NFPA® 1952

Standard on Surface Water Operations Protective Clothing and Equipment

2010 Edition

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An International Codes and Standards Organization

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NFPA® 1952

Standard on

Surface Water Operations Protective Clothing and Equipment

2010 Edition

This edition of NFPA 1952, *Standard on Surface Water Operations Protective Clothing and Equipment,* was prepared by the Technical Committee on Special Operations Protective Clothing and Equipment and released by the Technical Correlating Committee on Fire and Emergency Services Protective Clothing and Equipment. It was issued by the Standards Council on October 27, 2009, with an effective date of December 5, 2009.

This edition of NFPA 1952 was approved as an American National Standard on December 5, 2009.

Origin and Development of NFPA 1952

The Technical Committee on Special Operations Protective Clothing and Equipment began work on the first edition of NFPA 1952 in 2005 to answer the need for personal protective equipment for fire and emergency services personnel operating at surface water operations. Surface water operations are technical rescue activities requiring water functional capabilities involving surface water, swift water, tidal water, surf, and ice that do not require underwater respiratory equipment.

The technical committee developed NFPA 1952, *Standard on Surface Water Operations Protective Clothing and Equipment,* with the goal of establishing protection requirements for protective clothing and equipment to reduce the safety risks and health risks associated with exposure of personnel to the hazards of surface water operations.

The majority of performance criteria in this standard were based on the September 1993 U.S. Fire Administration Study "Protective Clothing and Equipment Needs of Emergency Responders for Urban Search and Rescue Missions" (FA-136, Federal Emergency Management Agency). That report documented the protective clothing and equipment needs for emergency responders engaged in technical rescue activities. Input was obtained from an emergency responder user requirements committee and resulted in proposed criteria based on a needs and risk analysis. The U.S. Fire Administration report contains survey results and test data for a number of materials. The jurisdiction of the Technical Committee on Special Operations Protective Clothing and Equipment does not include the respiratory protection that is necessary for these operations; the appropriate respiratory protection needs to be addressed by emergency responder organizations.

This standard specifies requirements for the following types of surface water protective clothing and equipment:

(1) Dry suits, wet suits, and ice suits
(2) Dry suit gloves, wet suit gloves, and ice suit gloves
(3) Dry suit footwear, wet suit footwear, and ice suit footwear
(4) Helmets
(5) PFDs

It is left to emergency services organizations to select the appropriate items for the protection of their emergency responders based on the expected and anticipated surface water incidents to which the organizations will or could respond.

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NOTE: Membership on a committee shall not in and of itself constitute an endorsement of the Association or any document developed by the committee on which the member serves.

Committee Scope: This Committee shall have primary responsibility for documents on the design, performance, testing, and certification of protective clothing and protective equipment manufactured for fire and emergency services organizations and personnel, to protect against exposures encountered during emergency incident operations. This Committee shall also have the primary responsibility for documents on the selection, care, and maintenance of such protective clothing and protective equipment by fire and emergency services organizations and personnel.

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NOTE: Membership on a committee shall not in and of itself constitute an endorsement of the Association or any document developed by the committee on which the member serves.

Committee Scope: This Committee shall have primary responsibility for documents on special operations protective clothing and protective equipment, except respiratory equipment, that provides hand, foot, torso, limb, head, and interface protection for fire fighters and other emergency services responders during incidents involving special operations functions including, but not limited to, structural collapse, trench rescue, confined space entry, urban search and rescue, high angle/mountain rescue, vehicular extraction, swift water or flooding rescue, contaminated water diving, and air operations.

Contents

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Standard on

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NOTICE: An asterisk (*) following the number or letter designating a paragraph indicates that explanatory material on the paragraph can be found in Annex A.

Information on referenced publications can be found in Chapter 2 and Annex D.

Chapter 1 Administration

1.1* Scope.

1.1.1* This standard shall specify the minimum design, performance, testing, and certification requirements for protective clothing and equipment items, including full body suits, helmets, gloves, footwear, and personal flotation devices designed to provide limited protection from physical, environmental, thermal, and certain common chemical and biological hazards for emergency services personnel during surface water operations.

1.1.2* This standard shall specify requirements for protective clothing and protective equipment used during operations in surface water, swift water, tidal water, surf, and ice.

1.1.3 This standard shall not specify requirements for protective clothing and protective equipment for any offshore water operations or any dive operations.

1.1.4* This standard shall not specify requirements for protective clothing and protective equipment for any other technical rescue operation, any fire-fighting operations, or any hazardous materials emergencies.

1.1.5* This standard shall specify requirements for any accessories or enhancements built into, attached to, or sold with surface water operations protective clothing and equipment by the protective clothing and equipment manufacturer for later attachment, and shall be tested with the protective clothing and equipment with the accessories and enhancements installed or attached, as specified in 4.3.9.4, to assure the performance and functions of the surface water operations protective clothing and equipment.

1.1.6 This standard shall not be construed as addressing all of the safety concerns associated with the use of compliant surface water operations protective clothing and equipment. It shall be the responsibility of the persons and organizations that use compliant surface water operations protective clothing and equipment to establish safety and health practices and to determine the applicability of regulatory limitations prior to use.

1.1.7 This standard shall not be construed as addressing all of the safety concerns, if any, associated with the use of this standard by testing facilities. It shall be the responsibility of the persons and organizations that use this standard to establish safety and health practices and to determine the applicability of regulatory limitations prior to use of this standard for designing, manufacturing, and testing.

1.1.8 Certification of surface water operations protective clothing and equipment to the requirements of this standard shall not preclude certification to additional appropriate standards where the protective clothing or equipment meets all the applicable requirements of each standard.

1.1.9 Nothing herein shall restrict any jurisdiction or manufacturer from exceeding these minimum requirements.

1.2 Purpose.

1.2.1* The purpose of this standard shall be to establish minimum levels of protection for emergency services personnel assigned to or involved in surface water search and rescue operations or other surface water incident operations.

1.2.2* Controlled laboratory tests used to determine compliance with the performance requirements of this standard shall not be deemed as establishing performance levels for all situations to which emergency services personnel might be exposed.

1.2.3* This standard is not intended as a detailed manufacturing or purchase specification, but shall be permitted to be referenced in purchase specifications as minimum requirements.

1.3 Application

1.3.1 This standard shall apply to the design, manufacture, and certification of new surface water operations protective clothing and equipment.

1.3.2 This standard shall not apply to any surface water operations protective clothing and equipment manufactured to the requirements of any other organization's standards.

1.3.3 This standard shall not apply to the use of any surface water operations protective clothing and equipment, as such use requirements for fire departments are specified in NFPA 1500, *Standard on Fire Department Occupational Safety and Health Program*, and the use requirements specified by other emergency services organizations.

1.3.4 This standard shall apply to protective clothing and protective equipment used during operations in surface water, swift water, tidal water, surf, and ice.

1.3.5 This standard shall not apply to protective clothing and protective equipment for any offshore water operations or any dive operations.

1.3.6 This standard shall not apply to protective clothing and protective equipment for any other technical rescue operation, any fire-fighting operations, or any hazardous materials emergencies.

1.3.7 This standard shall not apply to protection from all biological agents or to protection from all hazardous chemicals.

1.3.8* This standard shall apply to any accessories or enhancements built into, attached to, or sold with the surface water operations protective clothing and equipment by the protective clothing and equipment manufacturer for later attachment, and shall be tested with the protective clothing and equipment with the accessories and enhancements installed or attached, as specified in 4.3.9.4, to assure the performance and functions of the surface water operations protective clothing and equipment.

1.4* Units.

1.4.1 In this standard, values for measurement are followed by an equivalent in parentheses, but only the first stated value shall be regarded as the requirement.

1.4.2 Equivalent values in parentheses shall not be considered as the requirement, as these values might be approximate.

Chapter 2 Referenced Publications

2.1 General. The documents or portions thereof listed in this chapter are referenced within this standard and shall be considered part of the requirements of this document.

2.2 NFPA Publications. National Fire Protection Association, 1 Batterymarch Park, Quincy, MA 02169-7471.

NFPA 1500, *Standard on Fire Department Occupational Safety and Health Program,* 2007 edition.

NFPA 1670, *Standard on Operations and Training for Technical Search and Rescue Incidents,* 2009 edition.

2.3 Other Publications.

2.3.1 AATCC Publications. American Association of Textile Chemists and Colorists, P.O. Box 12215, Research Triangle Park, NC 27709.

AATCC 42, *Water Resistance: Impact Penetration Test*, 2002.

AATCC 70, *Test Method for Water Repellency: Tumble Jar Dynamic Absorption Test*, 2000.

AATCC 135, *Dimensional Changes in Automatic Home Laundering of Woven and Knit Fabrics*, 2001.

2.3.2 ASTM Publications. ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959.

ASTM B 117, *Standard Practice for Operating Salt Spray (Fog) Apparatus*, 2007.

ASTM D 471, *Standard Test Method for Rubber Property – Effects of Liquids*, 2006.

ASTM D 751, *Standard Method of Testing Coated Fabrics*, 2006.

ASTM D 2061, *Standard Test Methods for Strength Tests for Zippers*, 2007.

ASTM D 2062, *Standard Test Methods for Operability of Zippers,* 2003.

ASTM D 2582, *Standard Test Method for Puncture-Propagation Tear Resistance of Plastic Film and Thin Sheeting*, 2007.

ASTM D 3884, *Standard Test Method for Abrasion Resistance of Textile Fabrics (Rotary Platform, Double-Head Method)*, 2001.

ASTM D 4157, *Standard Test Method for Abrasion Resistance of Textile Fabrics (Oscillatory Cylinder Method)*, 2002.

ASTM D 4966, *Standard Test Method for Abrasion Resistance of Textile Fabrics*, 1998 (2004).

ASTM D 5034, *Standard Test Method for Breaking Strength and Elongation of Textile Fabrics (Grab Test)*, 1995 (2001).

ASTM E 810, *Standard Test Method for Coefficient of Retroreflection of Retroreflective Sheeting Utilizing the Coplanar Geometry*, 2003.

ASTM F 392, *Standard Test Method for Flex Durability of Flexible Barrier Materials*, 1993 (2004).

ASTM F 489, *Standard Test Method for Static Coefficient of Friction of Shoe Sole and Heel Materials as Measured by the James Machine*, 1996.

ASTM F 903, *Standard Test Method for Resistance of Protective Clothing Materials to Penetration by Liquids*, 2003 (2004).

ASTM F 1342, *Standard Test Method for Resistance of Protective Clothing Materials to Puncture,* 2005.

ASTM F 1359, *Standard Practice for Determining Liquid-Tight Integrity of Chemical Protective Suits or Ensembles under Static Conditions*, 1999a (2004).

ASTM F 1446, *Standard Test Methods for Equipment and Procedures Used in Evaluating the Performance Characteristics of Protective Headgear*, 2006.

ASTM F 1671, *Standard Test Method for Resistance of Materials Used in Protective Clothing To Penetration by Blood-Borne Pathogens Using Phi-X174 Bacteriophage as a Test System*, 2007.

ASTM F 1790, *Test Methods for Measuring Cut Resistance of Materials Used in Protective Clothing*, 2005.

ASTM F 1868, *Standard Test Method for Thermal and Evaporative Resistance of Clothing Materials using a Sweating Hot Plate*, 2002.

ASTM F 2010, *Standard Test Method for Evaluation of Glove Effects on Wearer Hand Dexterity Using a Modified Pegboard Test,* 2000 (2005).

2.3.3 CAN/CGSB Publications. Canadian General Standards Board, 11 Laurier Street, Gatineau, Quebec K1A 1G6 Canada

CAN/CGSB 65.16, *Immersion Suit Systems*, 2005.

2.3.4 ISO Publications. International Standards Organization, 1 rue de Varembé, Case Postale 56 CH-1211, Geneve 20, Switzerland.

ISO 27, *Guidelines for corrective action to be taken by a certification body in the event of misuse of its mark of conformity,* 1983.

ISO 65, *General requirements for bodies operating product certification systems*, 1996.

ISO 9001, *Quality management systems — requirements*, 2000.

ISO 17011, *General requirements for accreditation bodies accrediting conformity assessment bodies*, 2003.

ISO/IEC 17021, *Conformity assessment — requirements for bodies providing audit and certification of management systems,* 2006.

ISO 17025, *General requirements for the competence of calibration and testing laboratories*, 1999.

2.3.5 SAE Publications. Society of Automotive Engineers, 400 Commonwealth Drive, Warrendale, PA 15096.

SAE J211, *Instrumentation for Impact Test.*

2.3.6 UL Publications. Underwriters Laboratories Inc., 333 Pfingsten Road, Northbrook, IL 60062-2096.

ANSI/UL 1123, *Standard for Marine Buoyant Devices,* 2008, Revised 2009.

ANSI/UL 1197, *Standard of Safety for Immersion Suits,* 2007.

2.3.7 U.S. Government Publications. U.S. Government Printing Office, Washington, DC 20402.

Title 46, Code of Federal Regulations, Part 160.

Title 46, Code of Federal Regulations, Part 164.018, *Retroreflective Material for Lifesaving Equipment.*

2.3.8 Other Publications.

Merriam-Webster's Collegiate Dictionary, 11th edition, Merriam-Webster, Inc., Springfield, MA, 2003.

2.4 References for Extracts in Mandatory Sections. (Reserved)

Chapter 3 Definitions

3.1 General. The definitions contained in this chapter shall apply to the terms used in this standard. Where terms are not defined in this chapter or within another chapter, they shall be defined using their ordinarily accepted meanings within the context in which they are used. *Merriam-Webster's Collegiate Dictionary,* 11th edition, shall be the source for the ordinarily accepted meaning.

3.2 NFPA Official Definitions.

3.2.1* Approved. Acceptable to the authority having jurisdiction.

3.2.2* Authority Having Jurisdiction. An organization, office, or individual responsible for enforcing the requirements of a code or standard, or for approving equipment, materials, an installation, or a procedure.

3.2.3 Labeled. Equipment or materials to which has been attached a label, symbol, or other identifying mark of an organization that is acceptable to the authority having jurisdiction and concerned with product evaluation, that maintains periodic inspection of production of labeled equipment or materials, and by whose labeling the manufacturer indicates compliance with appropriate standards or performance in a specified manner.

3.2.4* Listed. Equipment, materials, or services included in a list published by an organization that is acceptable to the authority having jurisdiction and concerned with evaluation of products or services, that maintains periodic inspection of production of listed equipment or materials or periodic evaluation of services, and whose listing states that either the equipment, material, or service meets appropriate designated standards or has been tested and found suitable for a specified purpose.

3.2.5 Shall. Indicates a mandatory requirement.

3.2.6 Should. Indicates a recommendation or that which is advised but not required.

3.2.7 Standard. A document, the main text of which contains only mandatory provisions using the word "shall" to indicate requirements and which is in a form generally suitable for mandatory reference by another standard or code or for adoption into law. Nonmandatory provisions shall be located in an appendix or annex, footnote, or fine-print note and are not to be considered a part of the requirements of a standard.

3.3 General Definitions.

3.3.1* Basic Plane. The anatomical plane that includes the superior rim of the external auditory meatus, the upper edge of the external openings of the ear, and the interior margin of the orbit, which is the lowest point of the floor of the eye socket.

3.3.2 Body Borne Pathogen. An infectious bacteria or virus carried in human, animal, or clinical body fluids, organs, or tissues.

3.3.3 Body Fluids. Fluids that are produced by the body including, but not limited to, blood, semen, mucus, feces, urine, vaginal secretions, breast milk, amniotic fluid, cerebrospinal fluid, synovial fluid, and pericardial fluid.

3.3.4 Bootie. A sock-like extension of the garment or suit leg that covers the entire foot.

3.3.5 Brim. A part of the shell of the helmet extending around the entire circumference of the helmet.

3.3.6 Certification/Certified. A system whereby a certification organization determines that a manufacturer has demonstrated the ability to produce a product that complies with the requirements of this standard, authorizes the manufacturer to use a label on listed products that comply with the requirements of this standard, and establishes a follow-up program conducted by the certification organization as a check on the methods the manufacturer uses to determine continued compliance of labeled and listed products with the requirements of this standard.

3.3.7 Chin Strap. An adjustable strap for the helmet that fits under or around the chin to secure the helmet to the head.

3.3.8 Compliance/Compliant. Meeting or exceeding all applicable requirements of this standard.

3.3.9 Compliant Product. Product that is covered by this standard and has been certified as meeting all applicable requirements of this standard that pertain to the product.

3.3.10 Component(s). Any material, part, or subassembly used in the construction of the compliant product.

3.3.11 Composite. The layer or layers of materials or components.

3.3.12 Crown. The portion of the helmet that covers the head above the reference plane.

3.3.13 Crown Straps. The part of the helmet suspension that passes over the head.

3.3.14 Dry Suit. See 3.3.44, Surface Water Operations Protective Dry Suit.

3.3.15 Energy Absorbing System. A material or system used to attenuate impact energy.

3.3.16 Flotation Device. See 3.3.51, Surface Water Operations Protective Personal Flotation Device.

3.3.17 Fluorescence. The process by which radiant flux of certain wavelengths is absorbed and reradiated nonthermally in other, usually longer, wavelengths.

3.3.18 Follow-Up Program. The sampling, inspections, tests, or other measures conducted by the certification organization on a periodic basis to determine the continued compliance of labeled and listed products that are being produced by the manufacturer to the requirements of this standard.

3.3.19 Footwear. See 3.3.45, Surface Water Operations Protective Dry Suit Footwear; 3.3.49, Surface Water Operations Protective Ice Suit Footwear; and 3.3.53, Surface Water Operations Protective Wet Suit Footwear.

3.3.20 Glove. See 3.3.46, Surface Water Operations Protective Dry Suit Gloves; 3.3.50, Surface Water Operations Protective Ice Suit Gloves; and 3.3.54, Surface Water Operations Protective Wet Suit Gloves.

3.3.21 Glove Body. The part of the glove that extends from the tip of the fingers to the wrist crease or a specified distance beyond the wrist crease.

3.3.22 Glove Liner. The innermost component of the glove body composite that comes into contact with the wearer's skin.

3.3.23 Hardware. Non-fabric components of the protective clothing and equipment including, but not limited to, those made of metal or plastic.

3.3.24 Headform. A device that simulates the configuration of the human head.

3.3.25 Helmet. See 3.3.47, Surface Water Operations Protective Helmet.

3.3.26 Horizontal Center Plane. Any plane passing through the helmet whose intersection with the helmet surface is equidistant from the top of the helmet at all points.

3.3.27 Ice Suit. See 3.3.48, Surface Water Operations Protective Ice Suit.

3.3.28 Insole. The inner component of the footwear upon which the foot rests.

3.3.29 Liquidborne Pathogen. See 3.3.3, Body Fluids.

3.3.30 Manufacturer. The entity that directs or controls any of the following: compliant product design, compliant product manufacturing, or compliant product quality assurance; or the entity that assumes the liability for the compliant product or provides the warranty for the compliant product.

3.3.31* Model. The collective term used to identify a group of individual items, elements, or items of the same basic design and components from a single manufacturer produced by the same manufacturing and quality assurance procedures that are covered by the same certification.

3.3.32 Product. See 3.3.9, Compliant Product.

3.3.33 Product Label. A marking provided by the manufacturer for each compliant product, containing compliance statements, certification statements, manufacturer and model information, or similar data.

3.3.34 Reference Plane. A dimensionally defined plane, parallel to the basic plane, that is measured from the top of the applicable headform or the basic plane.

3.3.35 Rescue Operations. Those activities operations directed at locating and removing endangered persons, and removing endangered persons from danger, treating the injured at an emergency incident, and providing transport to an appropriate health care facility.

3.3.36 Retention System. The complete assembly by which the helmet is retained in position on the head.

3.3.37 Retroreflection/Retroreflective. The reflection of light in which the reflected rays are preferentially returned in the direction close to the opposite of the direction of the incident rays, with this property being maintained over wide variations of the direction of the incident rays.

3.3.38 Sample. The equipment, equipment component, ensemble, element, item, component, or composite that is conditioned for testing. *(See also 3.3.40, Specimen.)*

3.3.39 Seam. Any permanent attachment of two or more materials, in a line formed by joining the separate material pieces.

3.3.40 Specimen. The conditioned equipment, equipment component, ensemble, element, product, item, composite, or component, or opposite that is tested. Specimens are taken from samples. *(See also 3.3.38, Sample.)*

3.3.41 Suit. See 3.3.44, Surface Water Operations Protective Dry Suit; 3.3.48, Surface Water Operations Protective Ice Suit; and 3.3.52, Surface Water Operations Protective Wet Suit.

3.3.42 Suit Material. The primary protective principal material(s) used in the construction of surface water operations protective suits.

3.3.43 Surface Water Operations. Technical rescue activities requiring water functional capabilities involving surface water, swift water, tidal water, surf, and ice that do not require underwater respiratory equipment.

3.3.44* Surface Water Operations Protective Dry Suit. A suit that provides exposure protection for water operations.

3.3.45 Surface Water Operations Protective Dry Suit Footwear. An item of protective clothing used with surface water protective dry suits that are designed to provide minimum protection to the foot, ankle, and lower leg.

3.3.46 Surface Water Operations Protective Dry Suit Gloves. An item of protective clothing used with surface water protective dry suits that are designed to provide minimum protection to fingers, thumb, hand, and wrist.

3.3.47 Surface Water Operations Protective Helmet. An item of protective equipment designed to provide minimum protection to the head.

3.3.48* Surface Water Operations Protective Ice Suit. A suit that provides thermal and flotation protection for extreme cold water conditions.

3.3.49 Surface Water Operations Protective Ice Suit Footwear. An item of protective clothing used with surface water protective ice suits that are designed to provide minimum protection to the foot, ankle, and lower leg.

3.3.50 Surface Water Operations Protective Ice Suit Gloves. An item of protective clothing used with surface water protective ice suits that are designed to provide minimum protection to fingers, thumb, hand, and wrist.

3.3.51 Surface Water Operations Protective Personal Flotation Device. An item of protective equipment designed to provide flotation assistance to the wearer.

3.3.52* Surface Water Operations Protective Wet Suit. A permeable suit that preserves body heat by trapping water in between the suit and the body.

3.3.53 Surface Water Operations Protective Wet Suit Footwear. An item of protective clothing used with surface water protective wet suits that are designed to provide minimum protection to the foot, ankle, and lower leg.

3.3.54 Surface Water Operations Protective Wet Suit Gloves. An item of protective clothing used with surface water protective wet suits that are designed to provide minimum protection to fingers, thumb, hand, and wrist.

3.3.55 Surface Water Rescue. Rescue of a victim who is accessible from the surface of a body of water.

3.3.56 Suspension. An energy attenuating system of the helmet that is made up of the headband and crown strap.

3.3.57 Swiftwater. Water moving at a rate of greater than one knot (1.85 km/hr).

3.3.58* Tidal Water. Ocean water or bodies of water that are connected to oceans that either experience a twice daily rise and fall of their surface caused by the gravitational pull of the moon or experience a corresponding ebb and flow of water in response to the tides.

3.3.59 Trim. See 3.3.60, Visibility Markings.

3.3.60 Visibility Markings. Retroreflective and fluorescent conspicuity enhancements. Retroreflective enhancements improve nighttime conspicuity, and fluorescent enhancements improve daytime conspicuity.

3.3.61 Wet Suit. See 3.3.52, Surface Water Operations Protective Wet Suit.

Chapter 4 Certification

4.1 General.

4.1.1 The process of certification for surface water operations protective clothing and equipment as being compliant with NFPA 1952 shall meet the requirements of Section 4.1, General; Section 4.2, Certification Program; Section 4.3, Inspection and Testing; Section 4.4, Annual Verification of Product Compliance; Section 4.5, Manufacturer's Quality Assurance Program; Section 4.6, Hazards Involving Compliant Product; Section 4.7, Manufacturers' Investigation of Complaints and Returns; and Section 4.8, Manufacturers' Safety Alert and Product Recall Systems.

4.1.2 All compliant surface water operations protective clothing and equipment that is labeled as being compliant with this standard shall meet or exceed all applicable requirements specified in this standard and shall be certified.

4.1.3 All certification shall be performed by a certification organization that meets at least the requirements specified in Section 4.2, Certification Program, and that is accredited for personal protective equipment in accordance with ISO 65, *General requirements for bodies operating product certification systems.* The accreditation shall be issued by an accreditation body operating in accordance with ISO 17011, *General requirements for accreditation bodies accrediting conformity assessment bodies.*

4.1.4 Manufacturers shall not claim compliance with portions or segments of the requirements of this standard and shall not use the NFPA name or the name or identification of this standard, NFPA 1952, in any statements about their respective item(s) unless the item(s) is certified as compliant to this standard.

4.1.5 All compliant protective clothing and equipment shall be labeled.

4.1.6 All compliant surface water protective clothing and equipment items shall be listed by the certification organization. This listing shall uniquely identify the certified product, for example, by style, model number, or part number.

4.1.7 All compliant surface water protective clothing and equipment items shall also have a product label that meets the requirements specified in Section 5.1, Product Label Requirements.

4.1.8* The certification organization's label, symbol, or identifying mark shall be attached to the product label, shall be part of the product label, or shall be immediately adjacent to the product label.

4.2 Certification Program.

4.2.1* The certification organization shall not be owned or controlled by manufacturers or vendors of the items being certified.

4.2.2 The certification organization shall be primarily engaged in certification work and shall not have a monetary interest in the product's ultimate profitability.

4.2.3 The certification organization shall be accredited for personal protective equipment in accordance with ISO 65, *General requirements for bodies operating product certification systems.* The accreditation shall be issued by an accreditation body operating in accordance with ISO 17011, *General requirements for accreditation bodies accrediting conformity assessment bodies.*

4.2.4 The certification organization shall refuse to certify products to this standard that do not comply with all applicable requirements of this standard.

