



ANSI/CAN/UL 1191

JOINT CANADA-UNITED STATES
NATIONAL STANDARD

STANDARD FOR SAFETY

Components for Personal Flotation Devices



Standards Council of Canada
Conseil canadien des normes



SCC FOREWORD

National Standard of Canada

A National Standard of Canada is a standard developed by a Standards Council of Canada (SCC) accredited Standards Development Organization, in compliance with requirements and guidance set out by SCC. More information on National Standards of Canada can be found at www.scc.ca.

SCC is a Crown corporation within the portfolio of Innovation, Science and Economic Development (ISED) Canada. With the goal of enhancing Canada's economic competitiveness and social well-being, SCC leads and facilitates the development and use of national and international standards. SCC also coordinates Canadian participation in standards development, and identifies strategies to advance Canadian standardization efforts.

Accreditation services are provided by SCC to various customers, including product certifiers, testing laboratories, and standards development organizations. A list of SCC programs and accredited bodies is publicly available at www.scc.ca.

UL Standard for Safety for Components for Personal Flotation Devices, ANSI/CAN/UL 1191

Fifth Edition, Dated May 28, 2019

Summary of Topics

The Fifth Edition of UL 1191 has been issued to reflect the latest ANSI and SCC approval dates, and to incorporate the proposals dated June 8, 2018 and November 16, 2018.

The new requirements are substantially in accordance with Proposal(s) on this subject dated June 8, 2018 and November 16, 2018.

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, or transmitted in any form by any means, electronic, mechanical photocopying, recording, or otherwise without prior permission of UL.

UL provides this Standard "as is" without warranty of any kind, either expressed or implied, including but not limited to, the implied warranties of merchantability or fitness for any purpose.

In no event will UL be liable for any special, incidental, consequential, indirect or similar damages, including loss of profits, lost savings, loss of data, or any other damages arising out of the use of or the inability to use this Standard, even if UL or an authorized UL representative has been advised of the possibility of such damage. In no event shall UL's liability for any damage ever exceed the price paid for this Standard, regardless of the form of the claim.

Users of the electronic versions of UL's Standards for Safety agree to defend, indemnify, and hold UL harmless from and against any loss, expense, liability, damage, claim, or judgment (including reasonable attorney's fees) resulting from any error or deviation introduced while purchaser is storing an electronic Standard on the purchaser's computer system.

No Text on This Page



ANSI/UL 1191-2019

MAY 28, 2019



1

ANSI/CAN/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, 1993
Third Edition – June, 1997
Fourth Edition – December, 2008

Fifth Edition

May 28, 2019

This ANSI/CAN/UL Safety Standard consists of the Fifth Edition.

The most recent designation of ANSI/UL 1191 as an American National Standard (ANSI) occurred on May 28, 2019. ANSI approval for a standard does not include the Cover Page, Transmittal Pages, Title Page, Preface or SCC Foreword.

This standard has been designated as a National Standard of Canada (NSC) on May 28, 2019.

COPYRIGHT © 2019 UNDERWRITERS LABORATORIES INC.

UL COPYRIGHTED MATERIAL –
NOT AUTHORIZED FOR FURTHER REPRODUCTION OR
DISTRIBUTION WITHOUT PERMISSION FROM UL



Documents

Document Sharing Hub

No Text on This Page

UL COPYRIGHTED MATERIAL –
NOT AUTHORIZED FOR FURTHER REPRODUCTION OR
DISTRIBUTION WITHOUT PERMISSION FROM UL



Documents

Document Sharing Hub

CONTENTS

Preface	7
----------------------	----------

INTRODUCTION

1 Scope	11
2 General	11
2.1 Units of measurement	11
2.2 Use codes/product classifications	11
2.3 Material	12
2.4 Color – sample conditioning	12
2.5 Color – conspicuity	13
3 Definitions	15

THREAD

4 Construction	16
5 Performance	16
6 Marking	17

FABRIC

7 Construction	18
8 Performance	18
8.1 General	18
8.2 Yarn slippage – woven fabric only	18
8.3 Openness of weave	18
9 Marking	22

WEBBING AND TIE TAPE

10 Construction	22
11 Performance	22
11.1 General	22
11.2 Friction	22
11.3 Flexibility	22
11.4 Strength/slippage	23
11.5 Torsional stiffness	23
12 Marking	26

LACING

13 Construction	27
14 Performance	27
14.1 General	27
14.2 Untieability	27
15 Marking	28

ZIPPERS

16 Construction	28
17 Performance	29
17.1 General	29

UL COPYRIGHTED MATERIAL –

NOT AUTHORIZED FOR FURTHER REPRODUCTION OR
DISTRIBUTION WITHOUT PERMISSION FROM UL



Documents

Document Sharing Hub

17.2	Operability force test	32
17.3	Crosswise strength test	32
18	Marking	33

HARDWARE

19	Webbing Closures and Adjusters	34
19.1	General	34
19.2	Construction	34
19.3	Performance	34
19.4	Marking	37
20	Lacing Closures and Adjusters	38
20.1	General	38
20.2	Construction	38
20.3	Performance	39
20.4	Marking	41
21	Sailboard Harness Hooks	42
21.1	General	42
21.2	Performance	42
21.3	Marking	48
22	Multi-Eyelet Guides	48
22.1	General	48
22.2	Performance	48
22.3	Marking	49

FOAM FLOTATION MATERIAL

23	General	50
24	Performance	52
24.1	Density	52
24.2	Specific buoyancy	52
24.3	Buoyancy retention factors	53
24.4	Tensile strength	55
24.5	Oil resistance	56
24.6	Flexibility	56
24.7	Compression deflection	56
24.8	Dimensional analysis	57
24.9	Thickness	57
25	Marking	57

POLYMERIC ENCLOSURES FOR KAPOK

26	Performance	58
26.1	General	58
26.2	Air-leakage	59
26.3	Cold crack	61
27	Marking	64

RF WELDED, URETHANE COATED NYLON COMPARTMENT MATERIALS FOR HYBRID AND FULLY INFLATABLE RECREATIONAL PFDS

28	General	64
29	Performance	64
29.1	Breaking load test	64
29.2	Trapezoid tear strength test	64

29.3 Weight loss	68
30 Marking	69

INFLATION SYSTEMS FOR HYBRID AND FULLY INFLATABLE RECREATIONAL PFDS

31 Construction	69
31.1 General	69
31.2 Materials	70
31.3 Oral inflation systems	70
31.4 Actuation and rearming of manual, manual-auto, and automatic inflation systems	70
31.5 Means for verification of mechanism operation	71
31.6 Inflation medium and cylinders	71
31.7 Indicators	72
31.8 Window material	73
32 Performance	74
32.1 General	74
32.2 Use characteristics test – automatic, manual-auto, and manual inflation systems	74
32.3 Automatic operability test – automatic and manual-auto inflation systems	90
32.4 Conditioning test – cylinder seal indicating cylinders	91
32.5 Manual operability test – manual and manual-auto inflation systems	91
32.6 Operability test – oral systems	91
32.7 Discharge test – automatic, manual-auto, and manual inflation systems	92
32.8 Parallel and perpendicular strength of attachment – automatic, manual-auto, manual, oral inflation systems, and over-pressure relief valve systems	93
32.9 Humid atmosphere test – automatic and manual-auto inflation systems	93
32.10 System durability test – automatic, manual, and manual-auto inflation systems	96
32.11 Operability test – over-pressure relief valves	96
32.12 Pull test – automatic, manual-automatic and manual inflation systems, and cylinder seal indicating cylinders	96
32.13 Piercing test – cylinders	96
32.14 Inadvertent Puncture Test	103
33 Marking	103

POLYMERIC COATINGS

34 Performance	105
34.1 General	105
34.2 Flexibility	105
34.3 Blocking	105
35 Marking	107

KNITTED FABRIC LAMINATED TO FOAM FLOTATION MATERIAL

36 Performance	107
36.1 Performance	107
36.2 Thermal insulation test	110
37 Marking	113

ANNEX A – NORMATIVE REFERENCES

No Text on This Page

UL COPYRIGHTED MATERIAL –
NOT AUTHORIZED FOR FURTHER REPRODUCTION OR
DISTRIBUTION WITHOUT PERMISSION FROM UL



Documents

Document Sharing Hub

Preface

This is the Fifth Edition of the ANSI/CAN/UL 1191, Standard for Safety for Components for Personal Flotation Devices.

