24.9 Thickness

24.9.1 After being examined as described in 24.9.2, the samples specified in Table 23.1 shall comply with the compliance criteria specified therein.

24.9.2 A dial indicator measuring instrument with a circular presser foot area of 25 mm^2 (1 $inch^2$) which exerts a pressure of 28 grams (1 ounce) is to be used for measuring the thickness of the samples. The indicator is to have a measuring accuracy ±0.001 inch. Nine thickness measurements are to be made on each sample, and the average is to be computed for each sample. The average of the four samples is then to be calculated.

25 Marking

25.1 Each shipping label, shipping carton, or container shall be permanently and clearly marked in a color that contrasts with the color of the surface on which the markings are applied with the following:

a) Manufacturer's name, tradename, or symbol;

b) The nominal thickness of the material in inches or mm (for example, 1/2 inch, 13 mm, or 1/2");

c) The lot number;

d) Model or style; and

e) Use Codes.

POLYMERIC ENCLOSURES FOR KAPOK

26 Performance

26.1 General

26.1.1 Polymeric enclosures for kapok shall comply with the requirements in Table 26.1 and Table 26.2 when subjected to the tests therein.

Table 26.1
Polymeric enclosures for kapok

Tests	Exposure[a]	Test methods	Number of samples[b]	Use codes[c]	Compliance criteria pounds-force (N)
Tensile Strength & Ultimate Elongation	**1.** SC **2.** 70 ±2°C (158 ±4°F) for 7 days (168 h)	ASTM D412 Method A Dumbell Die A	5 for each direction for each conditioning	All[d]	See Table 26.2
Tear Resistance	**1.** SC **2.** 70 ±2°C (158 ±4°F) for 7 days (168 h)	ASTM D1004-94	5 for each direction for each conditioning	All[d]	See Table 26.2
Air Leakage	SC	See 26.2.1 & 26.2.2	10	All[d]	There shall be no leakage after being subjected to 2 psi (13.8 kpa) of air for 5 min.
Cold Cracking	-18 ±1°C (0 ±2°F) for 1 h	See 26.3.1 – 26.3.5	10	All[d]	There shall not be more than 2 samples that break into two or

Table 26.1 Continued on Next Page

Table 26.1 Continued

Tests	Exposure[a]	Test methods	Number of samples[b]	Use codes[c]	Compliance criteria pounds-force (N)
					more pieces as a result of the test.

[a] See Table 2.2 for exposure details.

[b] A minimum of 15 foot^2 (1.4 m^2).

[c] See Table 2.1 for explanation of Use Code designations.

[d] Applies to Use Codes 1, 2, 3, 4BC, 4H, 5H, and 5R.

Table 26.2
Compliance criteria for tensile strength, ultimate elongation, and tear resistance of polymeric enclosures for kapok

Property investigated	Minimum test values in pounds-force (N)[a]	
	For PFD Type IV (use code 4BC and 4H)	
	Column A	Column B
Tensile Strength	9.2 (41)	6.4 (28)
Ultimate Elongation (in percent)	200%	225%
Ultimate Elongation (Transverse direction)	200%	250%
Tear Resistance	1.76 (8)	1.76 (8)
	For PFD Type I/Level 150 & Type V (use codes 1 and 5H)	
	Column A	Column B
Tensile Strength	6.9 (31)	6.4 (28)
Ultimate Elongation (in percent)	150%	225%
Ultimate Elongation (Transverse direction)	200%	250%
Tear Resistance	1.06 (4.7)	1.76 (8)
	For PFD Type II/Level 100, Type III/Level 70, (use codes 2, 3, and 5R)	
	Column A	Column B
Tensile Strength	6.9 (31)	4.8 (21)
Ultimate Elongation (in percent)	150%	225%
Ultimate Elongation (Transverse direction)	200%	250%
Tear Resistance	1.06 (4.7)	1.06 (4.7)

[a] Two options are available as specified in Columns A & B and all values of a single vertical column shall be used depending on the PFD type. The values are not interchangeable from Column A to Column B.

