

NFPA®

1999

**Standard on
Protective Clothing and
Ensembles for Emergency
Medical Operations**

2018



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NFPA® 1999

Standard on

Protective Clothing and Ensembles for Emergency Medical Operations

2018 Edition

This edition of NFPA 1999, *Standard on Protective Clothing and Ensembles for Emergency Medical Operations*, was prepared by the Technical Committee on Emergency Medical Services Protective Clothing and Equipment and released by the Correlating Committee on Fire and Emergency Services Protective Clothing and Equipment. It was issued by the Standards Council on August 1, 2017, with an effective date of August 21, 2017, and supersedes all previous editions.

This document has been amended by one or more Tentative Interim Amendments (TIAs) and/or Errata. See “Codes & Standards” at www.nfpa.org for more information.

This edition of NFPA 1999 was approved as an American National Standard on August 21, 2017.

Origin and Development of NFPA 1999

This standard was developed to address protective garments, gloves, and facewear designed that protect persons providing emergency medical care against exposure to liquid-borne pathogens during emergency medical operations. NFPA 1999 defines minimum performance for protective clothing as required by the Occupational Safety and Health Administration (OSHA) Final Rule (29 CFR 1910.1030) *Protecting Health Care Workers from Occupational Exposure to Bloodborne Pathogens*. The Final Rule states:

“When there is occupational exposure, the employer shall provide at no cost to the employee, appropriate personal protective equipment, such as, but not limited to, gloves, gowns, laboratory coats, face shields or masks, and eye protection, and mouthpieces, resuscitation bags, pocket masks, or other ventilation devices. Personal protective equipment will be considered ‘appropriate’ only if it does not permit blood or other potential infectious materials to pass through to or reach the employee’s work clothes, street clothes, undergarments, skin, eyes, mouth, or other mucous membranes under normal conditions of use and for the duration of time which the protective equipment will be used.”

NFPA 1999 offers specific performance criteria that involve exposing protective clothing materials to surrogate virus challenge utilizing a specific time and pressure protocol. This procedure has been documented to discriminate between current protective clothing materials and to correlate with visual penetration results that are obtained with a human factors evaluation. Each type of clothing must resist penetration to blood-borne pathogens as determined by this test.

Additional garment requirements cover overall liquidtight integrity, material strength, physical hazard resistance, seam strength, and closure strength. Additional requirements for gloves cover minimum performance for tensile and elongation properties in an “as received” condition as well as following heat aging and isopropyl alcohol immersion, minimum sizing, and liquidtight integrity for intended areas of penetration.

Additional requirements for facewear or face protection devices cover adequate visibility and integrity, in addition to resisting penetration of blood-borne pathogens.

The selection of test methods and performance requirements was based on surveys of emergency medical services (EMS) personnel and a technical study supported by the U.S. Fire Administration. The Subcommittee on Hazardous Chemicals Protective Clothing began its work on the first edition of this document in 1990 and passed on its work to the Technical Committee on Fire Service Protective Clothing and Equipment in January 1991. The first edition was presented to the Association at the 1992 Annual Meeting in New Orleans, LA.

Since the first edition in 1992, the entire project for fire service protective clothing and equipment was reorganized in January 1995 by the Standards Council. The new project had a

Technical Correlating Committee on Fire and Emergency Services Protective Clothing and Equipment and eight technical committees operating within it. The Technical Committee on Emergency Medical Services Protective Clothing and Equipment was now responsible for NFPA 1999.

In 1997, the second edition incorporated single-use and reusable items of EMS protective clothing. Prior to that edition, there was no differentiation between single-use and reusable items. Items that were reused might not have continued to provide biopenetration barrier protection. Reusable items could be advantageous and cost-effective for certain items of EMS clothing such as garments. Durability conditioning was added to the test methods of items that would be identified as not for single use only. EMS gloves remained single-use items only. This was consistent with NFPA 1581, *Standard on Fire Department Infection Control Program*. EMS gloves were also newly required to be an FDA registered medical device.

The first edition allowed partial body garments, such as sleeve covers or apron-type gowns, and also allowed the biopenetration barrier protection to be less in area than the area covered by the garment (such as only the front of a smock or jacket having the biopenetration barrier protection). The second edition continued to permit partial body garments but did not allow partial biopenetration barrier protection in a garment. Biopenetration barrier protection was required for the full area covered by the garment.

Test methods were completely reformatted to present consistency in test methods and to assure that all key elements of a test were given within the method.

The third edition of NFPA 1999 was reformatted into the new style for all NFPA codes and standards and, therefore, the chapter titles and numbering, as well as paragraph numbering, changed. In that edition, the committee added new requirements for emergency medical work gloves, emergency medical footwear, and cleaning/utility gloves.

Emergency medical work gloves would provide the barrier protection from blood- and liquid-borne pathogens that all EMS PPE provides, and a higher level of physical protection for incidents where rough or sharp surfaces could be contacted, such as during extrication operations. The emergency medical footwear could be configured either as a single-use, disposable bootie to pull over work shoes or as normal footwear designed for multiple uses. Both would provide the same barrier protection from blood- and liquid-borne pathogens as other items of EMS PPE. The cleaning/utility gloves were single-use items to protect wearers during cleaning and decontamination of EMS equipment.

The third (2003) edition of NFPA 1999 was acted on by the NFPA membership at the November Association Technical Meeting in Atlanta, Georgia, on November 20, 2002, and became effective on February 6, 2003.

The 2008 (fourth) edition of NFPA 1999 included a number of changes that were implemented to address emerging needs for EMS providers as well as to address the special protection needs of first receivers at hospitals or other health care facilities. Specific attention was paid to types of emergency medical protective clothing items where certification activity and consequent use of certified products had been limited. Much of the work was supported by a research contract effort funded by the National Institute for Occupational Safety and Health (NIOSH) National Personal Protective Technology Laboratory (NPPTL). The NIOSH NPPTL research program involved a detailed investigation of emergency medical responder needs, identification of evaluation techniques to address these needs, testing of representative products, outreach to end-user groups to assist with discerning acceptable levels of protection, and the proposal of specific criteria. The results of this supporting work are available in the project final report, *Improved Criteria for Emergency Medical Protective Clothing, Contract No. 214-2006-M-15870 Final Report*.

The principal changes incorporated in the fourth edition of NFPA 1999 included the following:

- (1) Differentiation between multiple- and single-use protective garments based on specific physical property criteria.
- (2) Application of a flammability test for certain items of protective clothing to prevent the use of dangerous products in the event of accidental flame contact.
- (3) New design, performance, testing, documentation, and certification requirements for [C]BRN protective ensembles to provide protection for emergency services responders and medical receivers against biological agents and radiological particulates. The use of the [C] in the "[C]BRN" format is to indicate that chemical protection is not offered by this ensemble, while retaining the widely used "CBRN" term. This level of protection would be needed for medical receivers and medical treatment personnel where CBRN incident victims self-present at a medical facility, or the victims have not been decontaminated or only partially decontaminated prior to transport to a medical facility. This [C]BRN protection is not addressed by the single-use garments covered in NFPA 1994, *Standard on Protective Ensembles for First Responders to CBRN Terrorism Incidents*. The new requirements focus on full ensembles that are subject to multiple uses prior to use during a CBRN incident.
- (4) New criteria for head protection to establish protection requirements for impact hazards at emergency sites, and some guidance in the annex provided to also address prevention of trauma to emergency medical personnel traveling inside vehicles.
- (5) New category of footwear to address the physical environments for first receivers at hospitals or other health care facilities.
- (6) Revised criteria for footwear covers to address performance properties consistent with expected use, such as abrasion resistance of sole materials.

- (7) New classification and performance requirements for eye and face protection devices. The new system segregates the different types of eye/face protection into “single-use” and “reusable” devices, and a separate category of medical face masks that are frequently used by emergency services responders during emergency medical care.
- (8) Revision of requirements for cleaning glove performance to eliminate conflicting criteria.
- (9) New optional high-visibility markings criteria for emergency responder protective garments; these optional criteria are consistent with ANSI 107, *Standard on High-Visibility Safety Apparel*.

In addition to the principal changes, a number of clarifications and improvements were made to ensure consistency of requirements throughout the standard.

The fourth (2008) edition was issued by the NFPA Standards Council with an effective date of December 31, 2007.

The fifth (2013) edition of NFPA 1999 was a complete revision of the document that included editorial changes, updates to referenced publications, and new or revised definitions for *gusset*, *tongue*, *interface component*, and *manufacturer*.

The 2013 edition removed the puncture resistance test two and the impact and compression resistance test. Revisions to the abrasion test, slip resistance test, footwear upper materials testing, cut resistance test, washing and drying procedures, and chemical permeation resistance test were also included. This edition also featured a new section on work glove test areas.

The sixth (2018) edition of NFPA 1999 was a complete revision and mainly featured the incorporation of TIA 13-1 [related to the PPE requirements of first responders and medical first receivers against Ebola Viral Disease (EBD) and other highly infectious liquid-borne pathogens]. This edition features new provisions for performance requirements for PPE ensembles that offer full body protection and a liquid integrity evaluation to demonstrate an established protective level of performance.

Other changes include adding the word “ensembles” to the name of the standard. NFPA 1999 now also applies to single-use and multiple-use emergency protective ensembles and provides definitions for those terms. Changes were also made to the design requirements for garment footwear and respirator requirements. Changes were made to the liquidtight integrity test and the puncture resistance test. *Elastomer interface material* is now defined, and new performance requirements for those items was added. This one item alone resulted in a number of editorial changes for consistency throughout the standard.

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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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Committee Scope: This Committee shall have primary responsibility for documents on protective clothing and protective equipment, except respiratory protective equipment, that provides hand, torso, limb, and face protection for fire fighters or other emergency services responders during incidents that involve emergency medical operations. These operations include first aid, cardiopulmonary resuscitation, basic life support, advanced life support, and other medical procedures provided to patients prior to arrival at a hospital or other health care facility.

Additionally, this committee shall have primary responsibility for documents on the selection, care, and maintenance of emergency medical protective clothing and protective equipment by fire and emergency services organizations and personnel.

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NFPA 1999

Standard on

Protective Clothing and Ensembles for Emergency Medical Operations

2018 Edition

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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.

A reference in brackets [] following a section or paragraph indicates material that has been extracted from another NFPA document. As an aid to the user, the complete title and edition of the source documents for extracts in mandatory sections of the document are given in Chapter 2 and those for extracts in informational sections are given in Annex B. Extracted text may be edited for consistency and style and may include the revision of internal paragraph references and other references as appropriate. Requests for interpretations or revisions of extracted text shall be sent to the technical committee responsible for the source document.

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

Chapter 1 Administration

1.1 Scope.

1.1.1* This standard shall specify the minimum design, performance, testing, documentation, and certification requirements for new single-use and new multiple-use emergency medical operations protective clothing, including garments, helmets, gloves, footwear, and face protection devices, used by emergency medical responders prior to arrival at medical care facilities, used by medical first receivers at medical care facilities during emergency medical operations, and used by health care workers providing medical and supportive care.

1.1.2 This standard shall also specify additional minimum design, performance, testing, documentation, and certification as requirements for single-use and multiple-use emergency medical protective ensembles comprising the protective cloth-

ing items described in 1.1.1 for protection from airborne and liquid-borne pathogens.

1.1.3* This standard shall not be interpreted as specifying requirements for protection from chemical, biological, radioactive, and nuclear (CBRN) terrorism agents, from radiological agents, from hazardous chemicals, from flammable or explosive atmospheres, or from thermal hazards.

1.1.4 This standard shall also specify requirements for respiratory protective devices that are not already covered in 42 CFR 84, "Approval for Respiratory Protective Devices," that are intended for emergency medical operations by first responders, first receivers, and health care workers providing medical and supportive care.

1.1.5* Certification of all emergency medical ensemble elements and protective clothing items, and medical care facility ensemble elements and protective clothing items, as compliant with the requirements of this standard, shall not preclude certification to additional appropriate standards where the ensemble elements or protective clothing items meet all applicable requirements of each standard.

1.1.6* This standard shall not be construed as addressing all of the safety concerns associated with the use of compliant emergency medical operations protective clothing for the protection of their personnel. It shall be the responsibility of the persons and organizations that use this standard to conduct testing of protective clothing to establish safety and health practices and determine the applicability of regulatory limitations prior to using this standard for any designing, manufacturing, and testing.

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 conduct testing of protective clothing and ensembles to establish safety and health practices and determine the applicability of regulatory limitations prior to using this standard for any designing, manufacturing, and testing.

1.1.8* This standard shall not specify requirements for any accessories that could be attached to the certified product but are not necessary for the certified product to meet the requirements of this 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 a minimum level of protection from contact with blood and body fluid-borne pathogens for personnel performing patient care during emergency medical operations.

1.2.2 The purpose of this standard shall also be to establish a minimum level of whole body protection for emergency services personnel and medical first receivers from airborne and liquid-borne pathogens.

1.2.3 To achieve these purposes, this standard shall establish for emergency medical responders and medical first receivers the minimum requirements for upper and lower torso, head, hands, foot, and face protection devices to minimize skin and mucous membrane contact with body fluid-borne pathogens.

1.2.4 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 personnel can be exposed.

1.2.5* This standard shall not be interpreted or used 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, performance, testing, and certification of new emergency medical garments, emergency medical examination gloves, emergency medical helmets, emergency medical cleaning/utility gloves, emergency medical work gloves, emergency medical facemasks, emergency medical face protection devices, emergency medical footwear and footwear covers, care facility footwear, and single-use and multiple-use emergency protective ensembles.

1.3.2 This edition of NFPA 1999 shall not apply to any emergency medical operations protective clothing manufactured to previous editions of this standard.

1.3.3 This standard shall not apply to any emergency medical operations protective clothing manufactured to the requirements of any other standard.

▲ **1.3.4*** Other than the certification of emergency medical protective ensembles to the single-use and multiple-use ensemble requirements of this standard, this standard shall not apply to respiratory protection in emergency medical operations, as such requirements are specified by NIOSH in 42 CFR 84, and by OSHA in 29 CFR 1910.134 and 29 CFR 1910.1030.

● **1.3.5** This standard shall not apply to the use of or conditions of use for emergency medical protective clothing and ensembles by emergency medical responders and medical first receivers.

1.3.6 This standard shall not apply to any accessories that could be attached to the certified product, before or after purchase, but are not necessary for the certified product to meet the requirements of this standard.

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 are 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 704, *Standard System for the Identification of the Hazards of Materials for Emergency Response*, 2017 edition.

NFPA 1500, *Standard on Fire Department Occupational Safety, Health, and Wellness Program*, 2018 edition.

NFPA 1581, *Standard on Fire Department Infection Control Program*, 2015 edition.

NFPA 1951, *Standard on Protective Ensembles for Technical Rescue Incidents*, 2013 edition.

NFPA 1971, *Standard on Protective Ensembles for Structural Fire Fighting and Proximity Fire Fighting*, 2018 edition.

NFPA 1991, *Standard on Vapor-Protective Ensembles for Hazardous Materials Emergencies and CBRN Terrorism Incidents*, 2016 edition.

NFPA 1992, *Standard on Liquid Splash-Protective Ensembles and Clothing for Hazardous Materials Emergencies*, 2018 edition.

NFPA 1994, *Standard on Protective Ensembles for First Responders to Hazardous Materials Emergencies and CBRN Terrorism Incidents*, 2018 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*, 2013.

AATCC 61, *Colorfastness to Laundering, Home and Commercial: Accelerated*, 2013.

AATCC 70, *Test Method for Water Repellency: Tumble Jar Dynamic Absorption Test*, 2015.

AATCC 135, *Dimensional Changes in Automatic Home Laundering of Woven and Knit Fabrics*, 2004.

▲ **2.3.2 ANSI Publications.** American National Standards Institute, 25 West 43rd Street, 4th Floor, New York, NY 10036.

ANSI/ISEA 107, *American National Standard for High-Visibility Safety Apparel and Accessories*, 2015.

ANSI Z87.1, *American National Standard for Occupational and Educational Eye and Face Protection Devices*, 2015.

ANSI/ISEA Z89.1, *American National Standard for Industrial Head Protection*, 2014.

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

ASTM B117, *Standard Practice for Operating Salt Spray (Fog) Apparatus*, 2011.

ASTM D412, *Standard Test Methods for Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers — Tension*, 2015a.

ASTM D573, *Standard Test Method for Rubber-Deterioration in an Air Oven*, 2015.

ASTM D1230, *Standard Test Method for Flammability of Apparel Textiles*, 2016.

ASTM D1683/D1683M, *Standard Test Method for Failure in Sewn Seams of Woven Apparel Fabrics*, 2011a.

ASTM D1776/D1776M, *Standard Practice for Conditioning and Testing Textiles*, 2016.

ASTM D2582, *Standard Test Method for Puncture-Propagation Tear Resistance of Plastic Film and Thin Sheetings*, 2016.

ASTM D3787, *Method for Bursting Strength of Textiles — Constant-Rate-of-Traverse (CRT) Ball Burst Test*, 2016.

ASTM D3884, *Standard Test Method for Abrasion Resistance of Textile Fabrics (Rotary Platform, Double-Head Method)*, 2013, 2013e1.

ASTM D4966, *Standard Test Method for Abrasion Resistance of Textile Fabrics (Martindale Abrasion Test Method)*, 2012, 2012e1.

ASTM D5034, *Standard Test Method for Breaking Strength and Elongation of Textile Fabrics (Grab Test)*, 2013.

ASTM D5151, *Standard Test Method for Detection of Holes in Medical Gloves*, 2015.

ASTM D5169, *Standard Test Method for Shear Strength (Dynamic Method) of Hook and Loop Touch Fasteners*, 2015.

ASTM D5170, *Standard Test Method for Peel Strength ("T" Method) of Hook and Loop Touch Fasteners*, 2015.

ASTM D5587, *Standard Test Method for Tearing of Fabrics by Trapezoid Procedure*, 2015.

ASTM D5712, *Standard Test Method for Analysis of Aqueous Extractable Protein in Latex, Natural Rubber, and Elastomeric Products Using the Modified Lowry Method*, 2015.

ASTM E96/E96M, *Standard Test Methods for Water Vapor Transmission of Materials*, 2016.

ASTM E809, *Standard Practice for Measuring Photometric Characteristics of Retroreflectors*, 2013.

ASTM F739, *Standard Test Method for Permeation of Liquids and Gases through Protective Clothing Materials under Conditions of Continuous Contact*, 2012 e1.

ASTM F1154, *Standard Practice for Qualitatively Evaluating the Comfort, Fit, Function, and Durability of Protective Ensembles and Ensemble Components*, 2011.

ASTM F1342/F1342M, *Standard Test Method for Protective Clothing Material Resistance to Puncture*, 2013.

ASTM F1359/F1359M, *Standard Test Method for Liquid Penetration Resistance of Protective Clothing or Protective Ensembles Under a Shower Spray While on a Manikin*, 2016.

ASTM F1671/F1671M, *Standard Test Method for Resistance of Materials Used in Protective Clothing to Penetration by Blood-Borne Pathogens Using Phi-X174 Bacteriophage Penetration as a Test System*, 2013.

ASTM F1790, *Test Methods for Measuring Cut Resistance of Materials Used in Protective Clothing*, 2005.

ASTM F1862, *Standard Test Method for Resistance of Medical Face Masks to Penetration by Synthetic Blood (Horizontal Projection of Fixed Volume at a Known Velocity)*, 2013.

ASTM F1868, *Standard Test Method for Thermal and Evaporative Resistance of Clothing Materials Using a Sweating Hot Plate*, 2014.

ASTM F2010/F2010M, *Standard Test Method for Evaluation of Glove Effects on Wearer Hand Dexterity Using a Modified Pegboard Test*, 2010.

ASTM F2100, *Standard Specification for Performance of Materials Used in Medical Face Masks*, 2011.

ASTM F2413, *Standard Specification for Performance Requirements for Protective (Safety) Toe Cap Footwear*, 2011.

ASTM F2913, *Standard Test Method for Measuring the Coefficient of Friction for Evaluation of Slip Performance of Footwear and Test Surfaces/Flooring Using a Whole Shoe Tester*, 2011.

ASTM F2961, *Standard Test Method for Characterizing Gripping Performance of Gloves Using a Torque Meter*, 2015.

△ **2.3.4 CENELEC Publications.** CENELEC, European Committee for Electrotechnical Standardization, CEN-CENELEC Management Centre, Avenue Marnix 17, 4th floor, B-1000 Brussels, Belgium.

EN 420, *Protective Gloves — General requirements and test methods*, 2003 + A1: 2009.

EN 455-2, *Medical gloves for single use — Part 2: Requirements and testing for physical properties*, 2015.

△ **2.3.5 FIA Publications.** Footwear Industries of America, 1420 K Street, NW, Suite 600, Washington, DC 20005.

FIA Standard 1209, *Whole Shoe Flex*, 1984.

△ **2.3.6 ISO Publications.** International Organization for Standardization, ISO Central Secretariat, BIBC II, Chemin de Blandonnet 8, CP 401, 1214 Vernier, Geneva, 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 Guide 27, *Guidelines for corrective action to be taken by a certification body in the event of misuse of its mark of conformity*, 1983.

ISO Guide 62, *General requirements for bodies operating assessment and certification/registration of quality systems*, 1996.

ISO 2859-1, *Sampling schemes indexed by acceptance quality limit (AQL) for lot-by-lot inspection*, 1999/Amd 1:2011.

ISO 4649, *Rubber, vulcanized or thermoplastic — Determination of abrasion resistance using rotating cylindrical drum device*, 2010.

ISO 9001, *Quality management systems — Requirements*, 2008.

ISO 9001, *Quality management systems — Requirements*, 2015.

ISO 11092, *Textiles — Physiological effects — Measurement of thermal and water-vapor resistance under steady-state conditions (sweating guarded-hotplate test)*.

ISO/IEC 17011, *Conformity assessment — General requirements for accreditation bodies accrediting conformity assessment bodies*, 2004.

ISO/IEC 17021, *Conformity assessment — Requirements for bodies providing audit and certification of management systems — Part 1: Requirements*, 2015.

ISO/IEC 17025, *General requirements for the competence of testing and calibration laboratories*, 2005.

ISO 17065, *Conformity assessment — Requirements for bodies certifying products, processes, and services*, 2012.

△ **2.3.7 Psychological Corporation Publications.** Psychological Corporation, 555 Academic Court, San Antonio, TX 78204.

Crawford Small Parts Dexterity Test, 1981.

▲ **2.3.8 U.S. Government Publications.** U.S. Government Publishing Office, 732 North Capitol Street, NW, Washington, DC 20401-0001.

Title 29, Code of Federal Regulations, Part 1910.132, "General Requirements of Subpart I, Personal Protective Equipment."

Title 29, Code of Federal Regulations, Part 1910.134, "Respiratory Protection."

Title 29, Code of Federal Regulations, Part 1910.1030, "Protecting Health Care Workers from Occupational Exposure to Blood-Borne Pathogens."

Title 42, Code of Federal Regulations, Part 84, "Approval of Respiratory Protective Devices."

▲ **2.3.9 Department of Defense Publications.** Standardization Documents Order Desk, Building 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.

A-A-55126B, *Commercial Item Description: Fastener Tapes, Hook and Loop, Pile, Synthetic*, 2006.

A-A-55634A, *Commercial Item Description: Zippers (Fasteners, Slide, Interlocking)*, 2004.

▲ **2.3.10 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 (AHJ). 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 or service meets appropriate designated standards or has been tested and found suitable for a specified purpose.

ment, 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. An NFPA Standard, the main text of which contains only mandatory provisions using the word "shall" to indicate requirements and that is in a form generally suitable for mandatory reference by another standard or code or for adoption into law. Nonmandatory provisions are not to be considered a part of the requirements of a standard and shall be located in an appendix, annex, footnote, informational note, or other means as permitted in the NFPA Manuals of Style. When used in a generic sense, such as in the phrase "standards development process" or "standards development activities," the term "standards" includes all NFPA Standards, including Codes, Standards, Recommended Practices, and Guides.

3.3* General Definitions.

3.3.1 Accessories. An item, or items, that are attached to the certified product that are not necessary to meet the requirements of the standard.

3.3.2 Afterflame. Persistent flaming of a material after the ignition source has been removed.

3.3.3 Afterflame Time. The length of time for which a material continues to flame after the ignition source has been removed.

3.3.4 Arch. The bottom curve of the foot from the heel to the ball.

3.3.5 Barrier Layer. The layer of garment material, glove material, footwear material, or face protection device material designated as providing body fluid-borne pathogen resistance.

3.3.6 Biological Terrorism Agents. Liquid or particulate agents that can consist of biologically derived toxin or pathogen to inflict lethal or incapacitating casualties.

3.3.7 Body Fluid-Borne Pathogen. An infectious bacterium or virus carried in human, animal, or clinical body fluids organs, or tissue.

3.3.8 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, sweat, vomit, and pericardial fluid.

3.3.9 Brim. A part of the shell of the helmet that extends around the entire circumference of the helmet.

3.3.10 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 manufacturer to determine compliance with the requirements of this standard.

3.3.11 Certification Organization. An independent, third-party organization that determines product compliance with

the requirements of this standard with a labeling/listing/follow-up program.

3.3.12 Combined Performance Material. A retroreflective material that is also a fluorescent material.

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

3.3.14 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.

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

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

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

N 3.3.18 Elastomer. A polymeric material that returns to its original length and shape after stretching.

N 3.3.19 Elastomer Interface Material. An exposed elastomeric material that is not otherwise used as a garment material, which provides an interface between components of the ensemble or ensemble elements, and if applicable, the interface between the respirator facepiece and the ensemble or ensemble elements.

3.3.20 Elements. See 3.3.35, Ensemble Elements.

3.3.21* Emergency Medical Cleaning/Utility Glove. Multipurpose glove that provides a barrier against body fluids, cleaning fluids, and disinfectants and limited physical protection to the wearer.

3.3.22 Emergency Medical Examination Glove. An element or item of emergency medical protective ensemble or protective clothing that is designed and configured to provide barrier protection to the wearer's hand to at least the wrist. (See 3.3.33, Emergency Medical Work Glove.)

3.3.23* Emergency Medical Eye and Face Protection Device. An item of emergency medical protective clothing that is designed and configured to provide barrier protection to the wearer's eyes, face, or both eyes and face.

3.3.24* Emergency Medical Facemask. An item of emergency medical protective clothing that is designed and configured to provide protection to the wearer's face including the mucous membrane area of the wearer's nose and mouth.

3.3.25 Emergency Medical Footwear. An element or item of emergency medical protective ensemble or protective clothing that is designed and configured to provide barrier protection to the wearer's feet.

3.3.26 Emergency Medical Footwear Cover. An element or item of emergency medical protective ensemble or protective clothing designed and configured to be worn over standard footwear to provide barrier and limited physical protection to the wearer's feet.

3.3.27* Emergency Medical Garment. An element or item of emergency medical protective ensemble or protective clothing designed and configured as a single garment or an assembly of multiple garments to provide barrier protection to the wearer's upper and lower torso, excluding the hands, face, and feet.

3.3.28 Emergency Medical Helmet. An item of emergency medical protective clothing designed and configured to provide protection to the wearer's head.

3.3.29* Emergency Medical Operations. Provision of emergency patient care and transportation prior to arrival at a medical care facility by emergency medical responders, emergency patient care by medical first receivers at a medical care facility, and body recovery by emergency medical responders.

N 3.3.30 Emergency Medical Powered Air-Purifying Respirator. An element or item of an emergency medical protective ensemble designed and configured to provide respiratory protection to the wearer from airborne infectious diseases, to act as a barrier, and to provide limited physical protection to the wearer's head and neck.

3.3.31* Emergency Medical Protective Clothing. Items of both single-use and multiple-use protective clothing that provide limited physical protection and barrier protection against body fluid-borne pathogen contact with the wearer's body during delivery of emergency patient care and other emergency medical functions. (See 3.3.21, Emergency Medical Cleaning/Utility Glove; 3.3.22, Emergency Medical Examination Glove; 3.3.23, Emergency Medical Eye and Face Protection Device; 3.3.24, Emergency Medical Facemask; 3.3.25, Emergency Medical Footwear; 3.3.26, Emergency Medical Footwear Cover; 3.3.27, Emergency Medical Garment; 3.3.28, Emergency Medical Helmet; and 3.3.33, Emergency Medical Work Glove.)

3.3.32 Emergency Medical Responders. Emergency services response personnel who perform emergency medical operations prior to arrival at a medical care facility.

3.3.33 Emergency Medical Work Glove. An element or item of emergency medical protective ensemble or protective clothing that is designed and configured to provide physical and barrier protection to the wearer's hand and wrist. (See also 3.3.22, Emergency Medical Examination Glove.)

3.3.34 Emergency Patient Care. Treatment of patients by emergency medical responders or medical first receivers including first aid, cardiopulmonary resuscitation, basic life support, advanced life support, and other medical procedures that occur prior to arrival at a medical care facility, or after arrival at a medical care facility.

3.3.35 Ensemble Elements. The compliant products that provide protection to the upper and lower torso, arms, legs, head, hands, and feet.

3.3.36 Examination Glove. An abbreviated term for emergency medical examination glove. (See also 3.3.22, Emergency Medical Examination Glove.)

3.3.37 Fluorescence. A process by which radiant flux of certain wavelengths is absorbed and reradiated non-thermally in other, usually longer, wavelengths.

3.3.38 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.

3.3.39 Footwear. An abbreviated term for emergency medical footwear. (See also 3.3.25, Emergency Medical Footwear.)

3.3.40 Footwear Cover. An abbreviated term for emergency medical footwear cover. (See also 3.3.26, Emergency Medical Footwear Cover.)

3.3.41 Garment. An abbreviated term for emergency medical garment. (See also 3.3.27, Emergency Medical Garment.)

3.3.42 Garment Closure. The garment component designed and configured to allow the wearer to enter (don) and exit (doff) the garment.

3.3.43 Garment Closure Assembly. The combination of the garment closure and the seam attaching the garment closure to the garment, excluding any protective flap or cover.

3.3.44 Garment Material. All material layers used in the construction of emergency medical garments other than patches, reinforcements, and visibility markings.

3.3.45 Glove. See 3.3.21, Emergency Medical Cleaning/Utility Glove; 3.3.22, Emergency Medical Examination Glove; and 3.3.33, Emergency Medical Work Glove.

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

3.3.47 Glove Material. All material layers used in the construction of gloves.

3.3.48* Gusset. The part of the protective footwear that is a relatively flexible material joining the footwear upper (quarter) and the tongue, which is intended to provide expansion of the footwear front to enable donning of the footwear while maintaining continuous moisture integrity of the footwear.

3.3.49 Hazardous Materials. Any solid, liquid, gas, or mixture thereof that can potentially cause harm to the human body through respiration, ingestion, skin absorption, or contact.

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

3.3.51 Helmet. See 3.3.28, Emergency Medical Helmet.

3.3.52 Helmet Shell. A helmet without the suspension system, accessories, and fittings.

3.3.53 Insole. The inner part of the protective footwear upon which the foot rests and that conforms to the bottom of the foot.

3.3.54 Interface Component(s). Any material, part, or subassembly used in the construction of the **compliant** product that provides limited protection to interface areas.

3.3.55 Manufacturer. The entity that directs and 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.

3.3.56* Medical Care Facility Footwear. An item of emergency medical protective clothing that is designed and configured to provide protection to the wearer's feet and ankles at medical care facilities.

3.3.57 Medical First Receivers. Clinicians and other medical care staff at a medical care facility who have a role in emergency patient care including initial triage, decontamination, and treatment for patients who are delivered by emergency

medical services or who self-present at a medical care facility, and those staff whose roles support these functions, e.g., security, set up, and patient tracking.

3.3.58 Medical Responders. See 3.3.32, Emergency Medical Responders.

3.3.59 Model. The collective term used to identify a group of individual 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.

3.3.60* Multiple Use. Items that are designed to be repeatedly worn and used for protection during emergency medical operations.

3.3.61* Multiple-Use Emergency Medical Protective Ensemble. Multiple elements of compliant protective clothing and equipment providing full body coverage, intended for multiple use, that when worn together provide protection from some risks, but not all risks, of emergency medical operations.

3.3.62 Nape Device. A device located below the Bitracion Inion Arc used to aid in helmet retention.

3.3.63 Package. The wrapping or enclosure directly containing a glove or face protection device.

3.3.64 Package Product Label. The product label that is printed on or attached to a package containing one or more compliant products. (See also 3.3.66, Product Label.)

3.3.65 Peak. An integral part of the helmet shell extending forward over the eyes only.

3.3.66* Product Label. A label or marking affixed to each compliant garment, glove, or face protection device by the manufacturer. (See also 3.3.64, Package Product Label.)

3.3.67 Radiological Particulate Terrorism Agents. Particles that emit ionizing radiation in excess of normal background levels, used to inflict lethal or incapacitating casualties, generally on a civilian population as a result of terrorist attack.

3.3.68 Retroreflection. 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.

3.3.69 Retroreflective Markings. A material that reflects and returns a relatively high proportion of light in a direction in the direction close to the direction from which it came.

3.3.70 Safety Alert. The action by which a manufacturer identifies a specific compliant product or a compliant product component, provides notice to users of the compliant product, and informs the marketplace and distributors of potential safety concerns regarding the product or component.

3.3.71 Sample. The ensemble, element, item, component, or composite that is conditioned for testing. (See also 3.3.76, Specimen.)

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

3.3.73 Shell. A helmet without the suspension system, accessories, and fittings.

3.3.74* Single-Use Emergency Medical Protective Ensemble. Multiple elements of compliant protective clothing and equipment providing full body coverage, intended for a single use, that when worn together provide protection from some risks, but not all risks, of emergency medical operations.

3.3.75* Single-Use Item. Items that are designed to be used one time and then disposed of.

3.3.76 Specimen. The conditioned element, item, component, or composite that is tested. Specimens are taken from samples. (See also 3.3.71, *Sample*.)

3.3.77 Splash-Resistant Eyewear. Safety glasses, prescription eyewear with protective side shields, goggles, or chin-length face shields that, when worn properly, provide limited protection against splashes, spray, spatters, or droplets of body fluids.

3.3.78 Storage Life. The life expectancy of protective clothing and ensemble elements from the date of manufacture when it is only stored and inspected and has undergone proper care and maintenance in accordance with the manufacturer's instructions, but not used, donned, doffed, or repaired.

3.3.79* Tongue. The part of the protective footwear that is provided for protective footwear with a closure that extends from the vamp to the top line of the footwear between sides of the footwear upper and is exposed to the exterior environment when the footwear is correctly donned.

3.3.80 Trace Number. A code that can be used to retrieve the production history of a product (e.g., a lot or serial number).

3.3.81 Upper. That part of the protective footwear including, but not limited to, the toe, vamp, quarter, shaft, collar, and throat; but not including the sole with heel, puncture-resistant device, and insole.

3.3.82* Visibility Materials. Fluorescent and retroreflective materials used in the construction of garments to provide conspicuity for the purpose of providing both daytime and nighttime visibility of the wearer.

