UL 1180

STANDARD FOR SAFETY

Fully Inflatable Recreational Personal Flotation Devices

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UL Standard for Safety for Fully Inflatable Recreational Personal Flotation Devices, UL 1180

Second Edition, Dated February 13, 2009

Summary of Topics

This revision to ANSI/UL 1180 dated May 27, 2021 includes the removal of Low Mark requirements for Type III Inflatables; 24.4, 24.5 and SA6.4.2

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 revised requirements are substantially in accordance with Proposal(s) on this subject dated March 26, 2021.

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Standard for Fully Inflatable Recreational Personal Flotation Devices

First Edition – May, 1995

Second Edition

February 13, 2009

This ANSI/UL Standard for Safety consists of the Second Edition including revisions through May 27, 2021.

The most recent designation of ANSI/UL 1180 as an American National Standard (ANSI) occurred on May 27, 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 adult recreational wearable devices having at least one buoyancy compartment that relies upon inflation by gas or other medium to provide flotation to the wearer, for use by individuals at least 16 years of age and weighing 80 pounds (36.3 kg) or more.

1.2 These requirements cover devices intended for general boating activities where impacts with the water or other objects (i. e. those which occur during water skiing, white water paddling, personal watercraft use, and parasailing) are not likely.

1.3 These requirements cover rearming kits for the devices covered by this Standard.

1.4 Several levels of performance are set out by this standard to meet the needs of various boating activities, locations, and water conditions. The performance levels are designated by performance type.

1.5 *Deleted*

2 References

2.1 The following alpha-numeric list of Standards related to the American Society for Testing and Materials (ASTM) is provided for reference purposes:

a) Method for Salt Spray (Fog, Testing), ASTM B117-94.

b) Method for Rubber Property – Effect of Liquids, ASTM D471-79(R1991).

c) Methods of Testing Coated Fabrics, ASTM D751-89.

d) Method for Gas Transmission Rate of Plastic Film and Sheeting, ASTM D1434-82(R1992).

e) Method for Failure in Sewn Seams in Woven Fabrics, ASTM D1683-90a.

f) Practice for Operating Light Exposure Apparatus (Carbon-Arc Type) With or Without Water for Exposure of Nonmetallic Materials, ASTM G23-93.

3 Units of Measurement

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

4 Definitions

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

4.2 CLOSURE, PRIMARY – A primary closure is considered to be 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.

4.3 CLOSURE, SECONDARY – A secondary closure is considered to be a closure that meets the following:

a) Does not result in the device being donned as intended if it is the only closure that is closed on the device; and

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

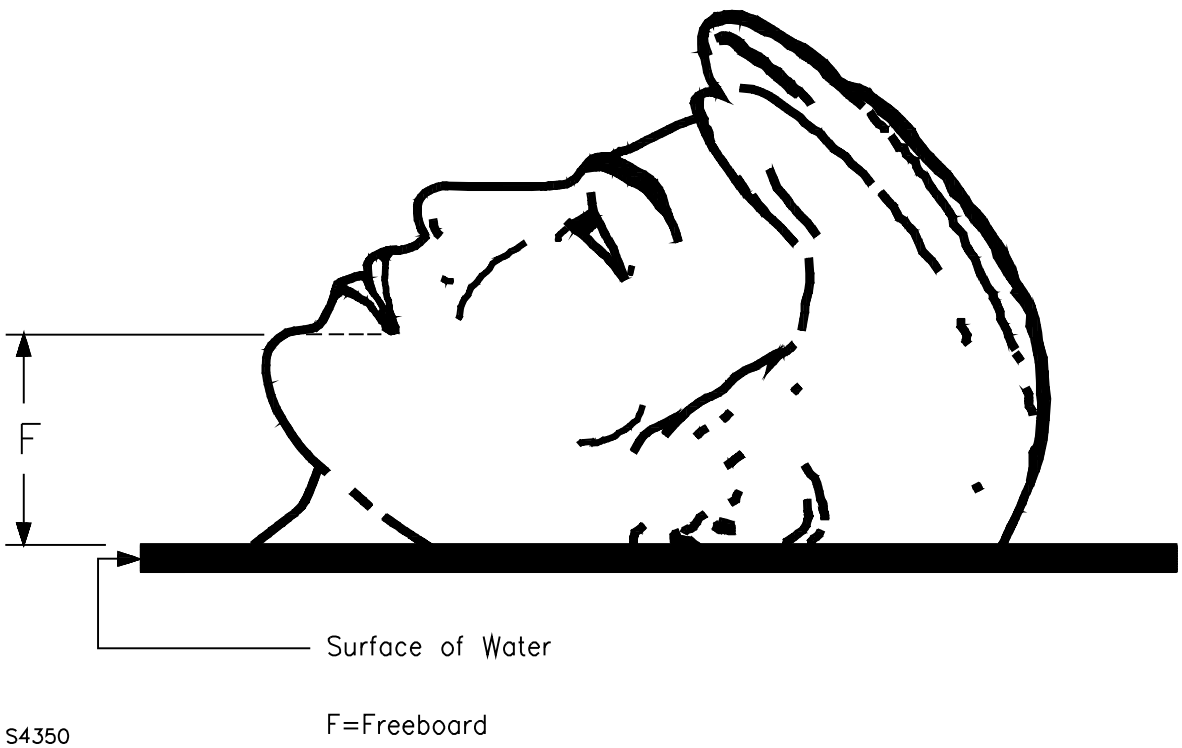
4.4 DESIGN INFLATION RANGE – The range of buoyancy and pressure, as specified by the manufacturer, to which a compartment may be inflated to provide the intended in-water performance.

4.5 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. A positive angle is achieved when a user's forehead is higher than their chin.

4.6 FREEBOARD – A distance measured perpendicularly from the surface of the water to the lowest point where the wearer's respiration may be impeded, typically to the corner of the mouth. See Figure 4.1.

Figure 4.1

Freeboard



4.7 FULL INFLATION – A chamber or chambers inflated to any value within the design inflation range.

4.8 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.

4.9 H. E. L. P. (HEAT ESCAPE LESSENING POSTURE) POSITION – A position recommended by the United States Coast Guard and the American Red Cross to lessen the rate of body heat loss in cold water. In the H. E. L. P. Position, test participants have their knees drawn up toward their chests, their faces forward and out of the water, their upper arms held at their sides, and their lower arms folded across their chests.

