof Tiles $\frac{1}{2}$ " $\frac{1}{2}$ " $\frac{5}{6}$ " $\frac{3}{4}$ "Forest Products $\frac{1}{4}$ " $\frac{5}{6}$ " $\frac{3}{4}$ " $\frac{5}{6}$ " $\frac{3}{4}$ "Hardwoods $\frac{3}{4}$ " $\frac{3}{2}$ " $\frac{5}{6}$ " $\frac{3}{4}$ " $\frac{5}{6}$ " $\frac{3}{4}$ "Forest Products $\frac{1}{2}$ " $\frac{3}{4}$ " $\frac{5}{6}$ " $\frac{3}{4}$ " $\frac{5}{6}$ " $\frac{3}{4}$ " $\frac{3}{2}$ "Hardwoods $\frac{3}{4}$ " $\frac{3}{2}$ " $\frac{5}{6}$ " $\frac{3}{4}$ " $\frac{5}{6}$ " $\frac{3}{4}$ " $\frac{3}{2}$ " $\frac{3}{2}$ " $\frac{3}{2}$ " $\frac{3}{2}$ "Hardwoods $\frac{3}{4}$ " $\frac{3}{2}$ " $\frac{5}{6}$ " $\frac{3}{4}$ " $\frac{5}{6}$ " $\frac{3}{4}$ " $\frac{3}{2}$ " $\frac{3}{2}$ " $\frac{3}{2}$ " $\frac{3}{2}$ "Hardwoods $\frac{3}{4}$ " $\frac{3}{2}$ " $\frac{5}{6}$ " $\frac{3}{4}$ " $\frac{5}{6}$ " $\frac{3}{4}$ " $\frac{3}{2}$ " $\frac{3}{2}$ " $\frac{3}{2}$ " $\frac{3}{2}$ "Hardwoods $\frac{3}{4}$ " $\frac{3}{2}$ " $\frac{3}{4}$ " $\frac{5}{6}$ " $\frac{3}{4}$ " $\frac{3}{2}$ " 3		Pallotized Printed		16 " 9 56 "		16 " 9 56 "		-		74.0 " 16 " 9 56 "	
Loads Brick <u>½ " ½ "</u>				72 X 78		<u>72 0 78</u>				716,72 X 78	
MasonryBlock/Pavers Roof Tiles $\frac{1/2 \sqrt{k} \sqrt{5}/6}{N}$ $\frac{1/2 \sqrt{k} \sqrt{k}/6}{N}$ $\frac{1/2 \sqrt{k} \sqrt{k}/6}{N}$ $\frac{1/2 \sqrt{k} \sqrt{k}/6}{N}$ $\frac{1/2 \sqrt{k} \sqrt{k}/6}{N}$ Forest Products $\frac{1}{4ardwoods}$ $\frac{3/4 \sqrt{n}}{N}$ $\frac{3/4 \sqrt{n}}{N}$ $\frac{5/6 \sqrt{k} \sqrt{k}/4}{N}$ $\frac{5/6 \sqrt{k} \sqrt{k}/4}{N}$ Forest Products $\frac{1}{4ardwoods}$ $\frac{3/4 \sqrt{n}}{N}$ $\frac{5/6 \sqrt{k} \sqrt{k}/4}{N}$ $\frac{5/6 \sqrt{k} \sqrt{k}/4}{N}$ $\frac{3/4 \sqrt{n}}{N}$ Forest Products $\frac{1}{4ardwoods}$ $\frac{3/4 \sqrt{n}}{N}$ $\frac{5/6 \sqrt{k} \sqrt{k}/4}{N}$ $\frac{5/6 \sqrt{k} \sqrt{k}/4}{N}$ $\frac{3/4 \sqrt{k}}{N}$ Forest Products $\frac{1}{4ardwoods}$ $\frac{3/4 \sqrt{n}}{N}$ $\frac{5/6 \sqrt{k} \sqrt{k}/4}{N}$ $\frac{5/6 \sqrt{k}}{N} \sqrt{k}/4}{N}$ $\frac{3/4 \sqrt{k}}{N}$ Endscape Tim- bers $\frac{3/4 \sqrt{n}}{N}$ $\frac{3/4 \sqrt{n}}{N}$ $\frac{5/6 \sqrt{n}}{N} \sqrt{k} \sqrt{n}$ $\frac{3/4 \sqrt{n}}{N}$		Brick		16 "	1/6 "					5/6 "	
Haddon'r avers Roof Tiles 1/2 1	Masonny			1/2 2 5/2 "	16 2 56 7					56 " 8 3/4 "	
Hardwoods 3/4" 1/2", 5/8 " & 3/4" 5/8 " & 3/4" 5/8 " & 3/4" 1/4" Forest Products Hardwoods 3/4" 5/8 " & 3/4" 5/8 " & 3/4" 1/4" Hardwoods 3/4" 5/8 " & 3/4" 5/8 " & 3/4" 5/8 " & 3/4" 5/8" & 3/4" Forest Products Hardwoods 5/8" & 3/4" 5/8 " & 3/4" 5/8 " & 3/4" 5/8" Hardwoods 5/8" & 3/4" 5/8 " & 3/4" 5/8 " & 3/4" 5/8 " & 3/4" 5/8 " & 3/4" Pressure Treated 5/8 " & 3/4" 5/8 " & 3/4" 5/8 " & 3/4" 5/8 " & 3/4" 5/8 " Lumber Lumber 5/8 " & 3/4" 5/8 " & 3/4" 5/8 " & 3/4" 5/8 " bers 3/4" 5/8 " & 3/4" 5/8 " & 3/4" 5/8 " & 3/4" 5/8 "	INIASOTITY	Boof Tiles		72 Q 78	72 Q 78			7/10 "		78 X 74	