N 3.3.83 Visor Material. The transparent material that allows the wearer to see outside the protective garment hood.

3.3.84 Wear Surface. A footwear term for the bottom of the sole, including the heel.

3.3.85 Work Glove. An abbreviated term for emergency medical work glove. (See also 3.3.33, *Emergency Medical Work Glove*.)

Chapter 4 Certification

4.1 General.

4.1.1 The process of certification for protective ensembles and ensemble elements as being compliant with NFPA 1999 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, Manufacturers' 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 protective clothing items, protective ensembles, and ensemble elements that are labeled as being

compliant with this standard shall meet or exceed all applicable requirements specified in this standard and shall be certified.

4.1.2.1 The certification organization shall permit only the certification of complete single-use and multi-use protective ensembles that include the garments, glove, footwear, and other elements specified in Section 6.7 and Section 6.8 respectively.

4.1.2.2 The certification organization shall further require that the single-use and multi-use protective ensemble manufacturer specify the respiratory protection for the ensemble.

△ 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 (PPE) in accordance with ISO 17065, *Conformity assessment — Requirements for bodies certifying products, processes, and services*. The accreditation shall be issued by an accreditation body operating in accordance with ISO/IEC 17011, *Conformity assessment — 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 1999, in any statements about their respective product(s) unless the product(s) is certified as compliant to this standard.

4.1.5 All compliant protective ensembles and ensemble elements shall be labeled.

4.1.6 All compliant protective ensembles and ensemble elements shall be listed by the certification organization. The listing shall uniquely identify the certified product, for example, by style, model number, or part number.

4.1.7 All compliant protective ensembles and ensemble elements shall also have a product label that meets the requirements specified in Section 5.1, Product Label Requirements for Emergency Medical Protective Clothing Items.

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.

4.1.9 The certification organization shall not issue any new certifications to the 2013 edition of this standard on or after the NFPA effective date for the 2018 edition, which is August 21, 2017.

4.1.10 The certification organization shall not permit any manufacturer to continue to label any protective clothing items that are certified as compliant with the 2013 edition of this standard on or after August 21, 2018.

4.1.11 The certification organization shall require manufacturers to remove all certification labels and product labels indicating compliance with the 2013 edition of this standard from all protective ensembles and ensemble elements that are under the control of the manufacturer on August 21, 2018, and the certification organization shall verify that this action is taken.

4.2 Certification Program.

4.2.1* The certification organization shall not be owned or controlled by manufacturers or vendors of the product 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 PPE in accordance with ISO/IEC 17065, *Conformity assessment — Requirements for bodies certifying products, processes, and services*. The accreditation shall be issued by an accreditation body operating in accordance with ISO 17011, *Conformity assessment — 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 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 The sample product shall be evaluated by the certification organization to verify the product's continued compliance in order to assure that the materials, components, and manufacturing quality assurance systems are consistent with the materials, components, and manufacturing quality assurance that were inspected and tested by the certification organization during certification and recertification.

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 the result to be in jeopardy of not complying with this standard, the certification organization shall conduct more frequent testing of the 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 protective ensembles and ensemble elements, 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/IEC 17025, *General requirements for the competence of calibration and testing 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/IEC 17011, *Conformity assessment — 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/IEC 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/IEC 17011, *Conformity assessment — 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 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 protective clothing element or item.

4.3.6 Inspection by the certification organization shall include an evaluation of any symbols and pictorial 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 by the certification organization shall include a review of the user information required by Section 5.2 to ensure that the information has been developed and is available.

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

4.3.9.1 Testing shall be performed on specimens representative of materials and components used in the actual construction of the protective ensemble and ensemble element.

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

4.3.10 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.

4.3.11 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.

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

4.3.13 The certification organization shall test ensemble elements with the specific ensemble(s) with which they are to be certified.

4.3.14 Any change in the design, construction, or material 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.

4.3.15 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 individual elements of the protective ensemble that are labeled as being compliant with this standard shall undergo recertification on an annual basis. (See Table 4.4.1.) This recertification shall include the following:

- (1) Inspection and evaluation to all design requirements as required by this standard on all manufacturer models and components
- (2) Testing to all performance requirements as required by this standard on all manufacturer models and components within the following protocol:
 - (a) Where a test method incorporates testing both before and after the laundering condition 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 the laundering condition 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 recertifications shall cycle through the remaining conditioning procedures to ensure

that all required conditionings are included over time.

- (c) Where a test method requires the testing on three specimens, a minimum of one specimen shall be tested for annual recertification.
- (d) Where a test method requires the testing of five or more specimens, a minimum of two specimens shall be tested for annual recertification.

4.4.2 Samples of manufacturer models and components for recertification acquired from the manufacturer or component supplier during random and unannounced visits as part of the follow-up inspection program in accordance with 4.2.9 shall be permitted to be used toward annual recertification.

4.4.3 The manufacturer shall maintain all design and performance inspection 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 Manufacturer's 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.

4.5.3.2 Where the registrar specified in 4.5.3.1 is currently accredited for personal protective equipment in accordance with the 1996 edition of ISO Guide 62, *General requirements for bodies operating assessment and certification/registration of quality systems*, that accreditation shall be permitted until September 14, 2008.

4.5.3.3 Not later than September 14, 2008, registrars specified in 4.5.3.1 shall be accredited for personal protective equipment in accordance with the 2006 edition of ISO/IEC 17021, *Conformity assessment — Requirements for bodies providing audit and certification of management systems*.

4.5.3.4 Any new accreditations for registrars specified in 4.5.3.1 for personal protective equipment shall only be in accordance with the 2011 edition of ISO/IEC 17021, *Conformity assessment — Requirements for bodies providing audit and certification of management systems*.

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.

4.5.5* Where the manufacturer uses subcontractors in the construction or assembly of the compliant product, the loca-

tions 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 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 products 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 a 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, 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 the manufacturer of the compliant product component if applicable, 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.

N Table 4.4.1 Initial Certification and Annual Recertification

Product Conditioning	Test/Section Number	Time	Samples for Conditioning
Single-use emergency medical garments and ensembles	Design Requirements (6.1) Liquidtight Integrity Test One (8.2) Biopenetration Test One (8.3) Burst Strength (8.5) Puncture Propagation Tear Resistance Test (8.6) Seam Breaking Strength Test (8.8) Moisture Vapor Transmission Rate Test (8.28) Flammability Test (8.39) Overall Function and Integrity (8.40)	Annual Annual Annual Annual Annual Annual Annual Annual Annual	Garment Garment Garment Initial certification: garment Garment
Multiple-use emergency medical garments	Design Requirements (6.1) Liquidtight Integrity Test One (8.2) Biopenetration Test One (8.3) Tensile Strength Test (8.4) Burst Strength (8.5) Puncture Propagation Tear Resistance Test (8.6) Tear Resistance Test One (8.7) Seam Breaking Strength Test (8.8) Water Absorption Resistance Test (8.31) Total Heat Loss Test (8.32) Evaporative Resistance (8.42) Label Durability and Legibility Test (8.33) Corrosion Resistance Test (8.22) Flammability Test (8.39) Visor Drop Ball Impact Resistance (8.41) Fastener Tape Strength Overall Function and Integrity (8.40)	Annual Annual Annual Annual Annual Annual Annual Annual Annual Annual Annual Annual Annual Annual Annual Annual Annual	Garment Garment Garment barrier layer and seams Garments or 1 m ² (10.7 ft ²) of composite materials Garments or 1 m ² (10.7 ft ²) of composite materials Garments or 1 m ² (10.7 ft ²) of composite materials Garments or 1 m ² (10.7 ft ²) of composite materials Garment seams Garments or 1 m ² (10.7 ft ²) of composite materials 1 m ² (10.7 ft ²) of composite materials 1 m ² (10.7 ft ²) of composite materials Labels applied to 1 m ² (10.7 ft ²) of composite materials Complete hardware items 1 m ² (10.7 ft ²) of composite materials Visors or visor material Fastener tape Garment
Single-use emergency medical examination gloves	Design Requirements (6.2) Liquidtight Integrity Test Two (8.9) Biopenetration Test Two (8.10) Ultimate Tensile Strength Test (8.11) Ultimate Elongation Test (8.12) Puncture Resistance Test One (8.13) Dexterity Test One (8.14) Protein Content Test (8.15)	Annual Annual Annual Annual Annual Annual Annual Annual	Gloves Gloves Gloves Gloves Gloves Gloves Gloves Gloves
Single-use emergency medical cleaning/utility gloves	Design Requirements (6.2) Liquidtight Integrity Test Two (8.9) Biopenetration Test Two (8.10) Chemical Permeation Resistance Test (8.24) Ultimate Tensile Strength Test (8.11) Puncture Resistance Test One (8.13) Cut resistance Test (8.18) Abrasion Resistance Test Two (8.25) Dexterity Test Two (8.26) Tactility Test (8.30) Flammability Test (8.39)	Annual Annual Annual Annual Annual Annual Annual Annual Annual Annual Annual	Gloves Gloves Gloves Glove barrier materials Gloves Gloves or glove composite swatches Gloves or glove composite swatches Gloves or glove composite swatches Gloves Gloves Gloves Gloves or glove composite swatches

(continues)

N Table 4.4.1 *Continued*

Product Conditioning	Test/Section Number	Time	Samples for Conditioning
Multiple-use emergency medical work gloves	Design Requirements (6.2) Overall Liquid Integrity Test Three (8.29) Biopenetration Test One (8.3) Puncture Resistance Test One (8.13) Cut resistance Test (8.18) Abrasion Resistance Test Two (8.25) Dexterity Test Two (8.26) Torque Test (8.27) Tactility Test (8.30) Corrosion Resistance Test (8.22) Flammability Test (8.39)	Annual Annual Annual Annual Annual Annual Annual Annual Annual Annual	Gloves Gloves Gloves or glove composite swatches Gloves or glove composite swatches Gloves or glove composite swatches Gloves or glove composite swatches Gloves Gloves Gloves Complete hardware items Gloves or glove composite swatches
Single-use emergency medical facemasks	Design Requirements (6.3) ASTM F2100 Liquidtight Integrity Test Three (8.17)	Annual Annual Annual	Facemasks Per ASTM F2100 Facemasks
Single-use emergency medical eye and face protection devices	Design Requirements (6.3) Biopenetration Test One (8.3) Liquidtight Integrity Test Three (8.17) Visual Acuity/Fogging Resistance (8.16) Flammability Test (8.39)	Annual Annual Annual Annual Annual	Eye and face protection devices Eye and face protection devices Eye and face protection devices Eye and face protection devices Eye and face protection devices
Multiple-use emergency medical eye and face protection devices	Design Requirements (6.3) ANSI Z87.1 Liquidtight Integrity Test Three (8.17) Corrosion Resistance Test (8.22)	Annual Annual Annual Annual	Eye and face protection devices Per ANSI Z87.1 Eye and face protection devices Complete hardware items
Single-use emergency medical footwear covers	Design Requirements (6.4) Biopenetration Test One (8.3) Tensile Strength Test (8.4) Burst Strength Test (8.5) Tear Resistance Test Two (8.38) Seam Breaking Strength (8.8) Abrasion Resistance Test Two (8.25) Puncture Resistance Test One (8.13) Slip Resistance Test (8.20) Flammability Test (8.39)	Annual Annual Annual Annual Annual Annual Annual Annual Annual Annual	Footwear covers Footwear covers Footwear covers Footwear covers Footwear covers Footwear covers Footwear covers or composite swatches Footwear covers Outermost layer of the footwear cover wear surface Footwear cover
Multiple-use emergency medical footwear	Design Requirements (6.4) Cut Resistance Test (8.18) Puncture Resistance Test One (8.13) Abrasion Resistance Test One (8.19) Slip Resistance Test (8.20) Eyelet and Stud Post Attachment Test (8.21) Corrosion Resistance (8.22) Biopenetration Test One (8.3) Overall Liquid Integrity Test Four (8.23)	Annual Annual Annual Annual Annual Annual Annual Annual Annual	Footwear Footwear composite swatches Footwear composite swatches Footwear soles Footwear Footwear Complete hardware items Footwear or footwear composite swatches Footwear

△ **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) Notification of 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) Notification of 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) Removal of the mark of certification from the product.
- (4) Where a hazardous condition exists and it is not practical to implement 4.6.11(1), 4.6.11(2), or 4.6.11(3), or the responsible parties refuse to take corrective action, the certification organization shall 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 their review to assist the certification organization with their 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 to 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 1-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 a product that is recalled and for documenting the effectiveness of the product recall
- (5) A plan for either repairing, replacing, or compensating purchasers for returned product

Chapter 5 Product Labeling and Information

5.1 Product Label Requirements for Emergency Medical Protective Clothing Items.

5.1.1 General Product and Package Label Requirements.

△ **5.1.1.1** All worded portions of the required product and package labels shall be at least in English.

△ **5.1.1.2** All letters and numbers on product labels and product package labels shall meet the following requirements:

- (1) The compliance statement in 5.1.2.2, 5.1.3.2, 5.1.4.2, 5.1.4.5, 5.1.5.2, 5.1.5.5, 5.1.6.2, 5.1.7.2, 5.1.7.5, 5.1.8.2, 5.1.8.5, 5.1.9.2, 5.1.9.5, 5.1.10.2, 5.1.10.5, 5.1.11.2, 5.1.12.2, 5.1.13.2, 5.1.14.2, 5.1.14.5, 5.1.15.2, and 5.1.16.2 shall be at least 2.5 mm ($\frac{3}{32}$ in.) high.
- (2) The certification organization's symbol shall be at least 6 mm ($\frac{1}{4}$ in.) high.
- (3) The certification organization's name shall be at least 2.5 mm ($\frac{3}{32}$ in.) high.
- (4) All other required labeling information shall be at least 1.6 mm ($\frac{1}{16}$ in.) high.

△ **5.1.1.3** Symbols and other pictorial graphic representations shall be permitted to be used to supplement worded statements on the product label(s).

△ **5.1.1.4** Configuration of the product label and attachment of the product label shall not interfere with the legibility of any printed portion of the product label.

△ **5.1.1.5** Where applicable, 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 entire product label shall be located adjacent to each other.

△ **5.1.1.6** Where package labels are required, the package product label shall be permanently and conspicuously located on the outside of the package or printed on the package and shall not be removed, obscured, or otherwise mutilated by the opening of the package when the package is opened as intended.

5.1.2 Single-Use Emergency Medical Protective Garment Product Label Requirements.

△ **5.1.2.1** Each garment shall have a product label or labels permanently and conspicuously located inside each garment when the garment is properly assembled with all layers and components in place.

△ 5.1.2.2 The product label shall have the certification organization's label, symbol, or identifying mark and at least the following statement legibly printed on the product label:

"THIS GARMENT IS FOR SINGLE USE ONLY!"

THIS GARMENT MEETS THE SINGLE-USE EMERGENCY MEDICAL GARMENT REQUIREMENTS OF NFPA 1999, STANDARD ON PROTECTIVE CLOTHING AND ENSEMBLES FOR EMERGENCY MEDICAL OPERATIONS, 2018 EDITION.

DO NOT REMOVE THIS LABEL!"

△ 5.1.2.3 The following information shall also be printed legibly on the product label:

- (1) Manufacturer's name, identification, or designation
- (2) Manufacturer's address
- (3) Country of manufacture
- (4) Garment model and style
- (5) Trace number
- (6) Materials of construction
- (7) Month and year of manufacture, not coded
- (8) Size

• **5.1.3 Multiple-Use Emergency Medical Protective Garment Product Label Requirements.**

△ 5.1.3.1 Each garment shall have a product label or labels permanently and conspicuously located inside each garment when the garment is properly assembled with all layers and components in place.

△ 5.1.3.2 The product label shall have the certification organization's label, symbol, or identifying mark and at least the following statement legibly printed on the product label:

"THIS GARMENT MEETS THE MULTIPLE-USE EMERGENCY MEDICAL GARMENT REQUIREMENTS OF NFPA 1999, STANDARD ON PROTECTIVE CLOTHING AND ENSEMBLES FOR EMERGENCY MEDICAL OPERATIONS, 2018 EDITION."

DO NOT REMOVE THIS LABEL!"

△ 5.1.3.3 The following information shall also be printed legibly on the product label, and lettering shall be at least 1.6 mm (0.06 in.) high:

- (1) Manufacturer's name, identification, or designation
- (2) Manufacturer's address
- (3) Country of manufacture
- (4) Garment model or style
- (5) Trace number
- (6) Materials of construction
- (7) Cleaning precautions
- (8) Month and year of manufacture, not coded
- (9) Size

△ 5.1.3.4 Where visibility materials are used on garments and the garment meets the requirements of ANSI/ISEA 107, *High-Visibility Safety Apparel and Accessories*, the product label shall also meet the marking information required by ANSI/ISEA 107.

△ 5.1.3.5 Where visibility materials are used on garments and are not intended to meet the requirements in ANSI/ISEA 107, *High-Visibility Safety Apparel and Accessories*, the product label shall include the following warning:

"WEARING OF THIS GARMENT ALONG ROADSIDES OR OTHER AREAS WITH VEHICULAR TRAFFIC REQUIRES ADDITIONAL HIGH VISIBILITY SAFETY APPAREL, COMPLIANT WITH AT LEAST THE CLASS 2 REQUIREMENTS OF ANSI/ISEA 107."

• **5.1.4 Single-Use Emergency Medical Examination Gloves Product Label Requirements.**

△ 5.1.4.1 The package containing the smallest number of glove items from which the user withdraws the product for use shall have a package product label.

△ 5.1.4.2 The certification organization's label, symbol, or identifying mark and at least the following statement shall be legibly printed on the package product label:

"THIS GLOVE IS FOR SINGLE USE ONLY!"

THIS GLOVE MEETS THE SINGLE-USE EMERGENCY MEDICAL EXAMINATION GLOVE REQUIREMENTS OF NFPA 1999, STANDARD ON PROTECTIVE CLOTHING AND ENSEMBLES FOR EMERGENCY MEDICAL OPERATIONS, 2018 EDITION.

DO NOT REMOVE THIS LABEL!"

△ 5.1.4.3 The following information shall also be printed legibly on the package product label:

- (1) Manufacturer's name, identification, or designation
- (2) Manufacturer's address
- (3) Country of manufacture
- (4) Glove model and style
- (5) Trace number
- (6) Materials of construction
- (7) Month and year of manufacture, not coded
- (8) Size

△ 5.1.4.4 In addition to the required package product label, each glove shall be permitted to have a product label on the outside of the glove.

△ 5.1.4.5 Where each glove has a product label, the certification organization's label, symbol, or identifying mark and at least the following statement shall be legibly printed as the product label on each glove:

"MEETS NFPA 1999, 2018 ED."

5.1.5 Single-Use Emergency Medical Cleaning/Utility Glove Product Label Requirements.

△ 5.1.5.1 The package containing the smallest number of glove items from which the user withdraws the product for use shall be permitted to have a package product label in place of the package label.

△ 5.1.5.2 The certification organization's label, symbol, or identifying mark and at least the following statement shall be legibly printed on the package product label:

“THIS GLOVE IS FOR SINGLE USE ONLY!”

THIS GLOVE MEETS THE SINGLE-USE EMERGENCY MEDICAL CLEANING/ UTILITY GLOVE REQUIREMENTS OF NFPA 1999, STANDARD ON PROTECTIVE CLOTHING AND ENSEMBLES FOR EMERGENCY MEDICAL OPERATIONS, 2018 EDITION.

DO NOT REMOVE THIS LABEL!”

△ 5.1.5.3 The following information shall also be printed legibly on the package product label:

- (1) Manufacturer's name, identification, or designation
- (2) Manufacturer's address
- (3) Country of manufacture
- (4) Glove model and style
- (5) Trace number
- (6) Materials of construction
- (7) Month and year of manufacture, not coded
- (8) Size

△ 5.1.5.4 In addition to the required package product label, each cleaning/utility glove shall be permitted to have a product label on the outside of the glove.

△ 5.1.5.5 Where each cleaning/utility gloves has a product label, the certification organization's label, symbol, or identifying mark and at least the following statement shall be legibly printed as the product label on each glove:

“MEETS NFPA 1999, 2018 ED.”

5.1.6 Multiple-Use Emergency Medical Work Glove Product Label Requirements.

△ 5.1.6.1 Each work glove shall have a product label(s) permanently and conspicuously attached inside each glove.

△ 5.1.6.2 The certification organization's label, symbol, or identifying mark and at least the following statement shall be legibly printed on the product label:

“THIS GLOVE MEETS THE MULTIPLE-USE EMERGENCY MEDICAL WORK GLOVE REQUIREMENTS OF NFPA 1999, STANDARD ON PROTECTIVE CLOTHING AND ENSEMBLES FOR EMERGENCY MEDICAL OPERATIONS, 2018 EDITION.

DO NOT REMOVE THIS LABEL!”

△ 5.1.6.3 The following information shall also be printed legibly on the product label:

- (1) Manufacturer's name, identification, or designation
- (2) Manufacturer's address
- (3) Country of manufacture
- (4) Glove model and style
- (5) Trace number
- (6) Materials of construction
- (7) Cleaning instructions
- (8) Month and year of manufacture, not coded
- (9) Size

5.1.7 Single-Use Emergency Medical Facemask Product Label Requirements.

△ 5.1.7.1 The package containing the smallest number of facemask items from which the user withdraws the product for use shall have a package product label.

△ 5.1.7.2 The certification organization's label, symbol, or identifying mark and at least the following statement shall be legibly printed on the package product label:

“THIS FACEMASK IS FOR SINGLE USE ONLY!”

THIS MASK MEETS THE SINGLE-USE EMERGENCY MEDICAL FACEMASK REQUIREMENTS OF NFPA 1999, STANDARD ON PROTECTIVE CLOTHING AND ENSEMBLES FOR EMERGENCY MEDICAL OPERATIONS, 2018 EDITION.

DO NOT REMOVE THIS LABEL!”

△ 5.1.7.3 The following information shall also be printed legibly on the package product label:

- (1) Manufacturer's name, identification, or designation
- (2) Manufacturer's address
- (3) Country of manufacture
- (4) Facemask model and style
- (5) Trace number
- (6) Materials of construction
- (7) Month and year of manufacture, not coded
- (8) Size, where applicable

△ 5.1.7.4 In addition to the required package product label, each mask shall be permitted to have a product label in an area of the facemask that does not affect its function.

△ 5.1.7.5 Where each facemask has a product label, the certification organization's label, symbol, or identifying mark and at least the following statement shall be legibly printed as the product label on each facemask:

“MEETS NFPA 1999, 2018 ED.”

△ 5.1.7.6 Where the medical facemask is not certified by National Institute for Occupational Safety and Health (NIOSH) as a respirator to 42 CFR 84, “Approval of Respiratory Protective Devices,” the package product label shall include the following additional warning:

THIS FACEMASK IS NOT A RESPIRATOR AND WILL NOT PROVIDE RESPIRATORY PROTECTION AGAINST AIRBORNE BIOLOGICAL HAZARDS.

5.1.8 Single-Use Emergency Medical Eye and Face Protection Device Product Label Requirements.

△ 5.1.8.1 The package containing the smallest number of eye and face protection device items from which the user withdraws the product for use shall have a package product label.

△ 5.1.8.2 The certification organization's label, symbol, or identifying mark and at least the following statement shall be legibly printed on the package product label:

"THIS {insert name of item} IS FOR SINGLE USE ONLY!"

**THIS {insert name of item} MEETS THE SINGLE-USE
EMERGENCY EYE AND FACE PROTECTION DEVICE
REQUIREMENTS OF NFPA 1999, STANDARD ON PROTEC-
TIVE CLOTHING AND ENSEMBLES FOR EMERGENCY
MEDICAL OPERATIONS, 2018 EDITION.**

DO NOT REMOVE THIS LABEL!"

△ 5.1.8.3 The following information shall also be printed legibly on the package product label:

- (1) Manufacturer's name, identification, or designation
- (2) Manufacturer's address
- (3) Country of manufacture
- (4) Eye and face protection device model or style
- (5) Trace number
- (6) Materials of construction
- (7) Month and year of manufacture, not coded
- (8) Size, where applicable

△ 5.1.8.4 In addition to the required package product label, each eye and face protection device shall be permitted to have a product label in a location of the eye and face protection device that does not interfere with the wearer's vision or device's function.

△ 5.1.8.5 Where each eye and face protection device has a product label, the certification organization's label, symbol, or identifying mark and at least the following statement shall be legibly printed as the product label on each eye and face protection device:

"MEETS NFPA 1999, 2018 ED."

5.1.9 Multiple-Use Emergency Medical Eye and Face Protection Devices Product Label Requirements.

△ 5.1.9.1 The package containing the smallest number of eye and face protection device items from which the user withdraws the product for use shall have a package product label.

△ 5.1.9.2 The certification organization's label, symbol, or identifying mark and at least the following statement shall be printed on the package product label:

**"THIS DEVICE MEETS THE MULTIPLE-USE EMERGENCY
MEDICAL EYE AND FACE PROTECTION REQUIREMENTS
OF NFPA 1999, STANDARD ON PROTECTIVE CLOTHING AND
ENSEMBLES FOR EMERGENCY MEDICAL OPERATIONS,
2018 EDITION."**

DO NOT REMOVE THIS LABEL!"

△ 5.1.9.3 The following information also shall be printed legibly on the package product label:

- (1) Manufacturer's name, identification, or designation
- (2) Manufacturer's address
- (3) Country of manufacture
- (4) Eye and face protection device model or style
- (5) Trace number
- (6) Materials of construction

- (7) Cleaning precautions
- (8) Month and year of manufacture, not coded
- (9) Size

△ 5.1.9.4 Each face protection device shall have a product label, in addition to the required package product label, placed in a conspicuous location on the device that shall not interfere with the wearer's vision.

△ 5.1.9.5 The certification organization's label, symbol, or identifying mark and at least the following statement shall be legibly printed on the product label of each multiple-use face protection device:

"MEETS NFPA 1999, 2018 ED."

5.1.10 Single-Use Emergency Medical Footwear Cover Product Label Requirements.

△ 5.1.10.1 The package containing the smallest number of footwear cover items from which the user withdraws the product for use shall have a package product label.

△ 5.1.10.2 The certification organization's label, symbol, or identifying mark and at least the following statement shall be legibly printed on the package product label:

"THIS FOOTWEAR COVER IS FOR SINGLE USE ONLY!"

**THIS FOOTWEAR COVER MEETS THE SINGLE-USE
EMERGENCY MEDICAL FOOTWEAR COVER REQUIRE-
MENTS OF NFPA 1999, STANDARD ON PROTECTIVE
CLOTHING AND ENSEMBLES FOR EMERGENCY MEDICAL
OPERATIONS, 2018 EDITION.**

DO NOT REMOVE THIS LABEL!"

△ 5.1.10.3 The following information shall also be printed legibly on the package product label:

- (1) Manufacturer's name, identification, or designation
- (2) Manufacturer's address
- (3) Country of manufacture
- (4) Footwear cover model or style
- (5) Trace number
- (6) Materials of construction
- (7) Month and year of manufacture, not coded
- (8) Size, where applicable

△ 5.1.10.4 In addition to the required package product label, each footwear cover shall be permitted to have a product label in area of the footwear cover that does not affect the comfort of the wearer.

△ 5.1.10.5 Where each footwear cover has a product label, the certification organization's label, symbol, or identifying mark and at least the following statement shall be legibly printed as the product label on each footwear cover:

"MEETS NFPA 1999, 2018 ED."

5.1.11 Multiple-Use Emergency Medical Footwear Product Label Requirements.

△ 5.1.11.1 Each footwear item shall have a product label or labels permanently and conspicuously attached inside each footwear item when the footwear is properly donned.

△ 5.1.11.2 The certification organization's label, symbol, or identifying mark and at least the following statement shall be legibly printed on the product label:

“THIS FOOTWEAR MEETS THE MULTIPLE-USE EMERGENCY MEDICAL FOOTWEAR REQUIREMENTS OF NFPA 1999, STANDARD ON PROTECTIVE CLOTHING AND ENSEMBLES FOR EMERGENCY MEDICAL OPERATIONS, 2018 EDITION.”

DO NOT REMOVE THIS LABEL!”

△ 5.1.11.3 The following information shall also be printed legibly on the product label:

- (1) Manufacturer's name, identification, or designation
- (2) Manufacturer's address
- (3) Country of manufacture
- (4) Footwear model or style
- (5) Trace number
- (6) Materials of construction
- (7) Cleaning precautions
- (8) Month and year of manufacture, not coded
- (9) Size

5.1.12 Multiple-Use Medical Care Facility Footwear Product Label Requirements.

△ 5.1.12.1 Each footwear item shall have a product label or labels permanently and conspicuously attached inside each footwear item when the footwear is properly donned.

△ 5.1.12.2 The certification organization's label, symbol, or identifying mark and at least the following statement shall be legibly printed on the product label:

“THIS FOOTWEAR MEETS THE MULTIPLE-USE MEDICAL CARE FACILITY FOOTWEAR REQUIREMENTS OF NFPA 1999, STANDARD ON PROTECTIVE CLOTHING AND ENSEMBLES FOR EMERGENCY MEDICAL OPERATIONS, 2018 EDITION.”

THIS FOOTWEAR HAS NOT BEEN REQUIRED TO PROVIDE RESISTANCE TO TOE IMPACT AND COMPRESSION OR SOLE PUNCTURE!

DO NOT REMOVE THIS LABEL!”

△ 5.1.12.3 The following information shall also be printed legibly on the product label:

- (1) Manufacturer's name, identification, or designation
- (2) Manufacturer's address
- (3) Country of manufacture
- (4) Footwear model or style
- (5) Trace number
- (6) Materials of construction
- (7) Cleaning precautions
- (8) Month and year of manufacture, not coded
- (9) Size

5.1.13 Multiple-Use Emergency Medical Helmet Product Labeling Requirements.

△ 5.1.13.1 Each helmet shall have a product label or labels permanently and conspicuously attached. At least one product label shall be conspicuously located on or inside each helmet when the helmet is properly assembled with all components in place.

△ 5.1.13.2 The certification organization's label, symbol, or identifying mark and at least the following statement shall be legibly printed on the product label:

“THIS HELMET MEETS THE EMERGENCY MEDICAL HELMET REQUIREMENTS OF NFPA 1999, STANDARD ON PROTECTIVE CLOTHING AND ENSEMBLES FOR EMERGENCY MEDICAL OPERATIONS, 2018 EDITION.”

DO NOT REMOVE THIS LABEL!”

△ 5.1.13.3 The following information shall also be printed legibly on the product label:

- (1) Manufacturer's name, identification, or designation
- (2) Manufacturer's address
- (3) Country of manufacture
- (4) Helmet model or style
- (5) Trace number
- (6) Helmet size or size range
- (7) Nominal weight of helmet
- (8) Month and year of manufacture, not coded
- (9) Cleaning precautions

N 5.1.14 Emergency Medical Powered Air-Purifying Respirator Product Label Requirements.

N 5.1.14.1 The package containing the smallest number of powered air-purifying respirator items from which the user withdraws the product for use shall have a package product label.

N 5.1.14.2 The certification organization's label, symbol, or identifying mark and at least the following statement shall be printed on the package product label:

“THIS RESPIRATOR MEETS THE MULTIPLE-USE EMERGENCY MEDICAL EYE AND FACE PROTECTION REQUIREMENTS OF NFPA 1999, STANDARD ON PROTECTIVE CLOTHING AND ENSEMBLES FOR EMERGENCY MEDICAL OPERATIONS, 2018 EDITION.”

DO NOT REMOVE THIS LABEL!”

N 5.1.14.3 The following information also shall be printed legibly on the package product label:

- (1) Manufacturer's name, identification, or designation
- (2) Manufacturer's address
- (3) Country of manufacture
- (4) Respirator model or style
- (5) Trace number
- (6) Materials of construction
- (7) Cleaning precautions
- (8) Month and year of manufacture, not coded
- (9) Size

N 5.1.14.4 Each respirator shall have a product label, in addition to the required package product label, placed in a conspicuous location on the respirator that shall not interfere with the wearer's vision.

N 5.1.14.5 The certification organization's label, symbol, or identifying mark and at least the following statement shall be legibly printed on the product label of each respirator:

“MEETS NFPA 1999, 2018 ED.”

5.1.15 Single-Use Emergency Medical Ensemble Product Label Requirements.

▲ **5.1.15.1** The garment portion of the ensemble shall have a product label or labels permanently and conspicuously located inside the garment when the ensemble is properly assembled with all layers and components in place.

▲ **5.1.15.2** The product label shall have the certification organization's label, symbol, or identifying mark and at least the following statement legibly printed on the product label:

"THIS ENSEMBLE IS FOR SINGLE USE ONLY! THIS ENSEMBLE MEETS THE SINGLE-USE EMERGENCY MEDICAL ENSEMBLE REQUIREMENTS OF NFPA 1999, STANDARD ON PROTECTIVE CLOTHING AND ENSEMBLES FOR EMERGENCY MEDICAL OPERATIONS, 2018 EDITION.

DO NOT REMOVE THIS LABEL!"

▲ **5.1.15.3** The following information shall also be printed legibly on the product label:

- (1) Manufacturer's name, identification, or designation
- (2) Manufacturer's address
- (3) Country of manufacture
- (4) Ensemble model and style
- (5) Trace number
- (6) Materials of construction
- (7) Month and year of manufacture, not coded
- (8) Size

▲ **5.1.15.4** The following additional language shall be provided on the product label:

"TO PROVIDE FULL BODY PROTECTION, THE FOLLOWING ADDITIONAL ITEMS MUST BE WORN AS PART OF THIS ENSEMBLE."

[list items including manufacturer name and model or style number.]

N 5.1.16 Multiple-Use Emergency Medical Protective Ensemble Product Label Requirements.

▲ **5.1.16.1** The garment portion of the ensemble shall have a product label or labels permanently and conspicuously located inside the garment when the garment is properly assembled with all layers and components in place.

▲ **5.1.16.2** The product label shall have the certification organization's label, symbol, or identifying mark and at least the following statement legibly printed on the product label:

"THIS ENSEMBLE MEETS THE MULTIPLE-USE EMERGENCY MEDICAL ENSEMBLE REQUIREMENTS OF NFPA 1999, STANDARD ON PROTECTIVE CLOTHING AND ENSEMBLES FOR EMERGENCY MEDICAL OPERATIONS, 2018 EDITION.

DO NOT REMOVE THIS LABEL!"

N 5.1.16.3 The following information shall also be printed legibly on the product label:

- (1) Manufacturer's name, identification, or designation
- (2) Manufacturer's address
- (3) Country of manufacture

- (4) Ensemble model or style
- (5) Trace number
- (6) Materials of construction
- (7) Cleaning precautions
- (8) Month and year of manufacture, not coded
- (9) Size

N 5.1.16.4 The following additional language shall be provided on the product label:

"TO PROVIDE FULL BODY PROTECTION, THE FOLLOWING ADDITIONAL ITEMS MUST BE WORN AS PART OF THIS ENSEMBLE."

[list items including manufacturer name and model or style number.]

