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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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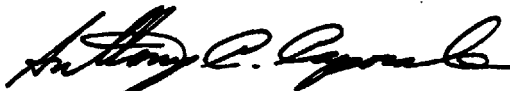


Documents
Document Sharing Hub

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.

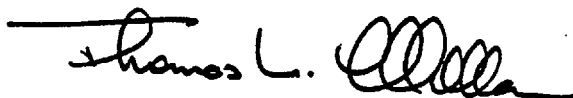


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May 16, 1995

Revision pages for

Standard for

Components for Personal Flotation Devices

UL 1191, Second Edition

Attached to this transmittal notice is a revision of the Second edition of UL 1191.

A CHANGE ON A PAGE DATED MAY 16, 1995 IS INDICATED BY A SMALL PRINT NOTE FOLLOWING THE AFFECTED ITEM, PRECEDED AND FOLLOWED BY AN ASTERISK.

THESE NEW AND REVISED REQUIREMENTS ARE NOW IN EFFECT EXCEPT FOR SECTIONS 31, 32, AND 33, WHICH BECOME EFFECTIVE SEPTEMBER 1, 1996 AS INDICATED IN THE SMALL PRINT NOTE FOLLOWING THE AFFECTED ITEM. TO RETAIN THE REQUIREMENTS IN EFFECT UNTIL SEPTEMBER 1, 1996, DO NOT DISCARD THE PREVIOUS PAGES CONTAINING THE REQUIREMENTS SPECIFIED ABOVE UNTIL THIS FUTURE EFFECTIVE DATE.

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 Recognition and Follow-Up Services after the effective date and understanding of this should be signified in writing.

The new and revised requirements are substantially in accordance with UL's bulletin on this subject dated November 16, 1994. The bulletin is now obsolete and may be discarded.

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

With the inclusion of the accompanying material, the standard consists of pages dated as shown in the following checklist:

Page	Date
1	May 13, 1993 (Reprinted May 16, 1995)
2, 3	May 16, 1995
4	May 13, 1993
5, 6	May 16, 1995
7	May 13, 1993
8, 8A, 8B	May 16, 1995
9 - 68	May 13, 1993
69, 70, 70A - 70C, 71 - 74, 74A - 74O	May 16, 1995
75 - 82	May 13, 1993

MAY 13, 1993

(Title Page Reprinted: May 16, 1995)

1

UL 1191

Standard for

Components for Personal Flotation Devices

Previous numbered and unnumbered editions of standards covering components for personal flotation devices have been published since January, 1976.

First Edition – January, 1976

Second Edition

May 13, 1993

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.

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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 components for use with personal flotation devices. Compliance with these requirements does not indicate that the product is acceptable for use as a component of an end product without further investigation. The requirements may be applied to other components if found to be appropriate.

1.2 These components are intended for use in personal flotation devices which comply with the requirements of Underwriters Laboratories Inc., and the United States Coast Guard Subparts of Chapter I, Title 46, Code of Federal Regulations. These include:

- a) USCG Subparts 160.002, 160.047, 160.048, 160.049, 160.050, 160.052, 160.053, 160.055, 160.060, 160.064, 160.076, 160.077, 160.150, and 160.155.
- b) The requirements for:
 - 1) Marine Buoyant Devices, UL 1123;
 - 2) Buoyant Cushions, UL 1175;
 - 3) Buoyant Vests, UL 1177;
 - 4) Hybrid Personal Flotation Devices, UL 1517; and
 - 5) Fully Inflatable Recreational Personal Flotation Devices, UL 1180.

1.2 revised May 16, 1995

1.3 These components may be used on devices that comply with other regulations and requirements (other than those tabulated in 1.2 where the acceptability of the component has been determined by Underwriters Laboratories Inc. and the United States Coast Guard.

2 General

2.1 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.

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

2.3 Use codes

2.3.1 A use code shall be assigned to each PFD component to show the PFD Type for which it is intended. See Table 2.1.

Table 2.1
Use codes

Use code	Type of PFD for which it is intended
1	I – Inherently Buoyant Adult or Child sizes
1F	I – Fully Inflatables
2	II – Inherently Buoyant Adult or Child sizes
2A	II – Inherently Buoyant Adult sizes only
2C	II – Inherently Buoyant Child sizes only
2F	II – Fully Inflatables
3	III – Inherently Buoyant Adult or Child sizes
3A	III – Inherently Buoyant Adult sizes only
3C	III – Inherently Buoyant Child sizes only
3F	III – Fully Inflatables
4	IV – Any styles
4B	IV – Any ring buoy
4BC	IV – Buoyant Cushions
4H	IV – Horseshoe buoys
4RB	IV – Recreational ring buoys
5	V – Any styles except Hybrids or work vests
5H	V – Hybrids
5SB	V – Recreational sailboard devices
5R	V – Any recreational style Type V; except Hybrids
5WV	V – Workvest
6	This Use Code is reserved for unique, limited or restricted categories for devices not covered in this Table. When used, the intended application for this Use Code shall be specifically described.

Table 2.1 revised May 16, 1995

2.4 ASTM standards

2.4.1 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 – 73 (1979).
- b) Methods of Testing Sewn Threads, ASTM D204 – 82 (1986).
- c) Test Method for Rubber Properties in Tension, ASTM D412 – 83.
- d) Test Methods for Rubber Properties – Adhesion to Flexible Substrate, ASTM D413 – 82.
- e) Test Method for Water Absorption of Plastics, ASTM D570 – 81.
- f) Methods of Testing Coated Fabrics, ASTM D751 – 79.
- g) Test Method for Initial Tear Resistance of Plastic Film and Sheeting, ASTM D1004 – 66 (1981).
- h) Method for Gas Transmission Rate of Plastic Film and Sheeting, ASTM D1434 – 82.

- i) Test Methods for Breaking Load and Elongation of Fabric, ASTM D1682 – 64 (1975).
- j) Definitions of Terms Relating to Zippers, ASTM D2050 – 78 (1982).
- k) Methods for Strength Tests for Zippers, ASTM D2061 – 87.
- l) Test Method for Tearing Strength of Woven Fabrics by the Tongue (Single Rip) Method (Constant-Rate-of-Extension Tensile Testing Machine), ASTM D2261 – 83.
- m) Methods for Tearing Strength of Woven Fabrics by the Tongue (Single Rip) Method (Constant-Rate-of-Traverse Tensile Testing Machine), ASTM D2262 – 83.
- n) Test Method for Weight Loss of Plasticizers on Heating, ASTM D2288 – 69 (1980).
- o) Specification for Zipper Dimensions, ASTM D3657 – 82.
- p) Test Method for Fabric Count of Woven Fabric, ASTM D3775 – 85.
- q) Test Method for Weight (Mass) per Unit Area of Woven Fabric, ASTM D3776 – 85.
- r) Specification for Knitted Fabric, ASTM D3887 – 80.
- s) Test Methods for Metals in Workplace Atmosphere by Atomic Absorption Spectrophotometry, ASTM D4185 – 83.
- t) Method for Seal Strength of Flexible Barrier Materials, ASTM F88 – 58 (1986).
- u) Standard Practice for Operating Light Exposure Apparatus With or Without Water for Exposure of Nonmetallic Materials, ASTM G23 – 1989.

2.5 Material

2.5.1 Polymeric material is to be considered essentially the same if it is of the same generic type, the same kind and amount of resin, filler, stabilizers, reinforcement, and the like as demonstrated by the applicable identification tests.