UL is accredited by the American National Standards Institute (ANSI) and the Standards Council of Canada (SCC) as a Standards Development Organization (SDO).

This Standard has been developed in compliance with the requirements of ANSI and SCC for accreditation of a Standards Development Organization.

This ANSI/CAN/UL 1191 Standard is under continuous maintenance, whereby each revision is approved in compliance with the requirements of ANSI and SCC for accreditation of a Standards Development Organization. In the event that no revisions are issued for a period of four years from the date of publication, action to revise, reaffirm, or withdraw the standard shall be initiated.

In Canada, there are two official languages, English and French. All safety warnings must be in French and English. Attention is drawn to the possibility that some Canadian authorities may require additional markings and/or installation instructions to be in both official languages.

Comments or proposals for revisions on any part of the Standard may be submitted to UL at any time. Proposals should be submitted via a Proposal Request in UL's On-Line Collaborative Standards Development System (CSDS) at <http://csds.ul.com>.

UL's Standards for Safety are copyrighted by UL. Neither a printed nor electronic copy of a Standard should be altered in any way. All of UL's Standards and all copyrights, ownerships, and rights regarding those Standards shall remain the sole and exclusive property of UL.

To purchase UL Standards, visit the UL Standards Sales Site at <http://www.shopulstandards.com/HowToOrder.aspx> or call tollfree 1-888-853-3503.

This Edition of the Standard has been formally approved by the UL Standards Technical Panel (STP) on Personal Flotation Devices, STP 1123.

This list represents the STP 1123 membership when the final text in this standard was balloted. Since that time, changes in the membership may have occurred.

STP 1123 MEMBERSHIP

Name	Representing	Interest Category	Region
Susan Balistreri	Balistreri Consulting	Producer	USA
David Broadbent	American Boat & Yacht Council	Testing and Standards	USA
Dennis Campbell	IMANNA Laboratory	Testing and Standards	USA
Shelly Dalke	Canadian Red Cross Swimming & Water Safety	Consumer	Ontario, Canada
Thomas Dardis	US Coast Guard – Boating Safety Division	Government	USA
Jack Davis	Takashina Life Preservers Company, Ltd.	Producer	Japan

NOT AUTHORIZED FOR FURTHER REPRODUCTION OR
DISTRIBUTION WITHOUT PERMISSION FROM UL

STP 1123 MEMBERSHIP Continued on Next Page



Documents
Document Sharing Hub

STP 1123 MEMBERSHIP Continued

Name	Representing	Interest Category	Region
Zeland D. DeLoach	DeLoach Marine Services, LLC	Commercial/Industrial User	USA
Brenda Espelien	PFD Consultants	General	USA
Troy Faletra	Customs Captains	Producer	USA
John Fetterman	NASBLA	General	USA
Ryan Ford	Fish Safe BC	Consumer	British Columbia, Canada
Sam Fowlkes	American Canoe Association	General	USA
Stewart Franck	Fisheries Association of Nova Scotia	General	Nova Scotia, Canada
Corey Goyman	ExxonMobil Canada	Commercial/Industrial User	Nova Scotia, Canada
John Gullick	Canadian Power Squadrons	Consumer	Ontario, Canada
Robin Holcomb	Sport Dimension	Producer	USA
Betty Holthouser	self	Consumer	USA
Peter Hopkins	Marine and Safety Tasmania	General	Australia
R. Andrew Hurlbut	Georgian Bay Association	General	Ontario, Canada
Chris James	UL LLC	Testing and Standards	USA
Ross Johnston	Industry Consultant Life Jackets & Survival Gear	Producer	Ontario, Canada
Leon Larson	USA Water Ski	General	USA
Bob Markle	Markle Marine Safety Services	General	USA
Jennifer Matthews	Canadian Association of Petroleum Producers	Commercial/Industrial User	Nova Scotia, Canada
Larry Meddock	Water Sports Industry Association	General	USA
Louis Novak	USCG – Boating Safety Division	Government	USA
Samuel Parker	Salus Marine Wear	Producer	Ontario, Canada
Nigel Parkes	Survitec Group	Producer	United Kingdom
Ernie Parolin	Canadian Armed Forces	Government	Ontario, Canada
Joachim Pektzilikoglou	CNSOPB	Consumer	Nova Scotia, Canada
Guy Perrin	Sail Canada	Consumer	Ontario, Canada
Robin Pope	self	Consumer	USA
Paul Potter	The Cord Group Limited	General	Nova Scotia, Canada
Todd Powis	Better Boating Safe Boat Training	General	Ontario, Canada
Fred Ray	self	General	USA
Robert Rippy	The Coleman Company, Inc.	Producer	USA
Tim Rogers	Charlotte Fire Department	Commercial/ Industrial User	USA
Steve Rogier	Halkey-Roberts Corporation	Producer	USA
Larry Spears	Transport Canada Marine Safety	Government	Ontario, Canada
Roxanne Standefer	self	General	Quebec, Canada
Lee Stanford	Leland Limited, Inc.	Producer	USA
Tony Stimatz	self	Consumer	USA

NOT AUTHORIZED FOR FURTHER REPRODUCTION OR
DISTRIBUTION WITHOUT PERMISSION FROM UL

STP 1123 MEMBERSHIP Continued on Next Page



Documents

Document Sharing Hub

STP 1123 MEMBERSHIP Continued

Name	Representing	Interest Category	Region
Dana Sweeney	Falck Safety Services	Testing and Standards	Nova Scotia, Canada
Wendell Uglene	Mustang Survival	Producer	British Columbia, Canada
Allen Van Camp	Sagittarius Sporting Goods, Inc.	Producer	USA
Matthew Vartola	Bestway USA, Inc.	Producer	USA
Mike Vollmer	Michael Vollmer Yacht Design, Inc.	General	Ontario, Canada
Wayne Walters	Kent Sporting Goods, Inc.	Producer	USA
Samuel Wehr	self	Consumer	USA
Kent Wootton	Canadian Tire Company	Supply Chain	Ontario, Canada
Jacqi Yurkovich	USCG – Lifesaving & Fire Safety Division	Government	USA
John Zimmerman	Ocean Rodeo	Producer	British Columbia, Canada
Chris Brooks	self	Non-Voting	Ontario, Canada
Nicolette Weeks – Project Manager	Underwriters Laboratories, Inc.	Non-Voting	USA
Maria Iafano – Chair STP 1123	Underwriters Laboratories, Inc.	Non-Voting	Ontario, Canada
Astrid Lozano	Public Works & Government Services Canada Standards Division	Non-Voting	Quebec, Canada
David Toshack	Underwriters Laboratories of Canada, Inc.	Non-Voting	Ontario, Canada

International Classification for Standards (ICS): 13.340.70

For further information on UL standards, please contact:

Underwriters Laboratories Inc.
 171 Nepean Street, Suite 400
 Ottawa, Ontario K2P 0B4
 Phone: 1-613.755.2729
 E-mail: cec@ul.com
 Web site: ul.com

This Standard is intended to be used for conformity assessment.

The intended primary application of this standard is stated in its scope. It is important to note that it remains the responsibility of the user of the standard to judge its suitability for this particular application.

CETTE NORME NATIONALE DU CANADA EST DISPONIBLE EN VERSIONS FRANÇAISE ET ANGLAISE

UL COPYRIGHTED MATERIAL –
 NOT AUTHORIZED FOR FURTHER REPRODUCTION OR
 DISTRIBUTION WITHOUT PERMISSION FROM UL

 **Documents**
 Document Sharing Hub

No Text on This Page

UL COPYRIGHTED MATERIAL –
NOT AUTHORIZED FOR FURTHER REPRODUCTION OR
DISTRIBUTION WITHOUT PERMISSION FROM UL



Documents

Document Sharing Hub

INTRODUCTION

1 Scope

1.1 These requirements cover components intended for use in the manufacturer of personal flotation devices and immersion suits. Compliance with these requirements does not indicate that the product is intended for use as a component of an end product without further investigation. The requirements shall be applied to other components if found to be appropriate.