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

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

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

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

c) MANUAL INFLATION SYSTEM – A system that inflates one or more compartments when activated by a single deliberate user action, such as by the pulling of a lanyard, and which has no provision for automatically actuated inflation.

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

4.12 JACKET – A device having sleeves.

4.13 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 (November 21, 1983).

4.14 LOT NUMBER – A marking assigned to each group of PFD's produced which incorporates a means for the user to identify the year and quarter of manufacture of the device (unless provided elsewhere). If a manufacturer produces PFDs at more than one factory, the lot number shall also provide a means of identifying the device as the product of a particular factory, although this information may be coded.

4.15 PERFORMANCE TYPE – The classification of the level and redundancy of assistance provided to the wearer based on the device's in-water flotation characteristics, number of compartments, and need for second stage donning as follows:

a) Type I devices have at least two flotation compartments, turn the largest percentage of participants face up, support the wearer's head such that the mouth is well clear of the water, and do not require second stage donning.

b) Type II devices have at least one flotation compartment, turn most test participants face up, support the wearer's head such that the mouth is well clear of the water, and do not require second stage donning.

c) Type III devices have at least one flotation compartment, turn many test participants face up, and support the wearer's head such that the mouth is well clear of the water, but may require second stage donning to achieve this in-water performance.

4.16 REFERENCE VEST – Stearns Manufacturing Company Model 1150, 30 – 52 inches (762 – 1321 mm) adult, inflatable PFD or equivalent. The vest utilizes a single 35 lbf (156.9 N) buoyancy chamber, built in sailing harness design with nylon chestbelt and shoulder harness, and a stainless steel front chest closure.

4.17 SECOND-STAGE DONNING – Additional donning or adjustment that is required to place the device in its functioning position from the position in which it is normally worn.

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

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

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

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

4.22 TORSO ANGLE – The angle between a vertical line and a line passing through the shoulder and hip. A positive angle is achieved when a test participant's hips are forward with respect to their shoulders.

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

4.25 UNIVERSAL SIZE – A size of device constructed to fit, as a minimum, persons in the 5th through 95th percentile of the adult U.S. population, as reported by the National Center for Health Statistics, with respect to height and girth. The universal size includes the chest size range of 30 – 52 inches (80– 130 cm).

4.26 USCG APPROVAL TYPE – A classification assigned based on a device's performance, serviceability, and status indicators.

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

4.28 WHITE WATER PADDLING – Any activity with a vessel on Class II and above rapids as determined by the six-class “International Scale of River Difficulty[4.28]”. This definition applies only to those sections of the river with such rapids, and not the entire river.

[*] American Whitewater, PO Box 1540, Cullowhee, NC 28723; 1-866-BOAT-4-AW; http://www. americanwhitewater. org/; info@amwhitewater.org.

CONSTRUCTION

5 Inflatable Devices

5.1 The construction and assembly of an inflatable device shall be judged with respect to its intended use as well as the requirements in this standard.

6 Components and Materials

6.1 A component of a device covered by this standard shall:

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a) Comply with the requirements for the component in the Standard for Components for Personal Flotation Devices, UL 1191; and

b) Comply with any USCG requirements for the component.

6.2 Unless its function is such that failure of the component will not affect the ability of the device to meet the requirements of this standard, a nonmetallic component of an inflatable device which is permanently covered shall retain at least 60 percent of its as-received strength after being subjected to 100 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 G23-93, using apparatus designated Type E. The lower arcs are to be No. 15 copper clad carbon. The black panel temperature is to be 68 ±5°C (155±10°F) per Federal Standard 191A, Method 5804-90. The arcs are to be replaced and the corex D glass cleaned every 24 hours.

6.3 Unless its function is such that failure of the component will not affect the ability of the device to meet the requirements of this standard, a nonmetallic component of an inflatable device which may be exposed to sun light when in service 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 G23-93, using apparatus designated Type E as specified in 6.2.

6.4 Inflation chamber compartment material shall retain at least 90 percent of its strength and the rate of transmission of CO_2 gas through the material shall not be increased by more than ten percent after being subjected to the mildew resistance test specified in Federal Test Method, Standard 191, Method 5762-78, when untreated cotton is used as the control specimen.

6.5 Unless it is expendable, or if failure of the component will not affect the ability of the device to meet the requirements of this standard, a metallic component of an inflatable device shall have salt water and salt air corrosion characteristics equal or superior to 410 stainless steel, or perform its intended function and have no visible pitting or other damage on any surface after 720 hours of salt spray testing in accordance with ASTM B117-94.

Exception: An expendable component need not be of corrosion-resistant material, provided that the component is provided with a durable zinc or cadmium plating, or is equivalently protected against corrosion.

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

Exception: Where galvanic compatibility cannot be provided, an expendable component may be utilized as a sacrificial anode.

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

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

7 Sizing and Arrangement

7.1 An inflatable device shall not be constructed for persons weighing less than 80 lbs (36 kg).

7.2 Type II and Type III performance inflatable devices shall be constructed to fit chest sizes over a marked range of at least 2 inches (51 mm). Type I performance devices shall be constructed to fit chest

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sizes over a marked range of at least the universal chest size range. In addition, all devices shall fit users having chest sizes 1.5 inches (38 mm) above and below the marked chest size range.

7.3 Hardware shall be arranged and attached to facilitate operation.

7.4 For devices which do not require second stage donning, oral and manual inflation systems shall be located and arranged to be operated by either hand of the wearer in a single deliberate action. Moving an unsecured flap, or the like, to gain access to the actuation means is not to be considered a deliberate action. For an oral inflation system, this requirement applies to the device in any intended condition of inflation, except the uninflated, packed condition. In this regard, the term "operated" refers only to the action of bringing the inflation tube to the mouth (not to the process of oral inflation). For devices which require second stage donning, manual inflation systems shall be located and arranged to be operated by either hand of the wearer in a single deliberate action with the device in the donned, packed condition, and oral and manual inflation systems shall be located and arranged to be operated by either hand of the wearer in a single deliberate action after second stage donning has been completed.