4.2.5* The contractual provisions between the certification organization and the manufacturer shall specify that certification is contingent on compliance with all applicable requirements of this standard.

4.2.5.1 The certification organization shall not offer or confer any conditional, temporary, or partial certifications.

4.2.5.2 Manufacturers shall not be authorized to use any label or reference to the certification organization on products that are not compliant with all applicable requirements of this standard.

4.2.6* The certification organization shall have laboratory facilities and equipment available for conducting proper tests to determine product compliance.

4.2.6.1 The certification organization laboratory facilities shall have a program in place and functioning for calibration of all instruments, and procedures shall be in use to ensure proper control of all testing.

4.2.6.2 The certification organization laboratory facilities shall follow good practice regarding the use of laboratory manuals, form data sheets, documented calibration and calibration routines, performance verification, proficiency testing, and staff qualification and training programs.

4.2.7 The certification organization shall require the manufacturer to establish and maintain a quality assurance program that meets the requirements of Section 4.5, Manufacturer's Quality Assurance Program.

4.2.7.1* The certification organization shall require the manufacturer to have a product recall system as specified in Section 4.8, Manufacturers' Safety Alert and Product Recall Systems, as part of the manufacturer's quality assurance program.

4.2.7.2 The certification organization shall audit the manufacturer's quality assurance program to ensure that the quality assurance program provides continued product compliance with this standard.

4.2.8 The certification organization and the manufacturer shall evaluate any changes affecting the form, fit, or function of the compliant product to determine its continued certification to this standard.

4.2.9* The certification organization shall have a follow-up inspection program of the manufacturing facilities of the compliant product with at least two random and unannounced visits per 12-month period.

4.2.9.1 As part of the follow-up inspection program, the certification organization shall select sample compliant product at random from the manufacturer's production line, from the manufacturer's in-house stock, or from the open market.

4.2.9.2 Sample product shall be inspected and tested by the certification organization to verify the product's continued compliance.

4.2.9.3 The certification organization shall be permitted to conduct specific testing to verify the product's continued compliance.

4.2.9.4 For products, components, and materials where prior testing, judgment, and experience of the certification organization have shown results to be in jeopardy of not complying with this standard, the certification organization shall conduct more frequent testing of sample product, components, and materials acquired in accordance with 4.2.9.1 against the applicable requirements of this standard.

4.2.10 The certification organization shall have in place a series of procedures, as specified in Section 4.6, Hazards Involving Compliant Product, that address report(s) of situation(s) in which a compliant product is subsequently found to be hazardous.

4.2.11 The certification organization's operating procedures shall provide a mechanism for the manufacturer to appeal decisions. The procedures shall include the presentation of information from both sides of a controversy to a designated appeals panel.

4.2.12 The certification organization shall be in a position to use legal means to protect the integrity of its name and label. The name and label shall be registered and legally defended.

4.3 Inspection and Testing.

4.3.1 For both initial certification and recertification of items, the certification organization shall conduct both inspection and testing as specified in this section.

4.3.2 All inspections, evaluations, conditioning, and testing for certification or for recertification shall be conducted by a certification organization's testing laboratory that is accredited in accordance with the requirements of ISO 17025, *General requirements for the competence of testing and calibration laboratories*.

4.3.2.1 The certification organization's testing laboratory's scope of accreditation to ISO 17025, *General requirements for the competence of testing and calibration laboratories*, shall encompass testing of personal protective equipment.

4.3.2.2 The accreditation of a certification organization's testing laboratory shall be issued by an accreditation body operating in accordance with ISO 17011, *General requirements for accreditation bodies accrediting conformity assessment bodies*.

4.3.3 A certification organization shall be permitted to utilize conditioning and testing results conducted by a product or component manufacturer for certification or recertification provided the manufacturer's testing laboratory meets the requirements specified in 4.3.3.1 through 4.3.3.5.

4.3.3.1 The manufacturer's testing laboratory shall be accredited in accordance with the requirements of ISO 17025, *General requirements for the competence of testing and calibration laboratories*.

4.3.3.2 The manufacturer's testing laboratory's scope of accreditation to ISO 17025, *General requirements for the competence of testing and calibration laboratories*, shall encompass testing of personal protective equipment.

4.3.3.3 The accreditation of a manufacturer's testing laboratory shall be issued by an accreditation body operating in accordance with ISO 17011, *General requirements for accreditation bodies accrediting conformity assessment bodies*.

4.3.3.4 The certification organization shall approve the manufacturer's testing laboratory.

4.3.3.5 The certification organization shall determine the level of supervision and witnessing of the conditioning and testing for certification or recertification conducted at the manufacturer's testing laboratory.

4.3.4 Sampling levels for testing and inspection shall be established by the certification organization and the manufacturer to ensure a reasonable and acceptable reliability at a reasonable and acceptable confidence level that products certified to this standard are compliant, unless such sampling levels are specified herein.

4.3.5 Inspection and evaluation by the certification organization shall include a review of all product labels to ensure that all required label attachments, compliance statements, certification statements, and other product information are at least as specified for the product in Section 5.1, Product Label Requirements.

4.3.6 Inspection and evaluation by the certification organization shall include an evaluation of any symbols and pictorial graphic representations used on product labels or in user information, as permitted by 5.1.5, to ensure that the symbols are clearly explained in the product's user information package.

4.3.7 Inspection and evaluation by the certification organization shall include a review of the user information required by Section 5.2, User Information, to ensure that the information has been developed and is available.

4.3.8 Inspection and evaluation by the certification organization for determining compliance with the design requirements specified in Chapter 6 shall be performed on whole or complete products.

4.3.9 Testing by the certification organization to determine product compliance with the performance requirements specified in Chapter 7 shall be conducted in accordance with the specified testing requirements of Chapter 8.

4.3.9.1 Testing shall be performed on new product.

4.3.9.2 Testing shall be performed on specimens representative of materials and components used in the actual construction of the compliant product.

4.3.9.3 The certification organization also shall be permitted to use sample materials cut from a representative product.

4.3.9.4 Where there are any accessories, enhancements, or both that are built into, or attachable to, or detachable from the surface water operations protective clothing and equipment, the certification organization shall inspect and evaluate the protective clothing and equipment as specified in Chapter 6 and shall test the protective clothing and equipment as specified in Chapter 8, and the protective clothing and equipment shall meet the performance requirements specified in Chapter 7 with those accessories and enhancements installed or attached.

4.3.10 The certification organization shall accept from the manufacturer, for evaluation and testing for certification, only product or product components that are the same in every respect to the actual final product or product component.

4.3.11 The certification organization shall not allow any modifications, pretreatment, conditioning, or other such special processes of the product or any product component prior

to the product's submission for evaluation and testing by the certification organization.

4.3.12 The certification organization shall not allow the substitution, repair, or modification, other than as specifically permitted herein, of any product or any product component during testing.

4.3.13 The certification organization shall not allow test specimens that have been conditioned and tested by one method to be reconditioned and tested by another test method unless specifically permitted in the test method.

4.3.14 Where certification testing includes product with one or more accessories, the product with each accessory shall be certified as complying with 4.3.9.4.

4.3.15 Any change in the design, construction, or materials of a compliant product shall necessitate new inspection and testing to verify compliance to all applicable requirements of this standard that the certification organization determines can be affected by such change. This recertification shall be conducted before labeling the modified product as being compliant with this standard.

4.3.16 The manufacturer shall maintain all design and performance inspection and test data from the certification organization used in the certification of the manufacturer's compliant product. The manufacturer shall provide such data, upon request, to the purchaser or authority having jurisdiction.

4.4 Annual Verification of Product Compliance.

4.4.1 All products that are labeled as being compliant with this standard shall undergo recertification on an annual basis. This recertification shall include the following:

(1) Inspection and evaluation to all design requirements as required by the standard on all manufacturer models and components
(2) Testing to all performance requirements as specified in Table 4.4.1 on all manufacturer models and components within the following protocol:
   (a) Where a test method incorporates testing both before and after the laundering preconditioning specified in 8.1.3 and the test generates quantitative results, recertification testing shall be limited to the conditioning that yielded the worst-case test result during the initial certification for the model or component.
   (b) Where a test method incorporates testing both before and after laundering preconditioning specified in 8.1.3 and the test generates nonquantitative results, recertifications shall be limited to a single conditioning procedure in any given year. Subsequent annual recertification shall cycle thought the remaining conditioning procedure to ensure that all required conditionings are included over time.
   (c) Where a test method requires the testing of three specimens, a minimum of one specimen shall be tested for annual certification.
   (d) Where a test method requires the testing of five or more specimens, a minimum of two specimens shall be tested for annual certification.

Table 4.4.1 Recertification Schedule

Product	Test	Time
Wet Suit	7.1.1 Overall Donning Efficiency Test	Initial certification only
Wet Suit	7.1.2 Thermal Insulation Test	Every year
Wet Suit	7.1.3 Breaking Strength Test	Every year
Wet Suit	7.1.4 Puncture Propagation Tear Resistance Test	Every year
Wet Suit	7.1.5 Seam Breaking Strength Test	Every year
Wet Suit	7.1.6 Liquid Absorption Resistance	Every year
Wet Suit	7.1.7 Retroreflectivity Test	Initial certification only
Wet Suit	7.1.8 Zipper Strength Test	Every year
Wet Suit	7.1.9 Resistance to Twist Test	Every year
Wet Suit	7.1.10 Opening & Closing of Zippers Test	Every year
Wet Suit	7.1.11 Corrosion Resistance Test	Every year
Wet Suit	7.1.12 Label Durability and Legibility Test	Every year
Dry Suit	7.2.1 Air Retention Test	Every year
Dry Suit	7.2.2 Overall Liquid Integrity Test One	Every year
Dry Suit	7.2.3 Overall Donning Efficiency Test	Initial certification only
Dry Suit	7.2.4 Water and Air Penetration Test	Every Year
Dry Suit	7.2.5 Thermal Insulation Test	Every year
Dry Suit	7.2.6 Breaking Strength Test	Every year
Dry Suit	7.2.7 Puncture Propagation Tear Resistance Test	Every year
Dry Suit	7.2.8 Cleaning Shrinkage Resistance Test	Every Two Years
Dry Suit	7.2.9 Seam Breaking Strength Test	Every year
Dry Suit	7.2.10 Liquid Absorption Resistance Test	Every year
Dry Suit	7.2.11 Liquid Penetration Resistance Test	Every year
Dry Suit	7.2.12 Viral Penetration Resistance Test	Seams only - Every year
Dry Suit	7.2.13 Zipper Strength Test	Every year
Dry Suit	5.2.14 Resistance to Twist Test	Every year
Dry Suit	7.2.15 Opening & Closing of Zippers Test	Every year

Table 4.4.1 *Continued*

Product	Test	Time
Dry Suit	7.2.16 Zipper Point Breaking Strength Test	Every year
Dry Suit	7.2.17 Zipper Leak Resistance Test	Every year
Dry Suit	7.2.18 Zipper Opening & Closing Force Test	Every year
Dry Suit	7.2.19 Retroreflectivity Test	Initial certification only
Dry Suit	7.2.20 Corrosion Resistance Test	Every year
Dry Suit	7.2.21 Label Durability and Legibility Test	Every year
Ice Suit	7.3.1 Overall Liquid Integrity Test One	Every Year
Ice Suit	7.3.2 Air Retention Test	Every year
Ice Suit	7.3.3 Viral Penetration Resistance Test	Seams only - Every year
Ice Suit	7.3.4 Overall Donning Efficiency Test	Initial certification only
Ice Suit	7.3.5 Thermal Insulation Test	Every year
Ice Suit	7.3.6 Breaking Strength Test	Every year
Ice Suit	7.3.7 Puncture Propagation Tear Resistance Test	Every year
Ice Suit	7.3.8 Seam Breaking Strength Test	Every year
Ice Suit	7.3.9 Liquid Absorption Resistance Test	Every year
Ice Suit	7.3.10 Liquid Penetration Resistance Test	Every year
Ice Suit	7.3.11 Retroreflectivity Test	Initial certification only
Ice Suit	7.3.12 Water and Air Penetration Test	Every year
Ice Suit	7.3.13 Buoyancy Test	Every year
Ice Suit	7.3.14 Corrosion Resistance Test	Every year
Ice Suit	7.3.15 Label Durability and Legibility Test	Every year
Ice Suit	7.3.16 Zipper Point Breaking Strength Test	Every year
Ice Suit	7.3.17 Zipper Leak Resistance Test	Every year
Ice Suit	7.3.18 Opening & Closing of Zippers Test	Every year
Ice Suit	7.3.19 Zipper Opening & Closing Force Test	Every Year
Surface Water Helmet	7.4.1 Helmet Bucketing Test	Initial certification only
Surface Water Helmet	7.4.2 Top Impact Resistance Test - Force	Every year
Surface Water Helmet	7.4.3 Physical Penetration Resistance Test	Every year
Surface Water Helmet	7.4.4 Suspension System Retention Test	Every year
Surface Water Helmet	7.4.5 Retention System Test	Every year
Surface Water Helmet	7.4.6 Corrosion Resistance Test	Every year
Surface Water Helmet	7.4.7 Retroreflectivity Test	Initial certification only
Surface Water Helmet	7.4.8 Label Durability and Legibility Test	Every year
Surface Water Helmet	7.4.9 Floatability Test	Initial certification only
Surface Water Helmet	7.4.10 Impact Resistance Test - Acceleration	Every year
Surface Water Helmet	7.4.11 Helmet Roll Off Test	Initial certification only
Surface Water Helmet	7.4.12 Helmet Water Absorption Test	Initial certification only
Wet Suit Glove	7.5.1 Cut Resistance Test	Every year
Wet Suit Glove	7.5.2 Puncture Resistance Test	Every year
Wet Suit Glove	7.5.3 Abrasion Resistance Test 2	Every year
Wet Suit Glove	7.5.4 Glove Hand Function Test	Every year
Wet Suit Glove	7.5.5 Grip Test	Every year
Wet Suit Glove	7.5.6 Glove Donning Test	Every year
Wet Suit Glove	7.5.7 Corrosion Resistance Test	Every year
Wet Suit Glove	7.5.8 Label Durability and Legibility Test	Every year
Wet Suit Glove	7.5.9 Thermal Insulation Test	Every year
Dry Suit Glove	7.6.1 Cut Resistance Test	Every year
Dry Suit Glove	7.6.2 Puncture Resistance Test	Every year
Dry Suit Glove	7.6.3 Abrasion Resistance Test 2	Every year
Dry Suit Glove	7.6.4 Glove Hand Function Test	Every year
Dry Suit Glove	7.6.5 Grip Test	Every year
Dry Suit Glove	7.6.6 Glove Donning Test	Every year
Dry Suit Glove	7.6.7 Corrosion Resistance Test	Every year
Dry Suit Glove	7.6.8 Liquid Penetration Resistance Test	Every year
Dry Suit Glove	7.6.9 Viral Penetration Resistance Test	Seams only - Every year
Dry Suit Glove	7.6.10 Overall Liquid Integrity Test 2	Every year

(continues)

Table 4.4.1 *Continued*

Product	Test	Time
Dry Suit Glove	7.6.11 Label Durability and Legibility Test	Every year
Dry Suit Glove	7.6.12 Thermal Insulation Test	Every year
Ice Suit Glove	7.7.1 Cut Resistance Test	Every year
Ice Suit Glove	7.7.2 Puncture Resistance Test	Every year
Ice Suit Glove	7.7.3 Abrasion Resistance Test 2	Every year
Ice Suit Glove	7.7.4 Glove Hand Function Test	Every year
Ice Suit Glove	7.7.5 Grip Test	Every year
Ice Suit Glove	7.7.6 Glove Donning Test	Every year
Ice Suit Glove	7.7.7 Corrosion Resistance Test	Every year
Ice Suit Glove	7.7.8 Liquid Penetration Resistance Test	Every year
Ice Suit Glove	7.7.9 Viral Penetration Resistance Test	Seams only - Every year
Ice Suit Glove	7.7.10 Label Durability and Legibility Test	Every year
Ice Suit Glove	7.7.11 Thermal Insulation Test	Every year
Wet Suit Footwear	7.8.1 Footwear Drain Test	Every year
Wet Suit Footwear	7.8.2 Abrasion Resistance Test 2 (Upper)	Every year
Wet Suit Footwear	7.8.3 Cut Resistance	Every year
Wet Suit Footwear	7.8.4 Puncture Resistance Test (Upper)	Every year
Wet Suit Footwear	7.8.5 Abrasion Resistance Test 2 (Sole)	Every year
Wet Suit Footwear	7.8.6 Puncture Resistance Test (Sole)	Every year
Wet Suit Footwear	7.8.7 Slip Resistance	Every year
Wet Suit Footwear	7.8.8 Corrosion Resistance	Every year
Wet Suit Footwear	7.8.9 Label Durability and Legibility Test	Every year
Dry Suit Footwear	7.8.1 Footwear Drain Test	Every year
Dry Suit Footwear	7.8.2 Abrasion Resistance Test 2 (Upper)	Every year
Dry Suit Footwear	7.8.3 Cut Resistance	Every year
Dry Suit Footwear	7.8.4 Puncture Resistance Test (Upper)	Every year
Dry Suit Footwear	7.8.5 Abrasion Resistance Test 2 (Sole)	Every year
Dry Suit Footwear	7.8.6 Puncture Resistance Test (Sole)	Every year
Dry Suit Footwear	7.8.7 Slip Resistance Test	Every year
Dry Suit Footwear	7.8.8 Corrosion Resistance Test	Every year
Dry Suit Footwear	7.8.9 Label Durability and Legibility Test	Every year
Ice Suit Footwear	7.9.1 Abrasion Resistance Test 2 (Upper)	Every year
Ice Suit Footwear	7.9.2 Cut Resistance Test	Every year
Ice Suit Footwear	7.9.3 Puncture Resistance Test (Upper)	Every year
Ice Suit Footwear	7.9.4 Abrasion Resistance Test 2 (Sole)	Every year
Ice Suit Footwear	7.9.5 Puncture Resistance Test (Sole)	Every year
Ice Suit Footwear	7.9.6 Slip Resistance Test	Every year
Ice Suit Footwear	7.9.7 Liquid Penetration Resistance Test	Every year
Ice Suit Footwear	7.9.8 Viral Penetration Resistance Test	Seams only - Every year
Ice Suit Footwear	7.9.9 Corrosion Resistance Test	Every year
Ice Suit Footwear	7.9.10 Label Durability and Legibility Test	Every year
Ice Suit Footwear	7.9.11 Thermal Insulation Test	Every year
Personal Flotation Device	7.10.1 Buoyancy Test — SG3 & 20 of UL 1123	Every Year
Personal Flotation Device	7.10.2 Label Durability and Legibility	Every Year
Personal Flotation Device	7.10.3 Corrosion Resistance Test	Every Year
Personal Flotation Device	6.11.1 Water Entry Test – SG3 & 16 of UL 1123	Every Year
Personal Flotation Device	6.11.1 Flotation Stability Test – SG3 & 17 of UL 1123	Every Year
Personal Flotation Device	6.11.1 Buoyancy Distribution Test – SG3 & 19 of UL 1123	Every Year
Personal Flotation Device	6.11.1 Tensile Test – SG3 & 24 of UL 1123	Every Year
Personal Flotation Device	6.11.1 730 Pound Shoulder Tensile Test – SG3, SG10, & 24 of UL 1123	Every Year
Personal Flotation Device	6.11.1 55 Pound Release Test – SG7 of UL 1123	Every Year
Personal Flotation Device	6.11.1 730 Pound Harness Strength Test (without accelerated weathering) – SG9 of UL 1123	Every Year
Personal Flotation Device	6.11.1 Pamphlet Strength of Attachment Test – SG3 & 35 of UL 1123	Every Year
Personal Flotation Device	6.11.1 Pull Toggle Security of Attachment Test – SG7A of UL 1123	Every Year

4.4.1.1 This recertification shall include inspection and evaluation to all design requirements and testing to all performance requirements as required by this standard on all manufacturer's models and components as required by 4.4.3.

4.4.1.2 Any change that affects the product's performance under design or performance requirements of this standard shall constitute a different model.

4.4.1.3 For the purpose of this standard, models shall include each unique pattern, style, or design of the product.

4.4.2 Any change that affects the element's performance under the design or performance requirements of this standard shall constitute a different model.

4.4.3 For the purpose of this standard, models shall include each unique pattern, style, or design of the individual element.

4.4.4 Samples of manufacturer models and components for recertification shall be acquired as part of the follow-up program in accordance with 4.2.7 and shall be permitted to be used toward annual recertification.

4.4.5 The manufacturer shall maintain all design, inspection, performance, and test data from the certification organization used in the recertification of manufacturer models and components. The manufacturer shall provide such data, upon request, to the purchaser or authority having jurisdiction.

4.5 Manufacturers' Quality Assurance Program.

4.5.1 The manufacturer shall provide and operate a quality assurance program that meets the requirements of this section and that includes a product recall system as specified in 4.2.7.1, and Section 4.8, Manufacturers' Safety Alert and Product Recall Systems.

4.5.2 The operation of the quality assurance program shall evaluate and test compliant product production to the requirements of this standard to assure production remains in compliance.

4.5.3 The manufacturer shall be registered to ISO 9001, *Quality management systems – requirements.*

4.5.3.1 Registration to the requirements of ISO 9001, *Quality management systems – requirements,* shall be conducted by a registrar that is accredited for personal protective equipment in accordance with ISO 17021, *Conformity assessment – Requirements for bodies providing audit and certification of management systems.*

4.5.3.2 The scope of the ISO registration shall include at least the design and manufacturing systems management for the personal protective equipment being certified.

4.5.3.3 The registrar shall affix the accreditation mark on the ISO registration certificate.

4.5.4* Any entity that meets the definition of manufacturer specified in Section 3.3, General Definitions, and therefore is considered to be the "manufacturer," but does not manufacture or assemble the compliant product, shall meet the requirements specified in this Section 4.5.

4.5.5* Where the manufacturer uses subcontractors in the construction or assembly of the compliant product, the locations and names of all subcontractor facilities shall be documented and the documentation shall be provided to the manufacturer's ISO registrar and the certification organization.

4.6 Hazards Involving Compliant Product

4.6.1* The certification organization shall establish procedures to be followed where situation(s) are reported in which a compliant product is subsequently found to be hazardous. These procedures shall comply with the provisions of ISO Guide 27, *Guidelines for corrective action to be taken by a certification body in the event of misuse of its mark of conformity,* and as modified herein.

4.6.2* Where a report of a hazard involved with a compliant product is received by the certification organization, the validity of the report shall be investigated.

4.6.3 With respect to a compliant product, a hazard shall be a condition, or create a situation, that results in exposing life, limb, or property to an imminently dangerous or dangerous condition.

4.6.4 Where a specific hazard is identified, the determination of the appropriate action for the certification organization and the manufacturer to undertake shall take into consideration the severity of the hazard and its consequences to the safety and health of users.

4.6.5 Where it is established that a hazard is involved with a compliant product, the certification organization shall determine the scope of the hazard including products, model numbers, serial numbers, factory production facilities, production runs, and quantities involved.

4.6.6 The certification organization's investigation shall include, but not be limited to, the extent and scope of the problem as it might apply to other compliant product or compliant product components manufactured by other manufacturers or certified by other certification organizations.

4.6.7 The certification organization shall also investigate reports of a hazard where compliant product is gaining widespread use in applications not foreseen when the standard was written, such applications in turn being ones for which the product was not certified, and no specific scope of application has been provided in the standard, and no limiting scope of application was provided by the manufacturer in written material accompanying the compliant product at the point of sale.

4.6.8 The certification organization shall require the manufacturer of the compliant product, or, if applicable, the manufacturer of the compliant product component, to assist the certification organization in the investigation and to conduct its own investigation as specified in Section 4.7, Manufacturers' Investigation of Complaints and Returns.

4.6.9 Where the facts indicating a need for corrective action are conclusive and the certification organization's appeal procedures referenced in 4.2.11 have been followed, the certification organization shall initiate corrective action immediately, provided there is a manufacturer to be held responsible for such action.

4.6.10 Where the facts are conclusive and corrective action is indicated but there is no manufacturer to be held responsible, such as when the manufacturer is out of business or the manufacturer is bankrupt, the certification organization shall immediately notify relevant governmental and regulatory agencies and issue a notice to the user community about the hazard.

4.6.11* Where the facts are conclusive and corrective action is indicated, the certification organization shall take one or more of the following corrective actions:

(1) Notify parties authorized and responsible for issuing a safety alert when, in the opinion of the certification organization, such a notification is necessary to inform the users
(2) Notify parties authorized and responsible for issuing a product recall when, in the opinion of the certification organization, such a recall is necessary to protect the users
(3) Remove the mark of certification from the product
(4) Where a hazardous condition exists and it is not practical to implement (1), (2), or (3); or the responsible parties refuse to take corrective action, notify relevant governmental and regulatory agencies and issue a notice to the user community about the hazard

4.6.12 The certification organization shall provide a report to the organization or individual identifying the reported hazardous condition and notify them of the corrective action indicated or that no corrective action is indicated.

4.6.13* Where a change to an NFPA standard(s) is felt to be necessary, the certification organization shall also provide a copy of the report and corrective actions indicated to the NFPA, and shall also submit either a Public Proposal for a proposed change to the next revision of the applicable standard or a proposed Temporary Interim Amendment (TIA) to the current edition of the applicable standard.

4.7* Manufacturers' Investigation of Complaints and Returns

4.7.1 Manufacturers shall provide corrective action in accordance with ISO 9001, *Quality management systems – requirements*, for investigating written complaints and returned products.

4.7.2 Manufacturers' records of returns and complaints related to safety issues shall be retained for at least 5 years.

4.7.3 Where the manufacturer discovers, during the review of specific returns or complaints, that a compliant product or compliant product component can constitute a potential safety risk to end users that is possibly subject to a safety alert or product recall, the manufacturer shall immediately contact the certification organization and provide all information about the review to assist the certification organization with its investigation.

