UL 1175

STANDARD FOR SAFETY

Buoyant Cushions

UL Standard for Safety for Buoyant Cushions, UL 1175

Fourth Edition, Dated April 20, 2007

Summary of Topics

This revision to ANSI/UL 1175 dated August 16, 2024 is being issued to update the title page to reflect the most recent designation as a Reaffirmed American National Standard (ANS). No technical changes have been made.

Text that has been changed in any manner or impacted by ULSE's electronic publishing system is marked with a vertical line in the margin.

The requirements are substantially in accordance with Proposal(s) on this subject dated June 21, 2024.

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UL 1175

Standard for Buoyant Cushions

Previous numbered and unnumbered editions of standards covering buoyant cushions have been published since October, 1974.

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Second Edition – August, 1978
Third Edition – October, 1999

Fourth Edition

April 20, 2007

This ANSI/UL Standard for Safety consists of the Fourth Edition including revisions through August 16, 2024.

The most recent designation of ANSI/UL 1175 as a Reaffirmed American National Standard (ANS) occurred on August 16, 2024. ANSI approval for a standard does not include the Cover Page, Transmittal Pages, and Title Page.

Comments or proposals for revisions on any part of the Standard may be submitted to ULSE at any time. Proposals should be submitted via a Proposal Request in the Collaborative Standards Development System (CSDS) at https://csds.ul.com.

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INTRODUCTION

1 Scope

1.1 These requirements cover buoyant cushions using unicellular plastic foam, kapok, or fibrous glass flotation material that are intended to be used in accordance with the applicable regulations of the United States Coast Guard (USCG).

1.2 The buoyant cushions covered by these requirements are intended for USCG approval under 46 CFR 160.048 or 160.049.

1.3 These requirements do not cover buoyant cushions that employ entrapped air as the prime buoyant means.

2 Units of Measurement

2.1 Values stated without parentheses are the requirement. Values in parentheses are explanatory or approximate information.

3 Undated References

3.1 Any undated reference to a code or standard appearing in the requirements of this standard shall be interpreted as referring to the latest edition of that code or standard.

4 Components

4.1 Except as indicated in 4.2, a component of a product covered by this standard shall comply with the requirements for that component.

4.2 A component is not required to comply with a specific requirement that:

a) Involves a feature or characteristic not required in the application of the component in the product covered by this standard, or

b) Is superseded by a requirement in this standard.

4.3 A component shall be used in accordance with its rating established for the intended conditions of use.

4.4 Specific components are incomplete in construction features or restricted in performance capabilities. Such components are intended for use only under limited conditions, such as certain temperatures not exceeding specified limits, and shall be used only under those specific conditions.

4.5 A component used in a device covered by this standard shall comply with the applicable requirements in the Standard for Components for Personal Flotation Devices, UL 1191.

5 General

5.1 A buoyant cushion shall be of the box, rectangular, or trapezoidal type and shall have a top, a bottom, and sides. A pillow type cushion having a top and bottom cover only does not comply with the requirement.

5.2 A cushion shall be constructed so that within 1 minute a swimmer is able to be oriented to the device in such a manner that the face is out of the water without the necessity for constant use of either hand.

5.3 A device shall not incorporate means obviously intended for fastening or securing the device to a boat, nor shall instructions accompanying the device indicate such intent.

Exception: A Type IV buoyant cushion may be provided with hook and pile fastener tapes, or the equivalent, on the cushion's bottom surface when the cushion complies with the requirements specified in the Release Test, Section 16, and is marked in accordance with 21.7.

5.4 A device shall be constructed to reduce the likelihood of shifting or bunching of internal materials.

6 Glossary

6.1 For the purpose of this Standard, the following definitions apply.

6.2 BAR TACK – A type of stitching sewn in a zig-zag pattern that is at least 3/32 inch (2.4 mm) wide, 5/8 inches (15.9 mm) long, and 18 stitches of a lock type stitch, such as Type 301, Federal Standard 751.

6.3 DEVICE – Any buoyant cushion.

6.4 FOAM – Closed-cell foamed polymeric material.

6.5 GROUP APPROVAL – A single approval granted by the USCG for buoyant cushions using foam, kapok, or fibrous glass flotation materials; and that are in accordance with all of the applicable established dimensions and specifications of this standard.

6.6 INSERT – A quantity of buoyant material that has been cut or formed for insertion into a device.

6.7 JOINING SEAM – A seam that serves a functional purpose in the end product as distinguished from a decorative function.

6.8 LOCK TYPE STITCH – A stitch that will not unravel when a force is applied in the direction of the seam on any of the threads forming the stitch.

6.9 SCRAP FOAM – Material obtained from production remnants.

6.10 SEAM – A joint consisting of a sequence or series of stitches uniting two or more pieces of material.

6.11 SPECIAL APPROVAL – A single approval granted by the USCG for a buoyant cushion that is more than 2 inches (50.8 mm) thick, or has dimensions other than those covered in Table 8.1 and Table 8.2.

CONSTRUCTION

7 Material

7.1 Material used in a cushion shall be new.

7.2 Buoyant materials shall be fibrous glass, kapok, or foam.

7.3 Fibrous buoyant material shall be completely encased in flexible heat-sealed film complying with the requirements for plastic film in the requirements in the Standard for Components for Personal Flotation Devices, UL 1191, or be in accordance with the requirements of Federal Specification LP375C.

7.4 Flexible film shall comply with the requirements for flexible film in the Standard for Components for Personal Flotation Devices, UL 1191.

7.5 Kapok used shall be raw fiber, long, clean, lustrous, creamy white, free from discoloration and other fiber, and shall be in accordance with 46 CFR 164.003. The kapok shall be processed by the "Air-Blow" method and shall separate fiber from masses and leave no more than 5 percent by weight of sticks, seeds, or other foreign matter. Processing shall not break down the fiber or cause undue powdering or pulverizing.

7.6 Fibrous glass buoyant materials shall be in accordance with the requirements of Military Specification MIL-B-2766.

7.7 Welting, when used, shall be of a fiber or plastic material acceptable for the purpose.

7.8 Thread shall have a minimum breaking strength after 100 hours of accelerated weathering of 4.7 pounds-force (20.9 N), wet, dry, or both, as applicable, and shall be in accordance with the applicable requirements for thread in 46 CFR 160.048 and 160.049.

7.9 Cover materials shall have a minimum breaking strength after 100 hours of accelerated weathering of 105 pounds-force (467 N) in the direction of greater thread count and 70 pounds-force (311 N) in the direction of lesser thread count and shall be in accordance with the applicable requirements in 46 CFR 160.048 and 160.049 for cover materials.

7.10 Fabrics shall comply with the requirements for fabrics in the requirements in the Standard for Components for Personal Flotation Devices, UL 1191. Name, denier, thread count, weight per square yard, and type and mount of coating shall be used to identify fabrics.

7.11 In addition to the requirements in 7.10, the adhesion of the coating shall be such as to require no less than 8 pounds-force (35 N) to separate it from the cloth backing in accordance with the applicable requirements in 46 CFR 160.048 and 160.049 for coated cover materials.

7.12 Liquid elastomeric compounds employed as dip coatings shall be applied to all external surfaces of buoyant material to provide a minimum thickness of 0.010 inches (0.25 mm) and shall be in accordance with the applicable requirements in 46 CFR 160.049 for dip materials.

7.13 To determine compliance with the requirements of 7.12, a piece of glass or other equivalent material shall be dipped following the same procedure used to dip the personal flotation device. Glass or equivalent material is to be used so that the vinyl coating separates from the material to allow the thickness to be measured accurately.

7.14 No less than 48 hours after dipping, the vinyl is then to be peeled off the glass, and the thickness measured at the center and four points around the perimeter. The average of the five values shall be the value checked for compliance with the requirements of 7.12.

7.15 Adhesives shall be all-purpose waterproof vinyl type in accordance with Subpart 160.049.

7.16 When used for vinyl-dip coated cushions, reinforcing vinyl shall have a minimum thickness of 0.040 inch (1.02 mm) and shall be attached to the foam by adhesive. See 7.15.

7.17 Uncoated 70 denier fabrics shall:

a) Have 3/4 inch (19.1 mm) seams; or

b) Incorporate two rows of lockstitch, or the equivalent.

7.18 Thread used for structural seams shall comply with the requirements for thread in the requirements in the Standard for Components for Personal Flotation Devices, UL 1191. See 1.2.

7.19 Monofilament thread shall not be used for structural seams.

7.20 Thread and fabric combinations shall be compatible. Cotton threads shall be used only with cotton fabrics; synthetic threads may be used with all fabrics.

8 Kapok or Fibrous Glass Cushions

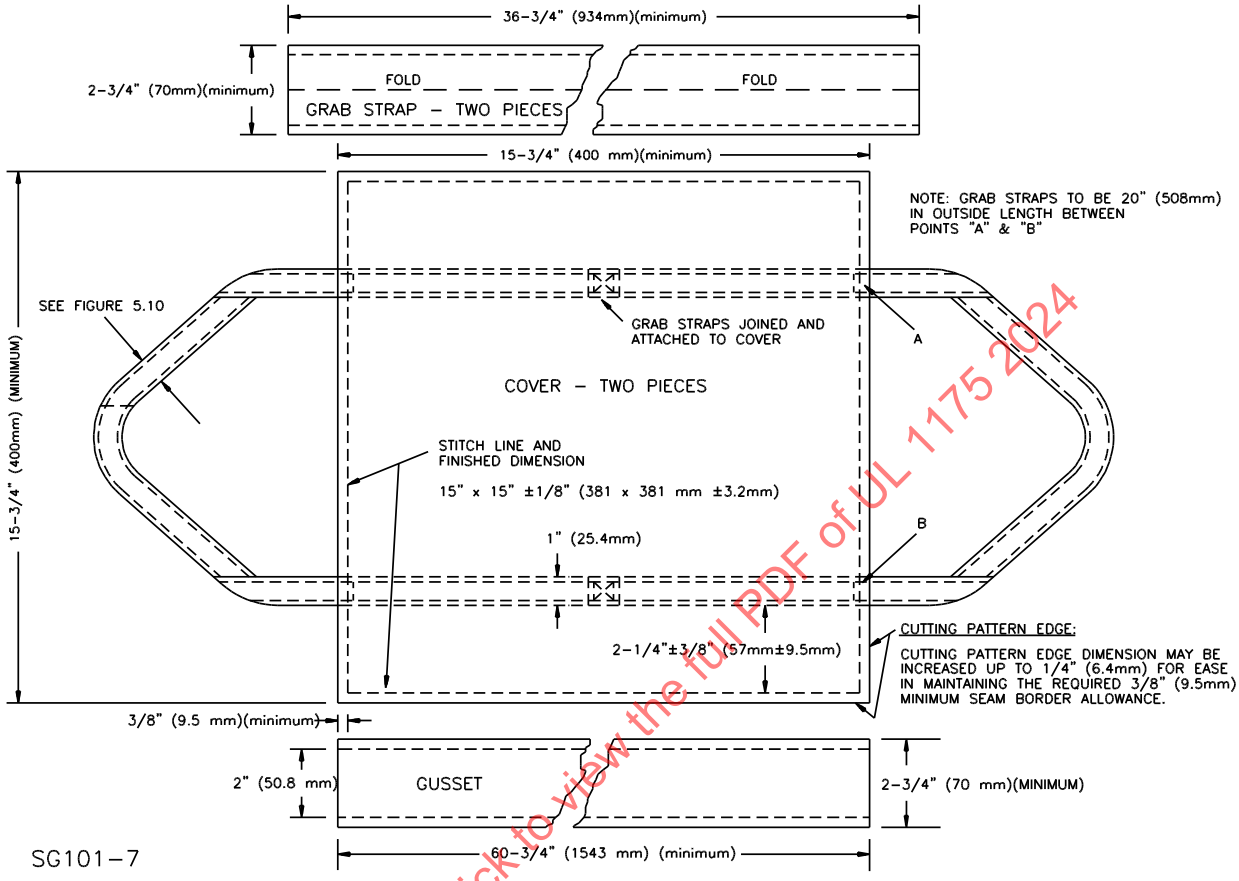
8.1 Kapok or fibrous glass cushions shall be in accordance with the construction requirements of 8.1 – 8.17.

8.2 Cushions shall have sufficient volume to provide at least 20 pounds-force (89 N) of buoyancy.

8.3 Kapok filled or fibrous glass cushions with group approval shall be constructed in accordance with Figure 8.1.

Figure 8.1

Buoyant cushions kapok, fibrous glass, or unicellular plastic foam



NOTE 1 – Tolerances on all finished dimensions 6 inches (152.4 mm) or less shall be ±1/8 inch (±3.2 mm) and shall be ±1/4 inch (±6.4 mm) on dimensions greater than 6 inches (152.4 mm), unless otherwise specified.

NOTE 2 – Uncoated 70 denier cover fabrics, other than cotton, shall comply with 8.14 or 9.9. However, the stitching shall be no less than 3/4 inch (19.1 mm) from the edges of the cloth or shall be topstitched (see Figure 8.12).

NOTE 3 – Finished dimension on the gusset width for 15 by 15 by 2 inch (381 by 381 by 50.8 mm) cushions shall be 2, plus 1/2, minus 0 inches (50.8, plus 12.7, minus 0 mm).

8.4 Kapok or fibrous glass cushions shall have at least 225 square inches (1452 cm^2) of top surface and shall have a thickness of not less than 2 inches (50.8 mm) nor more than 3 inches (76.2 mm). The width, length, and amount of kapok shall be as shown in Table 8.1 and Table 8.2 for group approval. All special approval buoyant cushions 2 inches (50.8 mm) or thicker or those having a shape different from those covered in Table 8.1 and Table 8.2 shall be filled with kapok or fibrous glass as determined by the equations in Table 8.1 and Table 8.2.

Table 8.1
Minimum weight (ounce[a]) of kapok for cushions 2 inches thick[d]

Length (Inches)[a,b,c]	Width (Inches)[a,b]												
	12	13	14	15	16	17	18	19	20	21	22	23	24
15	–	–	–	20	–	–	–	–	–	–	–	–	–
16	–	–	–	21	23	–	–	–	–	–	–	–	–
17	–	–	21	23	24	26	–	–	–	–	–	–	–
18	–	21	22	24	26	27	29	–	–	–	–	–	–
19	20	22	24	25	27	29	30	32	–	–	–	–	–
20	21	23	25	27	28	30	32	34	36	–	–	–	–
21	22	24	26	28	30	32	34	35	37	39	–	–	–
22	23	25	27	29	31	33	35	37	39	41	43	–	–
23	25	27	29	31	33	35	37	39	41	43	45	47	–
24	26	28	30	32	34	36	38	41	43	45	47	49	51
25	27	29	31	33	36	38	40	42	44	47	49	51	53
26	28	30	32	35	37	39	42	44	46	49	51	53	55
27	29	31	34	36	38	41	43	46	48	50	53	55	58
28	30	32	35	37	40	42	44	47	50	52	55	57	60
29	31	34	36	39	41	44	46	49	52	54	57	59	62
30	32	35	37	40	43	45	48	51	53	56	59	61	64
31	33	36	39	41	44	47	50	52	55	58	61	63	66
32	34	37	40	43	46	48	51	54	57	60	62	65	68
33	35	38	41	44	47	50	53	56	59	62	64	67	70
34	36	39	42	45	48	51	54	57	60	63	66	69	73
35	37	40	44	47	50	53	56	59	62	65	68	72	75
36	38	42	45	48	51	54	58	61	64	67	70	74	77

[a] Conversion Factors: 1 inch = 25.4 mm, 1 ounce = 28.3 g

[b] Length and width in inches shall be within + 1/4 inch and minus zero inch.

[c] Length in inches as applied to the Table for a trapezoid is to be computed as follows: Length = $(L_1 + L_2)/2$

where: L_1 and L_2 are the unequal sides of the trapezoid.

