UL 1517

STANDARD FOR SAFETY

Hybrid Personal Flotation Devices

UL Standard for Safety for Hybrid Personal Flotation Devices, UL 1517

Third Edition, Dated April 20, 2007

Summary of Topics

This revision of ANSI/UL 1517 dated October 28, 2021 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 UL'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 September 3, 2021.

No Text on This Page

APRIL 20, 2007
(Title Page Reprinted: October 28, 2021)

UL 1517

Standard for Hybrid Personal Flotation Devices

First Edition – November, 1984
Second Edition – March, 2000

Third Edition

April 20, 2007

This ANSI/UL Standard for Safety consists of the Third Edition including revisions through October 28, 2021.

The most recent designation of ANSI/UL 1517 as a Reaffirmed American National Standard (ANS) occurred on October 28, 2021. 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 UL at any time. Proposals should be submitted via a Proposal Request in UL's On-Line Collaborative Standards Development System (CSDS) at https://csds.ul.com.

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INTRODUCTION

1 Scope

1.1 These requirements cover wearable buoyant devices having:

a) At least one compartment that relies upon inflation by gas or other medium to provide buoyancy, and

b) A quantity of inherently buoyant material.

1.2 The hybrid devices covered by this standard are intended for United States Coast Guard (USCG) approval under 46 CFR 160.077 as recreational use devices.

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 Glossary

4.1 For the purpose of this standard the following definitions apply.

4.2 AUTOMATIC INFLATION SYSTEM – A system that automatically inflates one or more compartments when the buoyant device is submerged in the water, and operates independently of any action by the wearer.

4.3 BELT – A device that wraps around the torso but does not cover the shoulders or arms in the deflated condition.

4.4 CLOSURES

a) Primary – A means of securing the device onto the body so that the device can be expected to function substantially in the intended manner without the use of any other means of fastening the device onto the body.

b) Secondary – A closure that:

1) If it is the only closure that is closed on the device, does not result in the device being donned as intended; and

2) Is not usually required to be closed in order for the device to substantially comply with the requirements in this standard.

4.5 DESIGN PRESSURE RANGE – The range of pressures, as specified by the manufacturer, to which a compartment may be inflated to provide the intended in-water performance.

4.6 FACE PLANE ANGLE – The angle, relative to the surface of the water, of the plane formed by the most forward part of the forehead and chin of a wearer floating in the attitude of static balance in which respiration is least likely to be impeded.

4.7 FOAM – Closed-cell foamed polymeric material.

4.8 FREEBOARD – A distance measured perpendicularly from the surface of the water to the lowest point where the wearer's respiration may be impeded. The freeboard of a test subject in the water is measured with the subject at FRC (see 4.9) and in the attitude of static balance in which respiration is least likely to be impeded.

4.9 FUNCTIONAL RESIDUAL CAPACITY (FRC) – The amount of lung volume that a person has remaining at the bottom of the normal breathing cycle when at rest.

4.10 FULL INFLATION – A chamber inflated to any value of pressure within the design pressure range.

4.11 INFLATABLE COMPARTMENT – A container that is inflated by a gas or other medium through an automatic, manual, or oral system.

4.12 INHERENT BUOYANCY – That buoyancy provided by means that does not rely on an inflation system; that is, the buoyancy provided by inherently buoyant material.

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

4.14 JACKET – A device having sleeves.

4.15 LOCK STITCH – A stitch that will not unravel when a force is applied to any of the threads forming the stitch, such as the stitch designated as Type 301 in Federal Standard No. 751a (January 25, 1965).

4.16 MANUAL INFLATION SYSTEM – A system that inflates one or more compartments when a mechanism is actuated by a deliberate manual action on the part of the wearer, such as by the pulling of a lanyard.

4.17 ORAL INFLATION SYSTEM – A system through which a wearer exhales air to inflate a compartment.

4.18 PERFORMANCE TYPES – The intended performance of a hybrid device, when fully inflated, is classed as one of the following:

a) Type II – Turns most unconscious wearers from a face-down position in the water to a position in which the wearer's respiration is not impeded.

b) Type III – Supports a conscious wearer in an upright position in the water, and has no tendency to turn a slightly back of vertical wearer (see Figure 16.1) face-down in the water.

4.19 REFERENCE VEST – An AK-1 PFD constructed in accordance with 46 CFR 160.047 except as follows:

a) Each front insert has:

1) At least 8.25 ounces (234 g) of kapok; and

2) A total volume displacement in water that provides a buoyancy of 9.0 ±0.25 pounds-force (40 ±1 N).

b) The back insert has:

1) At least 5.5 ounces (150 g) of kapok; and

2) A total volume displacement in water that provides a buoyancy of 6.0 ±0.25 pounds-force (27 ±1 N).

4.20 SECOND-STAGE DONNING – Donning or adjustment that is required, after the device is inflated while being worn, to achieve the intended flotation characteristics.

4.21 SERVICEABLE – Exhibits no signs of functional deterioration (deformation of hardware, a rip or tear, a loose seam, or the like) sufficient to make the device unacceptable for continued intended use.

4.22 STRUCTURAL SEAM – A seam that serves a functional purpose, as distinguished from a decorative purpose.

4.23 TURNING TIME – The time required for a device to turn a face-down wearer to a position in which the wearer's respiration is not impeded.

4.24 UNIVERSAL SIZE – A size of device constructed to fit persons in the 5th through 95th percentile of the adult U. S. population with respect to height and girth.

4.25 VEST – A device that covers the shoulders but has no sleeves. A yoke-style device is considered to be a vest.

5 Components and Materials

5.1 A component of a device covered by this standard shall (see Table 5.1):

a) Comply with the requirements in the Standard for Components for Personal Flotation Devices, UL 1191, except as specified in Table 5.2; or

b) If not covered by specific requirements in UL 1191, be acceptable when investigated with respect to the application. In addition, if the USCG has specific requirements for the component, it shall comply with those requirements.

Table 5.1
Component requirements

Component	Application	Applicable UL 1191[a] (USCG) requirements
Body strap	Primary closure	Webbing, Section 7
	Secondary closure	Tie Tape and Reinforcing Tape, Section 9
Drawstrings	Secondary closure	Tie Tape and Reinforcing Tape, Section 9
Fabric	Envelope[b]	Fabrics for Wearable Devices, Section 5 (Type V)
	Cover for inflatable compartment[c]	Fabrics for Wearable Devices, Section 5 (Type V)
Foam	Buoyant material[d]	Closed-Cell Foamed Polymeric Material, Section 13
Hardware	Primary closure	Hardware, Section 10

Table 5.1 Continued on Next Page

Table 5.1 Continued

Component	Application	Applicable UL 1191[a] (USCG) requirements
Kapok	Buoyant material	(46 CFR 164.003)
Lacing	Any	Lacing, Section 8
Polymeric film	Kapok enclosure	Plastic Film for Kapok or Fibrous Glass Enclosures, Section 14
Reflective fabric or tape	Any	(46 CFR 164.018)
Survivor locating light	Any	(46 CFR 161.012)
Thread	Structural seam	Thread, Section 3
Tie tape	Secondary closure	Tie Tape and Reinforcing Tape, Section 9
Vinyl-dip coating	Any	Vinyl-Dip Coatings, Section 12
Zipper	Primary closure	Zippers, Section 11
Any material used to form an inflatable compartment		Compartment Materials for Hybrid Devices, Section 17
Any component (valve, cartridge, tube, or the like) used in an inflation system[e]		Inflation Systems, Section 18

NOTE: Not applicable to nonfunctional (decorative) components.

[a] The requirements for Components for Personal Flotation Devices, UL 1191.

[b] Does not reinforce or restrain an inflatable compartment.

[c] Also, see Abrasion Resistance Test, Section 35, of this standard.

[d] Material relied upon for compliance with the requirements in 19.1.1 of this standard.

[e] Also includes overpressure relief valves and deflation valves.

Table 5.2
Component properties

Applicable UL 1191 requirements			
Component	**Test[a]**	**Conditioning**	**Minimum required values[a,b]**
Fabric	Breaking Strength	As-received and after 100 hours of accelerated weathering	90 pounds-force (400 N) average in direction of both greater thread count and lesser thread count[c]
	Tear Strength	As-received	8.5 pound-force (38 N) in direction of both greater thread count and lesser thread count[d]
Hardware	Strength	After salt spray exposure (metal), as-received and after 100 hours of accelerated weathering and high and low temperature exposures (plastic)	225 pounds-force (1000 N)
Webbing	Breaking Strength	As-received and after 100 hours of accelerated weathering	400 pounds-force (1800 N) average

[a] Also, see 5.3 and 5.5.

[b] Also, shall retain at least 60 percent of the as-received breaking strength after accelerated weathering conditioning.

[c] A fabric used as an inner liner need only have a 70 pounds-force (311 N) average in both directions.

[d] A fabric used as an inner liner need only have a 6.0 pounds-force (27 N) average in both directions.

5.2 A component covered in Table 5.2 shall have at least the minimum properties specified in Table 5.2 when tested in accordance with the applicable specifications in the requirements for Components for Personal Flotation Devices, UL 1191.

5.3 A nonmetallic component of a hybrid device shall retain at least 40 percent of its as-received strength after being subjected to 300 hours of light and water exposure in accordance with Method I of the

Standard Practice for Operating Light Exposure Apparatus (Carbon-Arc Type) With or Without Water for Exposure of Nonmetallic Materials, ASTM G23, using apparatus designated Type D, DH, or E in ASTM G23.

Exception: This requirement does not apply to fabric used as the inner liner on the device, if the liner is protected from exposure to the weather when the device is worn as intended.

5.4 Unless inherently resistant to fungus, a nonmetallic component of a hybrid device shall retain at least 90 percent of its strength after being subjected to the mildew resistance test specified in Federal Test Method, Standard 191 (Method 5762) when untreated cotton is used as the control specimen. In addition, the gas transmission rate of the inflation chamber shall not increase by more than 10 percent. Covered materials may be tested with the covering.

5.5 A metallic component of a hybrid device shall be formed from AISI 300 or 400 Series stainless steel or other material having at least equivalent resistance to the corrosive effects of salt spray exposure.

Exception: An expendable component (for example, a gas cylinder) need not comply with this requirement, and shall be provided with a zinc or cadmium plating, or equivalently protected against corrosion.

5.6 Metals shall be used in combinations that are galvanically compatible.

5.7 An exposed edge or projection of a component shall not be sufficiently sharp to damage the material of an inflatable compartment or constitute a risk of injury to persons during intended use.

5.8 Referee measurements necessary to determine compliance with the requirement in 5.7 are to be those described in the requirements for Tests for Sharpness of Edges on Equipment, UL 1439.

5.9 Adhesive shall be a waterproof type that is acceptable for use with the materials being bonded.

5.10 Material used in the manufacture of a hybrid device shall be new.

5.11 The inherent buoyancy of a hybrid device shall be provided by either kapok or foam.

5.12 Foam shall have a V factor of 85 or more as determined in accordance with the requirements in the Standard for Components for Personal Flotation Devices, UL 1191.

Exception No. 1: This requirement does not apply to foam that is not relied upon for compliance with the requirements in Section 19, Buoyancy and Permeability Tests, when the device complies with the requirements in Sections 15, Inherent Flotation Characteristics Test and 16, Inflated Flotation Stability Test, both with and without the foam in place.

Exception No. 2: Foam may have a V factor of not less than 80 when the device complies with the requirement in 20.2.1.

5.13 The V factor (as determined in accordance with the requirements in the Standard for Components for Personal Flotation Devices, UL 1191) of foam forward of the body axis (see Figure 16.1) shall be greater than or equal to the V factor of foam aft of the body axis.

Exception: A device that complies with the requirement in 20.2.1 need not comply with this requirement.

CONSTRUCTION

6 General

6.1 The construction and assembly of a hybrid device shall be judged with respect to its intended use in addition to the requirements in this standard.

6.2 The construction of a hybrid device shall acceptably reduce the likelihood of shifting or bunching of internal materials.

6.3 Fibrous buoyant material shall be:

a) Completely encased in a flexible, sealed polymeric film; and

b) Provided in at least three separate inserts in a manner that gives a distribution similar to that of the reference vest (see 4.19).