4.8 Manufacturers' Safety Alert and Product Recall Systems

4.8.1 Manufacturers shall establish a written safety alert system and a written product recall system that describes the procedures to be used in the event that it decides, or is directed by the certification organization, to either issue a safety alert or conduct a product recall.

4.8.2 The manufacturers' safety alert and product recall system shall provide the following:

(1) The establishment of a coordinator and responsibilities by the manufacturer for the handling of safety alerts and product recalls
(2) A method of notifying all dealers, distributors, purchasers, users, and the NFPA about the safety alert or product recall that can be initiated within a one-week period following the manufacturer's decision to issue a safety alert or to conduct a product recall, or after the manufacturer has been directed by the certification organization to issue a safety alert or conduct a product recall
(3) Techniques for communicating accurately and understandably the nature of the safety alert or product recall and, in particular, the specific hazard or safety issue found to exist
(4) Procedures for removing product that is recalled and for documenting the effectiveness of the product recall
(5) A plan for either repairing or replacing, or compensating purchasers for, returned product.

Chapter 5 Labeling and Information

5.1 Product Label Requirements.

5.1.1* Each item of protective clothing and equipment shall have a product label or labels permanently and conspicuously located inside each product when the product is properly assembled with all layers and components in place.

5.1.2 Multiple label pieces shall be permitted in order to carry all statements and information required to be on the product label. However, all label pieces comprising the product label shall be located adjacent to each other.

5.1.3* The certification organization's label, symbol, or identifying mark shall be permanently attached to the product label or shall be part of the product label. All letters shall be at least 2.5 mm (3⁄32 in.) high. The label, symbol, or identifying mark shall be at least 6 mm (1⁄4 in.) in height and shall be placed in a conspicuous location.

5.1.4 All worded portions of the required product label shall be printed at least in English.

5.1.5 Symbols and other pictorial graphic representations shall be permitted to be used to supplement worded statements on the product label(s). Such graphic representations shall be consistent and clearly communicate the intended message.

5.1.6 The following statement shall be printed legibly on the product label. The appropriate term for the item type (suit type, helmet, glove type, footwear type, personal flotation device) shall be inserted in this compliance statement text where indicated. All letters shall be at least 2.5 mm (3⁄32 in.) in height.

"THIS SURFACE WATER OPERATIONS [*insert appropriate item term here*] MEETS THE REQUIREMENTS OF NFPA 1952, STANDARD ON SURFACE WATER OPERATIONS PROTECTIVE CLOTHING AND EQUIPMENT, 2010 EDITION.

DO NOT REMOVE THIS LABEL!"

5.1.7 The following information shall also be printed legibly on the product label. All letters shall be at least 1.6 mm (1⁄16 in.) high.

(1) Manufacturer's name, identification, or designation
(2) Manufacturer's address
(3) Country of manufacture
(4) Manufacturer's identification number, lot number, or serial number
(5) Month and year of manufacture (not coded)
(6) Model name, number, or design
(7) Size
(8) Materials of construction of the composite
(9) Cleaning precautions
(10) For suits, the clo value specified in 7.1.2, 7.2.5, or 7.3.5
(11) Total heat loss (THL) as required by 6.2.11

5.1.8 Supplementary Product Labels.

5.1.8.1 Where the protective clothing items consist of items or layers that can be separated from each other, each separable layer shall have a supplementary product label permanently attached.

5.1.8.2 Supplementary product labels shall also meet the requirements of 5.1.4 and 5.1.5.

5.2 User Information.

5.2.1 The manufacturer shall provide user information including, but not limited to, warnings, information, and instructions with each item.

5.2.2 The manufacturer shall attach the required user information, or packaging containing the user information, to the item in such a manner that it is not possible to use the item without being aware of the availability of the information.

5.2.3 The required user information, or packaging containing the user information, shall be attached to the item so that a deliberate action is necessary to remove it. The product manufacturer shall provide notice that the user information is to be removed ONLY by the end user.

5.2.4* The item manufacturer shall provide instructions and information regarding at least the following with each item:

(1) Pre-use information, including the following:
   (a) Safety considerations
   (b) Limitations of use
   (c) Marking recommendations and restrictions
   (d) A statement that most performance properties of the item cannot be tested by the user in the field
   (e) Warranty information
(2) Preparation for use, including the following:
   (a) Sizing/adjustment
   (b) Recommended storage practices
(3) Inspection, including inspection frequency and details
(4) Don/doff, including the following:
   (a) Donning and doffing procedures
   (b) Sizing and adjustment procedures
   (c) Interface issues
(5) Use, including proper use consistent with national/federal, state/provincial, and local jurisdiction laws/ordinances.
(6) For surface water operations, use consistent with NFPA 1670, *Standard on Operations and Training for Technical Search and Rescue Incidents.*
(7) For fire departments, use consistent with NFPA 1500, *Standard on Fire Department Occupational Safety and Health Program.*
(8) Maintenance and cleaning, including the following:
   (a) Cleaning instructions and precautions with a statement advising users not to use suits that are not thoroughly cleaned and dried
   (b) Inspection details
   (c) Maintenance criteria and methods of repair where applicable
   (d) Decontamination procedures for both chemical and biological contamination
(9) Retirement and disposal, including criteria and considerations

Chapter 6 Design Requirements

6.1* Surface Water Operations Protective Wet Suit Design Requirements.

6.1.1 Protective wet suits shall have at least the applicable design requirements specified in this section where inspected by the certification organization as specified in Section 4.3, Inspection and Testing.

6.1.2 Protective wet suits shall be permitted to be single-layer or multiple-layer suits.

6.1.3 Where multiple layers are necessary to meet the requirements of this standard, the protective wet suit shall have a means for securing the layers together.

6.1.4 The protective wet suit shall cover the wearer's upper torso and arms to the neck and wrist, and lower torso and legs to the ankle.

6.1.5 All protective wet suit hardware finish shall be free of rough spots, burrs, or sharp edges.

6.1.6 Protective wet suit metal components and closure systems shall not come in direct contact with the body.

6.1.7 Visibility Markings. Where visibility markings are provided for protective wet suits, the markings shall meet the following criteria:

(1) They shall be Type 1 retroreflective material approved by the USCG in accordance with 46 CFR 164.018.
(2) They shall provide visibility of the wearer to include arms, and front and back of the upper torso.
(3) They shall have a minimum area of 0.04 m^2 (62 $in.^2$).
(4) They shall have a retroreflective surface not less than 25 mm (1 in.) wide.
(5) They shall appear to be continuous for the length of the markings, with gaps between areas of retroreflectivity of not more than 6 mm (¼ in.).

6.1.8* Protective Wet Suit Sizing

6.1.8.1 Protective wet suit chest circumferences shall be provided in circumferences from 760 mm to 1475 mm (30 in. to 58 in.) in 50 mm (2 in.) increments or shall be cut to order.

6.1.8.2 Protective wet suit sleeve lengths shall be provided in lengths from 760 mm to 915 mm (30 in. to 36 in.) in 25 mm (1 in.) increments or shall be cut to order.

6.1.8.3 Protective wet suit waist circumferences shall be provided in circumferences from 660 mm to 1270 mm (26 in. to 50 in.) in 50 mm (2 in.) increments or shall be cut to order.

6.1.8.4 Protective wet suit inseam lengths shall be provided in lengths from 660 mm to 915 mm (26 in. to 36 in.) in 25 mm (1 in.) increments or shall be cut to order.

6.1.8.5 Men's and women's sizing shall be accomplished by the use of individual patterns for men's and women's wet suits.

6.2* Surface Water Operations Protective Dry Suit Design Requirements.

6.2.1 Protective dry suits shall have at least the applicable design requirements specified in this section where inspected by the certification organization as specified in Section 4.3, Inspection and Testing.

6.2.2 Protective dry suits shall be permitted to be single-layer or multiple-layer suits.

6.2.3 Where multiple layers are necessary to meet the requirements of this standard, the protective dry suit shall have a means for securing the layers together.

6.2.4 Protective dry suits shall be designed to cover the wearer's upper torso to the neck and the arms to the wrist; shall cover the wearer's lower torso, legs, and feet; and shall be designed with size-adjustable seals at the neck or face and at the wrists.

6.2.5 Protective dry suits shall be designed with an integrated bootie that shall cover the entire foot.

6.2.6 Protective dry suits shall be designed to accommodate gloves, which shall be permitted to be a separate item or a detachable item of the dry suit.

6.2.7 Where dry suits are designed to accommodate a hood, the hood shall be permitted to be a separate item or a detachable item of the dry suit. Where hoods are provided, the hood shall provide protection to at least the head and neck.

6.2.8 All protective dry suit hardware finish shall be free of rough spots, burrs, or sharp edges.

6.2.9 Protective dry suit metal components and closure systems shall not come in direct contact with the body.

6.2.10 Protective dry suits shall be reinforced at buttocks, forearms, elbow, and knees.

6.2.11* When the manufacturer designates a dry suit as "breathable," the total heat loss shall be measured as specified in Section 8.42, Total Heal Loss Test, and the result shall be printed on the product label as required by 5.1.7(11).

6.2.12 Visibility Markings. Where visibility markings are provided for protective dry suits, the markings shall meet the following criteria:

(1) They shall be Type 1 retroreflective material approved by the USCG in accordance with 46 CFR 164.018.
(2) They shall provide visibility of the wearer to include arms, and front and back of the upper torso.
(3) They shall have a minimum area of 0.04 m^2 (62 $in.^2$).
(4) They shall have a retroreflective surface not less than 25 mm (1 in.) wide.
(5) They shall appear to be continuous for the length of the markings, with gaps between areas of retroreflectivity of not more than 6 mm (¼ in.).

6.2.13* Protective Dry Suit Sizing

6.2.13.1 Protective dry suit chest circumferences shall be provided in circumferences from 760 mm to 1475 mm (30 in. to 58 in.) in 100 mm (4 in.) increments or shall be cut to order.

6.2.13.2 Protective dry suit sleeve lengths shall be provided in lengths from 760 mm to 915 mm (30 in. to 36 in.) in 50 mm (2 in.) increments or shall be cut to order.

6.2.13.3 Protective dry suit waist circumferences shall be provided in circumferences from 660 mm to 1270 mm (26 in. to 50 in.) in 100 mm (4 in.) increments or shall be cut to order.

6.2.13.4 Protective dry suit inseam lengths shall be provided in lengths from 660 mm to 915 mm (26 in. to 36 in.) in 50 mm (2 in.) increments or shall be cut to order.

6.2.13.5 Men's and women's sizing shall be accomplished by the use of individual patterns for men's and women's dry suits.

6.3* Surface Water Operations Protective Ice Suit Design Requirements.

6.3.1 Protective ice suits shall have at least the applicable design requirements specified in this section where inspected by the certification organization as specified in Section 4.3, Inspection and Testing.

6.3.2 Protective ice suits shall be designed to cover the wearer's entire body. The suit shall be permitted to cover the wearer's nose. The suit shall not cover the wearer's eyes.

6.3.3 Protective ice suits shall incorporate a hood, either detachable or integrated, that covers the wearer's neck and head, excluding the face.

6.3.4 Protective ice suits shall be permitted to be single-layer or multiple-layer suits.

6.3.5 Where multiple layers are provided to meet the requirements of this standard, the protective ice suit shall have a means for securing the layers together.

6.3.6 Protective ice suits shall incorporate integrated gloves and footwear of a compatible material that meets the performance requirements for protective ice suits in Chapter 7.

6.3.7 All protective ice suit hardware finish shall be free of rough spots, burrs, or sharp edges.

6.3.8 Protective ice suit metal components and closure systems shall not come in direct contact with the body.

6.3.9 Protective ice suits shall be reinforced at buttocks, forearms, elbow, and knees.

6.3.10 Protective ice suits shall have a means to automatically exhaust air from the lower extremities of the suit.

6.3.11 Visibility Markings. Visibility markings on protective ice suits shall meet the following criteria:

(1) They shall be Type 1 retroreflective material that is USCG approved in accordance with 46 CFR 164.018.
(2) They shall provide visibility of the wearer to include arms, front and back of the upper torso, and head.
(3) They shall have a minimum area of 0.04 m^2 (62 $in.^2$).
(4) They shall have a retroreflective surface not less than 25 mm (1 in.) wide.
(5) They shall appear to be continuous for the length of the markings, with gaps between areas of retroreflectivity of not more than 6 mm (¼ in.).

6.3.12* Protective Ice Suit Sizing.

6.3.12.1 Protective ice suit chest circumferences shall be provided in circumferences from 760 mm to 1475 mm (30 in. to 58 in.) in 100 mm (4 in.) increments, shall be adjustable from 760 mm to 1475 mm (30 in. to 58 in.), or shall be cut to order.

6.3.12.2 Protective ice suit sleeve lengths shall be provided in lengths from 760 mm to 915 mm (30 in. to 36 in.) in 50 mm (2 in.) increments, shall be adjustable from 760 mm to 915 mm (30 in. to 36 in.), or shall be cut to order.

6.3.12.3 Protective ice suit waist circumferences shall be provided in circumferences from 660 mm to 1270 mm (26 in. to 50 in.) in 100 mm (4 in.) increments, shall be adjustable from 660 mm to 1270 mm (26 in. to 50 in.), or shall be cut to order.

6.3.12.4 Protective ice suit inseam lengths shall be provided in lengths from 660 mm to 915 mm (26 in. to 36 in.) in 50 mm (2 in.) increments, shall be adjustable from 660 mm to 915 mm (26 in. to 36 in.), or shall be cut to order.

6.3.12.5 Men's and women's sizing shall be accomplished by the use of individual patterns for men's and women's ice suits.

6.4 Surface Water Operations Protective Helmet Design Requirements.

6.4.1 Surface water protective helmets shall have at least the applicable design requirements specified in this section where inspected by the certification organization as specified in Section 4.3, Inspection and Testing.

6.4.2 Surface water protective helmets shall be designed to consist of at least a means of absorbing energy and a chinstrap.

6.4.3 The back and sides of the surface water helmet shall extend a minimum of 50 mm (2 in.) downward from the reference plane when measured on an ISO J headform at any point behind the coronal plane.

6.4.4 Surface water protective helmets shall be permitted to have ventilation holes or shall be permitted to be continuous and tight fitting so that they do not collect water.

6.4.5 All materials used in the construction of the surface water protective helmet that are designed to come in contact with the wearer's head or skin shall be known to be nonirritating to normal skin.

6.4.6 The complete surface water protective helmet shall not weigh more than 710 g (25 oz) when dry.

6.4.7 Surface water protective helmets shall be permitted to have retroreflective visibility markings, fluorescent visibility markings, or both retroreflective and fluorescent visibility markings on the helmet exterior.

6.4.8 Where present, a minimum of 2580 mm^2 (4 $in.^2$) of retroreflective visibility markings shall be visible when the helmet is viewed from the top, left side, right side, and rear.

6.4.9 Product labels and any other identification labels or markers used on the surface water protective helmet shall be affixed without holes being made through the helmet and without the use of any metal parts or metallic labels.

6.4.10 Surface water protective helmets shall not have hardware that projects more than 2 mm (0.08 in.) beyond the outer surface. All hardware edges shall be smooth and edges shall be rounded to a radius of not less than 1 mm (0.04 in.). All rigid internal projections shall be covered with protective padding.

6.4.11 Surface water protective helmets shall be available in sizes to fit head circumferences of 510 mm to 650 mm (20 in. to 25 in.) when measured at the circumference of the headband.

6.5 Surface Water Operations Protective Wet Suit Glove Design Requirements.

6.5.1 Protective wet suit gloves shall have at least the applicable design requirements specified in this section where inspected by the certification organization as specified in Section 4.3, Inspection and Testing.

6.5.2 Protective wet suit gloves shall consist of a composite that shall be permitted to be configured as a single layer, multiple layers, or multiple gloves that are designed to be worn together. Where the glove is made up of multiple layers or where multiple gloves are used, all layers of the glove or all gloves shall be individually graded per size.

6.5.3 Protective wet suit gloves shall be designed with a cut- and puncture-resistant palm and palmside fingers area.

6.5.4 The protective wet suit glove body shall extend circumferentially not less than 50 mm (2 in.) beyond the wrist crease where measured from the tip of the finger. The location of the wrist crease shall be determined as shown in Figure 6.5.4.

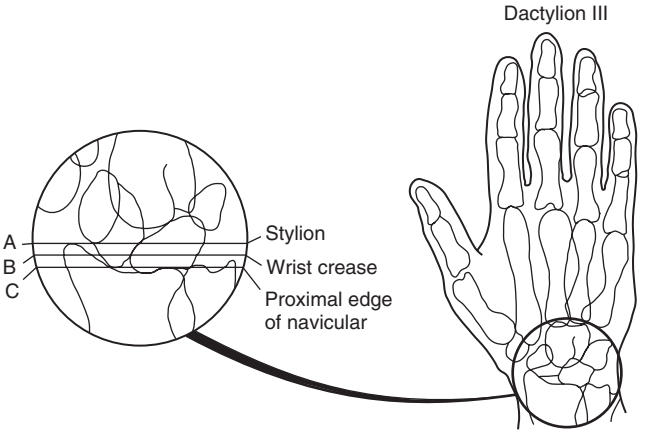


FIGURE 6.5.4 Anatomical Landmarks at Base of Hand, Palm Side Down.

6.5.5 In order to label or otherwise represent a protective wet suit glove as compliant with the requirements of this standard, the manufacturer shall provide gloves in not less than four separate and distinct sizes.

6.5.6 All protective wet suit glove hardware finishes shall be free of rough spots, burrs, or sharp edges.

6.6 Surface Water Operations Protective Dry Suit Glove Design Requirements.

6.6.1 Protective dry suit gloves shall have at least the applicable design requirements specified in this section where inspected by the certification organization as specified in Section 4.3, Inspection and Testing.

6.6.2 Protective dry suit gloves shall consist of a composite that shall be permitted to be configured as a single layer, multiple layers, or multiple gloves that are designed to be worn together. Where the protective dry suit glove is made up of multiple layers or if multiple gloves are used, all layers of the glove or all gloves shall be individually graded per size.

6.6.3 Protective dry suit gloves shall be designed with a cut- and puncture-resistant palm and palmside fingers area.

6.6.4 The protective dry suit glove body shall extend circumferentially not less than 50 mm (2 in.) beyond the wrist crease where measured from the tip of the finger. The location of the wrist crease shall be determined as shown in Figure 6.5.4.

6.6.5 In order to label or otherwise represent a protective dry suit glove as compliant with the requirements of this standard, the manufacturer shall provide gloves in not less than four separate and distinct sizes.

6.6.6 All protective dry suit glove hardware finishes shall be free of rough spots, burrs, or sharp edges.

6.7 Surface Water Operations Protective Ice Suit Glove Design Requirements.

6.7.1 Protective ice suit gloves shall have at least the applicable design requirements specified in this section where inspected by the certification organization as specified in Section 4.3, Inspection and Testing.

6.7.2 Protective ice suit gloves shall consist of a composite that shall be permitted to be configured as a single layer, multiple layers, or multiple gloves that are designed to be worn together. Where the ice suit glove is made up of multiple layers or if multiple gloves are used, all layers of the glove or all gloves shall be individually graded per size.

6.7.3 Protective ice suit gloves shall be designed with a cut- and puncture-resistant palm and palmside fingers area.

6.7.4 The protective ice suit glove body shall extend circumferentially not less than 50 mm (2 in.) beyond the wrist crease where measured from the tip of the finger. The location of the wrist crease shall be determined as shown in Figure 6.5.4.

6.7.5 In order to label or otherwise represent a protective ice suit glove as compliant with the requirements of this standard, the manufacturer shall provide ice suit gloves in not less than four separate and distinct sizes.

6.7.6 All protective ice suit glove hardware finishes shall be free of rough spots, burrs, or sharp edges.

6.8 Surface Water Operations Protective Wet Suit Footwear Design Requirements.

6.8.1 Protective wet suit footwear shall have at least the applicable design requirements specified in this section where inspected by the certification organization as specified in Section 4.3, Inspection and Testing.

6.8.2 Protective wet suit footwear shall consist of a composite that shall be permitted to be configured as a continuous or joined single layer or continuous or joined multiple layers.

6.8.3 Where the protective wet suit footwear is made up of multiple layers, all layers of the footwear shall be individually graded per size.

6.8.4 Protective wet suit footwear height shall be determined by measuring inside the footwear from the center of the insole at the heel up to a perpendicular reference line extending across the width of the footwear up to the highest point where the footwear composite completely and continuously encircles the leg. Removable insole inserts shall be removed prior to measurement.

6.8.5 All protective wet suit footwear hardware finishes shall be free of rough spots, burrs, or sharp edges.

6.9 Surface Water Operations Protective Dry Suit Footwear Design Requirements.

6.9.1 Protective dry suit footwear shall have at least the applicable design requirements specified in this section where inspected by the certification organization as specified in Section 4.3, Inspection and Testing.

6.9.2 Protective dry suit footwear shall consist of a composite that shall be permitted to be configured as a continuous or joined single layer or continuous or joined multiple layers.

6.9.3 Where the protective dry suit footwear is made up of multiple layers, all layers of the footwear shall be individually graded per size.

6.9.4 Protective dry suit footwear height shall be determined by measuring inside the footwear from the center of the insole at the heel up to a perpendicular reference line extending across the width of the footwear up to the highest point where the footwear composite completely and continuously encircles the leg. Removable insole inserts shall be removed prior to measurement.

6.9.5 All protective dry suit footwear hardware finishes shall be free of rough spots, burrs, or sharp edges.

6.10 Surface Water Operations Protective Ice Suit Footwear Design Requirements.

6.10.1 Protective ice suit footwear shall have at least the applicable design requirements specified in this section where inspected by the certification organization as specified in Section 4.3, Inspection and Testing.

6.10.2 Protective ice suit footwear shall consist of a composite that shall be permitted to be configured as a continuous or joined single layer or continuous or joined multiple layers.

6.10.3 Where the protective ice suit footwear is made up of multiple layers, all layers of the footwear shall be individually graded per size.

6.10.4 Protective ice suit footwear height shall be determined by measuring inside the footwear from the center of the insole at the heel up to a perpendicular reference line extending across the width of the footwear up to the highest point where the footwear composite completely and continuously encircles the leg. Removable insole inserts shall be removed prior to measurement.

6.10.5 All protective ice suit footwear hardware finishes shall be free of rough spots, burrs, or sharp edges.

6.11 Surface Water Operations Protective Personal Flotation Device Design Requirements.

6.11.1 Protective personal flotation devices shall be certified to UL 1123, *Standard for Marine Buoyant Devices*, as defined in Supplement SG, Type V Rescuer's Harness PFD's, excluding Markings – SG 11.

6.11.2 Protective personal flotation devices shall be available in a range of chest sizes from 760 mm to 1475 mm (30 in. to 58 in.).

6.11.3 Personal flotation devices (PFDs) shall have visibility markings on the exterior of the shell. A minimum of 200 cm^2 (31 $in.^2$) of retroreflective visibility markings shall be visible when the PFD is viewed from the front, and a minimum of 200 cm^2 (31 $in.^2$) retroflective visibility markings shall be visible when the PFD is viewed from the rear.

6.11.4 All protective personal flotation device hardware finishes shall be free of rough spots, burrs, or sharp edges.

Chapter 7 Performance Requirements

7.1 Surface Water Operations Protective Wet Suit Performance Requirements.

7.1.1 Protective wet suits shall be tested for donning efficiency as specified in Section 8.4, Overall Donning Efficiency Test, and shall be donned and doffed in 3 minutes or less.

7.1.2* Protective wet suit materials shall be tested for thermal insulation as specified in Section 8.5, Thermal Insulation Test, and shall have a clo value of at least 1.

7.1.3 Protective wet suit materials shall be tested for strength as specified in Section 8.7, Breaking Strength Test, and shall have a breaking strength of not less than 308 N (70 lbf).

7.1.4 Protective wet suit materials shall be tested for snag resistance strength as specified in Section 8.8, Puncture Propagation Tear Resistance Test, and shall have a puncture resistance of not less than 25 N (5.5 lbf).

7.1.5 All protective wet suit seam assemblies shall be tested for seam strength as specified in Section 8.11, Seam Breaking Strength Test, and shall demonstrate a breaking strength of 158 N (35 lbf) or greater for each seam type.

7.1.6 Protective wet suit materials shall be tested for water absorption resistance as specified in Section 8.12, Liquid Absorption Resistance Test, and shall not have a water absorption greater than 10 percent.

7.1.7 Where protective wet suit visibility markings are specified, the visibility markings shall be tested for retroreflectivity as specified in Section 8.15, Retroreflectivity Test, and shall have a total coefficient of retroreflection (R_a) of not less than 100 cd/lux/m^2 (cd/fc/ft^2).

7.1.8 Protective wet suit zippers shall be tested for strength as specified in Section 8.31, Zipper Strength Test, and shall have a minimum strength of 222 N (50 lbf).

7.1.9 Protective wet suit zippers shall be tested for resistance to twist as specified in Section 8.32, Resistance to Twist of Pull and Slider Test, and shall have a minimum force of 0.79 N-m (7 lbf-in.).

7.1.10 Protective wet suit zippers shall be tested for operability as specified in Section 8.33, Opening and Closing of Zippers Test, and shall have a minimum force of 67 N (15 lbf).

7.1.11 All protective wet suit metal hardware and hardware that includes metal parts shall be tested for corrosion resistance as specified in Section 8.16, Corrosion Resistance Test, and shall not have metals that are inherently resistant to corrosion show more than light surface-type corrosion or oxidation, shall not have ferrous metals show corrosion of the base metal, and shall have all hardware items remain functional.

7.1.12 Protective wet suit product labels shall be tested for legibility as specified in Section 8.17, Label Durability and Legibility Test, and shall not be torn, shall remain in place, and shall be legible to the unaided eye.