[d] Rectangular or trapezoidal shaped cushions more than 2 inches thick and more than 36 inches long and/or 24 inches wide are to have a minimum weight of kapok as determined by the following:

1. Rectangular Cushion, weight (ounces) = (L x W x t)/22.5

2. Trapezoidal cushion, weight (ounces) = $[(L_1 + L_2) \times W \times t]/45$

where:

Table 8.1 Continued on Next Page

Table 8.1 Continued

Length (Inches)[a,b,c]	Width (Inches)[a,b]												
	12	13	14	15	16	17	18	19	20	21	22	23	24

L is the length in inches

W is the width in inches

t is the thickness in inches

L_1 and L_2 are unequal sides of the trapezoid

Table 8.2
Minimum weight (ounces[a]) of fibrous glass for cushions 2 inches thick[d]

Length (Inches)[a,b,c]	Width (Inches)[a,b]												
	12	13	14	15	16	17	18	19	20	21	22	23	24
15	–	–	–	36	–	–	–	–	–	–	–	–	–
16	–	–	–	38	41	–	–	–	–	–	–	–	–
17	–	–	38	41	44	46	–	–	–	–	–	–	–
18	–	37	40	43	46	49	52	–	–	–	–	–	–
19	36	40	43	46	49	52	55	58	–	–	–	–	–
20	38	42	45	48	51	54	58	61	64	–	–	–	–
21	40	44	47	50	54	57	60	64	67	71	–	–	–
22	42	46	49	53	56	60	63	67	70	74	77	–	–
23	44	48	52	55	59	63	66	70	74	77	81	85	–
24	46	50	54	58	61	65	69	73	77	81	84	88	92
25	48	52	56	60	64	68	72	76	80	84	88	92	96
26	50	54	58	62	67	71	75	79	83	87	92	96	100
27	52	56	60	65	69	73	78	82	86	91	95	99	104
28	54	58	63	67	72	76	81	85	90	94	99	103	108
29	56	60	65	70	74	79	84	88	93	97	102	107	111
30	58	62	67	72	77	82	86	91	96	101	106	110	115
31	60	64	69	74	79	84	89	94	99	104	109	114	119
32	61	67	72	77	82	87	92	97	103	108	113	118	123
33	63	69	74	79	84	90	95	100	106	111	116	121	127
34	65	71	76	82	87	92	98	103	109	114	120	125	131
35	67	73	78	84	90	95	101	106	112	118	123	129	134
36	69	75	81	86	92	98	104	109	115	121	127	132	138

[a] Conversion Factors: 1 inch = 25.4 mm, 1 ounce = 28.3 g

[b] Length and width in inches shall be within +1/4 inch and minus zero inch.

[c] Length in inches as applied to the Table for a trapezoid is to be computed as follows: Length = $(L_1 + L_2)/2$

where: L_1 and L_2 are the unequal sides of the trapezoid.

Table 8.2 Continued on Next Page

Table 8.2 Continued

Length (Inches)[a,b,c]	Width (Inches)[a,b]												
	12	13	14	15	16	17	18	19	20	21	22	23	24

[d] Rectangular or trapezoidal shaped cushions more than 2 inches thick and more than 36 inches long and/or 24 inches wide are to have a minimum weight of fibrous glass as determined by the following:

1. Rectangular Cushion, weight (ounces) = (L x W x t)/12.5

2. Trapezoidal cushion, weight (ounces) = [(L1 + L2) x W x t]/25

where:

L is the length in inches

W is the width in inches

t is the thickness in inches

L_1 and L_2 are unequal sides of the trapezoid

8.5 Kapok or fibrous glass material shall not be contained in less than four waterproof, heat-sealed plastic insert envelopes which contain approximately equal amounts of the total required buoyant material.

8.6 Kapok or fibrous glass buoyant material shall be inserted directly into the plastic insert envelope or shall be packed in suitable cloth bags prior to enclosure in plastic insert envelopes.

8.7 Plastic film insert envelopes shall be constructed of vinyl film complying with the requirements for plastic film in the requirements in the Standard for Components for Personal Flotation Devices, UL 1191, or be not less than 0.008 inches (0.20 mm) in thickness in accordance with the applicable requirements for plastic film referenced in Chapter I, 46 CFR, Subpart 160.048-3(e). Heat-sealed seams of the envelope shall have an adhesion of not less than 8 pounds per inch (1.4 N/mm) using 1 inch (25.4 mm) wide test strips cut perpendicular to the seam being tested. Clamping jaws shall have a separation rate of 12 inches (305 mm) per minute. Alternatively, a mass of 8 pounds (3.6 kg) may be employed. This mass is to be gradually applied to the lower of the two jaws.

8.8 Prior to sealing, plastic insert envelopes shall be evacuated of sufficient air to prevent ballooning when subjected to external pressure.

8.9 Plastic insert envelopes for 15 by 15 by 2 inch (381 by 381 by 50.8 mm) cushions shall be cut approximately 12 inches (305 mm) wide by 12 inches (305 mm) long or approximately 8 inches (203 mm) wide by 18 inches (457 mm) long and shall have a sealed area approximately 125 square inches (806 cm^2). They shall contain not less than 5 ounces (0.142 kg) of kapok or 9 ounces (0.255 kg) of fibrous glass each. The volume displacement of the individual heat-sealed pad inserts shall be 5-1/2 pounds-force (24.5 N) each, ±1/2 pound-force (±2.22 N), at an atmospheric pressure of 29.92 in Hg (101 kPa) and a temperature of 20°C (68°F) when tested in accordance with the requirements of 12.1 – 12.7, except that the pad covers shall not be slit open, and the period of submergence shall be only long enough for the insert to reach ±3°F (±1.7°C) of the water temperature and to determine the displacement of the pads.

8.10 Results of the Volume Displacement Test shall be corrected to a pressure of 29.92 in Hg (101 kPa) and a temperature of 20°C (68°F), by use of the equation:

$$V_2 = \frac{V_1 \times P_1}{0.057 T_1 - 26.6}$$

where:

V_2 is volume displacement in pounds-force (N x 0.225), at a pressure of 29.92 inches Hg (101 kPa) and a temperature of 20°C (68°F),

V_1 is volume displacement in pounds-force, at the test temperature (°F) and pressure [inches Hg (kPa x 0.395)],

P_1 is pressure at time of test in inches Hg (kPa x 0.395), and

T_1 is temperature at time of test (°F).

8.11 Volume displacement of all cushions other than the 15 by 15 by 2 inch (381 by 381 by 50.8 mm) cushion, at a pressure of 29.92 in Hg (101 kPa) and a temperature of 20°C (68°F), shall be determined by using the following equation:

a) For kapok cushions;

$$V_2 = K_0 \times 1.10$$

b) For fibrous glass cushions;

$$V_2 = F_0 \times 0.61$$

where:

V_2 is volume displacement in pounds-force (N x 0.225),

K_0 is weight in ounces (kg x 0.035) of kapok in the pad insert, and

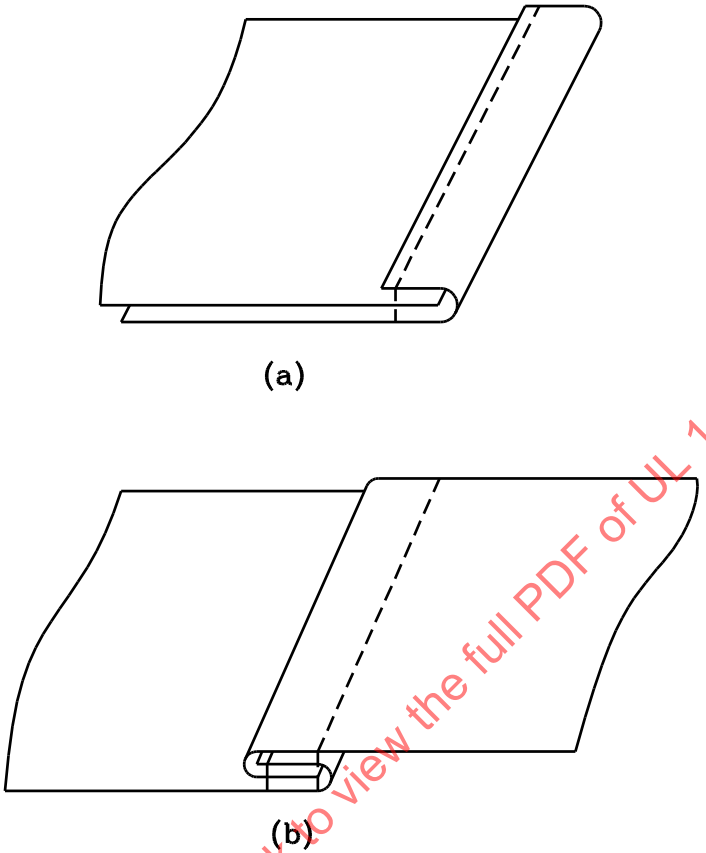
F_0 is weight in ounces of fibrous glass in the pad insert.

A tolerance of ±1/2 pound-force (±0.223 N) shall be applied to the value V_2 at a pressure of 29.92 inches Hg (101 kPa) and a temperature of 20°C (68°F).

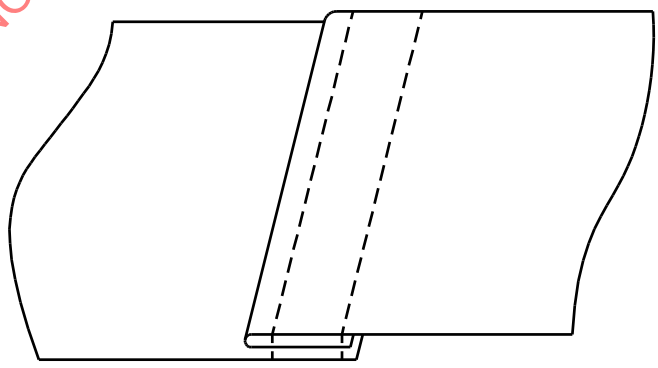
8.12 The cover shall consist of a top and bottom, each one piece. One or more pieces may be employed provided they are for decorative purposes only, and the pieces are joined using a double row of stitching as described in 8.14 in one of the seam types as illustrated by Figure 8.2. The material for the cover shall be either cotton or coated cloth, or equivalent, in accordance with applicable requirements referenced in 46 CFR Subpart 160.048.

Figure 8.2

Seam types



This type of seam shall be formed by: (a) superimposing two pieces of material, turning the edge of one ply of material over the edge of the second ply, and seaming with one row of stitches, and (b) turning back the body of the upper ply over the folded lower ply and seaming with one row of stitches.



This type of seam shall be formed by folding under the edge of one ply of the material overlapping it at the edge of another ply and seaming with one or more rows of stitches.

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8.13 Gusset or side cover shall be one or two pieces of cotton cloth, coated cloth, or equivalent. Provisions shall be provided on a cushion so that drainage will occur in accordance with the applicable requirements in 46 CFR Subpart 160.048 and 160.049, except that coated cloth or nonporous cloth shall be perforated or at least two 1/8-inch (3-mm) inner diameter drainage holes are provided on the gusset face adjacent to each grab strap loop. The holes shall be located at least 4-1/2 inches (114 mm) from the centerline of the cushion. When two pieces of coated cloth or nonporous cloth are used, they shall be joined using a double row of stitches in accordance with 8.14 and the seam type illustrated in Figure 8.3 . The gusset shall be joined at the top and bottom covers using the seam type in Figure 8.3 . The ends of a single piece gusset shall be joined by stitch types illustrated in Figure 8.4 – Figure 8.7.

Figure 8.3

Stitching of gusset

(broken lines show lock stitch)

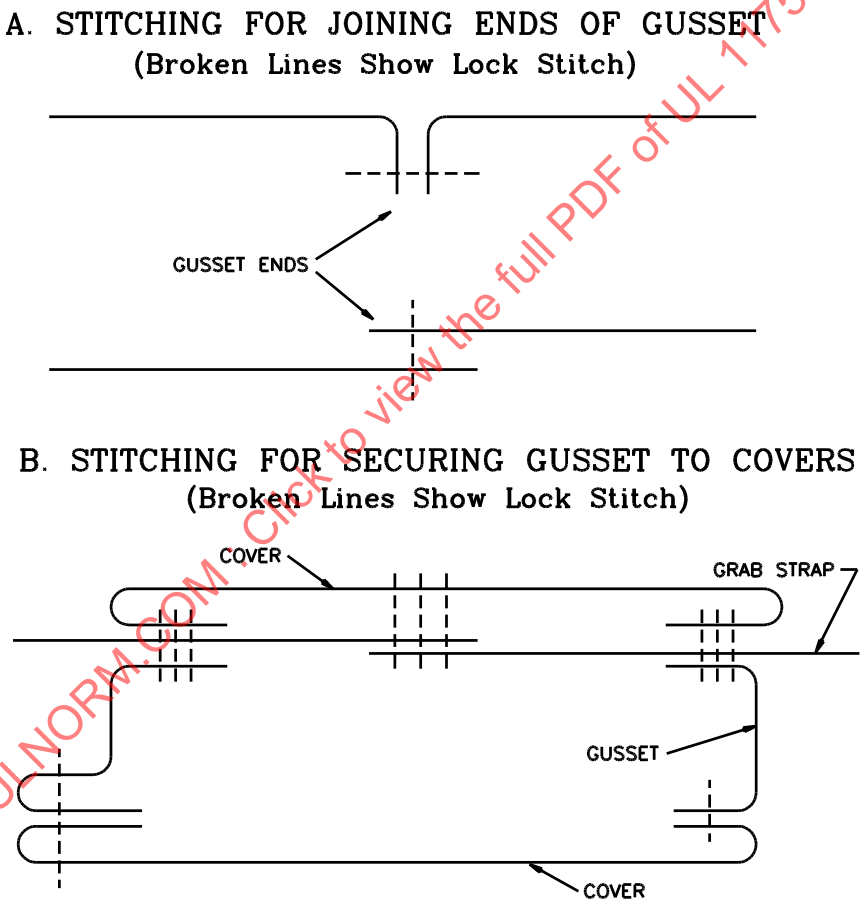
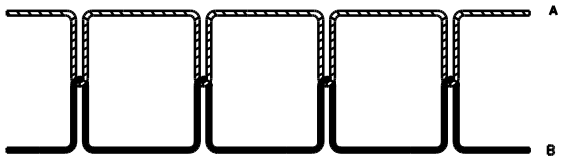


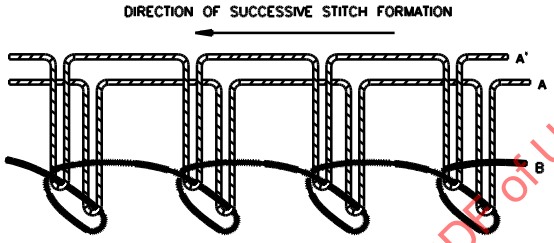
Figure 8.4

Lock stitches



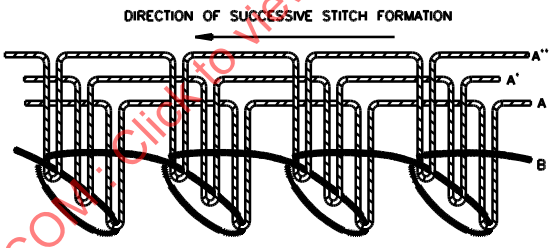
Stitch type 301

This type of stitch shall be formed with two threads: one needle thread, A, and one bobbin thread, B. A loop of thread A shall be passed through the material and interlaced with thread B. Thread A shall be pulled back so that the interlacing shall be midway between surfaces of the material or materials being sewn.



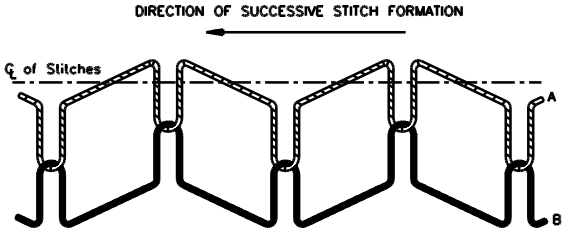
Stitch type 302

This type of stitch shall be formed with three threads: two needle threads, A and A', and one bobbin thread, B. Loops of threads A and A' shall be passed through the material and interlaced with thread B. The interlacings shall be on the underside of the material.



Stitch type 303

This type of stitch shall be formed with four threads: three needle threads, A and A' and A", and one bobbin thread, B. Loops of threads A, A' and A" shall be passed through the material and interlaced with thread B. The interlacings shall be on the underside of the material.



Stitch type 304

This type of stitch shall be formed with two threads: one needle thread, A, and one bobbin thread, B. This stitch type is exactly the same as stitch type 301 except that successive single stitches form a symmetrical zigzag pattern.

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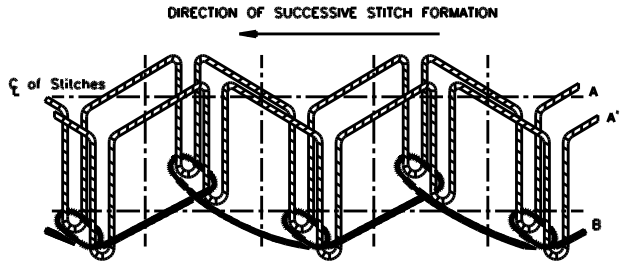
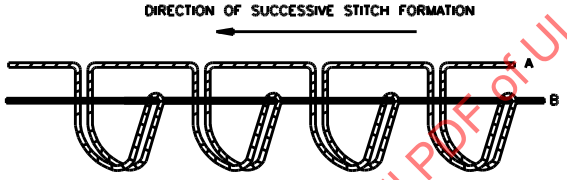
Figure 8.5

Lock stitches



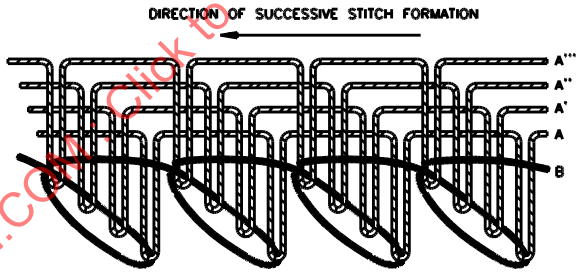
Stitch type 305

This type of stitch shall be formed with three threads: two needle threads, A and A', and one bobbin thread, B. Loops of threads A and A' shall be passed through the material and interlaced with thread B and the interlacing shall be left on the underside of the material. Successive single stitches form a symmetrical zigzag pattern.