6.4 A device shall have provision for drainage in areas that may entrap water. See Water Entrapment Test, Section 21.

7 Sizing and Arrangement

7.1 General

7.1.1 A hybrid device shall not be constructed for persons weighing 90 pounds or less.

7.1.2 A hybrid device shall be constructed to fit chest sizes within a range of at least 2 inches (51 mm). A universal size device shall be constructed to fit chest sizes within the range of 30 – 52 inches (80 – 130 cm).

7.1.3 A hybrid device shall be supplied in a ready-to-use condition. A device that employs cartridges for inflation shall be provided with at least one cartridge. A device that employs an automatic inflation system shall be provided with at least one automatic-activating device.

7.1.4 A hybrid device shall in both the deflated and fully-inflated conditions, as well as during inflation:

a) Be as comfortable, nonrestrictive of motion, respiration, and vision, and as nonbulky for the wearer as practicable, consistent with intended use.

b) Be such that the intended method of donning the device, including the second-stage donning, is obvious to an untrained person. A device designated as having Type II performance shall not require second-stage donning.

c) Incorporate strapping or other means of attachment that provides a secure fit (as tight as possible without causing discomfort). See Donning and Operability Tests, Section 13, and Jump Tests, Section 14.

7.1.5 The construction of a hybrid device shall permit the device to be partially inflated to a level that provides a total buoyancy of at least 13 pounds-force (60 N) without significantly changing the appearance, fit, or comfort of the device. For the purpose of this requirement, bulging or swelling of the device that does not cause the release of snaps holding compartment flaps or the like is acceptable.

7.1.6 Hardware shall be:

a) Arranged to facilitate operation; and

b) Attached in a manner that reduces the likelihood of improper operation.

7.1.7 The arrangement of a hybrid device shall acceptably reduce the likelihood of snagging, such as by providing means to secure the free ends of body straps and the like.

7.1.8 A hybrid device shall not provide access to inserts by means of zippers or the like, but inflatable compartments may be removable for servicing.

7.1.9 A hybrid device shall not form channels having a tendency to direct water into the face of the wearer to a degree greater than the reference vest.

7.2 Inflation systems and compartments

7.2.1 A hybrid device shall be provided with an oral inflation system for each inflatable compartment. A device designated as having Type II performance shall be provided with both an automatic and an oral inflation system.

7.2.2 Inflation systems in addition to those required by 7.2.1 may be provided.

7.2.3 The operating mechanism, actuation means, and related components of an inflation system shall be external to the inflatable compartment the system supplies.

7.2.4 An inflatable system shall be constructed to provide the required in-water performance by the device when operated as intended both:

a) Alone; and

b) In any combination with other inflation systems permitted by the construction of the device.

7.2.5 An inflation system shall be located and arranged to:

a) Be operated by either hand of the wearer in a single deliberate action (also, see 7.2.6). Moving an unsecured flap, or the like, to gain access to the actuation means is not to be considered a deliberate action. See 13.1.6.

b) Acceptably reduce the likelihood of components abrading or otherwise damaging the inflatable compartment or compartments of the device.

c) Be easily reset after use. A gas cylinder or similar (expendable or rechargeable) component shall not require the use of tools to be removed for servicing.

7.2.6 For an oral inflation system, the requirement in 7.2.5(a) applies with the device in any intended condition of inflation. In this regard, the term "operated" refers only to the action of bringing the inflation tube to the mouth (not to the act of inflating the device).

7.2.7 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 operated by either hand without the use of tools;

b) Reduce the likelihood of unintentional operation; and

c) Permit reinflation of the compartment after operation.

7.2.8 For a compartment supplied by an oral inflation system:

a) The minimum value of the design pressure range shall be not greater than 0.6 psig (4 kPa); and

b) The maximum value of the design pressure range shall be not less than 2 psig (14 kPa) or the maximum final pressure permitted by an overpressure-relief valve, whichever is less.

7.2.9 A compartment that is supplied by more than one inflation system shall be constructed so that the combined use of the systems, in any practicable sequence, does not result in a compartment pressure greater than the maximum value of the design pressure range. This may be accomplished by the provision of an over-pressure-relief valve or other equivalent means (see 29.2.1 and 29.2.2).

Exception: The pressure may be greater than the maximum value of the design pressure range, and not greater than the value at which the compartment was tested in the over-pressure test described in 29.1.1 – 29.1.4, when the device is marked and information is provided in accordance with 38.3.3 and 41.5.

7.2.10 For the purpose of the requirement in 7.2.9, it is to be assumed that an inflation pressure of 2 psig (14 kPa) will be achieved through the oral inflation system, unless limited to a lesser value by an over-pressure-relief valve (see 29.1.1 and 29.2.2).

7.2.11 An over-pressure-relief valve shall be located and arranged to acceptably reduce the likelihood of the valve becoming blocked or otherwise rendered ineffective.

7.2.12 The location and arrangement of an automatic inflation system shall acceptably reduce the likelihood of actuation from exposure to water other than that of complete submersion. See Environmental Tests, Section 32.

7.2.13 An inflation medium shall not generate compounds more toxic than carbon dioxide, including any compounds formed from reaction with water, compartment walls, or the like.

7.2.14 Window material used as a non-load bearing component for viewing the indicator(s) of the inflation system, shall comply with the requirements of Section 31.8, of the Standard for Components for Personal Flotation Devices, UL 1191.

8 Closures and Attachment Means

8.1 The cut ends of a body strap, tie tape, belt loop, or the like shall be turned under and stitched, or the equivalent, to reduce the likelihood of unraveling. Synthetic materials may be heat sealed in lieu of being turned under.

8.2 The free end of a body strap shall be provided with means to reduce the likelihood of unintentional disengagement from the hardware, such as a tab formed by box-x stitching two 1-1/2-inch (40-mm) turn unders. See 33.1 and 33.2.

8.3 A body strap shall be prevented from disengaging by means of belt loops or equivalent means that will attach at least one end of the strap to the device (the use of only a snap is not acceptable for this purpose). A belt loop used to secure a body strap to the device shall not permit the primary closure of the body strap to pass through the loop.

8.4 The width of the opening in a closure such as a buckle or dee ring shall be not more than 1/8 inch (3 mm) greater than the width of the associated webbing, as measured at the line of contact.

8.5 Hardware shall have a quick and positive lock mechanism.

8.6 A zipper shall be:

a) Easily initiated;

b) Nonjamming;

c) Right-handed; and

d) A locking type.

8.7 Drawstrings shall:

a) Be not less than 1 inch (25 mm) wide;

b) Have a positive closing mechanism; or

c) Comply with the tieability requirements for tie tapes in the requirements in the Standard for Components for Personal Flotation Devices, UL 1191.

8.8 The extended, finished length of a body strap shall be not more than 3 inches (76 mm) greater than the minimum length required to secure the device on a person having the maximum chest size.

8.9 Compliance with the requirement in 8.8 is to be determined by either of the following methods:

a) The length of each body strap is to be measured with all adjustments made to provide the maximum length. The outside circumference of the device at each strap location then is to be measured with the device fitted as intended on a subject of the maximum chest size (see 8.10). The difference between the strap measurement and the circumference measurement at the strap location shall not exceed 3 inches (76 mm).

b) The device is to be fitted as intended on a subject of the maximum chest size (see 8.10). A measurement is to be made along the means of adjustment to some reference mark on the strap. Then, with all adjustments made to provide the maximum length, a second measurement is to be made along the means of adjustment to the reference mark. The difference between the two measurements shall not exceed 3 inches (76 mm).

8.10 The subject specified in 8.9 is to be the subject having the largest chest size from the group specified in Table 12.1. The subject is to meet the qualifications specified in 13.1.4.

8.11 A hybrid device shall not provide means that may be used to fasten the device to a boat.

Exception No. 1: This requirement does not apply to the closures of the device.

Exception No. 2: This requirement does not apply to harness assemblies, or the like, intended to be attached to harness lines during activities such as boardsailing or hiking out on a sailboat, and that have been investigated and found to be acceptable for the application.

Exception No. 3: This requirement does not apply to a means that is rendered inoperative when subjected to the test described in 31.3.1.

Exception No. 4: This requirement does not apply to a device marked in accordance with 38.3.8 and provided with the text specified in 41.4.

9 Seams

9.1 A lock stitch, such as the stitch designated as Type 301 in Federal Standard No. 751a (January 25, 1965), shall be used for a structural seam formed by sewing. Also, see Seam Strength Test, Section 34.

9.2 Monofilament thread shall not be used for making structural seams.

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

9.4 A structural seam joining uncoated woven fabrics shall:

a) Be 3/4 inch (19.1 mm) wide;

b) Consist of two rows of a lock stitch; or

c) Be of a type having equivalent mechanical characteristics.

9.5 Window material attachments to the PFD shall have minimum seam strength (sewn or welded) of 53 N (12 lbs) for a 1-inch grip, in an as received condition, using the test method in Section 34, Seam Strength Test.

10 Coatings

10.1 A dip coating shall be applied smoothly and evenly and shall be free of visible blemishes. The coating may have a greater thickness at a stressed area than at an unstressed area.

10.2 A pocket comparator having a magnifying power not less than 6X is to be used to determine the uniformity of the thickness of a coating. Measurements are to be made at each of the following locations, as applicable:

a) At the top of one armhole;

b) At the bottom of one armhole;

c) On the left side of the neck edge;

d) On the right side of the neck edge;

e) On the left front panel near the lower center front;

f) On the right front panel near the lower center front; and

g) On the lower edge at the center back.

Three readings are to be taken at each location, and the average of the three readings is to be considered the thickness for that location.

PERFORMANCE

GENERAL

11 Configurations for Tests

11.1 Representative samples of a hybrid device shall be subjected to the applicable tests described in Sections 12 – 32. Components or material specimens are to be used for the tests specified in Sections 33 – 35.

11.2 A device having an optional feature, such as a harness assembly, is to be tested both with and without the use of the feature.

11.3 A device is to be tested in conditions of inflation as specified in Table 11.1. For tests involving inflation of the compartments of a sample to specific pressures, the inflation systems provided on the device may be modified to permit external pressurization, measurement of pressure, and the like.

Table 11.1
Inflation conditions for tests

Test	Deflated[a]	Inflated
Donning and Operability Tests, Section 13		
Deflated donning and operability	D[b]	
Inflated donning		M
Jump Tests, Section 14	D	M[c]
Inherent Flotation Characteristics Test, Section 15	D[d]	
Inflated Flotation Stability Test, Section 16		d
Water Emergence Test, Section 17		e
Operation Force and Inflation Pressure Test, Section 18	D[b]	
Buoyancy and Permeability Test, Section 19		
Inherent buoyancy	D	
Inflated buoyancy and permeation loss		f
Distribution Tests, Section 20		
Buoyancy	D	
Loss	D	
Water Entrapment Test, Section 21	D	
Tensile Tests, Section 23	D[g]	M[h]
Temperature Cycling Tests, Section 24	D[g]	M
Solvent Exposure Test, Section 25	D[g]	
Flame Exposure Test, Section 26	D[g]	M
Abrasion/Compression Test, Section 27	D[g]	
Puncture Resistance Test, Section 28		M
Over-Pressure Tests, Section 29		
Device		i
Over-pressure relief valve		k
Air Retention Test, Section 30		M
Strength of Attachment Tests, Section 31		
Inflation systems	D[g]	M
Pull	D[g]	
Environmental Tests, Section 32	D	

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Table 11.1 Continued

Test	Deflated[a]	Inflated
Note: Upper-case letters in this table refer to the following: D – Tested or conditioned in deflated condition. M – Maximum value of the design pressure range. [a] A vacuum of not greater than 0.1 psig (0.7 kPa) may be applied to a compartment to obtain complete deflation. [b] Initially. [c] See 14.3.1. [d] See 16.1 and 16.2. [e] See 17.4. [f] See 19.3.1. [g] Followed by inflation to maximum pressure. [h] Not required if portions of the device that will be stressed do not change under conditions of intended inflation. [i] Twice the maximum value of the design pressure range or 8 psig (55 kPa), whichever is greater. [j] See 29.2.2.		

USE TESTS

12 General

12.1 For the tests described in Sections 13 – 17, human test subjects as specified in Table 12.1 are to be employed. Each subject is to be wearing a swimsuit; except when the attire customary to the designated purpose of the device may adversely affect the test results, the tests are to be repeated with at least one subject wearing such attire. A subject shall not be familiar with the particular device under test, but may be familiar with PFDs in general. Unless specifically indicated otherwise, a subject is not to make adjustments to a device after donning is completed.