2.6 Color

2.6.1 If a textile or polymeric product is furnished in a range of colors, samples representative of the range are to be provided. Generally this will consist of a fluorescent color (if applicable) and the lightest (e.g., white) and darkest (e.g., black) colors; however, additional samples intermediate between the darkest and lightest may be required (see 2.6.2). An equivalent number of samples is to be provided for each additional color to be tested.

2.6.2 The darkness or lightness of color shade shall be determined by using the diffuse reflectance number specified in Federal Standard FED-STD 595B. The color is derived from the last three digits of the number assigned to each color.

Table 2.2
Sample conditioning

Exposure	Method
Standard Conditioning	Except for textile products (i.e., fabric, webbing, thread, tie tape), the applicable number of samples specified in each section are to be conditioned at 23 ± 2 °C (73.4 ± 3.6 °F) and 50 ± 5 percent relative humidity for not less than 40 hours prior to the tests. For textile products, the samples are to be conditioned at 21 ± 1 °C (70 ± 2 °F) and 65 ± 2 percent relative humidity for not less than 40 hours. If agreeable to all concerned, a different temperature and relative humidity may be used.
Accelerated Weathering	Except for nonmetallic components used in hybrid devices (Use Code 5H), samples are to be exposed to 100 hours of light and water exposure in accordance with Method 1 (102 minutes of light/18 minutes of light and water) of the Standard Practice for Operating Light Exposure Apparatus With or Without Water for Exposure of Nonmetallic Materials, ASTM G23 – 89, 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. The arcs are to be replaced and the corex D glass cleaned every 24 hours. For nonmetallic components used in hybrid devices (Use Code 5H), samples are to be exposed to 300 hours of light and water exposure in accordance with Method 1 (102 minutes of light/18 minutes of light and water) of the Standard Practice for Operating Light Exposure Apparatus With or Without Water for Exposure of Nonmetallic Materials, ASTM G23 – 89, using apparatus designated Type E. The black panel temperature is to be 68 ± 5 °C (155 ± 10 °F) per Federal Standard 191A, Method 5804. The arcs are to be replaced and corex D glass cleaned every 24 hours.

2A Definitions

2A.1 For the purpose of Sections 32 and 33 of this standard, the following definitions apply.

2A.1 added May 16, 1995

2A.2 Cylinder Seal Indicator – A visual display on an inflation system which provides information regarding the status of the seal on an installed cylinder.

2A.2 added May 16, 1995

2A.3 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.

2A.3 added May 16, 1995

2A.4 Fill Ratio – For inflation medium containers, the weight of the gas charge (in grams) divided by the volume of the inflation medium container (in milliliters).

2A.4 added May 16, 1995

2A.5 Full Inflation – A chamber or chambers inflated to any value within the design inflation range.

2A.5 added May 16, 1995

2A.6 Inflatable Compartment – A container that is inflated by a gas or other medium through an automatic, manual-auto, manual, or oral inflation system.

2A.6 added May 16, 1995

2A.7 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, depending 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.

2A.7 added May 16, 1995

2A.8 Lot Number – A marking assigned to each group of inflation systems produced which incorporates a means of identifying the year and quarter of manufacture of the device (unless provided elsewhere), and provides a means of identifying the device as the product of a particular factory, if a manufacturer produces inflation systems at more than one factory.

2A.8 added May 16, 1995

2A.9 Multi-Point Status Indicator – A status indicator which utilizes two or more independent visual display points to communicate inflation system readiness.

2A.9 added May 16, 1995

2A.10 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.

2A.10 added May 16, 1995

2A.11 Serviceable – Acceptable for continued use (i.e. exhibits no signs of functional deterioration, deformation of hardware, indicators not functional, oral inflation tube blocked or detached, manual inflator trigger detached, or the like).

2A.11 added May 16, 1995

2A.12 Single-Point Status Indicator – A status indicator which combines all system checks into a single visual display point to communicate inflation system readiness.

2A.12 added May 16, 1995

2A.13 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.

2A.13 added May 16, 1995

THREAD

3 Construction

Section 3 effective September 1, 1994

3.1 Thread containing cotton shall not be used in a PFD.

4 Performance

Section 4 effective September 1, 1994

4.1 General

4.1.1 Thread shall comply with the acceptance criteria specified in Table 4.1 when subjected to the tests therein.

INFLATION SYSTEMS FOR HYBRID AND FULLY INFLATABLE RECREATIONAL PFDs

31 Construction

31.1 General

31.1.1 An exposed edge or projection of an inflation system shall not be 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 requirements in the Standard for Tests for Sharpness of Edges on Equipment, UL 1439.

Revised 31.1.1 effective September 1, 1996

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

Revised 31.1.2 effective September 1, 1996

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

Revised 31.1.3 effective September 1, 1996

31.1.4 **Deleted May 16, 1995**

31.2 Materials

31.2.1 A metallic component of an inflation system 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. Combinations of metals shall be galvanically compatible.

Exception No. 1: An expendable component (for example, a gas cylinder) 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.

Exception No. 2: A component need not be of corrosion resistant material if failure of the component will not affect the ability of the device to meet the requirements of this standard.

Exception No. 3: Where galvanic compatibility can not be provided, an expendable component may be utilized as a sacrificial anode.

Revised 31.2.1 effective September 1, 1996

31.2.2 A nonmetallic component of an inflation system shall resist the deteriorating effects of exposure to light, water, gasoline, detergent, dry cleaning solvent, and motor oil (See the Exposure portion of Tables 32.1 – 32.3).

Revised 31.2.2 effective September 1, 1996

31.3 Oral inflation systems

31.3.1 An oral inflation system shall be provided with a pressure-actuated inlet valve (See the acceptance criteria under Oral Systems in Table 32.3). The pressure-actuated inlet valve shall not require a pull, push, or other mechanical action to open the inflation valve.

Revised 31.3.1 effective September 1, 1996

31.3.2 A mouthpiece for an oral inflation system shall not contain:

- a) Lead compounds of which the lead content exceeds 0.5 percent of the total weight of the contained solids (including pigments, film solids, and driers);
- b) Compounds of antimony, arsenic, mercury, or selenium of which the metal content individually or in total exceeds 0.06 percent by weight of the contained solids (including pigments, film solids, and driers); or
- c) Barium compounds of which the water soluble barium exceeds 1 percent of the total barium.

Revised 31.3.2 effective September 1, 1996

31.3.3 An oral inflation mechanism shall not be able to be locked in the open or closed position. A friction fit dust cap shall not be considered to lock the mechanism closed.

Revised 31.3.3 effective September 1, 1996

31.3.4 **Deleted May 16, 1995**

31.3.5 **Deleted May 16, 1995**

31.3.6 **Deleted May 16, 1995**

31.4 Actuation and rearming of manual, manual-auto, and automatic inflation systems

31.4.1 Rearming an inflation system shall not require the use of tools, unless the tool is a non-detachable part of the inflation system or is provided with every inflation system rearm kit.

Added 31.4.1 effective September 1, 1996

31.4.2 Devices shall be designed such that only the proper rearming sequence is possible and only the correct component orientation can be achieved for systems in which the correct rearming of a manual, manual-auto, or automatic inflation system is dependent upon the sequence of rearming actions or the orientation of user situated components. For example, automatic or manual-auto systems which utilize a water sensing element whose orientation within the device is critical to the proper functioning of the device shall be designed such that the element can only be installed in the correct orientation.