7.2 Surface Water Operations Protective Dry Suit Performance Requirements.

7.2.1 Protective dry suits shall be tested for air penetration resistance as specified in Section 8.2, Air Retention Test, and shall not show any sign of leakage.

7.2.2 Protective dry suits shall be tested for liquid penetration resistance as specified in Section 8.3, Overall Liquid Integrity Test One, and shall not allow liquid penetration.

7.2.3 Protective dry suits shall be tested for donning efficiency as specified in Section 8.4, Overall Donning Efficiency Test, and shall be donned in 3 minutes or less.

7.2.4 Protective dry suits shall be tested for ability to evacuate air from within the suit as specified in Section 8.34, Water and Air Penetration Test, and shall show no air or water entrapment.

7.2.5* Protective dry suit materials, dry suit bootie materials, and dry suit hood materials shall be tested for thermal insulation as specified in Section 8.5, Thermal Insulation Test, and shall have a clo value of at least 0.5.

7.2.6 Protective dry suit materials, dry suit bootie materials, and dry suit hood materials shall be tested for strength as specified in Section 8.7, Breaking Strength Test, and shall have a breaking strength of not less than 445 N (100 lbf).

7.2.7 Protective dry suit materials, dry suit bootie materials, and dry suit hood materials shall be tested for snag resistance as specified in Section 8.8, Puncture Propagation Tear Resistance Test, and shall have a puncture resistance of not less than 25 N (5.5 lbf).

7.2.8 Protective dry suit materials shall be individually tested for cleaning shrinkage resistance as specified in Section 8.10, Cleaning Shrinkage Resistance Test, and shall not shrink more than 5.0 percent in either direction.

7.2.9 Protective dry suit seam assemblies, dry suit bootie seam assemblies, and dry suit hood seam assemblies shall be tested for seam strength as specified in Section 8.11, Seam Breaking Strength Test, and shall have a seam breaking strength of not less than 158 N (35 lbf) for each seam type.

7.2.10 Protective dry suit materials, dry suit bootie materials, and dry suit hood materials shall be tested for water absorption resistance as specified in Section 8.12, Liquid Absorption Resistance Test, and shall not have a water absorption greater than 10 percent.

7.2.11 Protective dry suit materials and seams, dry suit bootie materials and seams, and dry suit hood materials and seams shall be tested for liquid penetration resistance as specified in Section 8.13, Liquid Penetration Resistance Test, and shall not show any chemical penetration.

7.2.12 Protective dry suit materials and seams, dry suit bootie materials and seams, and dry suit hood materials and seams shall be tested for biopenetration resistance as specified in Section 8.14, Viral Penetration Resistance Test, and shall not show any viral penetration.

7.2.13 Protective dry suit zippers shall be tested for strength as specified in Section 8.31, Zipper Strength Test, and shall have a minimum strength of 222 N (50 lbf).

7.2.14 Protective dry suit zippers shall be tested for resistance to twist as specified in Section 8.32, Resistance to Twist of Pull and Slider Test, and shall have a minimum force of 0.79 N-m (7 lbf-in.).

7.2.15 Protective dry suit zippers shall be tested for operability as specified in Section 8.33, Opening and Closing of Zippers Test, and shall have a minimum force of 67 N (15 lbf).

7.2.16 Protective dry suit zippers shall be tested for point breaking strength as specified in Section 8.40, Zipper Point Breaking Strength Test, and shall have a minimum strength of 440 N (90 lbf).

7.2.17 Protective dry suit zippers shall be tested for resistance to leakage as specified in Section 8.41, Zipper Leak Resistance Test, and shall not allow any water ingress.

7.2.18 Protective dry suit zippers shall be tested for opening and closing force as specified in Section 8.37, Zipper Opening and Closing Force Test, and shall have a minimum strength as defined in Table 7.2.18.

7.2.19 Where protective dry suit visibility markings are specified, the visibility markings shall be tested for retroreflectivity as specified in Section 8.15, Retroreflectivity Test, and shall have a total coefficient of retroreflection (R_a) of not less than 100 cd/lux/m^2 (cd/fc/ft^2).

7.2.20 All metal hardware and hardware that includes metal parts shall be tested for corrosion resistance as specified in Section 8.16, Corrosion Resistance Test, shall not have metals that are inherently resistant to corrosion show more than light surface-type corrosion or oxidation, shall not have ferrous metals show corrosion of the base metal, and shall have all hardware items remain functional.

7.2.21 Protective dry suit product labels shall be tested for legibility as specified in Section 8.17, Label Durability and Legibility Test, and shall not be torn, shall remain in place, and shall be legible to the unaided eye.

7.3 Surface Water Operations Protective Ice Suit Performance Requirements.

7.3.1 Protective ice suits shall be tested for liquid penetration resistance as specified in Section 8.3, Overall Liquid Integrity Test One, and shall not allow liquid penetration.

7.3.2 Protective ice suits shall be tested for air penetration resistance as specified in Section 8.2, Air Retention Test, and shall not show any sign of leakage.

7.3.3 Protective ice suit materials and seams and ice suit hood materials and seams shall be tested for biopenetration resistance as specified in Section 8.14, Viral Penetration Resistance Test, and shall not show any viral penetration.

Table 7.2.18 Zipper Force Test Strengths

Conditioning	Minimum Strength (N)
8.1.2, Room Temperature Conditioning Procedure	The opening and closing force shall not exceed 9 (40) and 11 (50) at the top stop.
720 hours of salt spray with 5 percent sodium chloride (ASTM B 117)	The opening and closing force shall not exceed 39 (175).
24 hours under 4 in. (100 mm) head of No. 2 marine diesel oil at 64°F–68°F (18°C–20°C)	
8 hours at room temperature[a,b]; 149°F (65°C) for 8 hours[a,b]; 8 hours at room temperature[a,b]; and –22°F (–30°C) for 8 hours[a,b,c]	The opening and closing force shall not exceed 13 (60).

a – The exposure sequence shall be performed five times.

b – Prior to exposures, the sample shall be folded in half lengthwise to form a radius of not more than 0.9 in. (25 mm).

c – The test shall be performed no less than 10 minutes after being removed from exposure.

7.3.4 Protective ice suits shall be tested for donning efficiency as specified in Section 8.4, Overall Donning Efficiency Test, and shall be donned in 3 minutes or less.

7.3.5* Protective ice suit and protective ice suit hood materials shall be tested for thermal insulation as specified in Section 8.5, Thermal Insulation Test, and shall have a clo value of at least 2.

7.3.6 Protective ice suit and protective ice suit hood materials shall be tested for strength as specified in Section 8.7, Breaking Strength Test, and shall have a breaking strength of not less than 445 N (100 lbf).

7.3.7 Protective ice suit and protective ice suit hood materials shall be tested for snag resistance strength as specified in Section 8.8, Puncture Propagation Tear Resistance Test, and shall have a puncture resistance of not less than 25 N (5.5 lbf).

7.3.8 Protective ice suit and protective ice suit hood seam assemblies shall be tested for seam strength as specified in Section 8.11, Seam Breaking Strength Test, and shall demonstrate a breaking strength of 158 N (35 lbf) or greater for each seam type.

7.3.9 Protective ice suit and protective ice suit hood materials shall be tested for water absorption resistance as specified in Section 8.12, Liquid Absorption Resistance Test, and shall not have a water absorption greater than 10 percent.

7.3.10 Protective ice suit materials and seams and ice suit hood materials and seams shall be tested for liquid penetration resistance as specified in Section 8.13, Liquid Penetration Resistance Test, and shall not show any chemical penetration.

7.3.11 Protective ice suit visibility markings shall be tested for retroreflectivity as specified in Section 8.15, Retroreflectivity Test, and shall have a total coefficient of retroreflection (R_a) of not less than 100 cd/lux/m^2 (cd/fc/ft^2).

7.3.12 Protective ice suits shall be tested for ability to evacuate air from within the suit as specified in Section 8.34, Water and Air Penetration Test, and shall show no air or water entrapment.

7.3.13 Protective ice suits shall be tested for buoyancy as specified in Section 8.36, Buoyancy Test, and the adjusted buoyancy shall be at least 100 N (22 lb) and the measured buoyancy shall not be reduced by more than 5 percent after 24 hours submersion in fresh water.

7.3.14 All protective ice suit metal hardware and hardware that includes metal parts shall be tested for corrosion resistance as specified in Section 8.16, Corrosion Resistance Test, and shall not have metals that are inherently resistant to corrosion show more than light surface-type corrosion or oxidation, shall not have ferrous metals show corrosion of the base metal, and shall have all hardware items remain functional.

7.3.15 All protective ice suit product labels shall be tested for legibility as specified in Section 8.17, Label Durability and Legibility Test, and shall not be torn, shall remain in place, and shall be legible to the unaided eye.

7.3.16 Protective ice suit zippers shall be tested for point breaking strength as specified in Section 8.40, Zipper Point Breaking Strength Test, and shall have a minimum strength of 440 N (90 lbf).

7.3.17 Protective ice suit zippers shall be tested for resistance to leakage as specified in Section 8.41, Zipper Leak Resistance Test, and shall not allow any water ingress.

7.3.18 Protective ice suit zippers shall be tested for operability as specified in Section 8.33, Opening and Closing of Zippers Test, and shall have a minimum force of 67 N (15 lbf).

7.3.19 Protective ice suit zippers shall be tested for opening and closing force as specified in Section 8.37, Zipper Opening and Closing Force Test and shall have a minimum strength as defined in Table 7.2.18.

7.3.20 Protective dry suit zippers shall be tested for strength as specified in Section 8.31, Zipper Strength Test, and shall have a minimum strength of 222 N (50 lbf).

7.3.21 Protective ice suit zippers shall be tested for strength as specified in Section 8.32, Resistance to Twist of Pull and Slider Test, and shall have a minimum force of 0.79 N-m (7 lbf-in.).

7.4 Surface Water Operations Protective Helmet Performance Requirements.

7.4.1 Protective helmets shall be tested for bucketing as specified in Section 8.18, Helmet Bucketing Test, and shall not produce a force greater than 55 N (12.4 lbf).

7.4.2 Protective helmets shall be tested for top impact resistance as specified by Section 8.19, Top Impact Resistance Test (Force), and shall not transmit an average force of more than 3780 N (850 lbf). No individual specimen shall transmit a force of more than 4450 N (1000 lbf).

7.4.3 Protective helmets shall be tested for physical penetration resistance as specified in Section 8.20, Physical Penetration Resistance Test, and shall exhibit no electrical or physical contact between the penetration striker and the headform.

7.4.4 Where a protective helmet includes a suspension system, it shall be tested for suspension system separation as specified in Section 8.21, Suspension System Retention Test, and shall not have the minimum force required to separate any individual attachment point of the suspension assembly from the helmet be less than 22 N (5 lbf).

7.4.5 Protective helmets shall be tested for retention system and chin strap efficiency as specified in Section 8.22, Retention System Test, and the retention system shall not break or show any slip or stretch greater than 20 mm (13⁄16 in.).

7.4.6 All protective helmet metal hardware and hardware that includes metal parts shall be tested for corrosion resistance as specified in Section 8.16, Corrosion Resistance Test, and shall not have metals that are inherently resistant to corrosion show more than light surface-type corrosion or oxidation, shall not have ferrous metals show corrosion of the base metal, and shall have all hardware items remain functional.

7.4.7 Where helmet visibility markings are specified, the visibility markings shall be tested for retroreflectivity as specified in Section 8.15, Retroreflectivity Test, and shall have a total coefficient of retroreflection (R_a) of not less than 100 cd/lux/m^2 (cd/fc/ft^2), and shall be designated as fluorescent.

7.4.8 Specimens of all protective helmet product labels shall be tested for legibility as specified in Section 8.17, Label Durability and Legibility Test, and shall not be torn, shall remain in place, and shall be legible to the unaided eye.

7.4.9 Protective helmets shall be tested for floatability as specified in Section 8.39, Floatability Test, and shall float.

7.4.10 Protective helmets shall be tested for impact acceleration as specified in Section 8.38, Impact Resistance Test — Acceleration, and shall not transmit a force of more than 200 Gn (1961 m/s^2, 6435 ft/s^2).

7.4.11 Protective helmets shall be tested for stability as specified in Section 8.6, Helmet Roll Off Test, and the retention system shall remain intact and the helmet shall not rotate more than 20 mm from its original position.

7.4.12 Protective helmets shall be tested for water absorption as specified in Section 8.9, Helmet Water Absorption Test, and shall not weigh more than 110 percent of the original dry weight.

7.5 Surface Water Operations Protective Wet Suit Glove Performance Requirements.

7.5.1 Protective wet suit glove palm composite materials and palmside finger composite materials shall be tested for resistance to cut as specified in Section 8.24, Cut Resistance Test, and shall have a distance of blade travel not less than 20 mm (¾ in.).

7.5.2 Protective wet suit glove palm composite materials and palmside finger composite materials shall be tested for puncture resistance as specified in Section 8.25, Puncture Resistance Test, and shall not puncture under an applied force of 12 N (2.7 lbf).

7.5.3 Protective wet suit glove palm composite materials, palmside finger composite materials, and back-of-hand composite materials shall be tested for abrasion resistance as specified in Section 8.26, Abrasion Resistance Test Two, and shall not wear through.

7.5.4 Wet suit protective gloves shall be tested for hand function as specified in Section 8.27, Glove Hand Function Test, and shall not have an average percent of barehand control exceeding 150 percent.

7.5.5 Wet suit protective gloves shall be tested for grip as specified in Section 8.28, Grip Test, and shall have a weight-pulling capacity not less than 120 percent of the barehand control values.

7.5.6 Wet suit protective gloves shall be tested for ease of donning as specified in Section 8.29, Glove Donning Test, and shall have a final donning time less than 20.0 seconds, shall have no detachment of the glove liner, and shall allow full insertion of all digits.

7.5.7 All wet suit protective glove metal hardware and hardware that includes metal parts shall be tested for corrosion resistance as specified in Section 8.16, Corrosion Resistance Test, and shall not have metals that are inherently resistant to corrosion show more than light surface-type corrosion or oxidation, shall not have ferrous metals show corrosion of the base metal, and shall have all hardware items remain functional.

7.5.8 Wet suit protective glove product labels shall be tested for legibility as specified in Section 8.17, Label Durability and Legibility Test, and shall not be torn, shall remain in place, and shall be legible to the unaided eye.

7.5.9* Wet suit protective glove materials shall be tested for thermal insulation as specified in Section 8.5, Thermal Insulation Test, and shall have a clo value of at least 1.

7.6 Surface Water Operations Protective Dry Suit Glove Performance Requirements.

7.6.1 Protective dry suit glove palm composite materials and palmside finger composite materials shall be tested for resistance to cut as specified in Section 8.24, Cut Resistance Test, and shall have a distance of blade travel not less than 20 mm (¾ in.).

7.6.2 Protective dry suit glove palm composite materials and palmside finger composite materials shall be tested for puncture resistance as specified in Section 8.25, Puncture Resistance Test, and shall not puncture under an applied force of 12 N (2.7 lbf).

7.6.3 Protective dry suit glove palm composite materials, palmside finger composite materials, and back-of-hand composite materials shall be tested for abrasion resistance as specified in Section 8.26, Abrasion Resistance Test Two, and shall not wear through.

7.6.4 Dry suit protective gloves shall be tested for hand function as specified in Section 8.27, Glove Hand Function Test, and shall not have an average percent of barehand control exceeding 150 percent.

7.6.5 Dry suit protective gloves shall be tested for grip as specified in Section 8.28, Grip Test, and shall have a weight-pulling capacity not less than 120 percent of the barehand control values.

7.6.6 Dry suit protective gloves shall be tested for ease of donning as specified in Section 8.29, Glove Donning Test, and shall have a final donning time less than 20 seconds, shall have no detachment of the glove liner, and shall allow full insertion of all digits.

7.6.7 All dry suit protective glove metal hardware and hardware that includes metal parts shall be tested for corrosion resistance as specified in Section 8.16, Corrosion Resistance Test, and shall not have metals that are inherently resistant to corrosion show more than light surface-type corrosion or oxidation, shall not have ferrous metals show corrosion of the base metal, and shall have all hardware items remain functional.

7.6.8 Protective dry suit glove composite materials and seams shall be tested for liquid penetration resistance as specified in Section 8.13, Liquid Penetration Resistance Test, and shall not show any chemical penetration.

7.6.9 Protective dry suit glove composite materials and seams shall be tested for biopenetration resistance as specified in Section 8.14, Viral Penetration Resistance Test, and shall not show any viral penetration.

7.6.10 Dry suit protective gloves shall be tested for overall watertight integrity as specified in Section 8.23, Overall Liquid Integrity Test Two, and shall show no water penetration.

7.6.11 Dry suit protective glove product labels shall be tested for legibility as specified in Section 8.17, Label Durability and Legibility Test, and shall not be torn, shall remain in place, and shall be legible to the unaided eye.

7.6.12* Dry suit protective glove materials shall be tested for thermal insulation as specified in Section 8.5, Thermal Insulation Test, and shall have a clo value of at least 0.5.

7.7 Surface Water Operations Protective Ice Suit Glove Performance Requirements.

7.7.1 Protective ice suit glove palm composite materials and palmside finger composite materials shall be tested for resistance to cut as specified in Section 8.24, Cut Resistance Test, and shall have a distance of blade travel not less than 20 mm (¾ in.).

7.7.2 Protective ice suit glove palm composite materials and palmside finger composite materials shall be tested for puncture resistance as specified in Section 8.25, Puncture Resistance Test, and shall not puncture under an applied force of 12 N (2.7 lbf).

7.7.3 Protective ice suit glove palm composite materials, palmside finger composite materials, and back-of-hand composite materials shall be tested for abrasion resistance as specified in Section 8.26, Abrasion Resistance Test Two, and shall not wear through.

7.7.4 Ice suit protective gloves shall be tested for hand function as specified in Section 8.27, Glove Hand Function Test, and shall not have an average percent of barehand control exceeding 150 percent.

7.7.5 Ice suit protective gloves shall be tested for grip as specified in Section 8.28, Grip Test, and shall have a weight-pulling capacity not less than 120 percent of the barehand control values.

7.7.6 Ice suit protective gloves shall be tested for ease of donning as specified in Section 8.29, Glove Donning Test, and shall have a final donning time less than 20 seconds, shall have no detachment of the glove liner, and shall allow full insertion of all digits.

7.7.7 All ice suit protective glove metal hardware and hardware that includes metal parts shall be tested for corrosion resistance as specified in Section 8.16, Corrosion Resistance Test, and shall not have metals that are inherently resistant to corrosion zinc show more than light surface-type corrosion or oxidation, shall not have ferrous metals show corrosion of the base metal, and shall have all hardware items remain functional.

7.7.8 Protective ice suit glove composite materials and seams shall be tested for liquid penetration resistance as specified in Section 8.13, Liquid Penetration Resistance Test, and shall not show any chemical penetration.

7.7.9 Protective ice suit glove composite materials and seams shall be tested for biopenetration resistance as specified in Section 8.14, Viral Penetration Resistance Test, and shall not show any viral penetration.

7.7.10 Ice suit protective glove product labels shall be tested for legibility as specified in Section 8.17, Label Durability and Legibility Test, and shall not be torn, shall remain in place, and shall be legible to the unaided eye.

7.7.11* Ice suit protective glove materials shall be tested for thermal insulation as specified in Section 8.5, Thermal Insulation Test, and shall have a clo value of at least 2.

7.8 Surface Water Operations Protective Wet Suit and Protective Dry Suit Footwear Performance Requirements.

7.8.1 Wet suit and dry suit protective footwear shall be tested for drainage as specified in Section 8.35, Footwear Drainage Test, and shall retain less than 100 g (0.22 lb) of water.

7.8.2 Wet suit and dry suit protective footwear uppers shall be tested for abrasion resistance as specified in Section 8.26, Abrasion Resistance Test Two, and shall not wear through.

7.8.3 Wet suit and dry suit protective footwear uppers shall be tested for cut resistance as specified in Section 8.24, Cut Resistance Test, and shall have a distance of blade travel not less than 20 mm (¾ in.).

7.8.4 Wet suit and dry suit protective footwear uppers shall be tested for puncture resistance as specified in Section 8.25, Puncture Resistance Test, and shall not puncture under an applied force of 45 N (10 lbf).

7.8.5 Wet suit and dry suit protective footwear soles shall be tested for abrasion resistance as specified in Section 8.26, Abrasion Resistance Test Two, and shall not wear through.

7.8.6 Wet suit and dry suit protective footwear soles shall be tested for penetration (physical) resistance as specified in Section 8.25, Puncture Resistance Test, and shall not have a puncture force of less than 90 N (20 lbf).

7.8.7 Wet suit and dry suit protective footwear soles shall be tested for slip resistance as specified in Section 8.30, Slip Resistance Test, and shall have a static coefficient friction of 0.75 or greater under wet conditions.

7.8.8 All wet suit and dry suit protective footwear metal hardware and hardware that includes metal parts shall be tested for corrosion resistance as specified in Section 8.16, Corrosion Resistance Test, and shall not have metals that are inherently resistant to corrosion show more than light surface-type corrosion or oxidation, shall not have ferrous metals show corrosion of the base metal, and shall have all hardware items remain functional.

7.8.9 Wet suit and dry suit protective footwear product labels shall be tested for legibility as specified in Section 8.17, Label Durability and Legibility Test, and shall not be torn, shall remain in place, and shall be legible to the unaided eye.

7.9 Surface Water Operations Protective Ice Suit Footwear Performance Requirements.

7.9.1 Ice suit protective footwear uppers shall be tested for abrasion resistance as specified in Section 8.26, Abrasion Resistance Test Two, and shall not wear through.

7.9.2 Ice suit protective footwear uppers shall be tested for cut resistance as specified in Section 8.24, Cut Resistance Test, and shall have a distance of blade travel not less than 20 mm (¾ in.).

7.9.3 Ice suit protective footwear uppers shall be tested for puncture resistance as specified in Section 8.25, Puncture Resistance Test, and shall not puncture under an applied force of 45 N (10 lbf).

7.9.4 Ice suit protective footwear soles shall be tested for abrasion resistance as specified in Section 8.26, Abrasion Resistance Test Two, and shall not wear through.

7.9.5 Ice suit protective footwear soles shall be tested for penetration (physical) resistance as specified in Section 8.25, Puncture Resistance Test, and shall not have a puncture force of less than 90 N (20 lbf).

7.9.6 Ice suit protective footwear soles shall be tested for slip resistance as specified in Section 8.30, Slip Resistance Test, and shall have a static coefficient friction of 0.75 or greater under wet conditions.

7.9.7 Ice suit protective footwear materials and seams shall be tested for liquid penetration resistance as specified in Section 8.13, Liquid Penetration Resistance Test, and shall show no chemical penetration.

7.9.8 Ice suit protective footwear materials and seams shall be tested for biopenetration resistance as specified in Section 8.14, Viral Penetration Resistance Test, and shall show no viral penetration.

7.9.9 All ice suit protective footwear metal hardware and hardware that includes metal parts shall be tested for corrosion resistance as specified in Section 8.16, Corrosion Resistance Test, and shall not have metals that are inherently resistant to corrosion show more than light surface-type corrosion or oxidation, shall not have ferrous metals show corrosion of the base metal, and shall have all hardware items remain functional.

7.9.10 Ice suit protective footwear product labels shall be tested for legibility as specified in Section 8.17, Label Durability and Legibility Test, and shall not be torn, shall remain in place, and shall be legible to the unaided eye.

7.9.11* Ice suit protective footwear materials shall be tested for thermal insulation as specified in Section 8.5, Thermal Insulation Test, and shall have a clo value of at least 2.

7.10 Surface Water Operations Protective Personal Flotation Device Performance Requirements.

7.10.1 Protective personal flotation devices shall be tested for buoyancy as specified in Section 8.36, Buoyancy Test, and shall have a buoyancy of at least 9.9 kg (22 lb).

7.10.2 Protective personal flotation device product labels shall be tested for legibility as specified in Section 8.17, Label Durability and Legibility Test, and shall not be torn, shall remain in place, and shall be legible to the unaided eye.

7.10.3 Protective personal flotation devices shall be tested for corrosion as specified in Section 8.16, Corrosion Test, and shall not have metals that are inherently resistant to corrosion show more than light surface-type corrosion or oxidation, shall not have ferrous metals show corrosion of the base metal, and shall have all hardware items remain functional.

Chapter 8 Test Methods

8.1 Sample Preparation Procedures.

8.1.1 Application.

8.1.1.1 The sample preparation procedures contained in this section shall apply to each test method in this chapter, as specifically referenced in the sample preparation section of each test method.

8.1.1.2 Only the specific sample preparation procedure or procedures referenced in the sample preparation section of each test method shall be applied to that test method.

8.1.2 Room Temperature Conditioning Procedure for Protective Suits, Protective Suit Materials, Protective Suit Material Seams, Hood Materials, Hood Material Seams, Helmets, Gloves, Glove Material Seams, Footwear, Bootie Materials and Bootie Material Seams, and Personal Flotation Devices.

8.1.2.1 Samples shall be conditioned at a temperature of 21°C, ±3°C (70° F, ±5°F) and a relative humidity of 65 percent, ±5 percent, for at least 24 hours.

8.1.2.2 Samples shall be tested within 5 minutes after removal from conditioning.

8.1.3 Washing and Drying Procedure for Protective Suits, Protective Suit Materials, Protective Suit Material Seams, Bootie Materials, and Bootie Material Seams, Hood Materials, Hood Material Seams, Gloves, and Glove Material Seams.