Table 12.1
Test participant selection

Chest size adjustment range of device, inches (mm)	Number of test participants
6 (150) or less	6
More than 6 but not more than 12 (300)	12
More than 12 (300)	18
NOTES: 1) Test participants selected are to be of varying height and weight so as to represent endomorphic, mesomorphic, and ectomorphic anatomic builds. The chest sizes of the subjects are to be within the intended chest size range of the device; except one subject having a chest size 1 ±0.5 inch (25 ±13 mm) larger than the marked maximum size, and one subject shall have a chest size 1 ±0.5 inch smaller than the marked minimum size. 2) May be any combination of males and females, provided that at least one male and one female are used. 3) For each set of six test participants, in the group, three of the participants are to be as follows: a) One having an in-water weight of less than 7.5 pounds (3.4 kg); b) One having an in-water weight of at least 10.5 pounds (4.9 kg), but less than 11 pounds (5.0 kg); and c) One having an in-water weight of at least 11 pounds.	

Table 12.1 Continued on Next Page

Table 12.1 Continued

Chest size adjustment range of device, inches (mm)	Number of test participants
4. Should a test participant having a chest size 1 ±0.5 inch (25 ±13 mm) smaller than the marked minimum size be unavailable, a test participant having the required chest size and a weight of 80 lbs. (36.4 kg) or more may be used to demonstrate acceptable performance of the device. However, should the candidate device perform unacceptably on such a participant, it shall not constitute failure of the device to comply with the requirements of this Standard, and another participant shall be selected.	
5. A youth test participant may be used to satisfy specific anthropomorphic characteristics for weight, chest size, or girth of an adult-size device. When testing an adult-size device, when the youth is less than 13 years of age, his or her test results may be excluded for Donning and Operability Test, Section 13; Jump Tests, Section SA6; or In-Water Removal Test, Section SA9 due to the participant's inherent limitations in dexterity, strength, and maturity. For an adult-size device, where the results for a youth test participant are excluded, a substitute test participant shall be used for the excluded test. The substitute participant shall have anthropomorphic characteristics within the candidate devices specified range, that are similar to, and not necessarily identical to the excluded participant.	

12.2 With reference to note c to Table 12.1, the in-water weight of a subject is to be determined as follows (see Figure 12.1):

a) The subject is to be placed in an assembly that does not restrict the subject's breathing, and the assembly attached to a scale. The subject then is to be immersed in a pool of fresh water until the tips of the chin and ear lobes touch the surface of the water.

b) The weight at FRC for each of ten normal breathing cycles of the subject then is to be recorded to the nearest 1/4 pound (0.11 kg). The in-water weight of the subject is to be as follows:

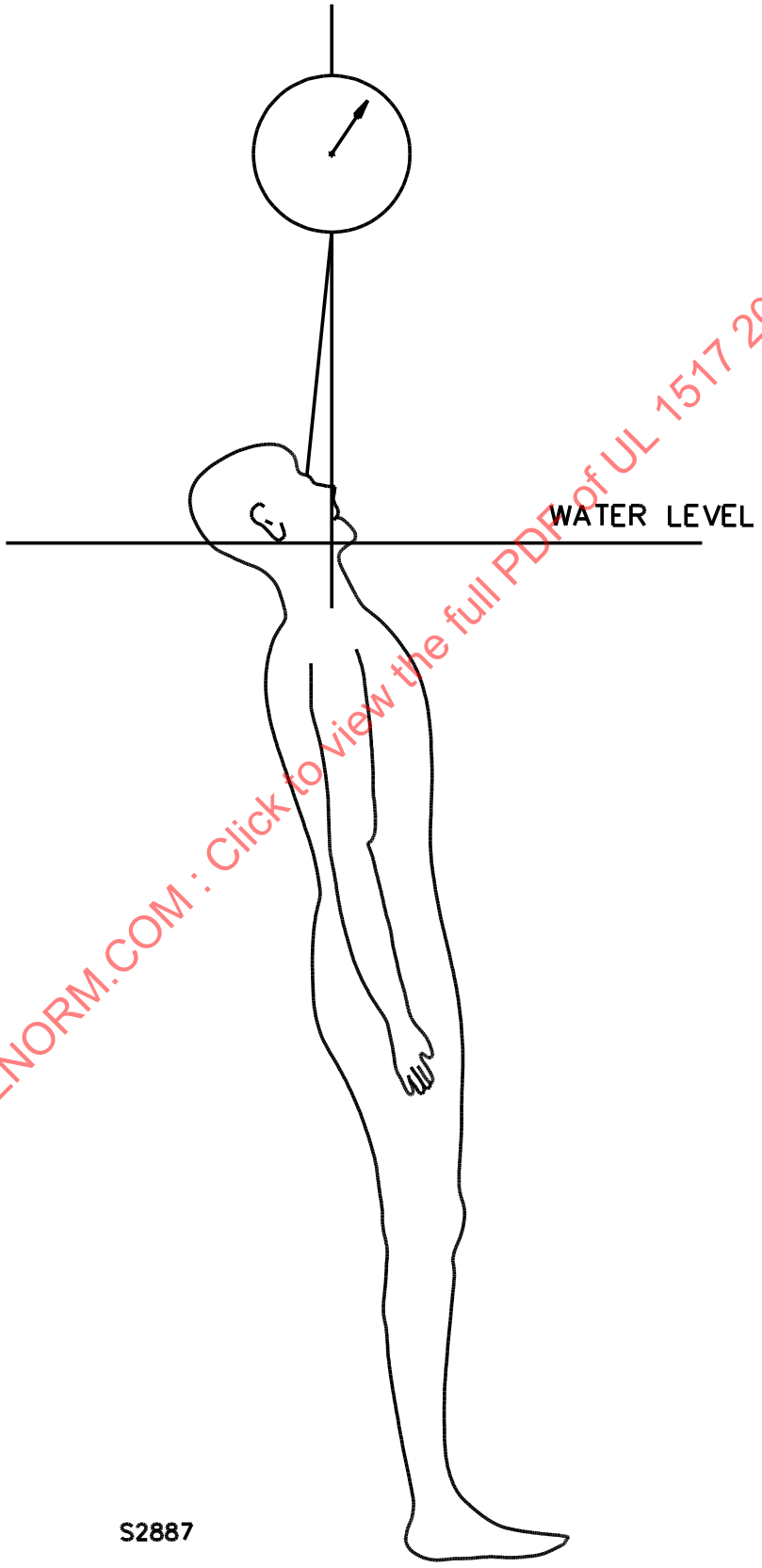
1) The maximum value of observed weight if the value is observed more than once;

2) The second-highest observed weight if this value is observed more than once and the criteria specified in (a) is not satisfied; or

3) The third-highest observed weight when neither the criteria specified in (a) or (b) are satisfied.

Figure 12.1

In-water weight measurement



12.3 Automatic inflation systems on samples of a hybrid device are to be rendered inoperative prior to being subjected to the tests described in Sections 13 – 17.

13 Donning and Operability Tests

13.1 Deflated donning and operability test

13.1.1 Complete donning (including any second-stage donning required), adjustment to a secure fit [see 7.1.4(c)], and full inflation shall be accomplished within 1 minute by each test subject when a hybrid device is tested as described in 13.1.2 – 13.1.5. Each inflation system shall be accessible by either hand of each subject with the deflated device donned and adjusted. In addition, the deflation mechanism and oral inflation system shall be accessible by either hand of each subject with the device donned, adjusted, and inflated.

13.1.2 The deflated device is to be given to the subject at pool side with the instruction "Please don as quickly as possible, adjust to fit snugly, and inflate." The donning attempt then is to be timed. All size adjustments are to be at the halfway point when the device is given to the subject.

13.1.3 When the subject, because of lack of familiarity with the device, is not able to adjust the device to fit or inflate the device within the specified time limit, the subject is to enter the water and be tested with the device as donned. The breathing of the test subject shall not be impaired and the test subject shall show no tendencies to turn face down or the like in the water. Then, the subject is to exit the water and be given the written instructions from the owner's manual regarding the proper donning technique. The procedure specified in 13.1.2 is then to be repeated.

13.1.4 When donning, adjustment, and full inflation of the hybrid device on a subject is not achieved within 1 minute after the instructions specified in 13.1.3 have been given, the test is to be repeated by the subject with a reference vest. When the reference vest is not donned and adjusted within 45 seconds, the subject is to be disqualified and replaced.

13.1.5 When, after 1 minute has elapsed, the subject is still making efforts to inflate the device, the subject's efforts are to be halted and the test specified in 14.3.1 and 14.3.2 conducted with the device in the condition achieved after the 1 minute.

13.1.6 Following each successful donning attempt, the accessibility by either hand of the wearer to each inflation system and each deflation mechanism is to be verified.

13.2 Inflated donning test

13.2.1 Donning and complete adjustment of an inflated device to a secure fit, including reinflation if necessary, shall be accomplished within 2 minutes by each test subject when a hybrid device is tested as specified in 13.2.2 and 13.2.3.

13.2.2 This test is to be conducted after the test specified in 13.1.1. A sample of the device is to be prepared as described in 13.1.2, after which compartments provided with manual or automatic inflation means are to be inflated using the means provided. The device is then to be given to the test participant with the instruction

"Please don as quickly as possible, adjust to fit snugly, and say "finished" once donning is completed." Further instructions are not to be given. If partial deflation is used to ease donning, the participant is to be instructed to orally reinflate the device until it is firm.

13.2.3 If donning, adjustment, and reinflation (if required) of the hybrid device on a test participant is not achieved within 2 minutes after the instructions specified in 13.2.2 have been given, the test participant is

to be given a maximum of 2 minutes to review the written and pictogram donning instructions provided by the manufacturer and the test is to be repeated.

14 Jump Tests

14.1 General

14.1.1 When tested as described in 14.2.1 – 14.3.2, a hybrid device shall:

a) Not present a risk of injury to persons;

b) Not be damaged;

c) Maintain its intended use position on each subject; and

d) Not tend to turn any subject face down.

14.2 Deflated device

14.2.1 Each subject is to don and adjust a deflated device prior to water entry (as specified in 13.1.2, but without inflating the device). After donning, secondary closure fabric belts and drawstrings that the subject has adjusted to obtain a fit are to be loosened.

14.2.2 Each subject is to jump feet first into a test pool from a height of 3 feet (0.91 m) while holding both hands above the head with arms extended. Before jumping, each subject is to be instructed that after surfacing, the device may be pulled down and tightened in order to see or breathe more easily.

14.2.3 The device is to be considered in the intended use position if:

a) The subject's arms are not trapped in the overhead position;

b) The device remains in a usable position on the subject; and

c) The device complies with the applicable requirements in Section 15 for the deflated condition.

When the subject elects to make any adjustments in accordance with the instructions specified in 14.2.2, the determination of compliance with (c) is to be made after the subject has made the adjustments and then has relaxed.

14.3 Inflated device

14.3.1 The procedure specified in 14.2.1 and 14.2.2 then is to be performed twice by each subject; first with the device donned and inflated in accordance with 13.1.2 – 13.1.5, and then after the device has been donned and inflated in accordance with 13.2.1 and 13.2.2.

14.3.2 For the test specified in 14.3.1, the intended-use position is to be considered maintained if there is compliance with 14.2.3, except that no subject's breathing shall be impeded in the static floating position.

14.4 Belts

14.4.1 The tests described in 14.2.2 and 14.3.1 are to be repeated, except that each subject is to dive head first into the water from the 3-foot (0.91-m) height. The belt shall comply with the requirements in 14.1.1.

15 Inherent Flotation Characteristics Test

15.1 When tested as described in 15.2 – 15.5, a deflated hybrid device shall comply with the following:

a) Each subject having an in-water weight of less than 7.5 pounds (3.4 kg) shall be floated in a manner complying with the requirements for Type III flotation stability in 16.4.1; except that:

1) The average freeboard shall be not less than 1 inch (25 mm) and no subject shall have a freeboard less than zero; and

2) The face plane angle requirement in 16.4.1(d) does not apply.

b) The device shall permit each subject having an in-water weight of 7.5 pounds or more, but less than 11 pounds (5.0 kg), to attain a position in which respiration is not impeded without swimming or treading water (no subject shall have a freeboard less than zero).

c) The device shall permit each subject having an in-water weight of 11 pounds or more to attain, by means of body movement, a position in which respiration is not impeded.

d) Regardless of the subject's in-water weight, the device shall:

1) Have no tendency to turn a subject face down at any time; and

2) Permit each subject to achieve sufficient inflation in not more than 30 seconds by means of the oral system,

to comply with the applicable requirements in Inflated Flotation Stability Tests, Section 16.

