



Subject 1191 (1123, 1175, 1177, 1197, 1517)

12 Laboratory Drive
Research Triangle Park, NC 27709
November 19, 1996

TO: Marine Council of Underwriters Laboratories Inc.,
United States Coast Guard,
Subscribers to UL's Standards Services for Components for Personal Flotation Devices;
Marine Buoyant Devices; Buoyant Cushions; Buoyant Vests; Immersion Suits; and
Hybrid PFDs

SUBJECT: Release of Foam Flotation Materials Having Commercial Use Codes by U.S. Coast
Guard Recognized Laboratory

As an alternate to Paragraphs 164.013-5 and 164.015-5 of the Code of Federal Regulations, and in accordance with the Memorandum of Understanding on PFDs and PFD Components between the United States Coast Guard and Underwriters Laboratories, UL has been granted the authority to release test reports and descriptive sections, prior to USCG review, for foam flotation materials that have been found to comply with the requirements for use in commercial-use personal flotation devices. This procedure is subject to the following restrictions:

1. The foam shall be manufactured using a previously approved resin type (i.e., polyvinyl chloride, polyethylene, ethylene vinyl acetate, nitrile butadiene rubber, or the like);
2. The foam shall be manufactured in thicknesses of at least 1/8 inch (3 mm) ; and
3. The formulation, manufacturing process, intended use, et cetera shall not vary from previously UL Recognized/USCG Accepted foam flotation materials to the extent that the foam is considered a new and unusual product.

In addition, UL may notify the manufacturer that Acceptance has been granted for foams meeting the above criteria in accordance with Subpart 164.013 or 164.015, as applicable, and Subpart 164.019, for use on inspected vessels, all uninspected commercial vessels, and all recreational boats.

Please note that the USCG's authorization letter to UL stated that use of the words "Coast Guard" or the like in marketing products is unlawful, unless specifically authorized by the U.S. Coast Guard, or unless clearly stating that Coast Guard acceptance is limited to the use of the product in USCG approved PFDs and then only as reviewed and authorized by the Coast Guard or its designated recognized testing laboratory (UL).

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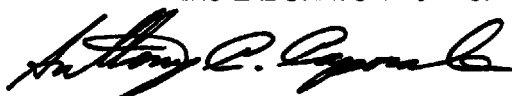
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Questions regarding interpretation of requirements for Foam Flotation Material or questions on this procedure should be directed to Anthony Caporale (919-549-1413) at UL's Research Triangle Park office.

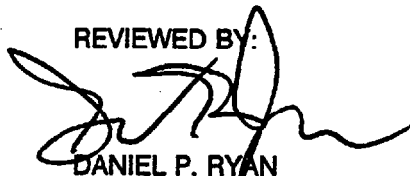
UL looks forward to exploring new ways of working with the PFD and related component industries and the USCG to improve service while maintaining the high standards of safety we have built together.

UNDERWRITERS LABORATORIES INC.

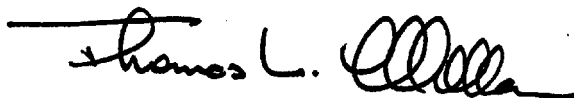


ANTHONY C. CAPORALE
Project Engineer
Engineering Services 115B
(919) 549 - 1413
caporalea@UL.com

REVIEWED BY:



DANIEL P. RYAN
Engineering Group Leader
Engineering Services 115B



THOMAS L. WOLLAN
Managing Engineer
Engineering Services 115

SR:SMB/ba

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12 Laboratory Drive
P.O. Box 13995
Research Triangle Park
North Carolina 27709-3995
(919) 549-1400
FAX No. (919) 549-1842



Subject 1123

12 Laboratory Drive
Research Triangle Park, NC 27709
November 11, 1996

TO: Marine Council of Underwriters Laboratories Inc.,
Subscribers to UL's Standards Service for Marine Buoyant Devices
Subscribers to UL's Listing Service for Commercial Special Use Devices (OPZY), Marine
Near-Shore Buoyant Vests (OQFZ), and Life Preservers and Lifejackets (OTPS)

SUBJECT: UL 1123 - Quarterly Production Volume Report

UL announces the request for completion of the attached form regarding quarterly production volume for the top ten follow-up procedure sections for each file.

As part of the USCG's shift to an oversight role in the PFD evaluation and Approval process, UL has been asked to provide the USCG with PFD production numbers to allow the USCG to target a weighted percentage of audits on high-volume products.

With the May 28, 1996 IAC meeting report, UL proposed a draft form for compilation of the data. Since all comments involving the form were supportive, UL is now ready to use this form and is requesting that this form be completed and returned. UL requests the completed information on the attached form by December 15, 1996 for the first, second, and third quarter 1996 production numbers. The information will remain confidential.

In regard to future reports, UL requests completed forms 30 days after the end of each quarter. Accordingly, the report for the fourth quarter of 1996 will be due January 30, 1997, the report for the first quarter of 1997 will be due April 30, 1997, and the schedule should continue in this manner.

Please send the completed forms for the first, second, and third quarters to Dan Ryan (919-549-1658) at UL's RTP Office no later than December 15, 1996.

Questions regarding the use of the form should be directed to Dan Ryan at UL's RTP Office.

UNDERWRITERS LABORATORIES INC.

BETTY C. ALLEN
Engineering Assistant
Standards Department
(919) 549-1896
FAX: (919) 547-6181
e-mail: allenb@ul.com

REVIEWED BY:

DANIEL P. RYAN
Engineering Group Leader
Engineering Services 115B
(919) 549-1658

SR:SMB

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REPORT TO UNDERWRITERS LABORATORIES INC.
ON QUARTERLY PRODUCTION VOLUME FOR TOP TEN FOLLOW-UP SERVICE PROCEDURE
SECTIONS RANKED IN ORDER OF DECREASING PRODUCTION VOLUME

Applicant Name: _____

Year and Quarter for report: 19____, Quarter (circle one) 1 2 3 4

Top Ten Sections	File	Volume	Section	Number of Devices Produced in quarter being reported
#1	MQ			
#2	MQ			
#3	MQ			
#4	MQ			
#5	MQ			
#6	MQ			
#7	MQ			
#8	MQ			
#9	MQ			
#10	MQ			

- Notes:
- 1) Files listed should only include those UL files describing personal flotation devices. Files describing components, USCG Approved products other than PFDs, and non-USCG Approved products should not be reported on.
 - 2) Production volumes reported for the top ten sections should be the total production numbers for all models, sizes, and styles described in the individual sections. Production volumes should not be broken down by model number. No File, Volume, Section should appear more than once in the above report.
 - 3) Mail this completed report within 30 days from the completion of each quarter to:

Underwriters Laboratories Inc.

P.O. Box 13995

Research Triangle Park, NC 27709

Attention: Engineering Services Department 1115

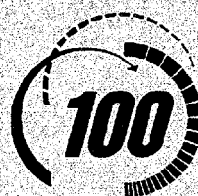
Personal Protective Equipment Team

Standard for Safety

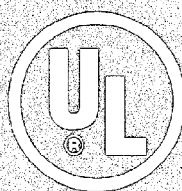
UL 1123

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Marine Buoyant Devices



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Standard



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Underwriters Laboratories Inc., founded in 1894, is chartered as a not-for-profit organization without capital stock, under the laws of the State of Delaware, to establish, maintain, and operate laboratories for the examination and testing of devices, systems and materials to determine their relation to hazards to life and property, and to ascertain, define and publish standards, classifications and specifications for materials, devices, products, equipment, constructions, methods, and systems affecting such hazards.