8.1.3.1 Samples shall be subjected to 10 cycles of washing.

8.1.3.2 A front-loading washer/extractor shall be used.

8.1.3.3 The wash load shall not exceed two-thirds of the rated capacity of the washer.

8.1.3.4 The wash cycle procedure in Table 8.1.3.4 shall be followed.

Table 8.1.3.4 Wash Cycle Procedure

Operation	Time (min)	Temperature ±3°C	Temperature ±5°F	Water Level
Suds using AATCC detergent #1993, 1.0 g/gal water	10	49	120	Low
Drain	1			
Carry-over	5	49	120	Low
Drain	1			
Rinse	2	38	100	High
Drain	1			
Rinse	2	38	100	High
Drain	1			
Rinse	2	38	100	High
Drain	1			
Extract	5			

8.1.3.5 Samples shall be completely dried after the last washing cycle by air drying prior to conducting the test.

8.1.4 Flexural Fatigue Procedure for Protective Suit Materials, Protective Suit Hood Materials, and Bootie Materials.

8.1.4.1 Samples shall be subjected to flexural fatigue in accordance with ASTM F 392, *Standard Test Method for Flex Durability of Flexible Barrier Materials*, with the following modifications:

(1) In lieu of Flexing Conditions A, B, C, D, or E, test specimens shall have a flex period of 100 cycles at 45 cycles per minute. A cycle shall be a full flex and twisting action.
(2) Anisotropic materials shall be tested in both machine and transverse directions.

8.1.4.2 The preconditioning shall be performed according to the sequence specified in the test methods of this chapter.

8.1.5 Abrasion Procedure for Protective Suit Materials, Protective Suit Hood Materials, and Bootie Materials. Samples shall be abraded in accordance with ASTM D 4157, *Standard Test Method for Abrasion Resistance of Textile Fabrics (Oscillatory Cylinder Method)*, under the following conditions:

(1) A 2.3 kg (5 lb) tension weight shall be used.
(2) A 1.6 kg (3½ lb) head weight shall be used.
(3) The abradant shall be silicone carbide, ultrafine, 600 grit.
(4) The specimen shall be abraded for 25 continuous cycles.

8.1.6 Wet Conditioning Procedure for Protective Helmets.

8.1.6.1 Sample helmets shall be conditioned by immersing them in water at a temperature of 20°C to 28°C (68°F to 82°F) for at least 4 hours, but not more than 24 hours.

8.1.6.2 The helmet shall be tested within 10 minutes after removal from water.

8.1.7 Wet Conditioning Procedure for Protective Gloves.

8.1.7.1 Samples shall be conditioned by complete immersion in water at a temperature of 21°C, ±3°C (70°F, ±5°F) for 2 minutes.

8.1.7.2 Samples shall be removed from water, hung in a vertical position for 5 minutes, laid horizontal with AATCC blotting paper both under and over the sample, under a weight of 3.5 kPa, ±0.35 kPa (0.50 psi, ±0.05 psi) for a period of 20 minutes. The AATCC blotting paper shall be in accordance with paragraph 5.4 of AATCC 70, *Test Method for Water Repellency: Tumble Jar Dynamic Absorption Test.*

8.2 Air Retention Test.

8.2.1 Application. This test method shall apply to complete protective dry suits and complete protective ice suits.

8.2.2 Samples.

8.2.2.1 Samples shall be complete protective suits assembled with all layers that are required for the suit to be compliant.

8.2.2.2 Samples shall be conditioned as specified in 8.1.2.

8.2.3 Specimens. A minimum of three specimens shall be tested.

8.2.4 Procedure. Air retention performance testing shall be performed in accordance with UL 1197, *Standard of Safety for Immersion Suits, Air Retention Test*, with the following modifications:

(1) The suit shall be pressurized to 2 psi (13.8 kPa).
(2) The suit shall be totally immersed in water and inspected for leaks.

8.2.5 Report. Any air leakage for each specimen shall be recorded and reported.

8.2.6 Interpretation. Pass or fail determination shall be based on evidence of air leakage.

8.3 Overall Liquid Integrity Test One.

8.3.1 Application. This test method shall apply to complete protective dry suits and complete protective ice suits.

8.3.2 Samples.

8.3.2.1 Samples shall be complete protective ice suits assembled with all layers that are required for the suit to be compliant.

8.3.2.2 Samples shall be preconditioned as specified in 8.1.3 followed by 8.1.2.

8.3.3 Specimens.

8.3.3.1 A minimum of three specimens shall be tested.

8.3.3.2 The size of the ice suits comprising the specimens shall be chosen to conform with the dimensions of the mannequin for proper fit of the specimen on the mannequin in accordance with the manufacturer's sizing system.

8.3.3.3 The size of the ice suits comprising the specimens shall be the same size as the mannequin in terms of chest circumference, waist circumference, and inseam height.

8.3.4 Apparatus. The apparatus and supplies for testing shall be those specified in ASTM F 1359, *Standard Practice for Determining Liquid-Tight Integrity of Chemical Protective Suits or Ensembles under Static Conditions,* with the following modifications:

(1) The surface tension of the water used in testing shall be 34 dynes/cm, ±5 dynes/cm.
(2) The mannequin used in testing shall have straight arms and legs, with the arms positioned at the mannequin's side.

8.3.5 Procedure. Liquidtight integrity testing of suits shall be conducted in accordance with ASTM F 1359, *Standard Practice for Determining Liquid-Tight Integrity of Chemical Protective Suits or Ensembles under Static Conditions,* with the following modifications:

(1) The method used for mounting of the mannequin in the spray chamber shall not interfere with the water spray.
(2) The suited mannequin shall be exposed to the liquid spray for a total of 20 minutes — 5 minutes in each of the four specified mannequin orientations.
(3) At the end of the liquid spray exposure period, excess liquid shall be removed from the surface of the specimen.
(4) The specimen shall be inspected within 5 minutes of the end of the liquid spray exposure period for evidence of liquid penetration.

8.3.6 Report. A diagram shall be prepared for each test that identified the locations of any liquid leakage as detected on the liquid-absorptive suit.

8.3.7 Interpretation. Any evidence of liquid on the liquid-absorptive suit as determined by visual, tactile, or absorbent toweling, shall constitute failure of the specimen.

8.4 Overall Donning Efficiency Test.

8.4.1 Application. This test method shall apply to complete protective wet suits, complete protective dry suits, and complete protective ice suits.

8.4.2 Samples.

8.4.2.1 Samples shall be complete protective suits assembled with all layers that are required for the suit to be compliant.

8.4.2.2 Samples shall be conditioned as specified in 8.1.3 followed by 8.1.2.

8.4.3 Specimens.

8.4.3.1 A minimum of three specimens shall be tested.

8.4.3.2 The size of the suits comprising the specimens shall be chosen for proper fit of the specimen on the test subject in accordance with the manufacturer's sizing system.

8.4.3.3 The size of the suits comprising the specimens shall be the same size as the test subject in terms of chest circumference, waist circumference, and inseam height.

8.4.4 Procedure.

8.4.4.1 A different test subject shall be used for evaluating the donning efficiency of each specimen.

8.4.4.2 The test subject will be provided instructions in the proper donning of the suit and shall practice donning and doffing the suit prior to testing.

8.4.4.3 To begin the test, the test subject shall be standing with the suit draped over a chair next to the test subject.

8.4.4.4 A timer shall be started when the test subject is instructed to begin donning the suit.

8.4.4.5 The timer shall be stopped when the test subject has completely donned the suit, ensuring that all closures are secured.

8.4.5 Report. The donning time for each test subject shall be reported.

8.4.6 Interpretation. Any donning time greater than 3.0 minutes shall constitute failure of the specimen.

8.5 Thermal Insulation Test.

8.5.1 Application. This test method shall apply to protective wet suit materials and wet suit glove materials; protective dry suit materials, dry suit hood materials, dry suit glove materials, and dry suit bootie materials; and protective ice suit materials, ice suit hood materials, ice suit glove materials, and ice suit footwear materials.

8.5.2 Samples.

8.5.2.1 Samples shall be at least a 1 m (1 yd) square of each material.

8.5.2.2 Samples shall be preconditioned as specified in 8.1.2.

8.5.3 Specimens.

8.5.3.1 A minimum of three specimens shall be tested.

8.5.3.2 Specimens shall consist of all layers used in the construction of the suit, excluding any areas of reinforcement, arranged in the order and orientation as worn.

8.5.4 Apparatus. The test apparatus shall be as specified in ASTM F 1868, *Standard Test Method for Thermal and Evaporative Resistance of Clothing Materials Using a Sweating Hot Plate.*

8.5.5 Procedure. Testing shall be conducted in accordance with ASTM F 1868, *Standard Test Method for Thermal and Evaporative Resistance of Clothing Materials Using a Sweating Hot Place,* using Part D.

8.5.6 Report. The average intrinsic thermal resistance (R_{cf}) of the sample shall be recorded and reported.

8.5.7 Interpretation. Pass or fail determination shall be based on the average reported intrinsic thermal resistance measurement of all specimens tested.

8.6 Helmet Roll Off Test.

8.6.1 Application. This test shall be applied to complete helmets.

8.6.2 Samples. Samples shall be complete helmets.

8.6.3 Specimens.

8.6.3.1 A minimum of three specimens shall be tested.

8.6.3.2 Specimens shall be conditioned as specified in 8.1.2, and 8.1.6 prior to each test.

8.6.4 Procedure.

8.6.4.1 Specimens shall be tested as specified in Section 12.7.2, Roll Off Test, of ASTM F 1446, *Standard Test Methods for Equipment and Procedures Used in Evaluating the Performance Characteristics of Protective Headgear.*

8.6.4.2 A drop weight of 4 kg (8.8 lb), and a drop height of 0.6 m (24 in.) shall be used.

8.6.5 Report.

8.6.5.1 The rotation of the helmet from the original position shall be measured, recorded, and reported for each helmet.

8.6.5.2 Damage to the retention system resulting in the retention system not remaining intact shall be recorded and reported.

8.6.6 Interpretation.

8.6.6.1 Pass or fail performance shall be determined for each specimen.

8.6.6.2 One or more helmet specimens failing this test shall constitute failing performance.

8.7 Breaking Strength Test.

8.7.1 Application.

8.7.1.1 This test method shall apply to protective wet suit materials; protective dry suit materials, dry suit hood materials, and dry suit bootie materials; and protective ice suit materials and ice suit hood materials.

8.7.1.2 Where the suit or hood is constructed of several separable layers, then all layers shall be individually tested.

8.7.2 Samples.

8.7.2.1 Samples shall be at least 1 m (1 yd) square of material.

8.7.2.2 Samples shall be conditioned as specified in 8.1.2.

8.7.3 Specimens.

8.7.3.1 Specimens shall be the size specified in ASTM D 5034, *Standard Test Method for Breaking Force and Elongation of Textile Fabrics (Grab Method)*.

8.7.3.2 A minimum of five specimens in each of the warp direction, machine or course, and the filling direction, cross machine or wales, shall be tested.

8.7.3.3 Where the material is isotropic, 10 specimens shall be tested.

8.7.4 Procedure. Specimens shall be tested for breaking strength in accordance with ASTM D 5034, *Standard Method for Breaking Force and Elongation of Textile Fabrics (Grab Test)*.

8.7.5 Report.

8.7.5.1 The breaking strength of each specimen shall be recorded and reported to the nearest 0.2 N (0.1 lb) of force.

8.7.5.2 An average breaking strength shall be individually calculated, recorded, and reported for the warp and filling directions.

8.7.5.3 For isotropic materials, a single average breaking strength shall be calculated, recorded, and reported.

8.7.6 Interpretation.

8.7.6.1 Pass or fail performance shall be based on the average breaking strength in the warp and filling directions.

8.7.6.2 Failure in any one direction shall constitute failure for the material.

8.8 Puncture Propagation Tear Resistance Test.

8.8.1 Application. This test method shall apply to protective wet suit materials; protective dry suit materials, dry suit hood materials, and dry suit bootie materials; and protective ice suit materials and ice suit hood materials.

8.8.2 Samples.

8.8.2.1 Samples shall be at least 0.5 m (0.5 yd) squares of material.

8.8.2.2 Samples shall be conditioned as specified in 8.1.3 followed by the conditioning specified in 8.1.2.

8.8.3 Specimens.

8.8.3.1 Specimens shall be the size specified in ASTM D 2582, *Standard Test Method for Puncture-Propagation Tear Resistance of Plastic Film and Thin Sheeting*.

8.8.3.2 A minimum of five specimens in each of the warp direction, machine or course, and the filling direction, cross machine or wales, shall be tested.

8.8.3.3 Where the material is isotropic, 10 specimens shall be tested.

8.8.4 Procedure. Specimens shall be tested in accordance with ASTM D 2582, *Standard Test Method for Puncture-Propagation Tear Resistance of Plastic Film and Thin Sheeting*.

8.8.5 Report.

8.8.5.1 The puncture propagation tear resistance for each specimen shall be recorded and reported to the nearest 1 N (0.1 lb) of force.

8.8.5.2 An average puncture propagation tear resistance shall be calculated for warp and filling directions. The average puncture propagation tear resistance calculations shall be recorded and reported.

8.8.6 Interpretation.

8.8.6.1 Pass or fail performance shall be based on the average puncture propagation tear resistance in the warp and filling directions.

8.8.6.2 Failure in any one direction constitutes failure for the material.

8.9 Helmet Water Absorption Test.

8.9.1 Application. This test shall apply to complete helmets.

8.9.2 Specimens. Specimens shall be complete helmets.

8.9.3 Procedure.

8.9.3.1 A minimum of three specimens shall be tested.

8.9.3.2 Specimens shall be weighed to the nearest gram.

8.9.3.3 Specimens shall be completely immersed in a sufficiently sized vessel of fresh water at a temperature of 21°C, ±3°C (70°F, ±5°F) for a period of 24 hours, +1/-0 hour.

8.9.3.4 Specimens shall be removed from the water and allowed to drain for 5 minutes, +1/-0 minutes.

8.9.3.5 Specimens shall be weighed to the nearest gram.

8.9.3.6 The percent difference in weight shall be determined using the following equation:

$$\% \text{ Difference} = \frac{W - D}{W} \times 100$$

where:
W = wet weight in grams
D = dry weight in grams

8.9.4 Report. The dry weight, wet weight, and percent difference shall be calculated, recorded, and reported for each specimen.

8.9.5 Interpretation.

8.9.5.1 Pass or fail performance shall be determined for each specimen.

8.9.5.2 Any individual specimen failing this test shall constitute failing performance.

8.10 Cleaning Shrinkage Resistance Test.

8.10.1 Application. This test method shall apply to dry suit materials.

8.10.2 Samples. Samples shall be conditioned as specified in 8.1.2.

8.10.3 Specimens. Cleaning shrinkage resistance testing shall be conducted on three specimens of each material, and each material shall be tested separately.

8.10.4 Procedure.

8.10.4.1 Specimens shall be tested using five cycles of Machine Cycle 3, Wash Temperature II, and Drying Procedure Aiii, of AATCC 135, *Dimensional Changes in Automatic Home Laundering of Woven and Knit Fabrics*.

8.10.4.2 A 1.8 kg, ±0.1 kg (4.0 lb, ±0.2 lb) load shall be used. A laundry bag shall not be used.

8.10.4.3 Specimen marking and measurements shall be conducted in accordance with the procedure specified in AATCC 135, *Dimensional Changes in Automatic Home Laundering of Woven and Knit Fabrics*.

8.10.5 Report.

8.10.5.1 The percent change in the width and length dimensions of each specimen shall be calculated and reported.

8.10.5.2 Results shall be reported as the average of all three specimens in each direction.

8.10.6 Interpretation.

8.10.6.1 The average percent change in both directions shall be used to determine pass or fail performance.

8.10.6.2 Failure in any one dimension constitutes failure for the entire sample.

8.11 Seam Breaking Strength Test.

8.11.1 Application. This test method shall apply to protective wet suit seam assemblies; protective dry suit seam assemblies, dry suit hood seam assemblies, and dry suit bootie seam assemblies; and protective ice suit seam assemblies and ice suit hood seam assemblies.

8.11.2 Samples.

8.11.2.1 Samples shall be full suits or 305 mm (12 in.) or greater lengths of seam with at least 150 mm (6 in.) of material on either side of the seam centerline.

8.11.2.2 Samples shall be conditioned as specified in 8.1.2.

8.11.3 Specimens.

8.11.3.1 Specimens shall be cut from the finished suit or shall be permitted to be prepared by the joining of two pieces of the suit fabric using the same thread, seam type, and stitch type as used in the finished garment.

8.11.3.2 Specimens shall be the size specified in ASTM D 751, *Standard Method of Testing Coated Fabrics*.

8.11.3.3 At least five seam specimens shall be tested for each seam type.

8.11.4 Procedure. All seam assemblies shall be tested in accordance with ASTM D 751, *Standard Method of Testing Coated Fabrics*. The test machine shall be operated at a rate of 305 mm/min (12 in./min).

8.11.5 Report.

8.11.5.1 The seam breaking strength for each seam specimen shall be recorded and reported.

8.11.5.2 The average seam breaking strength for each seam type shall also be calculated, recorded, and reported.

8.11.5.3 The type of seams tested shall be reported as to whether the specimens were cut from the finished suit or prepared from fabric samples.

8.11.6 Interpretation. The average seam breaking strength for each seam type shall be used to determine pass or fail performance.

8.12 Liquid Absorption Resistance Test.

8.12.1 Application. This test method shall apply to protective dry suit materials and dry suit hood materials; and also protective ice suit materials, ice suit hood materials and seams, and ice suit glove materials.

8.12.2 Samples.

8.12.2.1 Samples shall be at least 1 m (1 yd) square of each material.

8.12.2.2 Samples shall be conditioned as specified in 8.1.3.

8.12.3 Specimens.

8.12.3.1 Specimens shall be 200 mm × 200 mm (8 in. × 8 in.).

8.12.3.2 A minimum of three specimens shall be tested.

8.12.4 Apparatus. The test apparatus shall be as specified in AATCC 42, *Water Resistance: Impact Penetration Test*, with the following modifications:

(1) A metal roller 113 mm, ±6 mm (4.5 in., ±¼ in.) long and weighing 1 kg (2.25 lb) shall be used.
(2) Embroidery hoops, measuring 150 mm to 180 mm (6 in. to 7 in.) in diameter shall be used for mounting the specimen.
(3) The liquid for testing shall be water treated to a surface tension of 35 dynes/cm, ±2 dynes/cm.

8.12.5 Procedure.

8.12.5.1 The conditioned specimen shall be securely mounted in the metal embroidery hoops with sufficient tension to ensure a uniformly smooth surface.

8.12.5.2 The direction of the flow of water down the specimen shall coincide with the warpwise direction of the specimen as placed on the stand.

8.12.5.3 The mounted specimen shall be placed on the block with the center of the specimen directly beneath the center of the nozzle and the plane of the surface of the specimen at a 45 degree angle with the horizontal.

8.12.5.4 A 500 ml volume of the test liquid at a temperature of 27°C, ±1°C (80°F, ±2°F) shall be poured quickly into the funnel and allowed to spray onto the specimen.

8.12.5.5 The following operations shall then be executed as rapidly as possible:

(1) The specimen shall be removed from the hoops and placed between sheets of blotting paper on a flat horizontal surface.
(2) The metal roller shall be rolled quickly forward and back one time over the paper without application of any pressure other than the weight of the roller.
(3) A square 100 mm × 100 mm (4 in. × 4 in.) shall be cut out of the center of the wet portion of the specimen and weighed to the nearest 0.05 g. This weight shall be designated the "wet weight." Not more than 30 seconds shall elapse between the time the water has ceased flowing through the spray nozzle and the start of the weighing.
(4) The same 100 mm (4 in.) square shall be conditioned as specified in 8.1.2 until it has dried and reached moisture equilibrium with the surrounding standard atmosphere for textiles.
(5) Following this conditioning it shall be reweighed.
(6) This weight shall be designated the "dry weight."

8.12.5.6 The percent liquid absorption shall be calculated using the following equation:

$$\% \text{ liquid absorption} = \frac{W - D}{D} \times 100$$

where:
W = wet weight in grams
D = dry weight in grams

8.12.6 Report.

8.12.6.1 The percent liquid absorption for each specimen shall be recorded and reported.

8.12.6.2 The average percent liquid absorption for all tested specimens shall be calculated, recorded, and reported.

8.12.7 Interpretation. The average percent liquid absorption shall be used to determine pass or fail performance.

8.13 Liquid Penetration Resistance Test.

8.13.1 Application.

8.13.1.1 This test method shall apply to protective dry suit materials and seams, dry suit hood materials and seams, dry suit glove materials and seams, and dry suit bootie materials and seams; and protective ice suit materials and seams, ice suit hood materials and seams, ice suit glove materials and seams, and ice suit footwear materials and seams.

8.13.1.2 Modifications to this test method for testing protective suit materials and suit hood materials and protective bootie materials and bootie material seams shall be as specified in 8.13.7.

8.13.1.3 Modifications to this test method for testing protective suit and suit hood seams and protective bootie materials and bootie material seams shall be as specified in 8.13.8.

8.13.1.4 Modifications to this test method for testing protective glove materials shall be as specified in 8.13.9.

8.13.1.5 Modifications to this test method for testing protective footwear materials shall be as specified in 8.13.10.

8.13.2 Samples.

8.13.2.1 Samples shall be the chemical protection layer of the size specified in the modifications.

8.13.2.2 Samples shall be conditioned as specified in 8.1.2 after the conditioning specified in the modifications.

8.13.3 Specimens.

8.13.3.1 Specimens shall be the size specified in ASTM F 903, *Standard Test Method for Resistance of Protective Clothing Materials to Penetration by Liquids.*

8.13.3.2 A minimum of three specimens per liquid shall be tested for each material type.

8.13.3.3 Where the same materials are used as the barrier layer throughout the product, testing of seams only in lieu of testing both material and seams shall be permitted.

8.13.4 Procedure.

8.13.4.1 Liquid penetration resistance testing shall be conducted in accordance with ASTM F 903, *Standard Test Method for Resistance of Protective Clothing Materials to Penetration by Liquids,* using exposure procedure C, with the following modifications:

(1) All tests shall be conducted at 25°C, ±3°C (77°F, ±5°F) and 65 percent, ±5 percent relative humidity.
(2) The plexiglass shield shall be omitted from the test cell.
(3) Use of blotting paper at the end of the test shall be permitted to assist in the visual observation of liquid penetration.
(4) An observation to determine specimen penetration shall be made at the end of the chemical contact period.

8.13.4.2 Each of the following liquids shall be tested separately against each specimen:

(1) Fire-resistant hydraulic fluid, phosphate ester-based
(2) Surrogate gasoline fuel C as defined in ASTM D 471, *Standard Test Method for Rubber Property — Effect of Liquids,* a 50/50 percent volume of toluene and isooctane
(3) Swimming pool chlorinating chemical containing at least 65 percent free chlorine (saturated solution)
(4) Diesel fuel

8.13.4.3 The normal outer surface of the material shall be exposed to the liquid as oriented in the clothing item.

8.13.5 Report.

8.13.5.1 The pass or fail result for each specimen shall be recorded and reported.

8.13.5.2 Where applicable, identification of the location where penetration occurs, if discernible, shall be recorded and reported.

8.13.6 Interpretation.

8.13.6.1 Visually observed chemical on the blotting paper shall constitute failure of this test.

8.13.6.2 One or more failures of any specimen against any liquid shall constitute failure of the material.

8.13.7 Specific Requirements for Testing Protective Suits, Suit Hood Materials, and Booties.

8.13.7.1 Samples shall be 200 mm × 280 mm (8 in. × 11 in.) rectangles and shall consist of all layers as configured in the dry suit, ice suit, dry suit bootie, dry suit hood, and ice suit hood.

8.13.7.2 Samples shall first be conditioned by flexing as specified in 8.1.5.

8.13.7.3 Following abrasion, one specimen for penetration resistance testing shall be taken from each sample subjected to abrasion.

8.13.7.4 The penetration test specimen shall be taken from the exact center of the abraded sample so that the center of the penetration test and the center of the abraded sample coincide.

8.13.7.5 Where suit materials, suit hood materials, or bootie materials are the same, only one material shall be tested.

8.13.8 Specific Requirements for Testing Protective Suit Seams, Bootie Seams, and Hood Seams.

8.13.8.1 Protective dry suit seams, dry suit hood seams, dry suit bootie seams, protective ice suit seams, and ice suit hood seams shall consist of seams from the separable layer that is intended to prevent the penetration of liquids.

8.13.8.2 A minimum of three 75 mm (3 in.) squares for each material type shall be tested.

8.13.8.3 Where suit materials and seams, bootie materials and seams, or suit hood materials and seams are the same, only one seam-material configuration shall be tested.

8.13.9 Specific Requirements for Testing Glove Materials.

8.13.9.1 Specimens shall be taken from dry suit and ice suit glove specimens at the palm, back, and seam areas.

8.13.9.2 Only the separable layer of the specimen that is intended to prevent the penetration of liquids shall be tested.

8.13.9.3 Where the layer used for the prevention of liquid penetration is the same in palm and back areas, testing of the seams only shall be permitted.

8.13.9.4 A minimum of three 75 mm (3 in.) squares for each material type shall be tested.

8.13.10 Specific Requirements for Testing Footwear Materials.

8.13.10.1 Specimens shall be taken from the footwear upper and any upper seam areas. The footwear upper shall include the toe, vamp, quarter, shaft, collar, and throat, but shall not include the sole.

8.13.10.2 Only that separable layer of the footwear item intended to prevent the penetration of liquids shall be tested.

8.13.10.3 Where the layer used for the prevention of liquid penetration is the same throughout the footwear item, testing of the seams only shall be permitted.

8.13.10.4 A minimum of three 75 mm (3 in.) squares for each material type shall be tested.

8.14 Viral Penetration Resistance Test.

8.14.1 Application.

8.14.1.1 This test method shall apply to protective dry suit materials and seams, dry suit hood materials and seams, dry suit glove materials and seams, and dry suit bootie materials and seams, and also to protective ice suit materials and seams, ice suit hood materials and seams, ice suit glove materials and seams, and ice suit footwear materials and seams.