Added 31.4.2 effective September 1, 1996

31.4.3 The manual portion of a manual or manual-auto inflation system shall be capable of being manually actuated by one deliberate action by the user.

Added 31.4.3 effective September 1, 1996

31.4.4 For Use Code 2F, 3F, and 5H systems which do not have cylinder seal indication, the manual portion of an manual-auto or manual inflation system shall:

- a) Be designed such that the manual system cannot be reset without first unseating the spent cylinder; or
- b) Incorporate user-installed non-reusable indicating tabs or pins for use when rearming the device to provide an indication that a charged cylinder has been installed. Such tabs or pins shall break away or otherwise be ejected from the device during manual activation.

Added 31.4.4 effective September 1, 1996

31.4.5 A manual, manual-auto, or automatic inflation system shall not permit installation of a loaded inflation medium container unless the device is properly reset (i.e., an inflation medium container will discharge during installation if a system has not been reset).

Exception: For Use Code 2F, 3F, and 5H systems, an manual-auto inflation system may be designed such that the manual portion of the system may be rearmed when the automatic portion of the system is disarmed, provided the inflation system incorporates separate (multi-point) indicators for the automatic and manual portions of the system.

Added 31.4.5 effective September 1, 1996

31.4.6 The pull mechanism (lanyard) portion of a manual or manual-auto inflation system shall be provided in a highly visible color intended to contrast with the color of the PFD.

Added 31.4.6 effective September 1, 1996

31.5 Means for verification of mechanism operation

31.5.1 A manual, manual-auto, or automatic inflation system shall be designed such that the user may test the system during rearming to visually verify that all mechanisms are operating using only components which are integral to the device and without discharging a cylinder.

Added 31.5.1 effective September 1, 1996

31.6 Inflation medium and inflation medium containers (gas cylinders)

31.6.1 An inflation medium container (gas cylinder) for an automatic, manual-auto, or manual system shall meet the following requirements.

- a) The inflation medium container shall be of seamless construction and shall not be rechargeable following release of the gas charge.
- b) An inflation medium container, excluding the sealing cap, shall be capable of withstanding an internal, hydrostatically applied, pressure of 54 mPa (7.830 psi) without bursting.
- c) All charger inflation medium containers are to be conditioned at $65 \pm 2^\circ\text{C}$ ($149 \pm 4^\circ\text{F}$) for 30 minutes. No loss of gas or deformation of the inflation medium container shall occur.

Exception: A slight deformation of the sealing cap is permitted. After conditioning, the piercing surface of the sealing cap is to be within 0.012 inch (0.3 mm) of the plane of the outer diameter of the sealing cup.

- d) When filled with carbon dioxide, the nominal mass in grams of carbon dioxide shall not exceed 75 percent of the volume (water capacity) in ml of the inflation medium container.
- e) When exposed to a 5 percent salt spray for 96 hours in accordance with ASTM B117-89, the outer surface of the inflation medium container shall exhibit no corrosion of the base construction metal and the outer surface of steel inflation medium containers shall exhibit no red rust.
- f) The gross weight of the inflation medium container shall be the marked minimum gross weight (minus 0 + 10 percent of the marked nominal mass of gas or + 2 grams), whichever is the greater.

Added 31.6.1 effective September 1, 1996

31.6.2 An inflation medium shall not be flammable or more toxic, nor shall it generate compounds formed from reaction with water, compartment wall, and the like, that are flammable or more toxic than carbon dioxide.

Added 31.6.2 effective September 1, 1996

31.7 Indicators

31.7.1 Automatic, manual-auto, and manual inflation systems shall be provided with status indicators as follows:

- a) Use Code 1F – The inflation system shall incorporate cylinder seal indication in a single point indicator. The indicator shall be integral to the device and automatically reset to a positive or "ready" condition upon rearming of the system.
- b) Use Codes 2F and 3F – The status indicator shall provide information to the user as to whether the device is correctly armed except for the presence of a loaded inflation medium container (e.g., the user will need to check the inflation medium container status by removing it, inspecting it, and replacing it). The readiness of the system shall be displayed using single or multiple point indicator(s).
- c) All status indicators shall be designed such that a user will be able to visually verify that all indicators are operating properly upon inspection during rearming without using tools not integral to, or provided with, the system and without discharging a cylinder.
- d) For all status indicators, the color green shall be used to indicate an armed or "ready" condition and the color red shall be used to indicate an unarmed or "not ready" condition. A red status indicator shall be evident whenever a green status indicator is absent, and vice versa. In the case of pull pins or tabs for Use Code 2F and 3F status indicators, this may be accomplished by having the red indicator located beneath the green indicator so as to be visible after, but not readily apparent before, the pin or tab is removed.
- e) All status indicators shall be grouped or located such that when installed on a device in their intended position, they may be viewed simultaneously when examined prior to donning.
- f) Electronic indicators shall be provided with a means to test the working condition of the circuitry and the adequacy of the power supply.

Added 31.7.1 effective September 1, 1996

32 Performance

32.1 General

32.1.1 Inflation systems shall comply with the requirements specified in Tables 32.1 – 32.3 when subjected to the tests therein. For manual-auto inflation systems, the automatic portion of the system shall comply with the requirements for automatic inflation systems and the manual portion of the system shall comply with the requirements for manual inflation systems.

Exception: Inflation systems intended for use only in personal flotation devices marked "Do not dry clean," or the equivalent, need not comply with the requirements for exposure to perchloroethylene.

Revised 32.1.1 effective September 1, 1996

32.1.2 Over-pressure relief valve systems shall comply with the requirements specified in Table 32.4 when subjected to the tests therein.

Revised 32.1.2 effective September 1, 1996

32.1.3 If a system has a form of construction, or employs metals in a combination that is not known to provide acceptable resistance to corrosion, resistance to dezincification, or galvanic compatibility, samples are to be tested in accordance with Table 32.1 after being subjected to 720 hours of salt spray exposure in accordance with the Standard Test Method for Salt Spray (Fog) Testing, ASTM B117-89, in addition to tests following Standard Exposure (See Table 2.2).

Added 32.1.3 effective September 1, 1996

Table 32.1
Automatic inflation systems

Tests	Exposure ^a	Test method	Number of samples ^{b,c}	Acceptance criteria
Use Characteristics	Standard Conditioning	Section 32.2	As needed dependent upon design features	1. For Use Code 1F automatic inflation systems, correct identification regarding system status, including cylinder seal condition, shall be accomplished by at least 96 percent of the 25 or more subjects performing the status indicator evaluation. 2. For Use Code 2F and 3F automatic inflation systems, correct identification regarding system status, excluding cylinder seal condition, shall be accomplished by at least 92 percent of the 25 or more subjects performing the status indicator evaluation. 3. For Use Code 1F automatic inflation systems, proper rearming of the inflation system shall be accomplished by at least 93 percent of the 15 or more subjects performing the rearming evaluation. 4. For Use Code 2F and 3F automatic inflation systems, proper rearming of the inflation system shall be accomplished by at least 86 percent of the 15 or more subjects performing the rearming evaluation.