15.2 This test is to be conducted after each subject has entered the water as specified in 14.2.2 while wearing the deflated device.

15.3 For a subject having an in-water weight of less than 7.5 pounds (3.4 kg), the test procedure is to be as follows:

a) After the subject has surfaced from the jump and made any adjustments in accordance with the instructions specified in 14.2.2, the tests specified in 16.4.2 – 16.4.6 are to be performed with the device in the deflated condition. The device shall comply with the requirements in 15.1(a).

b) Then, beginning with the subject in a relaxed, upright position in the water, the subject is to be instructed: "At the command of 'go,' inflate the device through the oral system as fully and quickly as you can...ready...go." After the subject is unable to further inflate the device or 30 seconds have elapsed from the time of the command "go," whichever occurs first, the tests specified in Section 16 are to be conducted.

15.4 For a subject having an in-water weight of 7.5 pounds (3.4 kg) or more, but less than 11 pounds (5.0 kg), the test procedure is to be as follows:

a) Prior to jumping, and in addition to the instructions specified in 14.2.2, the subject is to be instructed: "Once you make it to the surface and make any adjustments to the device, relax your body and then, by repositioning your head only, attain a face-up position in the water in which you can breathe freely. When you achieve this position, breathe normally until told to continue. Then slowly count to ten out loud. Finally, when you reach the count of ten, inflate the device by the oral system as fully and quickly as you can."

b) The subject is to be observed after the jump to verify that the device permits the subject to attain a face-up position in which respiration is not impeded [see 15.1(b)]. After 30 seconds have elapsed

from the time of the subject's reaching the count of ten, or the subject is unable to further inflate the device, whichever occurs first, the tests specified in Section 16 are to be conducted.

15.5 For a subject having an in-water weight of 11 pounds (5.0 kg) or more, the test procedure is to be as follows:

a) Prior to jumping, and in addition to the instructions specified in 14.2.2, the subject is to be instructed: "Once you make it to the surface and make any adjustments to the device, attain a face-up position in the water in which you can breathe freely. Swim or tread water if necessary. When you achieve this position, breathe normally until told to continue. Then slowly count to ten out loud. Finally, when you reach the count of ten, inflate the device by the oral system as fully and quickly as you can."

b) The subject is to be observed after the jump to verify that the device permits the subject to attain a face-up position in which respiration is not impeded [see 15.1(c)]. After 30 seconds have elapsed from the time of the subject's reaching the count of ten, or the subject is unable to further inflate the device, whichever occurs first, the tests specified in Section 16 are to be conducted.

15.6 CAUTION – The freeboard of a subject may be close to zero during this test, and precautions are to be taken to reduce the likelihood of the subject inhaling water. Lightweight breathing aids may be used for this purpose.

16 Inflated Flotation Stability Tests

16.1 General

16.1.1 A hybrid device is to be subjected to the tests specified in either 16.2.1.1 – 16.3.3 or 16.4.1 – 16.4.7, based on the device's intended performance. The device is to be tested in the conditions of inflation achieved during the tests specified in the Inherent Flotation Characteristics Test, Section 15, and may also be tested in other conditions of inflation if necessary to provide representative indications of the device's performance in the various combinations of inflated and deflated compartments (see 7.2.4) that may occur in intended use.

16.1.2 When a compartment experiences significant dimensional changes between the minimum and maximum values of the design pressure range, additional inflated flotation stability tests may be required. Inflated flotation stability tests need be conducted only at pressures representative of the minimum value of the design pressure range when increased pressure does not affect the dimensional or distributional characteristics of the compartment or the fit and comfort of the device.

16.2 Type II characteristics tests

16.2.1 General

16.2.1.1 The tests described in 16.2.2.1 – 16.2.3.5 are to be conducted first with each subject wearing the reference vest, and then with each subject wearing the hybrid device.

16.2.2 Turning test

16.2.2.1 When tested as specified in 16.2.2.2, a hybrid device shall comply with the following:

a) The average turning time for the group of test subjects shall not exceed by more than 2 seconds the average turning time for the reference vest.

b) The total number of turns for the group of test subjects shall not be less than the number of turns obtained by using the reference vest.

16.2.2.2 Each subject is to take at least three breast strokes, assume a face-down position in the water, and relax completely while exhaling slowly to FRC. The subject is to remain limp in this position long enough to determine the subject's final stabilized attitude of static balance. The subject then is to repeat the test two additional times.

16.2.3 Freeboard, head support, and field of vision test

16.2.3.1 A hybrid device shall comply with the following when tested as specified in 16.2.3.2 – 16.2.3.5:

a) The average freeboard of the group of test subjects shall not be less than that of the reference vest by more than 1/4 inch (6.4 mm);

b) The average value of the lowest marks that can be viewed on a vertical scale (see 16.2.3.2) by the group of test subjects shall not be greater than that for the reference vest by more than 3 inches (76 mm) when viewed forward and 12 inches (305 mm) when viewed from the side;

c) The number of test subjects provided with chin support (see 16.2.3.5) shall not be less than that for the reference vest;

d) The maximum face plane angle for the group of test subjects shall be less than that of the reference vest, or not more than 85 degrees, whichever is greater; and

e) The minimum face plane angle for the group of test subjects shall be greater than that of the reference vest, or not less than 20 degrees, whichever is less.

16.2.3.2 The subjects used during the test specified in 16.2.2.1 and 16.2.2.2 are to be used for this test while still in the water. Starting from a vertical upright position (see 16.2.3.5), each subject is to attain a relaxed, face-up position of static balance. The subject then is to be positioned in line with a vertical scale mounted at the side of the pool, so that the subject's feet are closest to the scale and eyes are 20 feet (6.1 m) from the scale. The vertical scale is to be not less than 20 feet high and is to be marked in 3-inch (75-mm) increments so that the increment at the level of the surface of the water is equal to zero and the increment 20 feet above the level of the surface of the water is equal to 240.

16.2.3.3 While in the position of static balance specified in 16.2.3.2, the subject is to be instructed to "relax and breathe normally." The freeboard and face plane angle are to be measured while the subject is at FRC. The subject then is to attempt to touch the chin to the chest (see 16.2.3.5). The lowest mark on the scale that can be seen by the subject without movement of the head from the relaxed position then is to be identified (see 16.2.3.4). The subject then is to be turned 90 degrees relative to the scale and, with the eyes 20 feet from the scale, is to identify the lowest mark that can be seen by turning the head.

16.2.3.4 For the purpose of calculating the average lowest-viewable-mark height, the value for a subject that can see below the zero mark is to be zero and the value for a subject that cannot view below the 20-foot (6.1-m) mark is to be 240.

16.2.3.5 A subject is to be considered as having chin support if:

a) The device is in direct contact with the jawline while the subject is in either the vertical upright or relaxed face-up position; or

b) The device prevents the subject from touching the chin to the chest while the subject is in the relaxed face-up position of static balance.

16.3 HELP position test

16.3.1 When tested as described in 16.3.2, a device shall not permit a subject to turn face down in the water.

16.3.2 The subjects used during the tests specified in 16.2.3.1 – 16.2.3.5 are to be used for this test while still in the water. Starting in a relaxed, face-up position of static balance, each subject is to bring the legs and arms in towards the body so as to attain the HELP position (a fetal position, but holding the head back). A subject that turns face down during the test is to repeat the relaxed, face-up position of static balance. The subject then is to be instructed to tilt the head back or arch the back in order to maintain the HELP position. If this procedure is necessary to maintain the HELP position, it is to be recorded.

16.3.3 A subject that turns face down during the test described in 16.3.2 is to repeat the test in the reference vest. If the subject turns face down in the reference vest, the subject is to be disqualified.

16.4 Type III characteristics tests

16.4.1 When tested as described in 16.4.2 – 16.4.7, a hybrid device shall comply with the following:

a) The device:

1) Shall maintain each subject in an attitude of relaxed static balance (such as an upright or backward position) so that the subject's respiration is not impeded at any time; and

2) Shall not have a tendency to turn a subject face-down from the position of relaxed static balance in the water. See 16.4.7.

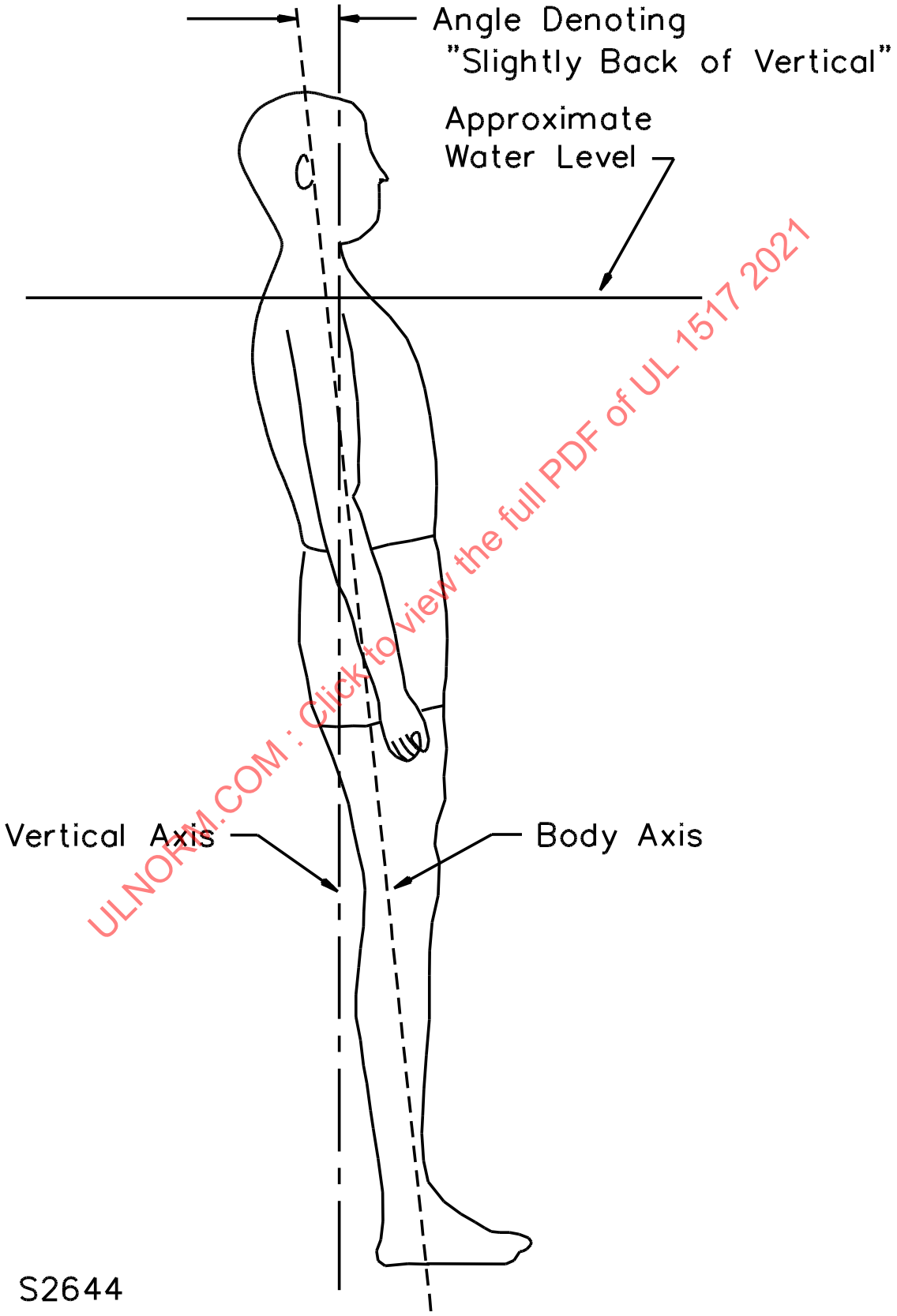
In addition, a device shall not have a shoulder gap of more than 6 inches (152.4 mm), measured at the right shoulder, following 3 self-induced bobbing actions in the water (see 16.4.3). Also, the device in the ridden-up condition shall not have a tendency to turn a subject face-down from the position of relaxed static balance in the water and shall comply with the requirements specified in (b) and (c) following the bobbing actions. The use of crotch straps is not acceptable for determining compliance with the ride-up requirements.

b) The average freeboard at static balance for the group of test subjects shall be not less than 2 inches (50.8 mm). In no case shall the freeboard measured on an individual test subject be less than 1 inch (25.4 mm).

c) The device shall permit each subject to attain at least a slightly backward of vertical position, see Figure 16.1, when starting from a face-down position in the water.