8.14.1.2 Modifications to this test method for testing suit and suit hood materials and booties shall be as specified in 8.14.7.

8.14.1.3 Modifications to this test method for testing suits, suit hood materials, and bootie seams shall be as specified in 8.14.8.

8.14.1.4 Modifications to this test method for testing glove materials shall be as specified in 8.14.9.

8.14.1.5 Modifications to this test method for testing footwear materials shall be as specified in 8.14.10.

8.14.2 Samples.

8.14.2.1 Samples shall be the chemical protection layer of the size specified in the modifications.

8.14.2.2 Samples shall be conditioned as specified in 8.1.2 after the conditioning specified in the modifications.

8.14.3 Specimens.

8.14.3.1 A minimum of three specimens shall be tested.

8.14.3.2 Specimens shall consist of three 75 mm (3 in.) squares for each material type unless otherwise specified.

8.14.4 Procedure.

8.14.4.1 Biopenetration resistance testing shall be conducted in accordance with ASTM F 1671, *Standard Test Method for Resistance of Materials Used in Protective Clothing to Penetration by Blood-Borne Pathogens Using Phi-X174 Bacteriophage as a Test System.*

8.14.4.2 The normal outer surface of the material as oriented in the clothing item shall be exposed to the liquid.

8.14.5 Report. The pass or fail result for each specimen shall be recorded and reported.

8.14.6 Interpretation. One or more failures of any specimen against any liquid shall constitute failure of the material.

8.14.7 Specific Requirements for Testing Suits, Suit Hood Materials, and Booties.

8.14.7.1 Samples shall be 200 mm × 280 mm (8 in. × 11 in.) rectangles and shall consist of all layers as configured in the suit, suit hood, or bootie.

8.14.7.2 Two samples shall first be conditioned by flexing as specified in 8.1.4.

8.14.7.3 One sample shall be flexed with the longitudinal axis parallel to the machine direction of the material, and the second sample shall be flexed with the longitudinal axis parallel to the cross machine direction of the material.

8.14.7.4 Following flexing, two samples for abrasion conditioning, each measuring 45 mm × 230 mm (1¾ in. × 9 in.), shall be cut from the center of the flexed samples.

8.14.7.5 At least one specimen for abrasion conditioning shall be taken from a sample flexed in the machine direction, and at least one specimen for abrasion conditioning shall be taken from a sample flexed in the cross machine direction for each chemical tested.

8.14.7.6 These new samples shall then be conditioned by abrading as specified in 8.1.5.

8.14.7.7 Following abrasion, only one specimen for penetration resistance testing shall be taken from each sample subjected to abrasion.

8.14.7.8 The penetration test specimen shall be taken from the exact center of the abraded sample so that the center of the penetration test specimen and the center of the abraded sample coincide.

8.14.7.9 Where suit materials, suit hood materials, or bootie materials are the same, only one material shall be tested.

8.14.8 Specific Requirements for Testing Suit, Suit Hood, and Bootie Seams.

8.14.8.1 Protective dry suit seams, dry suit hood seams, and dry suit bootie seams, as well as protective ice suit seams and ice suit hood seams shall consist of seams from the separable layer that is intended to prevent the penetration of liquids.

8.14.8.2 A minimum of three 75 mm (3 in.) squares for each material type shall be tested.

8.14.8.3 Where suit materials and seams, bootie materials and seams, or suit hood materials and seams are the same, only one seam-material configuration shall be tested.

8.14.9 Specific Requirements for Testing Glove Materials.

8.14.9.1 Specimens shall be taken from sample gloves at the palm, back, and seam areas.

8.14.9.2 Only that separable layer of the glove that is intended to prevent the penetration of liquids shall be tested.

8.14.9.3 Where the layer used for the prevention of liquid penetration is the same in palm and back areas, testing of the seams only shall be permitted.

8.14.9.4 A minimum of three 75 mm (3 in.) squares for each material type shall be tested.

8.14.10 Specific Requirements for Testing Footwear Materials.

8.14.10.1 Specimens shall be taken from the footwear upper and any upper seam areas. The footwear upper shall include the toe, vamp, quarter, shaft, collar, and throat, but shall not include the sole.

8.14.10.2 Only that separable layer of the footwear item intended to prevent the penetration of liquids shall be tested.

8.14.10.3 Where the layer used for the prevention of liquid penetration is the same throughout the footwear item, testing of the seams only shall be permitted.

8.14.10.4 A minimum of three 75 mm (3 in.) squares for each material type shall be tested.

8.15 Retroreflectivity Test.

8.15.1 Application.

8.15.1.1 This test method shall apply to visibility markings used on suits, PFDs, and helmets.

8.15.1.2 Visibility markings shall be tested for each procedure specified in 8.15.4.

8.15.2 Samples.

8.15.2.1 Samples for the conditioning shall include 305 mm (12 in.) long sections of visibility markings.

8.15.2.2 Samples shall be conditioned as specified in 8.1.2.

8.15.3 Specimens.

8.15.3.1 A minimum of three of each visibility marking specimens shall be tested.

8.15.3.2 Each visibility marking test specimen shall be 100 mm × 100 mm (4 in. × 4 in.) of the finished visibility marking product.

8.15.3.3 Where retroreflective and nonretroreflective surface areas are combined to form visibility markings, the specimen shall consist of the retroreflective and nonretroreflective portions of the finished visibility marking product.

8.15.4 Procedures for Measurement of Coefficient of Retroreflection.

8.15.4.1 The coefficient of retroreflection *(R_a)* shall be measured in accordance with ASTM E 810, *Standard Test Method for Coefficient of Retroreflection of Retroreflective Sheeting Utilizing the Coplanar Geometry*, with the following modifications:

(1) Test distance = 15.2 m (50 ft).
(2) Observation angle = 0.2 degree.
(3) Entrance angle = +5.0 degrees.
(4) The receiver shall be provided with an entrance aperture of 25 mm (1 in.), ±5 percent, in diameter, which is equivalent to 0.1 degree angular aperture.
(5) The exit aperture of the source shall be circular and 26 mm (1 in.), ±5 percent, in diameter, which corresponds to 0.1 degree angular aperture.
(6) Retroreflector reference angle = 90 degrees.
(7) Datum mark shall be placed as specified by the visibility markings manufacturer.

8.15.4.2 The R_a shall be calculated by the following equation:

$$R_a = \frac{R_l}{A_r}$$

where:
R_l = the coefficient of luminous intensity measured as specified in 8.15.4.1
A_r = only the retroreflective surface area of the visibility marking test specimen's surface area

8.15.4.3 A_r shall be calculated by subtracting the nonretroreflective surface area from the test specimen's total surface area.

8.16 Corrosion Resistance Test.

8.16.1 Application.

8.16.1.1 This test method shall apply to hardware items on suits, helmets, gloves, footwear, and personal flotation devices.

8.16.1.2 Modifications to this test method for testing suit, glove, footwear, and personal flotation device hardware shall be as specified in 8.16.7.

8.16.1.3 Modifications to this test method for testing helmet hardware shall be as specified in 8.16.8.

8.16.2 Samples. Samples shall be conditioned as specified in 8.1.2.

8.16.3 Specimens. A total of three specimens of each hardware type shall be tested.

8.16.4 Procedure.

8.16.4.1 Specimens shall be tested in accordance with ASTM B 117, *Standard Practice of Using Salt Spray (Fog) Apparatus*. Hardware items shall be exposed to a 5 percent, ±1 percent, saline solution for a period of 20 hours.

8.16.4.2 Immediately following the storage specified in 8.16.4.1 and prior to examination, specimens shall be rinsed under warm, running tap water and dried with compressed air.

8.16.4.3 Specimens shall then be examined visually with the unaided eye to determine the presence of corrosion.

8.16.4.4 The functionality of each specimen shall be evaluated.

8.16.5 Report. The presence of corrosion and the functionality of each specimen shall be recorded and reported.

8.16.6 Interpretation. One or more hardware specimens failing this test shall constitute failing performance for the hardware type.

8.16.7 Specific Requirements for Testing Protective Suit, Glove, Footwear, and Personal Flotation Device Hardware.

8.16.7.1 Samples shall be whole hardware items.

8.16.7.2 A total of three specimens of each hardware type shall be tested.

8.16.8 Specific Requirements for Testing Helmets. Samples shall be whole helmets.

8.17 Label Durability and Legibility Test.

8.17.1 Application.

8.17.1.1 This test method shall apply to labels on protective suits, helmets, gloves, footwear, and personal flotation devices.

8.17.1.2 Modifications to this test method for testing protective suit labels shall be as specified in 8.17.7.

8.17.1.3 Modifications to this test method for testing protective helmet labels shall be as specified in 8.17.8.

8.17.1.4 Modifications to this test method for testing protective glove labels shall be as specified in 8.17.9.

8.17.1.5 Modifications to this test method for testing protective footwear labels shall be as specified in 8.17.10.

8.17.1.6 Modifications to this test method for testing protective personal flotation device labels shall be as specified in 8.17.11.

8.17.2 Samples. Samples shall be conditioned as specified in 8.1.2.

8.17.3 Specimens.

8.17.3.1 A minimum of three specimens of each type of label for each element shall be tested in each test.

8.17.3.2 Where labels have an area of "write-in" information, two additional specimens shall be tested that include those areas with sample information written in.

8.17.4 Procedures.

8.17.4.1 Laundering Durability Test.

8.17.4.1.1 Specimens shall be subjected to 10 cycles of laundering and drying using Machine Cycle 1, Wash Temperature V, and Drying Procedure Ai of AATCC 135, *Dimensional Changes in Automatic Home Laundering of Woven and Knit Fabrics*.

8.17.4.1.2 A 1.8 kg, ±0.1 kg (4.0 lb, ±0.2 lb) load shall be used. A laundry bag shall not be used.

8.17.4.1.3 Specimens shall be examined for legibility to the unaided eye by a person with 20/20 vision, or vision corrected to 20/20, at a nominal distance of 305 mm (12 in.) in a well-illuminated area.

8.17.4.2 Abrasion Durability Test.

8.17.4.2.1 Specimens shall be subjected to abrasion in accordance with ASTM D 4966, *Standard Test Method for Abrasion Resistance of Textile Fabrics*, with the following modifications:

(1) The standard abrasive fabric and the felt-backing fabric shall be soaked for 24 hours or agitated in distilled water so that they are thoroughly wet.
(2) The standard abrasive fabric shall be rewetted after each set of cycles by applying 20 ml (0.68 oz) of distilled water from a squeeze bottle by squirting on the center of the abrasive composite pad.
(3) Specimens shall be subjected to 200 cycles, 3200 revolutions, of the test apparatus.

8.17.4.2.2 Specimens shall be examined for legibility to the unaided eye by a person with 20/20 vision, or vision corrected to 20/20, at a nominal distance of 305 mm (12 in.) in a well-illuminated area.

8.17.5 Report. The legibility of each specimen shall be recorded and reported as acceptable or unacceptable.

8.17.6 Interpretation. One or more label specimens failing this test shall constitute failing performance.

8.17.7 Specific Requirements for Testing Protective Suit Labels.

8.17.7.1 For testing label legibility after laundering, specimens shall include individual labels sewn onto a 1 m (1 yd) square of ballast material no closer than 50 mm (2 in.) apart in parallel strips.

8.17.7.2 The ballast material shall be as specified in AATCC 135, *Dimensional Changes in Automatic Home Laundering of Woven and Knit Fabrics*.

8.17.7.3 For testing label legibility after abrasion, specimens shall be individual labels.

8.17.7.4 Specimens shall be tested separately for legibility after laundering and abrasion as specified in 8.17.4.1 and 8.17.4.2, respectively.

8.17.8 Specific Requirements for Testing Protective Helmet Labels.

8.17.8.1 Samples shall be whole protective helmets with labels attached.

8.17.8.2 Samples shall be conditioned as specified in 8.1.6.

8.17.8.3 Label specimens shall be examined for legibility to the unaided eye by a person with 20/20 vision, or vision corrected to 20/20, at a nominal distance of 305 mm (12 in.) in a well-illuminated area.

8.17.9 Specific Requirements for Testing Protective Glove Labels.

8.17.9.1 For testing label legibility after laundering, specimens shall include gloves with labels attached.

8.17.9.2 For testing label legibility after abrasion, specimens shall be individual labels.

8.17.9.3 Specimens shall be tested separately for legibility after laundering and abrasion as specified in 8.17.4.1 and 8.17.4.2, respectively.

8.17.10 Specific Requirements for Testing Protective Footwear Labels.

8.17.10.1 For testing label legibility after laundering, specimens shall include protective gloves with labels attached.

8.17.10.2 For testing label legibility after abrasion, specimens shall be individual labels.

8.17.10.3 Specimens shall be tested separately for legibility after laundering and abrasion as specified in 8.17.4.1 and 8.17.4.2, respectively.

8.17.11 Specific Requirements for Testing Personal Flotation Device Labels.

8.17.11.1 For testing label legibility after laundering, specimens shall include individual labels sewn onto a 1 m (1 yd) square of ballast material no closer than 50 mm (2 in.) apart in parallel strips.

8.17.11.2 The ballast material shall be as specified in AATCC 135, *Dimensional Changes in Automatic Home Laundering of Woven and Knit Fabrics*.

8.17.11.3 For testing label legibility after abrasion, specimens shall be individual labels.

8.17.11.4 Specimens shall be tested separately for legibility after laundering and abrasion as specified in 8.17.4.1 and 8.17.4.2, respectively.

8.18 Helmet Bucketing Test.

8.18.1 Application. This test method shall apply to protective helmets.

8.18.2 Samples. Samples shall be conditioned as specified in 8.1.2.

8.18.3 Specimens. A total of three different protective helmets shall be tested.

8.18.4 Procedure.

8.18.4.1 Specimens shall be fitted onto a neutral buoyant spherical form sized such that the helmet fits tightly in accordance with the manufacturer's fitting instructions.

8.18.4.2 The spherical form shall have an attachment point directly opposite the crown of the helmet.

8.18.4.3 A force gauge shall be attached to the attachment point and the helmet shall be pulled through the water at a constant speed of 3 m/sec (6.7 mph) for a distance of not less than 10 m (32 ft).

8.18.4.4 The maximum force shall be measured.

8.18.5 Report.

8.18.5.1 The maximum force generated shall be recorded and reported.

8.18.5.2 The average force shall be calculated, recorded, and reported.

8.18.6 Interpretation. The average force generated shall be used to determine pass or fail performance.

8.19 Top Impact Resistance Test (Force).

8.19.1 Application. This test method shall apply to protective helmets.

8.19.2 Samples. Samples shall be complete protective helmets.

8.19.3 Specimens.

8.19.3.1 Specimens shall be conditioned for the environmental conditions specified in 8.1.2 and 8.1.6 prior to each impact.

8.19.3.2 A minimum of three helmet specimens of each shell/liner size combination shall be tested as specified for each environmental condition.

8.19.4 Apparatus.

8.19.4.1 An aluminum ISEA size 7 headform shall be used.

8.19.4.2 The headform shall have a mass of 3.6 kg, ±0.5 kg (8 lb, ±1.0 lb).

8.19.4.3 The test headform shall have the nominal dimensions of the headform in Table 8.19.4.3 and Figure 8.19.4.3(a) through Figure 8.19.4.3(c).

8.19.4.4 A steel drop mass of 3.58 kg, ±0.05 kg (7.9 lb, ±0.10 lb) shall be used. The striking face of the drop mass shall be a spherical segment with a radius of 48 mm, ±8 mm (1.9 in., ±0.3 in.) and a chord length of at least 75 mm (3 in.).

8.19.4.5 An electronic force measurement system with the following minimum specifications shall be used:

(1) Range: 4450 N (1000 lbf)
(2) Peak force measurement accuracy: ±2.5 percent
(3) Resolution: 22 N (5 lbf)
(4) Load cell rigidity:

$$4.4 \text{ Y} \times 10^9 \text{ N/m} \left(2.5 \text{ Y} \times 10^7 \text{ lb/in.}\right)$$

(5) Minimum mechanical resonant frequency of the headform/load cell system: 5000 Hz
(6) Load cell diameter: 75 mm (3 in.)

8.19.4.6 The system frequency response shall comply with SAE J211, *Instrumentation for Impact Test,* Channel Frequency Class 1000 specifications. The minimum mechanical resonant frequency shall be calculated from the following formula:

$$\int = \sqrt{\frac{kg/m}{2\pi}}$$

where:
kg = load cell rigidity (N/m or lbf/ft)
m = mass of the structure on top of the load cell (kg or slugs)

8.19.4.7 All surfaces in contact with the load cell shall have a surface finish of at least 0.8×10^{-6} m (32×10^{-6} in.) rms. In addition, those surfaces in contact with the load cell shall be flat to within 12.7×10^{-6} m (500×10^{-6} in.).

8.19.4.8 The load cell shall have a backup mass of at least 540 kg (1200 lb). The load cell assembly shall be rigidly mounted between the headform structure and a steel plate at least 305 mm (1 ft) square and 25 mm (1 in.) thick. The backup mass shall be concrete or a rigid material of equal or greater density at least 610 mm (2 ft) square.

Table 8.19.4.3 Data for Contour Drawing of ISEA Headform (all dimensions in mm)

Horizontal Plane	Distance from Datum Plane	Vertical Sections												
		0°	15°	30°	45°	60°	75°	90°	105°	120°	135°	150°	165°	180°
0-0	99	0	0	0	0	0	0	0	0	0	0	0	0	0
1-1	95	22.5	22.5	23.0	25.5	26.5	28.0	28.5	31.0	33.0	36.0	39.0	38.7	40.0
2-2	90	39.5	40.0	40.0	40.5	40.5	40.5	41.5	43.5	47.5	50.0	53.0	53.0	54.5
3-3	85	53.5	54.0	55.7	51.5	50.5	50.0	51.5	53.5	57.0	60.5	64.0	64.5	65.5
4-4	80	62.5	63.0	60.9	59.0	57.0	57.0	57.5	60.5	63.5	67.3	70.7	70.7	72.2
5-5	70	72.5	74.0	71.5	68.2	65.5	64.5	65.3	68.0	72.0	75.7	79.1	80.0	82.0
6-6	60	82.0	82.0	79.5	75.0	71.0	69.4	70.1	73.0	77.5	81.7	85.1	87.5	87.9
7-7	50	87.3	87.0	84.5	79.0	74.0	71.5	72.0	75.7	80.9	85.8	89.4	91.0	92.3
8-8	40	90.2	90.5	87.5	81.5	75.5	73.0	73.5	76.9	82.7	88.3	91.3	93.5	95.0
9-9	20	94.0	94.0	90.5	83.5	77.1	73.7	74.2	77.8	84.3	91.0	95.5	97.6	98.5
Datum Plane														
10-10	0	96.5	96.5	93.0	84.6	77.5	73.5	74.2	79.0	85.0	92.5	96.5	98.8	99.9
11-11	20	96.5	96.5	93.0	84.6	77.5	73.5	72.0	70.0	78.5	84.0	90.0	91.0	95.0
12-12	40	96.5	96.5	93.0	84.6	77.5	73.5	70.0	63.5	70.0	75.0	81.0	82.0	84.0
13-13	60	96.5	96.5	93.0	84.6	77.5	73.5	68.0	58.0	57.5	63.0	69.0	69.0	72.0
14-14	80	96.5	96.5	93.0	84.6	77.5	73.5	66.0	54.0	48.0	53.0	59.0	60.0	63.0
15-15	100	96.5	96.5	93.0	84.6	77.5	73.5	64.0	52.0	48.0	49.0	54.0	56.0	59.0
16-16	115.9	96.5	96.5	96.5	96.5	96.5	96.5	96.5	96.5	96.5	96.5	96.5	96.5	96.5
17-17	128.6	96.5	96.5	96.5	96.5	96.5	96.5	96.5	96.5	96.5	96.5	96.5	96.5	96.5

Note: All dimensions ±5 mm.
For SI units, 25 mm = 1 in.

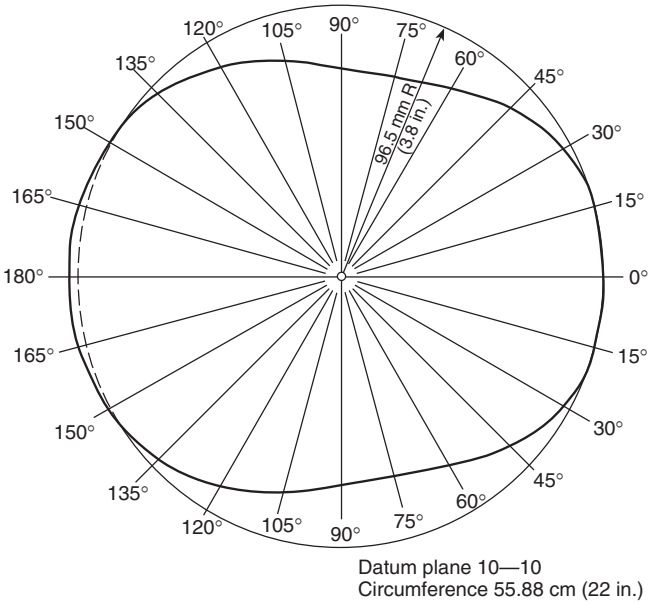


FIGURE 8.19.4.3(a) ISEA Size 7 Headform, Top.

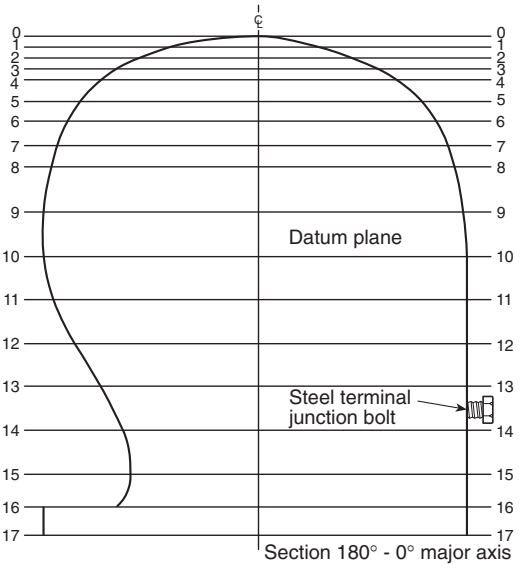


FIGURE 8.19.4.3(b) ISEA Size 7 Headform, Side with Modification for Steel Terminal Junction Bolt.

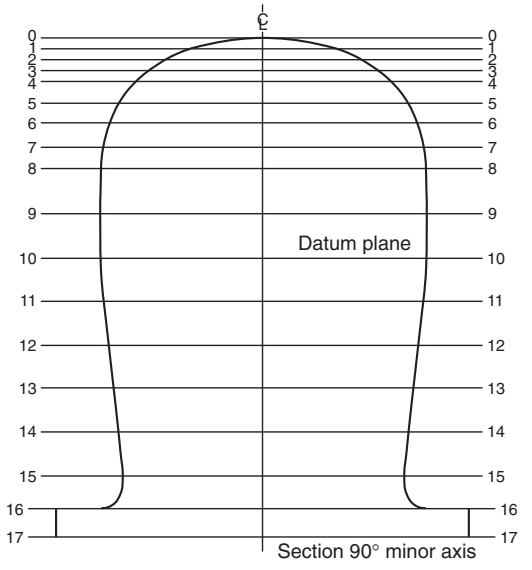


FIGURE 8.19.4.3(c) ISEA Size 7 Headform, Front.

8.19.4.9 The surface of the steel plate, in the area of the load cell assembly mounting, shall be flat within ±0.15 mm (±0.005 in.) and within 1 degree of level. The steel plate shall be rigidly attached to, and in intimate contact with, the backup mass.

8.19.4.10 The vertical centerline of the drop mass, the headform, and the load cell shall all be colinear within 3 mm (⅛ in.). The sensitive axis of the load cell shall be aligned within 1 degree of vertical. The guide or guides shall be vertical (or in the case of a double guide system, parallel) to within 6 mm (¼ in.) per 3 m (10 ft) of length.

8.19.4.11 The instrumentation calibration shall be verified at least before and after each test series or at the beginning and end of each day of testing, whichever is the shorter length of time. *(See Annex B for more information.)*

8.19.4.12 The test system shall be analyzed dynamically to ensure that any mechanical resonances associated with transducer mountings do not distort the output data.

8.19.4.13 Prior to testing, the instrumentation shall be allowed to warm up until stability is achieved.

8.19.4.14 Throughout calibration, verification, and testing, the ambient temperature shall be 20°C to 28°C (68°F to 82°F) and the relative humidity shall be 30 to 70 percent.

8.19.5 Procedure.

8.19.5.1 Specimens shall be adjusted to a size sufficiently large to prevent binding.

8.19.5.2 Specimens shall be positioned and secured to properly fit on the headform with the horizontal center plane parallel within 5 degrees of the reference plane.

8.19.5.3 The front-to-back centerline of the shell shall be within 13 mm (½ in.) of the midsagittal plane of the headform. The midsagittal plane shall be the plane perpendicular to the basic plane and coronal planes that bisects the head symmetrically.

8.19.5.4 Specimens shall be subjected to the environmental conditions specified in 8.1.2, 8.1.4, 8.1.5, and 8.1.6 prior to each impact and within the specified time after being removed from conditioning.

8.19.5.5 The impactor shall be dropped from a height that yields an impact velocity within 2 percent of 5.47 m/s (17.9 ft/s).

8.19.5.6 A means of verifying the impact velocity to within 2 percent for each impact shall be incorporated.

8.19.5.7 The verification tests shall demonstrate an accuracy of 2.5 percent or better in the measured force.

8.19.6 Report.

8.19.6.1 The peak force and impact velocity shall be recorded and reported for each test.

8.19.6.2 The results of each system verification shall be made part of the test results for the helmets being tested.

8.19.7 Interpretation.

8.19.7.1 Disengagement of, deformation of, or damage to the helmet shell or component parts shall not of itself constitute failure.