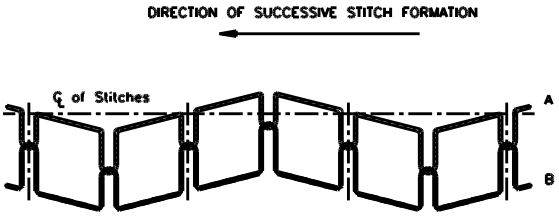
Stitch type 306

This type of stitch shall be formed with two threads: one needle thread, A, and one bobbin thread, B. Loops of thread A shall be passed through the top ply of material and horizontally through portions of the bottom ply without penetrating it the full depth and shall be interlaced with thread B on the top surfaces of the bottom ply of material.



Stitch type 307

This type of stitch shall be formed with five threads: four needle threads, A, A', A'', A''', and one bobbin thread, B. Loops of threads A, A', A'', A''', shall be passed through the material and interlaced with thread B. The interlacings shall be on the underside of the material.



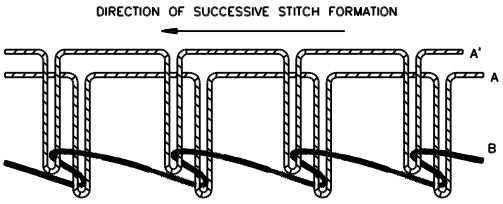
Stitch type 308

This type of stitch shall be formed with two threads: one needle thread, A, and one bobbin thread, B. This stitch type is the same as stitch type 304 except that successive pairs of stitches form a symmetrical zigzag pattern.

SG101-4

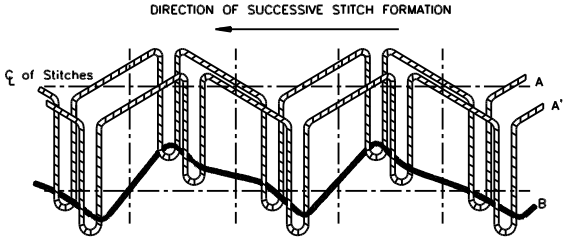
Figure 8.6

Lock stitches



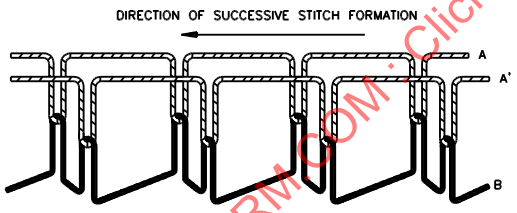
Stitch type 309

This type of stitch shall be formed with three threads: two needle threads, A and A', and one bobbin thread, B. Loops of threads A and A' shall be passed through the material and interlaced with thread B. The interlacings shall be left on the underside of the material.



Stitch type 310

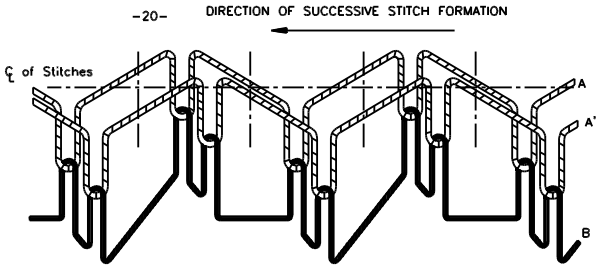
This type of stitch shall be formed with three threads: two needle threads, A and A', and one bobbin thread, B. Loops of threads A and A' shall be passed through the material and interlaced with thread B, and the interlacing shall be left on the underside of the material. Successive single stitches form a symmetrical zigzag pattern.



Stitch type 311

This type of stitch shall be formed with three threads: two needle threads, A and A', and one bobbin thread, B. Loops of threads A and A' shall be passed through the material and interlaced with thread B. Threads A and A' shall be pulled back so that the interlacings shall be midway between surfaces of the material or materials being sewn.

SG101-5

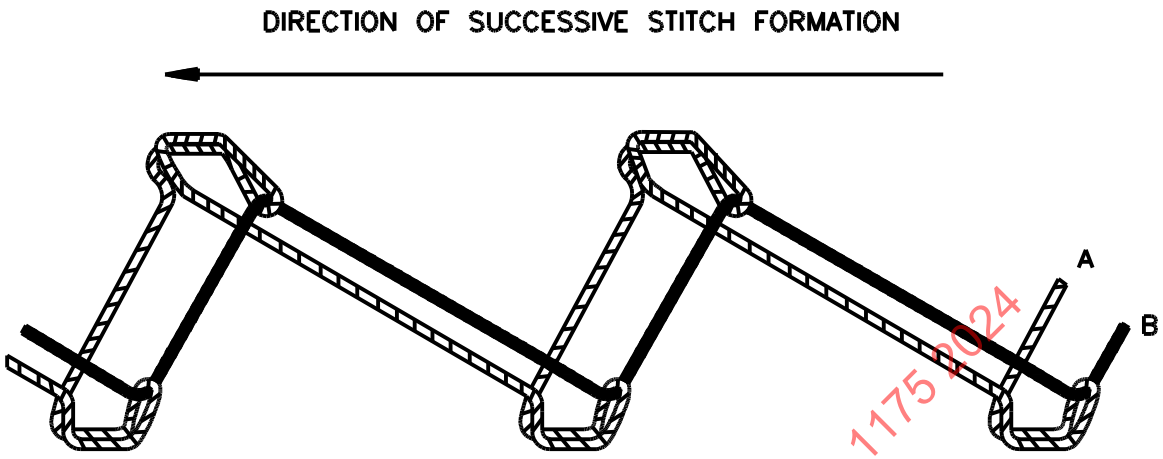


Stitch type 312

This type of stitch shall be formed with three threads: two needle threads, A and A', and one bobbin thread, B. This stitch type is exactly the same as stitch type 311 except that successive single stitches form a symmetrical zigzag pattern.

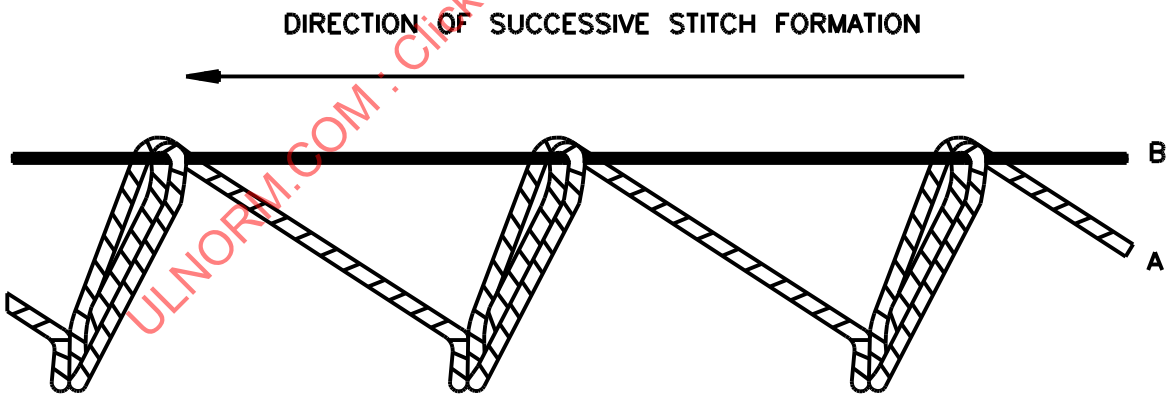
Figure 8.7

Lock stitches



Stitch type 313

This type of stitch shall be formed with two threads: one needle thread, A, and one bobbin thread, B. Loops of thread A shall be passed horizontally through portions of both plies of material without penentrating the full depth, and shall be interlaced with thread B on the top of the material.



Stitch type 314

This type of stitch shall be formed with two threads: one needle thread, A, and one bobbin thread, B. Loops of thread A shall be passed through the top ply material and horizontally through portions of the bottom ply without penetrating the full depth and shall be interlaced with thread B on the top of the material.

8.14 Seams shall be made using any of the following threads:

a) Cotton, Type 1A or 1B, Ticket No. 20, 4 ply;

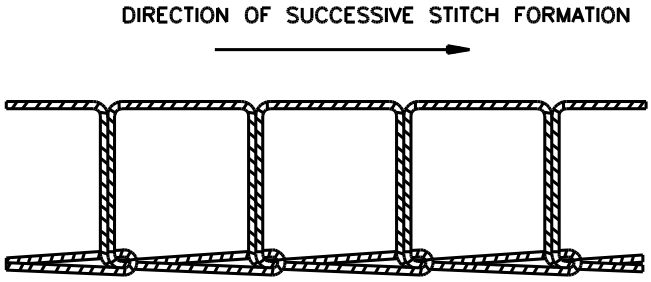
b) Cotton, Type 1A or 1B, Ticket No. 40, 3 ply;

c) Acceptable equivalents, such as polyester, nylon, and the like.

All stitching shall be no less than 3/8 inch (9.5 mm) from edges of cloth (see Note 2, Figure 8.1 for exceptions) and lockstitched as illustrated in Figure 8.4 – Figure 8.7 with 7 to 9 stitches per inch (25.4 mm). Grab straps shall employ a chain stitch as illustrated in Figure 8.8 and Figure 8.9 with 6 to 8 stitches per inch (25.4 mm).

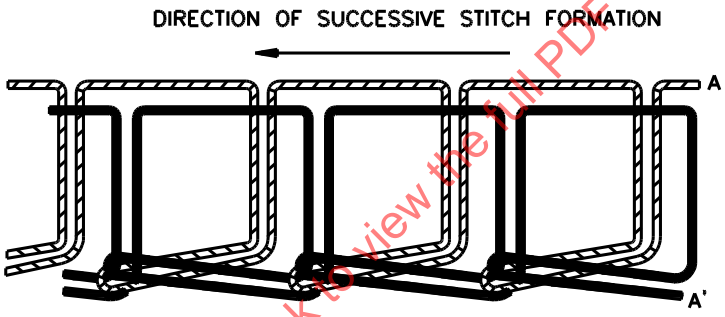
Figure 8.8

Chain stitches



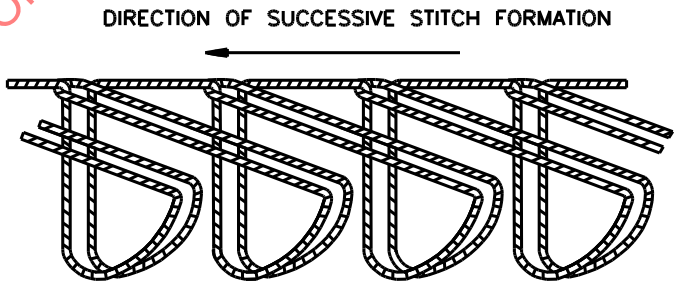
Stitch type 101

This type of stitch shall be formed with one needle thread which shall be passed through the material and interlooped with itself on the undersurface of the material.



Stitch type 102

This type of stitch shall be formed with two needle threads, A and A'. Both threads shall be passed through the material and thread A' shall be interlooped with itself and with thread A.



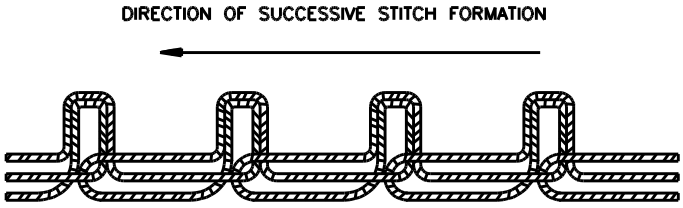
Stitch type 103

This type of stitch shall be formed with one needle thread, which shall interloop with itself on the top surface of the material. The thread shall be passed through the top ply and horizontally through portions of the bottom ply without penetrating it the full depth.

SG101 – 1

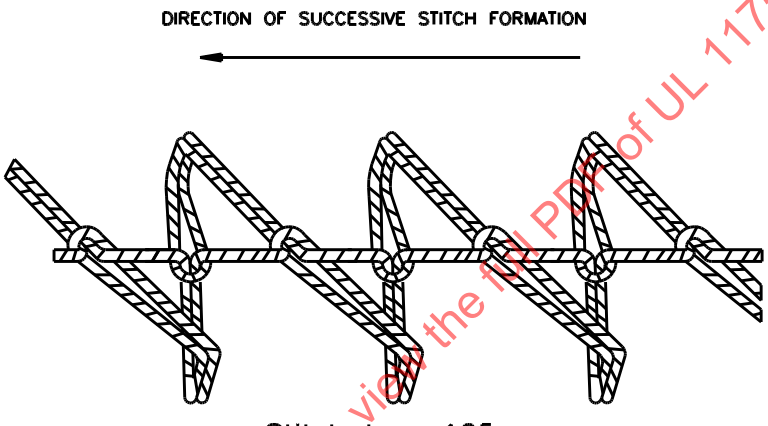
Figure 8.9

Chain stitches



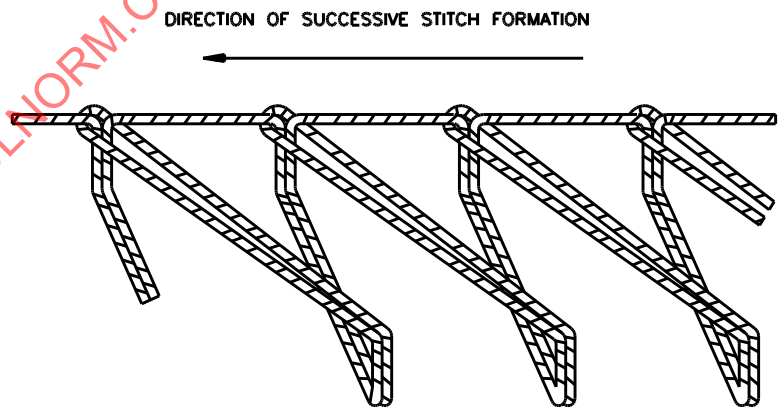
Stitch type 104

This type of stitch shall be formed with one needle thread which shall interloop with itself on the undersurface of the material.



Stitch type 105

This type of stitch shall be formed with one needle thread which shall be passed through the top ply of material and through portions of the bottom ply without penetrating it the full depth, on either side of the center line. The thread shall interloop with itself on the surface of the material at the center line.



Stitch type 106

This type of stitch shall be formed with one needle thread which shall be passed through the top ply of the material and through portions of the bottom ply without penetrating it the full depth, and interloop with itself on the surface of the material.

SG101–2

8.15 Grab straps for fabric covered cushions shall be of 1-inch (25.4 mm) webbing found acceptable for the application, or:

a) Of the same material as the top and bottom covers;

b) Folded flat with raw edges turned under; and

c) stitched to provide 1-inch (25.4 mm) wide, double thickness, construction as illustrated in Figure 8.10.

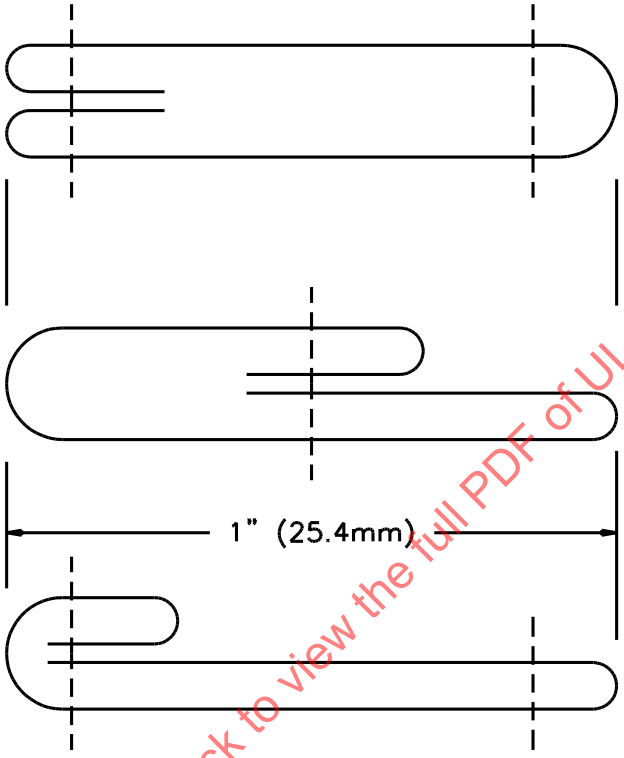
The grab straps shall be attached as illustrated in Figure 8.11. Alternately, each length of grab strap which passes on the outside of the cushion's cover shall be attached at least in three locations using Box-X stitching or multiple bar tack stitching (two bar tacks 1/2 inch apart may be substituted for one Box-X.) The distal ends of the grab strap shall be attached within 3/4 inch (19 mm) of the edge of the cushion.