Figure 16.1

Starting position – type III flotation test



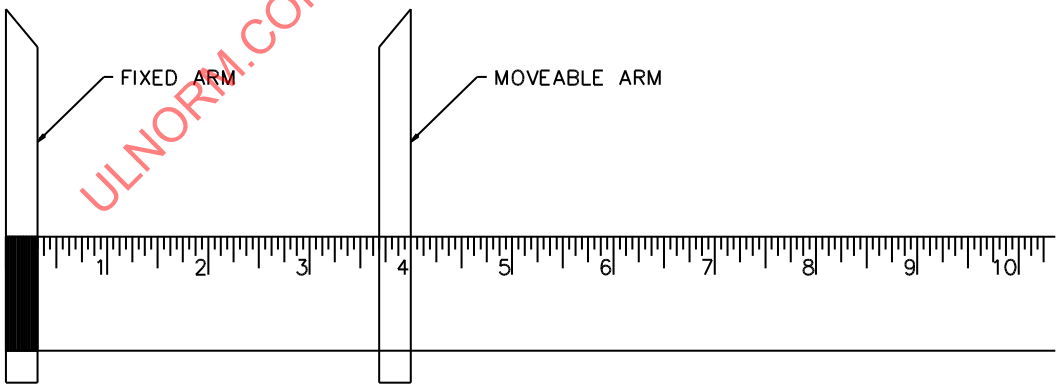
16.4.2 Each subject is to don the device and enter the water. The subject then is to assume an upright, slightly back of vertical position in the water, keeping the head and torso in the same plane, while holding the arms at the sides. Refer to Figure 16.1 for an illustration of the starting position. A straight rod with an inclinometer attached may be used to establish the starting position. The subject is to maintain this position until motion (forward or backward of vertical) is induced by the device. Then, assume their naturally relaxed positions, so that the head falls in the direction of induced motion. If motion is not induced, the subject is to allow the head to fall backward and then the subject is to allow the arms, legs, and torso to assume their naturally relaxed then is to allow the arms, legs, and torso to assume natural relaxed positions. After the subject attains an attitude of relaxed static balance, the freeboard and face plane angle of the subject are to be measured while the subject is at FRC. The subject is to be instructed to "relax and breathe normally" during measurement of the freeboard and face plane angle.

16.4.3 The subjects are to perform 3 bobbing motions in the water while in a vertical position to induce ride-up. See 16.4.1(a). Prior to the bobbing actions and while still in the water, the subjects are to be instructed to "readjust the device to a comfortably snug fit." Immature, young subjects with limited manual dexterity may be assisted when readjusting the device to a comfortably snug fit. The bobbing motions are then to be generated by stretching the arms straight out from the sides at the water's surface with the palms facing downward. While in this position, the subjects are to push down on the water with their hands in an open, flat orientation. While pushing down on top of the water, the subjects are to fully inhale and rise above the water's surface. After reaching the upward peak, the subjects are to bring their hands together over the head and fully exhale while sinking into the water. The head must go under the water's surface to be counted. This motion is to be repeated three total times.

16.4.4 Immediately following the last bobbing motion specified in 16.4.3, the right shoulder gap is to be measured by inserting the measuring device illustrated in Figure 16.2 between the top of the shoulder and the inside uppermost portion of the PFD above the right shoulder. The subject is to be oriented vertically in the water during this measurement. The hands are to be held together and located at approximately the mid-abdomen during the measurement. Following the shoulder gap measurement, the candidate device is to be tested in accordance with 16.4.2.

Figure 16.2

Shoulder gap measuring instrument



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16.4.5 The subject then is to attain a face-down position in the water. The device shall permit the subject to turn in not more than 5 seconds from the face-down position to a position in which respiration is not impeded.

16.4.6 When, during these tests, a subject is not maintained in an upright or backward face-up position, the subject is to repeat the test using a reference vest. When the reference vest does not maintain the subject in an upright or backward face-up position, the test is to be repeated with another subject of the same anatomic build.

16.4.7 When during the tests described in 16.4.2 the hybrid device does not comply with the requirements in 16.4.1 with one subject from the group, an additional 18 subjects as specified in Table 12.1 may be used. When the device performs acceptably (see 16.4.1) while being worn by each of the 18 subjects, the device is acceptable.

17 Water Emergence Test

17.1 A hybrid device shall permit each of the subjects selected in accordance with 17.3 to emerge from the water to the top of the platform specified in 17.2 in less than 45 seconds when tested as specified in 17.4.

17.2 A rigid wood platform mounted 6 inches (150 mm) above the water at the side of a pool is to be used for this test. The top of the platform is to have a smooth, painted surface.

17.3 Each subject is to don the reference vest, enter the water, and swim or tread water for at least 30 seconds. The subject then is to attempt to emerge from the pool onto the top of the platform without:

a) Gasping any edge of the platform; or

b) Contacting the side or bottom of the pool.

Those subjects that are able to emerge onto the platform in 45 seconds or less are to be used for the test specified in 17.4. When more than two-thirds of the original subjects are unable to qualify, this procedure is to be repeated with additional subjects until two-thirds of the original number of subjects is obtained.

17.4 Wearing a fully-inflated device, each subject is to enter the water and assume a position near the platform. The time required by the subject to emerge onto the top of the platform, without:

a) Grasping any edge of the platform; or

b) Contacting the side or bottom of the pool

is to be recorded. The subject may deflate the device during the emergence attempt if such an action is recommended in the instruction manual or in a marking on the device. If necessary, the subject may be provided with the manufacturer's written instructions for this purpose.

MECHANICAL CHARACTERISTICS TESTS

18 Operation Force and Inflation Pressure Test

18.1 When tested in accordance with 18.2 – 18.4, a hybrid device provided with a manual or automatic inflation system shall comply with the following:

a) The force required to manually actuate the system shall not be:

1) Less than 3 pounds (13.4 N); nor

2) More than 15 pounds (66.7 N).

The average actuation force shall not be less than 5 pounds (22.3 N).

b) Any compartment supplied by a manual inflation system shall achieve a pressure within its design pressure range in not more than 5 seconds from the time of actuation of the system.

Exception: A device need not comply with this requirement if the required minimum inflated buoyancy (see Table 19.1) is achieved within 5 seconds.

c) Any compartment supplied by an automatic inflation system shall achieve a pressure within its design pressure range in not more than 10 seconds from the time of submergence of the device.

Exception: A device need not comply with this requirement if the required minimum inflated buoyancy (see Table 19.1) is achieved within 10 seconds.

d) The maximum pressure achieved within a compartment shall not exceed the maximum value of the design pressure range.

18.2 Five samples of the device are to be mounted on a vertical test form (see Figure 23.2) to approximate the intended position on a wearer. The force required for actuation of each inflation system is to be measured in the intended direction of operation by means of a force indicator attached to the actuating mechanism or the equivalent.

18.3 For a device having an automatic inflation system, three additional samples are 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 approximately 2 inches (51 mm). For this test, the water in the tank is to be maintained at 68 ±2°F (20 ±1°C). The device is to be at room temperature prior to submersion.

18.4 The compartment pressure or device buoyancy is to be monitored until stabilization. The weights of cartridges are to be taken prior to and after the test to verify that full charges are present and complete discharge has occurred.

19 Buoyancy and Permeability Tests

19.1 Deflated device

19.1.1 After 24 hours of submersion (48 hours for a device employing fibrous buoyant material), the buoyancy of a hybrid device in the deflated condition shall not be less than the applicable minimum buoyancy specified in Table 19.1 or the value determined according to the following equation, whichever is greater:

$$B_t = (5.00)\sum_{i=1}^{N} \frac{P_i}{\frac{3V_i}{100-2}}$$

in which:

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

P_i is the buoyancy provided by the ith material, in pounds-force, divided by 7.5;

V_i is the V factor for the ith material, determined in accordance with the requirements for Components for Personal Flotation Devices, UL 1191; and

N is the number of materials used in the device.

Table 19.1
Minimum buoyancies

Condition	Minimum buoyancy[a], pounds-force (N)
Deflated	7.5 (33)
Inflated[b]	
Entire device	22 (98)
Single compartment[c]	15 (66)

[a] See 19.3.5.
[b] See 19.2.2.
[c] Multicompartment device only.

19.2 Inflated device

19.2.1 The buoyancy of an inflated hybrid device shall be not less than the applicable value specified in Table 19.1 after 15 minutes and after 24 hours of submergence. After 24 hours of submergence, the buoyancy of the device shall be not less than 95 percent of the buoyancy after 15 minutes of submergence.

Exception: The buoyancy of a device inflated with carbon dioxide need not comply with this requirement after 24 hours of submergence, if the device:

a) Complies with the requirements after not less than 6 hours of submergence; and

b) Is provided with information specified in 41.6.

19.2.2 For this test, compartments are to be inflated as follows:

a) A compartment supplied by an oral system only is to be pressurized with air to 0.6 psig (4 kPa).

b) A compartment supplied by a single automatic or manual system is to be inflated by actuation of the system.

c) A compartment supplied by a combination of systems is to be inflated using each system independently.

19.3 Buoyancy determination

19.3.1 This test is to be conducted in a test tank of water. Air entrapped in folds of the cloth, and the like, is to be removed from the device immediately following submersion. Tests on a deflated device that employs fibrous buoyant material are to be conducted twice; first with the device in the as-received condition, and then with the envelope slit at each corner and on each side. Slits are to be 2 inches (51 mm) long and not more than 2 inches apart so that the envelope will not entrap air.

19.3.2 A test basket made of wire mesh or equivalent material and of sufficient size to hold the sample without unduly compressing the device is to be ballasted with sufficient weight to permit the complete submergence of the basket and device.

19.3.3 The ballasted basket is to be suspended from a scale calibrated to an accuracy of at least ± 1 ounce (± 28.3 g), and the weight of the submerged apparatus determined.

19.3.4 The sample is to be placed in the basket so that its upper surface will be approximately 2 inches (51 mm) below the water surface, and is to remain submerged for 24 hours.

19.3.5 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. The result is to be corrected as necessary to establish the buoyancy at an atmospheric pressure of 29.92 inches Hg (101 kPa) and a water temperature of 68°F (20°C).

20 Distribution Tests

20.1 Buoyancy distribution test

20.1.1 In the deflated condition, at least 50 percent of the total buoyancy of a hybrid device shall be forward of the body axis (see Figure 16.1) when tested in accordance with 20.1.2.

Exception: A device that complies with the requirement in 20.2.1 need not comply with this requirement.

20.1.2 The buoyancy forward of the body axis and the buoyancy aft of the body axis are to be determined individually in accordance with 19.3.1 – 19.3.5. For this purpose, a sample need be submerged only long enough to provide a stabilized reading.

20.2 Loss distribution test

20.2.1 To comply with Exception No. 2 to 5.12 or the Exceptions to 5.13 or 20.1.1, a hybrid device shall comply with the requirements in Inherent Flotation Characteristics Tests, Section 15, and Inflated Flotation Stability Tests, Section 16, after being altered in accordance with 20.2.2.

20.2.2 Each foam insert of a sample of the device is to have an amount of the foam removed by skiving the surface of greatest area, or the equivalent, so that the buoyancy of each insert is as follows:

$$B = B_o\left[\frac{3V}{100} - 2\right]$$

in which:

B is the buoyancy of the altered insert (plus 0, minus 15 percent);

B_o is the buoyancy of the insert as provided in the as-received device; and

V is the V factor of the foam from which the insert is formed, determined in accordance with the requirements for Components for Personal Flotation Devices, UL 1191.

The sample then is to be reassembled in a manner that represents the construction of the complete device, to account for buoyancy loss from sewing and the like.

21 Water Entrapment Test

21.1 A hybrid device shall not entrap more than 5 pounds-mass (2.3 kg) of water after submergence in water.

21.2 The deflated device is to be submerged in an upright position for not less than 2 minutes. The device then is to be removed in a vertical upright position and immediately hung on a hanger from a weight scale having an accuracy of ±1/2 ounce (±14 g). Ten seconds after removal from the water, the total weight indicated on the scale is to be recorded. The device then is to be inverted or otherwise manipulated to remove all entrapped water, and reweighed. The difference in weight between the two readings shall comply with the requirement in 21.1.