UL Standards for Safety are developed under a procedure which provides for participation and comment from the affected public as well as industry. The procedure takes into consideration a survey of known existing standards and the needs and opinions of a wide variety of interests concerned with the subject matter of the standard. Thus manufacturers, consumers, individuals associated with consumer-oriented organizations, academicians, government officials, industrial and commercial users, inspection authorities, insurance interests and others provide input to UL in the formulating of UL Standards for Safety, to keep them consonant with social and technological advances.

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March 29, 1996

Standard for

Marine Buoyant Devices

UL 1123, Sixth Edition

Accompanying this transmittal notice is a copy of the Sixth edition of UL 1123.

A CHANGE IS INDICATED BY A SMALL PRINT NOTE FOLLOWING THE AFFECTED ITEM.

THIS EDITION OF THE STANDARD IS NOW IN EFFECT EXCEPT FOR TABLE 23.1, WHICH BECOMES EFFECTIVE SEPTEMBER 1, 1997 AS INDICATED IN THE SMALL PRINT NOTE FOLLOWING THE AFFECTED ITEMS.

THE CURRENT REQUIREMENTS IN EFFECT FOR THE REQUIREMENTS HAVING FUTURE EFFECTIVE DATES ARE LOCATED IN THE BACK OF THE STANDARD.

New product submittals made prior to a specified future effective date will be judged under all of the requirements in this standard unless the applicant specifically requests that the product be judged under the current requirements. However, should the applicant elect this option, it should be noted that compliance with all the requirements in this standard will be required as a condition of continued Listing and Follow-Up Services after the effective date and understanding of this should be signified in writing.

The requirements in this standard are substantially in accordance with UL's bulletin on this subject dated May 31, 1995. This bulletin is now obsolete and may be discarded.

Revised and/or additional pages may be issued from time to time.



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MARCH 29, 1996

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UL 1123

Standard for

Marine Buoyant Devices

Previous numbered and unnumbered editions of standards covering marine buoyant devices have been published since April, 1971.

The First through Third editions were titled "Marine Special Purpose Water Safety Buoyant Devices."

First Edition – April, 1971
Second Edition – June, 1972
Third Edition – April, 1973
Fourth Edition – August, 1978
Fifth Edition – April, 1986

Sixth Edition

March 29, 1996

An effective date included as a note immediately following certain requirements is one established by Underwriters Laboratories Inc.

Revisions of this standard will be made by issuing revised or additional pages bearing their date of issue. A UL Standard is current only if it incorporates the most recently adopted revisions, all of which are itemized on the transmittal notice that accompanies the latest published set of revision pages.

ISBN 0-7629-0029-6

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FOREWORD

A. This Standard contains basic requirements for products covered by Underwriters Laboratories Inc. (UL) under its Follow-Up Service for this category within the limitations given below and in the Scope section of this Standard. These requirements are based upon sound engineering principles, research, records of tests and field experience, and an appreciation of the problems of manufacture, installation, and use derived from consultation with and information obtained from manufacturers, users, inspection authorities, and others having specialized experience. They are subject to revision as further experience and investigation may show is necessary or desirable.

B. The observance of the requirements of this Standard by a manufacturer is one of the conditions of the continued coverage of the manufacturer's product.

C. A product which complies with the text of this Standard will not necessarily be judged to comply with the Standard if, when examined and tested, it is found to have other features which impair the level of safety contemplated by these requirements.

D. A product employing materials or having forms of construction differing from those detailed in the requirements of this Standard may be examined and tested according to the intent of the requirements and, if found to be substantially equivalent, may be judged to comply with the Standard.

E. UL, in performing its functions in accordance with its objectives, does not assume or undertake to discharge any responsibility of the manufacturer or any other party. The opinions and findings of UL represent its professional judgment given with due consideration to the necessary limitations of practical operation and state of the art at the time the Standard is processed. UL shall not be responsible to anyone for the use of or reliance upon this Standard by anyone. UL shall not incur any obligation or liability for damages, including consequential damages, arising out of or in connection with the use, interpretation of, or reliance upon this Standard.

F. Many tests required by the Standards of UL are inherently hazardous and adequate safeguards for personnel and property shall be employed in conducting such tests.

INTRODUCTION

1 Scope

1.1 These requirements cover marine buoyant devices, including vests, jackets, horseshoe buoys and ring buoys, with or without lifelines, intended for recreational use in accordance with the applicable regulations of the United States Coast Guard (USCG).

1.2 The buoyant devices covered by these requirements are intended for USCG approval under 46 CFR 160.064.

2 General

2.1 The buoyancy of devices covered by these requirements is provided by inherently buoyant material and is not dependent upon loose or granulated materials, gas compartments, or inflation.

2.2 If a value for measurement is followed by a value in other units in parentheses, the second value may be only approximate. The first stated value is the requirement.

2.3 Devices for which the intended use is indicated as "General Purpose Vest," "Boating Vest," or the like, shall be considered to include "Skiing" unless this is specifically excluded in the marking provided with the device. Statements such as "Hiking" are not considered general use statements.

3 Glossary

3.1 For the purpose of this standard, the following definitions apply.

3.2 ADULT DEVICE – A device intended for use by persons weighing more than 90 pounds (41 kg).

3.3 BUOYANT DEVICES – The following defines the device types covered by these requirements:

a) Type II – A device intended to turn an unconscious person from a face down position in the water to a position where the wearer's respiration is not impeded.

b) Type III – A device intended to support a conscious person in the water in an upright position. This type of device is not required to turn an unconscious person in the water from a face-down position to a position where the wearer's respiration is not impeded.

c) Type IV – A device intended to be thrown to and grasped by a person in the water. This device does not provide means for adjustment or close fitting to the body.

d) Type V – A device intended for a specific use, such as a work vest or sailing harness device, and having restricted USCG approval.

3.4 CANDIDATE DEVICE – The device being investigated.

3.5 CHILD MEDIUM DEVICE – A device intended for use by persons weighing not less than 50 pounds (23 kg) but not more than 90 pounds (41 kg).

3.6 CHILD SMALL DEVICE – A device intended for use by persons weighing not less than 30 pounds (14 kg) but not more than 50 pounds (23 kg).

3.7 CLOSURES:

- a) **Primary** – Means of securing the device on the body that causes the device to function in its intended manner without employing any other means of fastening the device to the body.
- b) **Secondary** – A closure that, when used on the device by itself, does not make the device appear to be donned as intended and is not required to be closed to comply with the requirements of this standard.

3.8 DEVICE – Any marine buoyant device.

3.9 DOGBONE – A piece of loop-shaped metal designed for attachment to a hiking harness.

3.10 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.

3.11 FOAM – Closed-cell foamed polymeric material.

3.12 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 wearing a device is measured with the subject in the attitude of static balance where respiration is not impeded.