1.2 The components addressed in this Standard are intended for use in personal flotation devices and immersion suits which comply with the requirements of Underwriters Laboratories Inc., the United States Coast Guard Subparts of Chapter I, Title 46, Code of Federal Regulations, and Transport Canada. 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, 160.155, 160.171, and 160.176.

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.
- 6) Immersion Suits, UL 1197.
- 7) Personal Flotation Devices – Part 5: Buoyancy Aids (Level 50) – Safety Requirements, UL 12402-5.

1.3 These requirements also cover personal flotation device components intended to meet the requirements of the United States Coast Guard Subparts of Chapter I, Title 46, Code of Federal Regulations. These include USCG Subparts 164.019 and 164.023.

1.4 The components addressed in this Standard are not prohibited from being used on devices that comply with other regulations and requirements (other than those tabulated in [1.2](#)) when the component meets the intent of the requirements of Underwriters Laboratories Inc., the United States Coast Guard, and Transport Canada.

2 General

2.1 Units of measurement

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

2.2 Use codes/product classifications

2.2.1 One or more use codes shall be assigned to each device component to show the classification of PFD or immersion suit for which it is intended. See [Table 2.1](#).

Table 2.1
Use codes

Use code	Product Classification	Description of device
1 1F	Level 150 and 100 Lifejacket	Inherently Buoyant Adult or Child sizes Fully Inflatables
2 2A 2C 2F 3F	Level 100 Lifejacket	Recreational Buoyant Adult or Child sizes Recreational Buoyant Adult sizes only Recreational Buoyant Child sizes only Recreational Fully Inflatables Recreational Fully Inflatables
3 3A 3C 3F	Level 50 and 70 Buoyancy Aid	Inherently Buoyant Adult or Child sizes Inherently Buoyant Adult sizes only Inherently Buoyant Child sizes only Inflatables
4 4B 4BC 4H 4RB	Throwable	Any Styles Any ring or horseshoe buoy Buoyant Cushions Horseshoe buoys Recreational ring buoys
5 5H 5SB 5R 5WV	Special Use Level 150 and 100 Lifejacket or Special Use Level 50 and 70 Buoyancy Aid	Any styles except Hybrids or work vests Hybrids Recreational sailboard devices Any recreational style Type V; except Hybrids Workvest
6F	Special Use Inflation systems	Unique, limited or restricted categories for devices not covered in this Table. When used, the intended application for this Use Code/Product Classification shall be specifically described, such as convertible inflation systems.
6I	Immersion Suit	Abandonment Suit or Constant Wear Suit

2.3 Material

2.3.1 Polymeric material shall comply with the regrind requirements specified in the Standard for Polymeric Materials – Fabricated Parts, UL 746D, and is to be determined the same when it is of the same generic type, the same kind and amount of resin, filler, stabilizers or reinforcement as demonstrated by the applicable identification tests.

2.4 Color – sample conditioning

2.4.1 When a textile or polymeric product is furnished in a range of colors, samples of each are to be provided for evaluation. Where various colors are evaluated by representative sample(s) of a range of colors, only the representative sample(s) are required to be evaluated.

Table 2.2
Sample conditioning

Exposure	Method
Standard Conditioning SC	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 $23 \pm 2^\circ\text{C}$ ($73 \pm 4^\circ\text{F}$) and 50 ± 5 percent relative humidity for not less than 24 h prior to the tests. For textile products, the samples are to be conditioned at $21 \pm 2^\circ\text{C}$ ($70 \pm 4^\circ\text{F}$) and 65 ± 5 percent relative humidity for not less than 24 h. A different temperature and relative humidity that provides equivalent conditioning is not prohibited from being used.
Natural Accelerated Weathering Nt_{75} Nt_{138}	Where Nt_{75} or Nt_{138} exposure is specified, samples are to be exposed to natural weathering of 75 or 138 MJ/m ² of UV radiation below 385 nm, respectively in South Florida (approximately 3 or 6 months) beginning between May 21 and July 21. Unless otherwise specified specimens are to be mounted with the face side (the side normally exposed to sunlight in service) toward the light, open backing, 45° angle, facing south. Condition samples to Standard Conditioning after exposure.
Sunshine Carbon Arc Accelerated Weathering CA_{100} CA_{300}	Unless otherwise specified, specimens are to be mounted with the face side (the side normally exposed to sunlight in service) toward the light so that the exposed area of each specimen is perpendicular to the light source rays. Condition samples to Standard Conditions after exposure. Where CA_{100} or CA_{300} exposure is specified, samples are to be exposed to 100 or 300 h of light and water exposure, respectively in accordance with Cycle 1 (102 min of light/18 min of light and water) of the Standard Practice for Operating Open Flame Carbon Arc Light Apparatus for Exposure of Nonmetallic Materials, ASTM G152. The lower arcs are to be No. 15 copper clad carbon. The black panel temperature is to be $68 \pm 5^\circ\text{C}$ ($155 \pm 10^\circ\text{F}$) per Federal Standard 191A, Method 5804. The arcs are to be replaced and the corex D glass cleaned every 24 h.
Xenon Accelerated Weathering Xe_{500} Xe_{750} Xe_{1380}	Unless otherwise specified, specimens are to be mounted with the face side (the side normally exposed to sunlight in service) toward the light so that the exposed area of each specimen is perpendicular to the light source rays. Condition samples to Standard Conditions after exposure. Where Xe_{500} or Xe_{750} or Xe_{1380} exposure is specified, samples are to be exposed to 500 or 750 or 1380 KJ/ (m² · nm)^{a,b,c} @ 340 nm of Xenon accelerated weathering conditions, respectively in accordance with the following specifications: Irradiance: 0.55 W/m² at 340 nm Filters: Daylight filters per ISO 4892-2 (if published, or substitute applicable ASTM) Black Panel Temp.: $63 \pm 2^\circ\text{C}$ ($145 \pm 4^\circ\text{F}$) Dry Bulb Temp.: $42 \pm 2^\circ\text{C}$ ($108 \pm 4^\circ\text{F}$) Relative Humidity (light only): 50% Initial Water Temp.^d: $20 \pm 5^\circ\text{C}$ ($68 \pm 10^\circ\text{F}$) Test Cycle: 102 min of light / 18 min of light and water spray / 24 min dark and water spray
^a 500 KJ/ (m² · nm) is approximately $[0.55 \text{ W}/(\text{m}^2 \cdot \text{nm})] \cdot [3600 \text{ sec/hr} \cdot \text{KJ}/ 1000\text{J}] \cdot [300 \text{ hr machine cycling} \cdot 83.3 \text{ percent light cycle}]$. ^b 750 KJ/ (m² · nm) is approximately $[0.55 \text{ W}/(\text{m}^2 \cdot \text{nm})] \cdot [3600 \text{ sec/hr} \cdot \text{KJ}/ 1000\text{J}] \cdot [450 \text{ hr machine cycling} \cdot 83.3 \text{ percent light cycle}]$. ^c 1380 KJ/ (m² · nm) is approximately $[0.55 \text{ W}/(\text{m}^2 \cdot \text{nm})] \cdot [3600 \text{ sec/hr} \cdot \text{KJ}/ 1000\text{J}] \cdot [835 \text{ hr machine cycling} \cdot 83.3 \text{ percent light cycle}]$. ^d Temperature of source water measured at inlet of test chamber.	

2.5 Color – conspicuity

2.5.1 The color of the exposed portions of outer materials used on lifejackets, immersion suits, and their inflatable compartment materials, if applicable, (excluding components such as webbing, zips and other fittings) shall be in the color range from yellow to red; the chromaticity coordinates for non-fluorescent colors shall lie within one of the areas defined in [Table 2.3](#) and the luminance factor shall exceed the corresponding minimum in [Table 2.3](#). The chromaticity coordinates and the minimum luminance factor for fluorescent colors shall comply with [Table 2.4](#).