(Continued)

Table 32.1 (Cont'd)
Automatic inflation systems

Tests	Exposure ^a	Test method	Number of samples ^{b,c}	Acceptance criteria
Automatic Operability	1. Standard Conditioning	32.3.1 – 32.3.5	3 for each separate conditioning plus 6 extra water sensing elements (if expendable) for each sample.	1. Following Exposures 1 – 7 and 9, the actuation time shall be not more than 5 seconds following immersion for each of the six trials (i.e., three in fresh water, three in salt water). Except for minimal residual vapor, the CO ₂ in the cylinders shall be completely discharged after each trial.
	2. 300 hours of accelerated weathering		See 32.5.1 (total 27 samples plus 162 extra water sensing elements if expendable).	2. Within 10 seconds of removal from the cold chamber following Exposure 8a, samples shall be dropped 3 times onto a concrete surface from a height of 6 feet (1.8 m). The samples shall then be subjected to Exposure 8b. Following Exposure 8b, the actuation time shall be not more than 5 seconds following immersion for each of the six trials (i.e., three in fresh water, three in salt water).
	3. 70 hours Immersion in ASTM Ref. Fuel B		Note: For the Discharge Test, an additional water sensing element is required for each sample for each separate conditioning.	3. Following Exposure 9, samples shall have no visible pitting or other damage on any surface.
	4. 70 hours Immersion in IRM 902 (Calumet Oil No. 2)		Note: Exposure 8 samples should have the largest intended CO ₂ cylinder attached following conditioning and prior to testing.	
	5. 70 hours Immersion in perchloroethylene			
	6. 70 hours Immersion in 0.5% detergent in "0" hardness water			
	7. 158 ± 4°F (70 ± 2°C) for 168 hours			
	8a. -22 ± 4°C (-30 ± 2°F) for 24 hours			
	8b. 32 ± 4°F (0 ± 2°C) for 24 hours			
Parallel Strength of Attachment	9. 720 hours of Salt Spray as specified in ASTM B117 – 89			
	Standard Conditioning	32.6.1 – 32.6.3	1	The joint between the inflator and the inflation chamber material shall not fail when a force of 75 lbf (334 N) is applied parallel to the surface of the chamber material at the point of attachment, for at least 5 minutes.

(Continued)

Table 32.1 (Cont'd)
Automatic inflation systems

Tests	Exposure ^a	Test method	Number of samples ^{b,c}	Acceptance criteria
Perpendicular Strength of Attachment	Standard Conditioning	32.6.1 - 32.6.3	1	The joint between the inflator and the inflation chamber material shall not fail when a force of 250 lbf (1112 N) is applied outwardly from and perpendicular to the surface of the chamber material at the point of attachment, for at least 3 seconds.
Discharge	Same as Automatic Operability	32.7.1 - 32.7.12	The samples with the remaining water sensing elements from each conditioning from the Automatic Operability Test.	For Exposures 1 - 7, and 9, the time for actuation following immersion shall be not more than 5 seconds. In addition, Use Code 1F and 2F systems shall achieve 150N (33.7 lbf) and Use Code 3F systems shall achieve 100N (22.5 lbf) within 10 seconds following immersion. For Exposure 8, the time for actuation following immersion shall be not more than 5 seconds. In addition, Use Code 1F and 2F systems shall achieve 75N (16.8 lbf) and Use Code 3F systems shall achieve 50N (11.2 lbf) within 10 seconds following immersion.
Hydrostatic Proof Pressure	Standard Conditioning	TSO - C13e 5.6.3	1	The inflation system shall withstand an internal hydrostatic pressure of 1500 psig (10342 kPa gauge) without deformation or leakage.
Proof Pressure	Standard Conditioning	TSO - C13e 5.6.3	The sample from the Hydrostatic Proof Pressure Test.	After the Hydrostatic Proof Pressure Test, the inflation system shall not leak when subjected to an air pressure of 2 psig (14 kPa gauge) for 30 seconds, followed by an air pressure of 40 psig (276 kPa gauge) for 30 seconds.
Air Flow	Standard Conditioning	TSO - C13e 5.6.4	1	The inflation system shall allow a minimum air flow of 4 lpm (1 gpm) at an inlet pressure of 40 psig (276 kPa gauge).
Vacuum	Standard Conditioning	TSO - C13e 5.6.4	The sample from the Air Flow Test.	The inflation system shall not show a loss of pressure greater than 0.05 inches (1.3 mm) of water in 1 minute or 0.1 inches (2.5 mm) of water in 1 hour when subjected to a vacuum of 12 inches (0.3 m) of water applied so as to reduce the seating spring pressure and with atmospheric pressure on the other side.

(Continued)

Table 32.1 (Cont'd)
Automatic inflation systems

Tests	Exposure ^a	Test method	Number of samples ^{b,c}	Acceptance criteria
Humid Atmosphere	7 cycles of the following consecutive exposures ^d : 1. 8 hours at 49 ±2°C (120 ±4°F) and 96 ±2,0 percent relative humidity 2. 16 hours at 23 ±2°C (73.4 ±3.6 °F)	32.8.1	1 complete sample	The sample shall not actuate during the exposure and shall operate as intended following the exposure.
System Durability	Standard Conditioning	32.9.1	1 complete sample	The inflation system shall operate as intended.
^a See Table 2.2 for conditioning details. ^b Potentially color dependent. See 2.6.1. ^c For polymeric/metallic inflation systems, a minimum of 35 samples with water sensing elements plus 170 extra water sensing elements. ^d The test samples are to be placed in an uninsulated, water tight enclosure prior to being transferred to the ambient condition and are to be removed from the enclosure upon return to the elevated temperature and humidity condition.				

Revised Table 32.1 effective September 1, 1996

Table 32.2
Manual inflation systems

Tests	Exposure ^a	Test method	Number of samples ^{b,c}	Acceptance criteria
Use Characteristics	Standard Conditioning	Section 32.2	As needed dependent upon design features	1. For Use Code 1F manual inflation systems, correct identification regarding system status, including cylinder seal condition, shall be accomplished by at least 96 percent of the 25 or more subjects performing the status indicator evaluation. 2. For Use Code 2F and 3F manual inflation systems, correct identification regarding system status, excluding cylinder seal condition, shall be accomplished by at least 92 percent of the 25 or more subjects performing the status indicator evaluation. 3. For Use Code 1F manual inflation systems, proper rearming of the inflation system shall be accomplished by at least 93 percent of the 15 or more subjects performing the rearming evaluation. 4. For Use Code 2F and 3F manual inflation systems, proper rearming of the inflation system shall be accomplished by at least 86 percent of the 15 or more subjects performing the rearming evaluation.