N 5.1.16.5 Where visibility materials are used on garments and the garment meets the requirements of ANSI/ISEA 107, *High-Visibility Safety Apparel and Accessories*, the product label shall also meet the marking information required by ANSI/ISEA 107.

N 5.1.16.6 Where visibility materials are used on garments and are not intended to meet the requirements in ANSI/ISEA 107, *High-Visibility Safety Apparel and Accessories*, the product label shall include the following warning:

"WEARING OF THIS ENSEMBLE ALONG ROADSIDES OR OTHER AREAS WITH VEHICULAR TRAFFIC REQUIRES ADDITIONAL HIGH VISIBILITY SAFETY APPAREL, COMPLIANT WITH AT LEAST THE CLASS 2 REQUIREMENTS OF ANSI/ISEA 107."

5.2 User Information.

▲ 5.2.1 The manufacturer shall provide the following instructions and information with each product, as applicable:

- (1) Pre-use information
 - (a) Safety considerations
 - (b) Limitations of use
 - (c) Marking recommendations and restrictions
 - (d) Statement that most performance properties cannot be tested by the user in the field
 - (e) Warranty information
- (2) Preparation for use
 - (a) Sizing/adjustment
 - (b) Recommended storage practices
- (3) Inspection frequency and details
- (4) Don/doff
 - (a) Donning and doffing procedures
 - (b) Sizing and adjustment procedures
 - (c) Interface issues
- (5) Proper use consistent with NFPA 1500, NFPA 1581, 29 CFR 1910.132, "General Requirements of Subpart I, Personal Protective Equipment," and 29 CFR 1910.1030, "Protecting Health Care Workers from Occupational Exposure to Blood-Borne Pathogens"
- (6) Maintenance and cleaning for multiple-use products
 - (a) Cleaning instructions and precautions with a statement advising users not to use products that are not thoroughly cleaned and dried
 - (b) Inspection details

- (c) Maintenance criteria and methods of repair where applicable
- (d) Retirement criteria and considerations
- (7) Decontamination procedures
- (8) Disposal criteria and considerations

● **Δ 5.2.2*** For single-use or multiple-use protective ensembles, the following additional instructions and information shall be provided:

- (1) The specific sequence and requirements for donning each item of the ensemble.
- (2) Specific recommended methods for cleaning each element where elements are combined or attached.
- (3)* Specific considerations for decontamination to be employed during the doffing of ensemble elements.
- (4)* The specific sequence, precautions, and requirements for doffing each item of the ensemble, when contaminated with body fluids, for the avoidance of cross-contamination of the individual wearer, other ensemble items, and the outside environment.

Δ 5.2.3 The manufacturer shall state the storage life for all single-use and multiple-use protective elements that have been certified as part of an ensemble, and shall include the storage life and the basis for recommended storage life as part of the user information.

N 5.3 Technical Data Package.

N 5.3.1 The manufacturer shall furnish a technical data package for single-use or multiple-use protective ensembles and ensemble elements upon the request of the purchaser.

N 5.3.1.1* The technical data package shall contain all documentation required by this standard and the values obtained from the initial certification showing compliance with the requirements of Chapter 7 in the current edition of this standard using the reporting formats provided in Table 5.3.1.1(a) and Table 5.3.1.1(b). The technical data package information shall indicate "Pass" for those requirements where there is no quantitative value reported and "Not applicable" for specific requirements that do not apply to the vapor-protective ensemble.

Table 5.3.1.1(a) Format for Reporting Certification Test Data in Technical Data Package

Ensemble or Element	Performance Requirement	Test Method	Requirement	Result
<i>Single-Use Emergency Medical Garment</i>				
Garment	Liquidtight Integrity (Test One)	ASTM F1359 (Section 8.2)	No liquid penetration	
	Overall Ensemble Function	ASTM F1154, Modified (Section 8.40)	Complete tasks in ≤ 20 min with garment closure remaining engaged Test subject properly identifies 3 out of 4 numbers on NFPA 704 placard at each angle Visual acuity ≥ 20/35 Protective flap remains closed over closure system No liquid penetration following exercises ≥ 66 N (14.9 lbf) ≥ 12 N (2.7 lbf)	
Garment material	Burst strength Puncture propagation tear resistance Flammability Moisture vapor transmission rate	ASTM D3787 (Section 8.5) ASTM D2582 (Section 8.6) ASTM D1230 (Section 8.35) ASTM E96, Procedure B (Section 8.28)	Flame spread ≥ 3.5 sec ≥ 650 g/m ² 24 hr	
Seams	Biopenetration (test one)	ASTM F1671 (Section 8.3)	No penetration of Phi-X174 bacteriophage ≥ 50 N (11.2 lbf)	
Visors	Seam breaking strength	ASTM D1683 (Section 8.8)	≥ 66 N (14.9 lbf)	
	Burst strength Puncture propagation tear resistance	ASTM D3787 (Section 8.5) ASTM D2582 (Section 8.6)	≥ 12 N (2.7 lbf)	
<i>Multiple-Use Emergency Medical Garment</i>				
Garment	Liquidtight integrity Overall function	ASTM F1359 (Section 8.2) ASTM F1154, modified (Section 8.40)	No liquid penetration after 8 min Complete in ≤ 20 min with garment closure remaining engaged Test subject has visual acuity of 20/35 or better through visor and facepiece lens Protective flap remains closed over closure system Test subject properly identifies 3 out of 4 numbers on NFPA 704 placard at each angle No liquid penetration following exercises	
Garment material	Biopenetration (test one) Tensile strength Burst strength Puncture propagation tear resistance Tear strength	ASTM F1671 (Section 8.3) ASTM D5034 (Section 8.4) ASTM D3787 (Section 8.5) ASTM D2582 (Section 8.6) ASTM D5587 (Section 8.7)	No penetration of Phi-X174 bacteriophage ≥ 225.5 N (50 lbf) ≥ 178 N (40 lbf) ≥ 25 N (5 ½ lbf) ≥ 36 N (8 lbf)	

(continues)

Table 5.3.1.1(a) *Continued*

Ensemble or Element	Performance Requirement	Test Method	Requirement	Result
Garment bootie	Water absorption resistance	AATCC 42, modified (Section 8.31)	$\leq 30\%$	
	Flammability	ASTM D1230 (Section 8.35)	Flame spread ≥ 3.5 sec	
	Total heat loss	ASTM F1868 (Section 8.32)	$\geq 450 \text{ W/m}^2$	
	Evaporative resistance	(Section 8.42)	$\leq 30 \text{ Pa m}^2/\text{W}$	
	Tensile strength	ASTM D5034 (Section 8.4)	$\geq 50 \text{ N (11.2 lbf)}$	
	Burst strength	ASTM D3787 (Section 8.5)	$\geq 66 \text{ N (14.9 lbf)}$	
Garment seams	Puncture propagation tear resistance	ASTM D2582 (Section 8.6)	$\geq 12 \text{ N (2.7 lbf)}$	
	Tear strength	ASTM D5587 (Section 8.7)	$\geq 17 \text{ N (3.8 lbf)}$	
	Seam breaking strength	ASTM D1683 (Section 8.8)	$\geq 50 \text{ N (11.2 lbf)}$	
Garment visors	Biopenetration (test one)	ASTM F1671 (Section 8.3)	No penetration of Phi-X174 bacteriophage	
	Breaking strength	ASTM D1683 (Section 8.8)	$\geq 222.5 \text{ N (50 lbf)}$	
Garment labels	Visor drop ball impact resistance	ANSI Z87.1, modified (Section 8.41)	No puncture, cracks, holes, or fractures	
Garment metal parts	Label durability and legibility	(Section 8.33)	Remain in place and legible	
Garment fastener tape	Corrosion resistance	ASTM B117 (Section 8.22)	No corrosion	
Garment zippers	Breaking strength	ASTM D5034 (Section 8.39)	\geq minimum breaking strength in Table 1 of A-A-55126B	
	Shear strength	ASTM D5169 (Section 8.39)	\geq minimum shear strength in Table 1 of A-A-55126B	
	Peel strength	ASTM D5170 (Section 8.39)	\geq minimum peel strength in Table 1 of A-A-55126B	
Garment zippers	Crosswise breaking strength	A-A-55634A	Report	
Single-Use Emergency Medical Examination Gloves				
Gloves	Liquidtight integrity (test two)	ASTM D5151 (Section 8.9)	AQL ≥ 1.5	
	Biopenetration (test two)	ASTM F1671 (Section 8.10)	No penetration of the Phi-X174 bacteriophage	
	Dexterity	Crawford small parts dexterity test, screws technique (Section 8.14)	$\leq 120\%$ of baseline test measurements	
Glove materials	Ultimate tensile strength	ASTM D412a, Method A (Section 8.11)	$\geq 14 \text{ MPa (2000 psi)}$	
	Ultimate elongation	ASTM D412a, Method A (Section 8.12)	$\geq 500\%$	
	Puncture resistance (test one)	ASTM F1342, Modified Method A (Section 8.13)	$\geq 4.5 \text{ N (1 lbf)}$	
	Protein Content	ASTM D5712 (Section 8.15)	$\leq 50 \mu\text{g/g}$	
Emergency Medical Cleaning/Utility Gloves				
Glove materials	Liquidtight integrity (test two)	ASTM D5151 (Section 8.9)	No leakage	
	Biopenetration (test two)	ASTM F1671 (Section 8.10)	No penetration of the Phi-X174 bacteriophage	
	Dexterity (test two)	ASTM F2010, Modified (Section 8.26)	Average % of barehanded control $\leq 200\%$	
	Tactility	ASTM (Section 8.30)	Permit pick-up of pins having a diameter of $\geq 5.0 \text{ mm (0.2 in.)}$	
	Chemical permeation resistance	ASTM F739, Modified (Section 8.24)	$\leq 6.0 \mu\text{g/cm}^2$	See separate table
	Tensile strength	ASTM D412a, Method A (Section 8.11)	$\geq 10.3 \text{ MPa (1500 psi)}$	
	Puncture resistance (test one)	ASTM F1342, Modified Method A (Section 8.13)	$\geq 9 \text{ N (2 lbf)}$	
	Cut resistance	ASTM F1790 (Section 8.18)	$\geq 20 \text{ mm (0.8 in.)}$	
Glove materials	Abrasion resistance (test two)	ASTM D3884 (Section 8.25)	No wear-through after 1000 cycles	
	Flammability	ASTM D1230 (Section 8.35)	Flame spread ≥ 3.5 sec	

(continues)

Table 5.3.1.1(a) *Continued*

Ensemble or Element	Performance Requirement	Test Method	Requirement	Result
<i>Multiple-Use Emergency Medical Work Gloves</i>				
Gloves	Liquidtight integrity	(Section 8.29)	No water penetration	
	Dexterity (test two)	ASTM F2010 (Section 8.26)	Average % of barehanded control $\leq 200\%$	
	Torque	ASTM F2961 (Section 8.27)	Barehanded control $\geq 65\%$	
	Tactility	(Section 8.30)	Permit pick-up of pins having a diameter of ≤ 8.0 mm (0.3 in.)	
Glove materials	Biopenetration	ASTM F1671 (Section 8.3)	No penetration of Phi-X174 bacteriophage	
	Puncture resistance	ASTM F1342 (Section 8.13)	No puncture under an applied force of 9 N (2 lbf)	
	Cut resistance	ASTM F1790 (Section 8.18)	≥ 20 mm (0.8 in.)	
	Abrasion resistance	ASTM D3884 (Section 8.25)	No wear-through	
	Flammability	ASTM D1230 (Section 8.35)	Flame spread ≥ 3.5 sec	
Hardware	Corrosion resistance	ASTM B117 (Section 8.22)	No more than light surface-type corrosion or oxidation, ferrous metals show no corrosion of the base metal, and hardware items remain functional	
Labels	Label durability and legibility	(Section 8.33)	Be legible	
<i>Single-Use Emergency Medical Facemask</i>				
Facemask	High barrier performance class	ASTM F2100	Meet Level 3 barrier in Table 1, Section 6 in ASTM F2100	
	Liquidtight integrity (test three)	ASTM F1862 (Section 8.17)	No liquid penetration	
<i>Single-Use Emergency Medical Eye and Face Protection Device</i>				
Eye and face protection device	Biopenetration (test one)	ASTM F1671 (Section 8.3)	No penetration of Phi-X174 bacteriophage	
	Liquidtight integrity (test three)	ASTM F1862 (Section 8.17)	No liquid penetration	
	Visual acuity/fogging resistance	(Section 8.16)	$\geq 20/35$ visual acuity line	
Device material	Flammability	ASTM D1230 (Section 8.35)	Flame spread ≥ 3.5 sec	
<i>Multiple-Use Emergency Medical Eye and Face Protection Device</i>				
Eye and face protection device	Liquidtight integrity (test three)	ASTM F1862 (Section 8.17)	No liquid penetration	
Device hardware	Corrosion resistance	ASTM B117 (Section 8.22)	No more than light surface-type corrosion or oxidation, ferrous metals show no corrosion of the base metal, and hardware items remain functional	
<i>Single-Use Emergency Medical Footwear Cover</i>				
Upper materials	Biopenetration (test one)	ASTM F1671 (Section 8.3)	No penetration of Phi-X174 bacteriophage	
	Tensile strength	ASTM D5034 (Section 8.4)	≥ 50 N (11.2 lbf)	
	Burst strength	ASTM D3787 (Section 8.5)	≥ 66 N (14.9 lbf)	
	Flammability	ASTM D1230 (Section 8.35)	Flame spread ≥ 3.5 sec	
Upper material seams	Biopenetration (test one)	ASTM F1671 (Section 8.3)	No penetration of Phi-X174 bacteriophage	
Wear surface materials	Breaking strength	ASTM D1683 (Section 8.8)	≥ 50 N (11.2 lbf)	
	Biopenetration (test one)	ASTM F1671 (Section 8.3)	No penetration of Phi-X174 bacteriophage	
	Abrasion resistance	ASTM D3884 (Section 8.25)	No wear-through	
	Puncture resistance	ASTM F1342 (Section 8.13)	Puncture force > 8 N (1.8 lbf)	
	Slip resistance	ASTM F2913 (Section 8.20)	Coefficient of friction of ≥ 0.40	
<i>Multiple-Use Emergency Medical Footwear</i>				
Footwear	Liquidtight integrity	FIA Standard 1209 (Section 8.23)	No leakage and no separation of outer sole	
Upper materials	Biopenetration	ASTM F1671 (Section 8.3)	No penetration of Phi-X174 bacteriophage	
	Cut resistance	ASTM F1790 (Section 8.18)	≥ 20 mm (0.8 in.)	

(continues)

Table 5.3.1.1(a) *Continued*

Ensemble or Element	Performance Requirement	Test Method	Requirement	Result
Upper material seams Outer sole	Puncture resistance	ASTM F1342 (Section 8.13)	No puncture under an applied force of 45 N (10 lbf)	
	Flammability	ASTM D1230 (Section 8.35)	Flame spread \geq 3.5 sec	
	Biopenetration Abrasion resistance	ASTM F1671 (Section 8.3) ISO 4649 (Section 8.19)	No penetration of Phi-X174 bacteriophage Relative volume loss shall \leq 250 mm ³	
Eyelets and stud hooks	Slip resistance Eyelet and stud post attachment	ASTM F2913 (Section 8.20) (Section 8.21)	Coefficient of friction of \geq 0.40 Detachment strength \geq 295 N (66 lbf)	
Hardware	Corrosion resistance	ASTM B117 (Section 8.22)	No more than light surface-type corrosion or oxidation, ferrous metals show no corrosion of the base metal, and hardware items remain functional	
Labels	Label durability and legibility	(Section 8.33)	Be legible	
<i>Multiple-Use Medical Care Facility Footwear</i>				
Footwear	Liquidtight integrity	FIA Standard 1209 (Section 8.23)	No leakage and no separation of outer sole	
Upper materials	Biopenetration	ASTM F1671 (Section 8.3)	No penetration of Phi-X174 bacteriophage \geq 20 mm (0.8 in.)	
	Cut resistance	ASTM F1790 (Section 8.18)	No puncture under an applied force of 45 N (10 lbf)	
	Puncture resistance	ASTM F1342 (Section 8.13)	No penetration of Phi-X174 bacteriophage Relative volume loss shall \leq 250 mm ³	
Upper material seams Outer soles	Biopenetration	ASTM F1671 (Section 8.3)	No penetration of Phi-X174 bacteriophage	
	Abrasion resistance	ISO 4649 (Section 8.19)	Relative volume loss shall \leq 250 mm ³	
	Slip resistance	ASTM F2913 (Section 8.20) (Section 8.21)	Coefficient of friction of \geq 0.40 Detachment strength \geq 295 N (66 lbf)	
Eyelets and stud hooks	Eyelet and stud post attachment	ASTM B117 (Section 8.22)	No more than light surface-type corrosion or oxidation, ferrous metals show no corrosion of the base metal, and hardware items remain functional	
Hardware	Corrosion resistance			
Labels	Label durability and legibility	(Section 8.33)	Be legible	
<i>Multiple-Use Emergency Medical Helmet</i>				
Suspension systems	Suspension system retention	(Section 8.36)	Force required to separate any individual attachment point of the suspension assembly from the helmet shell and each adjusting mechanism of the suspension system assembly \geq 22 N (5 lbf). Adjusting mechanism functions properly.	
Chin straps	Retention system	(Section 8.37)	No breakage and stretch or slip \leq 38 mm ($\frac{1}{2}$ in.). All mechanisms function properly.	
Goggle/headlamp clips	Goggle and headlamp clip attachment	(Section 8.38)	Not release from the shell. Clips deflect \leq 6 mm ($\frac{1}{4}$ in.) from their original position.	
Hardware	Corrosion resistance	ASTM B117 (Section 8.22)	No more than light surface-type corrosion or oxidation, ferrous metals show no corrosion of the base metal, and hardware items remain functional	
Helmet retroreflective markings	Retroreflection	(Section 8.37)	Ra \geq 100 cd/lux/m ² (100 cd/fc/ft ²)	
<i>Emergency Medical Powered Air-Purifying Respirator</i>				
Hood materials	Performance requirements		Meet requirements in 7.1.1 with exception of 7.1.1.7 or 7.1.2 with exception of 7.1.2.9 (provide test data as indicated for single-use or multiple-use emergency medical garments above)	
<i>Single-Use Emergency Medical Protective Ensemble</i>				
Ensembles	Liquidtight integrity (test one)	ASTM F1359 (Section 8.2)	No liquid penetration	
	Overall ensemble function	ASTM F1154, Modified (Section 8.40)	Complete tasks in \leq 20 min with garment closure remaining engaged	

(continues)

Table 5.3.1.1(a) *Continued*

Ensemble or Element	Performance Requirement	Test Method	Requirement	Result
Garments	Performance requirements		Test subject properly identifies 3 out of 4 numbers on NFPA 704 placard at each angle Visual acuity $\geq 20/35$ Protective flap remains closed over closure system No liquid penetration following exercises	
Examination gloves	Performance requirements		Meets requirements in 7.1.1 (provide test data as indicated for single-use emergency medical garments above)	
Footwear	Performance requirements		Meets requirements in 7.2.1 (provide test data as indicated for single-use emergency medical examination gloves above) Meets requirements in 7.4 for respective footwear (provide test as indicated for respective footwear above)	
<i>Multiple-Use Emergency Medical Protective Ensemble</i>				
Ensembles	Liquidtight integrity (test one) Overall ensemble function and integrity	ASTM F1359 (Section 8.2) ASTM F1164 (Section 8.40)	No liquid penetration Complete tasks in ≤ 20 min with garment closure remaining engaged Test subject properly identifies 3 out of 4 numbers on NFPA 704 placard at each angle Visual acuity $\geq 20/35$ Protective flap remains closed over closure system No liquid penetration following exercises	

Table 5.3.1.1(b) Format for Reporting Certification Permeation Test Data in Technical Data Package

Chemical	Cleaning Utility Glove Material	Result
Glutaraldehyde, 40% w/w	≤ 6.0	
Isopropanol, 70% w/w	≤ 6.0	
Sodium hypochlorite, 5%	≤ 6.0	
Peracetic acid, $\leq 30\%$	≤ 6.0	

N 5.3.2 In the technical data package, the manufacturer shall describe the single-use or multiple-use protective ensemble and ensemble elements in terms of manufacturer trade name and model number, manufacturer replaceable components, available options, accessories, testing devices, and sizes.

N 5.3.3 In the technical data package, the manufacturer shall describe the available sizes of the single-use or multiple-use protective ensemble and ensemble elements.

Chapter 6 Design Requirements

6.1 Emergency Medical Protective Garment Design Requirements.

6.1.1 Single-Use Emergency Medical Garment Design Requirements.

6.1.1.1 Garments shall be designed to cover any part of the upper and lower torso, excluding hands, face, and feet.

Δ 6.1.1.2* Garments shall be permitted to be configured as full body clothing such as jackets and pants or coveralls, and non-

full body clothing such as aprons, sleeve protectors, sleeved aprons or smocks, and hoods.

6.1.1.2.1 Where garments are configured as aprons, garments shall be designed to protect the front torso of the wearer from the neck to below the knees.

6.1.1.2.2 Where garments are configured as sleeve protectors, garments shall be designed to protect the arm of the wearer from the wrist crease to a distance of no less than 405 mm (16 in.) from the wrist crease.

6.1.1.2.3 Where garments are configured as sleeved aprons, garments shall be designed to protect the front torso of the wearer from the neck to below the knees and the arm of the wearer to the wrist crease.

6.1.1.2.4 Where garments are configured as separate hoods, garments shall be designed to protect the wearer at the top, side, and back of the wearer's head and the wearer's neck.

6.1.1.3 Garments shall be permitted to include integrated booties to protect the wearer's feet in conjunction with outer footwear.

6.1.1.3.1 Where garments incorporate booties, the booties shall be designed as an extension of the garment leg and shall cover the entire foot and ankle.

6.1.1.4 Garments shall be permitted to include integrated hoods to protect portions of the wearer's head and face in conjunction with eye and face protection devices and appropriate respirators.

6.1.1.4.1 Where garments incorporate hoods, the hood shall cover at least the top, back, and sides of the head.

N 6.1.1.4.2 Where garments are configured as separate hoods, the hood shall cover at least the top, back, and sides of the head.

N 6.1.1.4.3 Where garments incorporate hoods or are provided as separate hoods, the hood shall be permitted to have a face opening that accommodates the wearing of specific eye and face protection devices or respirators.

N 6.1.1.4.4 Where garments incorporate hoods or are provided as separate hoods, the hood shall be permitted to include a clear visor that covers the wearer's eyes and face.

6.1.1.5* All portions of the body covered by the garment item shall be provided with barrier protection.

6.1.1.6* The barrier layer used in the construction of the garment shall be a single, nonseparable layer.

6.1.1.7* All external fittings including, but not limited to, zippers, snaps, or other fasteners of specimen garments shall be examined and shall be free of rough spots, burrs, or sharp edges that could tear the garment or glove materials.

• **6.1.2 Multiple-Use Emergency Medical Garment Design Requirements.**

6.1.2.1 Garments shall be designed to cover any part of the upper and lower torso, excluding hands, face, and feet.

△ 6.1.2.2 Garments shall be permitted to be configured as full body clothing such as jackets and pants or coveralls, and non-full body clothing such as aprons, sleeve protectors, sleeved aprons or smocks, and hoods. (See A.6.1.1.2.)

6.1.2.2.1 Where garments are configured as aprons, garments shall be designed to protect the front torso of the wearer from the neck to below the knees.

6.1.2.2.2 Where garments are configured as sleeve protectors, garments shall be designed to protect the arm of the wearer from the wrist crease to a distance of no less than 405 mm (16 in.) from the wrist crease.

6.1.2.2.3 Where garments are configured as sleeved aprons, garments shall be designed to protect the front torso of the wearer from the neck to below the knees and the arms of the wearer to the wrist crease.

N 6.1.2.2.4 Where garments are configured as separate hoods, garments shall be designed to protect the wearer at the top, side, and back of the wearer's head and the wearer's neck.

6.1.2.3 Garments shall be permitted to include integrated booties to protect the wearer's feet in conjunction with outer footwear.

6.1.2.3.1 Where garments incorporate booties, the booties shall be designed as an extension of the garment leg and shall cover the entire foot and ankle.

6.1.2.4 Garments shall be permitted to include integrated hoods to protect portions of the wearer's head and face in conjunction with eye and face protection devices and appropriate respirators.

6.1.2.4.1 Where garments incorporate hoods, the hood shall cover at least the top, back, and sides of the head.

N 6.1.2.4.2 Where garments are configured as separate hoods, the hood shall cover at least the top, back, and sides of the head.

N 6.1.2.4.3 Where garments incorporate hoods or are provided as separate hoods, the hood shall be permitted to have a face opening that accommodates the wearing of specific eye and face protection devices.

N 6.1.2.4.4 Where garments incorporate hoods or are provided as separate hoods, the hood shall be permitted to include a clear visor that covers the wearer's eyes and face.

6.1.2.5 All portions of the body covered by the garment item shall be provided with barrier protection. (See A.6.1.1.5.)

6.1.2.6 The barrier layer used in the construction of the garment shall be a single, nonseparable layer. (See A.6.1.1.6.)

6.1.2.7 All external fittings including, but not limited to, zippers, snaps, or other fasteners of specimen garments shall be examined and shall be free of rough spots, burrs, or sharp edges that could tear the garment or glove materials.

6.1.2.8* Where visibility materials are used on garments, and the garments are intended to be used as high-visibility safety apparel, garments shall meet the respective requirements for Performance Class 1, 2, or 3 in accordance with ANSI/ISEA 107, *High-Visibility Safety Apparel and Accessories*.

• **6.2 Emergency Medical Glove Design Requirements.**

6.2.1 Single-Use Emergency Medical Examination Glove Design Requirements.

6.2.1.1* Examination gloves shall be designed and designated to meet only the single-use requirements of this standard.

6.2.1.2 In order to label or otherwise represent examination gloves as being compliant with the requirements of this standard, the manufacturer shall provide gloves in not less than five separate and distinct sizes.

6.2.1.3 Examination gloves shall be permitted to be provided in ambidextrous sizing.

6.2.1.4 Examination glove sizing shall be consistent with EN 455-2, *Medical gloves for single use — Part 2: Requirements and testing for physical properties*.

6.2.2 Single-Use Emergency Medical Cleaning/Utility Glove Design Requirements.

6.2.2.1 In order to label or otherwise represent cleaning/utility gloves as being compliant with the requirements of this code, the manufacturer shall provide gloves in not less than four separate and distinct sizes.

6.2.2.2 Cleaning/utility glove hand circumference sizing shall be in accordance with Clause 51 of EN 420, *General Requirements for Protective Gloves*. Requirements for glove length shall be disregarded.

6.2.2.3 Gloves shall have a length of at least 278 mm (11 in.).

6.2.2.4 Cleaning/utility gloves and related hardware shall be examined and shall be free of rough spots, burrs, or sharp edges that could tear garment or glove material.

6.2.3 Multiple-Use Emergency Medical Work Glove Design Requirements.

6.2.3.1 Emergency medical work gloves shall be designed and designated to meet only the multiple-use requirements of this standard.

6.2.3.2 Emergency medical work gloves shall be designed and configured to provide physical and barrier protection to the wearer's hand from the fingertips to at least the wrist crease.

N 6.2.3.2.1 Emergency medical work gloves shall be permitted to include a separable liner or inner glove for the purpose of achieving the barrier protection function.

N 6.2.3.2.2 Emergency medical work gloves shall be permitted to use either a single-use emergency medical examination glove or a single-use emergency medical cleaning/utility glove as the inner glove when designed to be part of a single use or multiple use emergency medical protective ensemble.

△ 6.2.3.3 The glove shall consist of a glove body.

6.2.3.3.1 The glove shall extend circumferentially from the tip of the fingers to the at least wrist crease.

6.2.3.3.2 The portion of the glove that extends from the tip of the fingers to the wrist crease shall be considered to be the glove body and shall meet the glove body requirements in 7.2.3.

6.2.3.3.3 The optional portion of the glove that extends from the wrist crease up to the end of the entire glove shall be considered to be the glove interface component and shall meet the glove interface component requirements in 7.2.3. If it is not attached to a garment sleeve or if it is part of an ensemble that includes an interface between the glove and garment sleeve, the glove interface component shall create a close fit at the opening to restrict the entry of foreign particles and shall allow the glove to fit closely around the wearer's wrist.

N 6.2.3.3.4 The glove shall be designed to fit closely around the wearer's wrist or shall be adjustable such that a close fit around the wearer's wrist can be achieved to restrict the entry of foreign particles.

△ 6.2.3.3.5 The location of the wrist crease shall be determined by placing the glove palm down on a measurement board and securing (locking) the fingertips down onto the board.

6.2.3.3.6 A 1 lb weight shall be attached to the end of the glove body or glove interface component. The weight shall not be attached to a knitted wristlet and shall be applied evenly across the glove.

6.2.3.3.7* Two points shall be marked on the back side of the glove. The location of the points shall be determined by measuring down the following distances according to glove size, from the finger crotch of digit two and from the finger crotch of digit three:

- (1) XS: 9.46 cm (3.72 in.)
- (2) S: 10.04 cm (3.95 in.)
- (3) M: 10.68 cm (4.20 in.)
- (4) L: 11.21 cm (4.42 in.)
- (5) XL: 11.73 cm (4.62 in.)

6.2.3.3.8 A straight line shall be drawn on the back side of the glove using the two points. This line shall be drawn around the side edges of the glove.

6.2.3.3.9 The glove shall be removed from the measurement board. A line shall be drawn on the palm side of the glove by connecting the lines from the side edges of the glove.

6.2.3.3.10 The resulting straight line around the circumference of the glove shall be the location of the wrist crease.

● 6.2.3.4 Hand dimensions for the selection of the proper emergency medical work glove size shall consist of measuring the hand circumference and hand length dimensions as shown in Figure 6.2.3.4.

6.2.3.4.1 Hand circumference shall be measured by placing a measuring tape on a table or other flat surface with the numerals facing downward. The subject shall place the right hand, palm down and fingers together, in the middle of the tape so that the tape can pass straight across the metacarpal knuckles. The circumference shall be measured to the nearest 3 mm ($\frac{1}{8}$ in.) as shown in Figure 6.2.3.4.

6.2.3.4.2 Finger circumference shall be measured at the proximal interphalangeal joint, the first knuckle. Finger length shall be measured from the tip of the finger to the base of the finger crease on the palm side.

6.2.3.4.3 Hand length shall be measured by placing the subject's hand, palm down, on a piece of paper with the fingers together and the hand and arm in a straight line. The thumb shall be fully abducted, extended away from the palm as far as possible. The paper shall be marked at the tip of the third, or middle, finger. A pencil mark shall be placed in the notch at the base of the thumb where the thumb joins the wrist. The straight line distance between the two points shall be measured to the nearest 3 mm ($\frac{1}{8}$ in.) as shown in Figure 6.2.3.4.

● 6.2.3.5 Any permanent attachment provided by the manufacturer to a work glove shall not interfere with the function of that work glove or with the function of any of the work glove component parts.

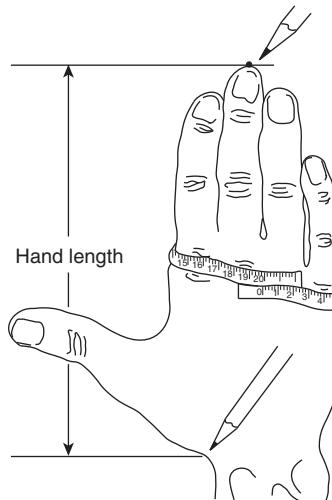


FIGURE 6.2.3.4 Method of Measuring Hand Dimensions for Selection of Proper Glove Size.

6.2.3.6 Where work gloves are provided by the manufacturer with permanent attachments, the work gloves shall meet all of the design and performance requirements of this standard with permanent attachments installed. In all cases, such permanent attachments shall not degrade the performance of the work gloves.

6.3* Emergency Medical Eye and Face Protection Device Design Requirements.

6.3.1 Single-Use Emergency Medical Facemask Design Requirements.

6.3.1.1 Facemasks shall incorporate a wire or other device that allows the portion of the facemask that covers the top of the nose to be shaped over the wearer's nose.

6.3.1.2 Facemasks shall include a means for securing the facemask to the wearer's head that does not require tying.

6.3.1.3 Where facemasks include plastic shields, the plastic shield shall overlap the top of the face mask by at least 19 mm ($\frac{3}{4}$ in.) over the entire top between points of attachment for the plastic shield.

6.3.1.4 Where facemasks include plastic shields, the plastic shield shall have a height of at least 50 mm (2 in.) above the top of the facemask.

6.3.1.5 Where facemasks include plastic shields, the sides of the plastic shield shall extend at least 19 mm ($\frac{3}{4}$ in.) beyond the points of attachment for the plastic shield.

6.3.2 Single-Use Emergency Medical Eye and Face Protection Device Design Requirements.

6.3.2.1 Eye and face protection devices shall be designed to cover part or all of the face, including the eyes.

6.3.2.2 Where the eye and face protection device is configured as a faceshield, the faceshield shall provide at least the following field of vision:

- (1) Dihedral angle of at least 85 degrees
- (2) Upper dihedral angle of at least 10 degrees
- (3) Lower dihedral angle of at least 40 degrees

6.3.2.3 The field of vision shall be measured from the center of the surface of the eye.

6.3.2.4 The faceshield shall be positioned on an Alderson 50th percentile male headform specified in Figure 6.3.2.4.

6.3.2.5 Face protection devices and related hardware shall be examined for, and shall be free of, rough spots, burrs, or sharp edges that could tear garment or glove materials.

6.3.3 Multiple-Use Emergency Medical Eye and Face Protection Device Design Requirements.

6.3.3.1 Eye and face protection devices shall be designed to cover part or all of the face or head. Face protection devices shall be permitted to be configured as, but are not limited to, splash-resistant eyewear, goggles, faceshields, hooded visors, and combinations of these items.

6.3.3.2 Eye and face protection devices to be certified as compliant with this standard shall need not be primary eye protection but shall be permitted to be primary eye protection.

6.3.3.3 Where the eye and face protection device is configured as safety glasses, the safety glasses shall meet the respective

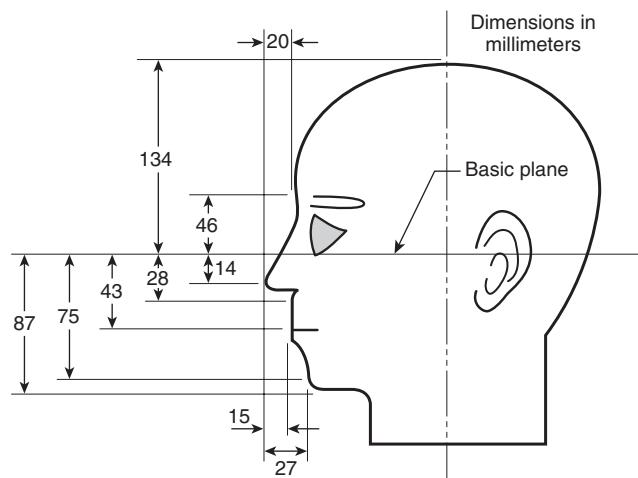


FIGURE 6.3.2.4 Alderson Headform.

requirements for spectacles and be marked at least "Z87 D3" in accordance with, ANSI Z87.1, *Occupational and Educational Personal Eye and Face Protection Devices*.