Table 2.3
Chromaticity coordinates x and y and luminance factor β for yellow, orange and red non-fluorescent colors of lifejacket and immersion suit material

Color	Chromaticity coordinates		Luminance factor
	x	y	β
Yellow	0.389	0.610	> 0.35
	0.320	0.490	
	0.405	0.400	
	0.500	0.500	
Orange	0.500	0.500	> 0.25
	0.405	0.400	
	0.470	0.330	
	0.600	0.400	
Red	0.600	0.400	> 0.15
	0.470	0.330	
	0.525	0.270	
	0.700	0.300	

Table 2.4
Chromaticity coordinates x and y and luminance factor β for yellow, yellow-orange, orange and orange-red fluorescent colors of lifejacket and immersion suit material

Color	Chromaticity coordinates		Luminance factor
	x	y	β
Fluorescent yellow	0.380	0.610	> 0.60
	0.320	0.490	
	0.370	0.440	
	0.440	0.550	
Fluorescent yellow-orange	0.440	0.550	> 0.50
	0.370	0.440	
	0.420	0.390	
	0.505	0.490	
Fluorescent orange	0.505	0.490	> 0.40
	0.420	0.390	
	0.460	0.350	
	0.575	0.425	
Fluorescent orange-red	0.575	0.425	> 0.30
	0.460	0.350	
	0.488	0.320	
	0.630	0.360	
Fluorescent red	0.630	0.360	> 0.20
	0.488	0.320	
	0.525	0.280	
	0.695	0.300	

2.5.2 The color of the material samples shall be measured with the procedures defined in CIE publication No. 15.2 with polychromatic illumination D65, 45/0 geometry and 2° standard observer. The specimen shall have a black underlay with reflectance of less than 0.04. The specimens shall be conditioned for at least 24 h at (20 ± 2)°C and (65 ± 5)% relative humidity. If the CIE procedures are carried out in other than

standard conditions described above, the test shall be conducted within 5 min after withdrawal from the conditioning atmosphere.

3 Definitions

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

3.2 **COURSE** – In knitted fabrics, the series of successive loops lying crosswise in the fabric, that is, lying at right angles to a line passing through the open throat to the closed end of the loops.

3.3 **CYLINDER SEAL INDICATOR** – A visual display on an inflation system which provides information regarding the status of the seal on an installed cylinder.

3.4 **DESIGN INFLATION RANGE** – The range of buoyancy and pressure, as specified by the manufacturer, to which a compartment is capable of being inflated to provide the intended in-water performance.

3.5 **FILLING** (also referred to as Weft) – In woven fabrics, yarn running from selvage to selvage at right angles to the warp (for knitted fabric see Wale).

3.6 **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).

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

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

3.9 **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, based 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), and 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.

3.10 **INITIAL JAW SEPARATION** – The distance between the bottom of the top clamp and the top of the bottom clamp of a tensile test machine prior to testing.

3.11 **LOT NUMBER** – A marking assigned to each group of materials or component produced which incorporates a means of identifying the year and quarter of manufacture (unless provided elsewhere), and provides a means of identifying the production of a particular factory, when a manufacturer produces at more than one factory.

3.12 **MULTI-POINT STATUS INDICATOR** – A status indicator which utilizes two or more independent visual display points to communicate inflation system readiness.

3.13 **SELVAGE** – The uncut edge portion of a fabric.

3.14 **SERVICEABILITY** – The ease with which the inflation system mechanism is 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.

3.15 **SERVICEABLE** – Capable of continued use (i. e. exhibits no signs of functional deterioration, deformation of hardware, indicators not functional, oral inflation tube blocked or detached, and manual inflator trigger detached).

3.16 **SINGLE-POINT STATUS INDICATOR** – A status indicator which combines all system checks into a single visual display point to communicate inflation system readiness.

3.17 **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.

3.18 **WALE** – In knitted fabrics, a column of loops in successive courses. The column is parallel to the loop axes.

3.19 **WARP** – In a woven fabric, the yarn running lengthwise, parallel to the selvage (for knitted fabrics see Course).

THREAD

4 Construction

4.1 Thread shall not contain cotton or be monofilament.

5 Performance

5.1 Thread shall comply with the requirements specified in [Table 5.1](#) and United States Coast Guard Subpart 164.023 of Chapter 1, Title 46, Code of Federal Regulations – Thread for Personal Flotation Devices.

UL COPYRIGHTED MATERIAL –
NOT AUTHORIZED FOR FURTHER REPRODUCTION OR
DISTRIBUTION WITHOUT PERMISSION FROM UL



**Table 5.1
Thread**

Tests	Exposure ^a	Test methods	Number of samples ^b	Sample size ^c inch (mm)	Use Codes ^d	Compliance criteria pounds-force (N)
Single Strand Breaking Strength	1. SC 2a. X _{e500} or CA ₁₀₀ 2b. X _{e750} or CA ₃₀₀ or Nt ₇₅₀	ASTM D204-93	5 for each separate exposure	36 (914)	All except 4B and 4H 4B and 4H All except 1F, 2F, 3F and 5H All except 4B and 4H 1F, 2F, 3F and 5H	Exposure 1 Average ≥ 5.7 (25) Exposure 1 Average ≥ 36 (160) Exposure 2a Average ≥ 60 percent of exposure 1 strength, or Exposure 2b Average ≥ 40 percent of exposure 1 strength Exposure 2a or 2b Average ≥ 5.1 (23) Exposure 2b Average ≥ 40 percent of exposure 1 strength
Loop Breaking Strength	SC	See 5.2	5 (each consisting of two pieces)	14 (356)	All except 4B and 4H 4B and 4H	Average ≥ 10 (44) Average ≥ 60 (267)
^a See Table 2.2 for conditioning details. ^b Color dependent. See 2.4 . ^c Minimum 150 linear yards (140 m) for both lightest and darkest. ^d See Table 2.1 for an explanation of Use Code designations.						

5.2 For the loop breaking strength test, the test machine described in the Standard Test Methods for Sewing Threads, ASTM D204 is to be used. Both ends of one piece are to be secured in one clamp of the testing machine so that the length of the loop equals one-half the total length between the jaws. One end of the second piece is to be passed through the loop formed by the first, and both ends of the second piece are to be secured in the other clamp of the machine. The clamps are to be separated at a rate of 12 ±0.5 inches per min (305 ±12.7 mm per min).

6 Marking

6.1 Each spool of thread and each shipping label shall be permanently and clearly marked with the following information in a color which contrasts with the color of the surface on which the marking is to be applied:

- The manufacturer's name, tradename, or symbol;
- The style (model) number of the thread;
- The size of the thread, unless a unique style (model) number is provided for each size;
- The lot number of the thread; and

e) Use Code(s).

FABRIC

7 Construction

7.1 Fabric used as drainage material in a structural application (for example, when removed, the device does not function as intended) shall comply with all of the applicable fabric requirements for the specific PFD for which it is intended.

8 Performance

8.1 General

8.1.1 Fabric shall comply with the acceptance criteria specified in [Table 8.1](#) when subjected to the tests in this Section.

8.1.2 Separate samples are to be used for each different conditioning exposure.

8.2 Yarn slippage – woven fabric only

8.2.1 The warp samples specified in [Table 8.1](#) are to be cut with the long dimension parallel to the warp yarns and filling samples are to be cut with the long dimension parallel to the filling yarns. No two warp samples are to contain the same warp yarns and no two filling samples are to contain the same filling yarns. No sample is to include selvage.

8.2.2 The narrow end of the sample is to be inserted approximately 1/4 inch (6.35 mm) into the nine-hole chuck illustrated in [Figure 8.1](#) and centered. A nine-needle bit is to be aligned with the holes in the chuck so that the smooth side of the needles faces the 1/4 inch (6.35 mm) edge of the sample. The needles are to be forced through the fabric past the scarf joint so that the fabric lays against the blade of the needles.