Figure 8.10

Chain stitches

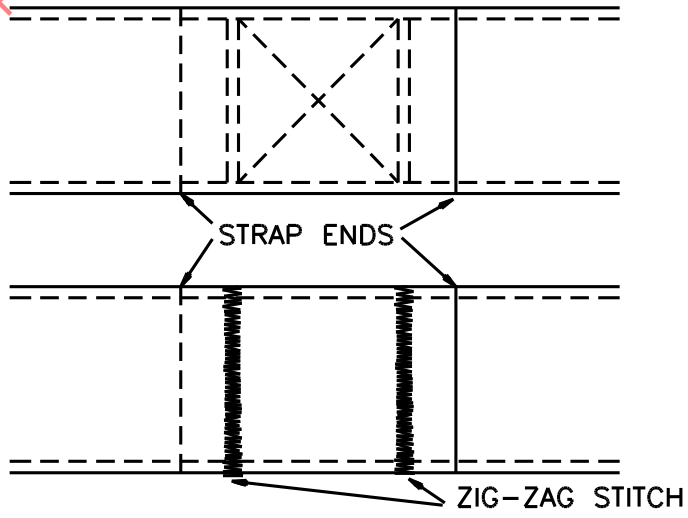
A. FOLDING AND STITCHING FOR GRAB STRAPS

(Broken Lines Show Lock or Chain Stitching)



B. STITCHING FOR JOINING GRAB STRAP ENDS

(Broken Lines Show Lock or Chain Stitching)



SG101-10

Figure 8.11

Stitching for securing grab straps to cover

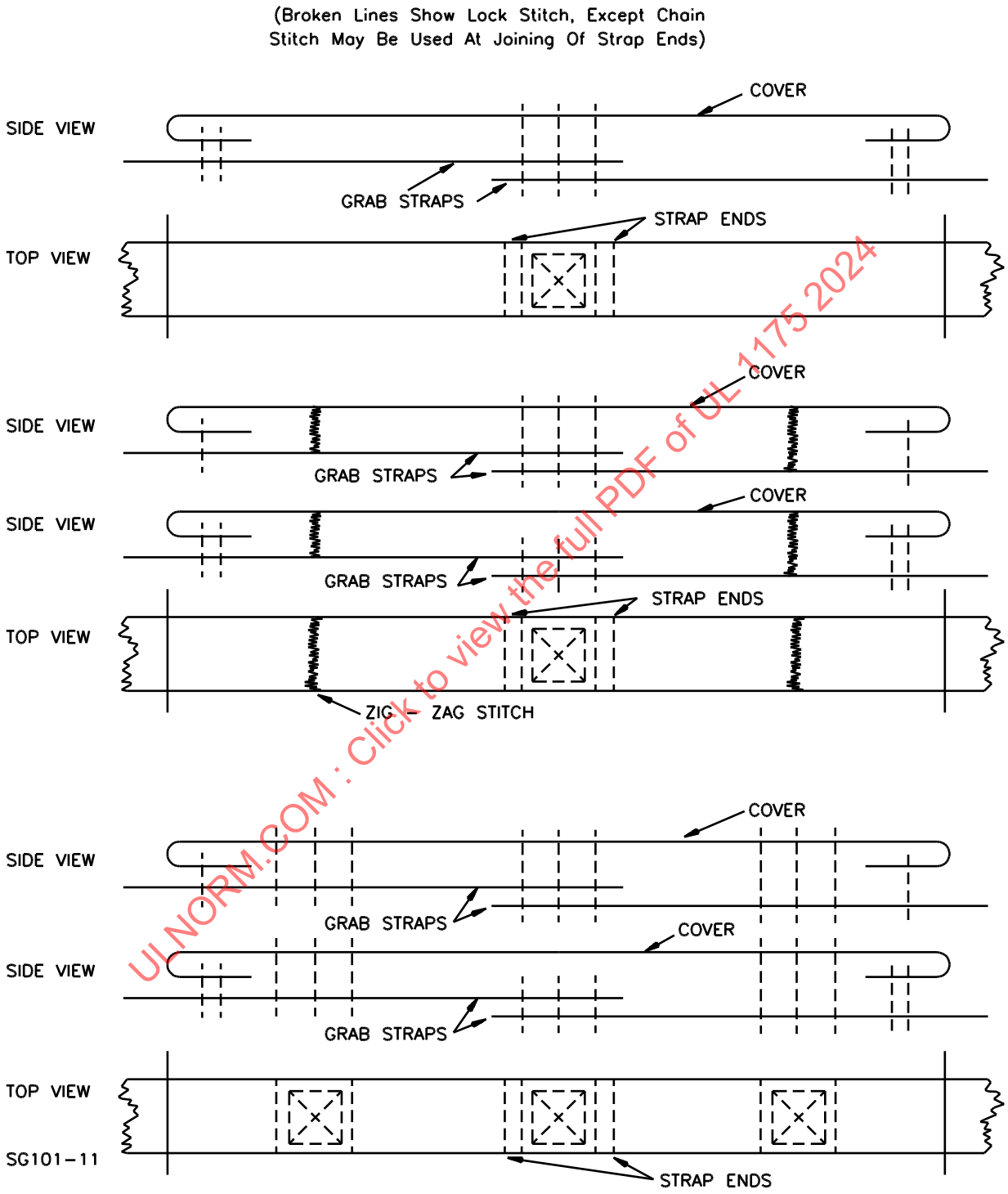
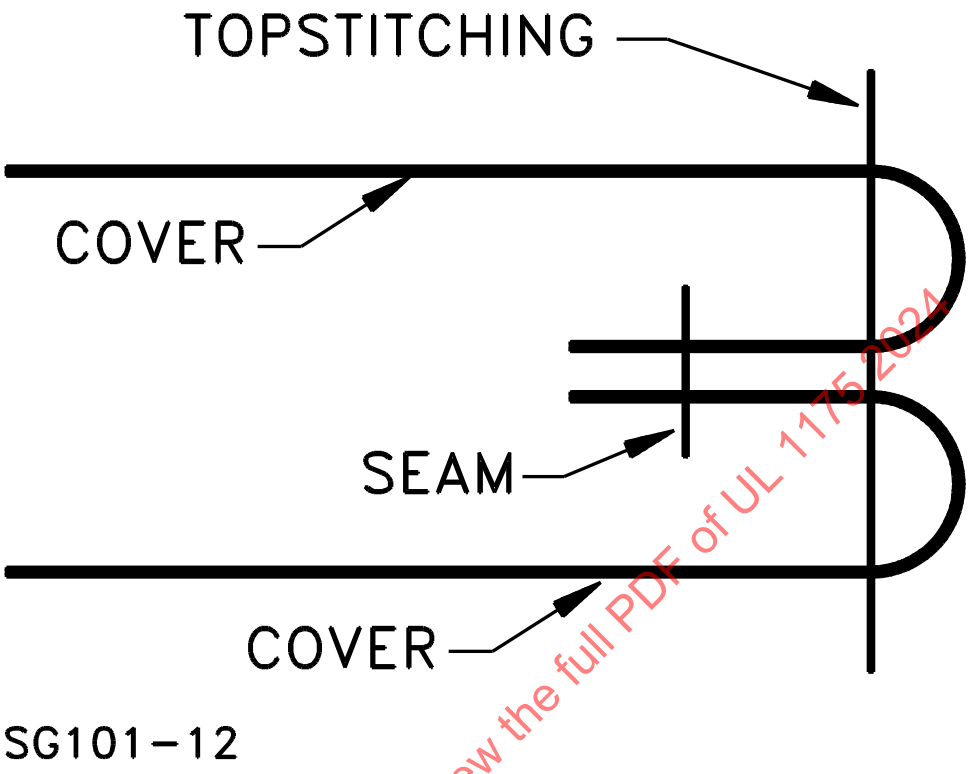


Figure 8.12

Top stitching



8.16 Sewn straps may be one or two pieces and shall:

a) Have ends overlapped a minimum of 1-1/4 inches (31.8 mm) at the center of a cushion; and

b) Be joined by stitching as illustrated in one of the diagrams in Figure 8.10 to provide a minimum 20 inch (508 mm) free length loop at each end of a cushion.

Where a box-X pattern stitch is to be employed, it shall have overall dimensions not less than 1/2 by 1/2-inch (12.7 by 12.7-mm) in length, and where a bartack stitch is to be employed, it shall have overall dimensions not less than 1/2 to 7/8-inch (12.7 to 22.2-mm) in length. Box-X and bartack pattern stitches shall be positioned to provide a minimum distance of 3/8 inch (9.5 mm) from the strap ends.

8.17 An assembled strap shall:

a) Pass through a cushion;

b) Be free of slack;

c) Be in contact with the inner surface of a cover; and

d) Be parallel and 2-1/4 ±3/8 inch (57.2 ±9.5 mm) from the sides of a finished cushion, measured from the outer edge of a strap.

Two lengths of the strap that pass through a cushion shall each be secured at three or five locations as illustrated in Figure 8.11, which includes two locations where stitching joins cover to gusset.

9 Unicellular Plastic Foam Cushions

9.1 Unicellular plastic foam cushions shall be in accordance with the construction requirements of 9.2 – 9.14.

9.2 A cushion shall have at least 20 pounds-force (89 N) buoyancy.

9.3 Unicellular plastic foam cushions, cloth-covered or vinyl-dipped, submitted for group approval shall be in accordance with Figure 8.1.

9.4 Unicellular plastic foam buoyant cushions shall:

a) Have not less than 225 square inches (1452 cm^2) of top surface area;

b) Contain not less than 630 cubic inches (10,324 cm^3) of closed cell material;

c) Be not less than 2 inches (50.8 mm) nor more than 3 inches (76.2 mm) thick; and

d) Have widths and lengths within the dimensions illustrated in Table 9.1 for group approval.

Cushions which are in accordance with (a) – (d), but which have widths and lengths other than as illustrated in Table 9.1 or have shapes other than rectangular or trapezoidal shall be considered for special approval. Buoyant inserts for rectangular or trapezoidal-shaped cushions shall be in accordance with Table 9.1. For trapezoidal-shaped cushions, the average length shall be used in determining the minimum thickness from Table 9.1. See Table 8.1, note (c).

Table 9.1
Minimum thickness (inches[a]) of unicellular plastic foam buoyant material for rectangular or trapezoidal-shaped cushions

Length (Inches)[b,c]	Width (Inches)[b]						
	12	13	14	15	16	17	Over 17
15	–	–	–	2-7/8	–	–	–
16	–	–	–	2-3/4	2-1/2	–	–
17	–	–	2-3/4	2-1/2	2-3/8	2-1/4	–
18	–	2-3/4	2-1/2	2-3/8	2-1/4	2-1/8	2
19	2-7/8	2-5/8	2-3/8	2-1/4	2-1/8	2	2
20	2-5/8	2-1/2	2-1/4	2-1/8	2	2	2
21	2-1/2	2-3/8	2-1/4	2	2	2	2
22	2-1/2	2-1/4	2-1/8	2	2	2	2
23	2-3/8	2-1/8	2	2	2	2	2
24	2-1/4	2-1/8	2	2	2	2	2
25	2-1/8	2	2	2	2	2	2
Over 25	2	2	2	2	2	2	2

[a] Conversion Factors: 1 inch = 25.4 mm.

[b] Any length 25 inches or less and any width 17 inches or less shall be within and + 1/2 minus zero inch of the dimensions specified. Length and width dimensions apply to both the fabric cover and buoyant foam.

[c] Length in inches as applied to the Table for a trapezoid is to be computed as follows: Length = $(L_1 + L_2)/2$

where: L_1 and L_2 are the unequal sides of the trapezoid.

9.5 Buoyant material shall be foam contained in a cloth cover or shall be dip coated and fitted with grab straps. It shall be either molded one piece or built up from sheet stock and shall be within plus 3/8 and minus 0 inch (plus 9.5 and minus 0 mm) of the uncovered thickness specified in Table 9.1. If constructed of sheet stock, foam shall be not more than three layers thick with not more than three pieces per layer. Butts and seams shall be staggered. All pieces within a layer shall be joined by an adhesive of the type described in 7.15. Layers may be joined to each other by means of the same adhesives. A cloth-covered, foam-filled cushion submitted for group approval shall also be in accordance with Table 8.1.

9.6 Foam used as buoyant material shall comply with the requirements for foam in the requirements in the Standard for Components for Personal Flotation Devices, UL 1191, and shall have a V factor of 85 or more as determined in accordance with UL 1191. Also, see 12.1.

9.7 The cover shall consist of a top and bottom, each one piece. The side cover or gusset shall be one or two pieces of cotton cloth, coated cloth, or the equivalent, in accordance with the applicable requirements of 46 CFR 160.049, except that coated cloth shall be perforated. If two pieces are to be used, they shall be joined using a double row of stitches in accordance with 9.9 – 9.11 and Figure 8.10. The ends of a single piece gusset shall be joined by stitches as illustrated in Figure 8.4 – Figure 8.7.

9.8 Covered cushions under group approval shall have material covers of cotton, coated cloth, or equivalent, in accordance with the applicable requirements referenced in 46 CFR Subpart 160.049 for cover material. Covered cushions under special approval shall have material covers in accordance with the applicable requirements referenced in Subpart 160.049 for cover cloth material, although not necessarily of cotton or coated cloth.

9.9 Seams shall be made using any of the following threads:

a) Cotton, Type 1A or 1B, Ticket No. 20, 4 ply;

b) Cotton, Type 1A 1B, Ticket No. 40, 3 ply; or

c) Acceptable equivalents, such as polyester, nylon, and the like.

All stitching shall be no less than 3/8 inches (9.5 mm) from edges of cloth (see Note 2, Figure 8.1 for exception) and lockstitched as illustrated in Figure 8.4 – Figure 8.7 with 7 to 9 stitches per inch (25.4 mm). Grab straps shall employ a chain stitch as illustrated in Figure 8.8 and Figure 8.9 with 6 to 8 stitches per inch (25.4 mm).

9.10 The grab strap shall be cotton cloth, coated cloth, or equivalent (for example, webbing); folded flat with raw edges turned under and stitched to provide 1 inch (25.4 mm) wide, double thickness construction as illustrated in one of the diagrams in Figure 8.10.

9.11 A sewn strap which may be one or two pieces shall have ends overlapped a minimum of 1-1/4 inches (31.8 mm) at the center location of a cushion, and shall be joined by stitching as illustrated in one of the diagrams in Figure 8.10 to provide a minimum 20 inches (508 mm) free length loop at each end of a cushion.

9.12 Where a box-X pattern stitch is to be employed, it shall have overall dimensions not less than 1/2- by 1/2-inch (12.7- by 12.7-mm) in length, and where bartack stitch is to be employed, it shall be 1/2- to 7/8-inch (12.7- to 22.2-mm) in length. Stitching of box-X and bartack pattern shall be positioned to provide a minimum distance of 3/8 inch (9.5 mm) between outer edges of stitches and strap ends. Grab straps shall be sewn with:

a) Lock stitches Type 301 through Type 314, see Figure 8.4 – Figure 8.7, and 7 to 9 stitches per inch (25.4 mm), or

b) Chain stitches Type 101 through Type 106, see Figure 8.8 and Figure 8.9, with 6 to 8 stitches per inch (25.4 mm), Ticket No. 20, 4 ply thread on the top and Ticket No. 40, 3 ply thread on the bottom.

9.13 An assembled strap shall:

a) Pass through a cushion;

b) Be free of slack;

c) Be in contact with the inner surface of a cover; and

d) Be parallel with and 2-1/4 ±3/8 inch (57.2 ±9.5 mm) from the sides of a finished cushion, as measured from the outer edge of a strap.

Each of the two lengths of the strap that pass through a cushion shall be secured at three or five locations as illustrated in Figure 8.11, including two locations where stitching joins the cover to the gusset.

9.14 Grab straps for vinyl-dip coated cushions shall be passed through the body of the buoyant material before coating is applied. The straps shall be parallel and 2-1/4±3/8 inch (57.2 ±9.5 mm) from the sides of the cushion, measured from the outer edge of the strap and in a plane parallel to the top or bottom surface.