6.3.3.4 Where the eye and face protection device is configured as goggles, the goggles shall meet the respective requirements for goggles and be marked at least "Z87 D3" in accordance with, ANSI Z87.1, *Occupational and Educational Personal Eye and Face Protection Devices*.

6.3.3.5 Where the eye and face protection device is configured as a faceshield, the faceshield shall meet the respective requirements for faceshields and be marked at least "Z87 D3" in accordance with, ANSI Z87.1, *Occupational and Educational Personal Eye and Face Protection Devices*.

6.3.3.6* Face protection devices and related hardware shall be examined for, and shall be free of, rough spots, burrs, or sharp edges that could tear garment or glove materials.

6.4 Emergency Medical Footwear Design Requirements.

6.4.1 Single-Use Emergency Medical Footwear Cover Design Requirements.

6.4.1.1 Footwear covers shall be permitted to be offered in only one size.

6.4.1.2 The footwear cover height shall be a minimum of 150 mm (6 in.).

6.4.1.2.1 An NFPA 1999-compliant footwear item in size 9, D width shall be used to determine the height of the footwear cover when placed over the footwear.

6.4.1.2.2 The footwear cover height shall be determined by measuring lowest point of the footwear cover that extends up over the ankle area of the NFPA 1999-compliant footwear.

6.4.1.3 The wear surface of the footwear cover shall extend 25 mm (1 in.) laterally in all directions from the wear surface of standard footwear when measured as specified in 6.5.3.1.

6.4.1.3.1 An NFPA 1999-compliant footwear item in size 9, D width shall be used to determine the lateral extension of the footwear cover wear surface.

6.4.1.3.2 The NFPA 1999-compliant footwear item shall be centered inside the footwear cover for determining lateral extension of the footwear cover wear surface.

6.4.1.4 The footwear cover shall have some means to allow the top of the footwear cover to fit snugly around the wearer's bottom leg.

6.4.2 Multiple-Use Emergency Medical Footwear Design Requirements.

6.4.2.1 Footwear shall be designed and designated to meet only the multiple-use requirements of this standard.

6.4.2.2 Footwear shall consist of an upper with sole and heel.

6.4.2.3 Footwear height shall be a minimum of 100 mm (4 in.) when measured according to 6.4.2.3.1 through 6.4.2.3.4.

6.4.2.3.1 The 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 footwear, at the lowest point of the topline, excluding the tongue and gusset.

6.4.2.3.2 Removable insole inserts shall not be removed prior to measurement.

6.4.2.3.3 Moisture protection shall be continuous circumferentially to within 50 mm (2 in.) of the footwear topline at all locations, with the exception of the area inside of and within 13 mm (0.5 in.) around pull-up holes that fully penetrate the footwear from outside to inside. The height of physical and moisture protection at all locations of the boot shall be no less than 100 mm (4 in.) when measured as described in 6.4.2.3.1.

6.4.2.3.4 Physical protection shall be continuous circumferentially to within 50 mm (2 in.) of the footwear topline at all locations, with the exception of the tongue, gusset, and the area inside of and within 13 mm (0.5 in.) around pull-up holes that fully penetrate the footwear from outside to inside. The height of physical protection at all locations of the boot, with the exception of the tongue and gusset, shall be no less than 100 mm (4 in.) when measured as described in 6.4.2.3.1.

6.4.2.4 Footwear shall be available in all of the following sizes:

- (1) Men's 5–13, including half sizes, and a minimum of three widths
- (2) Women's 5–10, including half sizes, and a minimum of three widths

6.4.2.4.1 Manufacturers shall be required to establish and provide, upon request, a size conversion chart for each model or style of protective footwear based on toe length, arch length, and foot width as measured on the Bannock Scientific Foot Measuring Device.

6.4.2.4.2 Full and half sizes, in each of the three required widths, shall be accomplished by individual and unique lasts to provide proper fit.

6.4.2.5 Any permanent attachment provided by the manufacturer to footwear shall not interfere with the function of that footwear or with the function of any of the footwear component parts.

6.4.2.6 Where footwear is provided by the manufacturer with permanent attachments, the footwear shall meet all of the design and performance requirements of this standard with permanent attachments installed. In all cases, such permanent

attachments shall not degrade the performance of the footwear.

6.4.3 Multiple-Use Medical Care Facility Footwear Design Requirements.

6.4.3.1 Footwear shall consist of an upper with sole and heel.

6.4.3.2 Footwear height shall be a minimum of 75 mm (3 in.) when measured according to 6.4.3.2.1 through 6.4.3.2.4.

6.4.3.2.1 The 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 footwear, at the lowest point of the topline, excluding the tongue and gusset.

6.4.3.2.2 Removable insole inserts shall not be removed prior to measurement.

6.4.3.2.3 Moisture protection shall be continuous circumferentially to within 50 mm (2 in.) of the footwear topline at all locations, with the exception of the area inside of and within 13 mm (0.5 in.) around pull-up holes that fully penetrate the footwear from outside to inside. The height of physical and moisture protection at all locations of the boot shall be no less than 75 mm (3 in.) when measured as described in 6.4.2.3.1.

6.4.3.2.4 Physical protection shall be continuous circumferentially to within 50 mm (2 in.) of the footwear topline at all locations, with the exception of the tongue, gusset, and the area inside of and within 13 mm (0.5 in.) around pull-up holes that fully penetrate the footwear from outside to inside. The height of physical protection at all locations of the boot, with the exception of the tongue and gusset, shall be no less than 75 mm (3 in.) when measured as described in 6.4.2.3.1.

6.4.3.3 Footwear shall be available in all of the following sizes:

- (1) Men's 5–13, including half sizes, and a minimum of three widths
- (2) Women's 5–10, including half sizes, and a minimum of three widths

6.4.3.3.1 Manufacturers shall be required to establish and provide, upon request, a size conversion chart for each model or style of protective footwear based on the toe length, arch length, and foot width as measured on the Bannock Scientific Foot Measuring Device.

6.4.3.3.2 Full and half sizes, in each of the three required widths, shall be accomplished by individual and unique lasts to provide proper fit.

6.5* Multiple-Use Emergency Medical Helmet Design Requirements.

6.5.1 Medical helmets shall be designed and designated to meet only the multiple-use requirements of this standard.

6.5.2 Helmets shall meet the requirements for Type 1, Class G helmets of ANSI/ISEA Z89.1, *Standard for Industrial Head Protection*.

6.5.3 Helmets shall be designed to consist of at least a shell with a brim or peak; a means of absorbing energy; a suspension system with a sweatband, chin strap, and nape device; and retroreflective markings.

6.5.3.1 The brim shall be an integral part of the helmet shell that extends outward around the entire circumference of the shell.

6.5.3.2 The peak shall be the part of the helmet shell and shall extend forward over the forehead.

6.5.3.3 Helmets shall be permitted to have goggle or headlamp clips.

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

6.5.5 The helmet complete with an energy-absorbing system; a suspension system with sweatband, chin strap, nape device, and goggle clips; and retroreflective markings shall not weigh more than 570 g (20 oz).

6.5.6 Where present, clips for headlamps or goggles shall be permanently attached with at least one clip at the rear of the helmet, and one clip on each side of the helmet. Clips shall be suitably located to retain straps and shall not be attached more than 55 mm (2 $\frac{3}{16}$ in.) above the lower edge of the helmet.

6.5.7 The suspension shall contain a nape device that shall be removable and replaceable.

6.5.7.1 The suspension shall be adjustable in $\frac{1}{8}$ hat size or smaller increments.

6.5.8 A sweatband shall be provided that shall cover at least the forehead portion of the suspension system. Sweatbands shall be either removable and replaceable, or shall be integral with the suspension.

6.5.9 The helmet shall be designed so that the distance between the top of the head and the underside of the shell cannot be adjusted to less clearance than the manufacturer's requirements for that specific helmet.

6.5.10 Chin straps shall be provided that attach to the helmet. Both chin and nape straps shall not be less than 13 mm ($\frac{1}{2}$ in.) in width.

▲ 6.5.11 A minimum of 2580 mm² (4 in.²) of retroreflective markings shall be visible when the helmet is viewed from the sides, front, and rear.

N 6.5.11.1 The retroreflective markings shall be placed above the goggle or headlamp clips so as not to be obscured by any clip or the strap retained by the clips.

6.5.12 Any permanent attachment provided by the manufacturer to helmets shall not interfere with the function of the helmet or with the function of any of the helmet's component parts.

6.5.13 Where helmets are provided by the manufacturer with permanent attachments, the helmet shall meet all of the design and performance requirements of this standard with permanent attachments installed. In all cases, such permanent attachments shall not degrade the performance of the helmet.

N 6.6 Emergency Medical Powered Air-Purifying Respirator Design Requirements.

N 6.6.1 The respirator shall be certified to the requirements of Title 42, CFR 84, "Approval of Respirator Protective Devices," and shall include a protection level of HE.

6.7 Single-Use Emergency Medical Protective Ensemble Design Requirements.

6.7.1* Ensemble elements to be specified by the manufacturer shall include a specific single-use emergency medical protective garment, the use of any NFPA 1999-certified single-use emergency medical examination gloves (two pairs — inner and outer), specific multiple-use emergency medical footwear, multiple-use medical care facility footwear, or single-use emergency medical footwear covers, specific eye and face protection devices, and specific filtering facepiece respirator.

N 6.7.1.1 Emergency medical protective footwear shall be permitted to include any footwear certified to NFPA 1951, NFPA 1971, NFPA 1991, NFPA 1992, or NFPA 1994.

N 6.7.1.2 If the ensemble garment is configured with a bootie that is constructed of garment material and covers the wearer's foot and ankle, then any footwear meeting ASTM F2413, *Standard Specification for Performance Requirements for Protective (Safety) Toe Cap Footwear*, shall be permitted to be specified in conjunction with the garment.

N 6.7.1.3* Eye and face protection devices shall be permitted to include goggles and faceshields that only meet ANSI Z87.1, *Occupational and Educational Personal Eye and Face Protection Devices*, requirements when marked for splash/droplet use.

N 6.7.1.4* The filtering facepiece respirator shall be a NIOSH-approved filtering facepiece in accordance with 42 CFR 84, "Approval of Respiratory Protective Devices," that also meets the requirements of ASTM F2100, *Standard Specification for Performance of Materials Used in Medical Face Masks*, or a surgical N95 filtering facepiece respirator that is a NIOSH-approved N95 respirator that has also been cleared by the U.S. Food and Drug Administration as a surgical mask.

N 6.7.1.5 The manufacturer shall be permitted to specify respirators that meet the requirements in 6.8.1.4.

N 6.7.1.6* The use of a specific tape specified by the manufacturer shall be permitted for securing items in interface areas.

N 6.7.1.7 Where the outer single-use emergency medical examination gloves are physically attached to the single-use emergency medical garment, it shall be permitted to exclude the inner single-use examination gloves.

N 6.7.1.8 Specific cleaning/utility gloves shall be permitted to be substituted by the manufacturer for the outer pair of NFPA 1999-certified single user emergency medical examination gloves.

● N 6.8 Multiple-Use Emergency Medical Protective Ensemble Design Requirements.

N 6.8.1* Ensemble elements to be specified by the manufacturer shall include a specific multiple-use emergency medical protective garment, specific single-use emergency medical cleaning/utility or multiple-use emergency medical work gloves worn over any NFPA 1999-certified single-use medical emergency examination gloves, specific multiple-use emergency medical footwear, or multiple-use medical facility footwear, and specific full facepiece respirator(s).

N 6.8.1.1 Emergency medical protective footwear shall be permitted to include any footwear certified to NFPA 1951, NFPA 1971, NFPA 1991, NFPA 1992, or NFPA 1994.

N 6.8.1.2 If the ensemble is specified with multiple-use emergency medical work gloves and the work glove design relies on either a single-use examination glove or a single-use emergency medical cleaning/utility glove for the barrier protection, or the work glove consists of a separable liner that is attached to the sleeve of the ensemble garment element, then an additional NFPA 1999-certified single-use medical emergency examination glove shall not be required as part of the ensemble.

N 6.8.1.3 If the garment is configured with a bootie that is constructed of garment material and covers the wearer's foot and ankle, then any footwear meeting ASTM F2413 shall be permitted to be specified in conjunction with the garment.

N 6.8.1.4 Full-face respirators shall be NIOSH-approved as either a full-facepiece, air-purifying respirator with minimum protection level of P100 or an appropriate tight- or loose-fitting NIOSH-approved powered air-purifying respirator with a protection level of HE. All respirators shall be approved in accordance with 42 CFR 84, "Approval of Respiratory Protective Devices."

N 6.8.1.5 Where a loose-fitting powered air-purifying respirator is specified, the materials used in the construction of the hood shall meet the garment material performance requirements specified in either 7.1.1 with the exception of the requirement in 7.1.1.6, or 7.1.2 with the exception of 7.1.2.9.

Chapter 7 Performance Requirements

7.1 Emergency Medical Garment Performance Requirements.

7.1.1* Single-Use Emergency Medical Garment Performance Requirements.

△ 7.1.1.1 Full body or full torso garments, including, but not limited to, coveralls, coats, jackets, pants, and overalls, shall be tested for liquidtight integrity as specified in Section 8.2, Liquidtight Integrity Test One, and shall allow no water penetration.

△ 7.1.1.2 Garment barrier layer material and barrier layer seams shall be tested for body fluid-borne pathogen resistance as specified in Section 8.3, Biopenetration Test One, and shall exhibit no penetration of the Phi-X174 bacteriophage.

● △ 7.1.1.3 Garment materials, excluding interface materials, and interface components, shall be tested for bursting strength as specified in Section 8.5, Burst Strength Test, and shall have a bursting strength of not less than 66 N (14.9 lbf).

△ 7.1.1.4 Garment materials, excluding interface materials, and interface components, shall be tested for puncture resistance as specified in Section 8.6, Puncture Propagation Tear Resistance Test, and shall have a puncture resistance of not less than 12 N (2.7 lbf).

△ 7.1.1.5 Garment material seams, excluding visors, interface materials, and interface components, shall be tested for breaking strength as specified in Section 8.8, Seam Breaking Strength Test, and shall have a breaking strength of not less than 50 N (11.2 lbf).

△ 7.1.1.6 Garment materials for full body garments including, but not limited to, coveralls and full torso and limb encapsulating garments, but excluding visors, interface materials, and interface components, shall be tested for moisture vapor transmission rate as specified in Section 8.28, Moisture Vapor Trans-

mission Rate Test, and shall have a moisture vapor transmission rate of 650 g/m²/24 hr or greater.

△ 7.1.1.7 Garment materials shall be tested for flammability as specified in Section 8.35, Flammability Test, and shall have a flame spread time of 3.5 seconds or more.

N 7.1.1.8 Full body garments that at least cover the upper and lower torso, arms, and legs shall be tested for overall function as specified in Section 8.40, Overall Ensemble Function and Integrity Test, shall allow the test subject to complete all tasks within 15 minutes, and shall allow no liquid penetration in subsequent liquidtight integrity testing as specified in Section 8.2, Liquidtight Integrity Test One, and the garment closure shall remain engaged during the entire garment function testing.

N 7.1.1.8.1 Where the garment element includes a hood with a visor, the garment shall permit the test subject to properly identify three out of four numbers on the NFPA 704-based placard at each of the following angles: upward 36 degrees, downward 30 degrees, and right and left 60 degrees.

N 7.1.1.8.2 Where the garment element includes a hood with a visor, the ensemble shall permit the test subject to see with a visual acuity of 20/35 or better through the combination of the hood visor and the respirator facepiece lens.

N 7.1.1.8.3 Where protective flaps cover the closure, the protective flaps shall remain closed for the duration of the overall garment function test.

N 7.1.1.8.4 The liquidtight integrity evaluation conducted as part of this testing shall be permitted to replace the testing required in 7.1.1.1.

7.1.2 Multiple-Use Emergency Medical Garment Performance Requirements.

△ 7.1.2.1 Garments shall be tested for liquidtight integrity as specified in Section 8.2, Liquidtight Integrity Test One, and shall allow no water penetration.

△ 7.1.2.2 Barrier layer material and barrier layer seams shall be tested for body fluid-borne pathogen resistance as specified in Section 8.3, Biopenetration Test One, and shall exhibit no penetration of the Phi-X174 bacteriophage.

△ 7.1.2.3 Each separable layer of garment material, excluding visors, interface materials, and interface components, shall be tested for tensile strength as specified in Section 8.4, Tensile Strength Test, and shall have a tensile strength of not less than 225.5 N (50 lbf).

△ 7.1.2.4 Each separable layer of garment material, excluding visors, interface materials, and interface components, shall be tested for bursting strength as specified in Section 8.5, Burst Strength Test, and shall have a bursting strength of not less than 178 N (40 lbf).

△ 7.1.2.5 Each separable layer of garment material, excluding visors, interface materials, and interface components, shall be tested for puncture propagation tear resistance as specified in Section 8.6, Puncture Propagation Tear Resistance Test, and shall have a puncture resistance of not less than 25 N (5½ lbf).

▲ 7.1.2.6 Each separable layer of garment material, excluding visors, interface materials, and interface components, shall be tested for tear strength as specified in Section 8.7, Tear Resistance Test One, and shall have a tear strength of not less than 36 N (8 lbf).

▲ 7.1.2.7 Seams from each separable layer of garment material, excluding visors, interface materials, and interface components, shall be tested for breaking strength as specified in Section 8.8, Seam Breaking Strength Test, and shall have a breaking strength of not less than 222.5 N (50 lbf).

▲ 7.1.2.8 Garment material, excluding visors, interface materials, and interface components, shall be tested for water absorption resistance as specified in Section 8.31, Water Absorption Resistance Test, and shall have a percent water absorption of 30 percent or less.

▲ 7.1.2.9 Garment materials and composites, excluding visors, interface materials, and interface components, shall be tested for total heat loss as specified in Section 8.32, Total Heat Loss Test, and shall have a total heat loss value of 450 W/m² or greater.

■ 7.1.2.10 Where garments include visors, the visor materials shall be tested for impact resistance as specified in Section 8.41, Visor Drop Ball Impact Resistance Test, and shall not have a full thickness puncture, cracks, holes, or fractures.

■ 7.1.2.11 Garment materials or composites shall be tested for evaporative resistance as specified in Section 8.42, Evaporative Resistance Test, and shall have an evaporative resistance of not greater than 30 Pa m²/W.

▲ 7.1.2.12 Product labels of garments designated for multiple use shall be tested for durability and legibility as specified in Section 8.33, Label Durability and Legibility Test, and shall remain in place and shall be legible.

▲ 7.1.2.13 All garment hardware and specimens of all garment hardware that include metal parts shall be individually tested for resistance to corrosion as specified in Section 8.22, Corrosion Resistance Test, and shall have metals that are inherently resistant to corrosion including, but not limited to, stainless steel, brass, copper, aluminum, and zinc show no more than light surface-type corrosion or oxidation, shall have ferrous metals show no corrosion of the base metal, and shall have all hardware remain functional.

▲ 7.1.2.14 Where visibility materials are used on garments and the garment is intended to provide high visibility of the wearer in accordance with the requirement in 6.1.2.8, the background, retroreflective, and combined performance materials shall meet the requirements of ANSI/ISEA 107, *High-Visibility Safety Apparel and Accessories*.

● ▲ 7.1.2.15 Each separable layer of garment material shall be tested for flammability as specified in Section 8.35, Flammability Test, and shall have a flame spread time of 3.5 seconds or more.

▲ 7.1.2.16 Fastener tape shall be tested for breaking strength as specified in Section 8.39, Fastener Tape Strength Tests, and shall meet or exceed the minimum breaking strength requirements as established in Table 1 of A-A-55126B, *Commercial Item Description: Fastener Tapes, Hook and Loop, Synthetic*.

▲ 7.1.2.17 Fastener tape shall be tested for shear strength as specified in Section 8.39, Fastener Tape Strength Tests, and shall meet or exceed the minimum shear strength requirements as established in Table 1 of A-A-55126B, *Commercial Item Description: Fastener Tapes, Hook and Loop, Synthetic*.

▲ 7.1.2.18 Fastener tape shall be tested for peel strength as specified in Section 8.39, Fastener Tape Strength Tests, and shall meet or exceed the minimum peel strength requirements as established in Table 1 of A-A-55126B, *Commercial Item Description: Fastener Tapes, Hook and Loop, Synthetic*.

▲ 7.1.2.19 Garment zippers shall be tested for crosswise breaking strength of chain; crosswise breaking strength of separating unit; holding strengths of stops, retainers, and separating units; operating force; and slider lock strength requirements of A-A-55634A, *Commercial Item Description — Zippers (Fasteners, Slide, Interlocking)*.

■ 7.1.2.20 Full body garments that at least cover the upper and lower torso, arms, and legs shall be tested for overall function as specified in Section 8.40, Overall Ensemble Function and Integrity Test, shall allow the test subject to complete all tasks within 15 minutes, and shall allow no liquid penetration in subsequent liquidtight integrity testing as specified in Section 8.2, Liquidtight Integrity Test One, and the garment closure shall remain engaged during the entire garment function testing.

■ 7.1.2.20.1 Where the garment element includes a hood with a visor, the garment shall permit the test subject to properly identify three out of four numbers on the NFPA 704-based placard at each of the following angles: upward 36 degrees, downward 30 degrees, and right and left 60 degrees.

■ 7.1.2.20.2 Where the garment element includes a hood with a visor, the garment shall permit the test subject to see with a visual acuity of 20/35 or better through the combination of the hood visor and the respirator facepiece lens.

■ 7.1.2.20.3 Where protective flaps cover the closure, the protective flaps shall remain closed for the duration of the overall garment function test.

■ 7.1.2.20.4 The liquidtight integrity evaluation conducted as part of this testing shall be permitted to replace the testing required in 7.1.2.1.

■ 7.1.2.21 Garment Booties.

■ 7.1.2.21.1 Where garment bootie materials are different from the garment material, the garment bootie material shall be tested for tensile strength in accordance with Section 8.4 and shall have a tensile strength of not less than 50 N (11.2 lbf).

■ 7.1.2.21.2 Where garment bootie materials are different from the garment material, the garment bootie material shall be tested for bursting strength in accordance with Section 8.5 and shall have a burst strength of not less than 66 N (14.9 lbf).

■ 7.1.2.21.3 Where garment bootie materials are different from the garment material, the garment bootie material shall be tested for puncture resistance in accordance with Section 8.6 and shall have a puncture resistance of not less than 12 N (2.7 lbf).

■ 7.1.2.21.4 Where garment bootie materials are different from the garment material, the garment bootie material shall be tested for tear strength in accordance with Section 8.7 and shall have a tear strength of not less than 17 N (3.8 lbf).

N 7.1.2.21.5 Where garment bootie material seams are different from the garment material seams, the garment bootie material seams shall be tested for seam breaking strength in accordance with Section 8.8 and shall have a seam breaking strength of not less than 50 N (11.2 lbf).

7.2 Emergency Medical Glove Performance Requirements.

7.2.1 Single-Use Emergency Medical Examination Glove Performance Requirements.

△ 7.2.1.1 Examination gloves shall be tested for liquidtight integrity as specified in Section 8.9, Liquidtight Integrity Test Two, and shall have an acceptable quality limit of 1.5 or better.

△ 7.2.1.2 Examination gloves shall be tested for body fluid-borne pathogen resistance as specified in Section 8.10, Bioperetration Test Two, and shall exhibit no penetration of the Phi-X174 bacteriophage.

△ 7.2.1.3 Examination glove material shall be tested for tensile strength as specified in Section 8.11, Ultimate Tensile Strength Test, and shall have an ultimate tensile strength of not less than 14 MPa (2000 psi).

△ 7.2.1.4 Examination glove material shall be tested for elongation as specified in Section 8.12, Ultimate Elongation Test, and shall have an ultimate elongation of not less than 500 percent.

△ 7.2.1.5 Examination glove material shall be tested for puncture resistance as specified in Section 8.13, Puncture Resistance Test One, and shall have a puncture resistance of not less than 4.5 N (1 lbf).

△ 7.2.1.6 Examination gloves shall be tested for dexterity as specified in Section 8.14, Dexterity Test One, and shall have test times no greater than 120 percent of baseline test measurements.

△ 7.2.1.7 Examination glove material shall be tested for protein levels as specified in Section 8.15, Protein Content Test, and shall have protein levels no greater than 50 µg/g.

7.2.2 Single-Use Emergency Medical Cleaning/Utility Glove Performance Requirements.

△ 7.2.2.1 Cleaning/utility gloves shall be tested for liquidtight integrity as specified in Section 8.9, Liquidtight Integrity Test Two, and shall show no leakage.

△ 7.2.2.2 Cleaning/utility gloves shall be tested for body fluid-borne pathogen resistance as specified in Section 8.10, Bioperetration Test Two, and shall exhibit no penetration of Phi-X174 bacteriophage.

△ 7.2.2.3 Cleaning/utility glove materials shall be tested for permeation resistance as specified in Section 8.24, Chemical Permeation Resistance Test, and shall not have a cumulative permeation of greater than 6 µg/cm² for each chemical tested.

△ 7.2.2.4 Cleaning/utility glove materials shall be tested for tensile strength as specified in Section 8.11, Ultimate Tensile Strength Test, and shall have an ultimate tensile strength of greater than 10.3 MPa (1500 psi).

△ 7.2.2.5 Cleaning/utility glove materials shall be tested for puncture resistance as specified in Section 8.13, Puncture Resistance Test One, and shall have a puncture resistance of greater than 9 N (2 lbf).

△ 7.2.2.6 Cleaning/utility gloves shall be tested for resistance to cut as specified in Section 8.18, Cut Resistance Test, and shall have a blade travel distance not less than 20 mm (0.8 in.).

△ 7.2.2.7 Cleaning/utility glove materials shall be tested for abrasion resistance as specified in Section 8.25, Abrasion Resistance Test Two, and shall not show wear-through after 1000 cycles.

△ 7.2.2.8 Cleaning/utility gloves shall be tested for dexterity as specified in Section 8.26, Dexterity Test Two, and shall have an average percent of barehanded control not exceeding 200 percent.

△ 7.2.2.9 Cleaning/utility gloves shall be tested for tactility as specified in Section 8.30, Tactility Test, and shall permit pick-up of pins having a diameter of 5 mm (0.2 in.) or less.

△ 7.2.2.10 Cleaning/utility glove materials shall be tested for flammability as specified in Section 8.35, Flammability Test, and shall have a flame spread time of 3.5 seconds or more.

7.2.3 Multiple-Use Emergency Medical Work Glove Performance Requirements.

△ 7.2.3.1 Work gloves shall be tested for liquidtight integrity as specified in Section 8.29, Overall Liquid Integrity Test Three, and shall show no water penetration.

△ 7.2.3.2 Work gloves shall be tested for body fluid-borne pathogen resistance as specified in Section 8.3, Bioperetration Test One, and shall show no penetration of the Phi-X174 bacteriophage.

△ 7.2.3.3 Work glove body materials shall be tested for puncture resistance as specified in Section 8.13, Puncture Resistance Test One, and shall not puncture under an applied force of 9 N (2 lbf).

△ 7.2.3.4 Work glove body and interface component materials shall be tested for resistance to cut as specified in Section 8.18, Cut Resistance Test, and shall have a blade travel distance of not less than 20 mm (0.8 in.).

△ 7.2.3.5 Work glove body composite materials shall be tested for abrasion resistance as specified in Section 8.25, Abrasion Resistance Test Two, and shall show no wear-through.

△ 7.2.3.6 Gloves shall be tested for hand function as specified in Section 8.26, Dexterity Test Two, and shall have an average percent of barehanded control not exceeding 200 percent.

△ 7.2.3.7 Work gloves shall be tested for grip as specified in Section 8.27, Torque Test, and shall have an average percent of bare-handed control not less than 65 percent.

△ 7.2.3.8 Work gloves shall be tested for tactility as specified in Section 8.30, Tactility Test, and shall permit pick-up of pins having a diameter of 8 mm (0.3 in.) or less.

△ 7.2.3.9 All metal hardware and hardware that includes metal parts shall be tested for corrosion resistance as specified in Section 8.22, Corrosion Resistance Test, and shall have metals that are inherently resistant to corrosion, including, but not limited to, stainless steel, brass, copper, aluminum, and zinc show no more than light surface-type corrosion or oxidation; shall have ferrous metals show no corrosion of the base metal; and shall have hardware items remain functional.

△ 7.2.3.10 Glove body and glove interface component materials shall be tested for flammability as specified in Section 8.35,

Flammability Test, and shall have a flame spread time of 3.5 seconds or more.

▲ 7.2.3.11 Product labels shall be tested for durability and legibility as specified in Section 8.33, Label Durability and Legibility Test, and shall be legible.

■ 7.2.3.12 If the work glove is configured with a separable inner glove, and the inner glove is a single-use emergency medical examination glove, then the inner glove shall meet all the performance requirements in 7.2.1. Testing specified in 7.2.3.1 and 7.2.3.2 shall not be performed.

■ 7.2.3.13 If the work glove is configured with a separable inner glove, and the inner glove is a single-use emergency medical cleaning/utility glove, then the inner glove shall meet all the performance requirements in 7.2.2. Testing specified in 7.2.3.1 and 7.2.3.2 shall not be performed.

7.3* Emergency Medical Eye and Face Protection Device Performance Requirements.

7.3.1 Single-Use Emergency Medical Facemask Performance Requirements.

▲ 7.3.1.1 Medical facemasks shall meet the Level 3 barrier requirements for medical facemasks in accordance with Table 1 and Section 6 of ASTM F2100, *Standard Specification for Performance of Materials Used in Medical Face Masks*.

▲ 7.3.1.2 Medical facemasks shall be tested for liquidtight integrity as specified in Section 8.17, Liquidtight Integrity Test Three, and shall allow no liquid penetration.

7.3.2 Single-Use Emergency Medical Eye and Face Protection Device Performance Requirements.

▲ 7.3.2.1 These requirements shall apply to eye and face protection devices that are not medical facemasks or eye and face protection devices that incorporate medical facemask-like designs, which are intended for single use only.

▲ 7.3.2.2 If the portion of the eye and face protection device covering the eyes and face is not a continuous plastic or solid film, materials used in the construction of eye and face protection devices, except straps used to secure the device on the wearer's head, shall be tested for body fluid-borne pathogen resistance as specified in Section 8.3, Biopenetration Test One, and shall exhibit no penetration of the Phi-X174 bacteriophage.

▲ 7.3.2.3 Eye and face protection devices shall be tested for liquidtight integrity as specified in Section 8.17, Liquidtight Integrity Test Three, and shall allow no liquid penetration.

▲ 7.3.2.4 Eye and face protection devices that cover the eyes or affect the vision of the wearer shall be tested for visual acuity as specified in Section 8.16, Visual Acuity/Fogging Resistance Test, and shall permit test subjects to read at least the 20/35 visual acuity line or better and shall have the eye and face protection device be able to be donned and adjusted in accordance with manufacturer's instructions.

▲ 7.3.2.5 Each textile layer used in the construction of the eye and face protection device shall be tested for flammability as specified in Section 8.35, Flammability Test, and shall have a flame spread time of 3.5 seconds or more.

7.3.3 Multiple-Use Emergency Medical Eye and Face Protection Device Performance Requirements.

▲ 7.3.3.1 Eye and face protection devices that involve junctures or interfaces between different items that are not continuous in their design shall be tested for liquidtight integrity as specified in Section 8.17, Liquidtight Integrity Test Three, and shall allow no liquid penetration.

● ▲ 7.3.3.2 Unless corrosion resistance is already evaluated in another requirement, all eye and face protection device hardware and specimens of all face protection device hardware that include metal parts shall be individually tested for resistance to corrosion as specified in Section 8.22, and shall have metals that are inherently resistant to corrosion including, but not limited to, stainless steel, brass, copper, aluminum, and zinc, show no more than light surface-type corrosion or oxidation, shall have ferrous metals show no corrosion of the base metal, and shall have all hardware remain functional.

7.4 Emergency Medical Footwear Performance Requirements.

7.4.1 Single-Use Emergency Medical Footwear Cover Performance Requirements.

▲ 7.4.1.1 Footwear cover materials and seams shall be tested for body fluid-borne pathogen resistance as specified in Section 8.3, Biopenetration Test One, and shall show no penetration of the Phi-X174 bacteriophage.

▲ 7.4.1.2 Footwear cover upper materials shall be tested for tensile strength as specified in Section 8.4, Tensile Strength Test, and shall have a tensile strength of not less than 50 N (11.2 lbf).

▲ 7.4.1.3 Footwear cover upper materials shall be tested for bursting strength as specified in Section 8.5, Burst Strength Test, and shall have a bursting strength of not less than 66 N (14.9 lbf).

● ▲ 7.4.1.4 Footwear cover material seams shall be tested for breaking strength as specified in Section 8.8, Seam Breaking Strength Test, and shall have a breaking strength of not less than 50 N (11.2 lbf).

▲ 7.4.1.5 Footwear cover wear surface materials shall be tested for abrasion resistance as specified in Section 8.25, Abrasion Resistance Test Two, and shall show no wear-through.

▲ 7.4.1.6 The footwear cover wear surface materials shall be tested for puncture resistance as specified in Section 8.13, Puncture Resistance Test One, and shall have a puncture force greater than 8 N (1.8 lbf).

▲ 7.4.1.7 The footwear cover wear surface materials shall be tested for slip resistance as specified in Section 8.20, Slip Resistance Test, and shall have a coefficient of friction of 0.40 or greater.

▲ 7.4.1.8 Footwear cover materials shall be tested for flammability as specified in Section 8.35, Flammability Test, and shall have a flame spread time of 3.5 seconds or more.

7.4.2 Multiple-Use Emergency Medical Footwear Performance Requirements.

▲ 7.4.2.1 Footwear uppers shall be tested for cut resistance as specified in Section 8.18, Cut Resistance Test, and shall have a blade travel distance not less than 20 mm (0.8 in.).

△ **7.4.2.2** Footwear uppers shall be tested for puncture resistance as specified in Section 8.13, Puncture Resistance Test One, and shall not puncture under an applied force of 45 N (10 lbf).

△ **7.4.2.3** Footwear soles and heels shall be tested for abrasion resistance as specified in Section 8.19, Abrasion Resistance Test One, and the relative volume loss shall not be greater than 250 mm³.

△ **7.4.2.4** Footwear outer soles shall be tested for slip resistance as specified in Section 8.20, Slip Resistance Test, and shall have a coefficient of friction of 0.40 or greater.

△ **7.4.2.5** Eyelets and stud hooks shall be tested for attachment strength as specified in Section 8.21, Eyelet and Stud Post Attachment Test, and shall have a minimum detachment strength of 295 N (66 lbf).