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

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

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

8 Inflatable Compartments

8.1 A Type I performance device shall have at least two inflatable compartments.

8.2 Type II and Type III performance devices shall have at least one inflatable compartment.

9 Over-Pressure-Relief Valves

9.1 Over-pressure-relief valves may only be provided on one compartment of a multi-compartmented device. If provided, an over-pressure-relief valve shall be located and arranged to reduce the likelihood of the valve becoming blocked or otherwise rendered ineffective.

10 Inflation Systems

10.1 An inflatable device shall be provided with inflation systems in accordance with 10.2 – 10.7, as applicable.

10.2 A Type I performance device shall have a Use Code 1F automatic or manual-auto inflator on one compartment which shall be mounted such that its status indicator is viewable before and after donning the device. A second compartment shall have a Use Code 3F or 6F manual, or Use Code 1F, 2F, or 6F manual-auto inflator mounted so the status indicator(s) are accessible for checking prior to donning the device.

10.3 A Type II performance device shall have a Use Code 1F or 2F manual-auto inflator or both a Use Code 1F automatic inflator and a Use Code 3F or 6F manual inflator. The manual-auto inflator and

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automatic inflator shall be mounted on the PFD so the status indicator(s) can be viewed before and after donning the device. The manual inflator shall be mounted on the PFD so the indicator(s) can be easily accessed for checking prior to donning the device.

10.4 A Type III performance device shall have at least one Use Code 3F manual inflator or one Use Code 1F or 2F manual-auto inflator on one compartment which shall be mounted on the PFD such that its indicator(s) can be viewed before and after donning the device.

10.5 A Type V device shall use an inflation system that complies with the appropriate supplement to the standard, or the following .

a) For those Type V PFDs provided with at least one 6F manual or manual-automatic inflator, the cylinder shall be easily accessed for checking its status prior to donning the PFD. The devices shall be marked as Type V PFDs, APPROVED ONLY WHEN WORN and incorporate educational material into the Owners Manual, Think Safe pamphlet, and approval label on the risk of not checking the indicators and cylinder cap prior to each use; or

b) For those Type V PFDs provided with at least one non-convertible Use Code 6F manual-auto inflator, the cylinder shall be easily accessed for checking its status prior to donning the PFD. These devices shall be marked as Type V PFD, APPROVED ONLY WHEN WORN and meet the following requirements:

1) Incorporate educational material on the risk of premature inflation in the "THINK SAFE" pamphlet, and the "Owner's Manual" with the PFD.

2) Include a label that states DO NOT ALTER THIS PFD. Contact [insert Manufacturer and phone] for adjustment/replacement if dissatisfied with performance of the inflator".

10.6 All inflatable devices shall be provided with both an oral inflator and either an manual-auto or manual inflator for each compartment whose presence is required for the device to meet the in-water performance requirements of this standard.

Exception: Type I performance devices may be provided with only automatic and oral inflators on one compartment (see 10.2).

10.7 Where a device has one or more redundant compartments which are not required to be inflated to achieve the in-water performance requirements, then the redundant compartment(s) may be fitted with an oral inflation system only. (For Type I performance devices this applies to compartments in excess of two.)

10.8 Inflation systems shall be located in a manner which permits servicing equivalent in ease to that performed in the Standard for Components for Personal Flotation Devices, UL 1191.

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

11 Deflation Systems

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

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

b) Reduce the likelihood of unintentional operation;

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

d) Not be lockable in an open position.

12 Closure, Adjustment, and Attachment Means

12.1 An inflatable device shall incorporate strapping or other means of adjustment that provides a secure fit (as tight as possible without causing discomfort, or as tight a fit as is consistent with the intended use).

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

12.3 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.

12.4 Body straps shall be permanently attached to the device using box-x stitching covering a minimum area of 0.3125 sq. inch per inch (7.9 sq. mm per mm) of webbing width or the equivalent, such as two bar-tack stitches bracketing the same minimum area and providing equal or greater strength. Equivalent performance is to be determined based on peal and shear strength test results.

12.5 Where body straps are held in their intended positions using belt loops or belt tunnels, the opening width of the loop or tunnel nearest the free end of the body strap shall not be more than 3/4 inch (19 mm) greater than the width of the body strap webbing, or shall be sized so as not to permit the unsecured end of the primary closure to pass through the opening.

Exception No. 1: Devices may have larger belt loop and belt tunnel openings provided they successfully meet the Use Characteristics Tests Sections 16 – 27 with the body straps free of the belt loops and/or tunnels.

Exception No. 2: This requirement does not apply to sliding belt loops provided to stow excess strap lengths while the device is worn.

12.6 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.

12.7 Drawstrings shall be positively secured to the device using means other than a knot alone. Drawstrings shall also:

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

b) Have a positive closing mechanism; or

c) Comply with the tieability requirements for tie tapes as specified in the standard for Components For Personal Flotation Devices, UL 1191.

12.8 For devices where the inflatable chambers may be displaced if worn by users having a chest size greater than those for which the device is intended, body straps shall have no more than 3 inches (76 mm) of remaining adjustment when measured:

a) On the largest test participant successfully tested in accordance with the Use Characteristics Tests in Sections 16 – 27; or

b) With the device placed over a cylinder having an outer circumference equal to the maximum chest size for which the device is intended.

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

Exception No. 1: This requirement does not apply to harness assemblies, or the like, intended to be attached to harness lines during activities such as board-sailing or hiking out on a sailboat, and that have been investigated and found to be acceptable for the application.

Exception No. 2: This requirement does not apply to a means that is rendered inoperative when subjected to the Miscellaneous Fastener Strength Test, Section 33.

Exception No. 3: This requirement does not apply to a device provided with an owner's manual containing the text specified in B15.4.

13 Seams and Stitching

13.1 A lock stitch shall be used for a structural seam formed by sewing. Also, see Seam Strength Test, Section 35.

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

13.3 Thread and fabric combinations shall be compatible.

13.4 A structural seam shall have at least 1/2 inch (12.7 mm) of seam allowance or have equivalent mechanical characteristics. The equivalency of the mechanical characteristics is to be determined by the Seam Breaking Strength Test – Overedge Stitch evaluation in the Standard for Marine Buoyant Devices, UL 1123, except that the candidate stitch is to be compared to a 1/2 inch (12.7 mm), ssA-1 seam produced with size E thread meeting the requirements of Federal Standard V-T-295E(1985) or V-T-285F(1991), at 9 stitches per inch (.35 stitches/mm).