(Continued)

Table 32.2 (Cont'd)
Manual inflation systems

Tests	Exposure ^a	Test method	Number of samples ^{b,c}	Acceptance criteria
Manual Operability	1. Standard Conditioning	32.4.1 - 32.4.5	3 for each separate conditioning. (Total 27 samples)	1. Following Exposures 1 - 7 and 9, the force required to puncture the CO ₂ cylinder shall be not less than 3 lbf (13 N) and not more than 15 lbf (67 N) for each of the trials, and the average force shall be not less than 5 lbf (22 N). Except for minimal residual vapor, the CO ₂ in the cylinders shall be completely discharged after each trial.
	2. 300 hours of accelerated weathering		Note: Exposure 8 samples should have largest intended CO ₂ cylinder attached following conditioning and prior to testing.	2. Within 10 seconds of removal from the cold chamber following Exposure 8, samples shall remain operable when dropped three times onto a concrete surface from a height of 6 feet (1.8 m). The force required to puncture the CO ₂ cylinder shall be not less than 3 lbf (13 N) and not more than 15 lbf (67 N) for each of the trials, and the average force shall be not less than 5 lbf (22 N).
	3. 70 hours immersion in ASTM Ref. Fuel B			3. Following Exposure 9, samples shall have no visible pitting or other damage on any surface.
	4. 70 hours immersion in IRM 902 (Calumet Oil No. 2)			
	5. 70 hours immersion in perchloroethylene			
	6. 70 hours immersion in 0.5% detergent in "0" hardness water			
	7. 158 ± 4°F (70 ± 2°C) for 168 hours			
	8. -22 ± 4°F (-30 ± 2°C) for 24 hours			
	9. 720 hours of Salt Spray as specified in ASTM B117 - 89			
Parallel Strength of Attachment	Standard Conditioning	32.6.1 - 32.6.3	1	The joint between the inflator and the inflation chamber material shall not fail when a force of 75 lbf (334 N) is applied parallel to the surface of the chamber material at the point of attachment, for at least 5 minutes.
Perpendicular Strength of Attachment	Standard Conditioning	32.6.1 - 32.6.3	1	The joint between the inflator and the inflation chamber material shall not fail when a force of 250 lbf (1112 N) is applied outwardly from and perpendicular to the surface of the chamber material at the point of attachment, for at least 3 seconds.

(Continued)

Table 32.2 (Cont'd)
Manual inflation systems

Tests	Exposure ^a	Test method	Number of samples ^{b,c}	Acceptance criteria
Discharge	Same as Operability for Exposures 1 – 7, and 9 For Exposure 8, 32 ± 4°C (0 ± 2°C) for 24 hours.	32.7.1 – 32.7.12	The samples from each conditioning from the Operability Test.	For Exposures 1 – 7, and 9, the time for discharge following actuation shall be not more than 5 seconds. Use Code 1F and 2F systems shall achieve 150N (33.7 lbf) and Use Code 3F systems shall achieve 100N (22.5 lbf) within 5 seconds of actuation. For Exposure 8, the time for discharge following actuation shall be not more than 5 seconds. Use Code 1F and 2F systems shall achieve 75N (16.8 lbf) and Use Code 3F systems shall achieve 50N (11.2 lbf) within 5 seconds of actuation.
Pull Cord Strength	1. Standard Conditioning 2. 300 hours of accelerated weathering	TSO – C13e 5.6.2	1 for each separate conditioning. Note – samples from the Operability Test may be used.	The pull cord, its attachment to the tab, and its attachment to the inflator shall withstand a force of 100 lbf (445 N) for 3 seconds without failing or separating from the inflator.
Hydrostatic Proof Pressure	Standard Conditioning	TSO – C13e 5.6.3	1	The inflation system shall withstand an internal hydrostatic pressure of 1500 psig (10342 kPa) without deformation or leakage.
Proof Pressure	Standard Conditioning	TSO – C13e 5.6.3	The sample from the Hydrostatic Proof Pressure Test.	After the Hydrostatic Proof Pressure Test, the inflation system shall not leak when subjected to an air pressure of 2 psig (14 kPa gauge) for 30 seconds, followed by an air pressure of 40 psig (276 kPa gauge) for 30 seconds.
Air Flow	Standard Conditioning	TSO – C13e 5.6.4	1	The inflation system shall allow a minimum air flow of 4 lpm (1 gpm) at an inlet pressure of 40 psig (276 kPa gauge).
Vacuum	Standard Conditioning	TSO – C13e 5.6.4	The sample from the Air Flow Test.	The inflation system shall not show a loss of pressure greater than 0.05 inches (1.3 mm) of water in 1 minute or 0.1 inches (2.5 mm) of water in 1 hour when subjected to a vacuum of 12 inches (0.3 m) of water applied so as to reduce the seating spring pressure and with atmospheric pressure on the other side.
System Durability	Standard Conditioning	32.9.1	1 complete sample	The inflation system shall operate as intended.

^a See Table 2.2 for conditioning details.

^b Potentially color dependent. See 2.6.1.

^c For polymeric/metallic inflation systems, a minimum of 35 samples.

Revised Table 32.2 effective September 1, 1996

Table 32.3
Oral inflation systems

Tests	Exposure ^a	Test method	Number of samples ^{b,c}	Acceptance criteria
Oral Operability	1. Standard Conditioning	32.5.1 - 32.5.3	3 for each separate conditioning. (Total 27 samples)	1. The crack pressure shall not exceed 0.44 psig (3 kPa).
	2. 300 hours of accelerated weathering			2. The air flow shall be not less than 100 lpm (26.1 gpm).
	3. 70 hours immersion in ASTM Ref. Fuel B			
	4. 70 hours immersion in IRM 902 (Calumet Oil No. 2)			
	5. 70 hours immersion in perchloroethylene			
	6. 70 hours immersion in 0.5% detergent in "0" hardness water			
	7. $158 \pm 4^{\circ}\text{F}$ ($70 \pm 2^{\circ}\text{C}$) for 168 hours			
	8. $-22 \pm 4^{\circ}\text{F}$ ($-30 \pm 2^{\circ}\text{C}$) for 24 hours			
	9. 720 hours of Salt Spray as specified in ASTM B117 - 89			
Parallel Strength of Attachment	Standard Conditioning	32.6.1 - 32.6.3	1	The joint between the inflator and the inflation chamber material shall not fail when a force of 75 lbf (334 N) is applied parallel to the surface of the chamber material at the point of attachment, for at least 5 minutes.
Perpendicular Strength of Attachment	Standard Conditioning	32.6.1 - 32.6.3	1	The joint between the inflator and the inflation chamber material shall not fail when a force of 100 lbf (445 N) is applied outwardly from and perpendicular to the surface of the chamber material at the point of attachment, for at least 3 seconds.

(Continued)

Table 32.3 (Cont'd)
Oral inflation systems

Tests	Exposure ^a	Test method	Number of samples ^{b,c}	Acceptance criteria
Back Pressure	Same as Oral Operability	TSO – C13e 4.1.4.2	The samples from the Operability Test.	The samples shall not leak when subjected to a back pressure of 0 to 10 psig (0 to 69 kPa). If leakage occurs using samples from the Salt Spray exposure or Detergent exposure, the valve may be rinsed from the outside by agitating the sample in fresh water for a period of not more than 15 seconds to dissolve any imbedded particles, and the test repeated.
^a See Table 2.2 for conditioning details. ^b Potentially color dependent. See 2.6.1. ^c For polymeric/metallic inflation systems, a minimum of 30 samples.				