△ **7.4.2.6** All footwear metal hardware and specimens of all footwear hardware that include metal parts shall be individually tested for resistance to corrosion as specified in Section 8.22, Corrosion Resistance Test, and shall have metals that are inherently resistant to corrosion including, but not limited to, stainless steel, brass, copper, aluminum, and zinc show no more than light surface-type corrosion or oxidation, shall have ferrous metals show no corrosion of the base metal, and shall have all hardware remain functional.

△ **7.4.2.7** The barrier layer material and barrier layer seams in the footwear shall be tested for body fluid-borne pathogen resistance as specified in Section 8.3, Biopenetration Test One, and shall show no penetration of the Phi-X174 bacteriophage.

△ **7.4.2.8** Footwear shall be tested for overall watertight integrity as specified in Section 8.23, Overall Liquid Integrity Test Four, and shall allow no liquid penetration, and the outer sole shall not separate.

△ **7.4.2.9** Product labels shall be tested for durability and legibility as specified in Section 8.33, Label Durability and Legibility Test, and shall be legible.

△ **7.4.2.10** Footwear shall be tested for flammability as specified in Section 8.35, Flammability Test, and shall have a flame spread time of 3.5 seconds or more.

N 7.4.2.11 Footwear shall meet the performance requirements as specified in ASTM F2413, *Standard Specification for Performance Requirements for Protective (Safety) Toe Cap Footwear*, for impact, compression, and puncture-resistant footwear, with the exception that flex resistance to cracking shall not be evaluated.

7.4.3 Multiple-Use Medical Care Facility Footwear Performance Requirements.

△ **7.4.3.1** Footwear uppers shall be tested for cut resistance as specified in Section 8.18, Cut Resistance Test, and shall have a blade travel distance not less than 20 mm (0.8 in.).

△ **7.4.3.2** Footwear uppers shall be tested for puncture resistance as specified in Section 8.13, Puncture Resistance Test One, and shall not puncture under an applied force of 45 N (10 lbf).

△ **7.4.3.3** Footwear soles and heels shall be tested for abrasion resistance as specified in Section 8.19, Abrasion Resistance Test One, and the relative volume loss shall not be greater than 250 mm³.

△ **7.4.3.4** Footwear outer soles shall be tested for slip resistance as specified in Section 8.20, Slip Resistance Test, and shall have a coefficient of friction of 0.40 or greater.

△ **7.4.3.5** Eyelets and stud hooks shall be tested for attachment strength as specified in Section 8.21, Eyelet and Stud Post Attachment Test, and shall have a minimum detachment strength of 295 N (66 lbf).

△ **7.4.3.6** All footwear metal hardware and specimen footwear hardware that include metal parts shall be individually tested for resistance to corrosion as specified in Section 8.22, Corrosion Resistance Test, and shall have metals that are inherently resistant to corrosion including, but not limited to, stainless steel, brass, copper, aluminum, and zinc show no more than light surface-type corrosion or oxidation, shall have ferrous metals show no corrosion of the base metal, and shall have all hardware remain functional unless specifically excluded in this test method.

△ **7.4.3.7** The barrier layer material and barrier layer seams in the footwear shall be tested for body fluid-borne pathogen resistance as specified in Section 8.3, Biopenetration Test One, and shall show no penetration of the Phi-X174 bacteriophage.

△ **7.4.3.8** Footwear shall be tested for overall watertight integrity as specified in Section 8.23, Overall Liquid Integrity Test Four, and shall allow no liquid penetration, and the outer sole shall not separate.

△ **7.4.3.9** Product labels shall be tested for durability and legibility as specified in Section 8.33, Label Durability and Legibility Test, and shall be legible.

7.5* Multiple-Use Emergency Medical Helmet Performance Requirements.

△ **7.5.1** Helmet suspension systems shall be tested for separation as specified in Section 8.36, Suspension System Retention Test, and shall not separate from the helmet, and the adjusting mechanism shall function properly.

△ **7.5.2** Helmet chin straps shall be tested for retention system separation as specified in Section 8.37, Retention System Test, and the chin strap shall not exhibit any breakage and shall not stretch or slip more than 38 mm (1½ in.), and shall have all mechanisms function properly.

△ **7.5.3** Where present, helmets with goggle or headlamp clips shall be tested for attachment strength as specified in Section 8.38, Goggle and Headlamp Clip Attachment Test, the clips shall not release from the shell, and the clips shall not deflect more than 6 mm (¼ in.) from their original position.

△ **7.5.4** All helmet metal hardware and helmet hardware that include metal parts shall be individually tested for resistance to corrosion as specified in Section 8.22, Corrosion Resistance Test, and shall have metals that are inherently resistant to corrosion including, but not limited to, stainless steel, brass, copper, aluminum, and zinc show no more than light surface-type corrosion or oxidation, shall have ferrous metals show no corrosion of the base metal, and shall have all hardware remain functional.

N 7.5.5 Helmet visibility markings shall be tested for retroreflectivity as specified in Section 8.37 and shall have a coefficient of retroreflection (R_a) of not less than 100 cd/lux/m² (100 cd/ft²).

N 7.6 Emergency Medical Powered Air-Purifying Respirator Performance Requirements.

N 7.6.1 Where a loose-fitting powered air-purifying respirator is specified, the materials used in the construction of the hood shall meet all garment material performance requirements specified in either 7.1.1, except the requirement in 7.1.1.6, or 7.1.2, except the requirements in 7.1.2.9 and 7.1.2.11.

7.7 Single-Use Emergency Medical Protective Ensemble Performance Requirements.

△ 7.7.1 Ensembles shall be tested for liquidtight integrity as specified in Section 8.2, Liquidtight Integrity Test One, and shall allow no water penetration.

△ 7.7.2 Garment elements specified as part of the ensemble shall meet the requirements in 7.1.1.

△ 7.7.3 Glove elements specified as part of the ensemble that are not already certified to this standard shall meet the requirements in 7.2.1.

△ 7.7.4 Footwear elements specified as part of an ensemble that does not use booties as part of its design that are not already certified to this standard or another standard specified in 6.7.1.1 shall meet the respective requirements in Section 7.4.

△ 7.7.5 Eye and face protection devices that are not already certified to this standard or are not marked at least "Z87 D3" in accordance with ANSI Z87.1, *Occupational and Educational Personal Eye and Face Protection Devices*, shall meet the respective requirements in Section 7.3.

△ 7.7.6 Ensembles shall be tested for overall function as specified in Section 8.40, Overall Ensemble Function and Integrity Test, shall allow the test subject to complete all tasks within 15 minutes, and shall allow no liquid penetration in subsequent liquidtight integrity testing as specified in Section 8.2, and the garment closure shall remain engaged during the entire ensemble function testing.

N 7.7.6.1 Where the ensemble element includes a hood with a visor that covers the respirator facepiece, the ensemble shall permit the test subject to properly identify three out of four numbers on the NFPA 704-based placard at each of the following angles: Upward 36 degrees, downward 30 degrees, and right and left 60 degrees.

N 7.7.6.2 Where the ensemble element includes a hood with a visor that covers the respirator facepiece, the ensemble shall permit the test subject to see with a visual acuity of 20/35 or better through the combination of the hood visor and the respirator facepiece lens.

N 7.7.6.3 Where protective flaps cover the closure, the protective flaps shall remain closed for the duration of the overall ensemble function test.

N 7.7.6.4 The liquidtight integrity evaluation conducted as part of this testing shall be permitted to replace the testing required in 7.7.1.

N 7.8 Multiple-Use Emergency Medical Protective Ensemble Performance Requirements.

N 7.8.1 Ensembles shall be tested for liquidtight integrity as specified in Section 8.2, Liquidtight Integrity Test One, and shall allow no water penetration.

N 7.8.2 Garment elements specified as part of the ensemble shall meet the requirements in 7.2.1.

N 7.8.3 Glove elements specified as part of the ensemble that are not already certified to this standard shall meet the requirements in Section 7.2.

N 7.8.4 Footwear elements specified as part of an ensemble that does not use booties as part of its design that are not already certified to this standard or another standard specified in 6.8.1.1 shall meet the respective requirements in Section 7.4.

N 7.8.5 Interface Material Requirements.

N 7.8.5.1 Where the ensemble includes elastomeric interface materials, each elastomeric interface material shall be tested for cut resistance as specified in Section 8.18, Cut Resistance Test, and shall have a blade travel distance of not less than 20 mm (0.8 in.).

N 7.8.5.2 Where the ensemble includes elastomeric interface materials, each elastomeric interface material shall be tested for puncture resistance as specified in Section 8.13, Puncture Resistance Test 1, and shall have a puncture resistance of not less than 7 N (1.6 lbf).

N 7.8.5.3 Where the ensemble includes elastomeric interface materials, each elastomeric interface material shall be tested for ultimate tensile strength as specified in Section 8.11, Ultimate Tensile Strength Test, and shall have an ultimate tensile strength of not less than 4 MPa (550 psi).

N 7.8.5.4* Elastomeric interface materials shall have an elongation at rupture of not less than 125 percent when tested as specified in Section 8.11, Ultimate Tensile Strength Test.

N 7.8.6 Ensembles shall be tested for overall function as specified in Section 8.40, Overall Ensemble Function and Integrity Test, shall allow the test subject to complete all tasks within 15 minutes, and shall allow no liquid penetration in subsequent liquidtight integrity testing as specified in Section 8.2, and the garment closure shall remain engaged during the entire ensemble function testing.

N 7.8.6.1 Where the ensemble element includes a hood with a visor that covers the respirator facepiece, the ensemble shall permit the test subject to properly identify three out of four numbers on the NFPA 704-based placard at each of the following angles: upward 36 degrees, downward 30 degrees, and right and left 60 degrees.

N 7.8.6.2 Where the ensemble element includes a hood with a visor that covers the respirator facepiece, the ensemble shall permit the test subject to see with a visual acuity of 20/35 or better through the combination of the hood visor and the respirator facepiece lens.

N 7.8.6.3 Where protective flaps cover the closure, the protective flaps shall remain closed for the duration of the overall ensemble function test.

N 7.8.6.4 The liquidtight integrity evaluation conducted as part of this testing shall be permitted to replace the testing required in 7.8.1.

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(s) 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 Garments, Gloves, and Face Protection Devices.

8.1.2.1 Samples shall be conditioned at a temperature of $21^{\circ}\text{C} \pm 3^{\circ}\text{C}$ ($70^{\circ}\text{F} \pm 5^{\circ}\text{F}$) and a relative humidity of 65 percent ± 5 percent, until equilibrium is reached, as determined in accordance with ASTM D1776/D1776M, *Standard Practice for Conditioning and Testing Textiles*, or for at least 24 hours.

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

8.1.3 Washing and Drying Procedure for Complete Garments, Work Gloves, and Work Glove Pouches.

8.1.3.1 When laundering complete garments, the garment shall be washed with all closures fastened.

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

8.1.3.3 Two-thirds of the rated capacity of the washer shall be used.

N 8.1.3.3.1 If ballast is needed to reach the minimum load size, materials similar to the test material shall be used.

N 8.1.3.3.2 Two-thirds of the rated capacity of the washer shall not be exceeded.

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

N 8.1.3.4.1 Water temperature shall be within $\pm 3^{\circ}\text{C}$ ($\pm 5^{\circ}\text{F}$) of the value in the table.

N 8.1.3.4.2 Low water shall be $12.7 \text{ cm} \pm 1 \text{ cm}$ ($5.0 \text{ in} \pm \frac{3}{8} \text{ in.}$) and high water level shall be $25.4 \text{ cm} \pm 1 \text{ cm}$ ($10.0 \text{ in} \pm \frac{3}{8} \text{ in.}$).

N 8.1.3.4.3 In addition, the g force shall not exceed 100 g throughout the wash cycle.

8.1.3.5 Samples shall be dried using a tumble dryer with a stack temperature of 38°C to 49°C (100°F to 120°F) when measured on an empty load 20 minutes into the drying cycle.

8.1.3.6 Garment samples shall be tumbled for a minimum of 30 minutes or until samples are completely dry and shall be removed immediately at the end of the drying cycle.

N 8.1.3.6.1 At the conclusion of the final drying cycle, the complete garment samples shall be allowed to air dry for at least 48 hours prior to conducting the test.

8.1.3.7 Work glove and work glove pouch samples shall be tumbled for 60 minutes and shall be removed immediately at the end of the drying cycle.

N 8.1.3.7.1 At the conclusion of the final drying cycle, the glove shall be dried on a forced air non-tumble drying mechanism operated at $10^{\circ}\text{C} \pm 5^{\circ}\text{C}$ ($18^{\circ}\text{F} \pm 9^{\circ}\text{F}$) above current room temperature until completely dry.

8.1.3.8 Samples shall be washed and dried for a total of 10 washings and 10 drying cycles.

N 8.1.3.9 Where work gloves used in conjunction with multiple-use ensembles consist of two separate gloves with the inner glove attached to the garment, the outer glove shall not be required to be washed and dried in accordance with 8.1.3.8.

8.1.4 Isopropanol Immersion Procedure for Gloves.

8.1.4.1 Glove specimens shall be cut from the sample prior to conditioning. Glove specimens shall be totally immersed in 100 percent isopropanol at room temperature for a period of 2 hours.

8.1.4.2 Glove specimens shall be removed from the isopropanol, hung in a vertical position for 5 minutes, laid horizontal with AATCC textile blotting paper both under and over the sample, under a weight of $2 \text{ }\mu\text{g}/\text{cm}^2 \pm 0.2 \text{ g}/\text{cm}^2$ ($\frac{1}{2} \text{ psi} \pm 0.05 \text{ psi}$), for a period of 20 minutes as specified in AATCC 70, *Test Method for Water Repellency: Tumble Jar Dynamic Absorption Test*.

8.1.4.3 Specimens shall be tested within 5 minutes following blotting.

N 8.1.5 Washing and Drying Procedure for Garment Materials. Specimens shall be subjected to 10 cycles of washing and drying in accordance with the procedure specified in Machine Cycle 1, Wash Temperature V, and Drying Procedure Ai, of the 2004 edition of AATCC 135, *Dimensional Changes in Automatic Home Laundering of Woven and Knit Fabrics*. A $1.8 \text{ kg} \pm 0.1 \text{ kg}$ ($4.0 \text{ lb} \pm 0.2 \text{ lb}$) load shall be used. A laundry bag shall not be used.

8.1.6 Heat Aging Procedure for Gloves.

8.1.6.1 Glove samples shall be subjected to heat aging in accordance with ASTM D573, *Standard Test Method for Rubber-Deterioration in an Air Oven*, at a temperature of $70^{\circ}\text{C} \pm 2^{\circ}\text{C}$ ($158^{\circ}\text{F} \pm 4^{\circ}\text{F}$) for 166 hours ± 2 hours.

8.1.6.2 The sample gloves shall be allowed to cool for 10 minutes ± 1 minute, prior to testing.

Table 8.1.3.4 Wash Cycle Procedure for Whole Garments

Operation	Time (minutes)	Temperature		Water Level
		°C	°F	
Suds using AATCC Detergent #1993, 1.0 g/4 L (1 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			

8.1.7 Abrasion Procedure for Garment Labels. Labels shall be subjected to abrasion in accordance with ASTM D4966, *Standard Test Method for Abrasion Resistance of Textile Fabrics (Martindale Abrasion Test Method)*, with the modifications in 8.1.7.1 through 8.1.7.3.

8.1.7.1 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.

8.1.7.2 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.

8.1.7.3 Specimens shall be subjected to 200 cycles, 3200 revolutions, of the test apparatus.

8.1.8 Wet Conditioning for Work Gloves.

8.1.8.1 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.

8.1.8.2 The wrist crease location shall be marked as described in 6.2.3.3 on each specimen around the entire glove $+0/-3$ mm ($+0/-0.25$ in.). Then, in the same manner, the water height line shall also be marked on each specimen 25 mm (1 in.) $+0/-3$ mm ($+0/-0.25$ in.) below (towards the fingers) the location of the wrist crease around the entire glove.

8.1.8.3 The test subject shall don the test specimen gloves.

8.1.8.4 The test subject shall immerse the donned specimens straight down into two containers of water at a temperature of $21^{\circ}\text{C} \pm 3^{\circ}\text{C}$ ($70^{\circ}\text{F} \pm 5^{\circ}\text{F}$) to the water height line for 15 seconds $+1.5/-0$ seconds.

8.1.8.5 The glove specimens shall be tested within 1 minute.

8.1.9* Work Glove Test Areas.

8.1.9.1 Work glove test areas shall be as described below and shown in Figure 8.1.9.1. Work glove test area abbreviations shall be as follows: P = Palm; B = Back; S = Side.

- (1) A-P: Palm side of hand from finger crotch line to $\frac{1}{3}$ of the way down (grasp area)
- (2) B-P: Palm side of hand from $\frac{1}{3}$ of the way down (grasp area) to the wrist crease
- (3) C-P: Palm side of hand from the wrist crease to the end of the glove
- (4) D-P: Palm side of thumb
- (5) E-P: Palm side of tip of thumb
- (6) F-P: Palm side of index finger
- (7) G-P: Palm side of fingertip of index finger
- (8) H-P: Palm side of nonindex fingers
- (9) I-P: Palm side of fingertip of nonindex fingers
- (10) A-PS: Sides of hand adjacent to section A-P
- (11) B-PS: Outside of hand adjacent to section B-P
- (12) C-PS: Sides of hand adjacent to section C-P
- (13) D-PS: Outside of thumb adjacent to section D-P
- (14) E-PS: Inside of thumb adjacent to section D-P
- (15) F-PS: Outside of index finger adjacent to section F-P
- (16) H-PS: In between fingers adjacent to sections F-P and H-P
- (17) I-PS: Outside of and adjacent to the smallest finger
- (18) A-B: Back side of hand from finger crotch line to $\frac{1}{3}$ of the way down (knuckle area)

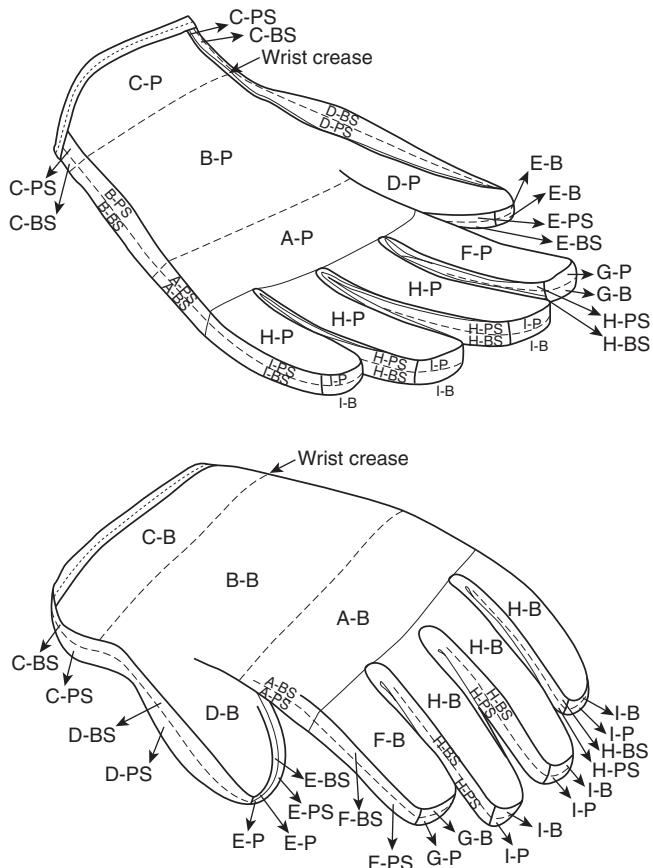
- (19) B-B: Back side of hand from $\frac{1}{3}$ of the way down (knuckle area) to the wrist crease
- (20) C-B: Back side of hand from the wrist crease to the end of the glove
- (21) D-B: Back side of thumb
- (22) E-B: Back side of tip of thumb
- (23) F-B: Back side of index finger
- (24) G-B: Back side of fingertip of index finger
- (25) H-B: Back side of nonindex fingers
- (26) I-B: Back side of fingertip of nonindex fingers
- (27) A-BS: Sides of hand adjacent to section A-B
- (28) B-BS: Outside of hand adjacent to section B-B
- (29) C-BS: Sides of hand adjacent to section C-B
- (30) D-BS: Outside of thumb adjacent to section D-B
- (31) E-BS: Inside of thumb adjacent to section D-B
- (32) F-BS: Outside of index finger adjacent to section F-B
- (33) H-BS: In between fingers adjacent to sections F-B and H-B
- (34) I-BS: Outside of and adjacent to the smallest finger

- **8.1.10 Cold Temperature Conditioning for Medical Facemasks and Eye and Face Protection Devices.** Specimens shall be exposed to cold in an environmental chamber at a temperature of $0^{\circ}\text{C} \pm 2^{\circ}\text{C}$, for a period of not less than 4 hours.

8.2 Liquidtight Integrity Test One.

8.2.1 Application.

- 8.2.1.1 This test method shall apply to garments and ensembles.



▲ FIGURE 8.1.9.1 Work Glove Test Areas.

N 8.2.1.2 Modifications to this test method for testing single-use garments or single-use ensembles shall be as specified in 8.2.8.

N 8.2.1.3 Modifications to this test method for testing multiple-use garments or multiple-use ensembles shall be as specified in 8.2.9.

8.2.2 Specimens.

8.2.2.1 A minimum of one specimen shall be tested. The specimen shall consist of the entire garment with all layers assembled that are required for the garment to be compliant.

8.2.2.2 The size of the garment comprising the specimen shall be chosen to conform with the dimensions of the manikin to ensure proper fit of the specimen on the manikin in accordance with the manufacturer's sizing system. The size of the garments comprising the specimen shall be the same size as the manikin in terms of chest circumference, waist circumference, and inseam height.

8.2.2.3 When ensembles are tested, specimens shall include all items that are specified as part of the ensemble in 6.7.1 or 6.8.1.

8.2.3 Sample Preparation.

8.2.3.1 Samples for conditioning shall be complete garments or ensembles.

8.2.4 Apparatus. The apparatus and supplies for testing shall be those specified in ASTM F1359, *Standard Test Method for Liquid Penetration Resistance Integrity of Protective Clothing or Protective Ensembles Under a Shower Spray While on a Manikin*, using the modifications in 8.2.4.1 and 8.2.4.2.

8.2.4.1* The surface tension of the water used in testing shall be 35 dynes/cm \pm 5 dynes/cm.

8.2.4.2 In the testing of garments, the manikin shall be positioned so that the manikin body is in a full vertical orientation with the manikin's head looking forward, manikin legs straight, and manikin arms pointing downward by the sides of the manikin torso. The manikin joints shall be tightened to ensure that the manikin maintains this position during testing.

8.2.4.3 In the testing of ensembles, the manikin shall be positioned so that the manikin body with the exception of the left arm is in a full vertical position with the manikin's head looking forward, manikin legs straight, and right manikin arm pointing down by the right side of the manikin torso. The left arm forearm shall be, bent upward at a 135-degree angle at the elbow from the manikin's side.

8.2.5 Procedure. Liquidtight integrity testing of garments shall be conducted in accordance with ASTM F1359, *Standard Test Method for Liquid Penetration Resistance Integrity of Protective Clothing or Protective Ensembles Under a Shower Spray While on a Manikin* with the modifications in 8.2.5.1 through 8.2.5.6.

8.2.5.1 No provision for garments with a partial barrier layer shall be allowed.

8.2.5.2* The method used for mounting of the manikin in the spray chamber shall not interfere with the water spray.

8.2.5.3 Where non-full body garments are tested, those portions of the body not covered by the garment shall be blocked off and shall not be evaluated for watertight integrity.

8.2.5.4 Procedure A shall be used.

8.2.6* Report. A diagram shall be prepared for each test that identifies the locations of any liquid leakage as detected on the liquid-absorptive garment.

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

N 8.2.8 Specific Requirements for Testing Single-Use Garments or Single-Use Ensembles.

8.2.8.1 Single-use garments and ensemble samples shall be conditioned as specified in 8.1.2.

8.2.8.2 Single-use garment and ensemble specimens shall be exposed to the liquid spray for a total of 2 minutes with 30 seconds in each of the four specified manikin orientations.

N 8.2.9 Specific Requirements for Testing Multiple-Use Garments or Multiple-Use Ensembles.

8.2.9.1 Multiple-use garments and the garment elements of the ensemble samples shall be conditioned as specified in 8.1.3 and then conditioned as specified in 8.1.2. All other ensemble elements that are not attached to the garment element shall be conditioned as specified in 8.1.2.

8.2.9.2 Multiple-use garment and ensemble specimens shall be exposed to the liquid spray for a total of 8 minutes with 2 minutes in each of the four specified manikin orientations.

8.3 Biopenetration Test One.

8.3.1 Application.

8.3.1.1 This test shall be applied to the barrier layer material and barrier layer seams used in the construction of garments, work gloves, face protection devices, footwear, and footwear covers.

8.3.1.2 Modifications to this test method for testing garments shall be as specified in 8.3.7.

8.3.1.3 Modifications to this test method for testing work gloves shall be as specified in 8.3.11.

8.3.1.4 Modifications to this test method for testing face protection devices shall be as specified in 8.3.8.

8.3.1.5 Modifications to this test method for testing footwear shall be as specified in 8.3.9.

8.3.1.6 Modifications to this test method for testing footwear covers shall be as specified in 8.3.10.

8.3.2 Specimens.

8.3.2.1 A minimum of three specimens shall be tested.

8.3.2.2 Each specimen shall consist of three 75 mm (3 in.) squares for each material type.

8.3.2.3 Specimens to be tested shall be representative materials and seams used in the actual construction, or representative of actual construction.

8.3.3 Sample Preparation.

8.3.3.1 Samples of single-use garments, footwear materials, and footwear cover materials shall be conditioned as specified in 8.1.2.

8.3.3.2 Samples of multiple-use garment barrier layer and garment barrier layer seams shall be conditioned as specified in 8.1.5 and then conditioned as specified in 8.1.2. The garment barrier layer and garment barrier layer seams shall be permitted to be representative materials and seams used in the actual construction, or representative of actual construction.

8.3.3.3 Samples of single- and multiple-use face protection devices shall be conditioned as specified in 8.1.2.

8.3.4 Procedure. Liquid penetration resistance testing shall be conducted in accordance with ASTM F1671/F1671M, *Standard Test Method for Resistance of Materials Used in Protective Clothing to Penetration by Blood-Borne Pathogens Using Phi-X174 Bacteriophage Penetration as a Test System*.

8.3.5 Report. The pass/fail result for each specimen shall be recorded and reported.

8.3.6 Interpretation. A failure of any specimen constitutes failure of the material.

8.3.7 Specific Requirements for Testing Garments. Specimens for biopenetration testing shall consist of the barrier layer and barrier layer seams only. Elastomeric interface material shall be included when joined with the barrier layer.

8.3.8 Specific Requirements for Testing Face Protection Devices.

8.3.8.1 Samples for conditioning shall be whole face protection devices.

8.3.8.2 Specimens to be tested shall consist of the barrier layer and barrier layer seams.

8.3.9 Specific Requirements for Testing Footwear Materials.

8.3.9.1 Samples for conditioning shall be complete footwear or footwear composite swatches. Footwear composite swatches shall be representative of the footwear construction.

8.3.9.2 Specimens to be tested shall consist of the barrier layer and barrier layer seams.

8.3.10 Specific Requirements for Testing Footwear Covers.

8.3.10.1 Samples for conditioning shall be whole footwear covers.

8.3.10.2 Specimens shall be taken from the footwear cover that are representative of the footwear cover construction.

8.3.10.3 Where more than one material is used in the construction of the footwear cover, each material shall be tested separately.

8.3.11 Specific Requirements for Testing Work Glove Materials.

N 8.3.11.1 Work gloves that include separable inner gloves that are either single-use emergency medical examination gloves or single-use emergency medical cleaning/utility gloves shall not be evaluated for this requirement.

N 8.3.11.2 If the work glove contains a separable liner, the liner shall be combined with the work glove for purposes of conditioning as specified in 8.3.11.4.

8.3.11.3 Specimens shall be representative of the glove moisture barrier and moisture barrier seams. Three specimens shall be tested.

8.3.11.4 Samples for conditioning shall be in the form of an 200 mm × 200 mm (8 in. × 8 in.) pouch. A smaller pouch size shall be permitted provided that the resulting test specimens are of sufficient size for the test. The pouch shall be made of two glove composite swatches. The two glove composites shall be permitted to be of the same materials and construction. The two glove body composites shall be permitted to be representative of either the palm or the back of the glove. The two glove composite swatches shall be constructed to simulate the actual layers of the glove, arranged in proper order. Where the moisture barrier material seam is being tested, the moisture barrier layer shall contain a seam. The seam shall run within 25 mm (1 in.) of the center and shall extend across the entire width of the specimen. Each of the two composite swatches shall be stitched on all four sides using the same thread as used in the glove construction. The two composite swatches shall then be sewn together, inner liner to inner liner, on three sides using the same thread as used in the glove construction.

8.3.11.5 Samples shall be conditioned as specified in 8.1.3. If the glove liner for an examination glove is issued for single use only, it shall be conditioned as specified in 8.1.2.

8.3.11.6 The glove moisture barrier layers shall be removed from the multilayer composite samples after all preconditioning has been completed and shall become the glove barrier test specimen.

8.3.11.7 Specimens for testing shall be the barrier layer only.

8.3.11.8 Where the moisture barrier material is continuous through the glove body, only the barrier seams shall be tested. The test cell shall include both the moisture barrier material and the moisture barrier seam. The seam shall be located in the approximate center of the test cell.

8.4 Tensile Strength Test.

8.4.1 Application.

8.4.1.1 This test shall apply to materials used in the construction of garments and upper materials for footwear covers. Where the garment or footwear cover is constructed of several separable layers, each separable layer of garment material or footwear upper material shall be tested.

8.4.2 Specimens. Five specimens in each of the warp and fill directions shall be tested from each sample unit.

8.4.3 Sample Preparation.

8.4.3.1 Samples for conditioning shall be at least 1 m² (1 yd²) of the garment material or whole footwear cover.

8.4.3.2 Single-use garment and footwear cover samples shall be conditioned as specified in 8.1.2.

8.4.3.3 Multiple-use garment samples shall be conditioned as specified in 8.1.3 and then conditioned as specified in 8.1.2.

8.4.4 Procedure. Specimens shall be tested in accordance with ASTM D5034, *Standard Test Method for Breaking Strength and Elongation of Textile Fabrics (Grab Test)*.

8.4.5 Report.

8.4.5.1 The tensile strength of each specimen shall be recorded and reported to the nearest 0.5 N (0.1 lbf) of force.

8.4.5.2 An average tensile strength shall be calculated and reported for warp and fill directions.

8.4.6 Interpretation.

8.4.6.1 Pass/fail performance shall be based on the average tensile strength in the warp and fill directions.

8.4.6.2 A failure in any one direction shall constitute failure for the material.

8.5 Burst Strength Test.

8.5.1 Application.

N 8.5.1.1 This test shall apply to materials used in the construction of garments. Where the garment is constructed of several separable layers, each separable layer of garment material shall be tested.

N 8.5.1.2 Modifications to this test method for testing garment or hood visors shall be as specified in 8.5.7.

8.5.2 Specimens. A total of 10 specimens shall be tested.

8.5.3 Sample Preparation.

8.5.3.1 Samples for conditioning shall be at least 1 m² (1 yd²) of material.

8.5.3.2 Single-use garment samples shall be conditioned as specified in 8.1.2.

8.5.3.3 Multiple-use garment samples shall be conditioned as specified in 8.1.3 and then conditioned as specified in 8.1.2.

8.5.4 Procedure. Specimens shall be tested in accordance with ASTM D3787, *Method for Bursting Strength of Textiles — Constant-Rate-of-Traverse (CRT) Ball Burst Test*.

8.5.5 Report. The burst strength of each specimen shall be recorded and reported to the nearest 0.5 N (0.1 lbf). The average burst strength of all specimens shall be calculated and reported.

8.5.6 Interpretation. The average burst strength shall be used to determine pass/fail performance.

N 8.5.7 Specific Requirements for Testing Garment or Hood Visor Materials. Visor materials that have a thickness greater than 0.25 mm (0.010 in.) when measured in accordance with ASTM D6988, *Standard Guide for Determination of Thickness of Plastic Film Test Specimens*, shall not be tested.

8.6 Puncture Propagation Tear Resistance Test.

8.6.1 Application.

N 8.6.1.1 This test shall apply to materials used in the construction of multiple-use garments. Where the garment is constructed of several separable layers, each separable layer of garment material shall be tested.

N 8.6.1.2 Modifications to this test method for testing garment or hood visors shall be as specified in 8.5.7.

8.6.2 Specimens. Five specimens in each of the warp and fill directions shall be tested from each sample unit.

8.6.3 Sample Preparation.

8.6.3.1 Samples for conditioning shall be at least 1 m² (1 yd²) of material.

8.6.3.2 Samples shall be conditioned as specified in 8.1.3 and then conditioned as specified in 8.1.2.

8.6.4 Procedure. Specimens shall be tested in accordance with ASTM D2582, *Standard Test Method for Puncture-Propagation Tear Resistance of Plastic Film and Thin Sheetings*.

8.6.5 Report.

8.6.5.1 The puncture propagation tear resistance of each specimen shall be recorded and reported to the nearest 0.5 N (0.1 lbf) of force.

8.6.5.2 An average puncture propagation tear resistance shall be calculated and reported for warp and fill directions.

8.6.6 Interpretation.

8.6.6.1 Pass/fail performance shall be based on the average puncture propagation tear resistance in the warp and fill directions.

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

N 8.6.7 Specific Requirements for Testing Garment or Hood Visor Materials. Visor materials that have a thickness greater than 0.25 mm (0.010 in.) when measured in accordance with ASTM D6988, *Standard Guide for Determination of Thickness of Plastic Film Test Specimens*, shall not be tested.

8.7 Tear Resistance Test One.

8.7.1 Application. This test shall apply to materials used in the construction of multiple-use garments. Where the garment is constructed of several separable layers, each separable layer of garment material shall be tested.

8.7.2 Specimens.

8.7.2.1 Five specimens in each of the warp and fill directions shall be tested for each material.

8.7.2.2 Specimens shall be prepared in accordance with ASTM D5587, *Standard Test Method for the Tearing of Fabrics by Trapezoid Procedure*.

8.7.3 Sample Preparation.

8.7.3.1 Samples for conditioning shall be at least 1 m² (1 yd²) of material.

8.7.3.2 Garment samples shall be conditioned as specified in 8.1.3 and then conditioned as specified in 8.1.2.

8.7.4 Procedure. Specimens shall be tested in accordance with ASTM D5587, *Standard Test Method for the Tearing of Fabrics by Trapezoid Procedure*.

8.7.5 Report.

8.7.5.1 The tear strength of an individual specimen shall be the average of the five highest peak loads of resistance registered for mm (in.) of separation of the tear.