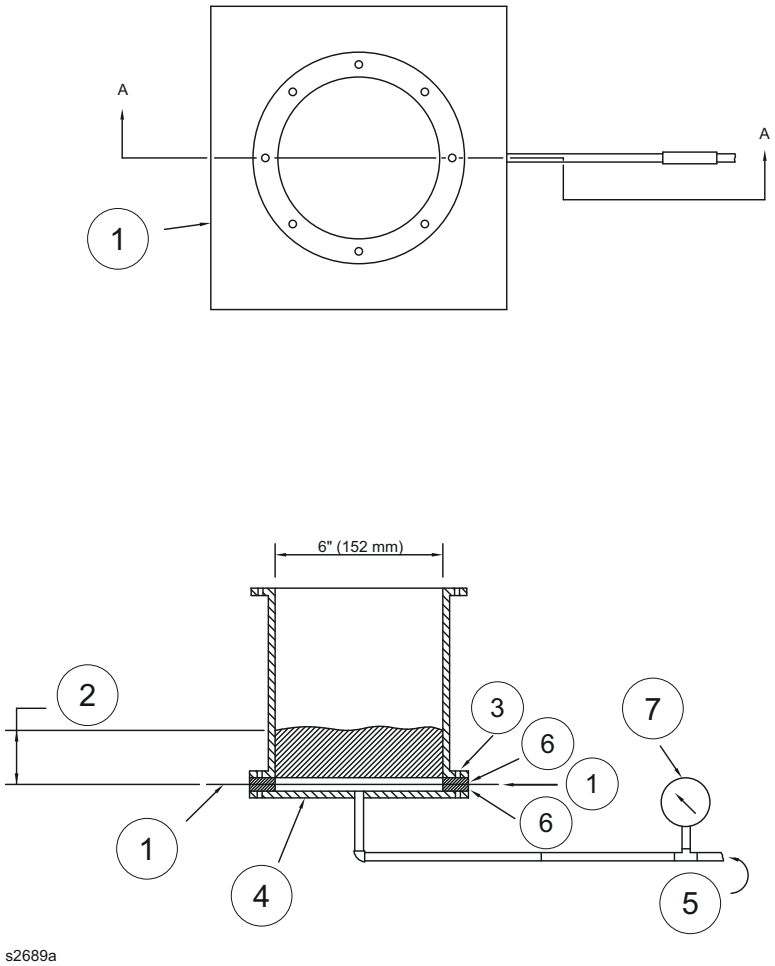
26.2 Air-leakage

26.2.1 The samples used for the test are to have dimensions of 8 by 8 inches (203 by 203 mm).

26.2.2 The samples are to be mounted individually in the apparatus illustrated in Figure 26.1 and subjected to a minimum 2 psig (13.8 kPa) air pressure for 5 min. During the test, each sample is to be covered by at least 1 inch (25.4 mm) of a soapy water solution. While under pressure, the samples are to be examined for leakage as evidenced by air bubbles coming through the enclosure.