13.5 Window material attachments to the PFD shall have minimum seam strength (sewn or welded) of 53 N (12 pounds) for a 1-inch grip, in an as received condition, using the test method in Section 35, Seam Strength Test.

14 Buddy Line

14.1 A buddy line installed on a PFD shall comply with the requirements specified in 14.2, Section 44, Pull Test, and Section 55, Buddy Line Identification.

14.2 The buddy line shall be a minimum of 600 mm (24 inches) long and shall be attached so that risk of the buddy line snagging is reduced. Means of stowage shall be provided to secure the buddy line to the PFD, so that it is not a snag hazard.

PERFORMANCE

GENERAL

15 Selection and Preparation of Test Samples

15.1 Representative samples of an inflatable device shall be subjected to the applicable Use Characteristics Tests described in Sections 17 – 27, and the Physical Properties Test in Sections 28 – 31, 33, 36 – 41, and 43. Components or material specimens are to be used for the Physical Properties Tests specified in 32.1, Sections 34, 35, and 42.

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15.2 A device having an optional or detachable feature, such as a harness assembly, which may adversely effect performance of the device shall be tested both with and without the optional or detachable feature in place.

15.3 For tests involving inflation of sample compartments to specific pressures, the inflation systems provided on the device may be modified to permit external pressurization, measurement of pressure, and the like.

15.4 If one or more compartments experience significant dimensional changes between the minimum and maximum pressure values of the design inflation range, the Use Characteristics Tests specified in Sections 22 – 27 are to be repeated with the inflation compartment(s) inflated to a sufficient number of buoyancy/pressure values within the design inflation range to demonstrate compliance with these requirements over the entire design pressure range.

USE CHARACTERISTICS TESTS

16 Test Participants

16.1 For the Use Characteristics Tests described in Section 17 – 27, human test participants as specified in Table 16.1 are to be employed. A test participant shall not be familiar with the particular device under test, but may be familiar with PFDs in general. Prior to testing, test participants are to be given a video orientation which covers the following topics:

a) The general purpose of an inflatable PFD.

b) General information regarding inflation medium containers.

c) General demonstration of reference vest donning.

d) The general principal and method of manual inflation.

e) The general principal and method of automatic inflation.

Table 16.1
Test subject 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 test participants are to be within the Intended chest size range of the device; except that one subject shall have a chest size 1 ±0.5 inch (25 ±13 mm) larger than the marked maximum size, and one test participant shall have a chest size 1 ±0.5 inch smaller than the marked minimum size.

2. Test participants may be any combination of males and females, provided that at least one male and one female is used. Participants shall have basic swimming skills (e.g. be capable of treading water for 1 minute).

Table 16.1 Continued on Next Page

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Table 16.1 Continued

Chest size adjustment range of device, inches (mm)	Number of test participants
3. 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 16 years of age, his or her test results may be excluded for the Ease of Donning, Adjustment and Operation Test, Section 17, Inflated Donning Test, Section 18, Ease of Use Test, Section 19, Post-Donning Ease of Adjustment Test, 20, In-Water Second-Stage Donning Test, Section 22, or Rearming and Repacking Test, Section 26, 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, but not necessarily identical to the excluded participant.	
4. A series of marked sized devices (for example, S,M,L,XL) utilizing the same inflation chamber is considered a single chest size adjustment range when the cover and closure materials differ proportionally over the chest size range. Test participant selection shall be such that each individual chest size range is represented proportionally and in accordance with Note 1.	

16.2 Each test participant is to wear a swimsuit, unless the attire customary to the designated purpose of the device may adversely affect the test results, in which case the tests are to be repeated with at least one test participant wearing such attire and representing size(s) that most adversely affect the devices performance.

17 Ease of Donning, Adjustment and Operation Test

17.1 All size adjustments are to be adjusted to their halfway point without the direct observation of the test participant. Where the halfway point is not inherently obvious due to the design of the device (i.e. an encircling body strap with only a single point of attachment), the test engineer is to move the adjustments to the point that best approximates the mid-point for the range of user sizes for which the device is to be rated. Zippers are to be opened with the slider located at the retainer end of the zipper. Buckles are to be opened, and tie tapes and drawstrings are to be untied. Side adjustment lacing hardware components are to be in their locked position. Where belt loops are located within the range of the tabbed end of a body or the chest strap webbing, the tabbed end of the webbing is to be routed through the belt loop. (Also, see 12.5).

17.2 When an inflatable device is tested as described in 17.3 – 17.5:

a) Complete donning, adjustment to a secure fit, and inflation shall be accomplished within 1 minute in the first donning attempt described in 17.4, or within 45 seconds in the second donning attempt described in 17.5. For Type III performance devices which require second-stage donning and additional oral inflation, or both, the measured time shall include the time required for the test participant to perform the first stage donning, the second-stage donning, and the inflation.

b) Two or more test participants shall not don the device in a like manner which is other than that intended and which results in the test participants believing that the device has been correctly donned.

c) For Type I and Type II performance devices, there shall be no intermediate donning configuration in which the device appears to be in a stage intended for use. (i.e., Type I and Type II performance devices shall not be designed for second stage donning).

17.3 The uninflated candidate device is to be given to the test participant at pool side with the instruction "Please put this on as quickly as possible, adjust to fit snugly, and inflate." The donning attempt is then to be timed. Test participants are not to be permitted to remove the device once donned (in order to manipulate adjustments or closures).

17.4 If donning, adjustment, and inflation of the candidate device is not achieved within 1 minute, when tested as specified in 17.3, an uninflated reference vest is to be given to the test participant at pool side with the instruction "Please put this on as quickly as possible, adjust to fit snugly, and inflate." The donning

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attempt is then to be timed. Test participants are not to be permitted to remove the device once donned (in order to manipulate adjustments or closures). If the reference vest cannot be donned within 1 minute, the test participant is to be disqualified and replaced.