3.13 IMPACT TEST SPEED – The speed of the boat, aircraft or other launching vehicle at the time a device is released for a water impact test.

3.14 INFANT DEVICE – A device intended for use by persons weighing less than 30 pounds (14 kg).

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

3.16 JACKET – A buoyant device having sleeves.

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

3.18 REFERENCE VESTS – The standard USCG vests: Model AK-1 (Adult), Model CKM-1 (Child Medium), and Model CKS-2 (Child Small and Infant).

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

3.20 SERVICEABLE – Acceptable for continued intended use. Exhibits no signs of functional deterioration.

3.21 SPECIAL PURPOSE – A buoyant device intended for one or more specific purposes, such as sailing, skiing, or similar activities in addition to general use.

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

3.23 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.

3.24 UNIVERSAL SIZE – Sized for the 5th through 95th percentile of the adult U.S. population. This size is intended to fit the 30 – 52 inch (0.8 – 1.3 m) chest sizes.

3.25 VEST – A sleeveless buoyant device.

CONSTRUCTION

4 General

4.1 The construction and assembly of a device shall be judged according to its intended application and use as well as according to these requirements.

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

- a) Comply with the applicable requirements for the component in the Standard for Components for Personal Flotation Devices, UL 1191 (see Table 4.1); or
- b) If not covered by specific requirements in UL 1191, be acceptable when investigated with respect to the application. In addition, if the United States Coast Guard has specific requirements for the component, it shall comply with those requirements.

4.3 Adhesive shall be an all-purpose, waterproof type, acceptable for use with the materials being bonded. See requirements for glued joints in 32.5.

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

4.5 A device intended to be worn shall:

- a) Be as comfortable, nonrestrictive of motion 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 is obvious to an untrained person, and
- c) Incorporate strapping or other means of adjustment that provides a snug fit (as tight as possible without causing discomfort). See Donning Test, Section 15, Flotation Stability Test, Section 16, and Water Entry Test, Section 17.
- d) Have the front pads remain in their intended position without excessive hinging (see 16.1.6).

4.6 Unless a PFD is reversible, under reduced lighting conditions a candidate device shall be obvious to the wearer as to which is the inside and outside of the device. This may be accomplished by pockets, belts, distictively different (tactile) fabrics, logos and the like. Logos as a sole means are not acceptable.

Table 4.1
Component requirements

Component	Application	Applicable Sections in UL 1191 ^a or USCG Requirements
Body Strap	Primary closure	Webbing
	Secondary closure	Tie Tape and Reinforcing Tape
Drawstrings	Secondary closure	Tie Tape and Reinforcing Tape
Fabric	Wearable device	Fabrics for Wearable Devices
	Throwable device	Fabrics for Buoyant Cushions
Foam	Buoyant material ^b	Closed-Cell Foamed Polymeric Material
Hardware	Primary closure	Hardware
Kapok	Buoyant material	46 CFR 164.003
Lacing	Any	Lacing
Polymeric film	Kapok or fibrous glass enclosure	Plastic Film for Kapok or Fibrous Glass Enclosures
Reflective fabric or tape	Any	46 CFR 164.018
Survivor locating light	Any	46 CFR 161.012
Thread	Structural seam	Thread
Tie Tape	Secondary closure	Tie Tape and Reinforcing Tape
Vinyl-dip coating	Any	Vinyl-Dip Coatings
Zipper	Primary closure	Zippers

NOTE — Not applicable to nonfunctional (decorative) components.

^a The Standard for Components for Personal Flotation Devices, UL 1191.

^b Material relied upon for compliance with the requirements of the Buoyancy Test, Section 20.

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

Exception No. 1: A Type V device for which the intended use includes fastening or securing the device to the boat, such as in hiking, need not comply with this requirement.

Exception No. 2: A device incorporating a D-ring, tab, or other construction feature that is not intended to secure the device to the boat need not comply with this requirement, if:

- a) The feature is rendered inoperative when subjected to the Pull Test, Section 26, or*
- b) The marking label information complies with the requirements of 36.2.1.6 and the Optional Texts, Section 39.*

Exception No. 3: A Type IV buoyant cushion may be provided with hook and pile fastener tapes, or the equivalent, on the cushion's bottom surface only provided the cushion complies with the requirements specified in the Release Test, Section 28.

4.8 Drawstrings shall comply with at least one of the following:

- a) Be at least 1 inch (25.4 mm) wide;
- b) Have a positive closing mechanism; or
- c) When tied into a square knot, be able to be untied within 1 minute by the number of test subjects selected as specified in Table 16.1.

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

4.9 An infant device shall:

- a) Have a means of closure that is constructed to reduce the risk of the wearer's undoing the closure; and
- b) Incorporate means for removing the wearer from the water without the necessity of grasping the wearer.

4.10 An infant device shall be a Type II device.

4.11 A child small and an infant device shall be provided with crotch straps; however, equivalent means will be investigated.

4.12 A child medium device shall be constructed for chest sizes no larger than 29 inches (737 mm).

4.13 A child small device shall be constructed for chest sizes no larger than 25 inches (625 mm).

4.14 A device shall have provision for drainage of entrapped water including water entrapped between the device and the wearer. See Water Retention Test, Section 21, and Water Emergence Test, Section 18.

4.15 If chest size marking is required, the chest size shall be expressed as a range and each range shall encompass a minimum of 2 inches (50.8 mm), for example, 30 – 32 inches (762 – 813 mm).

4.16 Uncoated 70 denier fabric shall:

- a) Have 3/4 inch (19.1 mm) seams; or
- b) Incorporate two rows of lockstitch, or the equivalent.

4.17 The ratio of the weight of a cushion to its total volume, as determined from the finished product, shall be not less than 4.0 pounds per cubic foot (65 kg/m³).

4.18 The spacing between parallel grab strap inner edges of a cushion shall be 4-1/4 ± 1/2 inches (108 ± 12.7 mm) from the centerline of the cushion to the inside edge of the grab strap.

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

4.20 A wearable device having side adjustments shall be provided with at least one positive means to maintain the front flotation pads in their intended positions.

5 Material

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

5.2 A fibrous buoyant material shall be completely encased in flexible, heat-sealed vinyl film.

5.3 Only inherently buoyant materials shall be used as the prime buoyant means in a device.

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

5.5 Foam used as buoyant material in a device intended to be worn shall have a V factor of 85 or more as determined in accordance with the Standard for Components for Personal Flotation Devices, UL 1191. Also, see 20.2.

Exception No. 1: Foam used in a jacket or suit to comply with the requirement of 20.2 may have a V factor of 80 or more provided that at least 85 percent of the regulatory minimum buoyancy for the device as specified in Table 20.1 is supplied by foam having a V factor of 85 or more.

Exception No. 2: This requirement does not apply to foam that is not relied upon for compliance with the requirement of 20.2, provided that the device complies with the requirements of the Flotation Stability Test, Section 16, both with and without the foam in place.

5.6 For a wearable device, the V factor (as determined in accordance with the Standard for Components for Personal Flotation Devices, UL 1191) of foam forward of the body axis (see Figure 16.1) shall be not more than 2 points less than the V factor of foam aft of the body axis.