8.2.3 The tensile machine is to be a Constant-Rate-of-Traverse (CRT) or Constant-Rate-of-Extension (CRE). The tensile machine is to be equipped with clamps having front jaws 1 x 1 inches (25.4 mm x 25.4 mm) and back jaws 1 x 1.5 inches (25.4 mm x 38.1 mm) or wider. The nine-hole chuck is to be centered and clamped in the upper jaws of the machine so the sample hangs lengthwise. The holes in the chuck are to be perpendicular to the direction of pull. The fabric is to be clamped to the lower jaws of the machine. Separation between the holes in the chuck and the top of the jaws is to be 2.5 inches (63.5 mm). The yarns are to be parallel to the direction of pull. The jaws are then to be separated at a rate of 12 ±0.5 inches (305 ±12.7 mm) per min. The maximum force required to cause rupture is to be recorded.

8.3 Openness of weave

8.3.1 The openness of weave, see [Table 8.1](#), is to be determined using a full width sample at least 1 yard (0.9 m) long. Five separate measurements are to be taken across the width of the roll. For each measurement a 1 inch square (645 mm²) is to be marked on the fabric. No measurement is to be within 1 inch (25.4 mm) of the selvage edge.

8.3.2 In the area of the marked fabric material, the size of each opening is to be measured using an optical comparator with a magnification sufficient to determine the size of each opening (i.e. 5X). Openings on the edge of a 1 inch square are to be counted as one whole opening only when more than 1/2 of the opening is inside the marked square. The openness of the weave is to be calculated as follows:

NOT AUTHORIZED FOR FURTHER REPRODUCTION OR
DISTRIBUTION WITHOUT PERMISSION FROM UL

$$O_W = 100 \sum_{i=1}^N \frac{T_A}{N \times 1 \text{ inch}^2}$$

In which:

O_W = Openness of Weave

N = Number of 1 inch squares

T_A = Total Area of all opening (inch²)

**Table 8.1
Fabric**

Tests	Exposure ^a	Number of samples ^b	Sample size ^c inch (mm)	Use Codes ^d	Compliance criteria pounds-force N)
Breaking Load (Woven fabrics only) per ASTM D5034-90 (G-E or G-T)	1. SC 2a. Xe ₅₀₀ 2b. Xe ₇₅₀ or Nt ₇₅ 3. 70 h immersion in ASTM Ref. Fuel B. 4. 70 h immersion in IRM 902 (Calumet Oil No. 2). 5. 70 h immersion in 0.5 percent per volume AATCC 2003 Standard Reference Liquid Detergent, by volume, in no greater than "1" hardness water.	5 warp and 5 fill for each separate exposure ^e	4 x 6 (102 x 152) ^e	2, 3, 4BC and 5R 1, 1F, 2F, 3F, 4, 4B, 4H, 4RB, 5, 5H, and 5WV 2, 3, 4BC and 5R 1, 1F, 2F, 3F, 4, 4B, 4H, 4RB, 5, 5H and 5WV 3, 4, 4BC, and 5R 1, 1F, 2F, 3F, 4, 4B, 4H, 4RB, 5, 5H and 5WV	Exposure 1 Average ≥ 70 (311) in each direction Exposure 1 Average ≥ 90 (400) in each direction Exposure 2a Average ≥ 40 (178) in each direction, or Exposure 2b Average ≥ 25 (111) in each direction Exposure 2a Average ≥ 60 (267) in each direction, or Exposure 2b Average ≥ 40 (178) in each direction Exposure 3 through 5 Average ≥ 70 (311) Exposure 3 through 5 Average ≥ 90 (400) Average ≥ 60 percent of exposure 1 strength
Ball Burst (knitted fabrics only) per ASTM D3787	Same as Breaking Load (Woven fabrics)	10 for each separate exposure	5 x 5 (127 x 127)	All 2, 3, 4BC, and 5R 1, 1F, 2F, 3F, 4, 4B, 4H, 4RB, 5, 5H, and 5WV	Exposure 1, and 3 – 5 Average ≥ 130 (578) Exposure 2a Average ≥ 130 (578), or Exposure 2b Average ≥ 46 (205) Exposure 2a Average ≥ 130 (578), or Exposure 2b Average ≥ 74 (329)

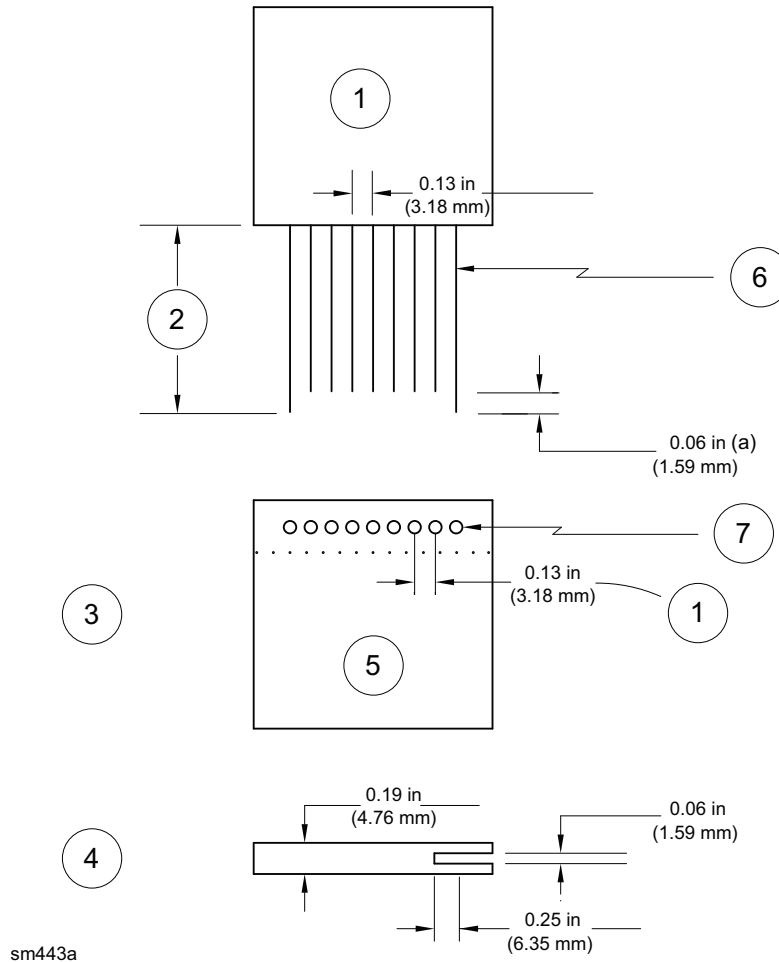
UL COPYRIGHTED MATERIAL - NOT AUTHORIZED FOR FURTHER REPRODUCTION OR DISTRIBUTION WITHOUT PERMISSION FROM UL

Table 8.1 Continued on Next Page

Table 8.1 Continued

Tests	Exposure ^a	Number of samples ^b	Sample size ^c inch (mm)	Use Codes ^d	Compliance criteria pounds-force N)
Tearing Strength (woven fabrics only) per ASTM D2261	SC	5 warp and 5 fill ^e	3 x 8 (76 x 203)	2, 3, 4BC, and 5R 1, 1F, 2F, 3F, 4, 4B, 4H, 4RB, 5, 5H, and 5WV	Average ≥ 6.0 (26.7) in each direction Average ≥ 8.5 (37.8) in each direction
Yarn Slippage (Woven Fabric only) per nine needle apparatus test (See 8.2)	SC	5 warp and 5 fill	4 x 6 (102 x 152)	All	Average ≥ 50 (220) in each direction
Openness of Weave ^g (See 8.3)	SC	5	1 linear yard Full width	All	Shall not exceed 20 percent.
Adhesion Strength ^f per ASTM D751	SC	2 warp and 2 fill	2 x 8 (51 x 203) or 3 x 8 (76 x 203)	All	Shall be at least 4 pounds per inch (18).
^a See Table 2.2 for conditioning details. ^b Color dependent. See 2.4. ^c Minimum 5 linear yards (4.5 m) for both lightest and darkest colors. ^d See Table 2.1 for an explanation of Use Code designations. ^e Sample requirements determined based on exposure facilities, number of fabric colors needing to be evaluated, and sample requirements for accelerated weathering correlation of natural weathering results. ^f Applies only to coated fabric with a coating of 5.5 oz/yd ² or more and where the base fabric or scrim does not comply with the applicable strength requirements when fabric is uncoated. ^g Applies to external cover fabrics only. Does not apply to gusset, lining, or drainage fabric.					