22 Dynamic Strength Test

22.1 *Deleted*

22.2 *Deleted*

Figure 22.1

Test form

Figure deleted

Table 22.1
Test form dimensions

Table deleted

22.3 *Deleted*

22.4 *Deleted*

23 Tensile Tests

23.1 A hybrid device shall not exhibit evidence of functional deterioration or impaired operation after being tested in accordance with Table 23.1, and 23.2 and 23.3. A friction-type closure assembly shall not slip more than 1 inch (25 mm) at any point of adjustment. Each primary closure is to be tested independently. Except as indicated in note h to Table 11.1, the device is to be tested both deflated and with all compartments inflated to the maximum value of the design pressure range.

Table 23.1
Tensile tests

Area of load application	Load, pounds-mass (kg)	Duration, minutes
Body[a,b]	450 (204)	5
Secondary closure[b]	120 (55)	5
Shoulder section or collar[c]	200 (91)	2

[a] On each primary closure independently.

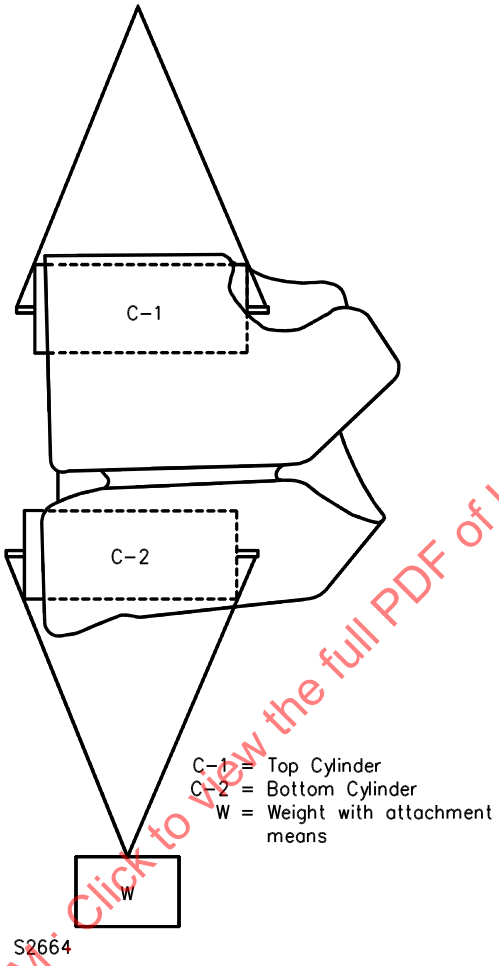
[b] Webbing and friction type closure assemblies are to be tested both wet (minimum 2 minute immersion) and dry.

[c] Not applicable to belts.

23.2 For tests on the body and closures, two cylinders are to be used. Each cylinder is to have a diameter of 5 inches (127 mm), and a length sufficient to freely support the device. See Figure 23.1. With the device supported by the top cylinder (C-1), a weight (W) is to be attached to the bottom cylinder (C-2) so that the required load is applied to the device. The total load is to include the weight (W), its attachment means, and the bottom cylinder (C-2).

Figure 23.1

Body and closures test arrangement



23.3 For tests on a shoulder section or collar, the device is to be secured to the test form as specified in Figure 23.2 and Table 23.2 and the form is to be secured to maintain an upright position. The specified load is to be applied to one shoulder section or the collar by a 3-inch (76-mm) wide strap having a 1/4-inch (6-mm) thick foam covering, passed through the shoulder section or collar.

Figure 23.2

Tensile test form

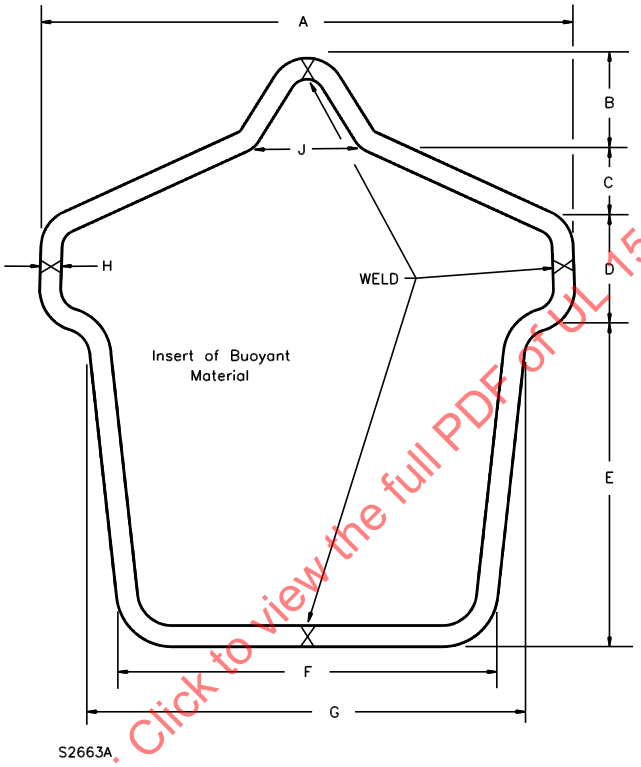


Table 23.2
Tensile test form dimensions

Size	Dimensions – Inches (mm)								
	A	B	C	D	E	F	G	H	J
Extra Large Adult	32 (813)	6 (152)	3-1/2 (86)	6 (147)	18 (441)	21 (532)	26 (637)	1 (25)	8 (196)
Adult	24 (610)	4-1/2 (114)	3 (76.2)	5 (127)	15 (381)	17 (432)	20 (508)	1 (25.4)	7 (178)

Notes:

1 – Fabricated from mild-steel rod. (Diameter – Dimension H).

2 – Grind welds and burns smooth.

3 – Prime and paint thoroughly.

24 Temperature Cycling Tests

24.1 General

24.1.1 A hybrid device shall remain serviceable after exposure to high and low temperatures as specified in 24.2.1 – 24.3.1. For tests in the deflated condition (see Table 11.1) on a device having either a manual or automatic inflation system, all compartments supplied by the system shall be fully inflated in not more than 10 or 15 seconds for a manual or automatic system, respectively, when the system is actuated within 15 seconds of removal of the device from the conditioning chamber.

Exception: For the high to low temperature exposure, the device need not comply with the requirement for the inflation pressure achieved if the device attains the required minimum buoyancy (see Table 19.1) in not more than 10 or 15 seconds for a manual or automatic system, respectively, when tested using the alternate procedure described in 24.2.3.

24.1.2 Three new samples are to be tested; one sample is to be in the packed (deflated, stored) condition during exposure, one is to be in a loose unpacked condition, and one is to be inflated to the maximum value of the design pressure range.

24.2 High to low temperature exposure

24.2.1 Each sample is to be placed in a circulating air oven maintained at 60 ±2.8°C (140 ±5°F) for at least 20 hours. The samples then are to be allowed to stand at room temperature for 2 – 4 hours. The samples then are to be placed in a cold chamber at minus 30 ±3°C (minus 20 ±5°F) for at least 20 hours.

24.2.2 Within 15 seconds of removal from the cold chamber, one of the samples (both samples if no manual or automatic inflation system is provided) is to be inflated to the maximum value of the design pressure range by means of the oral inflation system. If a manual or automatic inflation system is provided, the remaining sample is to be inflated by means of the system within 15 seconds of removal, and the compartment pressure is to be monitored. An automatic inflation system is to be actuated by submersing only the system in fresh water at 3 ±3°C (37 ±5°F).

24.2.3 As an alternate to the procedure specified in 24.2.2 for a device having a manual or automatic inflation system, the sample is to be completely submerged in fresh water at 3 ±3°C (37 ±5°F) to a depth of at least 2 inches (51 mm) within 15 seconds of removal from the conditioning chamber, and the buoyancy of the sample monitored. A manual inflation system is to be actuated immediately prior to the submersion.

24.3 Low to high temperature exposure

24.3.1 The same samples again are to be subjected to the procedure specified in 24.2.1 and 24.2.2; except that:

a) The order of the exposures is to be reversed; and

b) An automatic inflation system is to be actuated by submersing only the system in fresh water at 32 ±3°C (90 ±5°F).

Prior to the exposures, one of the samples is to be returned to the packed condition, and all manual and automatic inflation systems are to be replenished.

25 Solvent Exposure Test

25.1 A hybrid device shall remain serviceable after being subjected to the exposure described in 25.2.

25.2 A sample of the device 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) with a 30-minute drying period between submersions. After the last submergence period, the sample is to be removed from the liquid and the excess liquid allowed to run off. The sample then is to be inflated to the maximum value of the design pressure range.

26 Flame Exposure Test

26.1 A hybrid device shall withstand a 2-second exposure to flame as described in 26.2 – 26.7 without sustaining damage that may affect the intended performance.

26.2 The test pan is to be 12 by 18 by 2-1/2 inches (305 by 457 by 63.5 mm).

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

26.4 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 device is inserted.

26.5 Two samples of the device, one in the deflated condition and the other inflated to the maximum value of the design pressure range, are to be passed through the flames in an upright, vertical, freehanging 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.

26.6 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.

26.7 If the device shows evidence of damage after the flame exposure, it is to be subjected to the tests specified in Sections 15 and 16 (using only the subject having the greatest weight in water), Section 19 (the device need only be submerged a total of 2 hours), and to the body strength test specified in Table 23.1 at 75 percent of the specified load. The device shall comply with the requirements in Sections 15, 16, and 19, and the body strength requirements in Section 23, Tensile Tests.

27 Abrasion/Compression Test

27.1 *Deleted*

27.2 *Deleted*

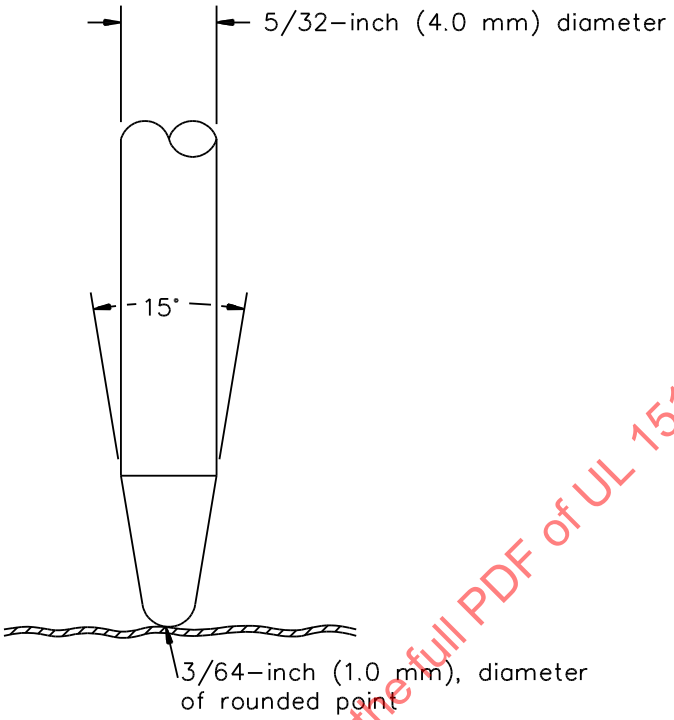
28 Puncture Resistance Test

28.1 Each inflatable compartment of a hybrid device shall withstand, without puncture, the test described in 28.2.

28.2 The compartment is to be inflated to the maximum value of the design pressure range and placed on a rigid, smooth, flat plywood surface. The steel test point illustrated in Figure 28.1 is to be pressed against each chamber at three different locations (such as each front side and the collar), at a point of maximum wall separation for each compartment, perpendicular to the wall, and with a uniform speed of 6 – 12 inches per minute (2.5 – 5.0 mm/s) until a force of 7 pounds (31 N) is attained.

Figure 28.1

Test point



29 Over-Pressure Tests

29.1 Device test

29.1.1 Each inflatable compartment of a hybrid device shall withstand, for 5 minutes, the application of twice the maximum value of the design pressure range or 8 psig (55 kPa), whichever is greater (also, see 7.2.9 and 7.2.10). There shall be no:

a) Loss in pressure greater than 5 percent; and

b) Evidence of material delamination, shredding, or degradation of seams that would impair serviceability.

An alternative test is described in 29.1.3 and 29.1.4.

29.1.2 For this test, each compartment of the device is to be inflated to the specified pressure and allowed to stand for 5 minutes. An over-pressure-relief valve is to be blocked or otherwise rendered inoperative.