17.5 If donning, adjustment, and inflation of the candidate device is not achieved within 1 minute when tested as specified in 17.3, and the participant qualified with the reference vest when evaluated in accordance with 17.4, the test participant is to be given a maximum of 2 minutes to review any written and pictogram donning instructions visible on the device and the test is to be repeated. Oral instruction and donning assistance are not to be given.

18 Inflated Donning Test

18.1 Donning and complete adjustment of an inflated device to a secure fit, and reinflation if necessary, shall be accomplished within 2 minutes by each test participant when an inflatable device is tested as specified in 18.2 and 18.3.

18.2 This test is to be conducted after the ease of donning, adjustment, and operation test specified in Section 17, Ease of Donning, Adjustment and Operation Test. A sample of the device is to be prepared as described in 17.1, 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 "Do what is needed to put this device on as quickly as possible, and adjust it to fit snugly." Further instructions are not to be given. If partial deflation is used to ease donning, the test participant is to be instructed to orally reinflate the device until it is firm.

18.3 If donning, adjustment, and reinflation (if required) of the inflatable device on a test participant is not achieved within 2 minutes after the instructions specified in 18.2 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 (see Figure 49.1) and the test is to be repeated.

19 Ease of Use Test

19.1 The device is to be correctly donned and adjusted in the uninflated condition, and any automatic inflation systems are to be disabled. Each test participant is then to be instructed to enter a pool of fresh water and position his or her body in the middle of the pool while treading water. A manual inflation system activator (e.g. lanyard) shall be accessible and operable by either hand of each test participant while in the water. With the device correctly donned and adjusted in the fully inflated condition, the deflation and oral inflation systems shall be accessible and operable by either hand of each test participant while in the water.

19.2 The device is to be correctly donned and adjusted in the uninflated condition, and automatic and manual inflation systems are to be disabled. Each test participant is to then be instructed to enter a pool of fresh water and position his or her body in the middle of the pool while treading water. With each test participant treading water, the device shall permit unpacking and oral inflation sufficient to provide the test participant with a positive freeboard within 45 seconds.

20 Post-Donning Ease of Adjustment Test

20.1 With the device donned and prior to entering the water, each test participant shall demonstrate his or her ability to adjust the device to snugger and looser conditions without having to remove the device, or open any closures to operate any adjustments. Such demonstration is to be made with the wet device donned and adjusted in the uninflated condition and immediately following inflation. In addition, at least one test participant shall be evaluated in a dry state.

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20.2 The demonstration required in 20.1 is then to be repeated with the test participant floating in the water with the device inflated.

21 Water Entry Tests

21.1 Devices not requiring second stage donning are to be tested using the parameters outlined in Table 21.1 or Table 21.2 and when so tested shall:

a) Not present a risk of injury to persons;

b) Not be damaged;

c) Maintain their intended use positions on each test participant; and

d) Have automatic and manual-auto inflation systems activate when armed.

Table 21.1
Water entry test procedures (Type I)

Test #	Automatic and manual-auto inflators	Pre-donning condition	Fully inflate after donning?	Water entry / height
1	Disarmed	Uninflated	Yes	Jump[a] / 1m (3.3 ft)
2	Armed	Uninflated	No	Jump[b] / 4.5m (14.85 ft)
3	Disarmed	Inflated	Yes[c]	Jump[b] / 4.5m (14.85 ft)

[a] With hands over the head.
[b] Test participant may hold on to the device.
[c] Sample to be inflated to maximum pressure of the design inflation range or 0.6 psi (4.14 kPa), whichever is the greater pressure.

Table 21.2
Water entry test procedures (Type II or Type III)

Test #	Automatic and manual-auto inflators	Pre-donning condition	Fully inflate after donning?	Water entry / height
1	Disarmed	Uninflated	Yes	Jump[a] / 1m (3.3 ft)
2	Armed	Uninflated	No	Jump[b] / 3m (9.8 ft)
3	Disarmed	Inflated	Yes[c]	Jump[b] / 3m (9.8 ft)

[a] With hands over the head.
[b] Test participant may hold on to the device.
[c] Sample to be inflated to maximum pressure of the design inflation range or 0.6 psi (4.14 kPa), whichever is the greater pressure.

21.2 Type III devices requiring second stage donning are to be tested using the parameters outlined in Table 21.3 and when so tested shall:

a) Not present a risk of injury to persons;

b) Not be damaged;

c) Maintain their intended use positions on each test participant; and

d) Have automatic and manual-auto inflation systems activate when armed.

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Table 21.3
Water entry test procedures (Type III devices requiring second-stage donning)

Test #	Automatic & manual-auto inflators	Pre-1st stage donning condition	Fully inflate after 1st stage donning?	2nd stage don?	Fully inflate after 2nd stage donning?	Water entry / height
1	Armed	Uninflated	No	No	No	Jump[a] / 3m (9.8 ft)
2	Armed	Uninflated	No	No	No	Dive / 1m (3.3 ft)
3	Armed	Uninflated	No	Yes	No	Jump[a] / 3m (9.8 ft)
4	Disarmed	Inflated	N/A	Yes	Yes	Jump[a] / 1m (3.3 ft)
5	Disarmed	Inflated	N/A	Yes	Yes[c]	Jump[b] / 3m (9.8 ft)

[a] With hands over the head.
[b] Test participant may hold on to the device.
[c] Sample to be inflated to maximum pressure of the design inflation range or 0.6 psi (4.14 kPa), whichever is the greater pressure.

21.3 In addition, immediately following water entry and automatic or manual inflation as intended, Type III performance devices shall not tend to turn any test participants face down from a position of face-up, stable flotation.

21.4 If a design reveals water entry configurations (device inflation/donning condition, user body angle and position during water entry) that are deemed to be more critical than those described in Table 21.1, Table 21.2, and Table 21.3, then these configurations are also to be tested.

21.5 A device is considered in its intended use position if:

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

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

c) The device does not come completely off the head.

21.6 Before water entry, each test participant is to be instructed that after surfacing after water entry, the device is not to be adjusted unless the participant's personal safety is threatened.

22 In-Water Second-Stage Donning Test

22.1 Type III performance devices which require second-stage donning shall be completely donned, adjusted to a secure fit, and inflated (in any order) within 30 seconds when tested as described in 22.2 – 22.3.