Figure 26.1

Apparatus for air leakage test



Key

1 – Film sample

2 – 1 inch (25 mm) minimum

3 – Flange

4 – Bottom Plate

5 – Air supply

6 – Gasket

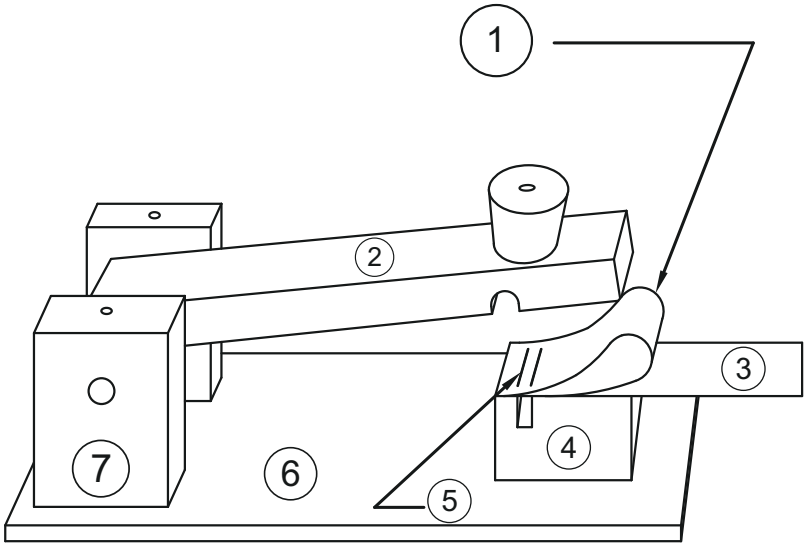
7 – Gauge

26.3 Cold crack

26.3.1 As illustrated in Figure 26.2, the short ends of each five 2 by 5 3/4 inch (51 by 146 mm) samples are to be laid one atop the other and their edges are to be placed on an underlying 2 by 5 inch (51 by 127 mm) stiff, paper card (standard index-file card stock). The sample is to loop naturally without creases or folds and is to be carefully stapled to the card twice with the staples close together and both parallel to and 1/2 inch (12 mm) from the 2 inch (51 mm) edges.

Figure 26.2

Placement of sample and arm



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Key

1 – Specimen looped naturally (no creases or folds)