8.19.7.2 Pass or fail performance shall be determined for each specimen.

8.19.7.3 One or more helmet specimens failing this test shall constitute failing performance.

8.20 Physical Penetration Resistance Test.

8.20.1 Application. This test method shall apply to protective helmets.

8.20.2 Samples.

8.20.2.1 Samples shall be complete protective helmets.

8.20.2.2 Samples shall be conditioned for the environmental conditions specified in 8.1.2 and 8.1.6 prior to each physical penetration.

8.20.3 Specimens. A minimum of three helmets shall be tested for each environmental condition.

8.20.4 Apparatus.

8.20.4.1 The ISO size J headform shall conform to the nominal dimensions in Figure 8.20.4.1. Above the test line, the headform shall have an electrically conductive surface that is electrically connected to the contact indicator.

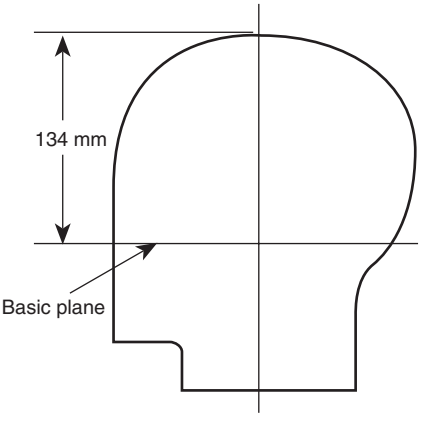


FIGURE 8.20.4.1 ISO Size J Headform.

8.20.4.2 The penetration striker shall have a mass of 1 kg, +0.02/-0.00 kg (2.2 lb, +0.01/-0.00 lb).

8.20.4.3 The point of the striker shall be a cone with an included angle of 60 degrees, ±½ degree, a height of 38 mm (1½ in.), and a tip radius of 0.5 mm, ±0.1 mm (0.020 in., ±0.004 in.).

8.20.4.4 The hardness of the striking tip shall be Rockwell Scale C-60, minimum. The penetration striker shall be electrically connected to the contact indicator.

8.20.4.5 The contact indicator shall indicate when electrical contact has been made between the penetration striker and the conductive surface of the test headform.

8.20.4.6 The contact indicator shall have a response time of less than 0.5 second.

8.20.4.7 The test shall be conducted at an ambient temperature of 20°C to 28°C (68°F to 82°F), and the relative humidity shall be 30 percent to 70 percent.

8.20.5 Procedure.

8.20.5.1 The environmentally conditioned helmet shall be placed on the rigidly mounted test headform and secured by the helmet retention system or by other means that will not interfere with the test.

8.20.5.2 The helmet shall be positioned so that the penetration striker shall impact perpendicular to the helmet.

8.20.5.3 The helmet shall be adjusted to a size sufficient to properly fit on the headform with the horizontal center plane parallel and within 5 degrees of the reference plane.

8.20.5.4 The front-to-back centerline of the shell shall be within 13 mm (½ in.) of the midsagittal plane of the headform. The midsagittal plane shall be the plane perpendicular to the basic plane and coronal planes that bisects the head symmetrically.

8.20.5.5 The drop height of the penetration striker shall be adjusted so that the velocity at impact is at 7 m/s, ±0.1 m/s (23 ft/s, ±0.5 ft/s).

8.20.5.6 The penetration striker shall be dropped to strike the sample helmet shell within a circle whose diameter is 75 mm (3 in.) and whose center shall be the geometric center of the shell.

8.20.5.7 The penetration striker shall not fall on any portion of the ridges of the helmet shell or make contact with the headform.

8.20.6 Report. The pass or fail results for each helmet shall be recorded and reported.

8.20.7 Interpretation. One or more helmet specimens failing this test shall constitute failing performance.

8.21 Suspension System Retention Test.

8.21.1 Application. This test method shall apply to protective helmets.

8.21.2 Samples.

8.21.2.1 Samples shall be complete protective helmets.

8.21.2.2 Samples shall be conditioned as specified in 8.1.2.

8.21.3 Specimens. A minimum of three helmets shall be tested for each test.

8.21.4 Apparatus. The suspension system retention test fixtures shall consist of rigid material of sufficient thickness and optional design to facilitate firm attachment to the helmet suspension and the tensile test machine as shown in Figure 8.21.4.

8.21.5 Procedure.

8.21.5.1 Sample helmets shall be positioned and secured so that the helmet's reference plane is horizontal.

8.21.5.2 Each attachment point of the crown straps shall be tested by applying a pull force perpendicular to the reference plane, to a maximum load of 45 N, ±5 N (10 lb, ±1 lb).

8.21.5.3 The force shall be increased from 0 N (0 lb) to 22 N, ±2 N (5 lb, ±½ lb) at a load rate of 25 mm, ±5 mm (1 in., ±3⁄16 in.) per minute.

8.21.5.4 The force shall be applied through the centerline of each attachment point.

8.21.6 Report. The individual pass or fail results for each attachment point shall be reported and recorded.

8.21.7 Interpretation. One or more helmet specimen failing this test shall constitute failing performance.

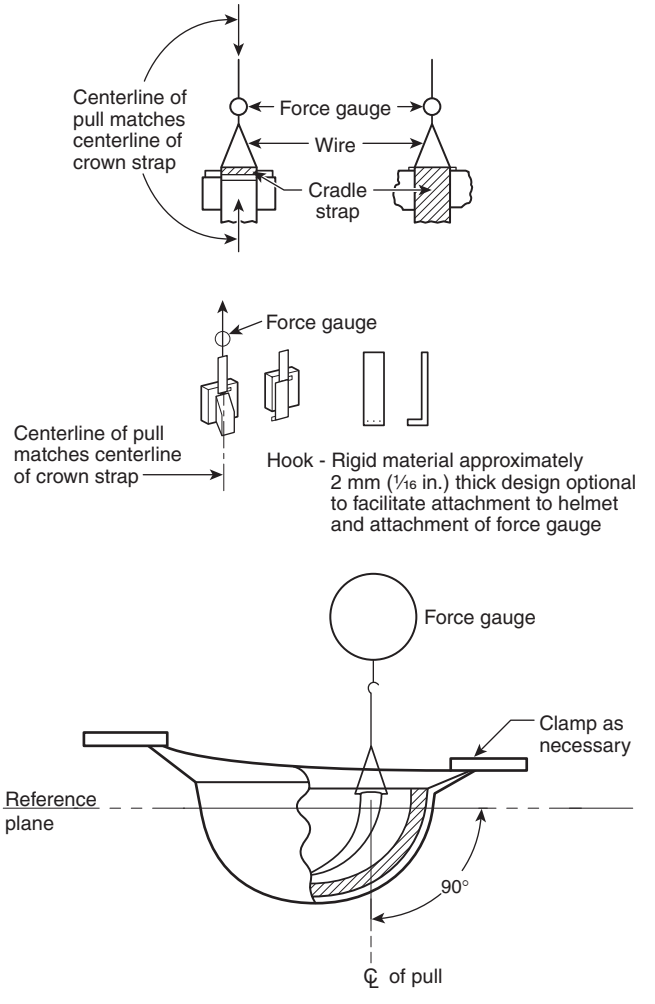


FIGURE 8.21.4 Suspension System Test Setup.

8.22 Retention System Test.

8.22.1 Application. This test method shall apply to helmets.

8.22.2 Samples.

8.22.2.1 Samples shall be complete helmets.

8.22.2.2 Samples shall be conditioned as specified in 8.1.2.

8.22.3 Specimens. A minimum of three helmets shall be tested for each test.

8.22.4 Apparatus.

8.22.4.1 An ISO size J headform shall be used. The nominal dimensions of the headform shall be as specified in Figure 8.20.4.1.

8.22.4.2 The mechanical chin structure shall consist of two rollers 13 mm (½ in.) in diameter with centers 75 mm (3 in.) apart. The mechanical chin structure shall conform with Figure 8.22.4.2 or equivalent.

8.22.4.3 The mechanical chin structure shall be designed to be used with a calibrated tensile test machine that shall be capable of measuring the force applied to the retention system within 2 percent at the specified force.

8.22.4.4 The test shall be conducted at an ambient temperature of 20°C to 28°C (68°C to 82°F), and the relative humidity shall be 30 percent to 70 percent.

8.22.4.5 Prior to testing, the test machine shall be allowed to warm up until stability is achieved.

8.22.5 Procedure.

8.22.5.1 The headform and mechanical chin structure shall be positioned so the distance between the bottom of the rollers and the top of the headform is 210 mm, ±10 mm (8¼ in., ±⅓ in.).

8.22.5.2 The chin strap shall be passed around the rollers, and the helmet shall be secured to the headform.

8.22.5.3 The chin strap shall be adjusted and preloaded to 45 N, ±5 N (10 lb, ±1 lb).

8.22.5.4 The distance between the top of the helmet and the rollers shall be measured, recorded, and reported to the nearest 0.5 mm (1/64 in.).

8.22.5.5 The force applied to the retention system shall be slowly increased to 445 N, ±5 N (100 lb, ±1 lb). The force shall be increased smoothly from 45 N (10 lb) to 445 N (100 lb) at between 9.0 N/s (2 lb/s) and 45 N/s (10 lb/s).

8.22.5.6 When using a tensile testing machine, the load rate shall be 25 mm (1 in.) per minute to a limit of 445 N (100 lb).

8.22.5.7 The distance between the top of the helmet and the rollers shall be measured, recorded, and reported to the nearest 0.5 mm (1/64 in.) again after the force has been maintained at 445 N (100 lb) for 60 seconds, +15/-0 seconds.

8.22.5.8 The difference between the second measurement and the first measurement shall be the retention system elongation.

8.22.6 Report. The retention system elongation shall be measured, recorded, and reported for each helmet specimen.

8.22.7 Interpretation. One or more helmet specimens failing this test shall constitute failing performance.

8.23 Overall Liquid Integrity Test Two.

8.23.1 Application. This test method shall apply to dry suit protective gloves.

8.23.2 Samples.

8.23.2.1 Samples shall be whole protective glove pairs and shall be in sizes small and large.

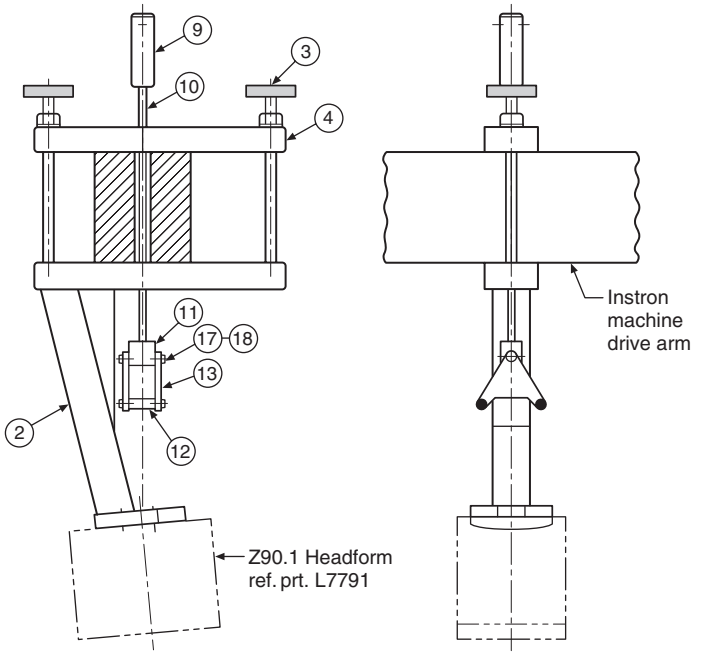


FIGURE 8.22.4.2 Retention System Test Setup.

ITEM NO.	PART NO.	SHT. NO.	DESCRIPTION	MAT'L.	VEND. OR STR. SIZE	QTY.
1	L8539	1	Retention Test Fixt. Assy.	—	—	1
2		2	Main Support Assy.	—	—	1
3		2	Knurled Knob Assy.	—	—	2
4		2	Rect. Alum. Bar	6061-T6	1 1/2 x 3 x 14 Lg.	1
5		2	Rect. Alum. Bar	6061-T6	1 1/2 x 3 x 14 Lg.	1
6		2	Alum. Bar	6061-T6	2 x 2 x 7 1/2 Lg.	1
7		2	Alum. Bar	6061-T6	2 x 2 x 12.96 Lg.	1
8		2	Alum. Flat	6061-T6	3/4 x 4 1/2 x 5 Lg.	1
9		2	C.F. Steel Rod	Stl.	1 1/4 Dia. x 4 Lg.	1
10		2	C.F. Steel Rod	Stl.	3/8 Dia. x 22 Lg.	1
11		2	C.F. Steel Flat	Stl.	1 x 1 1/4 x 1 1/2 Lg.	1
12		2	Hollow Steel Tube	Stl.	.500 O.D. .384 I.D. x 1 1/2	2
13		2	C.F. Steel Flat	Stl.	1/4 x 3 1/4 x 3 3/4 Lg.	2
14		2	C.F. Steel Flat	Stl.	39 x 3/4 Thk.	2
15		2	C.F. Steel Rod	Stl.	3/4 ∅ x 10 1/2 Lg.	2
16		2	Hex Nut	Stl.	3/4 - 10 Unc.	2
17		1	Hex Hd. Bolt	Stl.	3/8 - 24 Unf. x 2 1/2 Lg.	3
18		1	Hex Nut	Stl.	3/8 - 24 Unf.	3

Notes:

1. Remove burrs and break sharp edges.
2. All steel parts are to be solvent cleaned and zinc plated 0.0003 to 0.0010 in. thick.
3. Headform is to be bolted in place using 3 socket-head cap screws 1/2–13 UNC x 1 1/2 Lg.

8.23.2.2 Samples shall be conditioned as specified in 8.1.3 following by the conditioning as specified in 8.1.2.

8.23.3 Specimens.

8.23.3.1 Specimens shall be whole glove pairs, sizes small and large.

8.23.3.2 At least three glove pairs each for small and large sizes shall be tested.

8.23.4 Apparatus.

8.23.4.1* A water markable glove shall cover all areas of the tester's hand. The water markable glove shall be constructed of a fabric that is easily watermarked to determine leakage.

8.23.4.2 The water used for integrity testing shall be treated with a nonfoaming surfactant to lower its surface tension to 35 dynes/cm, ±2 dynes/cm.

8.23.5 Procedure.

8.23.5.1 Test subjects shall be selected such that their hand dimensions are as close as possible to those specified in accordance with manufacturing glove sizing guidelines.

8.23.5.2 The test subject shall don the glove specimen over the water markable glove.

8.23.5.3 The test subject shall immerse the glove specimen to within 25 mm (1 in.) of the top of the body of the glove specimen for 5 minutes in 20°C, ±3°C (68°F, ±5°F) water. The test subject shall flex the glove specimen in a fist clenching motion every 10 seconds.

8.23.5.4 The glove specimen shall be removed from the test subject's hand and the inner glove shall be inspected for water marks.

8.23.6 Report. The appearance of water marks on the inner glove after testing any of the three gloves shall be recorded and reported.

8.23.7 Interpretation. The appearance of water marks on the inner glove after testing any glove shall be considered leakage and shall constitute failing performance.

8.24 Cut Resistance Test.

8.24.1 Application.

8.24.1.1 This test method shall apply to protective dry suit materials and seams, dry suit hood materials and seams, dry suit glove materials and seams, and dry suit bootie materials and seams; and protective ice suit materials and seams, ice suit hood materials and seams, ice suit glove materials and seams, and ice suit footwear materials and seams.

8.24.1.2 Modifications to this test method for evaluation of protective glove materials shall be as specified in 8.24.7.

8.24.1.3 Modifications to this test method for evaluation of protective footwear upper materials shall be as specified in 8.24.8.

8.24.2 Samples.

8.24.2.1 Samples shall be whole protective gloves or protective footwear uppers.

8.24.2.2 Samples shall be conditioned as specified in 8.1.2.

8.24.3 Specimens. Specimens shall be the size specified in ASTM F 1790, *Test Methods for Measuring Cut Resistance of Materials Used in Protective Clothing*, consisting of all layers.

8.24.4 Procedure. Specimens shall be evaluated in accordance with ASTM F 1790, *Test Methods for Measuring Cut Resistance of Materials Used in Protective Clothing,* with the modification that specimens shall be tested to a specific load with the measurement of blade travel distance.

8.24.5 Report.

8.24.5.1 The blade travel distance shall be recorded and reported to the nearest 1 mm (1/32 in.) for each sample specimen.

8.24.5.2 The average blade travel distance in mm shall be recorded and reported for all specimens tested.

8.24.6 Interpretation. The average blade travel distance shall be used to determine pass or fail performance.

8.24.7 Specific Requirements for Testing Protective Glove Materials.

8.24.7.1 Specimens shall be taken from the palm and palm-side fingers of the glove and shall not include seams.

8.24.7.2 Cut resistance testing shall be performed under a load of 75 g (0.16 1b).

8.24.8 Specific Requirements for Testing Protective Footwear Upper Materials.

8.24.8.1 Specimens shall be taken from the parts of the footwear upper that provide uniform thickness and shall not include seams. The footwear upper shall include the toe, vamp, quarter, shaft, collar, and throat, but shall not include the sole.

8.24.8.2 Cut resistance testing shall be performed under a load of 350 g (0.77 lb).

8.25 Puncture Resistance Test.

8.25.1 Application.

8.25.1.1 This test method shall apply to protective wet suit protective gloves, wet suit footwear upper materials, and wet suit footwear soles; protective dry suit gloves, dry suit footwear upper materials, and dry suit footwear soles; and protective ice suit glove palm composites, ice suit footwear upper materials, and ice suit footwear soles.

8.25.1.2 Modifications to this test method for testing protective glove materials shall be as specified in 8.25.7.

8.25.1.3 Modifications to this test method for testing protective footwear upper material shall be as specified in 8.25.8.

8.25.1.4 Modifications to this test method for testing footwear soles shall be as specified in 8.25.9.

8.25.2 Samples.

8.25.2.1 Samples shall be complete protective gloves or protective footwear sections.

8.25.2.2 Samples shall be conditioned as specified in 8.1.2.

8.25.3 Specimens.

8.25.3.1 Specimens shall be at least 150 mm (6 in.) square.

8.25.3.2 At least three specimens shall be tested.

8.25.4 Procedure. Specimens shall be tested in accordance with ASTM F 1342, *Standard Test Method for Resistance of Protective Clothing Materials to Puncture.*

8.25.5 Report.

8.25.5.1 The puncture force shall be recorded and reported for each specimen to the nearest 0.4 N (0.1 lb) of force.

8.25.5.2 The average puncture force shall be recorded and reported for all specimens tested.

8.25.6 Interpretation. The average puncture force shall be used to determine pass or fail performance.

8.25.7 Specific Requirements for Testing Protective Glove Materials.

8.25.7.1 Specimens shall not include seams and shall be taken from the palm and palmside fingers of the glove.

8.25.7.2 Where the specimen composites of the palm and palmside of the fingers are identical, only one representative composite shall be required to be tested.

8.25.8 Specific Requirements for Testing Protective Footwear Upper Materials.

8.25.8.1 Specimens shall consist of each composite of the footwear item used in the actual suit footwear configuration, with layers arranged in proper order.

8.25.8.2 Specimens shall be taken from the thinnest portion of the footwear upper. The footwear upper shall include the toe, vamp, quarter, shaft, collar, and throat, but shall not include the sole.

8.25.9 Specific Requirements for Testing Protective Footwear Soles.

8.25.9.1 Specimens shall consist of each composite of the footwear item sole, including the heel, used in the actual suit footwear configuration, with layers arranged in proper order.

8.25.9.2 Specimens shall be taken from the thinnest portion of the footwear sole.

8.26 Abrasion Resistance Test Two.

8.26.1 Application.

8.26.1.1 This test method shall apply to protective dry suit gloves, dry suit footwear uppers, and dry suit footwear soles; protective wet suit gloves, wet suit footwear uppers, and wet suit footwear soles; and protective ice suit gloves, ice suit footwear uppers, and ice suit footwear soles.

8.26.1.2 Modifications to this test method for testing protective glove composite shall be as specified in 8.26.7.

8.26.1.3 Modifications to this test method for testing protective footwear upper materials shall be as specified in 8.26.8.

8.26.1.4 Modifications to this test method for testing protective footwear soles shall be as specified in 8.26.9.

8.26.2 Samples.

8.26.2.1 Samples shall be as specified in 8.26.7, 8.26.8, or 8.26.9.

8.26.2.2 Samples shall be conditioned as specified in 8.1.2.

8.26.3 Specimens.

8.26.3.1 Specimens shall be as specified in 8.26.7, 8.26.8, or 8.26.9.

8.26.3.2 Specimens shall be the size specified in ASTM D 3884, *Standard Test Method for Abrasion Resistance of Textile Fabrics (Rotary Platform, Double-Head Method)*.

8.26.3.3 At least five specimens of each different dry suit gloves, dry suit footwear uppers, and dry suit footwear soles shall be tested.

8.26.4 Procedure.

8.26.4.1 Specimens shall be tested in accordance with ASTM D 3884, *Standard Test Method for Abrasion Resistance of Textile Fabrics (Rotary Platform, Double-Head Method)*, using a Calibrase H-18 wheel using a total of 2500 cycles.

8.26.4.2 At the end of each abrasion exposure, the specimen shall be examined for wear-through of the outermost separable layer.

8.26.5 Report. The wear-through determination shall be recorded and reported for each specimen tested.

8.26.6 Interpretation. Any specimen showing wear-through shall constitute failure of this test.

8.26.7 Requirements for Testing Protective Glove Composites.

8.26.7.1 Samples shall be full gloves.

8.26.7.2 Samples and specimens shall be permitted to be materials representative of those used in the construction of the glove.

8.26.7.3 Specimens shall not include seams and shall be taken from the palm, palmside fingers, and back of the glove.

8.26.7.4 A load of 500 g (1.1 lb) on each wheel shall be used in abrasion testing of gloves.

8.26.8 Requirements for Testing Protective Footwear Upper Materials.

8.26.8.1 Samples shall be complete footwear items.

8.26.8.2 Samples and specimens shall be permitted to be materials representative of those used in the constriction of the footwear.

8.26.8.3 Specimens shall be taken from the footwear upper and shall not include seams. The footwear upper shall include the toe, vamp, quarter, shaft, collar, and throat, but shall not include the sole.

8.26.8.4 A load of 1000 g (2.2 lb) on each wheel shall be used in abrasion testing of footwear.

8.26.9 Requirements for Testing Protective Footwear Soles.

8.26.9.1 Samples shall be complete footwear items.

8.26.9.2 Samples and specimens shall be permitted to be materials representative of those used in the construction of the footwear.

8.26.9.3 Specimens shall consist of each composite of the footwear item sole, including the heel, used in the actual suit footwear configuration, with layers arranged in the proper order.

8.26.9.4 A load of 1000 g (2.2 lb) on each wheel shall be used in abrasion testing of footwear.

8.26.9.5 A total of 5000 cycles shall be used to evaluate abrasion resistance.

8.27 Glove Hand Function Test.

8.27.1 Application. This test shall apply to wet suit, dry suit, and ice suit protective gloves.

8.27.2 Samples.

8.27.2.1 Samples shall be whole protective glove pairs, sizes small and large.

8.27.2.2 Samples shall be conditioned as specified in 8.1.3 followed by conditioning as specified in 8.1.2.

8.27.3 Specimens.

8.27.3.1 Specimens shall be whole glove pairs, sizes small and large, in new, as-distributed condition.

8.27.3.2 At least three glove pairs each for small and large sizes shall be tested.

8.27.3.3 Each glove pair shall be tested as a complete set of gloves in new, as-distributed condition.

8.27.3.4 Glove pair specimens shall not receive special softening treatments prior to tests.

8.27.4 Procedures. Testing shall be conducted in accordance with ASTM F 2010, *Standard Test Method for Evaluation of Glove Effects on Wearer Hand Dexterity Using a Modified Pegboard Test*, with the following modifications:

(1) Each size of gloves shall be evaluated with at least one separate test subject with the same pair of gloves.
(2) A minimum of three different glove pairs shall be evaluated for each size specified in 8.27.2.1.

8.27.5 Report.

8.27.5.1 The average percent of barehand control shall be recorded and reported for each test subject.

8.27.5.2 The average percent of barehand control for all test subjects shall be calculated, recorded, and reported.

8.27.6 Interpretation. The average percent of barehand control for all test subjects shall be used to determine pass or fail performance.

8.28 Grip Test.

8.28.1 Application. This test shall apply to wet suit, dry suit, and ice suit protective gloves.

8.28.2 Samples.

8.28.2.1 Samples shall be whole protective glove pairs, sizes small and large, in new, as-distributed condition.

8.28.2.2 Samples shall be conditioned as specified in 8.1.3, followed by conditioning as specified in 8.1.2.

8.28.2.3 Other samples shall be conditioned as specified in 8.1.3, followed by conditioning as specified in 8.1.7.

8.28.3 Specimens.

8.28.3.1 Specimens shall be whole protective glove pairs, sizes small and large.

8.28.3.2 At least three glove pairs each for small and large sizes shall be tested.

8.28.3.3 Glove pair specimens shall not receive special softening treatments prior to tests.

8.28.3.4 Specimens shall be tested for each material and construction combination.

8.28.4 Apparatus. Grip testing shall be evaluated with the use of a 9.5 mm (⅜ in.) diameter, 3-strand prestretched polyester rope attached to a calibrated force measuring device.

8.28.5 Procedure.

8.28.5.1 Test subjects shall be selected such that their hand dimensions are as close as possible to those specified in accordance with manufacturing glove sizing guidelines.