22.2 Immediately after surfacing following Water Entry Test No. 1 described in Table 21.3, the test participant is to be instructed "Please inflate the device and then finish putting the device on" for devices without automatic inflation or "Please finish putting the device on" for devices with automatic actuation. The donning attempt then is to be timed. Test participants are not permitted to remove the device once donned (in order to manipulate adjustments or closures).

22.3 For devices without automatic inflation means, immediately after surfacing following Water Entry Test No. 2 described in Table 21.3, the test participant is to be instructed "Please finish putting the device on and then inflate it." The donning attempt is then to be timed. Test participants are not to remove the device once donned (in order to manipulate adjustments or closures).

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23 Turning Test

23.1 When tested as specified in 23.2, inflatable devices as prepared or pretested as indicated in Table 23.1 shall comply with the requirements in Table 23.2.

23.2 Each test participant is to take at least three gentle breast strokes and then, with minimum headway, relax completely (with the head down) simulating a state of utter exhaustion while exhaling slowly to their functional residual capacity. The test participant is to remain limp in this position long enough to determine the final stabilized attitude of static balance. The turning time is to be recorded. The test participant is then to repeat the turning procedure two additional times. The turning time is considered to be the average time for the three attempts.

Table 23.1
Turning test sample preparation / pretesting

Inflatable Devices shall meet the Turning Test performance requirements:
A. Following Water Entry Test No. 1 in Table 21.1 and Table 21.2 for devices which don't require second stage donning.
B. Following the In-Water Second-Stage Donning Test described in 22.2 for devices which require second stage donning.
C. Following any other Water Entry Test described in Table 21.1, Table 21.2 or Table 21.3 (as appropriate) in which the device has noticeably shifted from the position obtained in A or B.
D. With the device inflated to 0.6 psi (4.14 kPa) or the minimum pressure of the design inflation range, whichever is the lesser pressure.
E. With the device inflated to the maximum pressure of the design inflation range for devices where the shape or volume of the inflation compartment(s) will be noticeably altered from that achieved via manual or automatic inflation. (i.e., Water Entry Test No. 3 from Table 21.1, Water Entry Test No. 3 from Table 21.2, or Water Entry Test No. 5 from Table 21.3)
F. Following a single deliberate user action for devices having more than one manual inflation system, with any automatic inflators disabled.
G. With inflation systems operated alone and in any combination with other inflation systems provided on the device.
H. With either compartment individually inflated for a Type I device.

Table 23.2
Turning test performance requirements

Characteristic	Performance Type I devices	Performance Type II devices	Performance Type III devices
Minimum Percentage of Turns	100	96	80
Maximum Turning Time	5 seconds average for each test participant	5 seconds average for each test participant	6.5 seconds corrected[a]
[a] The corrected turning time is the average turning time for all turns divided by the fraction of turns per turning attempts.			

24 Static Flotation Tests

24.1 Inflatable devices shall meet the requirements in Table 24.1 for each test participant when tested in accordance with 24.2 – 24.3. These tests are to be performed immediately after each Turning Test series performed in Section 23, Turning Test. The device shall also comply with the following:

a) The inflation compartments of a candidate device shall not dislodge and tie tapes shall remain in the original tied position.

b) The inflation compartments shall remain in a position which produces a body list angle of less than 30 degrees measured from the vertical. If an angle of 30 degrees or more is measured and the pads have noticeably shifted, the test participant is to be instructed to remain in the water and

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attempt to correct the position of the pads by adjusting the device. The in-water correction shall be such that the pads are secured in place without the need for repeated adjustment or physical restraint by the test participant. The body list angle following such correction shall be less than 30 degrees.

c) An inflatable device shall not form channels having a tendency to direct water into the face of the wearer to an extent greater than that of the reference vest.

d) An inflatable device shall not permit a test participant in a position of relaxed flotation stability to place and maintain their head in a forward relaxed position in which their mouth touches the water.

Table 24.1
Static flotation performance requirements

Requirement	Performance Type I devices	Performance Type II devices	Performance Type III devices
Freeboard	The freeboard for each test participant shall be not less than 100 mm (4 inches) and the average freeboard for all test participants shall be not less than 120 mm (4.7 inches).	The freeboard for each test participant shall be not less than 85 mm (3.25 inches) and the average freeboard for all test participants shall not be less than 95 mm (3.75 inches).	The freeboard for each test participant shall be not less than 50 mm (2 inches) and the average for all test participants shall not be less than 75 mm (3 inches).
Torso Angle	The average of all subject's torso angles shall be at least 30 degrees back of vertical, and each individual subject's angle shall be at least 20 degrees back of vertical.	The average of all subject's torso angles shall be at least 30 degrees back of vertical, and each individual subject's angle shall be at least 20 degrees back of vertical.	Each individual subject's torso angle shall be greater than 0 degrees from the vertical.
Face Plane Angle	The average of all subject's faceplane angles shall be at least 30 degrees above horizontal, and each individual subject's angle shall be at least 20 degrees above horizontal.	Each individual subject's face plane angle shall be at least 20 degrees above horizontal.	Not Applicable
Chin Support	Required	Required	Required

24.2 Test participants who are successfully turned by the device in the final turning attempt required under Section 23, Turning Test, are to remain in the position of static balance achieved as a result of the final turn. Test participants who are not successfully turned by the device in the final turning attempt are to place their body in a vertical upright position and allow the device to bring them to a face-up position of static balance. While in the position of static balance, the test participant is to be instructed to "relax and breathe normally." The freeboard, face plane angle, and torso angle are to be measured while the test participant is at the lowest level attained during the normal breathing cycle.

24.3 Test participants are then to attempt to touch their chin to their chest while remaining in a position of relaxed static balance in order to determine whether the device provides chin support. A test participant is considered to have chin support if their mouth does not enter the water.

24.4 In the position of relaxed face-up static balance, each test participant, after repositioning the head when applicable, and when looking to the side shall see the water's surface at a point within 3 m (10 ft.) from the test participant's position and beyond.

Exception: Type III devices are not required to comply with 24.4.