2 – Arm

3 – Card

4 – Anvil

5 – Two staples

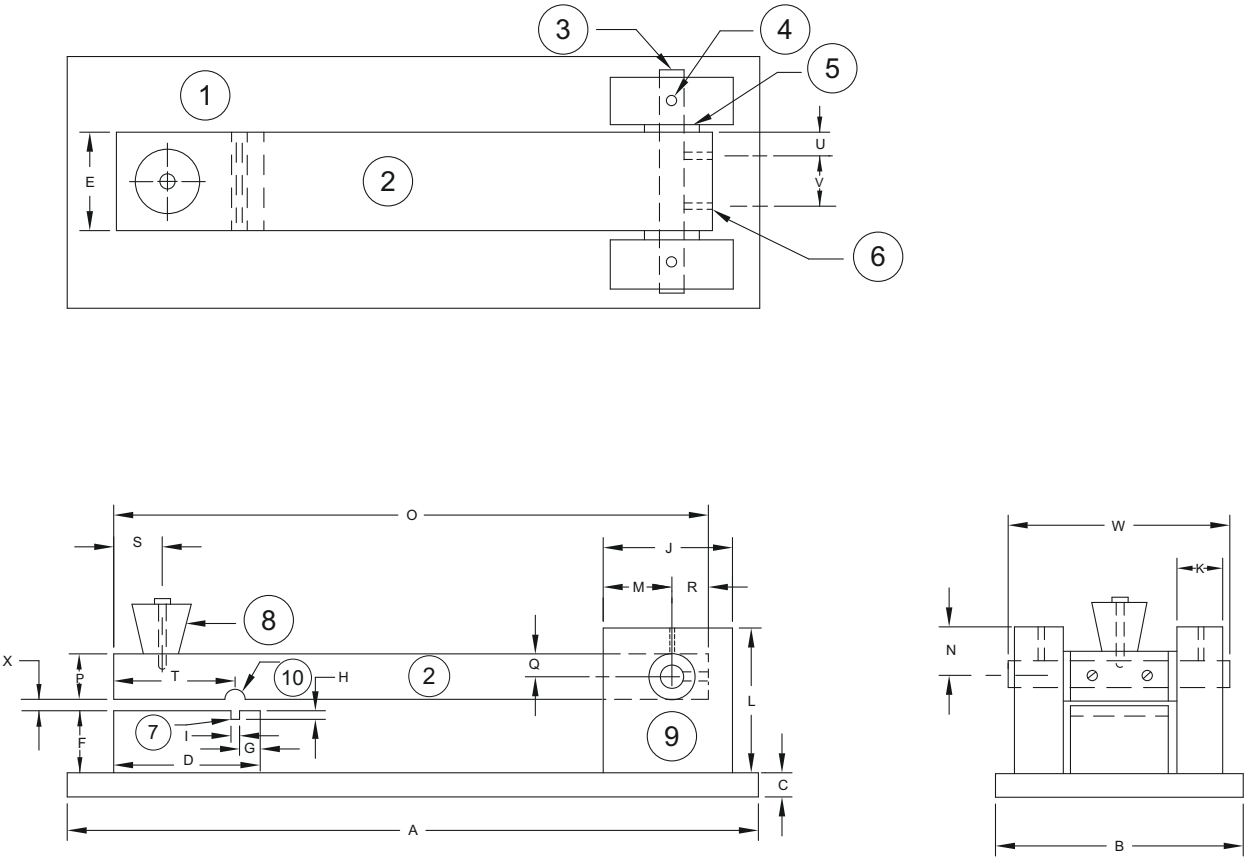
6 – Base

7 – Arm support

26.3.2 With the arm rotated 180 degrees from the anvil, the impacting device illustrated in Figure 26.3 (see Table 26.3 for the dimensions) is to be cooled to a temperature of minus 18 ±1° C (0 ±2° F) in a shallow refrigerator compartment having a square level floor 18 inches (457 mm) or more on a side and opening from the top.

Figure 26.3

Impacting device



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Key

1 – Base

2 – Arm

3 – Shaft fits loosely

4 – Countersunk oil hole

5 – Machined washer

6 – Tap for setscrew

7 – Slot

8 – Rubber stopper

9 – Arm support

10 – Groove

Table 26.3
Dimensions of impact device

Part	Dimensions			
	Name	Identification letter on drawing	Inches	Millimeters
Base	length	A	14	356
	width	B	5	127
	thickness	C	1/2	13
Anvil – bolted to base with machine screws (not shown)	length	D	3	76
	width	E	2	51
	height	F	1-7/16	37
	slot location	G	7/16	11
	slot depth	H	1/4	6
	slot width	I	1/8	3
Two arm supports – bolted to base with machine screws (not shown)	length	J	3	76
	thickness	K	1	25
	height	L	3	76
	diameter of oil holes	none	1/8	3
	oil-hole and shaft-hole centerline	M	1-1/2	38
	shaft-hole centerline	N	1/2	13
	diameter of shaft hole	none	slightly greater than 1/2	slightly greater than 13
Arm	length	O	12	305
	width	E	2	51
	thickness	P	1	25
	diameter of shaft hole	none	slightly greater than 1/2	slightly greater than 13
	shaft-hole centerline	Q	1/2	13
	shaft-hole centerline	R	1	25
	stopper-hole	S	1	25
	centerline	T	2-1/2	64
	groove centerline	none	1/4	6
	setscrew centerline	U	1/2	13
	centerline separation of setscrews	V	1	25
Two machined washers	outside diameter	none	1	25
	inside diameter	none	slightly greater than 1/2	slightly greater than 13
Shaft	diameter	none	1/2	13
	length	W	4-1/2	114
Separation between anvil and arm		X	1/16	1.6

26.3.3 All ten samples are to be placed on the floor of the cold chamber with their loops up and without being touched by the hands of the tester (the card is to be used for a handle), one another, or anything else, and is to cool for 1 h. Then, while the samples and the impacting device remain in the cold chamber, one of the samples is to be placed loop-up on the anvil of the impacting device with the staples in the slot as illustrated in Figure 26.2. Care is to be taken so that the sample does not touch anything during this process. The arm of the impacting device is to be raised from the 180 degree position to a position in which the impacting face of the arm is at an angle of 85 degrees with the horizontal face of the anvil.

26.3.4 By means of a mechanical release, the arm is to be freed so that it falls and strikes the sample. The arm then is to be raised and secured again at the 85 degree position, and the sample is to be removed and examined. A sample does not comply with this requirement when it has broken into two or more pieces.

26.3.5 In as rapid succession as possible (to reduce warming of the samples), each of the nine remaining samples, in turn, is to be placed on the anvil, impacted by the arm (with care being taken that the staples are in the slot), and examined for breakage of the sample.

27 Marking

27.1 Each shipping label shall be clearly and permanently marked in a contrasting color with the following:

a) Manufacturer's name, tradename, or symbol;

b) Style designation; and

c) Lot number.