Forest Products Hardwoods 3/4" 3/4" 5/8" & 3/4" 5/8" & 3/4" 1/4" Hardwoods 3/4" 5/8" & 3/4" 5/8" & 3/4" 5/8" & 3/4" 5/8" & 3/4" Hardboard Siding 5/6" & 3/4" 5/8" & 3/4" 5/8" & 3/4" 5/8" & 3/4" Hardboard Siding 5/6" & 3/4" 5/8" & 3/4" 5/8" & 3/4" 5/8" Lumber 1/1/4" 5/8" & 3/4" 5/8" & 3/4" 5/8" Lumber 5/8" & 3/4" 5/8" & 3/4" 5/8" 3/4" bers 3/4" 5/8", 3/4" & 1" 5/8"		Lumbor	56 " 9. 34 "	16 " 56 " 8 34 "	56 " 8 3/4 "	5/6 " 3/4 " 1" 8		716		56 " 8 34 "	
Forest ProductsHardwoods $\frac{34^{"}}{8}$ $\frac{94^{"}}{8}$ $\frac{56^{"}}{8}$ $\frac{34^{"}}{8}$ $\frac{56^{"}}{8}$ $\frac{34}{8}$ $\frac{1}{7}$ Forest ProductsHardboard Siding Pressure Treated $\frac{56^{"}}{8}$ $\frac{34^{"}}{8}$ $\frac{56^{"}}{8}$ $\frac{34^{"}}{8}$ $\frac{56^{"}}{8}$ $\frac{34^{"}}{8}$ $\frac{1}{7}$ Lumber Landscape Tim- bers $\frac{34^{"}}{8}$ $\frac{34^{"}}{2}$ $\frac{34^{"}}{26}$ $\frac{56^{"}}{8}$ $\frac{34^{"}}{2}$ $\frac{56^{"}}{8}$		Lumber	78 0 74	72,78 X 74	78 X 74	<u>11/4</u> "				78 X 74	
Forest Products Hardboard Siding Pressure Treated Lumber 5% " & 3/4 " 5% " & 3/4 " 5% " & 3/4 " 5% " & 3/4 " Lumber 1 5% " & 3/4 " 5% " & 3/4 " 5% " & 3/4 " 5% " & 3/4 " Landscape Tim- bers 3/4 " 3/4 " 5/8 ", 3/4 " & 1" 5/8 "		Hardwoods	3/4 "		3/4 "	5/2 " 2 3/4 "				3/4 " & 1"	
Forest Products Introduct or Grang /o a //a /o a //a <th a<="" o="" th=""> /o a //a /o a //</th>	/o a //a /o a //		Hardboard Siding	5/8 " 2. 3/4 "		5/8 " & 3/4 "	5/8 " & 3/4 "				5% "
<u>Lumber</u> <u>Landscape Tim-</u> <u>3/4</u> " <u>3/4</u> " <u>5/8</u> ", <u>3/4</u> " <u>5/8</u> ", <u>3/4</u> " <u>5/8</u> "	Forest Products	Pressure Treated	5/2 " 2 3/4 "	5/8 " & 3/4 "	5/2 " & 3/4 "	5/8 " & 3/4 "				5/6 "	
Landscape Tim- bers <u>34</u> " <u>56</u> ", <u>34</u> " <u>56</u> ", <u>34</u> " <u>56</u> "		Limher	70 X 74	/0 U 74	70 U 74	70 CX 74				/8	
bes 22		Landscape Tim-	3/4 "		3/4 "	5/8 " 3/4 " & 1 "				5/8 "	
		bers	<u>, -</u>		/-	<u>,,,, ,, ,, ,, ,, ,, ,, ,, ,, ,, ,, ,, ,</u>				<u></u>	

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

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				TABLE 4	Continued				
Panel Products	Flakeboard, MDF, OSB< Particle-		<u>5⁄8</u> "	<u>5⁄8 "</u>	<u>5/8 " & 3/4 "</u>				<u>5⁄8 " & 3⁄4 "</u>
<u> </u>	board & Plywood			0/ 10 41/ 1	5/ N 0/ N 4N 0				5 (11 0 0 (11
Engineered Wood	I-JOISTS, LVL, PSL			<u>3/4 ″ & 1 1/4 ″</u>	<u>⁹/8 ", ⁹/4 ", 1" &</u> <u>11/. "</u>				<u>3/8 " & 3/4 "</u>