24.5 In the position of relaxed face-up static balance, for all test participants, the average of the lowest mark on a vertical scale, which is placed 6 m (20 ft.) in front of the subject so that the test participant sees the scale without moving his or her head, shall not be higher than 0.3 m (12 in.) from the water level for

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performance Type II, test participants are able to reposition the head and the device, when applicable, and then relax for the measurement.

Exception: Type III devices are not required to comply with 24.5.

25 H.E.L.P. Position Test

25.1 When tested as described in 25.2, a device shall not cause any test participant to turn face down in the water when the test participant attempts to assume the H.E.L.P. position.

25.2 The test participant used during the tests specified in Static Flotation Tests, Section 24, static flotation tests are to be used for this test while still in the water. If necessary, test participants are to be instructed regarding the purpose and orientation of the H.E.L.P. position. Starting in a relaxed, face-up position of static balance, each test participant is to be instructed as follows:

"Slowly bring your legs up to your chest and try to put yourself in the H.E.L.P. position"

For Type III performance devices, the head may be held back for this test. For Type I and Type II performance devices, the device shall not require the wearer to hold their head back to maintain the H.E.L.P. position or the position as near to the H.E.L.P. position that can be attained.

26 Rearming and Repacking Test

26.1 When tested as described in 26.3, a device shall be rearmed and repacked in accordance with the manufacturer's instructions. Proper repacking includes, and is not limited to the proper stowing of inflations systems and lanyards, and refolding and securement of inflation chambers.

Exception: When repacking deviates from the manufacturer's instructions, the device shall comply in the abnormal repacked state with the Ease of Use Test, Section 19.

26.2 When tested in accordance with 26.6, complete donning, adjustment to a secure fit, and inflation shall be accomplished within 1 minute.

26.3 Each test participant shall be provided with a copy of the manufacturer's repacking instructions and shall be instructed to repack the device. When access to the inflation system is obstructed in any way, the rearming evaluations described in 26.4 and 26.5, are to be conducted. Inflation system rearming is able to be performed by the test engineer during the repacking when access to the inflation system is not obstructed in any way.

26.4 For test participant qualification for the rearming evaluation, each test participant is to be given the following written questions to respond to:

a) "Do you consider yourself to have mechanical aptitude?"

b) "Can you change a bag on a vacuum cleaner?"

c) "Do you assemble things such as toys?"

d) "With good instructions, would you be comfortable resetting a life vest inflation system?"

Test participants who respond negatively to any of the above questions are not to be used in the rearming evaluation.

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26.5 For the rearming evaluation, test participants qualified in accordance with 26.4 are to be informed that they are to rearm the inflation system and are to be provided with an incentive to perform the rearming correctly. The test participants are to be instructed that they are to be given two rearming kits and that they are free to test one of the kits when they need to do so in order to satisfy themselves that they can perform the rearming procedure properly. The participants are to be instructed that the rearming trial is completed when they present what they believe to be a properly rearmed device (which they have not actuated). Each test participant is then to be given the manufacturer's rearming instructions to be provided with each device (written, pictogram, video, etc.), two rearming kits, and access to the manufacturer's toll-free telephone number when provided. The test participant is then to be instructed to proceed with the rearming evaluation.

26.6 When the test participant indicates that rearming, when applicable, is complete and the device has been repacked, the device is to be given to the test participant with the instruction "Please put this on as quickly as possible, adjust to fit snugly, and inflate." The attempt is then to be timed. Test participants shall not be permitted to remove the device once donned (in order to manipulate adjustments or closures).

27 Pre-Inflated Automatic Discharge Test

27.1 Devices shall not be damaged when tested in accordance with 27.2 and shall not cause significant discomfort sufficient to affect immediate use under emergency conditions when tested in accordance with 27.4.

27.2 All inflation systems are to be armed and the undonned device is to be inflated through the oral inflation system to a pressure of 4.1 kPa (0.6 psig) while mounted on a frame which simulates the human body. All manual, automatic, or manual-auto inflation systems are then to be actuated and the internal pressure of the device is to be measured and recorded.

27.3 The device is to be pressurized to 1.5 times the pressure measured in 27.2, allowed to stand for 5 minutes, and then examined for evidence of seam damage or other changes that may result in failure when again pressurized to the measured pressure in 27.2. If the unit fails or shows signs of damage after the 1.5 times pressurization, it is to be replaced by another unit and the procedure repeated.

27.4 One male and female test participant who has a smaller waist circumference than chest circumference with the largest chest circumference that can fit in the uninflated device shall don the uninflated, unarmed device and enter a pool of water. The device shall be slowly inflated with water to the pressure measured in 27.2, or 34.5 kPa (5 psig), whichever is greater, or until the test participant indicates significant discomfort which would affect emergency use, whichever occurs first. When the test participant calls for the test to be stopped, the pressure attained is to be measured and recorded. When this pressure is at least 90 percent of the pressure measured in 27.2, and the same shape and tactile rigidity of the bladder as that obtained in 27.2 is obtained, the design shall comply with the requirement.

PHYSICAL PROPERTIES TESTS

28 Automatic, Manual-auto, and Manual Inflation Test

28.1 When tested in accordance with 28.2 – 28.3 an inflatable device inflation system shall comply with the following:

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

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

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

28.2 For manual and manual-auto inflation systems, a sample of the device is to be mounted on a torso frame or equivalent (see Figure 28.1 and Table 28.1) to approximate the intended position on a wearer. With the compartment pressure or buoyancy monitored as appropriate, the inflation system is to be manually activated and the time required for the compartment to enter the design inflation range is to be recorded.

28.3 Automatic and manual-auto inflation systems shall comply with the following:

a) A sample of the device is to be tested. The sample is to be mounted on a torso frame or equivalent (see Figure 28.1 and Table 28.1) to approximate the intended position on a wearer. With the compartment pressure monitored, the inflation system is to be tested by being rapidly submerged in a tank of fresh water, and then held so that the uppermost surface of the device is at a depth of at least 51 mm (2 inches). For this test, the water in the tank is to be maintained at 20 ±1°C (68 ±2°F). The device is to be at room temperature prior to submersion.

b) Timing is to begin when the automatic mechanism strikes the water. The sample is to be immersed in 5 different orientations:

1) Neck up, torso perpendicular to water surface;

2) Neck down, torso perpendicular to water surface;

3) Front down, torso parallel to water surface;

4) Back down, torso parallel to water surface; and

5) Shoulder down, torso parallel to water surface.