Added Table 32.3 effective September 1, 1996

Table 32.4
Over-pressure relief valve systems

Tests	Exposure ^a	Test method	Number of samples ^{b,c}	Acceptance criteria
Operability	1. Standard Conditioning 2. 300 hours of accelerated weathering 3. 70 hours immersion in ASTM Ref. Fuel B 4. 70 hours immersion in IRM 902 (Calumet Oil No. 2) 5. 70 hours immersion in perchloroethylene 6. 70 hours immersion in 0.5% detergent in "0" hardness water 7. 70 $\pm 2^{\circ}\text{C}$ (158 $\pm 4^{\circ}\text{F}$) for 168 hours 8. -30 $\pm 2^{\circ}\text{C}$ (-22 $\pm 4^{\circ}\text{F}$) for 24 hours 9. 720 hours of Salt Spray as specified in ASTM B117-89	32.10.1	3 for each separate conditioning. (Total 27 samples)	1. The crack pressure shall not exceed 120 percent of the rated pressure and shall not be less than 80 percent of the rated pressure. 2. The closing pressure shall be not less than 80 percent of the measured crack pressure.
Parallel Strength of Attachment	Standard Conditioning	32.6.1 - 32.6.3	1	The joint between the over-pressure relief valve and the inflation chamber material shall not fail when a force of 75 lbf (334 N) is applied parallel to the surface of the chamber material at the point of attachment, for at least 5 minutes.
Perpendicular Strength of Attachment	Standard Conditioning	32.6.1 - 32.6.3	1	The joint between the over-pressure relief valve and the inflation chamber material shall not fail when a force of 100 lbf (445 N) is applied outwardly from and perpendicular to the surface of the chamber material at the point of attachment, for at least 3 seconds.
^a See Table 2.2 for conditioning details. ^b Potentially color dependent. See 2.6.1. ^c For polymeric/metallic inflation systems, a minimum of 30 samples.				

Added Table 32.4 effective September 1, 1996

32.2 Use characteristics test – automatic, manual-auto, and manual inflation systems

32.2.1 Each Use Code 1F, 2F, and 3F automatic, manual-auto, or manual inflation systems shall meet the acceptance criteria in Table 32.1 or 32.2, as appropriate, when tested in accordance with 32.2.2 – 32.2.9.

Revised 32.2.1 effective September 1, 1996

32.2.2 Human test participants as specified in Table 32.5 are to be employed. A test participant shall not be familiar with the particular device under test, but is to be familiar with PFDs in general.

Added 32.2.2 effective September 1, 1996

Table 32.5
Test participant selection

Type of Inflation system	Number of test participants (group size)
Manual Inflation System	1 group of 25
Automatic Inflation System	1 group of 25
Manual-Auto Inflation System	1 group of 25
Note: A minimum of 5 and a maximum of 15 test participants shall be obtained for each subject group from each of the following age groups: a) 16 – 25 years; b) 26 – 50 years; and c) 51 and older.	

Added Table 32.5 effective September 1, 1996

32.2.3 Test Participant Qualification and Orientation for Status Indicator Test – Each test participant is to be given the following written questions to respond to:

- a) "Have you gone boating?"; and
- b) "What does a life vest (or life jacket) do for you?"

Test participants who respond negatively to question (a) or incorrectly to question (b) are to be eliminated and replaced.

Added 32.2.3 effective September 1, 1996

32.2.4 Qualifying 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) The general principal and method of manual inflation.
- d) The general principal and method of automatic inflation.

Added 32.2.4 effective September 1, 1996

32.2.5 Status Indicator Test Sample Preparation – Samples of the candidate inflation systems are to be mounted on boards or on inflation cells as follows:

- a) One sample properly armed.
- b) One sample normally fired manually for devices with manual systems.
- c) One sample normally fired automatically for devices with automatic systems.
- d) Samples incorrectly rearmed, excluding replacement with a fired cylinder.
- e) For Use Code 1F systems, samples incorrectly rearmed, including installation of a fired cylinder.

The order of presentation is to be varied for the different test participants.

Added 32.2.5 effective September 1, 1996

32.2.6 Status Indicator Evaluation – Each test participant from the group shall in turn be instructed that they will be shown a group of at least four inflation systems of which one is correctly armed and the others are not, and that they will be asked to select the one that is correctly armed based on the indicators on the device and any information on the instruction card provided by the manufacturer. They will be given any manufacturer's hang tag which will be with the device when sold (or permanently marked or attached), which they may use to help identify the properly armed system. Each test participant shall then be asked to examine the devices and the instructions provided. Up to 10 minutes shall be permitted for the examination. Upon completion of the examination, the test participant shall state which device they believe is ready for use. Each test participant's response is to be recorded. If a test participant indicates they believe a manual or manual-auto device is fully armed, they shall be asked to manually activate the device. The time to activate the device is to be recorded.

Added 32.2.6 effective September 1, 1996

32.2.7 At least 24 of the 25 participants shall identify the correct sample for a Use Code 1F system. At least 23 of the 25 test participants shall identify the correct sample for Use Code 2F, or 3F systems. If the required number of participants do not identify the correct sample, but at least 16 of the 25 test participants identify the correct sample, each test participant who identifies an incorrect sample is to be instructed as to why the sample they selected is visibly incorrect. These test participants shall again review the orientation video and manufacturer's instructions and shall then be asked the following questions:

- a) "What is the significance of green on this device?"
- b) "What is the significance of red on this device?"
- c) For manually actuated systems, "What is this for?" (while pointing out the manual lanyard)
- d) "What is this for?" (while pointing out the inflation medium container)

The responses are to be recorded. If any response is incorrect, the test participant is to be instructed as to the correct response. These test participants are then to be given a second 10 minute opportunity to correctly identify the correctly armed system.

Added 32.2.7 effective September 1, 1996

32.2.8 Test participant Qualification for Serviceability Test – Following completion of the Status Indicator 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 Serviceability Test.

Added 32.2.8 effective September 1, 1996

32.2.9 Rearming/Serviceability Evaluation – Test participants qualified in accordance with 32.2.7 shall be informed that they will be asked to rearm the inflation system they examined and shall be provided with incentive to perform the rearming correctly. They should also be instructed that they will be given two rearming kits and that they are free to test one of the kits if they need to do so in order to satisfy themselves that they can perform the rearming procedure properly. The participants should be instructed that the rearming trial will be completed when they present what they believe to be a properly rearmed device (which they have not actuated). Each test participant shall then be given the manufacturer's instructions to be provided with each device (written, pictogram, video, etc.), two rearming kits, and access to the manufacturer's toll-free telephone number if provided. The test participant shall then be instructed to proceed with the rearming evaluation. The time required to perform the rearming and the use of the second rearming kit shall be recorded.

Added 32.2.9 effective September 1, 1996

32.3 Automatic operability test – automatic and manual-auto inflation systems

32.3.1 Each automatic or manual-auto inflator is to be conditioned as a complete unit (with flanges, valves, water sensing elements, and the like, in place) but without an inflation medium container being fitted.

Exception: Water sensing elements need not be exposed to the following conditions:

- a) 300 hours weathering;
- b) 0.5 percent detergent in "0" hardness water; or
- c) 720 hours salt spray.

Added 32.3.1 effective September 1, 1996

32.3.2 Following the conditionings, each sample is to be fitted with a new inflation medium container of the size specified by the inflation system manufacturer.

Added 32.3.2 effective September 1, 1996

32.3.3 Other than as specified in the Exception to 32.3.1, a conditioned water sensing element is to be used for each of the trials.

Exception: If the water sensing element exposed to Reference Oil 2 does not perform as required by 32.3.5, the elements for this trial may be replaced with new, unconditioned elements and the marking specified in 33.4 applies.

Added 32.3.3 effective September 1, 1996

32.3.4 Each of the three samples is to be tested by dropping into water that is no more than 4 inches (0.1 m) deep. Each sample is tested 3 times in fresh water and three times in 5 percent w/v salt water using a new, conditioned water sensing element for each test. For Exposures 1 through 7, and 9, the water temperature is to be $68 \pm 4^\circ\text{F}$ ($20 \pm 2^\circ\text{C}$). For Exposure 8, the water temperature is to be $32 \pm 4^\circ\text{F}$ ($0 \pm 2^\circ\text{C}$).