Figure 8.1
Nine needle apparatus



Key

- 1 – Spacing
- 2 – Minimum 3/8"
- 3 – Nine hole spacer – Top View
- 4 – Side View (Rotated 90°)
- 5 – Grip area for 1" by 1" jaws
- 6 – Nine – size 18 singer thin ball point needles (b)
- 7 – Nine 1/16" thru-holes

Notes:

- (a) This spacing is optional. All needles are able to extend the same distance.
- (b) The needles used have a conventional cylindrical profile (not U-bladed) and standard scarf. The grooves of the needles all face in the same direction perpendicular to the plane formed by the nine needles.

UL COPYRIGHTED MATERIAL –
NOT AUTHORIZED FOR FURTHER REPRODUCTION OR
DISTRIBUTION WITHOUT PERMISSION FROM UL

9 Marking

9.1 Each shipping label shall be clearly and permanently marked in a color which contrasts with a color of the surface on which the marking is applied, with the following:

- a) Recognized company name, or tradename, or symbol;
- b) Style designation;
- c) Lot number; and
- d) One or more of the Use Code(s) specified for the product.

WEBBING AND TIE TAPE

10 Construction

10.1 Webbing shall be nominally 3/4 inch (19 mm) wide or wider for Use Codes 2C and 3C, nominally 2 inches (50.8 mm) wide or wider for Use Codes 4RB and 4B, and nominally 1 inch (25.44 mm) wide or wider for all other Use Codes.

10.2 Tie tape shall be nominally 1 inch (25.4 mm) wide or wider for Use Codes 1 and 1F and nominally 3/4 inch (19 mm) wide or wider for all other Use Codes.

11 Performance

11.1 General

11.1.1 Webbing and tie tape shall comply with the acceptance criteria specified in [Table 11.1](#) and [Table 11.2](#), respectively, when subjected to the tests therein.

11.2 Friction

11.2.1 Three samples each consisting of one 10 inch (254 mm) long piece and two 5 inch (127 mm) long pieces as specified in [Table 11.2](#), are to be used. Each 10 inch sample is to be centered between the two 5 inch samples to form a 90 degree cross. A 35 pound (16 kg) dead weight is to be placed on the intersection of the three pieces. A metal guide is then to be placed on top of this assembly. At the point of contact, the cross sectional area of the weight is to be approximately 1 square inch (645.2 mm²). The guide is constructed to:

- a) Hold the 5 inch (127 mm) pieces rigidly in place 2 inches (51 mm) on each side of the intersection; and
- b) Maintain the dead load weight directly over the intersection during the test. A force gauge is to be clamped to an end of the 10 inch (254 mm) piece.

The force required to initiate slippage of the 10 inch (254 mm) piece between the two 5 inch (127 mm) pieces under the 35 pound (16 kg) load is to be recorded.

11.3 Flexibility

11.3.1 Each sample specified in [Table 11.2](#), as applicable, is to be secured between two, 1/2 inch (12.7 mm) wide metal bars so that the cut edges of the sample are flush with the bottom edge of the bars to form a loop around the bars at a 90 degree angle to the bars. During this set-up, the sample is not to be creased. The sample is to be positioned vertically and left to hang for 1 min. The distance from the bottom

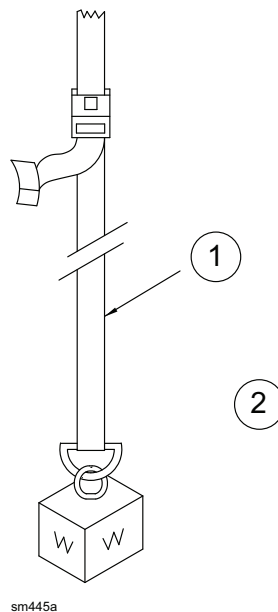
of the bars to the interior of the bottom of the loop (i.e., the loop length) is to be measured and recorded. The procedure is then to be repeated by taking the webbing out and turning it over. The values, both before and after being turned over are to be used in calculating the average.

11.4 Strength/slippage

11.4.1 A straight line pull on the webbing in combination with a piece of PFD hardware is to be performed. Each sample is to consist of two 24 inch (610 mm) lengths of the webbing and a friction adjusting PFD hardware, such as a buckle, that meets the requirements for the application and Use Codes. Other pieces of hardware, such as a snap hook/Dee rings or slide adjusters are able to be used to extend the conditions of compliance of the webbing.

11.4.2 The lengths of webbing are to be connected to opposite sides of the hardware according to the routing method recommended by the hardware manufacturer (see [Figure 11.1](#)). One length of the webbing is to be attached to a hoist and the other is to be attached to a weight in accordance with [Table 11.1](#). A 10 ± 2 pound (4.5 ± 0.9 kg) pre-load is to be applied and the webbing is to be marked at the bottom of the adjustable end of the hardware to allow for measurement of slippage after the test. The remainder of the applicable load specified in [Table 11.1](#) is to be applied for the required duration. The load is then to be removed and the webbing remarked at the bottom of the hardware. The distance between the marks is to be measured to the nearest $1/32$ inch (0.8 mm) to determine the extent of slippage.

Figure 11.1
Fixed straight-length method



1 – Fixed length body strap (no loop)

2 – Approximate length of webbing = 24 inches

11.5 Torsional stiffness

11.5.1 Three samples are to be used.

UL COPYRIGHTED MATERIAL –
NOT AUTHORIZED FOR FURTHER REPRODUCTION OR
DISTRIBUTION WITHOUT PERMISSION FROM UL



Documents
Document Sharing Hub

11.5.2 The samples specified in [Table 11.2](#) are to be laid flat on a hard surface, straight, and not under tension. One end of the sample is to be marked as the reference end. Marks are to be placed on the sample 1-1/4 inches (32 mm) and 36 inches (0.9 m) from the reference end.

11.5.3 The reference end of the sample is to be held in a clamping surface by taking the end of the strip at the reference end and folding it over until the end is even with the mark drawn 1-1/4 inches (32 mm) from the reference end. The reference end is then to be placed in a fabric clamp in accordance with the Test Methods for Breaking Load and Elongation of Textile Fabrics, ASTM D5034-90, centered and perpendicular to the clamp bars.

11.5.4 The end opposite the reference end is to be placed in a clamp. The clamping surface area is 1/2 x 4-1/2 inches (12.7 x 114.3 mm) and the jaws are not padded. The end of the strip is to be placed in the jaws of the clamp so that the 36 inch (0.9 m) mark is even with the outside bottom edge of the larger jaw of the clamp. The distance between the fabric clamp and the upper jaw is to be 34-3/4 inches (882 mm).

11.5.5 The clamp is then to be mounted so that the sample hangs freely down with the clamps parallel to each other.

11.5.6 The fabric clamp is then to be rotated five complete turns in the clockwise direction and released. The sample is allowed to unwind (counterclockwise), allowed to pass the point of zero twists, and allowed to continue in the counterclockwise direction until it stops winding in the direction momentarily. The time from which the sample was released until the counterclockwise twisting motion first pauses is to be recorded. The clamp is to be returned to its initial position. For tie-tape material that has a unsymmetrical weave, the procedure is then to be repeated with the sample rotated counterclockwise.