Exception: A device that complies with the requirement of 19.2.1 need not comply with this requirement.

5.7 Foam used as buoyant material in a buoyant cushion shall have a C factor of 94 or more as determined in accordance with the Standard for Components for Personal Flotation Devices, UL 1191.

6 Hardware

6.1 The width of the opening in the hardware through which webbing is routed, provided with a device, such as buckles, dee rings, and the like, shall not exceed the width of the associated webbing by more than 1/8 inch (3.2 mm) as measured at the line of contact.

6.2 The hardware used shall be so attached to the device that it will be retained in its intended position yet not to be so tight that the operation of the hardware is restricted.

6.3 Hardware used to secure a wearable device to the body shall have a quick and positive lock mechanism.

6.4 All buckles provided on a device with multiple buckle closures shall be operated in a similar manner, i.e., all buckles shall have center release mechanisms, or all buckles shall have side release mechanisms.

7 Body Straps

7.1 General

7.1.1 The free end of a body strap shall be provided with a t-tab or an equivalent means, such that the strap does not disengage from the hardware. See the Body Strap Hardware Secureness Test, Section 25.

7.1.2 A tab shall be formed by turning under 1-1/2 inches (40 mm) of material twice and stitching 3/4 inch (19 mm) from the end of the folds with bar tack stitching, rivets, or other equivalent means. Other constructions will be subjected to an investigation to determine acceptability which will include the Body Strap Hardware Secureness Test, Section 25.

7.1.3 Body straps shall be prevented from becoming disengaged from the device either by means of belt loop constructions intended for that purpose or by an equivalent means that will attach at least one end of the body strap to the device.

7.2 Water skiing devices

7.2.1 At least three front closures (two of which shall be encircling body straps, one of which shall be located beneath the rib cage) shall be provided on all child medium and adult devices which are marked "Water Skiing Vest," or the equivalent, as indicated by the intended use statement. See 36.2.1.7.

Exception: A device with features, such as integral legs, that prevent dislodging of the device during water impact need not comply with this requirement.

8 Belt Loops

8.1 The belt loops shall be constructed so that the primary closure does not pass through the loop if the belt loops are being used to prevent the body strap from becoming disengaged from the device.

9 Tie Tapes

9.1 All cut ends shall be turned under and stitched or the equivalent, so as not to ravel. Synthetic materials may be heat-sealed in lieu of turn-under.

9.2 Tie tapes shall remain in the original tied position during the Flotation Stability Test, Section 16; Water Entry Test, Section 17; and Impact Test, Section 23.

10 Thread

10.1 Monofilament thread shall not be used for structural seams.

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

11 Seams and Stitching

11.1 A lock-type stitch, such as type 301, Federal Standard 751a, shall be used for joining structural seams. The stitch density shall be 7 – 12 stitches per inch.

Exception: Except for closing seams, an overedge stitch constructed in accordance with 500 series requirements in Federal Standard 751a may be used in lieu of the lock stitch type 301 if the 500 series stitch complies with the requirements described in 31.3.1.1 — 31.3.3.1.

12 Primary Closures

12.1 The extended finished length of each body strap used on a device shall not exceed by more than 3 inches (76.2 mm) the minimum length required to secure the device on the test subject with the largest chest size successfully tested.

12.2 Compliance with 12.1 shall be determined by either of the following methods:

- a) The overall finished length of each body strap shall be measured with all adjustments at maximum body strap length. The outside circumference of the device at each strap location shall then be measured with the vest fitted as intended on a test subject of the maximum chest size successfully tested. The difference between the strap measurement and the circumference measurement at the strap location shall not exceed 3 inches (76.2 mm), or
- b) The vest shall be fitted as intended on a test subject of the maximum chest size successfully tested and a measurement shall be made along the means of adjustment to some reference points. Then all means of adjustment shall be at maximum body strap length and a second measurement shall be made along the means of adjustment to the reference points. The difference between the two measurements shall not exceed 3 inches (76.1 mm).

13 Coatings

13.1 Dip coatings shall be applied smoothly and evenly and shall be free of visible blemishes. This shall not preclude the stressed areas from having a greater thickness than unstressed areas.

13.2 A pocket comparator with a minimum magnifying power of 6X shall be used to determine the thickness of the dipped coating. One slash shall be made at each of the following locations for vests, or at seven high stress locations for other type devices:

- 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 shall be taken at each location and the average of the three readings shall be considered the minimum thickness for that location.

PERFORMANCE

14 General

14.1 Except as otherwise indicated, fully representative sample(s) of a device shall be subjected to the applicable tests specified in Sections 15 – 34.

14.2 A device having optional features shall be tested both during use and not during use of the optional feature.

14.3 Where human test subjects are employed in the testing of a device, adequate precautions shall be taken to reduce the risk of injury to the subjects at all times.

15 Donning Test

15.1 Donning and complete adjustment to a fit [see 4.5(c)] shall be accomplished within 1 minute by each test subject when a device is tested as described in 15.2 – 15.6.

15.2 Human test subjects as specified in Table 16.1 are to be used for this test. All size adjustments are to be at the halfway point when the device is given to a subject for donning.

15.3 For a child small or infant device, the donning and adjustment attempts specified in 15.4 – 15.6 may be performed with the assistance of an adult, if necessary.

15.4 The candidate device is to be given to the subject at pool side with the instruction "Please don as quickly as possible and adjust to fit snugly." The donning attempt then is to be timed.

15.5 If the subject, because of lack of familiarity with the candidate device, cannot adjust the device to fit within the specified time limits, the subject is to be given instructions in this regard and the procedure specified in 15.4 repeated.

15.6 If donning and adjustment of the candidate device on a subject is not achieved within 1 minute after the instruction specified in 15.5 has been given, the test is to be repeated by the subject with the reference vest. If the reference vest also is not donned and adjusted within 1 minute, the subject is to be disqualified and replaced.

16 Flotation Stability Test

16.1 General

16.1.1 Human test subjects as specified in Table 16.1 are to be used for these tests.

16.1.2 For these tests, the device is to be donned over a swimsuit; except that, if the attire customary to the designated purpose of the device may have an adverse effect on the test results, the tests are to be repeated with at least one subject wearing such attire.

16.1.3 The tests for Type II devices are to be conducted with the test subject wearing the reference vest, and then repeated wearing the candidate device.

16.1.4 The pads of a candidate Type II device shall not dislodge and tie tapes shall remain in the original tied position during the tests specified in 16.2.1 – 16.3.7.

Table 16.1
Test subject selection

Chest size adjustment range ^a of device, Inches (mm)	Number of subjects ^b (group size)
6 (150) or less	6
More than 6 but not more than 12 (300)	12
More than 12	18

NOTE – Subjects selected are to be of varying height and weight so as to represent endomorphic, mesomorphic, and ectomorphic anatomic builds. For an adult device, the chest sizes of the subjects are to be representative of the intended chest size range of the device; with one subject having a chest size 1 ± 0.5 inch (25 ± 13 mm) larger than the marked maximum size, and one subject having a chest size 1 ± 0.5 inch smaller than the marked minimum size. For a child medium, child small, or infant device, the weights of the subjects are to be representative of the intended weight range of the device and, when indicated, the chest sizes are to be representative of the intended chest size range.