Added 32.3.4 effective September 1, 1996

32.3.5 The time interval between the sample entering the water and the onset of bubble discharge due to piercing of the inflation medium container (the actuation time) shall be not more than 5 seconds.

Added 32.3.5 effective September 1, 1996

32.4 Manual operability test – manual and manual-auto inflation systems

32.4.1 Each manual or manual-auto inflator is to be conditioned as a complete unit (with flanges, valves, etc., in place) but without an inflation medium container fitted.

Added 32.4.1 effective September 1, 1996

32.4.2 The test specified in 32.4.5 is to be conducted three times for each sample for each conditioning, each time using a new inflation medium container of the type specified by the inflation system manufacturer.

Exception: Manual-auto inflation systems which have been subjected to the automatic systems Operability Tests may be tested with the use of inflation medium container head blanks, provided the average force required to puncture five blanks is equal to or greater than the average force required to puncture the inflation medium containers in the three trials for the Standard Conditioning samples as specified in 32.4.5.

Added 32.4.2 effective September 1, 1996

32.4.3 Samples conditioned at minus $22 \pm 4^\circ\text{F}$ ($-30 \pm 2^\circ\text{C}$) and $158 \pm 4^\circ\text{F}$ ($70 \pm 2^\circ\text{C}$) are to be tested as specified in 32.4.5 within 30 seconds of removal from the exposures.

Added 32.4.3 effective September 1, 1996

32.4.4 If the sample uses an expendable element such as a clip or pin to reduce the likelihood of inadvertent manual actuation, the first trial is to be with the use of that element. The second and third trials may be without the use of the expendable element.

Added 32.4.4 effective September 1, 1996

32.4.5 The sample is to be attached to a rigid fixture. Using a Constant-Rate-of-Extension tensile test machine with readability to 0.1 lbf (0.45 N), a force is to be applied to the pull cord in the intended direction of operation at a rate of 5 ± 0.5 inches/minute (127 ± 12.7 mm/minute) until complete puncturing of the inflation medium container has occurred. The force required to cause puncturing shall be as specified in Table 32.2.

Added 32.4.5 effective September 1, 1996

32.5 Operability test – oral systems

32.5.1 Each oral inlet valve is to be conditioned in an unsealed oral tube without an inflatable bladder attached.

Added 32.5.1 effective September 1, 1996

32.5.2 Following the conditionings, a gradually increasing air pressure is to be applied to the valve at a rate of approximately 0.5 psi per minute (3.5 kPa/minute). The pressure at which the valve begins to open (the crack pressure) shall be not more than 0.6 psig (4 kPa).

Added 32.5.2 effective September 1, 1996

32.5.3 An air pressure of 1 psig (7 kPa gauge) is then to be applied to the valve. The air flow through the system (i.e., valve and tube) shall be not less than 100 lpm (26.1 gpm).

Added 32.5.3 effective September 1, 1996

32.6 Parallel and perpendicular strength of attachment – automatic, manual-auto, manual, oral inflation systems, and over-pressure relief valve systems

32.6.1 The system is to be attached to a piece of inflation chamber material that complies with this standard using the system manufacturer's attachment instructions.

Added 32.6.1 effective September 1, 1996

32.6.2 To secure the joint during application of the load, an adaptor having an inside diameter at least 0.75 inch (19 mm) larger than the outside diameter of the inflator at the point of attachment is to be used.

Added 32.6.2 effective September 1, 1996

32.7 Discharge test – automatic, manual-auto, and manual inflation systems

32.7.1 Each inflator from the Operability Tests is to be fitted with an inflatable bladder (made of neutrally buoyant material) with an internal volume sufficient to hold the inflation medium from the inflation medium container specified by the manufacturer without full inflation of the bladder. If necessary, a new bladder flange piece may be used in this test to secure the bladder. However, all other parts of the inflatable assembly (i.e., valves, and the like) are to be those conditioned and used in the Operability Tests, except a water sensing element is not to be put in place.

Added 32.7.1 effective September 1, 1996

32.7.2 Each inflator with bladder is to be evacuated of air under a vacuum of at least 10 inches (254 mm) of mercury.

Added 32.7.2 effective September 1, 1996

32.7.3 The combined in-water weight of the evacuated inflator with bladder, a fully charged inflation medium container, and, for automatic or manual-auto inflators, an expended water sensing element (unassembled), is to be measured to the nearest ounce.

Added 32.7.3 effective September 1, 1996

32.7.4 The test sample is to be assembled using the evacuated bladder, the inflator, and the inflation medium container specified by the manufacturer after they have been dried and, for automatic or manual-auto inflators, with a water sensing element as described in 32.3.3.

Added 32.7.4 effective September 1, 1996

32.7.5 The fully charged inflation medium container is to be weighed to the nearest 0.1 grams.

Added 32.7.5 effective September 1, 1996

32.7.6 A dead-weight is then to be attached to the sample in a manner that will not reduce the volume of the inflatable bladder. The in-water weight of the dead-weight is to be as follows:

$$\text{In-water Weight of Dead Weight} = "A" - \text{Weight 32.7.3}$$

in which:

"A" weight for Exposures 1 – 7, and 9 is 150N (33.71 lbf) for Use Codes 1F and 2F or 100N (22.5 lbf) for Use Code 3F. "A" weight for Exposure 8 is 75N for Use Codes 1F and 2F or 50N for Use Code 3F.

Added 32.7.6 effective September 1, 1996

32.7.7 A test tank of fresh water of sufficient depth to totally submerge the test sample and bladder is to be used. The temperature of the water in the test tank is to be $68 \pm 4^{\circ}\text{F}$ ($20 \pm 2^{\circ}\text{C}$) for Exposures 1 – 7, and 9, and $32 \pm 4^{\circ}\text{F}$ ($0 \pm 2^{\circ}\text{C}$) for Exposure 8. The atmospheric pressure is to be 14.7 ± 0.02 psi (760 ± 5 mmHg), or the in-water weight of the dead-weight is to be corrected as follows:

$$\text{Corrected Weight} = \text{In-water Weight of Deadweight} \times \frac{\text{ATM Pressure psi}}{14.7 \text{ psi}} \times \frac{527.69^{\circ}\text{R}}{\text{Temp}^{\circ}\text{F} + 459.69}$$

Added 32.7.7 effective September 1, 1996

32.7.8 The test sample and weight are then to be dropped into the test tank.

Added 32.7.8 effective September 1, 1996

32.7.9 For automatic inflators or the automatic evaluation on an manual-auto inflator, the time interval between the sample entering the water and the audible piercing of the inflation medium container (the actuation time) shall be not more than 5 seconds. For manual inflators or the manual evaluation of an manual-auto inflator, the lanyard is to be pulled to puncture the inflation medium container.

Added 32.7.9 effective September 1, 1996

32.7.10 For automatic inflators or the automatic evaluation of an manual-auto inflator, the time interval between the sample entering the water and the time at which the weight is lifted from the bottom, or when the weight changes direction from a downward movement to an upward movement, (the discharge time) shall be not more than 10 seconds. Completeness of discharge is indicated by the lifting of the weight.