9.15 Grab straps for vinyl-dip coated cushions may be of 3/8 inch (9.5 mm) diameter polyethylene, polypropylene, or other acceptable buoyant type synthetic line material and need not pass through the body of the buoyant material of the cushion.

9.16 Grab straps for vinyl-dip coated cushions when made of cotton cloth, coated cloth, or 3/8 inch (9.5 mm) diameter polyethylene or polypropylene shall be one or two pieces and spliced to form a minimum 20 inch (508 mm) free length loop at each end of a cushion.

10 Scrap Foam Cushions

10.1 A cushion utilizing scrap foam shall comply with the construction requirements specified in 10.2 – 10.6, in addition to the other applicable requirements specified in Sections 7 and 8.

10.2 A cushion composed of scrap foam shall consist of a bonded construction with a core of scrap pieces glued to a top foam section and a bottom foam section, each of which is of one piece.

10.3 The length and width of the top foam section and the bottom section shall be approximately the same size as those of the cushion. At least one-half of the pieces shall be at least 1 inch (25.4 mm) wide and the remaining pieces shall have a width of at least 1/4 inch (6.4 mm).

10.4 The individual pieces of the core foam section shall be rectangular, triangular, or square in shape with thickness equal to the core thickness. At least one-half of the pieces used shall have one dimension equal to either the overall width or length of the top and bottom foam sections. The minimum length for the remaining pieces of the core foam section shall be at least one-half the length or width of the device.

10.5 Two of the four sides of the core foam section shall have the scrap pieces positioned so that it is possible to visually determine the distance between the adjacent pieces. The distance between the adjacent pieces shall not exceed 1/8 inch (3.2 mm), and, at a minimum of 80 percent of the interfaces between pieces, the pieces shall be touching.

10.6 The individual pieces of the core foam section shall be of the same type foam material, and from the same manufacturer as the top and bottom foam sections.

PERFORMANCE

11 General

11.1 In addition to complying with the tests specified in Sections 11 – 18, the cushion shall comply with the tests specified in 7.7 – 7.14 and 8.7.

12 Buoyancy Test

12.1 The total buoyancy provided by either a complete cushion or its inserts (see Table 12.1) shall be not less than 20 pounds-force (89 N), or for a cushion employing foam buoyant material, the value determined according to the following equation:

$$B_t = (16.40) \sum_{i=1}^{N} \frac{P_i}{\frac{3C_i}{100} - 2}$$

in which:

B_t is the total buoyancy required for the cushion, in pounds-force;

P_i is the fraction of buoyancy provided by the ith material to the total buoyancy of the cushion;

C_i is either the C factor for the ith material as determined in accordance with the requirements in the Standard for Components for Personal Flotation Devices, UL 1191, or 94 if the C factor is 94 or more; and

N is the number of materials used in the cushion.

Table 12.1
Condition for buoyancy test

Type of device	Test only	
	Assembled cushion	Inserts
Kapok or fibrous glass filled		X
Foam, cloth covered		X
Foam, dip coated	X	

12.2 The combined total buoyancy of the top and bottom sections of a cushion composed of scrap foam shall be at least one-third of the total cushion buoyancy.

12.3 The total buoyancies indicated in 12.1 and 12.2 are to be determined:

a) Immediately after the device is completely submerged and all entrapped air is removed; and

b) After complete submergence for 24 hours.

12.4 The test results are to be corrected to an atmospheric pressure of 29.92 inches Hg (101 kPa) and a temperature of 15.6°C (60°F).

12.5 Buoyancy tests are to be conducted in a test tank of fresh water that can be secured against change of water level or disturbance of the cushions being tested. When the cushion uses a protective cover over the buoyant material, the test is to be conducted with the covering slit in three places on each

side. Each slit is to be at least 6 inches (152 mm) long and not more than 2 inches (50.8 mm) apart so as to release all entrapped air.

12.6 A wire mesh basket or other container of sufficient size to hold the sample(s) without unduly compressing the material is to be ballasted with sufficient weight to completely submerge the basket and sample.

12.7 The ballasted basket is to be suspended from a scale calibrated to an accuracy of ±1/2 ounce (±14.2 g), and the underwater weight of the submerged apparatus recorded.

12.8 The sample(s) is to be placed in the basket so that its upper surface will be not less than 2 inches (50.8 mm) below the water surface and remain submerged for 24 hours.

12.9 The buoyancy furnished by the sample(s) is to be computed by subtracting the submerged weight of the ballasted basket and test sample from the submerged weight of the ballasted basket alone.

13 Tensile Test

13.1 The cushion shall support, without breakage of the grab straps, a weight of 150 ±5 pounds-mass (68 ±2.3 kg) for 10 minutes.

13.2 The cushion is to be rigged as a link in a hoist by suspending the cushion from a cable actuated by a winch by means of a 3 inch (76.2 mm) wide foam-covered strap passed over one end of the grab strap. A 150 ±5 pound (68 ±2.3 kg) mass is to be secured to the opposite end of the grab strap and the assembly is then to be raised until the weight clears the floor. It is to be held in this position for 10 minutes.

14 Insert Envelope Seam Strength Test

14.1 A 1 inch (25.4 mm) wide sample of the seam of the envelope shall withstand an 8 pound-force (35.6 N) pull for 15 seconds without separation.

14.2 A sample consisting of a 1 inch (25.4 mm) wide strip cut across and perpendicular to the seam is to be cut from a complete envelope. The sample is to be secured at each end by a clamping device having jaws not less than 1 inch (25.4 mm) wide and subject to the required pull for 15 seconds.

15 Throw Test

15.1 The throwing range of a cushion shall be comparable to that of a standard reference device when tested by six subjects as specified in 15.3.

15.2 Cushions of USCG approved design need not be tested for compliance with 15.1.

15.3 The test device is to be compared to a standard kapok boat cushion, when each is thrown, in turn, in three alternating sequences by six test subjects. Each subject is to throw the device toward a specified target 40 feet (12 m) away. The distance of the cushion from the target is to be measured on each throw. The test device shall be capable of being thrown

a) Closer to the target than the reference device; or

b) Within 1 foot (0.3 m) of the same location to which the reference device is thrown.

This is to be determined by averaging the distances of the test device from the target, averaging the distances measured for each thrower, and then comparing them with the corresponding distances of the reference device.

16 Release Test

16.1 To determine compliance with the Exception of 5.3, a cushion provided with hook and pile fastener tapes or the equivalent shall release from the dead weight and float free when subjected to the test specified in 16.2.

16.2 Either the hook or pile fastener tape is to be permanently attached to the cushion. The mating fastener tape is to be attached by adhesive, or similar means, to a flat surface of a dead weight that has a hydrostatic weight greater than the buoyant force of the cushion. The flat surface area of the dead weight is to be greater than the surface area of the attachment surface of the cushion. With the assembly in a horizontal attitude and with the cushion topside, the assembly is to be gently lowered into a pool of water until fully submerged. The test is to be repeated in the vertical attitude.

17 Temperature Tests

17.1 General

17.1.1 Special approval cushions shall withstand exposure to the High Temperature Test and the Low Temperature Test as evidenced by compliance with the requirements of the Tensile Test, Section 13, within 30 seconds following each of the Temperature Tests.

17.2 High temperature test

17.2.1 The cushion is to be placed in a chamber and maintained at a constant temperature of 60 ±2.8°C (140 ±5°F) for 24 hours. The cushion shall then be subjected to the Tensile Test, Section 13.

17.3 Low temperature test

17.3.1 The cushion is to be placed in a chamber and maintained at a constant temperature of minus 17.8±2.8°C (minus 0 ±5°F) for 24 hours. The device is then to be removed and subjected to the Tensile Test, Section 13.

18 Flame Exposure Test

18.1 A cushion shall support a mass of 112.5 ±1 pounds (51 ±0.5 kg) for 10 minutes following a 2 second exposure to flames produced by burning n-heptane .

18.2 The test pan is to be 12- by 18- by 2-1/2 inches (305- by 457- by 64-mm).

18.3 The test is to be conducted in an essentially draft-free area.

18.4 One-half inch (12.7 mm) of water is to be put in the bottom of the test pan, followed by enough n-heptane to make a minimum total depth of 1-1/2 inches (38.1 mm). The n-heptane is to be ignited and allowed to burn freely for 30 seconds before the cushion is inserted.

18.5 The cushion is to enter and pass through the flames with the bottom 9 inches (229 mm) above the top edge of the test pan. The 2 second timing is to start as soon as the leading edge of the sample is touched by the flames and stopped as the trailing edge leaves the flames.

18.6 If the cushion is burning upon emergence from the flame, 6 seconds are to elapse before extinguishing the flames with water.

18.7 The cushion shall then comply with the requirements of the Tensile Test, Section 13, except that the weight used shall be 112.5 ±1 pounds-mass (51 ±0.5 kg).

19 Seam Strength Test

19.1 The strength of a sewn seam that contributes to the integrity of the cushion shall not be less than 50 pounds-force (222 N) in both the directions of greater thread count and lesser thread count.

19.2 Five samples in each of the directions of greater thread count and lesser thread count consisting of two 4 by 4-inch (102 by 102-mm) pieces of cloth used for the cushion cover are to be stitched together with a 1/2 inch (12.7 mm) wide seam. Each sample is then to be placed in the 1 inch (25.4 mm) wide jaws of a tensile tester. The tester is to be adjusted so that the separation rate of the jaws is 12 inches (305 mm) per minute.

20 Tests for Adhesive Material of Scrap Foam Cushions

20.1 General

20.1.1 After being subjected to the exposures specified in 20.2.1 – 20.4.1 in separate groups of samples, and when subjected to the Tensile Test specified in 20.5.1, a scrap foam cushion sample shall break at a point other than at the glued section.

20.1.2 Samples composed of two longitudinal sections glued together at the center are to be 1 inch (25.4 mm) wide, 5 inches (102 mm) long, and not more than 1/2 inch (12.7 mm) thick.

20.2 Air oven exposure

20.2.1 Five samples are to placed in an air oven at a temperature of 60 ±2°C (140 ±3.6°F) for 168 hours (7 days). After removal from the oven the samples are to be subjected to the Tensile Test specified in 20.5.1.

20.3 Cold chamber exposure

20.3.1 Five samples are to be placed in a cold chamber at a temperature of 18 ±2°C (64.4±3.6°F) for 168 hours (7 days). After removal from the cold chamber, the samples are to be subjected to the Tensile Test specified in 20.5.1.

20.4 Humidity chamber exposure

20.4.1 Five samples are to be placed in a humidity chamber with 90 ±5 percent relative humidity at 32 ±2°C (89.6 ±3.6°F) for 168 hours (7 days). After removal from the humidity chamber the samples shall be subjected to the Tensile Test specified in 20.5.1.

20.5 Tensile test

20.5.1 Samples conditioned as specified in 20.2.1 – 20.4.1 are to be subjected to a tensile test using a Scott Tester or the equivalent. Jaws are to be placed at either end of each sample, and separated at a rate of 20 inches per minute (8.5 mm/s). The load is to be applied until the foam section breaks.

MARKINGS

21 General

21.1 Each cushion shall be permanently and clearly marked in accordance with Table 21.1 in waterproof lettering which can be read at a distance of 2 feet (0.61 m).

Table 21.1
Marking

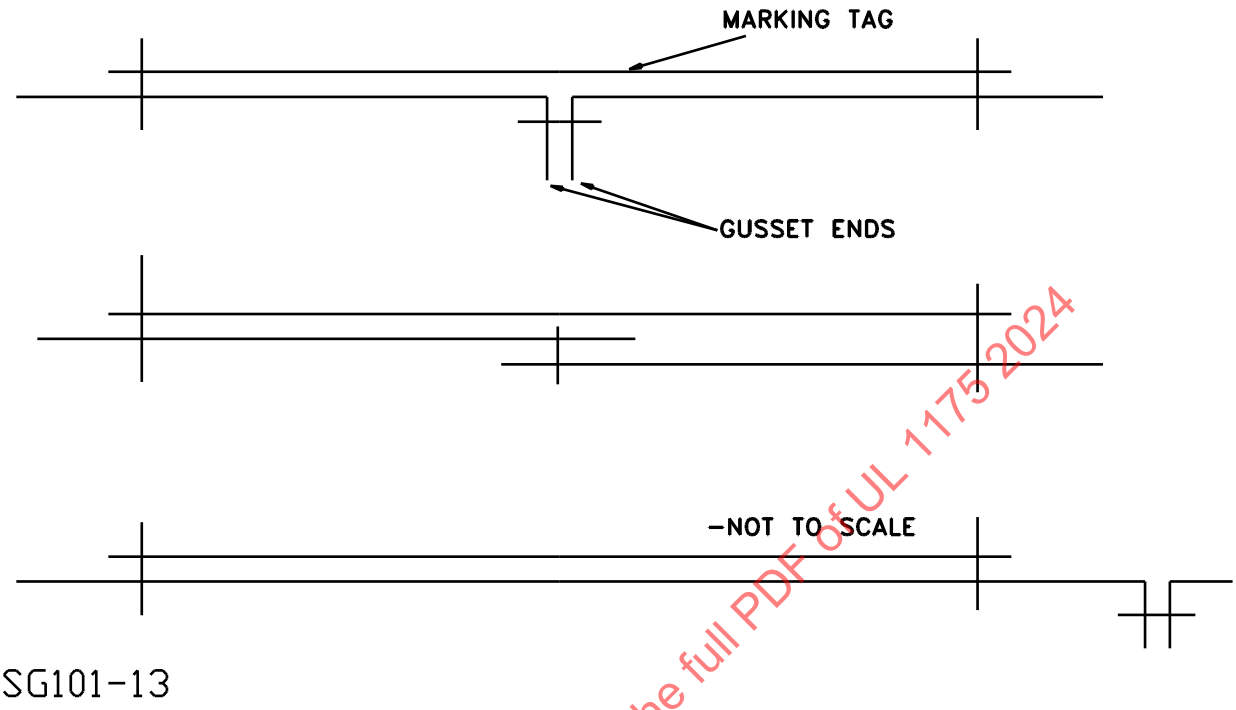
A.	"Throwable Device – TYPE IV PFD."
B.	"INSPECTED AND TESTED IN ACCORDANCE WITH U.S. COAST GUARD REGULATIONS."
C.	"WARNING: DO NOT WEAR ON BACK."
D.	"APPROVED FOR USE ON RECREATIONAL BOATS LESS THAN 16 FEET IN LENGTH AND ALL CANOES AND KAYAKS, AND ONLY AS A THROWABLE DEVICE ON ALL OTHER RECREATIONAL BOATS."
E.	"DRY OUT THOROUGHLY WHEN WET."[a]
F.	"U.S. COAST GUARD APPROVAL NO. 160.048/XXX/X (OR 160.049/XXX/X)."
G.	"MODEL (Number or Designation)."
H.	"LOT (Number)."
I.	NAME AND ADDRESS OF MANUFACTURER OR PRIVATE LABELER.
J.	The size: Length, width, and thickness in inches; both top and bottom lengths for trapezoidal cushions.
K.	"(Name of buoyant material) provides a minimum buoyant force of 20 lb."
L.	The following or equivalent wording: "There is a potential for buoyancy loss depending on how this device is used and cared for. The in-water performance of this device should be tested at the beginning of each season to determine that it provides adequate personal flotation." In addition, cushions utilizing kapok or fibrous glass buoyant material shall be marked:
M.	"IF PADS BECOME WATERLOGGED, REPLACE DEVICE."
N.	"DO NOT PUNCTURE OR SNAG INNER PLASTIC COVER."

[a] Applies to textile material only.

21.2 Fabric covered devices shall be marked with a waterproof ink, printed fabric label stitched on four edges to gusset at any location. See Figure 21.1. Waterproof ink silk screening or printing on the surface of cotton or other porous gusset cloth may be used. Printing on perforated upholstery cloth is permitted if perforations do not pierce any letters or numerals.

Figure 21.1

Gusset joining and marking tag attachment



21.3 Vinyl-dip coated cushions shall be marked as illustrated in Table 21.1 using vinyl paint silk screened on the surface at any location.

21.4 When a manufacturer produces buoyant cushions at more than one factory, each such assembly shall have a distinctive marking to identify it as the product of a particular factory.

21.5 The marking specified in Table 21.1(C) shall be prominent, that is, it shall be printed in contrasting style, size, color, or spacing with respect to the markings specified in items A, B, D – M, and in letters at least 1/4 inch (6.4 mm) in height.

21.6 The marking specified in items A, B, and D – F of Table 21.1 and all additional markings shall be prominent with respect to the markings specified in items G – M; that is, printed in contrasting style, size, color, or spacing.