FIOUUCIS	Paper Bolls	36 " & 16 "			1 /4				7/10 "
Paner	Conv Paper in	<u>78 0 72</u>				3/16 " 1/4 " & 3/8 "	1/4 " & 3/8 "	3/8 "	/16
<u>i apoi</u>	Cartons					710 , 74 G 78	<u>/4 0 /8</u>	/8	
	Aluminum Ingots			³ /4 " & 1 ¹ /4 "					5/8 ", 3/4 ", 1 " &
									11/4 "
	Aluminum Billets			<u> 3/4 "</u>					3/4 ", 1" & 11/4 "
	Aluminum Extru-			5/8 " & 3/4 "	1/2 ", 5/8 " & 3/4 "				<u>5/8</u> "
	sions								
	Scrap Aluminum			<u>5/8 " & 3/4 "</u>	02005.				<u>5/8 " & 3/4 "</u>
	Aluminum Rod			<u>3/4 " & 1 1/4 "</u>	<u>5/8 ", 3/4 " & 1"</u> 3/ " 1" 0 11/ "				<u>3/4 " & 1"</u>
Motolo	Colled Cooper			1 1/4	<u>%4 , 1 & 1 /4 </u>				<u> 9/4 & I</u>
<u>INIELAIS</u>	Steel Wire			1 14 " C	3/4 " 1" & 11/4 "				5% " & 3% "
	Steel Structural			3/4 " & 11/4 "	$\frac{74}{5/8}$, $\frac{10}{3/4}$, $\frac{17}{4}$				3/4 " & 1"
	Shapes			<u>/4 0 1/4</u>	<u>11/4</u> "				<u>/+ u i</u>
	Cut-to-Length			5/8 ", 3/4 " & 11/4 "	5/8 ", <u>3/4</u> ", 1" &				5/8 ", 3/4 ", 1 " &
	Flat Sheet Stock			<u>ASTM</u>	D407311/4 "4				11/4 "
	Steel Tubing			<u>5⁄8 ", 3⁄4 " & 11⁄4 "</u>	$\frac{5/8}{3/4}, \frac{3/4}{1}, \frac{1}{8}$				³ /4 " & 1"
	Steel Coils	1/2 ", 5/8 " & 3/4 "		5/8 ", 3/4 " & 11/4 "	3/4 ", 1", & 11/4 "				5⁄8 ", 3⁄4 " & 1"
Load Securement	Truck & Railcar		00.00	3/4 " & 13/4 "	3/4 ", 1" & 11/4 "	n u 1075			
	Unitization								
	Truck Tie Down			<u>1¹/4</u> "					
	Railcar Doorway			<u>3/4 " & 11/4 "</u>	<u>11⁄4 " & 11⁄2 "</u>				
	Protection			0/ 1 41/ 1 0 01					
	Open Top Railcar			<u>¾ ", 1¼ " & 2"</u>					
Linit Strop Li	iffing Method			11/. " LIQI M					
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3.2.24 yield point, *n*—when a strap is subjected to load beyond its elastic limit, the point<u>the stress</u> at which a strap reaches permanent deformation or continues to deform without an increase in load.<u>material begins to deform physically</u>. 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 <u>assists is intended to assist</u> the user in selecting <u>a</u>-strapping <u>material</u><u>material(s)</u> and <u>configuration for initial</u> <u>application method(s)</u>, for evaluation, when <u>subjected to</u> handling, transit, and storage tests. It describes general <u>load</u>, unit (load) <u>and package</u> types, strapping properties, <u>unit-strapping interaction</u>, <u>strapping performance</u>, weight considerations, <u>unit</u> shear planes, component frictional characteristics, and <u>unit</u> 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 <u>Cutting Strap—Strap Cutting</u>—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 StrappingStrap Cutting Techniqes