Table 11.1
Webbing

Tests	Exposure ^a	Number of samples ^b	Sample size inch (mm)	Use codes ^c	Compliance criteria pounds-force (N)
Breaking Strength per ASTM D5035 Method 4108	1. SC 2a. Xe ₅₀₀ or CA ₁₀₀ 2b. Xe ₇₅₀ or CA ₃₀₀ or Nt ₇₅ 2c. Xe ₁₃₈₀ or Nt ₁₃₈	5 for each separate exposure	48 (1.2 m)	1, 1F, 2F, 3F, 5, 5WV and 5H 2, 3 4BC, and 5R 2C and 3C All All except 1F, 2F, 3F, 4, 4B, 4H, 4RB, and 5H. 1F, 2F, 3F, and 5H. 4, 4B, 4H, and 4RB	Exposures 1 and 2a Average ≥ 400 (1776) Exposures 1 and 2a Average ≥ 200 (888) Exposures 1 and 2a Average ≥ 115 (511) Exposures 2a Change in width ≤ 5 percent Exposure 2a Average ≥ 60 percent of the exposure 1 strength, or Exposure 2b Average ≥ 40 percent of the exposure 1 strength. Exposure 2b Average ≥ 40 percent of exposure 1 strength Exposures 1 and 2a Average ≥ 750 lbs (3330 N) per inch of width or Average = 1500 lbs (6670 N) whichever is less Exposure 2a Average ≥ 60 percent of the exposure 1 strength for all widths and colors Exposure 2c Average ≥ 80 percent of the exposure 1 strength for all widths less than 2 inches for all colors except black Exposure 1 Average ≥ 750 lbs (3330 N) per inch of width or Average = 1500 lbs (6670 N) whichever is less Exposure 2a Average ≥ 80 percent of the exposure 1 strength for all widths and colors Exposure 2c Average ≥ 80 percent of the exposure 1 strength for all widths less than 2 inches for all colors except black
Strength/Slippage (See 11.4.1 and 11.4.2)	1. SC 2. Xe ₅₀₀ or CA ₁₀₀ 3. 2 min water soak	5	24 (610)	1, 1F, and 5 2, 3, 4H, and 5R	Exposures 1 – 3 Slippage ≤ 1 inch (25 mm) for 10 min at 360 (1600) Exposures 1 – 3 Slippage ≤ 1 inch (25 mm) for 10 min at 150 (666)

Table 11.1 Continued on Next Page



Documents
Document Sharing Hub

Table 11.1 Continued

Tests	Exposure ^a	Number of samples ^b	Sample size inch (mm)	Use codes ^c	Compliance criteria pounds-force (N)
				2C and 3C	Exposures 1 – 3 Slippage ≤1 inch (25 mm) for 10 min at 115 (511)
				2F, 3F, 5WV, and 5H	Exposures 1 – 3 Slippage ≤1 inch (25 mm) for 10 min at 225 (999)
^a See Table 2.2 for conditioning details. ^b Color dependent. See 2.4 (i.e. based on the diffuse reflectance number in FED-STD 595B). ^c See Table 2.1 for an explanation of Use Code designations. ^d Minimum total of 80 linear yards (73 meters) for test program.					

Table 11.2
Tie tape

Tests	Exposure ^a	Test method	Number of samples	Sample size ^b inch (mm)	Use codes ^c	Compliance criteria pounds-force (N)
Breaking Load	1. SC 2a. Xe ₅₀₀ or CA ₁₀₀ 2b. Xe ₇₅₀ or CA ₃₀₀ or Nt ₇₅	ASTM D5035	10 ^{b,c}	54 (1.3 m)	2, 3, and 5R 1, 1F, 2F, 3F, 5 and 5H All except 1F, 2F, 3F and 5H 1F, 2F, 3F and 5H	Exposure 1 Average ≥ 120 (533) Exposure 1 Average ≥ 200 (888) Exposure 2a Average ≥ 60 percent of exposure 1 strength, or Exposure 2b Average ≥ 40 percent of exposure 1 strength Exposure 2b Average ≥ 40 percent of exposure 1 strength
Flexibility	SC	See 11.3.1	3 for each separate test	10 (254)	All	Average ≥ 1.5 inches (38 mm)
Friction	SC	See 11.2.1		3 pieces 10 (254) or 6 pieces 5 (127)	All	Average ≥ 18 (80)
Torsional Stiffness	SC	See 11.5.1 – 11.5.6		40 (1.0 m)	All	Average ≥ 5 s

^a See [Table 2.2](#) for conditioning details.

^b Color dependent. See [2.4](#).

^c See [Table 2.1](#) for an explanation of Use Code designations.

12 Marking

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

- a) Manufacturer's name, tradename, or symbol;

- b) The product's style designation;
- c) The width of the product in inches;
- d) Lot number; and
- e) Use Code(s).

LACING

13 Construction

13.1 Lacing shall be nominally 1/8 inch (3.2 mm) in diameter or nominally 1/4 inch (6.35 mm) wide.

14 Performance

14.1 General

14.1.1 Lacing shall comply with the acceptance criteria specified in [Table 14.1](#) when subjected to the tests therein.

14.2 Untieability

14.2.1 The samples specified in [Table 14.1](#) are to be given to test subjects who are to be instructed to "tie the lacing into a square knot and pull the knot snug." The subjects are then to be instructed to "untie the square knot as quickly as possible." The time to untie the square knot is to be recorded.

UL COPYRIGHTED MATERIAL –
NOT AUTHORIZED FOR FURTHER REPRODUCTION OR
DISTRIBUTION WITHOUT PERMISSION FROM UL



Documents
Document Sharing Hub

Table 14.1
Lacing

Tests	Exposure ^a	Test method	Number of samples ^b	Sample size ^c inch (mm)	Use codes ^d	Compliance criteria pounds-force (N)
Ultimate Breaking Strength	1. SC 2a. Xe ₅₀₀ or CA ₁₀₀ 2b. Xe ₇₅₀ or CA ₃₀₀ or Nt ₇₅	ASTM D5035; except separation 12 ±0.5 inch per min	5 for each separate conditioning	54 (1.4 m)	2, 2F, 3, 3F, 5, 5H and 5R 2, 3, and 5R 2F, 3F, 5, and 5H	Exposure 1 and 2a or 2b Average ≥ 120 (533) Exposure 2a Average ≥ 60 percent of exposure 1 strength, or Exposure 2b Average ≥ 40 percent of exposure 1 strength Exposure 2b Average ≥ 40 percent of exposure 1 strength
Untieability	1. Tied and Untied at Standard Conditioning 2. Tied and Untied after 1 min Water Soak 3. Tied after Standard Conditioning and Untied after 1 min Water Soak	See 14.2.1	2	36 (914)	All	Each of the five test subjects shall be able to untie the square knot within 1 min following exposures 1 – 3
^a See Table 2.2 for conditioning details. ^b Color dependent. See 2.4 . ^c Minimum of 50 linear yards (45.5 m) ^d See Table 2.1 for an explanation of Use Code designations.						

15 Marking

15.1 Each shipping label used for the smallest carton shipped shall be clearly and permanently marked in a contrasting color with the following:

- a) Manufacturer's name, tradename, or symbol;
- b) The product's style designation;
- c) The width or diameter of the product in inches;
- d) Lot number; and
- e) Use Code(s).

ZIPPERS

16 Construction

16.1 The slider of the zipper shall be of the automatic locking type.

16.2 For the purpose of these requirements the Definitions of Terms Relating to Zippers, ASTM D2050 apply.

17 Performance

17.1 General

17.1.1 Zippers shall comply with the acceptance criteria specified in [Table 17.1](#) for PFDs and [Table 17.2](#) for immersion suits when subjected to the tests therein.