^a For a child medium, child small, or infant device, six subjects are to be used. For a combined infant/child small device (less than 50 pounds), nine subjects are to be used. For a combined child small/child medium device (30 – 90 pounds), twelve subjects are to be used.

^b May be any combination of males and females, provided that at least one male and one female are used.

16.1.5 During the conduct of the Flotation Stability Test (16.4.1 – 16.4.9) and the Water Entry Test, Section 17, the pads of a candidate Type III shall comply with the following:

- a) The pads shall not dislodge.
- b) The pads shall remain in a position which produces a body list angle of less than 30 degrees. If an angle of 30 degrees or more is measured and the pads have noticeably shifted, the subject is to be instructed to remain in the water and 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 subject. The body list angle following such correction shall be less than 30 degrees.
- c) The pads shall not hinge away from the body more than a length equal to one-quarter of the longest vertical dimension on the front of a complete device. For example, if the longest vertical dimension is 20 inches, the pads shall not hinge more than 5 inches away from the body, measured from the part of the PFD furthest from the body, to the point on the body where that part rests when held against the body.

Exception: A device other than an open-sided single belt design having a sufficiently small portion of its buoyancy in the hinged portion need not comply with the requirement if it complies with 16.1.7

16.1.6 A child medium or adult Type II or Type III candidate device is to be tested in accordance with the Water Emergence Test, Section 18, if subjects have difficulty emerging from the pool during the in-water flotation stability tests due to excess water retained by the device. A device need not comply with the Water Retention Test, Section 21, if it complies with the Water Emergence Test, Section 18, for all subjects specified in Table 16.1.

16.1.7 A device as indicated in the Exception to 16.1.5 shall:

- a) In no case have more than 25 percent of its front buoyancy free hinge away from the body; and
- b) When evaluated in accordance with the following equation, be no larger than 0.50:

$$\frac{[BFF + (BH)(1 + 12 \cdot (BH/BF))]}{(BR + 1) \cdot (1 + (BF/BT) - .6)}$$

in which:

BR = Regulatory minimum buoyancy;

BT = Total Design buoyancy;

BF = Buoyancy of the complete front;

BH = Buoyancy of the front hinged portion; and

BFF = *BF* — *BH* = Buoyancy fixed in front.

16.2 Type II turning test

16.2.1 A child medium and an adult Type II candidate device are to be tested as specified in 16.2.4. The device shall comply with the following:

- a) The average turning time (or the corrected average turning time — See 16.2.2) for the group of test subjects shall not exceed that for the reference vest by more than 2 seconds; and
- 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 The corrected average turning time (see 16.2.1 and 16.2.3) is to be computed based on the following:

$$A_c = \frac{A_t}{T_t / T_{total}}$$

in which:

A_c is the corrected average tuning time;

A_t is the average turning time for tests resulting in a turn;

T_t is the number of tests resulting in a turn; and

T_{total} is total number of tests performed.

16.2.3 A child small and an infant Type II candidate device are to be rested as specified in 16.2.4. The device shall comply with the following:

- a) The average turning time (or the corrected average turning time – see 16.2.2) for the group of test subjects shall not exceed that for the reference vest by more than 1 second;
- b) The total number of turns for the group of test subjects shall be not less than the number of turns obtained by using the reference vest; and
- c) Water shall not funnel or be cupped into the face of a test subject as a result of the turning moment.

16.2.4 The following are the test methods for conducting the Type II turning test specified in 16.2.1 and 16.2.3:

- a) For a child medium and adult Type II candidate device the subject is to don the device and enter the water^a. The subject then is to take at least three breast strokes and then, face down in the water, relax completely while exhaling slowly. The subject is to remain limp in this position long enough so that the final stabilized attitude of static balance can be determined. The turning time is to be recorded. The subject then is to repeat the test two additional times.
- b) For a child small Type II candidate device, the device is to be fastened in the intended manner on the subject. The subject is to gently push-off from the side of the pool, take a single breast stroke, and then face down in the water relax and exhale slowly. The turning time is to be recorded. The test then is to be repeated two additional times. As an alternative, the device is to be fastened in the intended manner on the subject, who then is to be placed in a face down (mouth above the water) position in the water and released. The turning time is to be recorded. The subject then is to repeat the test two additional times.
- c) For an infant Type II candidate device, the device is to be fastened in the intended manner on the subject, who then is to be placed in a face down (mouth above the water) position in the water and released. To prevent the test subject from inhaling water during the test it is permissible to gently blow air into the child's face immediately prior to the release. The turning time is to be recorded. The test is to be repeated two additional times.

^a The Donning Test, Section 15, and Water Entry Test, Section 17, may be conducted at this point. In addition, if an examination of the candidate device indicates that it may have a tendency to permit movement of the buoyant material from the position it was in when the device was donned to a position toward the sides or back of a subject, at least one test subject is to enter the water by diving so that the subject strikes the water in a prone position.

16.3 Type II freeboard, head support, face plane angle, and chin support test

16.3.1 A child medium and adult Type II candidate device shall comply with the following when tested as specified in 16.3.3 – 16.3.7:

- a) The average freeboard of the group of test subjects shall be not less than that of the reference vest by more than 1/4 inch (6.4 mm);
- b) Each individual freeboard measurement of the group of test subjects shall be no less than 1 inch (25 mm);
- c) The average value of the lowest marks that can be viewed on a vertical scale (see 16.3.3) by the group of test subjects shall be not greater than that for the reference vest by more than 3 inches (76 mm), or the average face plane angle for the group of test subjects shall be not less than that for the reference vest by more than 5 degrees, providing vision to the scale is not obscured by the candidate device to a degree greater than by the reference vest; and
- d) The number of test subjects provided with chin support (see 16.3.7) shall be not less than that for the reference vest.

16.3.2 An infant and child small Type II candidate device shall comply with the following when tested as specified in 16.3.3 – 16.3.7:

- a) The average freeboard of the group of test subjects shall be not less than that of the reference vest by more than 1/4 inch (6.4 mm);
- b) Each individual freeboard measurement of the group of test subjects shall be no less than 1 inch (25 mm);
- c) The average distance of the ear canal above the surface of the water for the group of test subjects shall be not less than that for the reference vest by more than 1/4 inch (6.4 mm);
- d) The average face plane angle for the group of test subjects shall be not less than that for the reference vest by more than 5 degrees and vision to the scale shall not be obscured by the candidate device to a degree greater than by the reference vest;
- e) The head support shall cradle the subject's head in a stable manner to limit lateral rotation and tilting from side to side of the head; and
- f) The number of test subjects provided with chin support (see 16.3.7) shall be not less than that for the reference vest.

16.3.3 The subjects used during the test specified in 16.2.1 – 16.2.4 are to be used for this test while still in the water. Starting from a vertical upright position (see 16.3.7), 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 12 feet (3.6 m) 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 12 feet above the level of the surface of the water is equal to 144.