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Figure 28.1

Test form

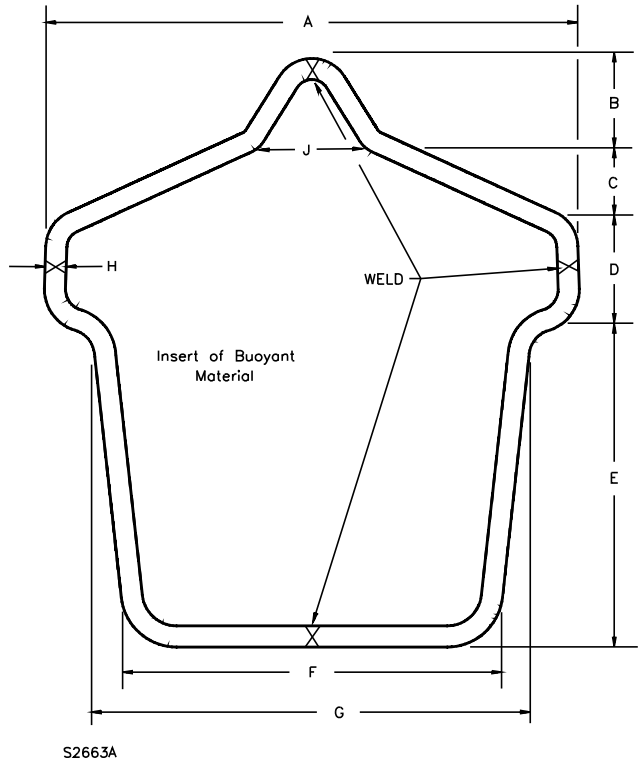

Table 28.1
Test form dimensions

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 burrs smooth.

3 – Prime and paint thoroughly.

29 Buoyancy Test

29.1 An uninflated device shall maintain a positive buoyancy after 15 minutes of submergence when tested in accordance with 29.5 – 29.10.

29.2 The buoyancy of the fully inflated device (minimum design inflation range buoyancy) shall not be less than the value indicated in Table 29.1 when tested in accordance with 29.4, and 29.6 – 29.10.

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Table 29.1
Minimum inflated buoyancy requirements

Requirement	Performance Type I devices	Performance Type II devices	Performance Type III devices
Minimum Buoyancy, N (lbf)	150 (33.7)	150 (33.7)	100 (22.5)

29.3 After 24 hours of submergence, the buoyancy of the inflated device shall not be less than 95 percent of the stabilized buoyancy achieved after a period of 15 minutes to 2 hours of submergence when tested in accordance with 29.4, and 29.6 – 29.10.

Exception: The buoyancy of a device inflated with carbon dioxide need not comply with this requirement after 24 hours of submergence, if the device complies with the requirements after not less than 6 hours of submergence and is provided with a user's manual containing the information specified in B15.5.

29.4 For the tests referenced in 29.2 and 29.3, compartments are to be inflated as follows:

a) For compartments supplied by more than one inflation system, each inflation system is to be tested independently.

b) For devices provided with more than one inflation compartment, each compartment is to be tested independently.

c) A compartment supplied by an oral system only is to be pressurized with air to 1.4 kPa (0.2 psig).

29.5 For the test referenced in 29.1, compartments are to be deflated with a vacuum of 10 inches (245 mm) of water until the compartments have been completely evacuated of air.

29.6 The buoyancy tests are to be conducted in a tank of water. Air entrapped in folds of fabric, or the like, is to be removed from the device immediately following submersion. This is to be accomplished by submerging the evacuated device and agitating the device by hand for a period of 3 minutes.

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

29.8 The ballasted basket is to be suspended from a scale calibrated to an accuracy of ±1 ounce (±28 g), and the weight of the submerged basket determined.

29.9 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 the specified test duration.

29.10 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).

30 Water Entrapment Test

30.1 An inflatable device shall not entrap more than 5 pounds-mass (2.3 kg) of water after submergence in water. The device is to be tested in both the uninflated and inflated conditions.

30.2 The device is to be submerged in an upright position for not less than 2 minutes. The device is then to be removed in a vertical upright position and immediately hung on a hanger from a weight scale having

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an accuracy of ±1 ounce (±28 g). Ten seconds after removal from the water, the total weight indicated on the scale is to be recorded. The device is then 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 30.1.

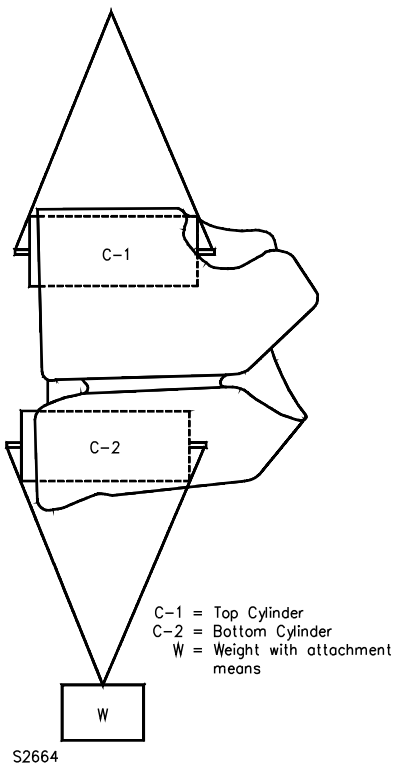
31 Body, Primary Closure, Shoulder, and Collar Strength Tests

31.1 An inflatable device shall not exhibit evidence of functional deterioration or impaired operation after being tested in accordance with 31.2 – 31.3. A friction type closure or adjustment assembly shall not slip more than 1 inch (25 mm) at any point of adjustment. Devices are to be tested in the uninflated condition and the inflated condition (to the maximum value of the design pressure range).

31.2 For horizontal load tests on the body and primary closure systems, 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 31.1). 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 specified in Table 31.1 is applied to the device. The total load is to include the weight (W), its attachment means, and the bottom cylinder (C-2). The load is to be applied for the duration specified in Table 31.1.

Figure 31.1

Body or primary closure systems test arrangement



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