Table 17.1
Zippers for PFDs

Tests	Exposure ^a	Test method	Number of samples ^{b,c}	Sample size inch (mm)	Use codes ^d	Compliance criteria pounds-force (N)
Operability Force	1. SC 2a. Xe ₅₀₀ or CA ₁₀₀ 2b. Xe ₇₅₀ or CA ₃₀₀ or Nt ₇₅ 3. 70 h immersion in ASTM Ref. Fuel B ^g 4. 70 h immersion in IRM 902 (Calumet Oil No.2) ^g 5. 70 h immersion in Perchloroethylene ^g 6. 70 h immersion in 0.5 percent per volume AATCC 2003 Standard Reference Liquid Detergent, by volume, in no greater than "1" hardness water ^g 7. 720 h of salt spray as specified in ASTM B117-94 ^e	ASTM D2062-93 See 17.2.1 .	Six for each separate exposure	6 (152)	2, 3, and 5 2F, 3F and 5H	Exposures 1, 3 – 7, and 2a or 2b Open and Close Force ≤ 15 (67) Exposures 1 – 7, except 2a Open and Close Force ≤ 15 (67)
Crosswise Strength	Same samples as Operability Force	ASTM D2061-93 except for top of zipper (including slider) and bottom of zipper (for moveable retainer) See 17.3.2	The samples used in the Operability Force Tests.	6 (152)	2, 2F, 3, 3F, 5 and 5H 2, 2F, 3, 3F, 5 and 5H 2F, 3F, and 5H	Exposures 1 – 7, except 2b Average ≥ 50 (222) for the top (including slider) and the chain (crosswise). Average ≥ 30 (133) for the separating unit (crosswise). Exposures 2a – 7, except 2b Average ≥ 60 percent of exposure 1 strength Exposure 2b Average ≥ 40 percent of exposure 1 strength
Resistance to Pull-Off of Slider Pull	SC	ASTM D2061-93	3	6 (152)	2, 2F, 3, 3F, 5, and 5H.	The pull-and-slider zipper assembly shall not dislodge when subjected to a force of 40 (177).
Resistance to Twist of	SC	ASTM D2061-93	4 (2 for each direction)	6 (152)	2, 2F, 3, 3F, 5, and 5H.	The pull and slider shall resist a force of 7 lbf-in (0.79 N·m) torsional stress without

NOT AUTHORIZED FOR FURTHER REPRODUCTION OR
DISTRIBUTION WITHOUT PERMISSION FROM UL

Table 17.1 Continued on Next Page

Table 17.1 Continued

Tests	Exposure ^a	Test method	Number of samples ^{b,c}	Sample size inch (mm)	Use codes ^d	Compliance criteria pounds-force (N)
Pull and Slider						significant deformation or rupture.
Holding Strength of Slider Lock	SC	ASTM D2061-93	3	6 (152)	2, 2F, 3, 3F, 5, and 5H.	The locking mechanism shall remain locked when subjected to a force of 5 (22) and the slider shall be operable following the test .
^a See Table 2.2 and 17.2.1 for conditioning details. ^b Color dependent. See 2.4 ^c Minimum of 75 (6 inch) zippers for both the lightest and darkest colors. ^d See Table 2.1 for an explanation of the Use Code designations ^e Applies to zippers employing metallic parts; except certified AISI 300 or 400 series stainless steel or equivalent corrosion resistant metals. ^f Mount each of 3 samples vertically so the top of sample 1, the center of chain of sample 2, and the bottom of sample 3 are in the same plane as the horizontal centerline of the source of radiation. The outer side of the samples is to face the arcs. See 17.2.1 . ^g Samples are to be blotted dry to remove surface moisture and are to rest for 30 min at ambient room temperature prior to the operability force and strength tests.						

Table 17.2
Zippers for Immersion Suits

Tests	Exposure ^a	Test method	Number of samples	Sample size inch (mm)	Use codes ^b	Compliance criteria pounds-force (N)
Opening and Close Force	1. SC 2. 720 h of salt spray as specified in ASTM B117 ^{c,f} 3. 24 h under a 100 mm head of No. 2 marine diesel oil at 18 – 20° C. ^{d,f} 4. Temperature Cycling (repeat 5 times) ^e a. 8 h at 65°C b. 8 h at 20°C c. 8 h at -30°C d. 8 h at 20°C	ASTM D2062	Five for each separate exposure	750	6I	Exposure 1 Open and Close Force ≥ 40 N Exposures 2 and 3 Open and Close Force ≥ 175 N Exposure 4 Open and Close Force ≥ 60 N
Crosswise Strength	Same samples as Opening and Close Force Test	ASTM D2061 except for top of zipper (including slider) and bottom of zipper (for moveable retainer) See 17.3.2	Same samples as Opening and Close Force Test	Same samples as Opening and Close Force Test	6I	Exposures 1 – 4 Average ≥ 440 N for top, bottom end and center
Leak Resistance	CGSB 65.16. Sec. 6.3.6.4.	CGSB 65.16. Sec. 6.3.6.4.	2	356	6I	CGSB 65.16. Sec. 6.3.6.4.
^a See Table 2.2 and 17.2.1 for conditioning details. ^b See Table 2.1 for an explanation of the Use Code designations. ^c Applies to zippers employing metallic parts. ^d Samples are to be blotted dry to remove surface moisture and are to rest for 30 min at ambient room temperature prior to the operability force and strength tests. ^e Testing shall occur after the sequence has occurred 5 times. ^f Zippers shall be conditioned with the slide at midpoint on the chain.						

17.2 Operability force test

17.2.1 For each set of six samples (see [Table 17.1](#)), three are to be used to determine the force required to open the zipper, and three are to be used to determine the force required to close the zipper. Samples for opening force are to be closed for conditioning. Samples for closing force are to be open (separated) for conditioning. Tests are to be conducted on the slider and on the moveable retainer, when provided.

17.3 Crosswise strength test

17.3.1 The same samples subjected to the operability force test are to be used. The zippers are to be closed for these tests.

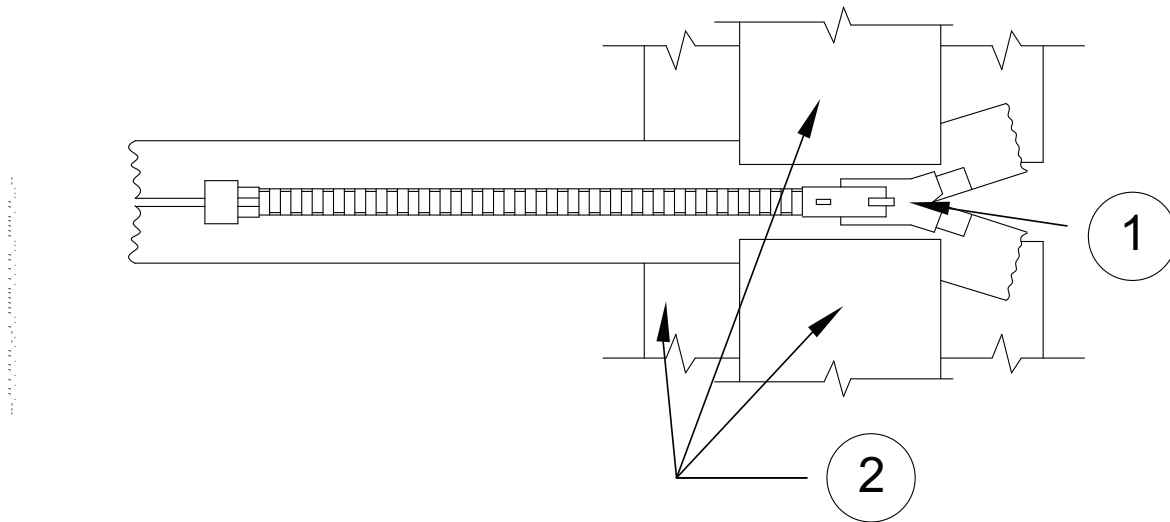
17.3.2 The following tests are to be conducted in accordance with the Methods for Strength Tests for Zippers, ASTM D2061-93:

- a) For the chain (crosswise); and
- b) For a separating unit (crosswise), or for a bottom stop holding (crosswise).

17.3.3 The test described in [17.3.4](#) is to be conducted for the test at the top of the zipper including slider, and for the test at the bottom of the zipper when a moveable retainer (second slider) is used.

17.3.4 The apparatus used for the strength test at the top of the zipper including the slider, and for the test at the bottom of the zipper when a moveable retainer (second slider) is used, is to be as described in the Test Methods for Strength Tests for Zippers, ASTM D2061-93. The tapes of each zipper are to be mounted in the clamps of the tension machine as illustrated in [Figure 17.1](#) with the edges of the jaws parallel to, and approximately 1/8 inch (3 mm) from the sides of the slider. The slides are to be positioned so that the exposed end of the slider is aligned with the sides of the front jaws as illustrated in [Figure 17.1](#). The load is to be applied until the slider comes apart, until the tape breaks or until some other kind of malfunction occurs. The maximum load to obtain rupture is to be recorded.

Figure 17.1
Crosswise strength test top (including slider)



s2686b

1 – Slider

2 – Testing machine clamps, 1 inch (25.4 mm) wide front and 2 inch (50.8 mm) wide back

18 Marking

18.1 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;