29.1.3 As an alternative, a device may be tested as specified in 29.1.4. There shall be no:

a) Loss in buoyancy greater than 5 percent;

b) Signs of leakage as evidenced by the continuous production of air bubbles; and

c) Evidence of material delamination, shredding, or degradation of seams.

29.1.4 The device is to be inflated to twice the maximum value of the design pressure range or 8 psig (55 kPa), whichever is greater, in accordance with 29.1.2. The device then is to be submerged in the buoyancy test apparatus described in 19.3.2 and 19.3.3. The buoyancy of the device is to be measured immediately after submersion and after 5 minutes of submersion in accordance with 19.3.4 and 19.3.5.

29.2 Over-pressure relief valve test

29.2.1 When tested as described in 29.2.2, a device having an over-pressure-relief valve that is relied on for compliance with the requirement in 7.2.9 shall not permit a pressure greater than the value at which the device was tested in accordance with 29.1.1 – 29.1.4. During the test, if the device attains a pressure greater than the maximum value of the design pressure range for more than 1 second, the device shall be marked and information shall be provided in accordance with 38.3.3 and 41.5.

29.2.2 The device is to be inflated by means of the oral inflation system to 2 psig (14 kPa) or the maximum equilibrium pressure allowed by the over-pressure-relief valve, whichever is less. Each automatic or manual inflation system then is to be actuated, and the pressures achieved are to be recorded until an equilibrium pressure is obtained.

30 Air Retention Test

30.1 An inflatable compartment of a hybrid device shall not experience a pressure loss of more than 0.4 psig (2.8 kPa) or 20 percent of the initial pressure, whichever is less, when inflated with air to the maximum value of the design pressure range and allowed to stand at room temperature for 12 hours.

31 Strength of Attachment Tests

31.1 Inflation systems test

31.1.1 General

31.1.1.1 Each inflation system of a hybrid device shall withstand, without damage to any joint formed by the system or any compartment or reinforcement, the tests described in 31.1.2.1 and 31.2.1. For the test on the inflated device as described in 31.1.2.1, the compartment to which the inflation system is attached shall not experience a pressure loss greater than 0.4 psig (2.8 kPa) or 20 percent of the initial pressure, whichever is less.

31.1.1.2 For an inflation system having a joint or coupling other than at the connection to the compartment, the test described in 31.1.2.1 is to be repeated with the weight attached at a point beyond the joint or coupling.

31.1.2 Inflated device

31.1.2.1 An inflation system of a sample of the device is to be tested. The sample is to be mounted on the test form as specified in Figure 23.2 and Table 23.2 in the deflated condition. Each compartment of one sample then is to be inflated to the maximum value of the design pressure range. A supported weight of 75 pounds-mass (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 test form is to be freely supported from the top, and then is to be slowly raised until the inflation system completely supports the weight, and is to be maintained in this position for 2 minutes.

31.1.3 Deflated device

31.1.3.1 An inflation system of the same device tested in 31.1.2.1 is to be totally deflated and the test is to be repeated; except a supported weight of 30 pounds-mass (13.6 kg) is to be used.

31.2 Secondary closure test

31.2.1 For a device that employs a secondary closure (tie tape, chest strap, or the like) that is attached directly to the cover fabric, the average breaking strength of samples of the closure/fabric combination shall be not less than 120 pounds-force (530 N) when they are subjected to the test specified in 31.2.2 and 31.2.3. The breaking strength of any individual sample shall not be less than 60 pounds-force (267 N).

31.2.2 Ten samples of the closure/fabric combination, five with the closure material sewn parallel to the direction of greater thread count and five with the closure material sewn parallel to the direction of lesser thread count, are to be prepared using the intended securing means, such as a box-X or bar tack stitch. The samples are to represent the weakest combination used.

31.2.3 The samples are to be placed, in turn, in a constant-rate-of-traverse tensile test machine by clamping the closure perpendicularly in the fixed jaws, aligning the threads (in the direction of greater thread count or of lesser thread count) of the cover fabric portion of the sample parallel to the closure length, and then securing the cover fabric portion in the moving jaws. The jaws are to be separated at a rate of 12 inches (305 mm) per minute.

31.3 Pull test

31.3.1 To comply with Exception No. 3 to 8.11, the feature (dee ring, tab, or the like) shall become disengaged from the device when a force of 50 pounds (220 N) is applied to the feature with the device secured to the test form as specified in Figure 23.2 and Table 23.2. There shall be no mechanical damage to the device that may affect serviceability.

32 Environmental Tests

32.1 General

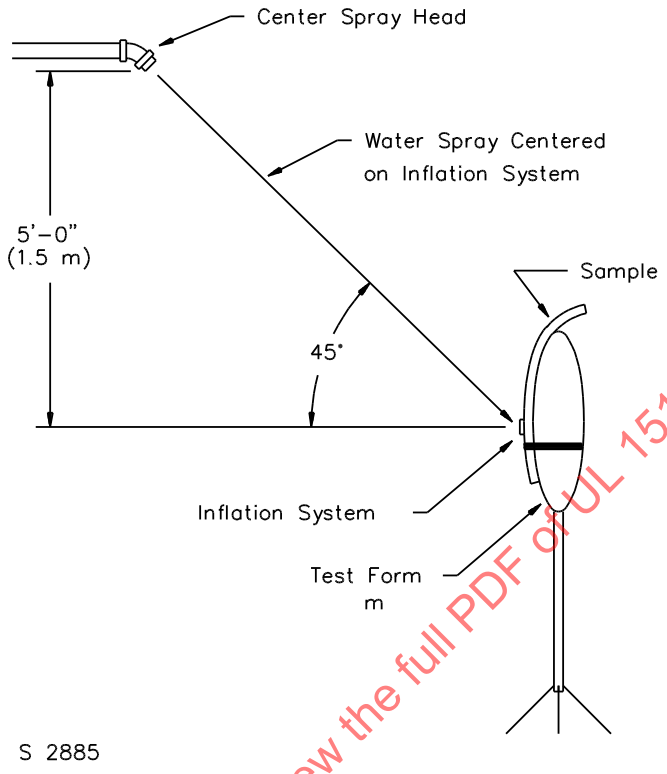
32.1.1 An automatic inflation system provided on a hybrid device shall not actuate during and after 1 hour of exposure to water spray in accordance with 32.2.1 and 32.2.2 and 168 hours of humid atmosphere exposure in accordance with 32.3.1. Following each exposure, the system shall operate as intended.

32.2 Water exposure test

32.2.1 A sample of the device is to be mounted on the test form as specified in Figure 23.2 and Table 23.2 to simulate the intended use position. A water spray then is to be applied to the device as illustrated in Figure 32.1.

Figure 32.1

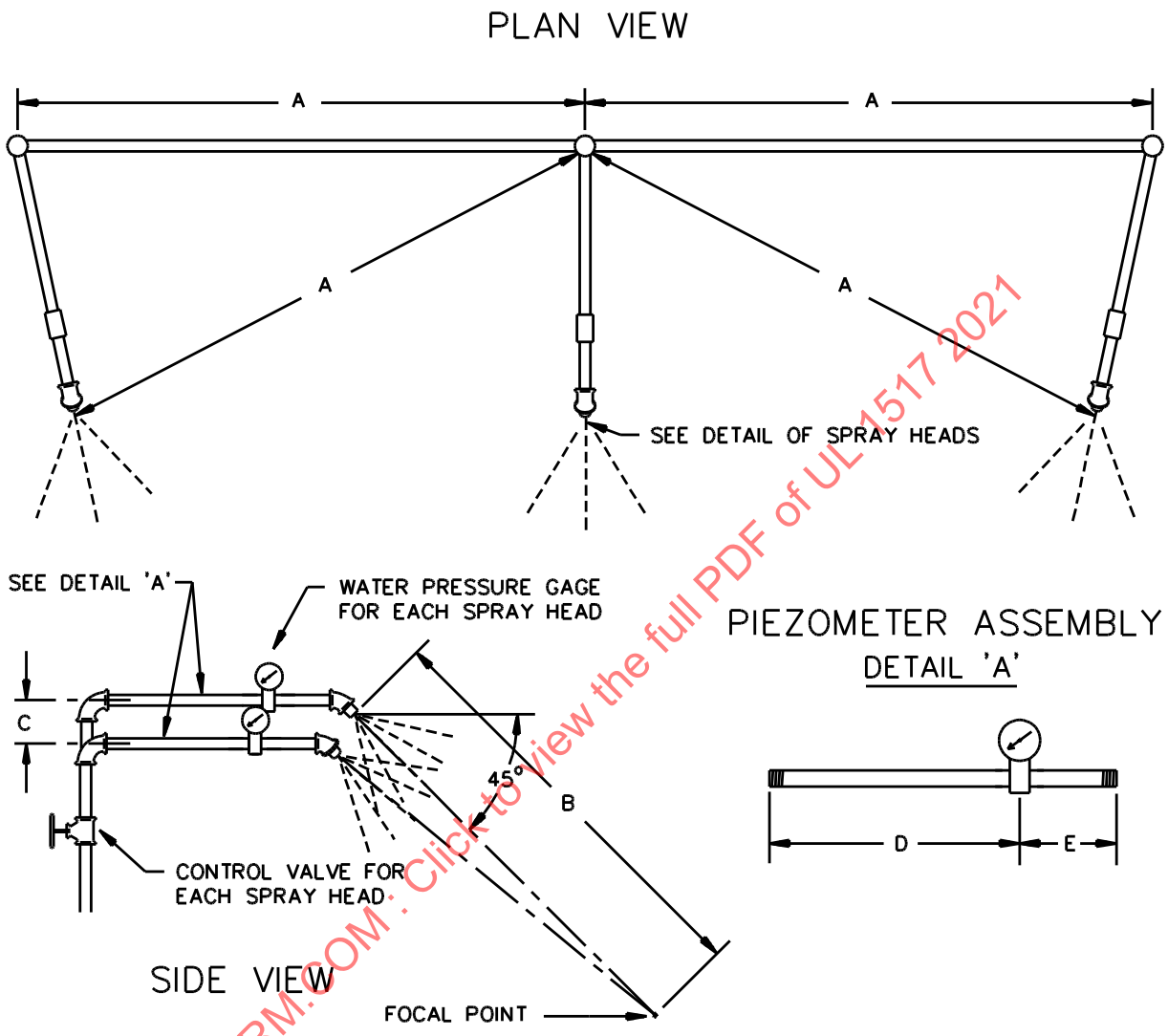
Test arrangement



32.2.2 The water spray test apparatus is to consist of three spray heads mounted in a water supply pipe rack as illustrated in Figure 32.2. Spray heads are to be constructed in accordance with the details shown in Figure 32.3. The water pressure at each spray head is to be maintained at 5 psi (34.5 kPa).