21.7 When a cushion is provided with hook and pile fastener tapes, the cushion shall be provided with the following, or the equivalent, marking: "Warning! Attach cushion to cooler top only. Do not attach cooler or cushion to boat", either on the cushion label or on a separate marking in close proximity to the label in letters that comply with 21.1.

SUPPLEMENTARY INFORMATION

22 General

22.1 Each device shall be accompanied by two informational items which shall comply with the requirements of 22.2 – 22.5, and which shall incorporate the texts of 23.2 and 23.4.

22.2 The text specified in 23.2 shall be provided in a manner such that it can be read prior to purchase of the device. The text specified in 23.4 is intended to be read after purchase.

22.3 When the device package is not transparent, the text specified in 23.2 may be printed directly on the outside of the package or may appear on a separate card so that it is legible to the purchaser, and the text specified in 23.4 shall be printed in a pamphlet enclosed in each package.

22.4 If the device package is transparent, the text specified in 23.2 shall be printed in a pamphlet enclosed in each package so that the text can be read through the package. The text specified in 23.4 shall be printed on the remaining pages of the pamphlet or on a separate pamphlet.

22.5 If the device is not provided in a package, the texts specified in 23.2 and 23.4 shall be printed in a pamphlet attached to the device.

23 Required Texts

23.1 The text in 23.2 shall be verbatim and shall conform with the location requirements of 22.2 – 22.5. The illustrations provided by the manufacturer may be photographs or drawings of his own products or, where this is not possible, may be illustrations of other U. S. Coast Guard Approved PFD's. The text shall be printed in the sequence shown in 23.2. Additional information, instructions or illustrations may not be included. Minimum type size shall be 8-point.

23.2 The following text, to be readable prior to purchase, shall be provided:

"FEDERAL REGULATIONS REQUIRE PERSONAL FLOTATION DEVICES

Coast Guard regulations in Part 175 of Title 33, Code of Federal Regulations require personal flotation devices in the following three situations:

a) No person may use a recreational boat less than 16 feet in length or a canoe or kayak unless at least one personal flotation device (PFD) of the following types is on board for each person:

1) Type I PFD

2) Type II PFD

3) Type III PFD

4) Type IV PFD

b) No person may use a recreational boat 16 feet or more in length, except a canoe or kayak, unless at least one personal flotation device of the following types is on board for each person:

1) Type I PFD

2) Type II PFD

3) Type III PFD

c) No person may use a recreational boat 16 feet or more in length, except a canoe or kayak, unless at least one Type IV PFD is on board in addition to the PFD's required in (b)."

"THERE ARE FIVE TYPES OF PERSONAL FLOATATION DEVICES

This is a Type (I,II,III,IV, or V) PFD

NOTE: The following types of PFD's are designed to perform as described in calm water and when the wearer is not wearing any other flotation material (such as a wetsuit).

Type I – A Type I PFD has the greatest required buoyancy and is designed to turn most unconscious persons in the water from a face down position to a vertical and slightly backward position and to maintain the person in the vertical and slightly backward position, and, therefore, greatly increase his or her chances of survival. The Type I PFD is suitable for all waters, especially for cruising on waters where there is a probability of delayed rescue, such as large bodies of water where it is not likely that a significant number of boats will be in close proximity. This type PFD is the most effective of all types in rough water. The Type I PFD is easiest to don in any emergency because it is reversible and available in only two sizes C Adult (90 pound or more) and child (less than 90 pound) which are universal sizes (designed to fit all persons in the appropriate category).

(Illustration of Type I PFD)

Type II 7 – A Type II PFD is designed to turn the wearer to a vertical and slightly backward position in the water. The turning action is not as pronounced as with a Type I and the device will not turn as many persons under the same conditions as the Type I. The Type II PFD is usually more comfortable to wear than the Type I. This type PFD is normally sized for ease of emergency donning and is available in the following sizes: Adult (more than 90 pound), Medium Child (50 to 90 pound), and two categories of Small Child (less than 50 pound or less than 30 pound). Additionally, some models are sized by chest sizes. You may prefer to use the Type II where there is a probability of quick rescue such as areas where it is common for other persons to be engaged in boating, fishing, and other water activities.

(Illustration of Type II PFD)

Type III – The Type III PFD is designed so that the wearer can place himself or herself in a vertical and slightly backward position, and the device will maintain the wearer in that position and have no tendency to turn the wearer face down. A Type III can be the most comfortable, comes in a variety of styles which should be matched to the individual use, and is usually the best choice for water sports, such as skiing, hunting, fishing, canoeing, and kayaking. This type PFD normally comes in many chest sizes and weight ranges; however, some universal sizes are available. You may also prefer to use the Type III where there is a probability of quick rescue such as areas where it is common for other persons to be engaged in boating, fishing, and other water activities.

(Illustration of Type III PFD)

Type IV – A Type IV PFD is designed to be grasped and held by the user until rescued as well as to be thrown to a person who has fallen overboard. While the Type IV is acceptable in place of a wearable device in certain instances, this type is suitable only where there is a probability of quick rescue such as areas where it is common for other persons to be engaged in boating, fishing, and other water activities. It is not recommended for nonswimmers and children.

(Illustration of Type IV PFD)

Type V – A Type V PFD is a PFD approved for restricted use. No Type V PFD is currently approved for use on recreational boats to meet the mandatory carriage requirements listed in (a), (b), or (c) above."

23.3 The text in 23.4 shall be verbatim and shall conform with the location requirements of 22.2 – 22.5. The text shall be printed in the sequence shown in 23.4. Additional information, instructions, or illustrations may be included at the end of each paragraph, provided there is no contradiction to the text in 23.2 and 23.4.

23.4 The following text, to be readable after purchase, shall be provided:

a) "YOUR PERSONAL FLOTATION DEVICE

You are required by Federal Regulations to have at least one Coast Guard approved personal flotation device (PFD) for each person in your recreational boat. You may not use your recreational boat unless all your PFD's are in serviceable condition, are readily accessible, are legibly marked with the Coast Guard approval number, and are of an appropriate size (within the weight range and chest sizes marked on the PFD) for each person on board."

b) "WHY DO YOU NEED A PFD?

Your PFD provides buoyancy to help keep your head above the water and to help you remain in a satisfactory position in the water. The average weight of an adult is only 10 to 12 pounds in the water and the buoyancy provided by the PFD will support that weight in water. Unfortunately, your body weight does not determine how much you will weigh in water. In fact, your weight in water changes slightly throughout the day. There is no simple method of determining your weight in water. You should try the device in the water to make sure it supports your mouth out of the water. Remember, all straps, zippers, and tie tapes must be used and of course the PFD must be the proper size (size limitations are on the label)."

c) "THINGS TO CONSIDER ABOUT PFD'S

1) USCG approval of a PFD does not imply that it is ideal for all uses. For instance, there are a number of PFD's which are better suited for water skiing and others for white water canoeing and kayaking. These and other PFD's are labeled accordingly.

2) Some PFD's are more rugged and durable than others but usually cost more. You should evaluate the trade-offs of cost, your intended use, and how often the PFD will have to be replaced.

3) The use of most Type IV throwable PFD's usually requires you to grasp the device until rescued, which could prove difficult if there is an extended delay or if you are overcome by hypothermia (loss of body heat to the water). Also it implies that if you find yourself in the water there will be someone available to throw it to you."

d) "EACH OF THESE DEVICES IS INTENDED TO HELP YOU SAVE YOUR OWN LIFE

For your PFD to function properly, follow these suggestions to insure that it fits, floats, and remains in good condition:

1) Try your wearable PFD on and adjust until it fits comfortably in and out of the water.

2) Try your PFD out in the water. This will show you how it works and will give you confidence when you use it. You should be aware that your PFD may perform differently under different conditions such as in swift water, with bulky clothing, etc.

3) Mark your PFD with your name if you are the only wearer.

4) Do not alter your PFD. If it doesn't fit properly, get one that does. An altered device is no longer Coast Guard approved.

5) Your PFD is not intended for use as a fender or kneeling pad.

6) Inspect your PFD periodically to ensure that it is free of rips, tears, or holes, that the flotation pads have no leaks, and that all seams and joints are securely sewn.

7) Keep your PFD away from sharp objects which may rip the fabric or puncture the flotation pads.

8) If your PFD contains kapok, the kapok fibers may become waterlogged and lose their buoyancy after the vinyl inserts are split or punctured. When the kapok becomes hard or if the kapok is soaked with water, the PFD is no longer serviceable. It may not work when you need it and must be replaced.

9) If your PFD contains foam buoyant material, the foam may lose buoyancy from compression, water absorption, and other effects of use, to the degree that it is no longer serviceable. The in-water performance of the device should therefore be checked at the beginning of each season (more often if you subject it to frequent or very hard use) to determine that it supplies enough flotation for your needs.

10) If your PFD is wet, allow it to dry thoroughly before storing it. Store it in a well ventilated area.

11) Do not dry your PFD in front of a radiator or other source of direct heat.

12) If you must swim while wearing your PFD use a back or side stroke."

e) "PFD'S AND CHILDREN

A child is difficult to float in a safe position because of the distribution of body weight and because a child tends to panic when suddenly in an unfamiliar environment. The violent movement of the arms and legs in an attempt to "climb out" of the water tends to nullify the stability of the PFD. An approved device will keep a child afloat, but not always in a face up position. A child should be taught how to put on the device and should be allowed to try it out in the water. It is important that the child feels comfortable and knows what the PFD is for and how it functions. Parents should note, however, that PFD's are not a substitute for adult supervision."

f) "WEAR YOUR PFD

Your personal flotation device won't help you if you don't have it on. If you don't choose to wear it at all times, you should keep it handy and put it on when heavy weather threatens, or when danger is imminent. Don't wait until it is too late; nonswimmers and children especially should wear their PFD's at all times when on or near the water."

g) "HYPOTHERMIA

Hypothermia, the loss of body heat to the water, is a major cause of deaths in boating accidents. Often the cause of death is listed as drowning; but, most often the primary cause is hypothermia and the secondary cause is drowning. After an individual has succumbed to hypothermia, he will lose consciousness and then drown. The following chart shows the effects of hypothermia:

Water temperature (Degrees Fahrenheit)	Exhaustion or unconsciousness	Expected time of survival
32.5	Under 15 min.	Under 15 to 45 min.
32.5 to 40	15 to 30 min.	30 to 90 min.
40 to 50	30 to 60 min.	1 to 3 hrs.
50 to 60	1 to 2 hrs.	1 to 6 hrs.
60 to 70	2 to 7 hrs.	2 to 40 hrs.
70 to 80	3 to 12 hrs.	3 hrs. to indefinite
Over 80	Indefinite	Indefinite

PFD's can increase survival time because of the insulation they provide. Naturally, the warmer the water, the less insulation one will require. When operating in cold water (below 40°F), consideration

should be given to using a coat or jacket style PFD as they cover more of the body than the vest style PFD's.

Some points to remember about hypothermia protection:

1) While afloat in the water, do not attempt to swim unless it is to reach a nearby craft, fellow survivor, or a floating object on which you can lean or climb. Unnecessary swimming increases the rate of body heat loss. In cold water drownproofing methods that require putting your head in the water are not recommended. Keep your head out of the water. This will greatly lessen heat loss and increase your survival time.

2) Keep a positive attitude about your survival and rescue. This will improve your chances of extending your survival time until rescue. Your will-to-live does make a difference!

3) If there is more than one person in the water, huddling is recommended while waiting to be rescued. This action tends to reduce the rate of heat loss and thus increase the survival time.

4) Always wear your PFD. It won't help you fight off the effects of hypothermia if you don't have it on when you go into the water."

h) "REMEMBER – SAFE BOATING IS NO ACCIDENT

If you need more information about PFD's and safe recreational boating, contact your state boating authority, U. S. Coast Guard Auxiliary, U. S. Power Squadron, Red Cross, or your nearest unit of the U. S. Coast Guard."

SUPPLEMENT SA – INFLATABLE BUOYANT CUSHION

SA1 Scope

SA1.1 The requirements in this supplement cover inflatable buoyant cushions.

SA1.2 The buoyant cushions covered by these requirements are intended for USCG approval under 46 CFR 160.049.

SA1.3 An inflatable buoyant cushion device shall have both an oral inflation and manual-automatic inflation system with single point status indication viewable in the packed condition without the necessity of unpacking the device.

SA1.4 These devices shall comply with requirements specified in Sections 2 – 5, 12 – 13, 15 – 18 except as modified or superseded by the requirements within this Supplement.

SA2 Glossary

SA2.1 For the purpose of this Standard, the following definitions apply in addition to the definitions in Section 6.

SA2.2 DESIGN INFLATION RANGE – The range of buoyancy and pressure, as specified by the manufacturer, to which a compartment may be inflated to provide the intended in-water performance.

SA2.3 INFLATABLE COMPARTMENT – A shamber that is inflated by a gas or other medium through an automatic, manual-auto, manual, or oral inflation system.

SA2.4 INFLATION SYSTEM – A means of inflating one or more compartments to make the device buoyant or more buoyant on demand, either actively or passively of the wearer's action, dependent on its type as follows:

a) AUTOMATIC INFLATION SYSTEM – A system that activates to inflate one or more compartments upon immersion in water without any action by the user (a passive system), and which has no provision for manually actuated inflation.

b) MANUAL-AUTO INFLATION SYSTEM – A system that activates to inflate one or more compartments upon immersion in water without any action by the user (a passive system) but which also has provision for being activated by a single deliberate user action, such as by the pulling of a lanyard.

SA2.5 ORAL INFLATION SYSTEM – A means for a user to blow air into a compartment by mouth.

SA2.6 SERVICEABILITY – The ease with which the inflation system mechanism can be properly rearmed. Use Code 1F inflation systems have the most stringent serviceability requirements, with Use Code 2F and 3F systems having correspondingly less stringent requirements.

SA2.7 SERVICEABLE – Acceptable for continued use (e.g. exhibits no signs of functional deterioration such as deformation of hardware, a rip or tear, a loose seam, indicators not functional, oral inflation tube blocked or detached, manual inflator trigger detached, or the like).

SA2.8 STATUS INDICATOR – The part or parts of an inflation system which provide user feedback to assist in keeping an inflatable buoyant cushion in an armed and ready condition. Use Code 1F inflation systems have the most stringent status indicator user recognition requirements, with Use Code 2F and 3F systems having correspondingly less stringent requirements.

SA2.9 UNINFLATED – A device with the chamber(s) deflated and in the packed condition.

CONSTRUCTION

SA3 Inflatable Devices

SA3.1 Components used in a device covered by this supplement shall comply with the applicable requirements in the Standard for Components for Personal Flotation Devices, UL 1191.

SA3.2 Inflation systems used in the inflatable cushion shall have a Use Code of 1F. All other structural components shall have a Use Code of 4.

SA3.3 The cut ends of woven or braided components and construction features shall be turned under and stitched, or the equivalent, so as not to ravel. Synthetic materials such as webbing and lacing may be heat-sealed in lieu of being turned under.

SA3.4 The construction and assembly of an inflatable device shall be designed to minimize the likelihood of inflation compartments, and other device components whose positioning within the device are critical to the performance of the device, from becoming bunched, knotted, tangled, dislocated, or otherwise rendered inoperative.

SA3.5 The construction and assembly of an inflatable device shall be designed to minimize the likelihood of inflation compartments being abraded or otherwise damaged by adjacent components such as the inflation system.

SA3.6 The arrangement of an inflatable device shall acceptably reduce the likelihood of snagging, such as by providing means to secure the free ends of body straps and the like.

SA3.7 An inflatable compartment shall be provided with means to be deflated, which may be integral with or separate from any inflation system provided for the compartment. The deflation means shall be located and arranged to:

a) Be easily operated by either hand without the use of tools;

b) Reduce the likelihood of unintentional operation;

c) Self-seal after operation and permit re-inflation of the compartment; and

d) Not be lockable in an open position.

SA3.8 If one or more compartments experience significant dimensional changes between the minimum and maximum pressure values of the design inflation range, the tests specified in Section SA6 are to be repeated with the inflation compartment(s) inflated to a sufficient number of buoyancy/pressure values within the design inflation range to demonstrate compliance with these requirements over the entire design pressure range.

SA3.9 Only a lock-type stitching or redundant chain stitching shall be used for structural sewn seams.

SA3.10 An inflatable buoyant cushion shall not provide means intended to fasten the device to a boat.

Exception No. 1: This requirement does not apply to a device provided with an owner's manual containing the text specified in SA33.2.4.

Exception No. 2: An inflatable cushion may be provided with hook and pile fastener tapes or the equivalent on the packed cushion's bottom surface when the cushion complies with the requirements specified in the Release Test, Section 16.