16.3.4 While in the position of static balance specified in 16.3.3, the subject is to be instructed to "relax and breathe normally." The freeboard, face plane angle, and distance of the ear canal from the surface of the water is to be measured (see 16.3.5) while the subject is at the lowest level attained during the normal breathing cycle. 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 16.3.6). The subject then is to attempt to touch the chin to the chest (see 16.3.7).

16.3.5 For the purpose of calculating the average ear-canal distance above the water, if the ear canal is below the surface of the water, the distance is to be measured and recorded as a negative value.

16.3.6 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 12-foot (3.6-m) mark is to be 144.

16.3.7 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.

16.4 Type III device test

16.4.1 A Type III Device:

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

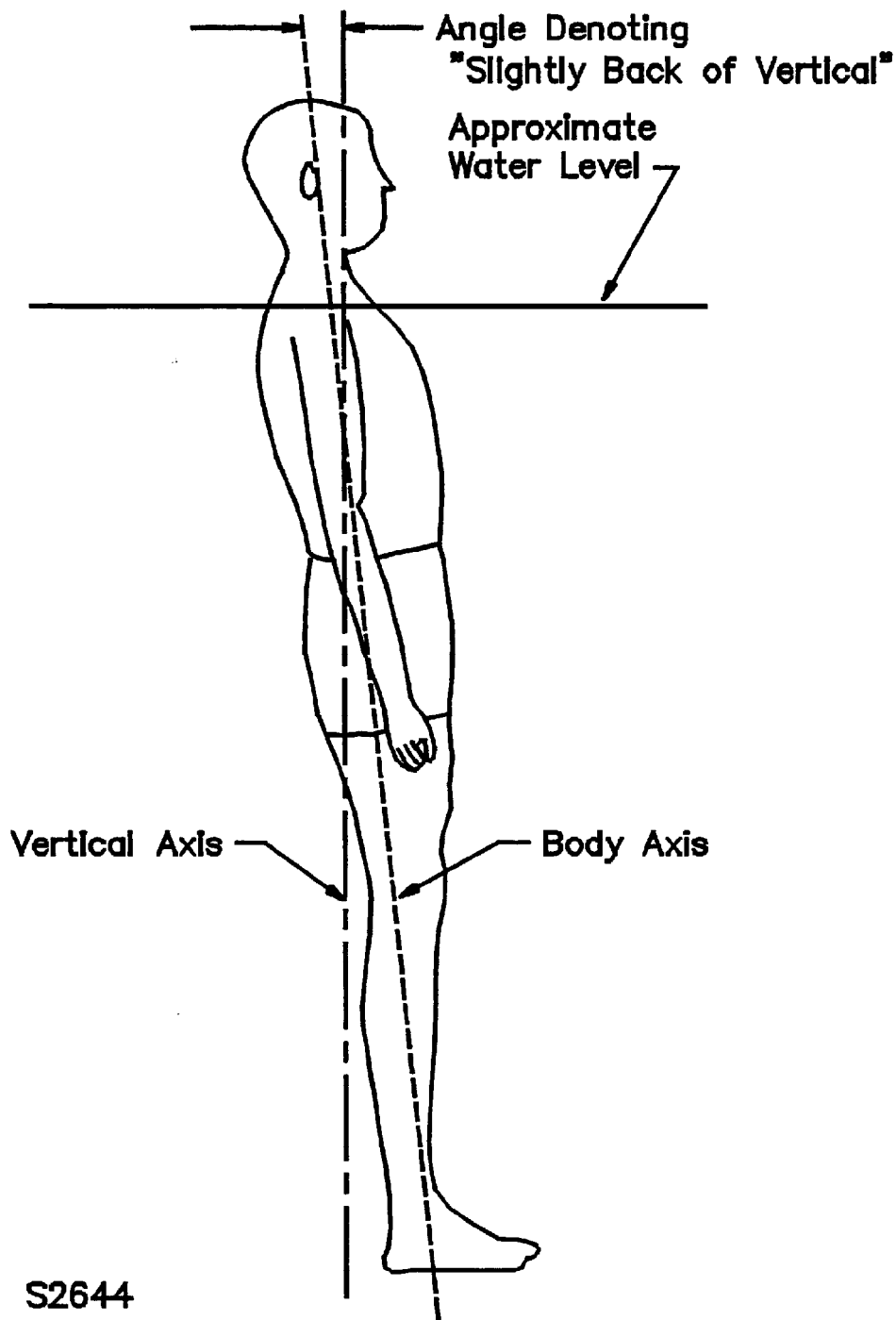
See 16.4.4 and 16.4.9. In addition, a child medium and adult device shall not have a shoulder gap of more than 6 inches (152.4 mm), measured at the right shoulder, following 3 self-induced bobbing actions in the water (see 16.4.5). Also, the device in the ridden-up condition shall not have a tendency to turn a subject face-down from the position of relaxed static balance in the water and shall comply with the requirements specified in 16.4.2 and 16.4.3 following the bobbing actions. The use of crotch straps is not acceptable to achieve compliance with the ride-up requirements.

Exception No. 1: The shoulder gap requirements do not apply to float coat or wetsuit style PFDs.

Exception No. 2: For pear-shaped individuals only (i.e., stomach is larger than chest), a device need not comply with the shoulder gap requirements provided the device is marked in accordance with 36.2.1.1(g). For the purposes of this exception, chest size measurement is taken with a tightened tape, similar to a snug fitting PFD.

16.4.2 A Type III 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



16.4.3 The average freeboard of a Type III device 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). The subject is to be instructed to "relax and breathe normally" during measurement of the freeboard.

16.4.4 Each subject is to don the device and enter the water^a. 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, the subject is to allow the arms, legs, torso, and head to 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 backwards and then the subject is to allow the arms, legs, and torso to assume their naturally relaxed positions. After the subject attains an attitude of relaxed static balance, the freeboard of the subject is to be measured while the subject is at the lowest level attained during the normal breathing cycle.

^a The Donning Test, Section 15, and Water Entry Test, Section 17, may be conducted at this point. In addition, if an examination of the candidate device indicates that it may have a tendency to permit movement of the buoyant material from the position it was in when the device was donned to a position toward the sides or back of a subject, at least one test subject is to enter the water by diving so that the subject strikes the water in a prone position.

16.4.5 For an adult and child medium Type III device, the subjects are to perform 3 bobbing motions in the water while in a vertical position to induce ride-up. See 16.4.1. Prior to the bobbing actions and while 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. Subjects weighing 50 – 90 pounds (22 – 41 kg) may be assisted in performing the bobs.

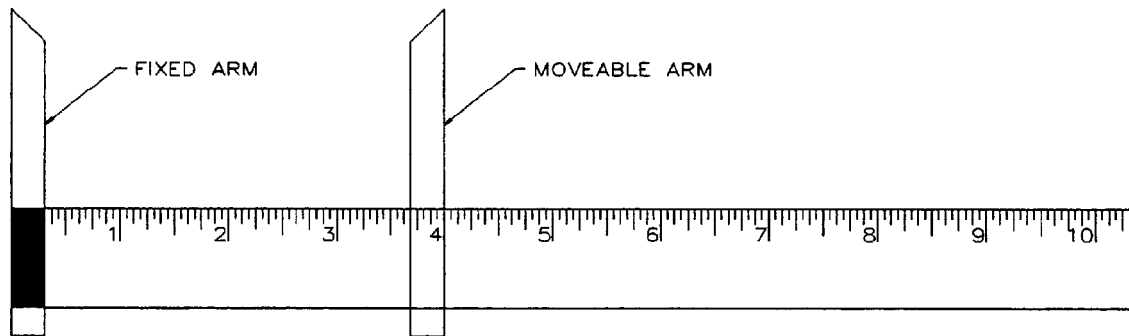
16.4.6 Immediately following the last bobbing motion specified in 16.4.5, the right shoulder gap is to be measured by inserting the measuring device illustrated in Figure 16.2 between the top of the shoulder and the inside uppermost portion of the PFD above the right shoulder. The test subject is to 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 and 16.4.3. See 16.4.1.