Added 32.7.10 effective September 1, 1996

32.7.11 For manual inflators or the manual evaluation of an manual-auto inflator, the time interval between the manual actuation and the time at which the weight is lifted from the bottom, or when the weight changes direction from a downward movement to an upward movement, (the discharge time) shall be not more than 5 seconds. Completeness of discharge is indicated by the lifting of the weight.

Added 32.7.11 effective September 1, 1996

32.7.12 If completeness of discharge as specified in 32.7.10 and 32.7.11 is not attained within 10 seconds, then the inflation medium container is to be removed, dried, and reweighed. If the difference between the preweight in 32.7.5 and this weight is less than the minimum design charge value for the inflation medium container (indicating that the cylinder was under-charged), then the trial is to be repeated using a new inflation medium container and, if necessary, a new water sensing element.

Added 32.7.12 effective September 1, 1996

32.8 Humid atmosphere test – automatic and manual-auto inflation systems

32.8.1 An automatic or manual-auto inflation system shall not actuate during the humid atmosphere cycling exposure. Following the exposure, the system shall operate as intended.

Added 32.8.1 effective September 1, 1996

32.9 System durability test – automatic, manual, and manual-auto inflation systems

32.9.1 An automatic or manual inflation systems shall be cycled through 100 actuation and rearming procedures. The manual and the automatic portions of an manual-auto inflation system shall be cycled through 100 actuation and rearming procedures each. Each of the rearming/actuation trials is to be performed using a new fully charged inflation medium container. Following the cycling, each system shall operate as intended. For manually actuated systems, the operation force shall not exceed 20 lbf (89 N) after the last cycles.

Added 32.9.1 effective September 1, 1996

32.10 Operability test – over-pressure relief valves

32.10.1 The valve is to be cycled 10 times from 0 psi to the crack pressures.

Added 32.10.1 effective September 1, 1996

33 Marking

33.1 Inflation Systems – Each shipping label shall be permanently and clearly marked with the following in a color that contrasts with the color of the surface on which the marking is applied:

- a) Manufacturer's name, tradename, or symbol;
- b) Model number;
- c) Use Code 1F, 2F, 3F, and/or 5H as appropriate;
- d) Lot number; and
- e) Largest gram charge weight, evaluated, inflation medium container connection specifications (thread size), manufacturer, and manufacturer's part number for the inflation medium container (for manual, manual-auto, or automatic inflation systems only).

Added 33.1 effective September 1, 1996

33.2 Each automatic, manual, or manual-auto inflation system shall be marked with a unique model number and the manufacturer's name, tradename, or symbol. Each oral inflation system shall be marked with the manufacturer's name, tradename, or symbol.

Added 33.2 effective September 1, 1996

33.3 Inflation Medium Containers – The markings of inflation medium containers shall be durable in normal use and shall include:

- a) The nominal mass (in grams) of the gas (identified by its chemical symbol) in the inflation medium container, in the form, "33 GRAMS CO₂ FILLED" for example, for a nominal mass of 33 grams of carbon dioxide in the container;
- b) The minimum gross weight in grams of the container;
- c) The date of manufacturer (month/year of filling);
- d) The manufacturer's name, tradename, or symbol;
- e) The words, "DO NOT HEAT"; and
- f) The part number(s) for the inflation medium containers which will be specified on the fully inflatable PFDs.

Added 33.3 effective September 1, 1996

33.4 For automatic or manual-auto inflation systems that require the exception to 32.3.3, each shipping container shall be permanently and clearly marked with the following in a color that contrasts with the color of the surface on which the marking is applied:

ATTENTION: USCG APPROVED PFDS THAT USE THIS INFLATOR ARE REQUIRED TO BE MARKED "WARNING: REPLACE WATER SENSING ELEMENT IF EXPOSED TO OIL."

Added 33.4 effective September 1, 1996

33.5 A lanyard actuated manual or manual-auto inflation system shall be marked "JERK TO INFLATE" or the equivalent on the handle, with an arrow indicating the intended direction of pull. Equivalent marking may be symbols or pictograms.

Exception: This marking may be omitted if the fully inflatable recreational PFD satisfactorily meets the performance requirements of UL 1180, Standard for Fully Inflatable Recreational Personal Flotation Devices with alternate markings or no marking.

Added 33.5 effective September 1, 1996

33.6 Each inflation system shall include any markings used to comply with this standard.

Added 33.6 effective September 1, 1996

POLYMERIC COATINGS

34 Performance

Section 34 effective September 1, 1994

34.1 General

34.1.1 Polymeric coatings shall comply with the acceptance criteria specified in Table 34.1 when subjected to the tests therein.

34.1.2 Except for samples used for the Adhesion to Foam Tests, the tests are to be conducted on samples of the coating that have been prepared, by the recommended method, in the form of unsupported film in the minimum thickness recommended.

34.2 Flexibility

34.2.1 Within 5 seconds after removal from the cold chamber, each sample, in turn, is to be bent 180 degrees around a 1/2 inch (12.7 mm) diameter steel mandrel that has been conditioned with the samples.

34.3 Blocking

34.3.1 Resistance to blocking is to be investigated as follows:

- a) No blocking: Surfaces are free or adhere slightly.
- b) Slight Blocking: Surfaces must be lightly peeled to separate.
- c) Blocking: Surfaces separate with difficulty.

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Subjects 1123, 1175, 1177,
 1191, 1517

12 Laboratory Drive
 Research Triangle Park, NC 27709
 September 30, 1993

TO: Marine Council of Underwriters Laboratories Inc.;
 United States Coast Guard;
 Subscribers to UL's Listing Services for Marine Buoyant
 Throwable Devices, Flotation Aids and Special Use
 Devices, Near-Shore Buoyant Vests, Hybrid Personal
 Flotation Devices, Life Preservers and Lifejackets,
 and Commercial Ring Buoys;
~~Subscribers to UL's Recognition Service for Components~~
 for Personal Flotation Devices;
 and
 Others Interested

SUBJECT: Revision to USCG requirements for Personal Flotation
 Device (PFD) Components

On Thursday, May 20, 1993, a final rule affecting components for
 personal flotation devices was published in the Federal Register.
 A copy of this final rule was transmitted to all PFD manufacturers
 and PFD component manufacturers by the United States Coast Guard
 with Mr. R. L. Markle's June 25, 1993 letter.

As noted in the USCG transmittal, a result of the adoption of the
 final rule is that the USCG Letter of Acceptance program will be
 discontinued for non-standard components, requiring these
 components to be acceptance tested under the production quality
 control oversight of a recognized laboratory. **This requirement
 becomes effective on November 16, 1993.**

As a result of these regulatory changes, UL intends to perform a
 review of all PFD Follow-Up Service Procedures to delete, effective
 November 16, 1993, those non-standard components which are not
 under UL's Recognized Component program.

The cost of performing the file review will be applied to each PFD
 Applicant. Applicants will be notified of any components being
 deleted from their Follow-Up Service Procedures.

These Follow-Up Service Procedure revisions will not affect
 standard components which are certified by the component
 manufacturer to comply with the applicable Standard or CFR subpart,
 and which have been submitted to and reviewed and accepted by the
 USCG in accordance with CFR Subpart 164.019-5, Personal Flotation
 Device Components, Standard Components; acceptance criteria and
 procedures. At this time, standard components will continue to be
 accepted using the established procedures.

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