8.7.5.2 The tear strength of each specimen shall be recorded and reported to the nearest 0.5 N (0.1 lbf) of force.

8.7.5.3 An average tear strength shall be calculated and reported for warp and fill directions.

8.7.6 Interpretation.

8.7.6.1 Pass/fail performance shall be based on the average tear strength in the warp and fill directions.

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

8.8 Seam Breaking Strength Test.

8.8.1 Application.

8.8.1.1 This test shall be applied to seams used in the construction of garments.

8.8.1.2 Where garments consist of multiple separable layers, the test shall be applied to the seams of each separable layer.

8.8.2 Specimens.

8.8.2.1 A minimum of five seam specimens representative of the garment shall be tested for each seam type.

8.8.2.2 Straight-seam specimens shall be cut from conditioned samples.

8.8.2.3 Specimens for testing shall include at least 100 mm (4 in.) of material on either side of the seam.

8.8.3 Sample Preparation.

8.8.3.1 Samples for conditioning shall be at least 1 m² (1 yd²) of material.

8.8.3.2 Single-use garment samples shall be conditioned as specified in 8.1.2.

8.8.3.3 Multiple-use garment samples shall be conditioned as specified in 8.1.3 and then conditioned as specified in 8.1.2.

8.8.4 Procedure. All seams shall be tested in accordance with ASTM D1683/D1683M, *Standard Test Method for Failure in Sewn Seams of Woven Apparel Fabrics*.

8.8.5 Report.

8.8.5.1 The breaking strength for each seam specimen shall be recorded and reported to the nearest 0.5 N (0.1 lbf) of force.

8.8.5.2 The average breaking strength for each seam type shall also be recorded and reported.

8.8.6 Interpretation. The average breaking strength for each seam or closure assembly type shall be used to determine pass/fail performance.

8.9 Liquidtight Integrity Test Two.

8.9.1 Application.

8.9.1.1 This test shall be applied to whole examination gloves and cleaning/utility gloves.

8.9.1.2 Modifications to this test method for testing examination gloves shall be as specified in 8.9.7.

8.9.1.3 Modifications to this test method for testing cleaning/utility gloves shall be as specified in 8.9.8.

8.9.2 Specimens. Specimens shall be whole examination gloves or cleaning/utility gloves.

8.9.3 Sample Preparation. Samples shall be conditioned as specified in 8.1.2.

8.9.4* Procedure. Liquidtight integrity testing shall be conducted in accordance with ASTM D5151, *Standard Test Method for Detection of Holes in Medical Gloves*, with the modification that the water shall be replaced with water treated with a

surfactant to achieve a surface tension of 35 dynes/cm ± 2 dynes/cm.

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

8.9.6 Interpretation. Passing performance shall be based on the number of passing and failing specimens.

8.9.7 Specific Requirements for Testing Examination Gloves.

8.9.7.1 The number of specimens shall be determined in accordance with ISO 2859-1, *Sampling procedures for inspection by attributes. Part 1: Sampling plans indexed by acceptable quality level (AQL) for lot-by-lot inspection*.

8.9.7.2 A minimum of 32 specimens shall be tested.

8.9.7.3 Passing performance shall be consistent with a set of specimens that meets an acceptable quality level of 1.5 or better, in accordance with ISO 2859-1, *Sampling procedures for inspection by attributes. Part 1: Sampling plans indexed by acceptable quality level (AQL) for lot-by-lot inspection*.

8.9.8 Specific Requirements for Testing Cleaning/Utility Gloves.

8.9.8.1 A total of 10 different specimens shall be tested.

8.9.8.2 The cleaning/utility glove shall be filled with the surfactant-treated water to a height 25 mm (1 in.) above the top of the thumb crotch, when the glove is oriented in the fingers down position.

8.9.8.3 If one of the 10 specimens fails, a second set of 10 specimens shall be tested and the results of the second specimen set used to determine pass/fail performance.

8.10 Biopenetration Test Two.

8.10.1 Application. This test shall be applied to whole gloves.

8.10.2 Specimens. A minimum of five whole glove specimens shall be tested.

8.10.3 Sample Preparation.

8.10.3.1 Samples for conditioning shall be whole gloves.

8.10.3.2 Specimens shall be conditioned as specified in 8.1.2.

8.10.4 Procedure.

8.10.4.1 Liquid penetration resistance testing shall be conducted in accordance with ASTM F1671/F1671M, *Standard Test Method for Resistance of Materials Used in Protective Clothing to Penetration by Blood-Borne Pathogens Using Phi-X174 Bacteriophage Penetration as a Test System*.

8.10.4.2 The modifications specified in 8.10.4.2.1 through 8.10.4.2.7 shall apply.

8.10.4.2.1 The test shall be performed by placing a sufficient volume of Phi-X174 bacteriophage suspension into a 1000 ml (34 fl oz) Erlenmeyer flask or other suitably sized vessel such that the height of bacteriophage suspension is 50 mm ± 5 mm (2 in. ± $\frac{1}{16}$ in.) above the specimen glove thumb crotch.

8.10.4.2.2 The specimen shall be carefully immersed into the challenge suspension and shall be positioned such that the distance from the top of the flask to the middle finger of the glove is 180 mm (7 in.). The excess top of the specimen shall be stretched over the mouth of the flask.

8.10.4.2.3 The specimen shall be filled with a sufficient volume of nutrient broth such that the height of the nutrient broth is approximately $25\text{ mm} \pm 2.5\text{ mm}$ (1 in. $\pm \frac{3}{32}$ in.) lower than the outside level of the bacteriophage suspension.

8.10.4.2.4 Five ml (0.2 fl oz) of nutrient broth shall be removed from the interior of the specimen and assayed to determine that the specimen was not contaminated.

8.10.4.2.5 The specimen cuff shall be sealed onto the flask using parafilm or tape. A sterile closure shall be placed on the top of the flask.

8.10.4.2.6 The flask shall be placed onto the platform of an orbital shaker and shaken at a speed of 100 rpm $+10\text{ min}/-0$ rpm. The flask shall be shaken for a period of 1 hour $+5\text{ minutes}/-0$ minutes.

8.10.4.2.7 At the end of 1 hour, $+5\text{ minutes}/-0$ minutes, the flask shall be removed from the orbital shaker and the contents from inside the specimen shall be carefully transferred to a sterile bottle and assayed for the presence of Phi-X174 bacteriophage.

8.10.5 Report. The pass/fail result for each specimen shall be recorded and reported.

8.10.6 Interpretation. A failure of any specimen constitutes failure of the material.

8.11 Ultimate Tensile Strength Test.

8.11.1 Application.

N 8.11.1.1 This test shall be applied to glove and elastomeric interface materials.

N 8.11.1.2 Modifications to this test method for testing elastomeric interface materials shall be as specified in 8.11.7.

8.11.2 Specimens.

8.11.2.1 A minimum of 10 specimens shall be tested.

8.11.2.2 Specimens shall be taken from the palm and back of individual gloves.

8.11.3 Sample Preparation.

8.11.3.1 Samples for conditioning shall be cut from whole gloves.

8.11.3.2 Specimens shall be tested for ultimate tensile strength after conditioning as specified in 8.1.2.

8.11.3.3 Specimens shall be tested for ultimate tensile strength after conditioning as specified in 8.1.6.

△ 8.11.4 Procedure. Specimens shall be tested in accordance with Method A — Dumbbell Specimens, of ASTM D412, *Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers — Tension*. Specimens shall be cut using Die C (metric).

N 8.11.4.1 The specimen elongation at break shall be measured.

8.11.5 Report.

8.11.5.1 The ultimate tensile strength before and after heat aging shall be recorded and reported for each specimen to the nearest 10 kPa (2 psi).

8.11.5.2 The average ultimate tensile strength before and after heat aging shall be calculated and reported for all specimens tested.

N 8.11.5.3 The elongation of the specimens at break shall be reported before heat aging with the average elongation at break calculated and reported.

8.11.6 Interpretation.

N 8.11.6.1 The average ultimate tensile strength both before and after heat aging shall be individually used to determine pass/fail performance.

N 8.11.6.2 The average elongation at break before heat aging shall be used to determine pass/fail performance.

N 8.11.7 Specific Requirements for Testing Elastomeric Interface Materials.

N 8.11.7.1 Samples for conditioning shall be either elastomeric interface sheet material of a size that is sufficiently large to provide the required number of specimens or formed elastomeric interface material components such as hood gaskets.

N 8.11.7.2 Specimens shall be taken from elastomeric interface sheet material or formed elastomeric interface material components that are representative of the component material nominal thickness.

8.12 Ultimate Elongation Test.

8.12.1 Application. This test shall be applied to glove materials.

8.12.2 Specimens.

8.12.2.1 A minimum of 10 specimens shall be tested.

8.12.2.2 Specimens shall be taken from the palm and back of individual gloves.

8.12.3 Sample Preparation.

8.12.3.1 Samples for conditioning shall be cut from whole gloves.

8.12.3.2 Specimens shall be tested after conditioning as specified in 8.1.4.

8.12.3.3 Specimens shall be tested after conditioning as specified in 8.1.6.

8.12.4 Procedure. Specimens shall be tested in accordance with Method A — Dumbbell Specimens, of ASTM D412, *Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers — Tension*.

8.12.5 Report.

8.12.5.1 The ultimate elongation (percentage) shall be recorded and reported for each specimen to the nearest 10 percent.

8.12.5.2 The average ultimate elongation (percentage) shall be recorded and reported for all specimens tested.

8.12.6 Interpretation. The average ultimate elongation after heat aging and the average ultimate elongation after isopropanol immersion shall be used to determine pass/fail performance.

8.13 Puncture Resistance Test One.

8.13.1 Application.

△ 8.13.1.1 This test shall be applied to examination, cleaning, and work glove materials, footwear upper materials, footwear cover materials, and elastomeric interface materials.

8.13.1.2 Modifications to this test method for testing examination, cleaning, and work glove materials shall be as specified in 8.13.7 and 8.13.8.

8.13.1.3 Modifications to this test method for testing footwear upper material shall be as specified in 8.13.9.

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

Ν 8.13.1.5 Modifications to this test method for testing elastomeric interface materials shall be as specified in 8.13.11.

△ 8.13.2 Specimens. A minimum of three specimens measuring at least 150 mm² (6 in.²) shall be tested.

8.13.3 Sample Preparation.

8.13.3.1 Samples for conditioning shall be complete whole gloves, whole footwear, and whole footwear covers.

8.13.3.2 Specimens shall be tested after conditioning as specified in 8.1.2.

8.13.4 Procedure.

8.13.4.1 Specimens shall be tested in accordance with ASTM F1342/F1342M, *Standard Test Method for Protective Clothing Material Resistance to Puncture*, using Test Method A, with the following modification:

(1) The compression load cell shall be capable of discerning 0.5 N (0.1 lbf) of force in the range suitable for the glove material being tested. The upper limit of the load cell shall not be more than 10 times the actual puncture resistance measured for the glove specimens.

8.13.5 Report.

8.13.5.1 The puncture force shall be recorded and reported for each specimen to the nearest 0.5 N (0.1 lbf) of force.

8.13.5.2 The average puncture force shall be calculated and reported for all specimens tested.

8.13.6 Interpretation. The average puncture force shall be used to determine pass/fail performance.

8.13.7 Specific Requirements for Testing Examination and Cleaning Glove Materials.

8.13.7.1 Specimens shall consist of each composite of the palm, palm side of the fingers, and back of the glove with layers arranged in the proper order.

8.13.7.2 Where the specimens of the palm, palm side of the fingers, and back of the glove are identical, only one representative composite shall be required to be tested.

8.13.8 Specific Requirements for Testing Work Glove Materials.

8.13.8.1 Specimens shall be representative of the glove body composite construction at the following glove areas as described in 8.1.9: A-P, B-P, D-P, E-P, F-P, G-P, H-P, and I-P. Where the specimen composites of the palm and palm side of the fingers

are identical, only one representative composite shall be required to be tested. All variations in composite construction and the order of layering of composite materials shall constitute a new composite and shall be tested separately. Where a composite is identical to another composite except for additional reinforcement layer(s), the composite with no reinforcement layers shall be representative of the composite with reinforcement layer(s). Specimens shall not include seams except in the following cases:

- (1) Ridged areas or similar where stitching is used to create specific performance characteristics rather than for glove assembly
- (2) When there are size constraints of a material making it necessary to allow stitching in order to create the sample size required

8.13.8.2 Stitching shall be of the same type as is used in the actual glove construction.

8.13.9 Specific Requirements for Testing Footwear Upper Materials. Specimens shall consist of each composite of the footwear item used in the actual footwear construction, excluding the tongue and gusset, with layers arranged in proper order. Where a composite is identical to another composite except for additional reinforcement layer(s), the composite with no reinforcement layers shall be tested. Specimens shall not include seams.

8.13.10 Specific Requirements for Testing Footwear Cover Materials. Specimens shall be taken from the footwear wear surface and shall include all layers used in the construction of the footwear cover from wear surface exterior to interior of the footwear cover.

8.13.10.1 Specimens shall be taken from the footwear cover that are representative of the footwear cover construction.

8.13.10.2 Where more than one material is used in the construction of the footwear cover, then each material shall be tested separately.

Ν 8.13.11 Specific Requirements for Testing Elastomeric Interface Materials.

Ν 8.13.11.1 Samples for conditioning shall be either elastomeric interface sheet material of a size that is sufficiently large to provide the required number of specimens or formed elastomeric interface material components such as hood gaskets.

Ν 8.13.11.2 Specimens shall be taken from elastomeric interface sheet material or formed elastomeric interface material components that are representative of the gasket material's nominal thickness.

8.14 Dexterity Test One.

8.14.1 Application. This test shall be applied to examination gloves.

8.14.2 Specimens.

8.14.2.1 A minimum of three glove pairs each for size small and for size large shall be used for testing.

8.14.2.2 Each glove pair shall be tested as a complete set of gloves in new, as-distributed condition.

8.14.3 Sample Preparation.

8.14.3.1 Samples for conditioning shall be whole glove pairs.

8.14.3.2 Glove pair specimens shall be conditioned as specified in 8.1.2.

8.14.3.3 Glove pair specimens shall not receive special softening treatments prior to tests.

8.14.4 Procedure.

8.14.4.1 Dexterity shall be evaluated using the standardized procedure known as the Crawford Small Parts Dexterity Test, Screws Technique.

8.14.4.2 Two test subjects, one for hand size small and one for hand size large, shall be selected such that their hand dimensions are consistent with those specified in 6.2.1 for emergency medical examination gloves.

8.14.4.3 Each test subject used to perform the test shall practice until the baseline times of that person's last three repetitions vary no more than 6 percent.

8.14.4.4 Each test subject shall be tested with a minimum of three pairs of gloves. A minimum of six dexterity tests with gloves shall be conducted, with at least three dexterity tests with size small gloves and three dexterity tests with size large gloves.

8.14.4.5 Dexterity test times with gloves shall be compared with baseline dexterity test times for specific test subjects. The percentage of dexterity test times with gloves to baseline dexterity test times shall be calculated as follows:

N

[8.14.4.5]

$$\text{Percent of bare-handed control} = \frac{\text{Dexterity test time with gloves}}{\text{Baseline dexterity test time}} \times 100$$

8.14.5 Report. The percent of barehanded control shall be recorded and reported for each glove pair specimen and test subject tested.

8.14.6 Interpretation. One or more glove pair specimens failing this test shall constitute failing performance.

8.15 Protein Content Test.

8.15.1 Application. This test shall be applied to glove materials.

8.15.2 Specimens.

8.15.2.1 Specimens, measuring at least 25 mm (1 in.) square, shall be taken from a minimum of three different gloves for each glove type.

8.15.2.2 A minimum of three specimens per glove shall be tested.

8.15.3 Sample Preparation.

8.15.3.1 Samples for conditioning shall be whole gloves and shall be conditioned as specified in 8.1.2.

8.15.3.2 Specimens shall be taken from conditioned samples.

8.15.4 Procedure. Specimens shall be tested in accordance with ASTM D5712, *Standard Test Method for Analysis of Aqueous Extractable Protein in Latex, Natural Rubber, and Elastomeric Products Using the Modified Lowry Method*.

8.15.5 Report.

8.15.5.1 The protein level of each specimen shall be recorded and reported to the nearest 10 µg per gram of glove material.

8.15.5.2 The average protein level shall be calculated and reported for all specimens.

8.15.6 Interpretation. Pass/fail performance shall be based on the average reported protein level for each glove type.

8.16 Visual Acuity/Fogging Resistance Test.

8.16.1 Application. This test method shall apply to the portion of medical facemasks and eye and face protection device that cover the wearer's eyes.

8.16.2 Specimens.

8.16.2.1 A minimum of three specimens shall be tested.

8.16.2.2 Specimens shall be complete medical facemasks or eye and face protection devices.

8.16.2.3 Specimens shall be selected to fit each test subject in accordance with the manufacturer's sizing guidelines.

8.16.3 Sample Preparation.

8.16.3.1 Samples for conditioning shall be complete medical facemasks or eye and face protection devices.

8.16.3.2 Samples shall be conditioned as specified in 8.1.10.

8.16.4 Procedure.

8.16.4.1 Testing shall be conducted in an atmosphere with a temperature of 21°C ± 3°C, and a relative humidity of 50 percent ± 5 percent.

8.16.4.2 Testing shall be conducted using a minimum of three different test subjects.

8.16.4.3 The test subjects shall have a minimum visual acuity of 20/20 in each eye uncorrected, or corrected with contact lenses, as determined by a visual acuity test or doctor's examination.

8.16.4.4 Prior to evaluation for visual acuity, the medical facemask or eye and face protection device shall be inspected for functionality and the ability to be donned and adjusted in accordance with the manufacturer's instructions.

8.16.4.5 To evaluate visual acuity, the medical facemask or eye and face protection device shall be donned and adjusted in accordance with the manufacturer's instructions.

8.16.4.6 The test subject shall wear the medical facemask or eye and face protection device for a period of 3 minutes ± 30 seconds, before reading the eye chart. The 3-minute period shall commence when the facemask is fully donned and adjusted by the subject.

8.16.4.7 The test shall be conducted using a standard 6.1 m (20 ft) eye chart with a normal lighting range of 100 to 150 foot-candles at the chart and with test subjects positioned at a distance of 6.1 m (20 ft) from the chart.

8.16.4.8 Test subjects shall then read the standard eye chart through the medical facemask or eye and face protection device, and the visual acuity of each subject shall be determined.

8.16.5 Report.

8.16.5.1 The visual acuity of each test subject through the medical facemask or eye and face protection device shall be recorded and reported.

8.16.5.2 The ability of the test subject to don and doff the medical facemask or eye and face protection device without difficulty or without damage to the medical facemask or eye and face protection device shall be noted.

8.16.6 Interpretation.

8.16.6.1 Failure of any one test subject to achieve the required visual acuity while wearing the medical facemask or eye and face protection device shall constitute failure of the test.

8.16.6.2 If any medical facemask or eye and face protection device cannot be properly donned or doffed, or sustains any damage during the testing, the medical facemask or eye and face protection device shall be considered to have failed the test.

8.17 Liquidtight Integrity Test Three.

8.17.1 Application.

8.17.1.1 This test shall apply to medical facemasks and eye and face protection devices.

8.17.1.2 Modifications to this test method for evaluating medical facemasks shall be as specified in 8.17.8.

8.17.1.3 Modifications to this test method for evaluating single-use eye and face protection devices shall be as specified in 8.17.9.

8.17.1.4 Modifications to this test method for evaluating single-use eye and face protection devices shall be as specified in 8.17.10.

8.17.2 Specimens.

8.17.2.1 A minimum of three specimens shall be tested for each target area.

8.17.2.2 Specimens shall be complete medical facemasks or eye and face protection devices.

8.17.3 Sample Preparation.

8.17.3.1 Samples for conditioning shall be complete medical facemasks or eye and face protection devices.

8.17.3.2 Samples shall be conditioned as specified in 8.1.2.

8.17.4 Apparatus.

8.17.4.1 The test apparatus shall be as specified in ASTM F1862, *Standard Test Method for Resistance of Medical Face Masks to Penetration by Synthetic Blood (Horizontal Projection of Fixed Volume at a Known Velocity)*.

8.17.4.2 Where needed to support the specimen, a headform shall be used.

8.17.4.3 The headform shall be permitted to be a human-shape headform, such as the Alderson headform shown in Figure 6.3.2.4.

8.17.5 Procedures. Medical facemasks and eye and face protection devices shall be tested as specified in ASTM F1862, *Standard Test Method for Resistance of Medical Face Masks to Penetration by Synthetic Blood (Horizontal Projection of Fixed Volume at a Known Velocity)*.

tion by Synthetic Blood (Horizontal Projection of Fixed Volume at a Known Velocity), with the modifications specified below:

- (1) The medical facemask or eye and face protection device shall be positioned on an appropriate holder or headform such that the distance from the tip of pneumatic valve cannula to the target area on the face protection device is 305 mm (12 in.) and the target area of the medical facemask or eye and face protection device is perpendicular to the path of the synthetic blood.
- (2) Testing shall be conducted at a blood velocity equivalent to a blood pressure of 21.3 kPa (160 mm Hg).
- (3) An absorptive blotting paper or similar absorptive material shall be permitted to be placed on the interior side of the medical facemask or eye and face protection device to provide an aid in determining the occurrence of synthetic blood strikethrough.
- (4) Pass/fail results shall be reported only. An acceptable quality limit shall not be applied in testing.

8.17.5.1 Straps, ear loops, and temple portions of face protection devices shall not be evaluated.

8.17.6 Report. The pass/fail result for each target for each face protection device evaluated shall be recorded and reported.

8.17.7 Interpretation. Failure of any one target area for any tested face protection device shall constitute failing performance for the face protection device.

8.17.8 Specific Requirements for Testing Medical Facemasks.

8.17.8.1 Where medical facemasks do not incorporate visors or faceshields, target areas shall include locations 13 mm (½ in.) from each side of the medical facemask and 13 mm (½ in.) from the top and bottom of the medical facemask, centered on the horizontal height or span of the medical facemask, respectively.

8.17.8.2 Where medical facemasks do incorporate visors or faceshields, target areas shall include locations 13 mm (½ in.) from each side of the medical facemask, 13 mm (½ in.) from the bottom of the medical facemask, and 13 mm (½ in.) from the bottom center of the visor or faceshield centered on the horizontal height or span of the medical facemask, respectively.

8.17.8.3 Target areas shall not coincide with attachment points for ear loops or other attachment or hardware provided on the medical facemask.

8.17.9 Specific Requirements for Testing Single-Use Eye and Face Protection Devices.

8.17.9.1 Specific target areas on each eye and face protection device to be evaluated shall include the portions of the eye and face protection device that directly cover the center of each of the wearer's eyes, two locations 13 mm (½ in.) from the edge of the protective area provided by the eye and face protection device, and at least one location at every representative seam or junction of the eye and face protection device.

8.17.9.2 Target areas shall not coincide with attachment points for ear loops or other attachment or hardware provided on the eye and face protection device.

8.17.10 Specific Requirements for Testing Multiple-Use Eye and Face Protection Devices. Specific target areas shall include at least one location at every representative juncture or

interface between different items that are not continuous for the eye and face protection device.

8.18 Cut Resistance Test.

8.18.1 Application.

▲ 8.18.1.1 This test method shall apply to cleaning/utility gloves, work gloves, footwear upper materials, and elastomeric interface materials.

8.18.1.2 Modifications to this test method for evaluation of cleaning/utility gloves shall be as specified in 8.18.7.

8.18.1.3 Modifications to this test method for evaluation of work gloves shall be as specified in 8.18.8.

8.18.1.4 Modifications to this test method for evaluation of footwear upper materials shall be as specified in 8.18.9.

■ 8.18.1.5 Modifications to this test method for evaluation of elastomeric interface materials shall be as specified in 8.18.10.

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

8.18.3 Sample Preparation.

8.18.3.1 Samples for conditioning shall be whole gloves or footwear uppers.

8.18.3.2 Specimens shall be conditioned as specified in 8.1.2.

8.18.4 Procedure. Specimens shall be evaluated in accordance with ASTM F1790, *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 cut distance.

8.18.5 Report.

8.18.5.1 The cut distance shall be recorded and reported to the nearest 1 mm ($\frac{1}{32}$ in.) for each specimen.

8.18.5.2 The average cut distance in mm (in.) shall be calculated and reported for all specimens tested.

8.18.6 Interpretation. The average cut distance shall be used to determine pass/fail performance.

8.18.7 Specific Requirements for Testing Cleaning/Utility Gloves.

8.18.7.1 Specimens shall be taken from the back and palm of the glove and shall not include seams.

8.18.7.2 Cut resistance testing shall be performed under a load of 25 g (0.9 oz).

8.18.8 Specific Requirements for Testing Work Gloves.

8.18.8.1 Specimens shall be representative of the glove body composite construction at the following glove areas as described in 8.1.9 and shall not include seams: A-P, B-P, D-P, E-P, F-P, G-P, H-P, I-P, A-B, B-B, D-B, E-B, F-B, G-B, H-B, and I-B. Specimens shall be representative of each glove body composite construction. All variations in composite construction and the order of layering of composite materials shall constitute a new composite and shall be tested separately. Where a composite is identical to another composite except for additional reinforcement layer(s), the composite with no reinforcement layers shall be representative of the composite with reinforcement layer(s).

Specimens shall not include seams except in the following cases:

- (1) Ridged areas or similar where stitching is used to create specific performance characteristics rather than for glove assembly
- (2) When there are size constraints of a material making it necessary to allow stitching in order to create the sample size required

8.18.8.2 Stitching shall be of the same type as is used in the actual glove construction.

8.18.8.3 Cut resistance testing shall be performed under a load of 75 g (2.5 oz).

8.18.9 Specific Requirements for Testing Footwear Upper Materials.

8.18.9.1 Specimens shall consist of each composite of the footwear upper used in the actual footwear construction, excluding the tongue and gusset with layers arranged in proper order. Where a composite is identical to another composite except for additional reinforcement layer(s), the composite with no reinforcement layers shall be tested. Specimens shall not include seams.

8.18.9.2 Cut resistance testing shall be performed under a load of 350 g (12.3 oz).

■ 8.18.10 Specific Requirements for Testing Elastomeric Interface Materials.

■ 8.18.10.1 Samples for conditioning shall be either elastomeric interface sheet material of a size that is sufficiently large to provide the required number of specimens or elastomeric interface material components such as formed hood gaskets.

■ 8.18.10.2 Specimens shall be taken from elastomeric interface sheet material or elastomeric interface material components that are representative of the component material nominal thickness.

■ 8.18.10.3 Cut resistance testing shall be performed under a load of 50 g (1.75 oz).

8.19 Abrasion Resistance Test One.

8.19.1 Application. This test method shall apply to footwear soles.

8.19.2 Sample Preparation.

8.19.2.1 Samples shall be uniform cylinders of footwear soles and heel material as specified in ISO 4649, *Rubber, vulcanized or thermoplastic — Determination of abrasion resistance using a rotating cylindrical drum device*.

8.19.2.2 Samples shall be conditioned as specified in 8.1.2.

8.19.3 Specimens.

8.19.3.1 Specimens shall be uniform cylinders of footwear soles and heel material as specified in ISO 4649, *Rubber, vulcanized or thermoplastic — Determination of abrasion resistance using a rotating cylindrical drum device*.

8.19.3.2 At least three specimens shall be tested.

8.19.4 Procedure. Abrasion resistance shall be performed in accordance with ISO 4649, *Rubber, vulcanized or thermoplastic — Determination of abrasion resistance using rotating cylindrical drum*

device, Method A, with a vertical force of 10 N over an abrasion distance of 40 m.

8.19.5 Report. The relative volume loss of each specimen shall be recorded and reported.

8.19.6 Interpretation. One or more footwear specimens failing this test shall constitute failing performance.

8.20 Slip Resistance Test.

8.20.1 Application. This test method shall apply to footwear.

8.20.2 Sample Preparation.

8.20.2.1 Samples shall be the whole footwear in men's size 9D, medium width.

▲ **8.20.2.2** Samples shall be conditioned as specified in *ASTM F2913, Standard Test Method for Measuring the Coefficient of Friction for Evaluation of Slip Performance of Footwear and Test Surfaces/Flooring Using a Whole Shoe Tester*.

8.20.3 Specimens.

8.20.3.1 Specimens shall be the whole footwear in men's size 9D, medium width.

8.20.3.2 At least three specimens shall be tested.

▲ **8.20.4 Procedure.** Slip resistance shall be performed in accordance with *ASTM F2913, Standard Test Method for Measuring the Coefficient of Friction for Evaluation of Slip Performance of Footwear and Test Surfaces/Flooring Using a Whole Shoe Tester*, in the following configurations. References to any other flooring and/or contaminant within *ASTM F2913* shall not apply.

- (1) Footwear shall be tested both in the forepart and heel positions.
- (2) Footwear shall be tested in the wet condition.
- (3) Footwear shall be tested on a quarry tile surface that meets the specifications of *ASTM F2913* and shall be calibrated in accordance with *ASTM F2913*. The calibration frequency of 10 tests specified in *ASTM F2913* shall be equivalent to 50 test runs.

8.20.5 Report.

8.20.5.1 The coefficient of friction of each specimen shall be reported.

8.20.5.2 The average coefficient of friction of all specimens for each configuration shall be calculated, recorded, and reported.

8.20.6 Interpretation. The average coefficient of friction for each configuration shall be used to determine pass/fail performance.

8.21 Eyelet and Stud Post Attachment Test.

8.21.1 Application. This test method shall apply to protective footwear eyelets and stud posts.

8.21.2 Specimens.

8.21.2.1 Specimens shall total two eyelets and two stud posts on three separate footwear items.

8.21.2.2 Specimens shall be removed from the footwear and shall be 25 mm × 50 mm (1 in. × 2 in.).

8.21.3 Sample Preparation.

8.21.3.1 Samples for conditioning shall be whole footwear.

8.21.3.2 The eyelets or stud post specimens shall be conditioned as specified in 8.1.2.

8.21.4 Apparatus.

8.21.4.1 A tensile testing machine shall be used with a traverse rate of 50 mm/min (2 in./min).

8.21.4.2 Clamps measuring 25 mm × 38 mm (1 in. × 1½ in.) shall have gripping surfaces that are parallel, flat, and capable of preventing slippage of the specimen during the test.

8.21.5 Procedure.

8.21.5.1 The stud post or eyelet puller shall be inserted or attached to the upper position of the tensile machine.

8.21.5.2 The traverse rate shall be set at 50 mm/min (2 in./min). The test eyelet or stud post shall be attached using the appropriate puller fixture.

8.21.5.3 The eyelet stay shall be clamped, but clamping the base of the eyelets or stud hooks in the lower clamps shall not be permitted.

8.21.5.4 The distance between the clamps and stud hooks or eyelets shall be 2 mm to 3 mm ± 0.5 mm (⅛ in. to ⅜ in. ± ⅛ in.).

8.21.5.5 The test shall then be started.

8.21.6 Report.

8.21.6.1 The force will reach a peak, decline slightly, and then increase to complete failure; however, the value at which the force first declines shall be recorded and reported as the initial failure point, as this is the separation point of the material around the eyelet or stud post.

8.21.6.2 The average force shall be calculated and reported.

8.21.7 Interpretation. The average force shall be used to determine pass/fail.

8.22 Corrosion Resistance Test.

8.22.1 Application. This test method shall apply to hardware items on multiple-use eye and face protection devices, work gloves, footwear, and helmets.

8.22.2 Specimens. A total of five different items of each hardware type shall be tested.

8.22.3 Sample Preparation. Specimens shall be conditioned as specified in 8.1.2.

8.22.4 Procedure.

8.22.4.1 Specimens shall be tested in accordance with *ASTM B117, Standard Practice for Operating Salt Spray (Fog) Apparatus*. Salt spray shall be 5 percent saline solution, and test exposure shall be for 20 hours, +1/-0 hour.

8.22.4.2 Immediately following the test exposure and prior to examination, specimens shall be rinsed under warm, running tap water and dried with compressed air.

8.22.4.3 Specimens shall then be examined visually with the unaided eye to determine pass/fail.

8.22.4.4 The functionality of each specimen shall be evaluated.

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

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

8.23 Overall Liquid Integrity Test Four.

8.23.1 Application. This test shall apply to protective footwear.

8.23.2 Samples.

8.23.2.1 A minimum of three footwear items shall be tested.

8.23.2.2 Samples for conditioning shall be whole footwear.

8.23.3 Specimen Preparation. Specimens shall be conditioned as specified in 8.1.2.

8.23.4 Procedure.

8.23.4.1 Protective footwear shall be tested in accordance with FIA Standard 1209, *Whole Shoe Flex*, with the following modifications:

- (1) Water shall not be used.
- (2) The flex speed shall be 60 cycles/min \pm 2 cycles/min.
- (3) Alternative flexing equipment shall be permitted to be used when the flexing equipment meets the following parameters:
 - (a) The alternative flexing equipment shall be capable of providing the angle of flex as described in FIA 1209.
 - (b) The alternative flexing equipment shall be capable of a flex speed of 60 cycles/min \pm 2 cycles/min.
 - (c) The alternative flexing equipment shall provide a means of securing the footwear during flexing.

8.23.4.2 The test shall consist of 100,000 flexes.

8.23.4.3 After flexing, the outer sole shall be examined for evidence of sole separation. Separation occurring in this test shall be recorded and reported if it is at least 1.4 mm \times 18 mm (0.05 in. \times 0.7 in.) in any orientation.

N 8.23.4.4 After flexing and observation for separation, the footwear specimen shall be marked with a water height line on the exterior at a height of 75 mm (3 in.) below the height of the boot as defined in 6.4.2.3.1 and 6.4.3.2.1, but no lower than 75 mm (3 in.) for multiple-use emergency medical footwear or no lower than 50 mm (2 in.) for multiple-use medical care facility footwear, where measured up from the center of the insole at the heel.

8.23.4.5 The measurement shall be made on the interior and transferred to the exterior. Plain white paper toweling shall be placed inside the footwear specimen such that the paper toweling intimately contacts all areas inside the footwear specimen to at least the water height line.

8.23.4.6* The footwear specimen shall then be placed in a container that allows its immersion in tap water, treated with a dye and surfactant that achieves a surface tension of 35 dynes/cm \pm 5 dynes/cm, to the water height line.

8.23.4.7 After 2 hours \pm 10 minutes, the paper toweling shall be removed and examined for evidence of liquid leakage.

8.23.5 Report. Outer sole separation or the appearance of water leakage on the removed paper toweling shall be recorded and reported as failure for the tested specimen.

8.23.6 Interpretation. One or more footwear specimens failing this test shall constitute failing performance.

8.24 Chemical Permeation Resistance Test.

8.24.1 Application. This test method shall apply to cleaning/utility glove materials.

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

8.24.3 Sample Preparation. Specimens shall be conditioned as specified in 8.1.2.

8.24.4 Procedure.

8.24.4.1 Permeation resistance shall be measured in accordance with ASTM F739, *Standard Test Method for Permeation by Liquids and Gases through Protective Clothing Materials under Conditions of Continuous Contact*, at 25°C \pm 2°C (77°F \pm 3°F), using the following test parameters and modifications:

- (1) A test duration of 1 hour shall be used.
- (2) The test shall be done in the closed loop configuration, using distilled water as the collection medium.
- (3) The selected method of detection shall have a sensitivity for measuring a cumulative permeation of 0.1 $\mu\text{g}/\text{cm}^2$ over the 1-hour test period. The actual sensitivity of the selected method of detection shall be determined.
- (4) The total cumulative permeation over 1 hour shall be measured in lieu of breakthrough time and permeation rate.