SA4 Buoyancy

SA4.1 The total buoyancy of an inflatable buoyant cushion shall not be less than 20 lbf (89 N), when tested in accordance with Section SA9. Inherently buoyant foam, when used to meet the Uninflated Buoyancy Test, shall not be counted towards the total buoyancy provided by the device.

SA4.2 The device shall remain afloat for 15 minutes when tested in accordance with Section SA10. Inherently buoyant foam, when used to meet the Uninflated Buoyancy test, shall not be counted towards the total buoyancy provided by the device.

SA5 Inflation

SA5.1 Inflatable buoyancy chambers shall withstand an overpressure without damage or evidence of leakage when tested in accordance with Section SA18.

SA5.2 An automatic inflatable device shall inflate within 10 s when tested in accordance with Section SA6. The manual head shall not fire below 3 lbf (13 N) and shall fire between 3 and 15 lbf (13 and 67 N) when tested in accordance with Section SA7.

PHYSICAL PROPERTIES TESTS

SA6 Automatic, Manual-Auto, and Manual Inflation Test

SA6.1 When tested in accordance with SA6.2 – SA6.3 an inflatable device inflation system shall comply with the following:

a) A compartment supplied by a manual-auto inflation system shall achieve a buoyancy within its design inflation range in not more than 5 seconds from the time of manual actuation of the system.

b) Any compartment supplied by an automatic or manual-auto inflation system shall achieve a buoyancy within its design inflation range in not more than 10 seconds from the time of submergence of the device.

c) The maximum buoyancy and pressure achieved by a compartment shall not exceed the maximum values of the design inflation range.

SA6.2 For manual and manual-auto inflation systems, a sample of the device is to be mounted on a frame or equivalent. With the compartment pressure or buoyancy monitored as appropriate, the inflation system is to be manually activated and the time required for the compartment to enter the design inflation range is to be recorded.

SA6.3 Automatic and manual-auto inflation systems shall comply with the following:

a) A sample of the device is to be tested. The sample is to be placed in a wire mesh or equivalent test basket of sufficient size to hold the sample without compressing the device and which is to be ballasted with sufficient weight to permit the complete submergence of the basket and device. With the compartment pressure monitored, the inflation system is to be tested by being rapidly submerged in a tank of fresh water, and then held so that the uppermost surface of the device is at a depth of at least 51 mm (2 inches). For this test, the water in the tank is to be maintained at 20 ±1°C (68 ±2°F). The device is to be at room temperature prior to submersion.

b) Timing is to begin when the automatic mechanism strikes the water.

SA7 Manual Inflation test

SA7.1 Principle

SA7.1.1 This test is to demonstrate that the device will not be unintentionally inflated by the user, as well as will not require excessive force to inflate.

SA7.2 Apparatus

SA7.2.1 A CRE or CRT machine shall be used to determine the force to operate the manual inflation mechanism and pierce the cylinder.

SA7.3 Procedure

SA7.3.1 The device in its packed condition shall be tested at room temperature. A force starting at 2-1/4 lb (10 N) shall be applied to the pull toggle in the direction to fire the operating head as intended by the manufacturer. The force shall be increased until the head fires or 15 lbf (67 N) is reached. The force required to fire the head shall be recorded.

SA7.4 Basis for acceptability

SA7.4.1 The force required to actuate the firing mechanism shall be greater than 2.9 lbf (13 N) or less than 15 lbf (67 N).

SA8 Automatic Inflation test

SA8.1 Principle

SA8.1.1 This test is to demonstrate that the automatic inflation system will inflate when thrown to a user.

SA8.2 Procedure

SA8.2.1 A packed and ready to use device with the automatic inflation system armed shall be dropped into a tank of fresh water from a height of 6.5 ± 0.30 ft (2000 ± 100 mm). The device shall be released in an orientation that allows the automatic inflation system to enter the water last. The time required for the automatic inflation system to activate shall start once the device enters the water.

SA8.3 Basis for acceptability

SA8.3.1 The time required for the inflation system to activate shall be recorded. The time required for the inflation system to actuate shall be ≤ 5 s. The configuration of the device after inflation shall also be recorded.

SA9 Buoyancy Test

SA9.1 Principle

SA9.1.1 This test is to demonstrate if the device has adequate buoyancy.

SA9.2 Apparatus

SA9.2.1 The equipment required shall be a test basket made of wire mesh or equivalent material and of sufficient size to hold the sample without unduly compressing the device and ballasted with sufficient weight to permit the complete submergence of basket and sample, which when submerged, maintains the device at a depth of 2 to 4 inches (50 mm to 100 mm) below the water surface. The movement of the cage

shall not be restricted by contact with the side or bottom of the tank. The buoyancy shall be measured using a calibrated load cell or scale.

SA9.3 Procedure – Oral inflation

SA9.3.1 The inflatable cushion shall be inflated with air through the oral valve inflation tube to a pressure of 0.6 psi – 0 ±0.1 psi.

SA9.3.2 The device shall be enclosed in the ballasted basket and submerged in water to a depth of 2 to 4 inches (50 mm to 100 mm). The device shall then be manipulated while submerged to remove any entrapped air on the outside of the device.

SA9.3.3 Once the buoyancy has stabilized, the buoyancy shall be recorded. The device shall then remain submerged for 24 ±0.5 h.

SA9.3.4 At the conclusion of the 24 hours, the buoyancy of the device shall be measured and recorded.

SA9.3.5 The water temperature, air temperature, and atmospheric pressure shall be recorded at the start of each test and then after completion of each test.

SA9.4 Basis for acceptability

SA9.4.1 The buoyancy values shall be corrected to a temperature of 68°F (20°C) and pressure of 14.7 psi (101.325 kPa) and recorded.

SA9.4.2 The final buoyancy recorded at the conclusion of the 24 hours shall be not less than 95% of the initial stabilized buoyancy.

SA9.5 Procedure – CO_2 inflation

SA9.5.1 The device shall be inflated with CO_2 through the manifold assembly to the pressure recorded when the cushion is manually inflated using a new fully charged cylinder of the correct size.

SA9.5.2 The device shall be enclosed in the ballasted basket and submerged in water to a depth of 2 to 4 inches (50 mm to 100 mm). The device shall then be manipulated while submerged to remove any entrapped air on the outside of the device.

SA9.5.3 Once the buoyancy has stabilized, the device shall then remain submerged for 24 ±0.5 h.

Exception: The buoyancy of a device inflated with carbon dioxide need not comply with this requirement after 24 hours of submergence, if the device complies with the requirements after not less than 6 hours of submergence and is provided with a user's manual containing the information specified in SA33.2.5.

SA9.5.4 At the conclusion of the 24 hours, the buoyancy of the device shall be measured and recorded.

SA9.5.5 The water temperature, air temperature, and atmospheric pressure shall be recorded at the start of each test and then after completion of each test.

SA9.6 Basis for acceptability

SA9.6.1 The buoyancy values shall be corrected to a temperature of 68°F (20°C) and pressure of 14.7 psi (101.325 kPa) and recorded.

SA9.6.2 The total buoyancy provided shall be not less than 20 lbf (89 N).

SA10 Uninflated Buoyancy Test

SA10.1 Principle

SA10.1.1 To avoid being lost overboard if dropped in the water uninflated, inflatable cushions shall demonstrate their ability to float when dropped into water uninflated.

SA10.2 Procedure

SA10.2.1 An inflatable device, packed in its ready to use condition with full gas cylinder (or equivalent in-water weight), shall be released from a height of 6.5 ±0.3 ft (2000 ±100 mm) into water such that the inflator is closest to the water. Auto inflation shall be disabled prior to the test.

SA10.3 Basis for acceptability

SA10.3.1 After 15 minutes the uninflated device shall remain floating at the surface of the water.

SA11 Strength of Attachment Test

SA11.1 Principle

SA11.1.1 Attachments to the inflatable chambers shall be capable of withstanding a specified load without damage.

SA11.2 Procedure

SA11.2.1 The sample is to be mounted in a manner that will allow the inflation system to be tested. The uninflated device shall be then inflated to the maximum pressure of the design inflation range. A mass of 75 lb (34 kg) is to be attached to each inflation system, in turn, by means of a clamp, lacing, or the like as close as possible to the point of attachment to the device. The sample is to be freely supported and is then to be slowly raised until the inflation system completely supports the weight, and is to be maintained in this position for 5 minutes.

SA11.2.2 For an inflation system having a joint or coupling other than at the connection to the compartment, the test shall be repeated with the force exerted at a point beyond the joint or coupling. Any tubes or hoses are to be evaluated by adjusting the point of attachment to the location(s) most critical for the specific design being evaluated.

SA11.2.3 For an inflatable device having other identifiable grab points, the test is to be repeated using a mass of 30 lb (13.6 kg) applied to the grab points.

SA11.3 Basis for acceptability

SA11.3.1 For each attachment, record whether the load was supported without causing loss of function. The device shall not leak.

SA11.3.2 Inflatable devices shall remain serviceable and shall not experience a pressure loss greater than 0.4 psig (2.8 kPa) or 20 percent of the initial pressure, whichever is less.

SA12 Attachment Means

SA12.1 An inflatable device shall incorporate a grab strap or other means of providing a secure fit (as tight as possible without causing discomfort, or as tight as is consistent with the intended use).

SA12.2 Grab straps shall be permanently attached to the device using box-x stitching covering a minimum area of 0.3125 sq. inch (7.9 sq. mm) or the equivalent, such as bar-tack stitches bracketing the

same minimum area and providing equal or greater strength. Equivalent performance is to be determined based on peel and shear strength test results.

SA12.3 An inflatable device shall not provide means intended to fasten the device to a boat.

Exception No. 1: This requirement does not apply to a device provided with an owner's manual containing the following verbatim text,

"DO NOT ATTACH PFD'S TO YOUR BOAT"

Exception No. 2: This requirement does not apply to a device provided with an owner's manual containing the text specified in SA33.2.4.

Exception No. 3: An inflatable cushion may be provided with hook and pile fastener tapes or the equivalent on the packed cushion's bottom surface when the cushion complies with the requirements specified in the Release Test, Section 16.

SA13 Tensile Test

SA13.1 Principle

SA13.1.1 The inflatable device shall withstand a load via its integral structure without damage.

SA13.2 Procedure

SA13.2.1 Grab strap tensile

SA13.2.1.1 Samples are to be tested in the following conditions:

a) Opened in the uninflated condition, and

b) Inflated condition at the maximum pressure of the design inflation range.

Note: A different inflatable device may be used for each condition.

SA13.2.2 Uninflated condition

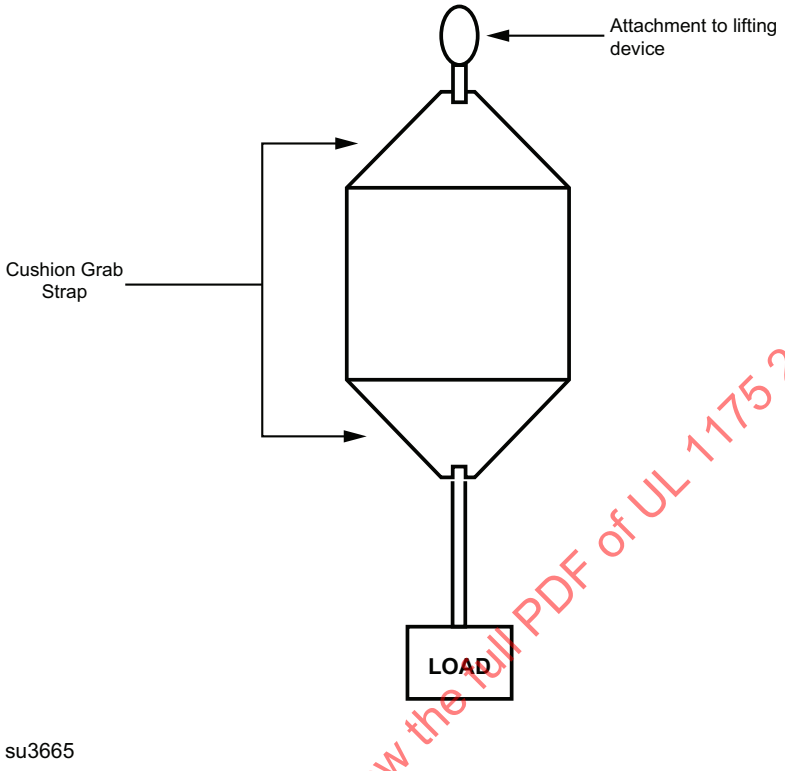
SA13.2.2.1 The inflatable device is to be suspended by means of a strap passed about a grab strap. The test load specified is to be applied by means of a second identical size strap passed about the opposing grab line or grab strap, directly opposite the point of suspension.

SA13.2.2.2 The inflatable device shall be rigged as a link in a hoist by suspending the device from a cable actuated by a winch by means of a 3 ±0.25 inch (75 ±6 mm) wide foam-covered strap passed through one end of a grab strap. A weight of 150 lb (68 kg) shall be attached to the opposite grab strap and the assembly is then to be raised until the load clears the floor as shown in Figure SA13.1. It shall be held in this position for 10 minutes.

SA13.2.2.3 The inflatable device shall be submerged and examined for any evidence of leakage after completion of the tests.

Figure SA13.1

Grab strap tensile test



SA13.2.2.4 The inflatable device shall be submerged and examined for any evidence of leakage after completion of the tests.

SA13.3 Basis for acceptability

SA13.3.1 The device shall show no signs of damage or leak when inflated to the maximum design pressure.

SA13.4 Inflated condition

SA13.4.1 The device shall be inflated to the maximum design inflation range before being tested to SA13.2.2.2 and SA13.2.2.3.

SA13.5 Basis for acceptability

SA13.5.1 The device shall show no signs of damage or leak when inflated to the maximum design pressure.

SA13.6 Grab strap to body tensile

SA13.6.1 General

SA13.6.1.1 Samples are to be tested in the following conditions:

a) Opened in the uninflated condition, and

b) Inflated condition at the maximum pressure of the design inflation range.

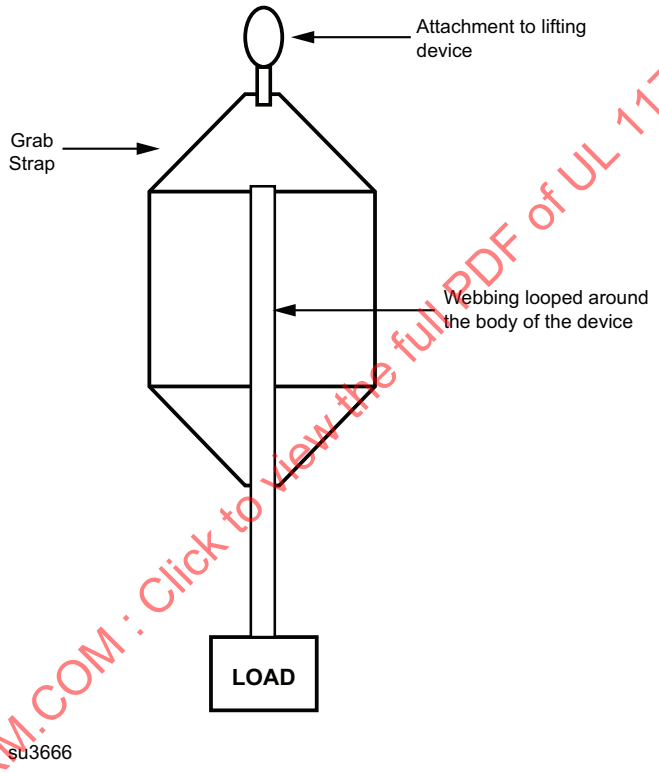
Note: A different device may be used for each condition.

SA13.6.1.2 Uninflated condition

SA13.6.1.2.1 The test load, 150 lb (68 kg), is to be applied by means of a strap passed about the grab strap and a second strap passed about the body directly opposite the point of suspension as shown in Figure SA13.2. The straps are to be 2 (-0, +1/4) inches [51 (0, +8) mm] wide and are to be covered with 1/4-inch (6.4-mm) thick closed-cell PVC or PE foam. The assembly is then to be raised until the load clears the floor. It shall be held in this position for 10 minutes.

Figure SA13.2

Grab strap to body tensile test



SA13.6.1.3 Basis for acceptability

SA13.6.1.3.1 The device shall show no signs of damage or leak when inflated to the maximum design pressure.

SA13.6.1.4 Inflated condition

SA13.6.1.4.1 The device shall be inflated to the maximum design inflation range before being tested to SA13.6.1.2.1.

SA13.6.1.5 Basis for acceptability

SA13.6.1.5.1 The device shall show no signs of damage or leak when inflated to the maximum design pressure.

SA14 Temperature Resistance / Stability Test

SA14.1 Principle

SA14.1.1 An inflatable device shall provide a minimum resistance against extreme temperatures.