Figure 32.2

Spray head pipe rack

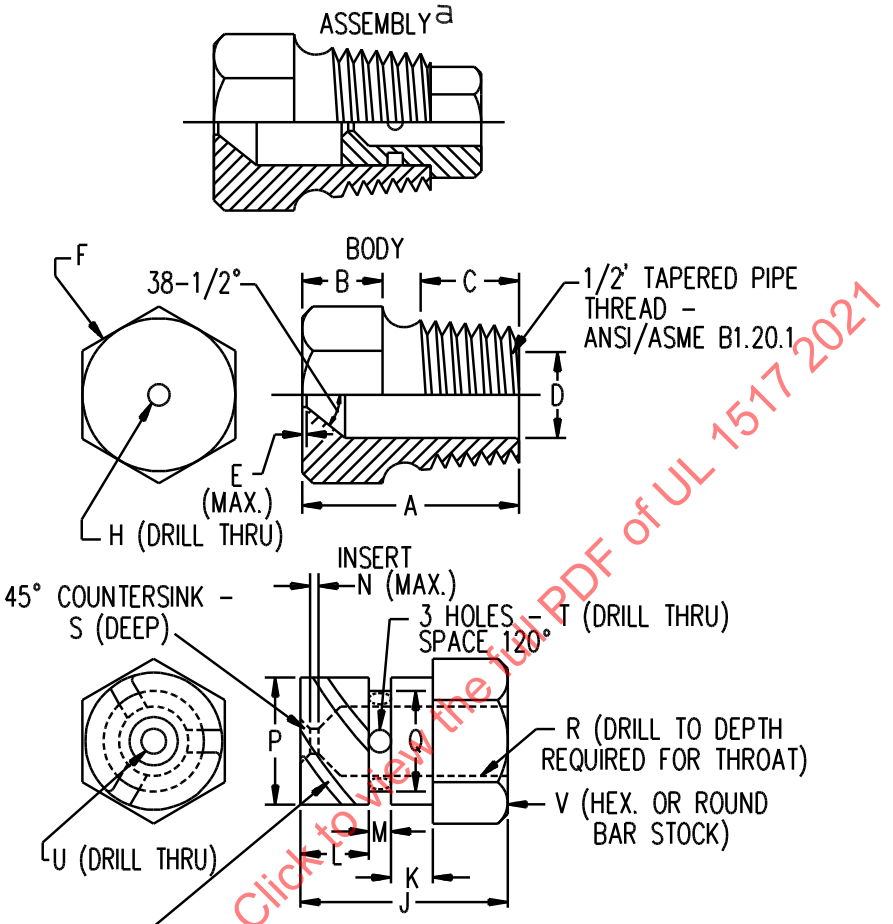


Item	mm	inch
A	710	28
B	1400	55
C	55	2–1/4
D	230	9
E	75	3

RT101F

Figure 32.3

Spray head assembly



Item	mm	inch	Item	mm	inch
A	31.0	1-7/32	N	0.80	1/32
B	11.0	7/16	P	14.61	.575
C	14.0	9/16		14.63	.576
D	14.68	.578	Q	11.51	.453
	14.73	.580		11.53	.454
E	0.40	1/64	R	6.35	1/4
F	c	c	S	0.80	1/32
G	1.52	.06	T	2.80	(No. 35)[b]
H	5.0	(No.9)[b]	U	2.50	(No. 40)[b]
J	18.3	23/32	V	16.0	5/8
K	3.97	5/32	W	1.52	0.06
L	6.35	1/4			
M	2.38	3/32			

[a] Nylon Rain-Test Spray Heads are available from Underwriters Laboratories

[b] ANSI B94.11M Drill Size

[c] Optional - To serve as a wrench grip.

RT100F

32.3 Humid atmosphere test

32.3.1 A sample of the device, mounted as described in 32.2.1, is to be conditioned for 168 hours in a chamber at 32 ±2°C (90 ±4°F) and a relative humidity of 90 ±5 percent.

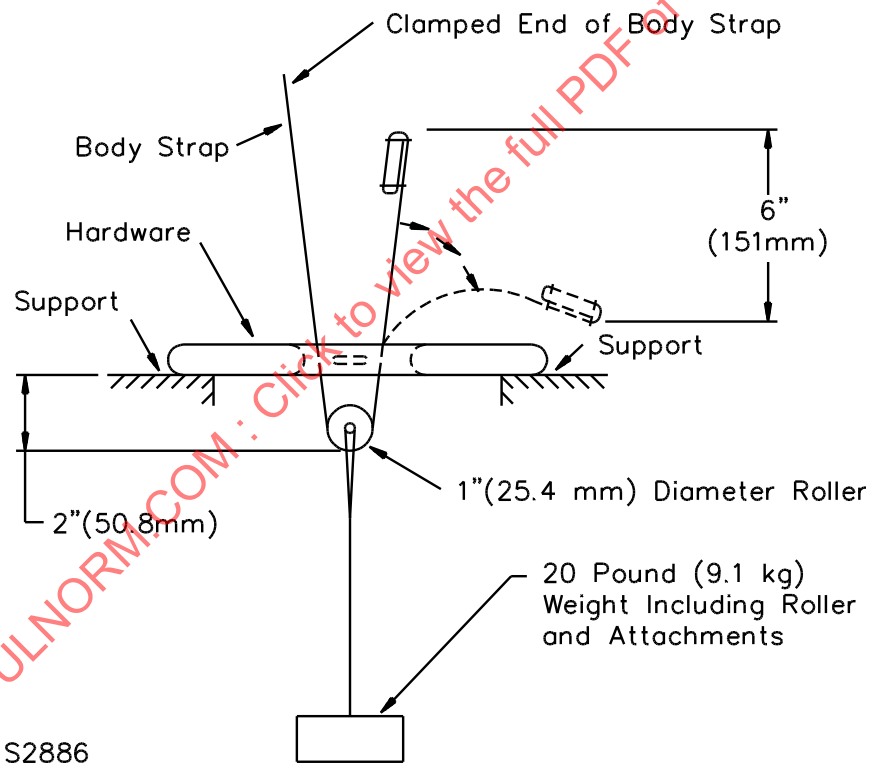
33 Body Strap – Hardware Securement Test

33.1 When tested as described in 33.2, a body strap shall remain firmly engaged in the hardware.

33.2 The body strap is to be loosened to provide a 2-inch (51-mm) loop at the center of the hardware with a 6-inch (150-mm) free end as shown in Figure 33.1. The hardware is to be held firmly in the horizontal plane. The length of the free end of the body strap is to be measured and the free end then allowed to fall free. A 20-pound (89-kg) weight and roller assembly is to be secured in the loop, released, and left hanging for 30 seconds.

Figure 33.1

Body strap – hardware test



34 Seam Strength Test

34.1 When prepared and conditioned in accordance with 34.2 and 34.3 and tested in accordance with the specifications for breaking strength tests in the Standard Test Method for Failure in Sewn Seams in Woven Fabrics, ASTM D1683, the breaking strength of a sewn structural seam of a hybrid device shall be not less than 80 pounds-force (356 N) in the directions of both greater and lesser thread count.

34.2 Samples may be cut directly from the device or may be prepared specifically for this test. Each type of seam used on the device is to be tested.

34.3 Prior to the test, samples are to be conditioned at 23 ±2°C (73 ±4°F) and 50 ±5 percent relative humidity for not less than 40 hours.

35 Abrasion Resistance Test

35.1 Samples of a cover material used to reinforce or restrain an inflatable compartment of a hybrid device shall have a residual average breaking strength of not less than 75 percent of the as-received breaking strength, as determined by the breaking strength test for fabrics in the requirements in the Standard for Components for Personal Flotation Devices, UL 1191, after being subjected to an abrasion test in accordance with Method 5304.1 of Federal Standard No. 191a .

MANUFACTURING AND PRODUCTION TESTS

36 General

36.1 To verify continued compliance with these requirements in production, the manufacturer shall provide the necessary production control, inspection, and tests. The program shall include the Air Retention Test, Section 37.

37 Air Retention Test

37.1 Each inflatable compartment of each hybrid device is to be inflated with air to the maximum value of the design pressure range and allowed to stand for 12 hours at room temperature. At the end of the 12-hour period, no compartment shall have a pressure loss of more than 0.4 psig (2.8 kPa) or 20 percent of the initial pressure, whichever is less.

Exception: An alternate test method may be used if found to provide the equivalent production control.

MARKING

38 General

38.1 General

38.1.1 All required markings shall be in permanent, waterproof lettering that can be read at a distance of 3 feet (0.9 m). Except where otherwise indicated, required markings shall be grouped together in one location on the device.

38.1.2 The markings specified in these requirements that are shown entirely in UPPER-CASE letters shall be prominent (for example, printed in contrasting style, size, or color) with respect to other required markings, but need not be printed in upper-case letters on the device.

38.1.3 A required marking shall be of a color that contrasts with the color of the surface on which it is applied.

38.2 USCG recreational use approval

38.2.1 Each hybrid device shall be marked with the following, in the order shown:

a) "ADULT – For a person weighing more than 90 pounds."

b) "TYPE V PFD: Recreational Hybrid Inflatable – Approved for use only on recreational boats. REQUIRED TO BE WORN to meet U.S. Coast Guard carriage requirements (except for persons in enclosed spaces as explained in owner's manual)."

c) "YOU MAY HAVE TO INFLATE THIS PFD TO FLOAT."

d) "This PFD requires maintenance."

e) "Try this PFD in the water to see if you will float without inflation."

f) "When inflated this PFD provides performance equivalent to a Type _____ PFD;" in which _____ is a "II" or "III," as applicable.

g) "When new, this PFD provides a minimum buoyant force of 7.5 pounds uninflated and 22 pounds inflated." If the buoyant force is greater than 7.5 pounds it may be marked accordingly.

h) "A pamphlet and owner's manual must be provided with this PFD."

38.3 Identification and information

38.3.1 Each hybrid device shall be marked with the following:

a) Manufacturer's or private labeler's name and address.

b) Model number.

c) Lot number. See 38.3.2.

d) Year and quarter of manufacture.

e) A generic identification of the inherently buoyant material (PE, PVC, kapok, or the like).

f) The USCG approval number in the form "U. S. Coast Guard Approval No. 160.077/XXX/X."

g) For a device employing foam having a V factor less than 94, as determined in accordance with the requirements for Components for Personal Flotation Devices, UL 1191: "There is a potential for buoyancy loss depending on how this device is used and cared for. Therefore, test the device periodically as explained in the owner's manual."

h) For a device employing kapok: "If pads become waterlogged, replace the device," or the equivalent.

i) Necessary vital care or use instructions, if any, such as the following:

a) Warning against dry cleaning.

b) Size and type of inflation medium cartridges required.

j) Identification of user (adequate space shall be provided to mark the name or other identification of the user).

38.3.2 A lot shall consist of not more than 1000 devices. In addition, a new lot shall be established when the materials or production methods for the device are changed. Lots shall be numbered serially.

38.3.3 To comply with the Exception to 7.2.9, a hybrid device shall be marked to clearly indicate that only one system is to be used to inflate the device.

38.3.4 A hybrid device shall not be marked with an impact class.

38.3.5 A lanyard-actuated manual inflation system shall be marked "JERK TO INFLATE" on the handle, with an arrow indicating the intended direction of pull.

38.3.6 A hybrid device that is other than universal size shall be clearly marked on the inside of the collar or other prominent place with the chest sizes for which it is intended, in inches. The size shall be expressed as a range of not less than 2 inches (for example, 30 – 32 inches). If the marking is not visible when the device is packaged, it shall also appear on the outside of the package.

38.3.7 A hybrid device having a fabric cover shall be marked "WARNING – DO NOT DRY CLEAN."

38.3.8 To comply with Exception No. 4 to 8.11, a hybrid device shall be marked "THIS DEVICE IS NOT TO BE FASTENED TO THE BOAT," or the equivalent. Also, see 41.4. In any case, a device shall not be marked to indicate that attachment to a boat is acceptable.

38.3.9 A hybrid device having a component that requires replacement after use shall be marked to indicate an acceptable replacement by manufacturer and model number and size.

38.3.10 If a manufacturer produces hybrid devices at more than one factory, each device shall have a distinctive marking to identify it as the product of a particular factory.

SUPPLEMENTARY INFORMATION

39 General

39.1 Each device shall be accompanied by an information pamphlet and owners manual, which shall be provided in accordance with 39.2 – 39.5 and which shall incorporate the texts specified in 40.1 and 41.1.

39.2 The text specified in 40.1 (a) and (b) shall be provided so that it can be read prior to purchase of the device. The text specified in 40.1 (c) – (f) shall be provided together with the text specified in 40.1 (a) and (b) (on additional sheets of the pamphlet, or the like), but need not be visible prior to purchase. The owner's manual specified in 41.1 shall be provided to be readable after purchase.

39.3 If the device package is not transparent, the text specified in 40.1 (a) and (b) may be printed directly on the outside of the package or may appear on a separate pamphlet so that it is legible to the purchaser. The text specified in 41.1 shall be printed in a manual enclosed in each package.

39.4 If the device package is transparent, the text specified in 40.1 (a) and (b) shall be printed on a pamphlet enclosed in each package so that the text can be read through the package. The text specified in 41.1 shall be printed in a separate manual.

39.5 If the device is not provided in a package, the texts specified in 40.1 and 41.1 shall be printed in a separate pamphlet and manual, respectively, that are attached to the device.

40 Information Pamphlet

40.1 The following text shall be verbatim and shall conform with the location requirements in 39.2 – 39.5. The text specified in (b) shall be accompanied by illustrations of the types of devices being described. The illustrations provided may be photographs or drawings of the manufacturer's own products or, where this is not possible, may be illustrations of other USCG approved PFDs. The text shall be printed in the sequence shown and shall be preceded by the words "Do not remove prior to sale." Additional information, instructions, or illustrations shall not be included within the required text. The type size shall be not smaller than 8-point.

a) "FEDERAL REGULATIONS REQUIRE PERSONAL FLOTATION DEVICES