8.24.4.2 Permeation resistance shall be separately evaluated against the following chemicals:

- (1) 40 \pm 10 percent weight-for-weight (w/w) solution of glutaraldehyde
- (2) 70 \pm 10 percent w/w isopropanol
- (3) 5 \pm 1 percent solution of sodium hypochlorite
- (4) Peracetic acid with a minimum of 30 \pm 10 percent acetic acid

8.24.5 Report.

8.24.5.1 The cumulative permeation in 1 hour shall be calculated, recorded, and reported in $\mu\text{g}/\text{cm}^2$ for each specimen for each challenge chemical.

8.24.5.1.1 If no challenge chemical is detected at the end of the 60-minute test period, then the cumulative permeation shall be recorded and reported as less than the minimum detectable mass per unit area for the specific chemical being tested.

8.24.5.2 The average cumulative permeation shall be calculated and reported by averaging the results from all specimens for each challenge chemical.

8.24.5.2.1 For the calculation of average cumulative permeation, if the results of one or more of the specimens tested is less than the minimum detectable cumulative permeation, then the minimum detectable cumulative permeation shall be used as the result for those specimens.

8.24.5.2.2 For the calculation of average cumulative permeation, if the results of all the specimens tested are less than the minimum detectable cumulative permeation, then the average cumulative permeation shall be reported as the minimum detectable cumulative permeation.

8.24.5.3 Any observations of degradation or other abnormalities at the conclusion of the testing of each specimen shall be reported.

8.24.6 Interpretation. The average cumulative permeation for each challenge chemical shall be used to determine pass or fail performance.

8.25 Abrasion Resistance Test Two.

8.25.1 Application.

8.25.1.1 This test shall apply to cleaning/utility glove, work glove, and footwear cover materials.

8.25.1.2 Modifications to this test method for testing cleaning/utility glove materials shall be as specified in 8.25.7.

8.25.1.3 Modifications to this test method for testing work glove materials shall be as specified in 8.25.8.

8.25.1.4 Modifications to this test method for testing work footwear cover wear surface materials shall be as specified in 8.25.9.

8.25.2 Specimens. A minimum of five specimens shall be tested.

8.25.3 Sample Preparation. Specimens shall be conditioned as specified in 8.1.2.

8.25.4 Procedure.

8.25.4.1 Specimens shall be tested in accordance with ASTM D3884, *Standard Test Method for Abrasion Resistance of Textile Fabrics (Rotary Platform, Double-Head Method)*, using a Calibrase H-18 wheel.

8.25.4.2 At the end of each abrasion exposure, the specimen shall be examined for evidence of wear-through. Wear-through shall be defined as the occurrence of one or more holes that permits the insertion of a 6.5 mm (1/4 in.) rod into the abraded area.

8.25.5 Report. The wear-through determination shall be recorded and reported for each specimen tested.

8.25.6 Interpretation. Any specimen showing wear-through shall constitute failure of this test.

8.25.7 Specific Requirements for Testing Cleaning/Utility Gloves. Testing shall be conducted under a load of 500 g, and specimens shall be examined after 1000 cycles.

8.25.8 Specific Requirements for Testing Work Gloves.

8.25.8.1 Specimens shall be taken from the palm area of the gloves representative of the glove body composite construction at the following glove areas as described in 8.1.9 and shall not include seams: A-P, B-P, D-P, E-P, F-P, G-P, H-P, and I-P. Specimens shall be representative of each glove body composite construction. Samples and specimens shall be permitted to be materials representative of those used in the construction of the glove. Specimens shall consist of a separable layer outside the barrier layer of the glove composite.

8.25.8.2 Testing shall be conducted under a load of 500 g, and specimens shall be examined after 1000 cycles.

8.25.8.3 The layer outside the barrier layer in the work glove shall be examined for wear-through.

8.25.9 Specific Requirements for Testing Footwear Cover Wear Surface Materials.

8.25.9.1 Specimens shall include all layers used in the construction of the footwear cover at the wear surface.

8.25.9.2 Testing shall be conducted under a load of 1000 g, and specimens shall be examined after 5000 cycles.

8.25.9.3 The combination of all layers shall be examined for wear-through.

8.26 Dexterity Test Two.

8.26.1 Application.

8.26.1.1 This test shall apply to cleaning/utility gloves and work gloves.

8.26.1.2 Modifications for testing work gloves shall be as specified in 8.25.8.

8.26.2 Specimens.

8.26.2.1 A minimum of three glove pairs each for small and large sizes shall be used for testing.

8.26.2.2 Each glove pair shall be tested as a complete set of gloves in new, as-distributed, condition.

8.26.2.3 Glove pair specimens shall not receive special softening treatments prior to tests.

8.26.3 Sample Preparation.

8.26.3.1 Samples for conditioning shall be whole glove pairs.

8.26.3.2 Glove pair specimens shall be conditioned as specified in 8.1.2.

8.26.4 Apparatus. The test apparatus shall be as specified in ASTM F2010/F2010M, *Standard Test Method for Evaluation of Glove Effects on Wearer Hand Dexterity Using a Modified Pegboard Test*.

8.26.5 Procedures. Gloves shall be tested as specified in ASTM F2010/F2010M, *Standard Test Method for Evaluation of Glove Effects on Wearer Hand Dexterity Using a Modified Pegboard Test*.

8.26.6 Report.

8.26.6.1 The average percent of barehanded control shall be recorded and reported for each test subject.

8.26.6.2 The average percent of barehanded control for all test subjects shall be calculated and reported for each size.

8.26.7 Interpretation. The average percent of barehanded control for size small and size large shall be used to determine pass or fail performance.

8.27 Torque Test.

8.27.1 Application. This test method shall apply to work gloves.

8.27.2 Specimens.

8.27.2.1 A minimum of three glove pairs each for small and large sizes shall be used for testing.

8.27.2.2 Each glove pair shall be tested as a complete set of gloves in new, as-distributed condition.

8.27.2.3 Glove pair specimens shall not receive special softening treatments prior to tests.

8.27.2.4 Glove pair specimens shall be tested for each material and construction combination.

8.27.3 Sample Preparation.

8.27.3.1 Samples for conditioning shall be whole gloves.

8.27.3.2 Glove pair specimens shall be conditioned as specified in 8.1.2.

8.27.4 Apparatus. The apparatus shall be as specified in ASTM F2961, *Standard Test Method for Characterizing Gripping Performance of Gloves Using a Torque Meter*.

8.27.5 Procedure. The testing procedures shall be as specified in ASTM F2961, *Standard Test Method for Characterizing Gripping Performance of Gloves Using a Torque Meter*.

8.27.6 Report.

N 8.27.6.1 The percent of barehanded control shall be recorded and reported for each test subject.

N 8.27.6.2 The average percentage of barehanded control value shall be recorded and reported for each specimen glove size.

8.27.7 Interpretation.

N 8.27.7.1 The percentage of barehanded control value for size small and size large shall be used to determine pass or fail performance.

N 8.27.7.2 Failure of either size shall constitute failure of the test.

8.28 Moisture Vapor Transmission Rate Test.

8.28.1 Application. This test method shall apply to the single-use protective garment materials or composites.

8.28.2 Specimens.

8.28.2.1 Moisture vapor transmission rate testing shall be conducted on at least three specimens.

8.28.2.2 Specimens shall consist of all layers in the protective garment composite arranged in the order and orientation as worn.

8.28.2.3 Specimen composite shall consist only of base composite layers required to meet the specifications of this standard. Specimens shall not include layers added for reinforcement, or externally added materials for visibility or identification.

8.28.3 Sample Preparation.

8.28.3.1 Samples for conditioning shall be at least a 1-m (1-yd) square of each material.

8.28.3.2 Specimens to be tested shall be conditioned as specified in 8.1.2.

8.28.4 Apparatus. The test apparatus shall be as specified in ASTM E96/E96M, *Standard Test Methods for Water Vapor Transmission of Materials*.

8.28.5 Procedure. Testing shall be conducted in accordance with ASTM E96/E96M, *Standard Test Methods for Water Vapor Transmission of Materials*, with the following modifications:

- (1) The specimen shall be placed on the test plate with the side normally facing the human body toward the water in the test dish.
- (2) For multiple layers, the layers shall be arranged in the order and orientation as worn.
- (3) Procedure B, Water Method at 23°C (73.4°F), as specified in X1.1.2 of ASTM E96/E96M, *Standard Test Methods for Water Vapor Transmission of Materials*, shall be used.
 - (a) The free stream air velocity shall be 2.79 m/s, ± 0.25 m/s (550 ft/min, ± 50 ft/min) as measured 50 mm (2 in.) above the fabric specimen.
 - (b) The air gap between the water surface and the back of the specimen shall be 19.0 mm, ± 1.6 mm ($\frac{3}{4}$ in., $\pm \frac{1}{16}$ in.).

8.28.6 Report. The individual and average moisture vapor transmission rate of all specimens shall be recorded and reported.

8.28.7 Interpretation. Pass/fail determination shall be based on the average reported moisture vapor transmission rate of all specimens tested.

8.29 Overall Liquid Integrity Test Three.

8.29.1 Application. This test method shall apply to work gloves that are not configured with either single-use emergency medical examination gloves or single-use emergency medical cleaning/utility gloves.

8.29.2 Specimens. A minimum of three glove pairs each for small and large sizes shall be used for testing.

8.29.3 Sample Preparation.

8.29.3.1 Specimens shall be tested after being subjected to the procedure specified in 8.1.3.

8.29.3.2 Specimens to be tested shall be conditioned as specified in 8.1.2.

8.29.4 Apparatus.

8.29.4.1 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 water-marked to determine leakage.

8.29.4.2* Water used for integrity testing shall be at a temperature of $20^\circ\text{C} \pm 3^\circ\text{C}$ ($68^\circ\text{F} \pm 5^\circ\text{F}$) and treated with a nonfoaming surfactant to achieve a surface tension of 35 dynes ± 2 dynes.

8.29.4.3 The following equipment shall be used for the test procedure:

- (1) A clear container(s) for submerging gloved hand(s)
- (2) A stopwatch

8.29.5 Procedure.

8.29.5.1 Two test subjects, one for hand size small and one for hand size large, shall be selected such that their hand dimensions are as close as possible to the middle of the range for

hand length and hand circumference as specified by the manufacturer for small and large gloves.

8.29.5.2 The wrist crease location shall be marked on each test specimen glove as described in 6.2.3 after the conditioning described in 8.29.3. At the location of the wrist crease, the maximum water height line shall be drawn on each test specimen glove around the entire glove $50\text{ mm (2 in.)} +0/-3\text{ mm}$ ($+0/-0.25\text{ in.}$) towards the fingers. In the same manner, the minimum water height line shall be drawn on each test specimen glove $75\text{ mm (3 in.)} +0/-3\text{ mm}$ towards the fingers from the wrist crease around the entire glove $+0/-3\text{ mm}$ ($+0/-0.25\text{ in.}$).

8.29.5.3 The test subject shall don the specimen(s) over the water-markable glove(s).

8.29.5.4 The test subject shall then immerse the donned glove specimens straight down into the surfactant treated water to between the minimum and maximum water height line for 5 minutes $+30/-0\text{ sec}$. An observer shall be present to ensure that the glove is not immersed beyond the maximum water height line.

8.29.5.5 If the test subject immerses the glove beyond the maximum water height line, the glove shall be retested after air drying and conditioning as specified in 8.1.3.

8.29.5.6 The test subject shall flex the glove specimen in a gentle, complete (but not tight) fist-clenching motion until the fingertips touch the palm every 10 seconds with each fist-clenching motion taking 10 seconds, $+2/-2\text{ seconds}$ to complete.

8.29.6 Report. The appearance of water marks on the inner glove after testing any of the glove pairs shall be recorded and reported.

8.29.7 Interpretation. The appearance of water marks on the inner glove after testing any glove shall be considered leakage and shall constitute failing performance.

8.30 Tactility Test.

8.30.1 Application.

8.30.1.1 This test shall apply to cleaning/utility gloves and work gloves.

8.30.1.2 Modifications to this test method for testing cleaning/utility gloves shall be as specified in 8.30.7.

8.30.1.3 Modifications to this test method for testing work gloves shall be as specified in 8.30.8.

8.30.2 Specimens.

8.30.2.1 A minimum of three glove pairs each for two different sizes shall be used for testing.

8.30.2.2 Each glove pair shall be tested as a complete set of gloves in new, as-distributed condition.

8.30.2.3 Glove pair specimens shall not receive special softening treatments prior to tests.

8.30.3 Sample Preparation.

8.30.3.1 Samples for conditioning shall be whole glove pairs.

8.30.3.2 Glove pair specimens shall be conditioned as specified in 8.1.2.

8.30.4 Procedures.

8.30.4.1 A separate test subject shall be used for each pair of gloves to be evaluated.

8.30.4.2 Test subjects shall be selected such that their hand dimensions conform to the offered respective sizes for each glove.

8.30.4.3 Ten metal pins having diameters of 11 mm (0.430 in.) , $9.5\text{ mm (0.370 in.)}$, 8 mm (0.310 in.) , $6.5\text{ mm (0.260 in.)}$, 5 mm (0.200 in.) , $3.5\text{ mm (0.138 in.)}$, $2.5\text{ mm (0.098 in.)}$, $1.5\text{ mm (0.058 in.)}$, $0.5\text{ mm (0.018 in.)}$, and $0.2\text{ mm (0.008 in.)}$, which have a length of $50\text{ mm} \pm 10\text{ mm (2 in.} \pm 0.4\text{ in.)}$, shall be used.

8.30.4.4 With each of the metal pins lying on a flat, smooth surface at a spacing of $100\text{ mm} \pm 20\text{ mm (4 in.} \pm 0.8\text{ in.)}$, the test subject shall attempt to pick up each pin starting with the largest diameter pin. The test subject shall be provided a period of 10 seconds to complete picking up each pin with his/her finger and thumb and then shall hold the pin for a minimum of 10 seconds without changing the position of his/her hand. The test subject shall not pick up the pins by their ends.

8.30.5 Report.

8.30.5.1 The diameter of the smallest pin that can be successfully picked up shall be recorded and reported for each test subject.

8.30.5.2 The average diameter that can be successfully picked up by all test subjects shall be calculated and reported for each size.

8.30.6 Interpretation. The average diameter of the smallest pin that can be picked up for each size shall be used to determine pass/fail performance.

8.30.7 Specific Requirements for Testing Cleaning/Utility Gloves. The sizes selected for testing shall represent the smallest and largest sized gloves that are available for the specific style of glove being evaluated.

8.30.8 Specific Requirements for Testing Work Gloves. Size small and size large shall be evaluated.

8.31 Water Absorption Resistance Test.

8.31.1 Application. This test method shall apply to the multiple-use garment materials.

8.31.2 Sample Preparation.

8.31.2.1 Samples for conditioning shall be at least 1 m (1 yd) square of each material.

8.31.2.2 Specimens shall be conditioned as specified in 8.1.3 followed by conditioning as specified in 8.1.2.

8.31.3 Specimens.

8.31.3.1 Specimens shall be $200\text{ mm} \times 200\text{ mm (8 in.} \times 8\text{ in.)}$.

8.31.3.2 At least three (3) specimens shall be tested.

8.31.4 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 \pm 6 mm (4½ in. \pm ¼ in.) long and weighing 1 kg (2½ 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.

8.31.5 Procedure.

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

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

8.31.5.3 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.

8.31.5.4 A 500 ml volume of distilled water at a temperature of 27°C \pm 1°C (80°F \pm 2°F) shall be poured quickly into the funnel and allowed to spray onto the specimen.

8.31.5.5 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. 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.
- (2) A square 100 \times 100 mm (4 in. \times 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.
- (3) 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. Following this conditioning it shall be reweighed. This weight shall be designated the "dry weight."

8.31.5.6 The percent water absorption shall be calculated using the following equation:

N

[8.31.5.6]

$$\text{Percent water absorption} = \frac{[(\text{Wet Weight} - \text{Dry Weight}) / (\text{Dry Weight})]}{100}$$

8.31.6 Report. The percent water absorption for each specimen shall be reported. The average percent water absorption for all tested specimens shall be calculated and reported.

8.31.7 Interpretation. The average percent water absorption shall be used to determine pass/fail performance.

8.32 Total Heat Loss Test.

8.32.1 Application. This test method shall apply to the protective garment composites.

8.32.2 Specimens.

8.32.2.1 Total heat loss testing shall be conducted on at least three specimens.

8.32.2.2 Specimens shall consist of all layers in the protective garment composite arranged in the order and orientation as worn.

8.32.2.3 Specimen composite shall consist of base composite layers only required to meet the specifications of this standard. Specimens shall not include layers added for reinforcement, or externally added materials for visibility or identification.

8.32.3 Sample Preparation.

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

8.32.3.2 Specimens to be tested shall be conditioned as specified in 8.1.2.

8.32.4 Apparatus. The test apparatus shall be as specified in ASTM F1868, *Standard Test Method for Thermal and Evaporative Resistance of Clothing Materials Using a Sweating Hot Plate*.

8.32.5* Procedure. Testing shall be conducted in accordance with Part C of ASTM F1868, *Standard Test Method for Thermal and Evaporative Resistance of Clothing Materials Using a Sweating Hot Plate*, with the following modifications:

- (1) The specimen shall be placed on the test plate with the side normally facing the human body toward the test plate.
- (2) For multiple layers, the layers shall be arranged in the order and orientation as worn.
- (3) Each layer shall be smoothed by hand to eliminate wrinkles or bubbles in each layer and, if necessary, the edges shall be secured.
- (4) Once the test is started, no further adjustments to the specimen shall be made.

8.32.6 Report.

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

8.32.6.2 The average apparent intrinsic evaporative resistance (AR_{cf}) of the sample shall be recorded and reported.

8.32.6.3 The average total heat loss (Qt) of the sample shall be calculated and reported.

8.32.7 Interpretation. Pass/fail determination shall be based on the average reported total heat loss measurement of all specimens tested.

8.33 Label Durability and Legibility Test.

8.33.1 Application.

8.33.1.1 This test shall apply to multiple-use garments, footwear, and work glove labels.

8.33.1.2 Modifications to this test method for testing multiple-use garment labels shall be as specified in 8.33.7.

8.33.1.3 Modifications to this test method for testing footwear and work glove labels shall be as specified in 8.33.8.

8.33.2 Specimens.

8.33.2.1 A minimum of three specimens for each type of label shall be tested.

8.33.2.2 If labels have areas of “write-in” information, the specimens shall include those areas with the sample information written in.

8.33.3 Sample Preparation. Samples shall be prepared as specified in the respective section for each item.

8.33.4 Procedure. 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.

8.33.5 Report. The legibility for each specimen shall be recorded and reported as acceptable or unacceptable.

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

8.33.7 Specific Requirements for Testing Multiple-Use Garment Labels.

8.33.7.1 Samples for conditioning shall be at least 1 m² (1 yd²) of material.

8.33.7.2 Multiple-use garment samples shall be conditioned as specified in 8.1.3.

8.33.7.3 For multiple-use garments, additional samples of individual labels shall be conditioned only as specified in 8.1.7.

8.33.8 Specific Requirements for Testing Footwear and Work Glove Labels.

8.33.8.1 Samples for conditioning shall be individual labels.

8.33.8.2 Individual labels only shall be conditioned as specified in 8.1.7.

8.34 Retroreflectivity Test.

8.34.1 Application.

8.34.1.1 This test method shall apply to helmet visibility marking materials.

8.34.1.2 Visibility materials shall be tested for each procedure specified in 8.34.4.

8.34.2 Specimens.

8.34.2.1 A minimum of three test specimens shall be tested.

8.34.2.2 Specimens of retroreflective material shall be 100 mm (4 in.) in length by the width of the finished trim product.

N 8.34.2.2.1 Where retroreflective and nonretroreflective surface areas are combined to form a combined performance material, the specimen shall consist of the retroreflective and nonretroreflective portions of the finished combined performance material.

8.34.3 Sample Preparation.

N 8.34.3.1 Samples for conditioning shall include 305 mm (12 in.) sections of visibility markings that are sewn onto ballast materials that meet the requirements of AATCC 135, *Dimensional Changes of Fabrics after Home Laundering*.

N 8.34.3.2 Samples shall be conditioned as specified in 8.1.2.

8.34.4 Procedures.

8.34.4.1 Measurement of Coefficient of Retroreflection.

Δ 8.34.4.1.1 The coefficient of retroreflection (R_a) shall be determined in accordance with ASTM E809, *Standard Practice for Measuring Photometric Characteristics of Retroreflectors*, using the following modifications:

- (1) Test distance shall equal 15.2 m (50 ft).
- (2) Observation angle shall equal 0.2 degree.
- (3) Entrance angle shall equal 5 degrees.
- (4) Receiver shall be provided with an entrance aperture of 25 mm (1 in.) \pm 5 percent in diameter that is equivalent to 0.1 degree angular aperture.
- (5) Exit aperture of the source shall be circular and 25 mm (1 in.) \pm 5 percent in diameter that corresponds to 0.1 degree angular aperture.
- (6) Retroreflector reference angles shall equal 0 and 90 degrees.
- (7) The datum mark shall be placed as specified by the trim manufacturer.

8.34.4.1.2 The coefficient of retroreflection (R_a) shall be calculated by the following equation:

N

[8.34.4.1.2]

$$R_a = R_l / A_r$$

where:

R_l = coefficient of luminous intensity measured as specified in 8.34.4.1.1

A_r = only the retroreflective surface area of the trim test specimen's surface area

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

8.34.4.2 Rainfall Test.

Δ 8.34.4.2.1 Specimens of visibility markings shall be tested for retroreflectivity when wet as specified in Appendix A of ANSI/ISEA 107, *High-Visibility Safety Apparel and Accessories*.

8.34.4.2.2 The coefficient of retroreflection (R_a) shall be measured as specified in 8.37.4.1, 2 minutes \pm 15 seconds after the rainfall has started.

8.34.5 Report. The coefficient of retroreflection (R_a) shall be recorded and reported for each specimen. The average R_a of all specimens shall be calculated and reported separately for each of the test procedures specified in 8.34.4.1.

8.34.6 Interpretation. For trim retroreflectivity, pass or fail performance shall be determined using the average coefficient of retroreflection (R_a) for the procedures specified in 8.34.4.1.

8.35 Flammability Test.

8.35.1 Application.

8.35.1.1 This test shall apply to materials used in garments, cleaning/utility gloves, work gloves, single-use eye and face protection devices, footwear covers, and multiple-use footwear.

8.35.1.2 Modifications to this test method for testing multiple-use garments shall be as specified in 8.35.7.

8.35.1.3 Modifications to this test method for testing footwear covers and single-use garments shall be as specified in 8.35.8.

8.35.1.4 Modifications to this test method for testing cleaning/utility gloves shall be as specified in 8.35.9.

8.35.1.5 Modifications to this test method for testing single-use eye and face protection devices shall be as specified in 8.35.10.

8.35.1.6 Modifications to this test method for testing work gloves shall be as specified in 8.35.11.

8.35.1.7 Modifications to this test method for testing footwear shall be as specified in 8.35.12.

8.35.2 Specimens. A minimum of five specimens shall be tested.

8.35.3 Sample Preparation. Samples shall be conditioned as specified in 8.1.2.

8.35.4 Procedure. Specimens shall be tested in accordance with ASTM D1230, *Standard Test Method for Flammability of Apparel Textiles*, with the following modifications:

- (1) Sample preparation and conditioning shall be as specified in this section.
- (2) The specimens shall be positioned in the flammability tester specimen holder so that the tip of the flame contacts the bottom edge of the specimen.
- (3) The time of flame application shall be 1 second.

8.35.5 Report.

8.35.5.1 The flame spread time for each specimen shall be reported to the nearest 0.1 second.

8.35.5.2 The average flame spread time for all specimens shall be reported.

8.35.5.3 Specimens that do not ignite shall be recorded as "Did not ignite" and shall not be included in the average flame spread time.

8.35.5.4 Specimens that ignite, but where the flame is extinguished before reaching the stop cord, shall be recorded as "Ignited but extinguished" and shall not be included in the average flame spread time.

8.35.6 Interpretation.

8.35.6.1 Pass/fail performance shall be based on the average flame spread time.

8.35.6.2 If no specimens have a recorded flame spread time because the specimens did not ignite or ignited but extinguished, the material performance shall be interpreted as passing.

8.35.7 Specific Requirements for Multiple-Use Garments.

8.35.7.1 Where the garment is constructed of several separable layers, each separable layer of garment material shall be tested.

8.35.7.2 Five specimens in each of the warp and fill directions shall be tested from each sample unit.

8.35.7.3 Samples for conditioning shall be at least 1 m² (1 yd²) of material.

8.35.7.4 Garment samples shall be conditioned as specified in 8.1.3 and then conditioned as specified in 8.1.2.

8.35.7.5 Pass/fail performance shall be based on the average flame spread time in the warp and fill directions.

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

8.35.8 Specific Requirements for Footwear Covers and Single-Use Garments.

8.35.8.1 Where the footwear cover or garment is constructed of several separable layers, each separable layer of garment material shall be tested.

8.35.8.2 Five specimens in each of the warp and fill directions shall be tested from each sample unit.

8.35.8.3 Samples for conditioning shall be the entire complete footwear cover or garment.

8.35.8.4 Pass/fail performance shall be based on the average flame spread time in the warp and fill directions.

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

8.35.9 Specific Requirements for Cleaning/Utility Gloves. Samples for testing shall be taken from the palm and back portions of the gloves in the gauntlet area.

8.35.10 Specific Requirements for Single-Use Eye and Face Protection Devices.

8.35.10.1 Samples for testing shall only be taken from the textile portions of the eye and face protection device, where applicable.

8.35.10.2 If specimens do not meet the size requirements as specified in ASTM D1230, *Standard Test Method for Flammability of Apparel Textiles*, then sections of inherently flame resistant material shall be attached to the sides of specimens to meet the specimen width of 50 mm (2 in.).

8.35.11 Specific Requirements for Work Gloves.

8.35.11.1 Samples shall be taken from each exterior surface of the work gloves.

8.35.11.2 Work glove samples shall be conditioned as specified in 8.1.3, and then conditioned as specified in 8.1.2.

8.35.12 Specific Requirements for Multiple-Use Footwear.

8.35.12.1 Specimens for testing shall be taken from each exterior surface of the footwear, including the tongue and outsole, but excluding emblems, visibility markings, gusset, zipper, laces, eyelets, and any other external hardware.

8.35.12.2 Where samples are relatively thick, specimens shall be permitted to be prepared to provide a facsimile layer representative of the material used in the construction of the footwear.

8.36 Suspension System Retention Test.

8.36.1 Application. This test shall apply to helmets.

8.36.2 Sample Preparation.

8.36.2.1 Samples shall be conditioned as specified in 8.1.2.

8.36.2.2 Samples for conditioning shall be whole helmets.

8.36.3 **Specimens.** A minimum of three complete helmets shall be tested.

8.36.4 Apparatus.

8.36.4.1 The suspension system retention test fixtures shall consist of rigid material of sufficient thickness and optional design to facilitate fire attachment to the helmet suspension and the tensile test machine as shown in Figure 8.36.4.1.

8.36.4.2 The calibrated tensile test machine shall be capable of measuring the force applied to the retention system within 2 percent of the specified forces.

8.36.5 Procedure.

8.36.5.1 Each helmet suspension strap shall be cut such that sufficient length of strap remains to be gripped by the movable jaw of the testing machine.

8.36.5.2 Specimens shall be positioned and secured in the tensile testing machine so that the helmet's reference plane is horizontal.

8.36.5.3 Each attachment point of the crown strap shall be tested by applying a pull force perpendicular to the reference plane to a maximum load of 23 N $+1/-0$ N (5 lbf $+0.25/-0$ lbf). The force shall be increased from 0 N to 23 N at a load rate of 25 mm/min ± 5 mm (1 in./min $\pm \frac{3}{16}$ in.).

8.36.5.4 After application of the force is complete, the load shall be released and the suspension system shall be inspected for any separation from the helmet shell.

8.36.5.5 Each adjusting mechanism of the helmet suspension system assembly shall be secured and unsecured, as applicable, for 20 repetitions.

8.36.6 Report.

8.36.6.1 The individual pass/fail results for each attachment point shall be recorded.

8.36.6.2 Each adjusting mechanism of the helmet suspension system shall be observed for proper functioning to determine pass or fail.

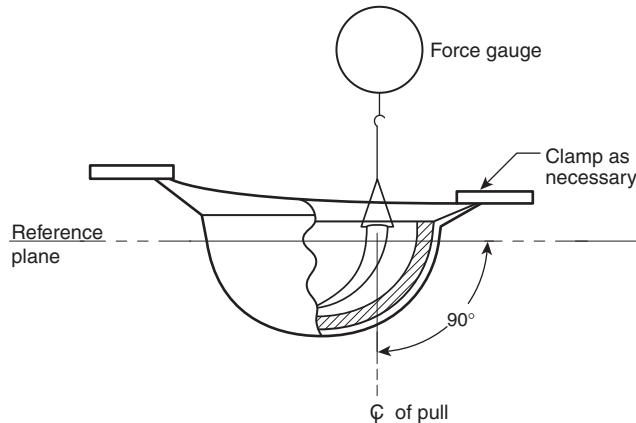


FIGURE 8.36.4.1 Suspension System Retention Test Setup.

8.36.7 Interpretation.

8.36.7.1 Separation of the helmet suspension from the helmet shall constitute failing performance.

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

8.37 Retention System Test.

8.37.1 **Application.** This test shall apply to helmets.

8.37.2 Sample Preparation.

8.37.2.1 Samples for conditioning shall be whole helmets.

8.37.2.2 Samples shall be conditioned as specified in 8.1.2.

8.37.3 **Specimens.** A minimum of five complete helmets shall be tested.

8.37.4 Apparatus.

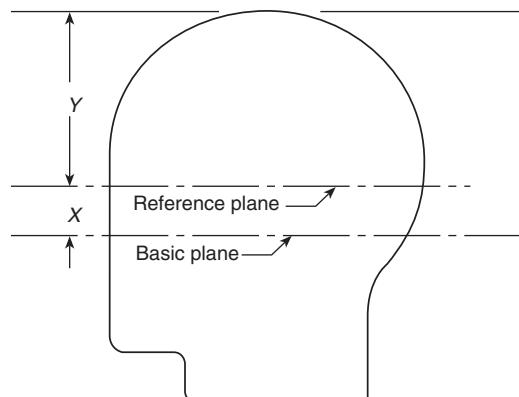
8.37.4.1 An ISO size J headform conforming to the nominal dimensions in Figure 8.37.4.1 shall be used.

8.37.4.2 A mechanical chin structure shall be designed for use with a calibrated tensile test machine. The mechanical chin structure shall consist of two rollers 13 mm ($\frac{1}{2}$ in.) in diameter with centers that are 75 mm (3 in.) apart. The mechanical chin structure shall conform with Figure 8.37.4.2(a), Figure 8.37.4.2(b), and Figure 8.37.4.2(c).

8.37.4.3 The calibrated tensile test machine shall be capable of measuring the force applied to the retention system within 2 percent at the specific force.

8.37.5 Procedure.

8.37.5.1 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.



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 8.37.4.1 Location of Reference Plane.

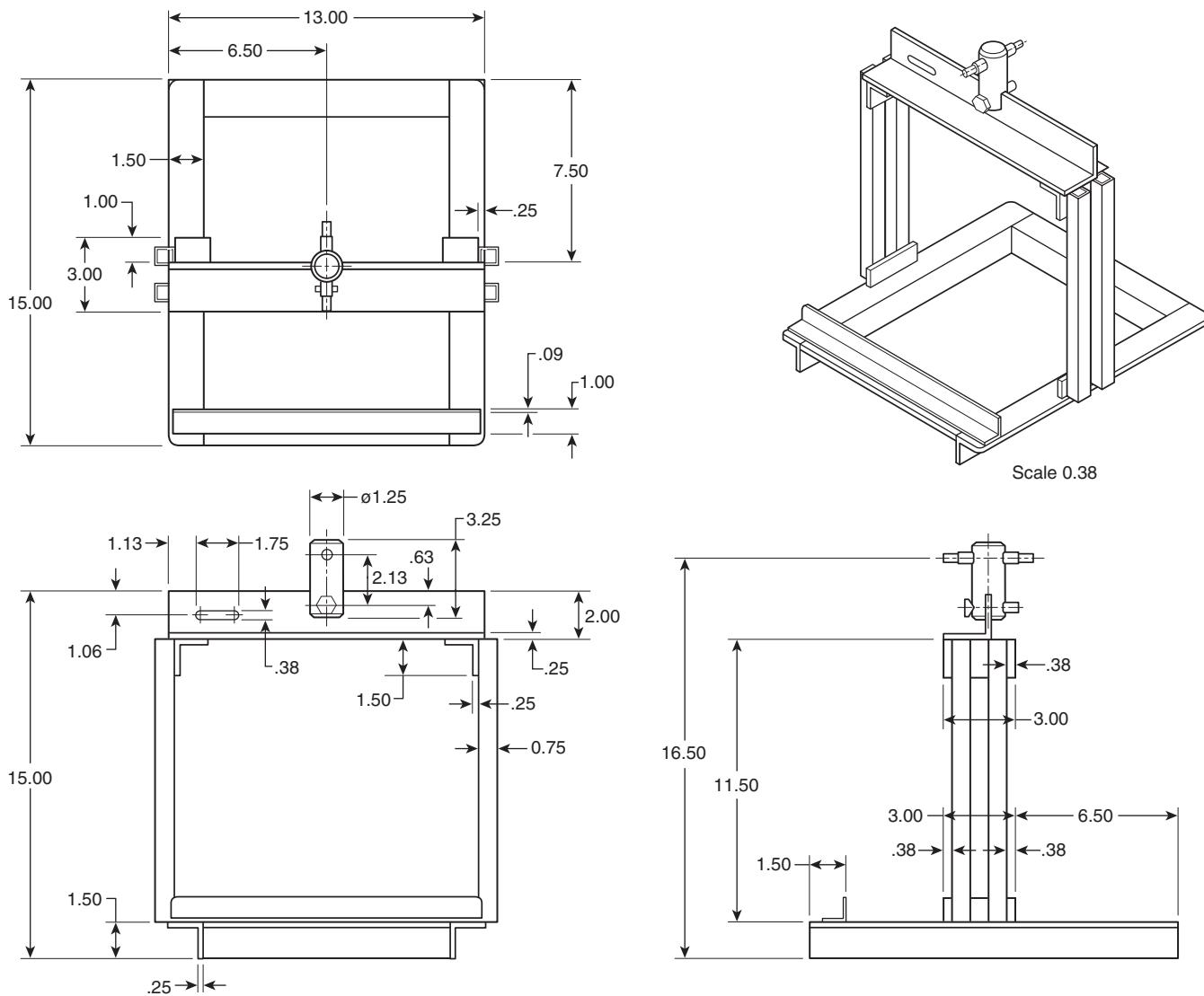


FIGURE 8.37.4.2(a) Retention Test Fixture.