SA14.2 Procedure

SA14.2.1 An inflatable device shall remain serviceable and show no evidence of inflation compartment coating transfer or delamination after exposure to high and low temperatures as specified in SA14.2.4 and SA14.2.5. For tests in the uninflated condition on a device having either a manual or automatic inflation system, after the action required to activate the inflation system, the system shall discharge and all compartments supplied by the system shall inflate to the following levels:

a) At least 50 percent of the minimum inflated buoyancy requirement in not more than 10 seconds from water immersion for Sample No. 1 evaluated in accordance with SA14.2.3.

b) At least 50 percent of the minimum inflated buoyancy requirement in not more than 5 seconds from manual activation for Sample No. 2 evaluated in accordance with SA14.2.3.

c) At least 100 percent of the minimum inflated buoyancy requirement in not more than 10 seconds from water immersion for Sample No. 1 evaluated in accordance with SA14.2.4.

d) At least 100 percent of the minimum inflated buoyancy requirement in not more than 5 seconds from manual activation for Sample No. 2 evaluated in accordance with SA14.2.4.

SA14.2.2 The action required to activate the inflation system is to be performed within 15 seconds of removal of the device from the final conditioning compartment.

SA14.2.3 Three samples are to be tested as follows:

a) Sample No. 1 is to be in the uninflated condition during exposure;

b) Sample No. 2 is to be in a loose unpacked deflated condition; and

c) Sample No. 3 is to be inflated to the maximum pressure of the design inflation range.

SA14.2.4 Samples are to be subjected to the following high to low temperature exposures:

a) Each sample is to be placed in a circulating air oven maintained at 60 ±2.8°C (140 ±5°F) for 24 hours. The samples then are to be placed in a cold compartment at minus 30 ±2°C (minus 22 ±4°F) for 24 hours. The temperature of the cold compartment is then to be raised gradually to 0 ±2°C (32 ±4°F) over a period not to exceed 24 hours.

b) Sample No. 1 is to be inflated by means of automatic actuation if provided, or manual actuation otherwise. An automatic inflation system is to be actuated by submersing the sample in fresh water at 2 ±2°C (37 ±4°F). Sample No. 2 is to be inflated using all manual inflators provided. Devices inflated using manual inflators is to be immediately immersed in fresh water at 2 ±2°C (37 ±4°F). Within 15 seconds of removal from the cold compartment, Sample No. 3 is to be reinflated to the maximum pressure of the design inflation range by means of the oral inflation system.

SA14.2.5 The same samples again are to be subjected to the procedure specified in SA14.2.4; except that the order of the exposures is to be reversed, and an automatic inflation system is to be actuated by submersing the sample in fresh water at 32 ±3°C (90 ±5°F). Prior to the exposures, Samples No. 1 and No. 2 are to be deflated, rearmed, and returned to their pretest conditions. Sample No. 3 is to be allowed to return to ambient temperature and then is to be adjusted to the maximum pressure of the design inflation range.

SA14.3 Basis for acceptability

SA14.3.1 The device shall not show any sign of damage such as shrinking, cracking, swelling, or change of mechanical properties that would impair the operation of the inflation mechanism or cause the inflation chamber to leak.

SA15 Solvent Resistance Test

SA15.1 Principle

SA15.1.1 An inflatable device shall remain serviceable after being subjected to the exposure described in SA15.2.1.

SA15.2 Procedure

SA15.2.1 A sample of the device, with any automatic inflation means disabled, is to be subjected to a series of three separate 5-minute periods of total submergence in ASTM Reference Fuel B [as described in the Standard Test Method for Rubber Property – Effect of Liquids, ASTM D471-79(R1991)], with 30-minute drying periods between submersions. After the last submergence period, the sample is to be removed from the liquid and the excess liquid allowed to run off for 5 minutes. The sample then is to be inflated to the maximum pressure of the design inflation range.

SA15.3 Basis for acceptability

SA15.3.1 The device shall not show any sign of damage such as shrinking, cracking, swelling, or change of mechanical properties that would impair the operation of the inflation mechanism or cause the inflation chamber to leak.

SA16 Flame Resistance Test

SA16.1 Principle

SA16.1.1 This test is to demonstrate that the device does not propagate flames when exposed to an external flame source.

SA16.1.2 An inflatable device shall withstand a 2-second exposure to flame as described in SA16.3.1 – SA16.3.4 without sustaining damage that may affect the intended performance.

SA16.2 Apparatus

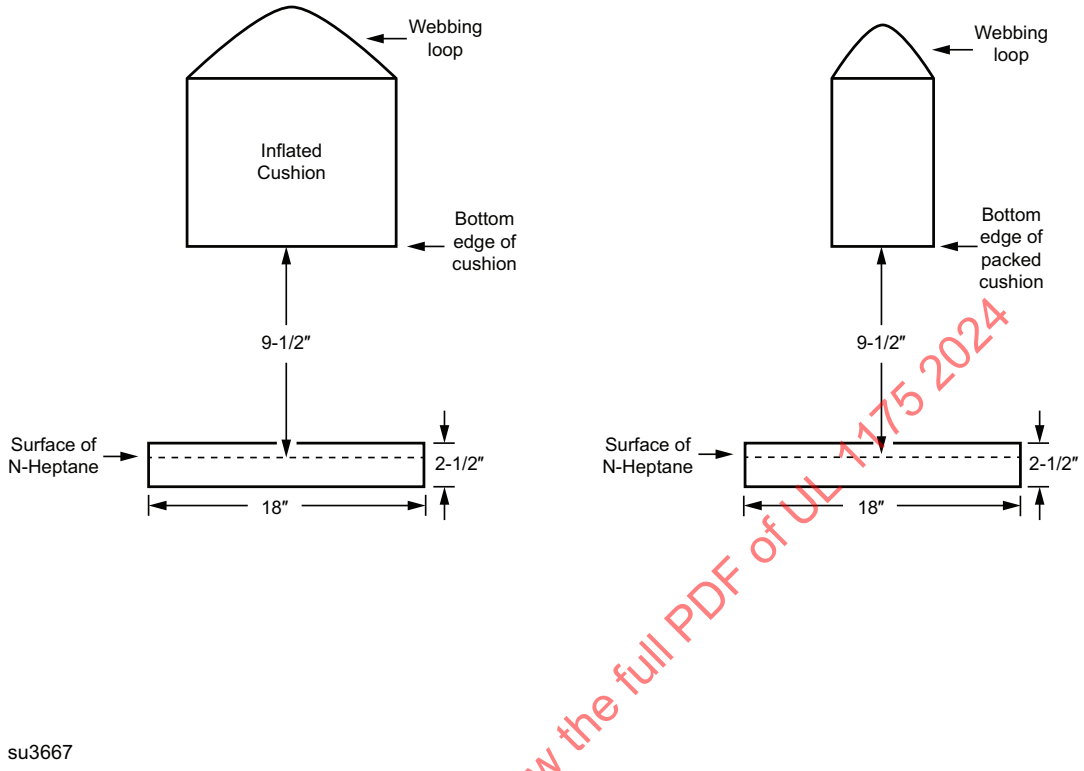
SA16.2.1 A test pan with the following dimensions, 12 ±0.75 in x 18 ±0.75 in x 2.5 ±0.20 in (305 ±20 mm x 457 ±20 mm x 63.5 ±5 mm) shall be used. The test area shall be essentially draft-free.

SA16.3 Procedure

SA16.3.1 One-half inch (12.7 mm) of water is to be put in the bottom of a test pan measuring 12 by 18 by 2-1/2 inches (305 by 457 by 63.5 mm) followed by enough n-heptane to make a minimum total depth of 1-1/2 inches (38.1 mm). The test is to be conducted in an essentially draft-free area. See Figure SA16.1.

Figure SA16.1

Fire test orientation



SA16.3.2 The n-heptane is to be ignited and allowed to burn freely for 30 seconds before the device is inserted.

SA16.3.3 Two samples of the device, one in the deflated unpacked condition and the other inflated to the maximum pressure of the design inflation range, are to be passed through the flames in an upright, vertical free hanging position and a forward direction, with the lowest portion of the device 9-1/2 inches (240 mm) above the surface of the burning n-heptane. The sample is to be passed through the flames at a rate that exposes the sample for 2 seconds. The 2-second period is to begin with the forward portion of the sample contacting the flames and is to end with the trailing portion just leaving the flames.

SA16.3.4 A sample that is burning as it emerges from the flames is to be allowed to continue to burn for 6 seconds and then extinguished with water.

SA16.4 Basis for acceptability

SA16.4.1 At the conclusion of the test, record the time of continued burning of the device and whether or not the device continued to burn after 6 s. Examine the device for physical damage and record observations. The device shall not leak when reinflated to the maximum design pressure.

SA17 Puncture Resistance Test

SA17.1 Principle

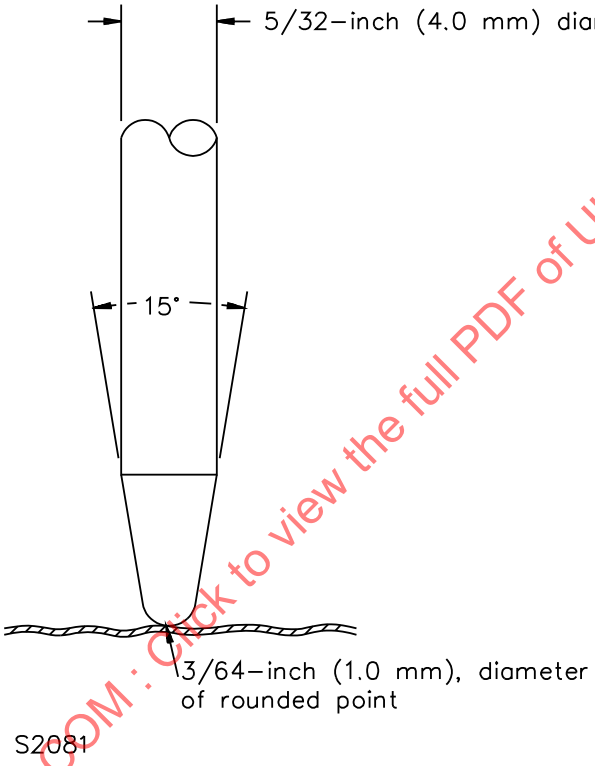
SA17.1.1 To provide adequate durability while in use, inflatable devices shall have a minimum resistance to puncture as demonstrated by being subjected to a probe representing a medium pen point.

SA17.2 Procedure

SA17.2.1 Each chamber is to be inflated separately to the maximum pressure of the design inflation range as stated by the manufacturer and placed on a smooth, flat surface. The steel test point, shown in Figure SA17.1, is to be pressed against the inflatable chamber at three different locations at a point of maximum wall separation for the compartment, perpendicular to the wall, and with a uniform speed of 6 – 12 in/min (152.4 – 304.5 mm/s) until a force 7 lbf (31 ±1 N) is attained.

Figure SA17.1

Test point



SA17.3 Basis for acceptability

SA17.3.1 Each chamber tested shall not be punctured.

SA18 Over-Pressure Test

SA18.1 Principle

SA18.1.1 The inflatable buoyancy chambers shall be capable of withstanding an internal over-pressure at ambient temperature.

SA18.2 Procedure

SA18.2.1 If provided, an over-pressure-relief valve is to be blocked or otherwise rendered inoperative. Prior to being submerged in water, the device shall be inflated to whichever of the following pressures is greatest for a period of 5 minutes:

a) Twice the maximum pressure of the design inflation range;

b) 8 psig (55 kPa); or

c) 1.2 times the pressure attained after oral inflation to 0.6 psig (4.1 kPa) followed by actuation of all automatic, manual-auto, and manual inflation systems.

SA18.2.2 After the 5 minute over-pressurization period, the device shall be submerged in water and leakage shall be monitored by evidence of streaming air bubbles.

SA18.3 Basis for acceptability

SA18.3.1 There shall be no signs of leakage.

SA19 Air Retention Test

SA19.1 General

SA19.1.1 Either Method 1 or Method 2 is to be used. Samples tested using Method 2 may be retested using Method 1 and accepted if the results of the Method 1 test are acceptable. For PFDs having more than one inflatable compartment, the Air Retention Test is to be repeated on each inflatable chamber.

SA19.2 Method 1 (Method 1 – change in buoyancy)

SA19.2.1 This test is to be conducted in a tank of fresh water. A wire mesh, or equivalent, test basket of sufficient size to hold the sample without compressing the device is to be ballasted with sufficient weight to permit the complete submergence of the basket and device.

SA19.2.2 The ballasted basket is to be suspended from a calibrated scale and the weight of the submerged basket determined.

SA19.2.3 The main inflatable compartment is to be inflated with air to the maximum pressure of the design inflation range specified. Air entrapped in folds of fabric, or the like, is to be removed from the device immediately following submersion by agitating the device by hand for at least one minute while holding below the water surface. Without removing the device from the water, the device is to be placed under the basket so that its upper surface is approximately 50 mm below the water surface. To verify that temperature equilibrium / buoyancy stabilization has been achieved, the weight of the basket, with sample is to be recorded every 15 minutes after submersion until consecutive readings are within 2 ounces of each other, at which point stabilization is considered to have been achieved. The weight of the basket with the sample is to be recorded again at least 12 hours after the initial stabilized buoyancy reading.

SA19.2.4 The temperature of the water and the barometric pressure is to be recorded at stabilization and at the end of the test.

SA19.2.5 The buoyancy of the device is to be computed by subtracting the submerged weight of the ballasted basket and device from the submerged weight of the ballasted basket alone.

SA19.3 Basis for acceptability

SA19.3.1 If during the test the water temperature is not maintained at 20 ±3°C or the barometric pressure does not remain at 101 ±1 kPa, then the initial and/or final buoyancy shall be corrected using the formulas described for the Buoyancy and Inflation Medium Retention Test, Section SA19.

SA19.3.2 Each inflatable compartment of a device shall not experience a buoyancy loss of more than 1 percent over a period of 12 hours.

SA19.4 Air retention test (Method 2 – change in pressure)

SA19.4.1 Procedure

SA19.4.1.1 The main inflatable compartment is to be inflated with air:

a) Until the Over Pressure Relief Valve (OPRV) opens, if supplied, or

b) To 12 kPa (1.7 psi), or

c) To the maximum pressure of the design inflation range specified whichever is greater.

SA19.4.1.2 As an alternative, the inflatable compartment may be inflated to 6.8 kPa or (1 psi) above the maximum pressure of the design inflation range specified. After a minimum 30 minute stabilization period, the pressure is to be measured and if necessary, adjusted to the test pressure value. This value is to be noted. If adjustment is necessary, an additional stabilization period may be conducted. The initial ambient temperature and barometric pressure is to be recorded after stabilization. At least twelve hours after the first stable reading, the final ambient temperature, barometric pressure and pressure is to be measured and recorded.

SA19.5 Basis for acceptability

SA19.5.1 If, during the test, the ambient temperature changes by more than 3°C (5°F) or the barometric pressure changes by more than 1 kPa (0.3 in Hg), the results shall be corrected using one the formulas described for the Buoyancy and Inflation Medium Retention Test with the buoyancy replaced with pressure.

SA19.5.2 Each inflatable compartment of a device shall not experience a pressure loss of more than 2.7 kPa (0.4 psi) or 20 percent (whichever was is less) of the stable pressure over a period of 12 hours. If the time exceeded 12 hours, but was less than 16 hours, the 12 hour loss is to be determined by linear interpolation. For 13.7 kPa (2.0 psi) the maximum acceptable loss is as follows:

LENGTH OF AIR RETENTION TEST	LOWEST ACCEPTABLE VALUE WHEN STARTING @ 13.7 kPa (2.0 psi)
12 Hours	11 kPa (1.6 psi)
13 Hours	10.8 kPa (1.6 psi)
14 Hours	10.5 kPa (1.5 psi)
15 Hours	10.3 kPa (1.5 psi)
16 Hours	10.1 kPa (1.5 psi)

SA20 Environmental Tests

SA20.1 General

SA20.1.1 An automatic inflation system on an inflatable device shall not actuate during exposure to water spray.

SA20.2 Procedure

SA20.2.1 The device shall comply with the following Water Exposure Test:

a) A sample of the device is to be mounted on the test stand illustrated in Figure SA20.1. The device is to be in its normal, packed configuration. A water spray is then to be applied to the device as illustrated in Figure SA20.1.

b) The water spray test apparatus is to consist of three spray heads mounted in a water supply pipe rack as illustrated in Figure SA20.2. Spray heads are to be constructed in accordance with the details shown in Figure SA20.3. The water pressure at each spray head is to be maintained at 5 psi (34.5 kPa).

SA20.3 Apparatus

Figure SA20.1

Water spray apparatus