RF WELDED, URETHANE COATED NYLON COMPARTMENT MATERIALS FOR HYBRID AND FULLY INFLATABLE RECREATIONAL PFDs

28 General

28.1 Woven coated compartment materials for hybrid and fully inflatable PFDs shall comply with the compliance criteria specified in Table 29.1 when subjected to the tests therein.

28.2 Unsupported compartment materials shall be completely enclosed in 1F, 2F, 3F or 5H fabric and shall also comply with the requirements in Table 29.2 when subjected to the tests therein.

28.3 The samples shall not include selvage and shall not be subject to more than one exposure.

29 Performance

29.1 Breaking load test

29.1.1 Each sample specified in Table 29.1 shall be tested in accordance to ASTM D5034-90, Method G-E. The dimension of the front jaws for each clamp shall be 1 inch by 1 inch (25 mm by 25 mm) and must be rubber padded to prevent slippage. The dimension of the back jaw for each clamp shall be 1 inch (25 mm) parallel to the application of load by 1 inch (25 mm) or more perpendicular to the application of load. The initial jaw separation must be 3 inches (76 mm) unless specified otherwise. The tensile testing machine shall be operated at a uniform pulling speed of 12 ±0.5 in/min (305 ±13 mm/min). The load cell range shall be capable of providing the maximum load to break (break strength value shall be within 5 percent to 95 percent of full range). The samples shall be placed in the tensile testing machine with the long dimension parallel to the application of load. The samples shall be marked with a line 1-1/2 inches from the left edge that extends throughout the sample following along a single yarn. The sample shall be placed in the tensile testing machine with the marked line along the left edge of the upper and lower jaws to ensure equal yarn extension. The sample shall extend 0.5 inches (12.7 mm) above the top jaw and 0.5 inches (12.7 mm) below the bottom jaw.

Table 29.1
Woven coated compartment materials

Tests	Exposure[a]	Test method	Number of samples[c]	Sample size inches (mm)	Use Codes[f]	Compliance criteria pounds-force (N)
Breaking Load (woven fabrics only)	**1.** SC **2.** After accelerated aging in accordance to ASTM D5427 or 168 h at 158°F (70°C) **3.** After soil burial and fungus resistance in accordance to Method 5762 of AATCC-30 (12 weeks exposure); or After *aspergillius niger* fungus resistance in accordance to ASTM G21[h] **4.** Xe_{750} or Nt_{75}[d]	ASTM D5034-90 Method G-E	5 warp and 5 fill for each separate conditioning	4 x 6 (101 x 152)	1F, 2F, 3F, and 5H	**Exposure 1** Average ≥210 (935) in the warp direction (direction of greater thread count), and Average ≥180 (800) in the fill direction (direction of lesser thread count). **Exposure 2** The sample shall be examined visually and shall show no evidence of blister or other defects that affect the intended use. **Exposures 2 and 3** Average ≥ 189 (841) in the warp direction; and Average ≥ 162 (721) in the fill direction **Exposure 4** Average ≥ 84 (374) in the warp direction; and Average ≥ 72 (320) in the fill direction
Trapezoid Tear Strength	**1.** SC **2.** After accelerated aging in accordance to ASTM D5427, or 168 h at 158°F (70°C)	Method 5136 of FTMS 191A	5 warp and 5 fill for each separate conditioning	3 x 6 (76 x 152)	1F, 2F, 3F, and 5H	**Exposure 1** Average ≥10 (45) for each direction in the warp direction and 8 (36) in the fill direction. **Exposure 2** Average ≥ 9 (40) in the warp direction; and Average ≥ 7 (32) in the fill direction
Permeability	**1.** SC **2.** After accelerated aging in accordance to ASTM D5427 or 168 h at 158°F (70°C)[g] **3.** After soil burial and fungus resistance in accordance to AATCC-30 (12 weeks exposure); or After *aspergillius niger* fungus resistance in accordance to ASTM G21 **4.** 65 ±1°C (149 ±2°F) at 95 % relative humidity for 360 h in accordance to ASTM D3690-78(1990)[g]	ASTM D1434-82 (1992) with CO_2	3 for each separate conditioning	5 x 5 (125 x 125)	1F, 2F, 3F, and 5H	**Exposures 2 – 4** Average ≤110 percent of the value determined following exposure 1.