8.37.5.2 Prior to testing, the test machine shall be allowed to warm up until stability is achieved.

8.37.5.3 The headform and mechanical chin structure shall be positioned so that the vertical straight line distance between the bottom of the rollers and the crown of the headform is $200\text{ mm} \pm 10\text{ mm}$ (8 in. $\pm \frac{3}{8}$ in.). The chin strap shall be passed around the rollers, and the helmet shall be secured to the headform. The chin strap shall be adjusted and preloaded to $45\text{ N} \pm 5\text{ N}$ (10 lbf ± 1 lbf). The distance between the top of the helmet and the rollers shall be measured and recorded to the nearest 0.5 mm ($\frac{1}{64}$ in.).

8.37.5.4 The force applied to the retention system shall be slowly increased to 225 N/sec + 5 N/sec (50 lbf/sec + 1 lbf/sec).

8.37.5.5 Where using a tensile testing machine, the load rate shall be 25 mm/min (1 in./min) to a limit of 225 N (50 lbf).

8.37.5.6 The distance between the top of the helmet and the bottom of the rollers shall be measured and recorded again after the force has been maintained at $225 \text{ N} \pm 5 \text{ N}$ ($50 \text{ lbf} \pm 1 \text{ lbf}$) for 60 seconds $+5/-0$ seconds. The difference between the second measurement and the first shall be the retention system elongation.

8.37.5.7 In addition, each adjusting mechanism of the helmet chin strap assembly shall be secured and unsecured, as applicable, for 20 repetitions.

8.37.6 Report.

8.37.6.1 The retention system elongation shall be measured, recorded, and reported for each helmet specimen.

8.37.6.2 Each mechanism shall be observed for proper functioning to determine pass or fail.

8.37.7 Interpretation. One or more helmet specimens failing this test constitutes failing performance.

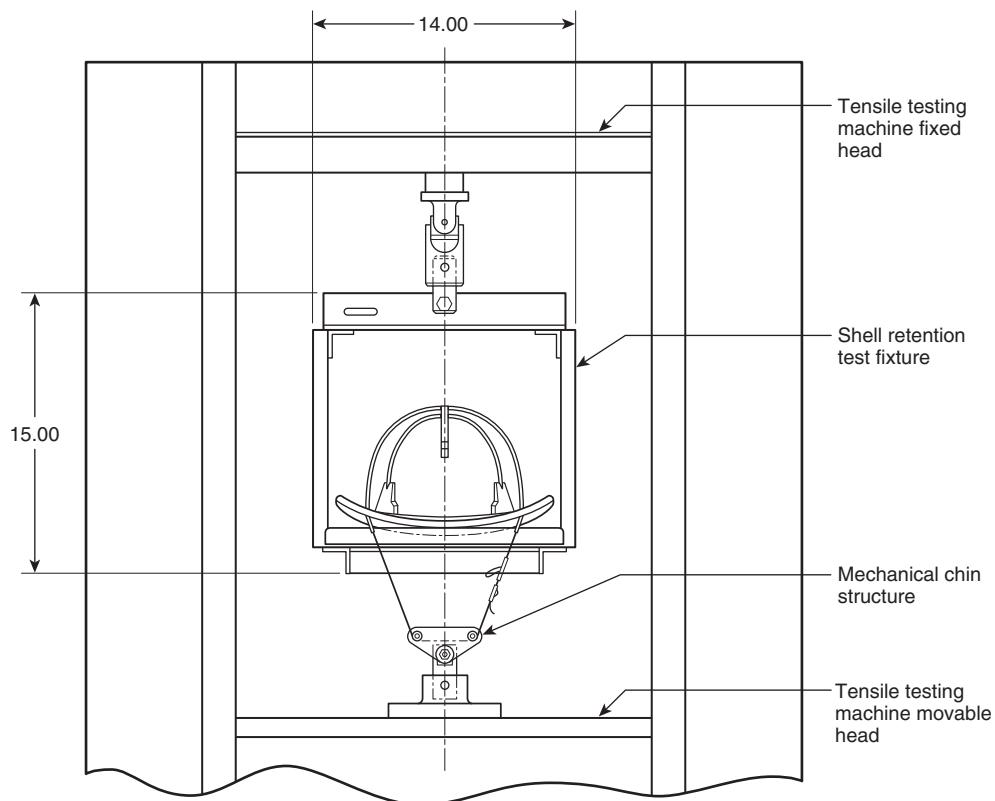


FIGURE 8.37.4.2(b) Retention Test Setup 1.

8.38 Goggle and Headlamp Clip Attachment Test.

8.38.1 Application. This test method shall apply to goggle and headlamp clips on protective helmets, where present.

8.38.2 Sample Preparation.

8.38.2.1 Specimens shall be conditioned as specified in 8.1.2.

8.38.2.2 Samples for conditioning shall be complete helmets with goggle and headlamp clips in place.

8.38.3 Specimens. A minimum of three helmets with goggle and headlamp clips shall be tested for each test.

8.38.4 Apparatus. The test fixture shall consist of a 1.4 kg (3 lb) weight attached to a 1 mm ($\frac{1}{32}$ in.) diameter wire loop.

8.38.5 Procedure.

8.38.5.1 The helmet shall be turned on edge with the clip to be tested facing directly down and supported on the brim except directly beneath the clip as shown in Figure 8.38.5.1.

8.38.5.2 The wire shall be looped under the clip and, without allowing any vertical drop, the weight shall be suspended from the clip.

8.38.5.3 After 5 seconds $+2/-0$ seconds, the clip shall be inspected to determine if it has pulled away from the helmet or deformed more than 6 mm ($\frac{1}{4}$ in.) from its original position, either of which constitutes a failure.

8.38.6 Report. The individual pass/fail results for each specimen and clip shall be recorded.

8.38.7 Interpretation. One or more helmet specimens failing this test constitutes failing performance.

N 8.39 Fastener Tape Strength Test.

N 8.39.1 Application. This test shall apply to fastener tape used in the construction of garments.

N 8.39.2 Samples.

N 8.39.2.1 Sample size shall be defined in the A-A 55126B, *Commercial Item Description, Fastener Tapes, Hook and Loop, Synthetic*.

N 8.39.2.2 Samples shall be washed for three washings as specified in AATCC 61, *Colorfastness to Laundering, Home and Commercial: Accelerated*, using the laundering conditions established for Test 3A.

N 8.39.3 Specimens. A minimum of four specimens shall be evaluated.

N 8.39.4 Procedures.

N 8.39.4.1 Fastener tape breaking strength shall be measured in accordance with ASTM D5034, *Standard Test Method for Breaking Strength and Elongation of Textile Fabrics (Grab Test)*, with the following modifications:

- (1) Specimens shall be tested in the provided width only in lieu of the specified 100 mm (3.9 in.) width.
- (2) Only specimens parallel to the length of the tape shall be tested.

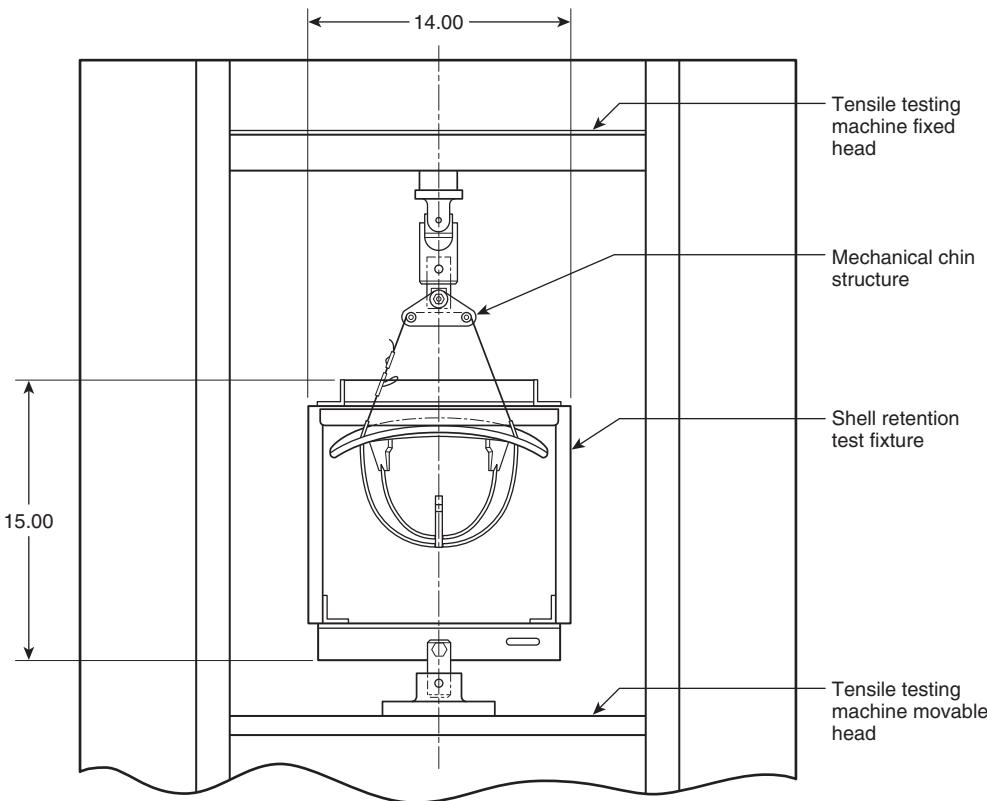


FIGURE 8.37.4.2(c) Retention Test Setup 2.

N 8.39.4.2 Fastener tape shear strength shall be measured in accordance with ASTM D5169, *Standard Test Method for Shear Strength (Dynamic Method) of Hook and Loop Touch Fasteners*.

N 8.39.4.3 Fastener tape shear strength shall be measured in accordance with ASTM D5170, *Standard Test Method for Peel Strength ("T" Method) of Hook and Loop Touch Fasteners*.

N 8.39.5 Report. The average breaking strength, shear strength, and peel strength shall be calculated and recorded.

N 8.39.6 Interpretation. Pass or fail determinations shall be based on the average breaking strength, shear strength, and peel strength specified for Type 2, Class 1 and 4 fastener tapes, as established in Table 1 of A-A 55126B, *Commercial Item Description, Fastener Tapes, Hook and Loop, Synthetic*.

N 8.40 Overall Ensemble Function and Integrity Test.

N 8.40.1 Application.

N 8.40.1.1 This test method shall apply to ensembles and full body garments that at least cover the upper and lower torso, arms, and legs.

N 8.40.1.2 Modifications to the test method for testing single-use garments or ensembles shall be as specified in 8.40.8.

N 8.40.1.3 Modifications to the test method for testing multiple-use garments or ensembles shall be as specified in 8.40.9.

N 8.40.2 Sample Preparation. Samples shall be complete ensembles.

N 8.40.3 Specimens.

N 8.40.3.1 Specimens shall be complete ensembles.

N 8.40.3.2 At least three specimens shall be tested using a different test subject for each specimen.

N 8.40.3.3 Where the vapor-protective ensemble consists of multiple separate layers, and outer layers are not considered gastight, then only the portion of the vapor-protective suit that is considered gastight shall be tested.

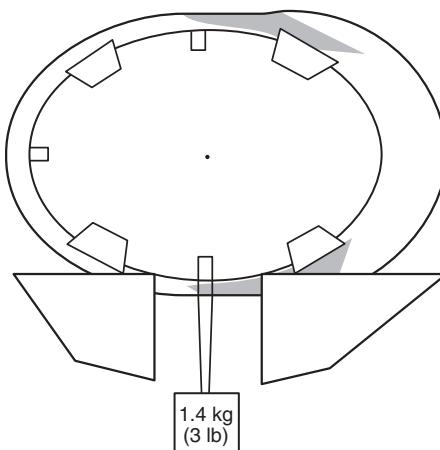


FIGURE 8.38.5.1 Test Setup (Side View of Top of Helmet).

N 8.40.4 Apparatus. The equipment and supplies specified in ASTM F1154, *Standard Practices for Qualitatively Evaluating the Comfort, Fit, Function, and Integrity of Chemical Protective Suit Ensembles*, shall be used along with the following additional items:

- (1) A Snellen eye chart for a 6 m (20 ft) distance
- (2) A stopwatch or other timing device
- (3) A protractor or other device to measure the angle of the placard relative to the test subject
- (4) An NFPA 704-based placard as seen in Figure 8.40.4

N 8.40.5 Procedure.

N 8.40.5.1 Ensemble or garment overall function and integrity shall be measured in accordance with ASTM F1154, *Standard Practices for Qualitatively Evaluating the Comfort, Fit, Function, and Integrity of Chemical Protective Suit Ensembles*, with the following parameters:

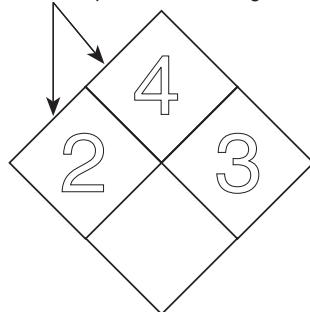
- (1) Exercise Procedure A and the ladder climb exercise in Paragraph 8.9.7 of Procedure B shall be used.
- (2) Ensembles tested shall meet the sizing range of the test subject as determined in 5.3.1.4 of ASTM F1154. The garment shall be donned in accordance with the manufacturer's instructions.
- (3) Testing shall be conducted at $25^{\circ}\text{C} \pm 7^{\circ}\text{C}$ ($77^{\circ}\text{F} \pm 10^{\circ}\text{F}$) and relative humidity of 50 percent ± 20 percent.
- (4) Test subjects shall wear underclothing in accordance with the manufacturer's recommendations, or in lieu of a detailed recommendation, a full body coverall.

N 8.40.5.2 Visual acuity testing shall be conducted using the eye chart, with a normal lighting range of 100 through 150 ft candles at the chart and with the test subject positions at a distance of 6.1 m (20 ft) from the chart.

N 8.40.5.2.1 The test subject shall have a minimum visual acuity of 20/20 in each eye, uncorrected or corrected with contact lenses, as determined in a visual acuity test or doctor's examination.

N 8.40.5.2.2 The test subject shall read the standard eye chart through the facepiece, visor, or eye/face protection device to determine its impact on the test subject's visual acuity.

Adhesive-backed plastic background pieces; one needed for each numeral, three needed for each complete hazard rating



For use where specified color background is used with numerals of contrasting colors

FIGURE 8.40.4 NFPA Placard.

N 8.40.5.3 The field of vision for the test subject shall be assessed by determining the angular degree to the left and right where the test subject can read a word of four random letters 10 mm (0.4 in.) high from a distance of 6 m (20 ft) that is 2 m (6 ft) off the ground.

N 8.40.5.4 Following the completion of the function tests on the garment or ensemble, the specimen shall be subjected to liquidtight integrity testing as specified in Section 8.2, Liquid Integrity Test One.

N 8.40.6 Report.

N 8.40.6.1 The measure of the ability of the test subject to complete all exercises shall be measured and reported.

N 8.40.6.2 The visual acuity of the test subject when in and out of the ensemble shall be recorded and reported.

N 8.40.6.3 The angular degree for both the left and right defining the field of vision shall be measured and reported. The average angular degree for the left and right field of vision for all test subjects shall be calculated and reported.

N 8.40.6.4 A diagram shall be prepared for each test that identifies the locations of any liquid leakage detected on the liquid-absorptive garment inside the specimen.

N 8.40.7 Interpretation.

N 8.40.7.1 The ability for the test subject to fully complete all exercises shall be measured and reported.

N 8.40.7.2 The visual acuity of the test subject when inside the ensemble shall be used for determining pass or fail performance.

N 8.40.7.3 The average left and average right angular field of vision shall be used for determining pass or fail performance.

N 8.40.7.4 Evidence of liquid on the liquid-absorptive garment inside the specimen shall constitute failing performance.

N 8.40.8 Specific Requirements for Testing Single-Use Garments or Single-Use Ensembles. Single-use garments and ensemble samples shall be conditioned as specified in 8.1.2.

N 8.40.9 Specific Requirements for Testing Multiple-Use Garments or Multiple-Use Ensembles. Multiple-use garments and the garment elements of the ensemble samples shall be conditioned as specified in 8.1.3 and then conditioned as specified in 8.1.2. All other ensemble elements that are not attached to the garment element shall be conditioned as specified in 8.1.2.

N 8.41 Visor Drop Ball Impact Resistance Test.

N 8.41.1 Application.

N 8.41.1.1 This test shall apply to visor materials.

N 8.41.1.2 Where the visor is constructed of several layers, then all layers, assembled in the order in which they appear in the suit, shall be tested as a composite.

N 8.41.2 Sample Preparation.

N 8.41.2.1 Samples shall be at least 2 m^2 (2 yd^2) of material.

N 8.41.2.2 Samples shall be conditioned as specified in 8.1.2.

N 8.41.3 Specimens.

N 8.41.3.1 Specimens shall be 450 mm × 305 mm.

N 8.41.3.2 A minimum of five specimens shall be tested.

N 8.41.4 Procedure. Specimens shall be tested in accordance with Section 9.6 of ANSI Z87.1, *American National Standard for Occupational and Educational Personal Eye and Face Protective Devices*, with the following modifications:

N 8.41.4.1 Visor material shall be securely mounted to test fixture shown in Figure 8.41.4.1(a) and Figure 8.41.4.1(b).

N 8.41.4.2 Sample number shall be as indicated above.

N 8.41.4.3 Impact location shall be in the center of the visor.

N 8.41.5 Report. Visible penetration or full thickness cracks shall be recorded and reported.

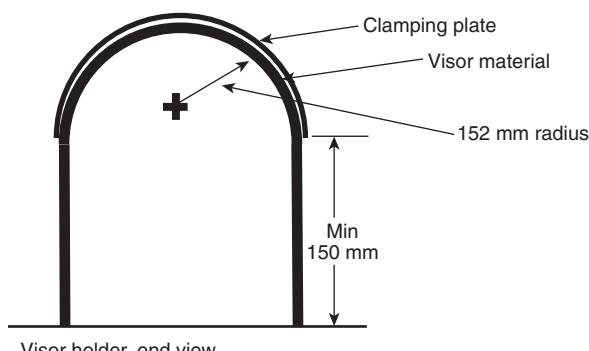
N 8.41.6 Interpretation. Penetration or full thickness cracking on any single impact shall be used to determine compliance.

N 8.42 Evaporative Resistance Test.

N 8.42.1 Application. This test method shall apply to protective garment composites.

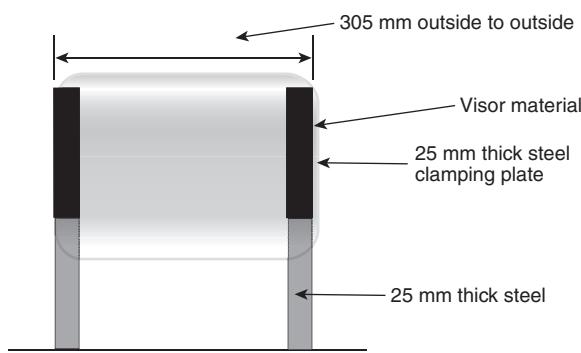
N 8.42.2 Samples.

N 8.42.2.1 Samples shall be conditioned at a temperature of $25^{\circ}\text{C} \pm 7^{\circ}\text{C}$ ($77^{\circ}\text{F} \pm 13^{\circ}\text{F}$), and a relative humidity of 65 percent ± 5 percent, for at least 4 hours.



Visor holder, end view.

FIGURE 8.41.4.1(a) Fixtures for Positioning Visor Material for Impact Resistance Testing.



Visor holder, side view.

FIGURE 8.41.4.1(b) Fixtures for Positioning Visor Material for Impact Resistance Testing.

N 8.42.2.2 The minimum sample size shall be 51 cm × 51 cm (20 in. × 20 in.).

N 8.42.3 Specimens.

N 8.42.3.1 Evaporative resistance testing shall be conducted on at least three specimens.

N 8.42.3.2 Specimens shall consist of all layers in the emergency medical protective garment composite, arranged in the order and orientation as worn.

N 8.42.4 Apparatus.

N 8.42.4.1 The test apparatus shall be as specified in ISO 11092, *Textiles — Physiological effects — Measurement of thermal and water-vapor resistance under steady-state conditions (sweating guarded-hotplate test)*.

N 8.42.4.2 The dimensions for the sweating guarded hot plate shall be a 25.4 cm (10 in.) test plate with a 12.7 cm (5 in.) guard surrounding the test plate.

N 8.42.5 Procedure. Testing shall be conducted in accordance with ISO 11092, *Textiles — Physiological effects — Measurement of thermal and water-vapor resistance under steady-state conditions (sweating guarded-hotplate test)*, with the following modifications:

- (1) The specimen shall be placed on the test plate with the side normally facing the human body toward the test plate.
- (2) For multiple layers the layers shall be arranged in the order and orientation as worn.
- (3) Each layer shall be smoothed by hand to eliminate wrinkles or bubbles in each layer and, if necessary, secure the edges.
- (4) Once the test is started, no further adjustments to the specimen shall be made.

N 8.42.6 Report.

N 8.42.6.1 The total evaporative resistance (R_{et}) of each sample shall be recorded and reported.

N 8.42.6.2 The average total evaporative resistance (R_{et}) of all tested samples shall be recorded and reported.

N 8.42.7 Interpretation.

N 8.42.7.1 Pass or fail determination shall be based on the average reported total evaporative resistance (R_{et}) measurement of all specimens tested.

N 8.42.7.2 If 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.

Annex A Explanatory Material

Annex A is not a part of the requirements of this NFPA document but is included for informational purposes only. This annex contains explanatory material, numbered to correspond with the applicable text paragraphs.

● **Δ A.1.1.1** This standard addresses only emergency medical products and the design, performance, testing, and certification of specific products. For fire departments and fire department-based EMS services, the use criteria for emergency medical protective ensembles or protective clothing are covered in NFPA 1500 and NFPA 1581.

This document is intended to address the wide range of potential threats to emergency medical workers from the time of in-the-field incident intervention through the time of medical facility emergency room treatment. These threats range from mechanical to biological and can impact each emergency medical worker in a variety of ways. Each emergency medical worker should be trained to understand and respect the potential hazards inherent in the emergency medical field. It is essential that each worker evaluate the particular circumstances of each incident and appropriately evaluate the level of personal protection needed to protect themselves from the transmission of diseases and blood/body fluid-borne pathogens. The methods of transmission of currently known diseases are well known. Emergency medical workers are trained to understand these methodologies and protect themselves as well as the patient from incidental exposure. However, new diseases emerge every day, further necessitating the vigilance of emergency medical workers to protect themselves from unnecessary exposure.

This document provides emergency medical workers with a wide array of personal protective clothing and equipment that can be chosen to significantly reduce the possibility of exposure to body fluid-borne pathogens. In addition, the document has been expanded to include limited protection from biological, nuclear, and radiological hazards.

The hazards associated with emergency medical operations can be generally classified by the following groups:

- (1) *Physical hazards.* Protection is needed against cuts, punctures, abrasive surfaces, falling objects, incidental flame contact, environmental hazards such as rain and extreme ambient temperatures.
- (2) *Body fluid-borne pathogen hazards.* Protection is needed to reduce the potential for skin and particularly mucus membrane exposure to body fluid-borne pathogens.
- (3) *Protection from chemical and biological agents.* Protection is needed to reduce the cross contamination of exposed victims to emergency medical workers during rescue, triage, decontamination, pre-transport emergency medical treatment, transport, and treatment at the receiving medical facility. Specialized decontamination and/or isolation can be initiated at the emergency scene and continued at the receiving medical facility.

This document is designed to offer a wide range of protective clothing and equipment options to meet the specific functional needs of emergency medical operations personnel performing a wide variety of tasks, working in a variety of environments, and with varying degrees of control over exposure and environmental threats. The frequency of exposure as well as the severity can also be addressed in the provision of protective clothing designed for single use as well as protective clothing designed for multiple use and certified as compliant with this standard.

Research and testing for the development of criteria specific to single-use garments, cleaning/utility gloves, footwear covers, eye and face protection devices, and helmets was supported by NIOSH National Personal Protective Technology Laboratory as addressed in the report, "Improvement of Criteria for EMS Personal Protective Equipment."

- **A.1.1.3** Organizations responsible for CBRN first responders, chemical response functions, and other hazard protection, including radiological, cryogenic, or hazardous chemicals,

should use protective ensembles and protective clothing specifically designed for those activities.

Specific criteria for [C]CBRN protective ensembles previously addressed in NFPA 1999 for the 2013 and 2008 editions were moved to NFPA 1994. NFPA 1994 establishes requirements for biological/radiological particulate protection as part of the Class 4 requirements. NFPA 1994–2012 specified criteria for single use [C]CBRN protective ensembles; however, the 2017 edition of the standard include [C]CBRN protection criteria for both single and multiple use protective ensembles.

Criteria for protection from hazardous materials are provided in the following standards:

- (1) NFPA 1991, *Standard on Vapor-Protective Ensembles for Hazardous Materials Emergencies*
- (2) NFPA 1992, *Standard on Liquid Splash-Protective Ensembles and Clothing for Hazardous Materials Emergencies*
- (3) NFPA 1994, *Standard on Protective Ensembles for First Responders to CBRN Terrorism Incidents.*

Specific criteria addressing respiratory protection are not covered in this standard. However, responders and receivers that are engaged in emergency medical operations involving airborne pathogens or other respiratory hazards should wear appropriate respiratory protection. At a minimum, appropriate respiratory protection should include filtering facepieces that are certified by the National Institute for Occupational Safety and Health (NIOSH). P-100 air-purifying respirators will provide the highest level of particulate protection. In addition, responders and receivers engaged in operations involving [C]CBRN hazards should, as a minimum, wear air-purifying respirators that are certified by NIOSH as CBRN air-purifying respirators (CBRN APRs) or certified by NIOSH as CBRN powered air-purifying respirators (CBRN PAPRs).

Biological agents can also be transmitted via aerosols, which are a hazard by inhalation, and in some cases, by dermal exposure. Organizations responsible for biological hazard protection should use protective clothing and respiratory protection specifically designed for those activities, including protective ensembles that are designed for [C]CBRN protection covered under this standard. Criteria for protection from chemical agents, airborne and liquid-borne biological hazards, and particulate hazards are also provided in NFPA 1994.

- **A.1.1.5** Examples of other potential standards to which specific protective clothing or ensembles can be certified depending on their materials, components, and overall design include but are not limited to the following:

NFPA 1951 establishes requirements for two types of ensembles for utility and rescue and recovery technical rescue operations. Protective garments, gloves, and footwear for rescue and recovery technical rescue include performance criteria for viral penetration resistance and overall product liquid integrity. However, the standard also includes additional criteria for flame, heat, and thermal insulation performance that is not currently addressed in NFPA 1999.

NFPA 1992 establishes requirements for protective clothing that is intended to provide protection against liquid chemical splashes that can occur during hazardous material operations. The requirements in the standard for garments, gloves, footwear, and ensemble includes liquid penetration resistance of materials and seams against a selected battery of chemicals as

well as the demonstration of overall liquid integrity for full products.

NFPA 1994 establishes four different classes of ensembles addressing the hazards present during chemical terrorism incidents. These ensembles consist of full body one- or multi-piece suits, gloves, and footwear. Depending on the class, different types of respirators are worn with the ensemble and varying levels of material barrier performance and overall product integrity are applied. Class 1 and 2 ensembles are designed for use with CBRN SCBA that can be worn either inside or outside the ensemble, while Class 3 and 4 ensembles are designed for use with CBRN APR or PAPR. Different levels of material barrier performance criteria are applied for ensemble material and seam chemical permeation resistance against both chemical warfare agents and toxic industrial chemicals for Class 1, 2, and 3. Viral penetration resistance is applied to the material and seams of all ensemble materials for each class. Different levels of overall product integrity are applied to each class of ensemble. Class 1, 2, and 3 ensembles are evaluated using the man-in-simulant test (MIST) while Class 4 ensembles are evaluated for inward particle leakage. All ensembles are evaluated for overall liquid integrity. Different levels of material physical properties and component functionality are specified for each ensemble class. Both base and ruggedized performance levels are set for ensemble Classes 2, 3, and 4.

▲ A.1.1.6 This standard provides a range of different types of protective clothing and equipment that can be used in the provision of emergency patient care and transportation prior to arrival at a medical care facility by emergency medical responders, emergency patient care by medical first receivers at a medical care facility, and body recovery by emergency medical responders. The selection of protective clothing and equipment for emergency medical operations should account for a hazard assessment undertaken by the department or organization that is responsible for employees that are involved in emergency medical operations. The hazard assessment should be performed in accordance with 29 CFR 1910.132, "General Requirements of Subpart I, Personal Protective Equipment," to ensure compliance with 29 CFR 1910.1030, "Protecting Health Care Workers from Occupational Exposure to Blood-Borne Pathogens," or the applicable local, state, regional, or national regulations. The hazard assessment should identify the specific risks of emergency medical responders or medical first receivers to hazards that include, but are not limited to, those listed in Table A.1.1.6(a).

It is important to recognize that the protective clothing specified in this standard does not protect against all of the hazards listed in Table A.1.1.6(a). In identifying the potential hazards, the department or organization should determine the likelihood of exposure and the consequence of exposure. The combination of these two factors should establish the risk of exposure and should permit the prioritization of protection needs.

As the requirements in this standard were designed to provide individuals with some protection against hazards associated with blood-borne pathogen exposure, it is important that the selected clothing and equipment enable the department or organization to comply with 29 CFR 1910.1030, "Protecting Health Care Workers from Occupational Exposure to Blood-Borne Pathogens." These regulations require that employers (departments and organizations) provide appropriate protective clothing and equipment to their workers. Appropriate

protective clothing and equipment are defined as those items that prevent blood and other infectious liquids from passing through the clothing or equipment item to the wearer's skin or underclothing. For this reason, a principal component of most clothing and equipment requirements in this standard is a test that demonstrates the barrier performance of the item and the material in preventing liquid penetration. Additional requirements are added to demonstrate that the respective clothing or equipment item provides some degree of protection against other hazards that are relevant to the use of that item that might commonly be anticipated as part of emergency medical operations.

As part of the hazard and risk assessment conducted by the department or organization, it is important that the department or organization consider which portions of the body might become exposed. Exposures might occur to the arms and legs, as well as to the head, eyes and face, hands, feet, respiratory system, and hearing. Protective clothing and equipment should be specified for any body area that is at risk of exposure.

Table A.1.1.6(b) provides some factors for consideration of each of the protective clothing items addressed in this standard.

▲ Table A.1.1.6(a) List of Potential Emergency Medical and Related Hazards

Biological Hazards	Thermal Hazards
Blood-borne pathogens	High convective heat
Airborne pathogens	Low radiant heat
Biological toxins	High radiant heat
Biological allergens	Flame impingement
Chemical Hazards	Steam
Inhalation	Hot liquids
Skin absorption or contact	Molten metals
Chemical ingestion or injection	Hot solids
Liquefied gas contact	Hot surfaces
Chemical flashover	
Chemical explosions	
Physical Hazards	Electrical Hazards
Falling objects	High voltage
Flying debris	Electrical arc flashover
Projectiles or ballistic objects	Static charge buildup
Abrasive or rough surfaces	
Pointed objects	Person-Position Hazards
Slippery surfaces	Daytime and nighttime visibility
Excessive vibration	Falling from elevated surfaces
Environmental Hazards	Drowning
High heat and humidity	Person-Equipment Hazards
Ambient cold	Material biocompatibility
Wetness	Ease of contamination
High wind	Thermal comfort
Insufficient or bright light	Range of motion
Excessive noise	Hand function
Radiation Hazards	Ankle and back support
Ionizing radiation	Vision clarity
Nonionizing radiation	Communications ease
	Fit (poor)
	Ease of donning and doffing

Δ Table A.1.1.6(b) Selection Factors for Emergency Protective Clothing and Equipment

Protected Area	Clothing or Equipment	Selection Factors
Body (arms and legs)	Single-use protective garments	Could cover body entirely or partially. (Protection is provided only to that part of the body that is covered.) Partial body clothing might not provide protection to interface areas unless the item is designed to interface effectively with the other item (e.g., sleeve protective with garment). Clothing material might or might not be breathable, which will affect wearing comfort. Single-use items tend to be less durable than multiple-use items. Might be subject to degradation in rigorous physical environments.
	Multiple-use protective garments	Factors above apply, except multiple-use items are designed to be cleaned and reused while maintaining their performance properties.
Hands	Single-use examination gloves	Gloves intended to provide protection to hand and wrist for one-time use with a maximum of dexterity and tactility. Gloves fit intimately with hand and appropriate size must be selected. Can be subject to degradation in rigorous physical environments.
	Single-use cleaning/utility gloves	Gloves that are more robust and likely to resist physical hazards compared to examination gloves. Gloves that are more resistant to chemical solvents used in cleaning. Gloves intended for a single use only.
	Multiple-use work gloves	Gloves intended to provide barrier protection, but with sacrifice of dexterity and tactility as compared to examination and cleaning/utility gloves. Gloves can be used repeatedly if properly cared for and maintained, unless gloves cannot be properly decontaminated. Gloves are not flame or heat resistant and should not be used in thermal hazard environments.
Eyes/face	Single-use face mask	Can cover only mouth and nose (visors are optional). Visors do not provide primary eye protection and might not be effective for eye splash protection. Requirement for wearer to breathe through mask lowers blood-borne pathogen penetration resistance as compared to garments, gloves, and footwear, and other eye/face protection devices. Might be subject to degradation in rigorous physical environments. Might be used only once.
	Single-use eye and face protection device	Devices such as disposable faceshield. Periphery of device might not provide effective protection of entire face and eyes. Can be subject to degradation in rigorous physical environments. Only for a one-time use.
	Multiple-use eye and face protection device	Can include spectacles, goggles, or faceshields. Spectacles provide only limited eye protection. Goggles provide primary eye protection. Faceshields do not provide primary eye protection, but provide face and primary eye protection when combined with goggles. Can be used for multiple uses, if properly cared for and maintained, and if item can be cleaned following exposure.
Feet and ankles	Single-use footwear covers	Disposable item that covers shoe or boot and is intended to provide barrier (splash) protection to primary footwear. Required to have slip-resistant wear surface. Can be subject to degradation in rigorous physical environments.
	Multiple-use footwear	Standard footwear with 3 in. of barrier protection. Intended to be reusable, if properly cared for and maintained, and if can be decontaminated effectively.
	Medical care facility footwear	Same as multiple-use footwear and single-use covers, but does not have requirements for impact/compression resistance for toe and puncture resistance of sole, allowing footwear to be lighter and more flexible.
Head	Helmet	Standard industrial helmet that also includes requirements for suspension and chin strap height. No specific criteria are included for side impact protection as might be needed for wearers inside vehicles.