16.4.7 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.

16.4.8 If, 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. If 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.

16.4.9 If during the tests described in 16.4.4 and 16.4.8 the candidate device does not comply with these requirements with one subject from the group, an additional 18 subjects as specified in Table 16.1 may be used. If the device performs acceptably (see 16.4.1 – 16.4.3) while being worn by each of the 18 subjects, the device is acceptable.

Figure 16.2
Shoulder gap measuring instrument



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16.5 PFD's with oversized pockets

16.5.1 If a device employs more than 150 square inches (967 cm²) of total pocket area when measured in accordance with 16.5.3, the pockets of the device are to be filled with the nonbuoyant material (i.e., weights) determined in accordance with 16.5.2. With the pockets filled, the device is considered to be acceptable if it complies with one of the following:

- a) The subject's freeboard shall not be reduced to below water's surface when measured at the bottom of the subject's normal breathing cycle with the subject in the starting position and in the achieved position of static balance. Also, the device shall maintain the subject in an upright or back of vertical position.
- b) If the use of the nonbuoyant items no longer permits the device to provide adequate freeboard or does not maintain the subject in an upright or back of vertical position in the water, the test is to be repeated as follows. The performance of the device with pockets is deemed acceptable if only the backward tilting of the head described as follows is necessary to maintain the subject in an upright or back of vertical position and the average freeboard at static balance is not less than 1 inch (25.4 mm). The subject is to be instructed to breathe normally during measurement of the freeboard.
 - 1) The subject is to assume an upright, slightly back of vertical position in the water, while holding the arms at the sides. The subject is to relax the neck to allow the head to tilt backward so that it is behind the plane of the body axis. The subject then is to allow the arms, legs, and torso to assume a natural relaxed position, until motion is induced by the device.

- 2) After the subject attains an attitude of static balance, the freeboard of the subject is to be measured while the subject is at the lowest level attained during the normal breathing cycle.
- c) If, even with the head tilted backward, the device does not maintain the subject with a freeboard of 1 inch (25.4 mm) or more in an upright or back of vertical position, the test is to be repeated as follows. The freeboard at static balance shall not be less than 1 inch (25.4 mm).
- 1) The subject is to assume an upright slightly back of vertical position and then is to assume a posture in the water where breathing is not impaired. This posture may be attained by arching of the back and tilting of the head, or the like.
- 2) After the subject attains an attitude of static balance, the freeboard of the subject is to be measured while the subject is at the lowest level attained during the normal breathing cycle. The subject is to be instructed to breathe normally during measurement of the freeboard. A device requiring such posturing effort to maintain an adequate stable angle and freeboard shall be prominently marked with the cautionary statement specified in 26.2.1.14.

The device is considered unacceptable if any action other than the posturing specified in (a) – (c) is needed to maintain the specified minimum freeboard.

16.5.2 To determine the maximum capacity of the pocket, rigid foam cubes (to represent ammunition boxes) are to be placed in the pockets. Nonbuoyant items with in-water weight equivalent to the ammunition boxes are then to be used for the swim test specified in 16.5.1. The dimensions for the rigid foam cubes and the weight for the nonbuoyant items are to be as follows:

- a) For lower or middle pockets on the front of a device the cube is to measure 4-1/4 by 3 by 1 inches (114 mm by 76 mm by 25 mm). Each box nonbuoyant item, representing 1 box of ammunition, is to have an in-water weight (i.e. weight under two inches of fresh water) of 250 ±5 grams (7.7 ±0.1 ounces).
- b) For upper pockets the cube is to measure 1-1/4 by 1-1/2 by 2-1/2 inches (32 mm by 38 mm by 64 mm). Each nonbuoyant item, representing 1 box of ammunition, is to have an in-water weight (i.e. weight under two inches of fresh water) of 140 ±5 grams (4.5 ±0.1 ounces).

Exception: If agreeable to all concerned, boxes of ammunition of appropriate weight and shape may be substituted for the weights during the tests.

16.5.3 The area (A) of each pocket is to be determined by the following equations:

- a) For flat pockets:

$$A = h \times w$$

where:

h is the height of the pocket, and

w is the width of the pocket. See Figure 16.3.

- b) For pouch type pockets or pockets with gussets:

$$A = (h + g_b) \times (w + g_m)$$

in which:

h is the height of the outer surface of the pocket,

w is the width of the outer surface of the pocket,

g_b is the depth at the bottom gusset, and

g_m is the depth at the middle side gusset. See Figure 16.4.

- c) The total area (AT) is the sum of all pocket areas:

$$AT = A_1 + A_2 + \dots A_n$$

16.5.4 The in-water weight of the test subject is to be approximately 12-1/2 ± 1/4 pounds (5.6 ± 0.1 kg) and is to be determined in accordance with the Standard for Hybrid Personal Flotation Devices, UL 1517. A subject of higher in-water weight may be used if agreeable to all concerned.

16.5.5 If a device is available in a range of sizes, the device with the minimum amount of designed up-front buoyancy distribution and the device with the minimum designed overall buoyancy are to be tested.

Figure 16.3
Area flat pocket

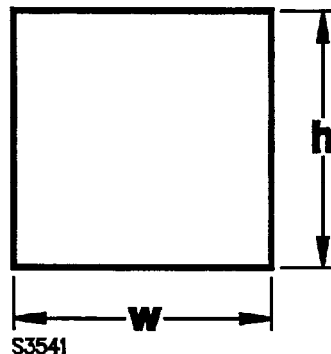
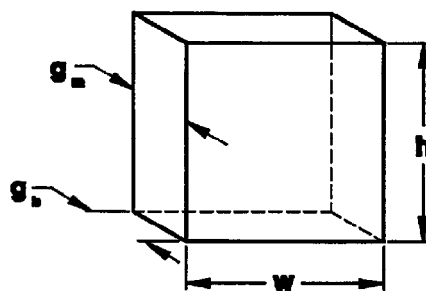


Figure 16.4
Area of pouch type or gusseted pocket



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17 Water Entry Test

17.1 A device shall maintain its intended position on each subject and the pads shall not dislodge when tested as described in 17.2 – 17.4.

Exception: An infant device need not be tested.

17.2 For this test, subjects as specified in Table 16.1 are to be used. Prior to this test, each subject is to don and adjust the device prior to water entry as specified in the Donning Test, Section 15. After donning, secondary closure fabric belts and drawstrings that the subject has adjusted to obtain a fit are to be loosened and all elastic is to be defeated.