Table 29.1 Continued on Next Page

Table 29.1 Continued

Tests	Exposure[a]	Test method	Number of samples[c]	Sample size inches (mm)	Use Codes[f]	Compliance criteria pounds-force (N)
Abrasion Resistance (Woven Fabrics)	**1.** SC **2.** After abrasion resistance in accordance to ASTM D4157 using No. 8 cotton duck, 18 ounces per square yard, 6 lbs. tension, 2 lbs. pressure, and 100,000 double rubs	ASTM D5035-90 Method 1C-E	8 warp and 8 fill for each separate conditioning	9 x 1-7/8 (229 x 48)	1F, 2F, 3F, and 5H	Except for a material intended for use under a fabric envelope or otherwise protected, the 8 sample average for each direction shall retain at least 75 percent of that value determined following exposure 1

[a] See Table 2.2 for the sample conditionings.

[b] For fully inflated and packed conditions, only Xe_{750} of weathering is to be conducted for a material not intended to be fully encased within a cover fabric.

[c] Color dependent. See 2.4.

[d] Every color shall be weathered.

[e] The abradant material shall be orientated such that the warp direction is perpendicular to the rotational direction of the abrasion resistance machine.

[f] See Table 2.1 for explanation of Use Code designations.

[g] Optional – In lieu of the Permeability Test for exposures 2 and 4 only, the Buoyancy Test using carbon dioxide as defined in the exception for 29.3 in UL 1180 shall be conducted after the exposures 2 and 4 on the complete device.

[h] This exposure is not required for polyurethane coatings with a weight ≥ 146 g/m^2 (4.35 oz/yd^2).

Table 29.2
Unsupported compartment materials

Tests	Exposure[a]	Test method	Number of samples	Sample size inches (mm)	Use Codes[b]	Compliance criteria
Ultimate Tensile and Elongation	**1.** SC **2.** 70 ±2°C (158 ±4°F) for 7 days (168 h) **3.** After soil burial and fungus resistance in accordance to AATCC-30 (12 weeks exposure); or After *aspergillius niger* fungus resistance in accordance to ASTM G21[d]	ASTM D882	5 for each direction for each conditioning	4 x 0.25 (101.6 x 6.4)	1F, 2F, 3F, and 5H	**Exposure 1** Average ultimate tensile strength ≥3000 psi in each direction and Average ultimate elongation ≥ 15,000 psi in each direction. **Exposures 2 and 3** Average ultimate tensile strength ≥2700 psi in each direction and Average ultimate elongation ≥ 12,150 psi in each direction.
Tear Strength	**1.** SC **2.** 70 ±2°C (158 ±4°F) for 7 days (168 h)	ASTM D1004	5 for each direction for each conditioning	ASTM D1004	1F, 2F, 3F, and 5H	**Exposure 1** Average ≥ 400 psi for each direction **Exposure 2** Average ≥ 360 psi for each direction.
Weight Loss	**1.** SC **2.** Abrasion Resistance in accordance with ASTM D3884 with	See 29.3.1–29.3.2	3 for each separate conditioning	6 x 6 (152 x 152	1F, 2F, 3F, and 5H	**Exposure 2** Average percent weight loss shall not be greater than 0.06 percent of the weight