8.28.5.2 Each test subject shall make three successive attempts to exert as much horizontal pulling force as possible, using both hands, one in front of the other. Thumbs shall not overlap the fingers, and both feet shall be firmly planted on the ground. The average weight hoisted over the three trials shall be the barehand weight lift capability.

8.28.5.3 Dry-conditioned sample gloves shall be tested on a dry rope and then on a wet rope.

8.28.5.4 Wet-conditioned sample gloves shall be tested on a dry rope and then on a wet rope.

8.28.5.5 Each test subject shall be tested with a minimum of three pairs of gloves. Test subjects shall attempt one trial with each pair of gloves for a minimum of six grip tests for each set of conditions, with at least three grip tests with small sized gloves and three grip test with large sized gloves.

8.28.5.6 The weight pulling capacity with gloves shall be compared with barehand weight lifting capability. The percentage of weight pulling capacity with gloves to barehand weight lifting capability shall be calculated as follows:

$$\frac{WPC_g}{WLC_b} \times 100$$

where:
WPC_g = weight-pulling capacity with gloves
WLC_b = barehand weight lifting capability

8.28.6 Report. The percent of barehand control shall be calculated, recorded, and reported for each glove pair specimen, condition, and test subject tested.

8.28.7 Interpretation. One or more glove pair specimens failing this test shall constitute failing performance.

8.29 Glove Donning Test.

8.29.1 Application. This test shall apply to wet suit, dry suit, and ice suit gloves.

8.29.2 Samples.

8.29.2.1 Samples shall be whole protective glove pairs, sizes small and large.

8.29.2.2 Samples shall be conditioned as specified in 8.1.2.

8.29.3 Specimens.

8.29.3.1 Specimens shall be whole protective glove pairs, sizes small and large.

8.29.3.2 At least three glove pairs each for small and large sizes shall be tested.

8.29.4 Procedure.

8.29.4.1 Test subjects shall be selected such that their hand dimensions are as close as possible to those specified in accordance with manufacturing glove sizing guidelines.

8.29.4.2 The time to don one glove of the glove pair specimen shall be determined by measuring the time it takes for the test subject to don the single glove on three consecutive trials without altering the sample glove linings between donnings.

8.29.4.3 Each donning trial shall start with the glove lying in front of the test subject and shall end when the test subject's fingers are seated in the glove sample.

8.29.4.4 The baseline donning time shall be the average of the first three donning times as determined in 8.29.4.2. The baseline donning time shall not exceed 10 seconds. The doffing time between donnings shall not exceed 10 seconds.

8.29.4.5 Glove pair specimens shall then be conditioned as specified in 8.1.3.

8.29.4.6 The final donning time shall be the average of the times for the first three donnings after removal from the final drying cycle as specified in 8.29.4.5.

8.29.4.7 No preparation of the gloves shall be permitted.

8.29.5 Report.

8.29.5.1 The final donning time and the baseline donning time shall be calculated and reported to the nearest 0.1 second for each trial.

8.29.5.2 The average final and average baseline donning times shall be calculated, recorded, and reported.

8.29.5.3 Any glove liner or barrier layer separations shall be recorded and reported.

8.29.5.4 Any glove digits that do not allow full insertion shall be recorded and reported.

8.29.6 Interpretation.

8.29.6.1 Pass or fail determinations shall be made using the average final and average baseline donning times.

8.29.6.2 Any detachment of the glove liner or barrier layer shall constitute failing performance.

8.30 Slip Resistance Test.

8.30.1 Application. This test method shall apply to protective wet suit footwear soles, protective dry suit footwear soles, and protective ice suit footwear soles.

8.30.2 Samples.

8.30.2.1 Samples shall be at least three of each whole protective footwear.

8.30.2.2 Samples shall be conditioned as specified in 8.1.2.

8.30.3 Specimens.

8.30.3.1 Specimens shall be at least three of each whole protective footwear.

8.30.3.2 At least three specimens shall be tested.

8.30.4 Procedure. Slip resistance testing shall be performed in accordance with ASTM F 489, *Standard Test Method for Static Coefficient of Friction of Shoe Sole and Heel Materials as Measured by the James Machine,* in a wet condition.

8.30.5 Report. The static coefficient of friction under a wet condition of each specimen shall be reported.

8.30.6 Interpretation. One or more footwear specimens failing this test shall constitute failing performance.

8.31 Zipper Strength Test.

8.31.1 Application. This test method shall apply to all protective suit zippers.

8.31.2 Samples. Samples shall be conditioned as specified in 8.1.2.

8.31.3 Specimens. A minimum of three specimens shall be tested.

8.31.4 Procedure. Zippers shall be tested in accordance with ASTM D 2061, *Standard Test Methods for Strength Tests for Zippers*, and the following procedures shall be used:

(1) Strength of Chains and Elements, Sections 9–16, Chain Crosswise Strength
(2) Where separating zippers are used, Holding Strengths of Separable Units, Sections 25–32, Separating Unit, Crosswise
(3) Where non-separating zippers are used, Holding Strengths and Stops, Sections 17–24, Bottom Stop Holding, Crosswise

8.31.5 Report.

8.31.5.1 The crosswise strength of each specimen shall be recorded and reported.

8.31.5.2 The average crosswise strength of all specimens shall be calculated, recorded, and reported.

8.31.6 Interpretation.

8.31.6.1 The average crosswise strength shall be used to determine pass or fail performance.

8.31.6.2 Where an individual result from any test set varies more than ±10 percent from the average result, the results from the test set shall be discarded and another set of specimens shall be tested.

8.32 Resistance to Twist of Pull and Slider Test.

8.32.1 Application. This test method shall apply to all protective suit zippers.

8.32.2 Samples. Samples shall be conditioned as specified in 8.1.2.

8.32.3 Specimens. A minimum of three specimens shall be tested.

8.32.4 Procedure. Zippers shall be tested in accordance with Sections 52–61, Resistance to Twist of Pull and Slider Test, of ASTM D 2061, *Standard Test Methods for Strength Tests for Zippers.*

8.32.5 Report. The average force shall be calculated, recorded, and reported.

8.32.6 Interpretation.

8.32.6.1 The average resistance to twist strength shall be used to determine pass or fail performance.

8.32.6.2 Where an individual result from any test set varies more than ±10 percent from the average result, the results from the test set shall be discarded and another set of specimens shall be tested.

8.33 Opening and Closing of Zippers Test.

8.33.1 Application. This test method shall apply to all protective suit zippers.

8.33.2 Samples. Samples shall be conditioned as specified in 8.1.2.

8.33.3 Specimens. A minimum of three specimens shall be tested.

8.33.4 Procedure. Zippers shall be tested in accordance with Sections 14–17, Opening and Closing of Zippers Test, of ASTM D 2062, *Standard Test Methods for Operability of Zippers.*

8.33.5 Report.

8.33.5.1 The operability force of each specimen shall be calculated, recorded, and reported.

8.33.5.2 The average operability force of all specimens shall be calculated, recorded, and reported.

8.33.6 Interpretation.

8.33.6.1 The average operability force shall be used to determine pass or fail performance.

8.33.6.2 Where an individual result from any test set varies more than ±10 percent from the average result, the results from the test set shall be discarded and another set of specimens shall be tested.

8.34 Water and Air Penetration Test.

8.34.1 Application. This test method shall apply to protective dry suits and protective ice suits.

8.34.2 Samples.

8.34.2.1 Samples shall be whole protective suits.

8.34.2.2 Samples shall be conditioned as specified in 8.1.2

8.34.3 Specimens. A minimum of three specimens of each type of suit shall be tested.

8.34.4 Procedure. Specimens shall be tested in accordance with Section 18, Water and Air Penetration Test, as specified in UL 1197, *Standard of Safety for Immersion Suits.*

8.34.5 Report. Any air or water trapped inside the suit shall be recorded and reported.

8.34.6 Interpretation. Air entrapment in the suit shall be used to determine pass or fail performance.

8.35 Footwear Drainage Test.

8.35.1 Application. This test method shall apply to protective dry suit footwear and protective wet suit footwear.

8.35.2 Samples.

8.35.2.1 Samples shall be whole protective dry suit footwear and protective wet suit footwear.

8.35.2.2 Samples shall be conditioned as specified in 8.1.2.

8.35.3 Specimens. At least three complete protective dry suit footwear specimens and three protective wet suit footwear specimens shall be tested.

8.35.4 Procedure.

8.35.4.1 Individual dry suit footwear specimens and individual wet suit footwear specimens shall be weighed to the nearest gram.

8.35.4.2 Specimens shall be fully submerged in an upright position in a tank of water for a period of 5 minutes.

8.35.4.3 Water in tank shall be tap water maintained at 21°C, +/-3°C (70°F, +/-5°F).

8.35.4.4 Specimens shall be removed from the water completely and allowed to drain in the upright position for a period of 60 seconds.

8.35.4.5 Within 30 seconds following draining, the individual dry suit footwear specimens shall be weighed to the nearest gram. The weights of each specimen shall be recorded.

8.35.4.6 Within 30 seconds following draining, the individual wet suit footwear specimens shall be weighed to the nearest gram. The weights of each specimen shall be recorded.

8.35.5 Report.

8.35.5.1 The weights of the individual dry suit footwear specimens before submersion shall be recorded and reported.

8.35.5.2 The weights of the individual wet suit footwear specimens before submersion shall be recorded and reported.

8.35.5.3 The weights of the individual dry suit footwear specimens after submersion shall be recorded and reported.

8.35.5.4 The weights of the individual wet suit footwear specimens after submersion shall be recorded and reported.

8.35.5.5 The difference between the before-submersion weight and the after-submersion weight of the individual dry suit footwear specimens shall be recorded and reported.

8.35.5.6 The difference between the before-submersion weight and the after-submersion weight of the individual wet suit footwear specimens shall be recorded and reported.

8.35.6 Interpretation.

8.35.6.1 For the dry suit footwear specimens, the difference between dry and wet weights shall be used to determine pass or fail performance.

8.35.6.2 For the wet suit footwear specimens, the difference between dry and wet weights shall be used to determine pass or fail performance.

8.35.6.3 One or more footwear specimens failing this test shall constitute failing performance.

8.36 Buoyancy Test.

8.36.1 Application. This test method shall apply to protective ice suits and protective personal flotation devices.

8.36.2 Samples.

8.36.2.1 Samples shall be whole protective ice suits or protective personal flotation devices.

8.36.2.2 Samples shall be conditioned as specified in 8.1.2.

8.36.3 Specimens. A minimum of three specimens shall be tested.

8.36.4 Procedure.

8.36.4.1 Protective ice suit specimens shall be tested as specified in Section 23, Buoyancy Test, of UL 1197, *Standard of Safety for Immersion Suits.*

8.36.4.2 Protective personal flotation device specimens shall be tested as specified in Section 20, Buoyancy Test, of UL 1123, *Standard for Marine Buoyant Devices.*

8.36.5 Report. The measured buoyancy shall be calculated, recorded, and reported.

8.36.6 Interpretation.

8.36.6.1 Pass or fail determinations shall be based on the average reported buoyancy force of all specimens.

8.36.6.2 Where an individual result from any test set varies more than ±10 percent from the average result, the results from the test set shall be discarded and another set of specimens shall be tested.

8.37 Zipper Opening and Closing Force Test.

8.37.1 Application. This test method shall apply to protective dry suit zippers and protective ice suit zippers.

8.37.2 Samples.

8.37.2.1 Dry suit zipper samples shall be conditioned as specified in Table 7.2.18.

8.37.2.2 Ice suit zipper samples shall be conditioned as specified in Table 7.2.18.

8.37.2.3 The opening force samples shall be conditioned with the zippers closed, and the closing force samples shall be conditioned with the zippers opened (separated).

8.37.3 Specimens. A minimum of two specimens (1 open/1 closed) for each condition shall be tested.

8.37.4 Procedure. Zippers shall be tested as specified in Section 6.3.6.1, Opening and Closing Force Test, of CAN/CGSB-65.16, *Immersion Suit Systems*.

8.37.5 Report.

8.37.5.1 The average opening and closing force of each specimen shall be recorded and reported.

8.37.5.2 The average opening and closing force of all specimens shall be calculated, recorded, and reported.

8.37.6 Interpretation.

8.37.6.1 The average opening and closing force shall be used to determine pass or fail performance.

8.37.6.2 Where an individual result from any test set varies more than ±10 percent from the average result, the results from the test set shall be discarded and another set of specimens shall be tested.

8.38 Impact Resistance Test — Acceleration.

8.38.1 Application. This test shall be applied to complete protective helmets.

8.38.2 Samples. Samples shall be complete protective helmets.

8.38.3 Specimens.

8.38.3.1 Three helmet specimens shall be tested for each condition specified.

8.38.3.2 Specimens shall be conditioned for each environmental condition specified in 8.1.2 and 8.1.6 prior to each impact.

8.38.3.3 Where testing helmet specimens following the conditioning environment specified in 8.1.6, if the specimen is returned to the conditioning environment within 4 minutes, the specimen shall be kept in the conditioning environment for a minimum of 3 minutes before resumption of testing with that specimen.

8.38.3.4 When a specimen has been out of the conditioning environment more than 4 minutes, before resumption of testing with that specimen, the specimen shall be returned to the conditioning environment for a minimum of 3 minutes for each minute, or portion thereof, that the specimen remained out of the conditioning environment in excess of 4 minutes, or a maximum of 24 hours, whichever is less.

8.38.4 Apparatus.

8.38.4.1 An ISO size J headform conforming to the nominal dimensions in Figure 8.38.4.1 shall be used.

8.38.4.2 The ISO size J test headform shall exhibit no resonant frequencies below 3000 Hz, and it shall be made of any low-resonance alloy, such as magnesium K-1A.

8.38.4.3 A drop assembly shall be used. The drop assembly shall consist of the test headform, the accelerometer, and the moving portion of the headform guidance assembly.

8.38.4.4 The drop assembly shall have a total mass of 5.17 kg, ±0.18 kg (11.4 lb, ±0.4 lb).

8.38.4.5 The guidance assembly shall comprise not more than 20 percent of the total mass of the drop assembly.

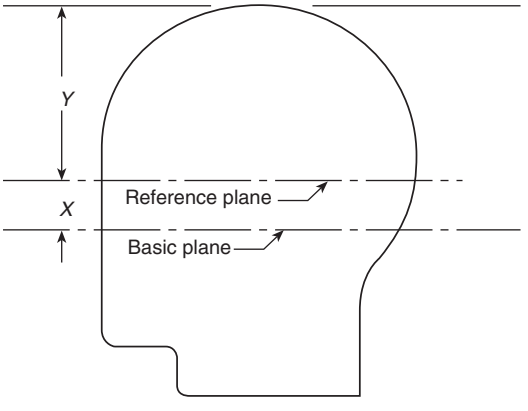
8.38.4.6 The center of mass of the drop assembly shall lie within a cone of 10 degrees included angle about the vertical, with the apex at the point of the targeted impact over the center of the test anvil.

8.38.4.7 A steel test anvil shall be used and shall have a smooth, flat striking surface 125 mm, ±15 mm (5 in., ±⅝ in.), in diameter.

8.38.4.7.1 The anvil shall be mounted securely on a steel plate at least 305 mm (1 ft) square and 25 mm (1 in.) thick.

8.38.4.7.2 The steel plate shall be rigidly attached to and in intimate contact with a backup mass of at least 540 kg (1200 lb).

8.38.4.7.3 The backup mass shall be of concrete or a rigid material of equal or greater density that has an area of at least 0.185 m^2 (2 ft^2).



Headform	Size (mm)	*X* (mm)	*Y* (mm)
A	500	24	90
B	540	26	96
J	570	27.5	102.5
M	600	29	107
O	620	30	110

FIGURE 8.38.4.1 Location of Reference Plane.

8.38.4.8 An electronic acceleration measurement system with the following minimum specifications shall be used:

(1) Range: 500 Gn
(2) Peak acceleration measurement: ±2.5 percent accuracy
(3) Resonant frequency: 5000 Hz
(4) Accelerometer shock limit: 2000 Gn
(5) Resolution: 5 Gn

8.38.4.9 The system frequency response shall comply with SAE J211, *Instrumentation for Impact Test*, Channel Frequency Class 1000, specifications. The time duration of acceleration levels shall be measured to within ±0.2 millisecond.

8.38.4.10 A reference anvil shall be substituted for the test anvil to verify the calibration of the acceleration measurement system. The reference anvil shall be constructed of any material that will yield reproducible test results during a period of at least 4 months.

8.38.4.11 For calibration, the center of the reference anvil shall be aligned within 3 mm (⅛ in.) of the impact point on the headform. The sensitive axis of the accelerometer shall be aligned within 1 degree of vertical and shall be colinear within 3 mm (⅛ in.) with the center of the reference anvil and the impact point on the headform. The guide(s) shall be vertical and, in the case of a double guide system, parallel to within 6 mm per 3 m (¼ in. per 10 ft) of length. *(See Annex C for more information.)*

8.38.4.12 The instrumentation calibration shall be verified at least before and after each test series or at the beginning and end of each day of testing, whichever is the shorter length of time.

8.38.4.13 The test system shall be analyzed dynamically to ensure that any mechanical resonance does not distort the output data.

8.38.4.14 Prior to testing, the instrumentation shall be allowed to warm up until stability is achieved.

8.38.4.15 Throughout calibration, verification, and testing, the ambient temperature shall be 20°C to 28°C (68°F to 82°F), and the relative humidity shall be 30 percent to 70 percent.

8.38.5 Procedure.

8.38.5.1 A conditioned specimen shall be positioned on the headform with the horizontal center plane of the helmet parallel within 5 degrees of the reference plane of the headform.

8.38.5.2 The specimen shall be secured to the drop assembly by its retention system so as to maintain this position during the test.

8.38.5.3 No part of the specimen shell shall be cut away to accommodate the test system.

8.38.5.4 No part of the test system, other than the anvil, shall contact the specimen shell either as mounted or during an impact test.

8.38.5.5 The drop assembly with a specimen attached shall be dropped from a height that yields an impact velocity within 2 percent of 3.0 m/sec (9.8 ft/sec).

8.38.5.6 A means of verifying the impact velocity within 2 percent for each impact shall be incorporated in the test system.

8.38.5.7 The acceleration time duration values, peak acceleration, and impact velocity shall be recorded for each test.

8.38.5.8 Each specimen shall be environmentally conditioned prior to each impact in each of the five impact areas specified in Figure 8.38.5.8.

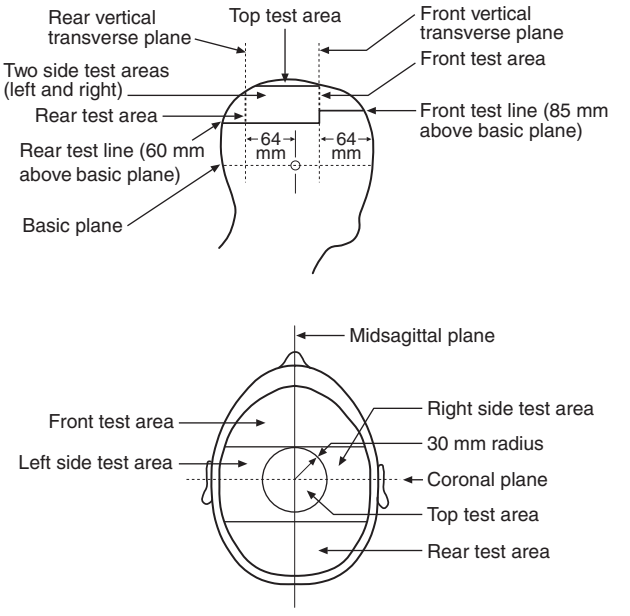


FIGURE 8.38.5.8 Helmet Test Areas and Landmarks.

8.38.5.9 Specimens shall be impacted at the top, front, rear, and side impact areas.

8.38.5.10 Specimen front, rear, and side targeted impact areas shall be at a distance of 63 mm, +13/-0 mm (2½ in., +½/-0 in.) above the test line as shown in Figure 8.38.5.8.

8.38.5.11 The headform with mounted specimen shall be rotated such that the targeted helmet impact area is over the center of the anvil.

8.38.5.12 The impact areas shall be as specified in Figure 8.38.5.8. The top, front, rear, and side areas of the specimen shall be tested.

8.38.5.13 The top impact area shall consist of a 30 mm (1³⁄₁₆ in.) radius measured from a point located on the headform at the junction of the coronal plane and midsagittal plane.

8.38.5.14 The front impact test area shall consist of an area defined as extending forward on the headform from the front vertical transverse plane to the test line.

8.38.5.15 The rear impact test area shall consist of an area defined as extending backward on the headform from the rear vertical transverse plane extending down to the test line.

8.38.5.16 The side test areas shall consist of the areas between the top test area and test line extending from the rear vertical transverse plane and the front vertical transverse plane.

8.38.5.17 Each conditioned specimen in a series shall be impacted once on the top, rear, front, and side test areas of the specimens as defined in Figure 8.38.5.8. At least one impact shall occur in each test area.

8.38.5.18* The initial point of contact of the specimen with the anvil shall not occur on the brim of the specimen.

8.38.5.19 The verification tests shall demonstrate an accuracy of 20 percent or better in the measured acceleration.

8.38.6 Report.

8.38.6.1 The results of each system verification shall be recorded and reported as part of the test results for the specimens being tested.

8.38.6.2 The maximum acceleration shall be recorded and reported for each test.

8.38.7 Interpretation.

8.38.7.1 Pass or fail performance shall be determined for each specimen.

8.38.7.2 One or more specimens failing this test shall constitute failing performance.

8.39 Floatability Test.

8.39.1 Application. This test shall apply to complete protective helmets.

8.39.2 Specimens.

8.39.2.1 Specimens shall be complete protective helmets.

8.39.2.2 A minimum of three specimens shall be tested.

8.39.3 Procedure.

8.39.3.1 Specimens shall be completely immersed in a sufficiently sized vessel of fresh water at a temperature of 21°C, ±3°C (70°F, ±5°F) for a period of 24 hours, +1/-0 hour.

8.39.3.2 The specimen shall then be allowed, over a maximum of 1 minute, to float to the surface.

8.39.4 Report. Observation of each specimen's ability to float within 1 minute shall be recorded and reported.

8.39.5 Interpretation. Any part of the specimen excluding the chin strap breaking the surface shall constitute passing performance.

8.40 Zipper Point Breaking Strength Test.

8.40.1 Application. This test method shall apply to zippers used in protective dry suits and protective ice suits.

8.40.2 Samples.

8.40.2.1 Dry suit zipper samples shall be conditioned as specified in Table 7.2.18.

8.40.2.2 Ice suit zipper samples shall be conditioned as specified in Table 7.2.18.

8.40.3 Specimens. A minimum of three specimens shall be tested.

8.40.4 Procedure Zippers shall be tested as specified in Section 6.3.6.2, Point Breaking Strength Test, of CAN/CGSB-65.16, *Immersion Suit Systems.*

8.40.5 Report.

8.40.5.1 The point breaking strength of each specimen shall be recorded and reported.

8.40.5.2 The average point breaking strength of all specimens shall be calculated, recorded, and reported.

8.40.6 Interpretation.

8.40.6.1 The average point breaking strength shall be used to determine pass or fail performance.

8.40.6.2 Where an individual result from any test set varies more than ±10 percent from the average result, the results from the test set shall be discarded and another set of specimens shall be tested.

8.41 Zipper Leak Resistance Test.

8.41.1 Application. This test method shall apply to zippers used in protective dry suits and protective ice suits.

8.41.2 Samples. Samples shall be conditioned as specified in Section 6.3.6.4, Leak Resistance Test, of CAN/CGSB-65.16, *Immersion Suit Systems.*

8.41.3 Specimens. A minimum of three specimens shall be tested.

8.41.4 Procedure.

8.41.4.1 Zippers shall be tested as specified in Section 6.3.6.4, Leak Resistance Test, of CAN/CGSB-65.16, *Immersion Suit Systems.*

8.41.4.2 Following the test procedure, the specimens shall be examined for any water leakage.

8.41.5 Report. Water leakage shall be recorded and reported.

8.41.6 Interpretation. Any amount of water leakage in any of the test specimens shall constitute failing performance.

8.42 Total Heat Loss Test.

8.42.1 Application. This test method shall apply to the protective dry suit base composites.

8.42.2 Sample Preparation.

8.42.2.1 Samples for conditioning shall be at least a 1 m (1 yd) square of each material.

8.42.2.2 Samples to be tested shall be conditioned as specified at a temperature of 25°C, ±7°C (75°F, ±12°F) and a relative humidity of 65 percent, ±5 percent, for at least 5 hours.

8.42.3 Specimens.

8.42.3.1 Specimen size shall be the size required to cover the sweating guarded hot plate.

8.42.3.2 At least three specimens shall be tested.

8.42.3.3 Specimens shall consist of all layers in the protective garment base composite arranged in the order and orientation as worn and shall not include any reinforcement materials.

8.42.4 Apparatus. The test apparatus shall be as specified in ASTM F 1868, *Standard Test Method for Thermal and Evaporative Resistance of Clothing Materials Using a Sweating Hot Plate.*

8.42.5 Procedure. Testing shall be conducted in accordance with ASTM F 1868, *Standard Test Method for Thermal and Evaporative Resistance of Clothing Materials Using a Sweating Hot Plate,* Part C.

8.42.6 Report.

8.42.6.1 The average intrinsic thermal resistance (R_{cf}) of the sample shall be calculated, recorded, and reported.

8.42.6.2 The average apparent intrinsic evaporative resistance (AR_{ef}) of the sample shall be calculated, recorded, and reported.

8.42.6.3 The average total heat loss (Q_t) of the sample shall be calculated and reported on the product label.

8.42.7 Interpretation. Where an individual result from any test set varies more than ±10 percent from the average result, the results from the test set shall be discarded and another set of specimens shall be tested.