17.3 Each subject is to enter the water as specified in Table 17.1. 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.

Table 17.1
Water entry test specifications

PFD type	Test number	Platform Height	Subject Configuration
Type II ^a Type III	1	3 feet (0.91 m)	Feet first, hands above head with arms extended.
Type II ^b	1	9.9 feet (3 m)	Feet first, hands above head with arms extended.
	2	3 feet (0.91 m)	Head first dive, hands above head with arms extended.

^a Child Medium and Child Small devices. Adult devices which utilize a chest strap or tie tapes.

^b Adult devices which do not utilize a chest strap or tie tapes.

17.4 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 subject's breathing is not impeded.

If the subject elects to make any adjustments in accordance with the instructions specified in 17.3, the determination of compliance with (c) is to be made after the subject has made the adjustments and then has relaxed.

18 Water Emergence Test

18.1 If it is determined that a Water Emergence Test is required (see 16.1.5), the candidate child medium or adult Type III device shall permit at least as many subjects to emerge from the water to the top of the platform specified in 18.2 as are capable of emerging in the reference vest.

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

18.3 Each subject is to don the candidate device, enter the water, and swim or tread water for at least 30 seconds. The subject is then to attempt to emerge from the pool onto the top of the platform within 30 seconds without grasping any edge of the platform, or contacting the side or bottom of the pool; only the top surface of the platform may be used to emerge from the water. The test is then to be repeated using the reference vest.

19 Buoyancy Distribution Tests

19.1 Distribution test

19.1.1 At least 50 percent of the total buoyancy of a wearable device for which the buoyancy is provided by foam shall be forward of the body axis (see Figure 16.1) when tested in accordance with 19.1.2 or 19.1.3, as applicable.

Exception: A device that complies with the requirement of 19.2.1 need not comply with this requirement.

19.1.2 If the Flotation Stability Test, Section 16, indicates that the performance of a wearable device is due to an angular stability (Type III) or an angular change (Type II) in the position of the body axis, as opposed to its rotation about the body axis, buoyancy of the material aft of the body axis and the buoyancy of the material forward of the body axis is to be determined individually in accordance with 20.4 – 20.8. For this purpose, the sample need only be submerged long enough to provide a stabilized reading.

19.1.3 If the Flotation Stability Test, Section 16, indicates that the performance of the wearable device is due to the rotation around the body axis, the buoyancy of the material is to be divided as necessary into three or more polar segments and tested individually in accordance with 20.4 – 20.8, following submersion to the point of stabilization.

19.2 Loss distribution test

19.2.1 In lieu of compliance with the requirements of 5.6 or 19.1.1, or both, a sample of the device may be altered in accordance with 19.2.2 and tested in accordance with Flotation Stability Test, Section 16. The sample shall comply with the applicable requirements in Section 16.

19.2.2 Each foam insert of the sample 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:

$$B = B_0 \left[\frac{3V}{100} - 2 \right]$$

in which:

B is the buoyancy of the altered insert (for front inserts: plus 0, minus 15 percent; and for back inserts: plus 15, minus 0 percent);

B₀ 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 Standard 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.

20 Buoyancy Test

20.1 The total buoyancy of a horseshoe or ring buoy, or a kapok device shall be not less than the applicable minimum value specified in Table 20.1.

Table 20.1
Regulatory minimum buoyancies

Device	Minimum buoyancy ^a	
	pounds-force	(N)
Devices intended to be worn:		
Persons weighing over 90 pounds-mass (40.8 kg)	15-1/2	(68.9)
Persons weighing 50 to 90 pounds-mass (22.7 – 40.8 kg)	11	(48.9)
Persons weighing 30 to 50 pounds-mass (13.6 – 22.7 kg)	7	(31.1)
Persons weighing under 30 pounds-mass (13.6 kg)	7	(31.1)
Kapok buoyant cushions	20	(89.0)
Foam buoyant cushions	18	(80.1)
Horseshoe buoys	20	(89.0)
Ring buoys	16-1/2	(73.4)
^a Minimum values either measured at, or corrected to, atmospheric pressure of 29.92 inches (760 mm) mercury and water temperature of 68°F (20°C).		

20.2 The total buoyancy of a cushion or wearable device for which the buoyancy is provided by foam shall be not less than the applicable regulatory minimum buoyancy specified in Table 20.1 or the value determined according to the following equation, whichever is greater:

a) For a cushion:

$$B_t = (0.91) (F) \sum_{i=1}^N \frac{P_i}{3R_i - 2}$$

b) For a vest:

$$B_t = (0.82) (F) \sum_{i=1}^N \frac{P_i}{3R_i - 2}$$

c) For a jacket:

$$B_t = (0.70) (F) \sum_{i=1}^N \frac{Q_i}{3R_i - 2}$$

where:

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

F is the applicable regulatory minimum buoyancy for the device specified in Table 20.1, in pounds-force;

P_i is the fraction of Buoyancy provided by the i^{th} material to the total buoyancy of the device;

Q_i is the fraction of buoyancy provided by the i^{th} material to the applicable regulatory minimum buoyancy of the device as specified in Table 20.1.

R_i is the applicable value specified in Table 20.2; and

N is the number of materials used in the device.

Table 20.2
Values of R_i

Application	Applicable factor	Factor for material ^a	R_i ^b
Buoyant cushion	C	97 or more Less than 97	0.97 C factor/100
Wearable device	V	94 or more Less than 94	0.94 V factor/100
^a The applicable factor (V or C) as determined in accordance with the Standard for Components for Personal Flotation Devices, UL 1191. ^b Also, see 5.5 – 5.7.			

20.3 The total buoyancies mentioned in 20.1 and 20.2 are to be determined:

- Immediately after the device is completely submerged and all entrapped air removed, and
- After complete submergence for 24 hours for devices for which buoyancy is provided by foam and 48 hours for devices for which buoyancy is provided by kapok.

20.4 Tests for buoyancy are to be conducted on a complete device in a test tank of water that can be secured against change of water level or disturbance of the device being tested. Entrapped air, air enclosed in folds of the cloth, and the like, is to be removed from the device immediately following immersion. If the device utilizes fibrous buoyant material enclosed in a plastic envelope, the test is 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. Each slit is to be at least 2 inches (50.8 mm) long and not more than 2 inches (50.8 mm) apart so that the envelope will not entrap air.

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

20.6 The ballasted basket is to be suspended from a scale calibrated to an accuracy of $\pm 1/2$ ounce (± 14.2 g), and the weight of the submerged apparatus determined.

20.7 The complete device is to be placed in the basket so that its upper surface is approximately 2 inches (50.8 mm) below the water surface and is to remain submerged for a 24-hour period. For tests in which the envelope of a device utilizing fibrous buoyant material has been slit, the device is to be submerged for a 48-hour period.

20.8 The buoyancy of the complete device is computed by subtracting the submerged weight of the ballasted basket and test sample from the submerged weight of the ballasted basket alone.

21 Water Retention Test

21.1 Following total immersion in water, a candidate device shall not entrap more than:

- Five pounds-mass (2.3 kg) of water if the device is intended for use by persons weighing more than 90 pounds-mass (40.8 kg),