Table 29.2 Continued on Next Page

Table 29.2 Continued

Tests	Exposure[a]	Test method	Number of samples	Sample size inches (mm)	Use Codes[b]	Compliance criteria
	the following characteristics: a) 1000 cycles; b) CS17 abrasion wheel; and c) 1000 gram load					determined following exposure 1.
Cold Cracking	minus 56 ±4°C (minus 70 ±2°F) for 1 day	See 26.3.1 – 26.3.5	10	See 26.3.1 – 26.3.5	1F, 2F, 3F, and 5H	Each sample shall not break, crack, or separate as a result of the test.
Permeability	**1.** SC **2.** After accelerated aging in accordance to ASTM D5427 or 168 h at 158°F (70°C)[c] **3.** After soil burial and fungus resistance in accordance to AATCC-30 (12 weeks exposure); or After *aspergillius niger* fungus resistance in accordance to ASTM G21 **4.** 65 ±1°C (149 ±2°F) at 95 % relative humidity for 360 h in accordance to ASTM D3690-78 (1990) [c]	ASTM D1434-82(1992) with CO_2	3 for each separate conditioning	5 x 5 (125 x 125)	1F, 2F, 3F, and 5H	**Exposures 2 – 4** Average ≤110 percent of the value determined following exposure 1.

[a] See Table 2.2 for the sample conditionings.

[b] See Table 2.1 for explanation of Use Code designations.

[c] Optional – In lieu of the Permeability Test for exposures 2 and 4 only, the Buoyancy Test using carbon dioxide as defined in the exception for 29.3 in UL 1180 shall be conducted after the exposures 2 and 4 on the complete device in the uninflated condition.

[d] This exposure is not required for polyurethane coatings with a weight ≥ 146 g/m^2 (4.35 oz/yd^2).

29.2 Trapezoid tear strength test

29.2.1 Two samples, measuring 3 inches (76.2 mm) wide by 6 inches (152.4 mm) long are to be used. The warp samples shall be cut with the long dimension perpendicular to the warp yarns and the filling samples shall be cut with the long dimension parallel to the warp yarns. No two warp samples shall contain the same warp yarns and no two samples shall contain the same filling yarns. No sample shall include selvage.

29.2.2 An isosceles trapezoid having an altitude of 3 inches (76.2 mm) and bases of 1 inch (25.4 mm) and 4 inches 101.6 mm) respectively, shall be marked on each sample. A cut approximately 3/8 inch (9.5 mm) in length shall be made in the center of and perpendicular to the 1 inch (25.4) base. The specimen shall be clamped in the tensile testing machine along the nonparallel sides of the trapezoid so that these sides lie along the lower edge of the upper clamp and the upper edge of the lower clamp with the cut halfway between the clamps. The short trapezoid base shall be held taut and the long trapezoid base shall lie in the folds. Set the nominal gauge length at 1 inch (25.4 mm) and select the capacity of the tester

suitable for the specimens to be tested. The maximum load required to tear the specimen must be within the rated operating capacity of the tester. For a CRT machine this should be considered as the range of 15 to 85 percent of the rated capacity. Operate the pulling jaw at 12 ±1/2 inch (304.8 ±12.7 mm) inch per min.

29.3 Weight loss

29.3.1 Three samples, measuring 6 inches (152 mm) wide by 6 inches (152 mm) long are to be used.

29.3.2 Prior to conducting the abrasion resistance, each sample shall be weighed. After the completion of the abrasion resistance, each sample shall be reweighed. The percent weight loss shall be calculated by using the following equation:

$$\%\,WL = \left[\frac{(W_o - W_t)}{W_o}\right] \times 100$$

Where:

%WL = Percent Weight Loss

W_f = Final Weight

W_o = Original Weight

30 Marking

30.1 Each shipping label shall be clearly and permanently marked in a contrasting color with the following:

a) Manufacturer's name, tradename, or symbol;

b) Style designation;

c) Lot number;

d) Lab dye lot number, color code number, or color formulation; and

e) Use Code(s).

INFLATION SYSTEMS FOR HYBRID AND FULLY INFLATABLE RECREATIONAL PFDs

31 Construction

31.1 General

31.1.1 An exposed edge or projection of an inflation system shall not be so sharp as to damage the material of an inflatable compartment or constitute a risk of injury to persons during intended use. Referee measurements required to determine compliance with this requirement are to be those described in the requirements in the Standard for Tests for Sharpness of Edges on Equipment, UL 1439.

31.1.2 Inflation systems shall be unidirectional; that is, at working pressures the construction shall permit the passage of the inflation medium only in the direction that supplies an inflatable compartment unless intentionally over-ridden.

31.1.3 An inflation system inflator mechanism shall not be located inside an inflation compartment.