

NFPA®

1971

**Standard on
Protective Ensembles for
Structural Fire Fighting and
Proximity Fire Fighting**

2018



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NFPA® 1971

Standard on

Protective Ensembles for Structural Fire Fighting and Proximity Fire Fighting

2018 Edition

This edition of NFPA 1971, *Standard on Protective Ensembles for Structural Fire Fighting and Proximity Fire Fighting*, was prepared by the Technical Committee on Structural and Proximity Fire Fighting 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 1971 was approved as an American National Standard on August 21, 2017.

Origin and Development of NFPA 1971

The original work on this project was done by the Sectional Committee on Protective Equipment for Fire Fighters that was a part of the Committee on Fire Department Equipment. In 1973, the Sectional Committee released a tentative standard, NFPA 19A-T, *Tentative Standard on Protective Clothing for Fire Fighters*. The Sectional Committee continued its work, and with the cooperation of the Program for Fire Services Technology of the National Bureau of Standards, developed NFPA 1971, *Standard on Protective Clothing for Structural Fire Fighting*. NFPA 1971 was adopted as a standard at the Fall Meeting in Pittsburgh, PA, on November 18, 1975.

Since that time, the Sectional Committee has been removed from the Committee on Fire Department Equipment and made a full Technical Committee.

The 1981 edition of NFPA 1971 represented a complete editorial reworking of the 1975 edition to make the document more usable by both the fire service and protective clothing manufacturers. The 1981 edition was acted on at the Annual Meeting in Dallas, TX, on May 19, 1981.

The 1986 edition incorporated a complete revision of the document to include more performance requirements and fewer specifications. Separate performance and testing chapters were written. The 1986 edition was acted on at the Annual Meeting in Atlanta, GA, on May 19–22, 1986.

Following the 1986 edition, the committee was renamed from the Technical Committee on Protective Equipment for Fire Fighters to the Technical Committee on Fire Service Protective Clothing and Equipment.

The 1991 edition incorporated third-party certification, labeling, and listing for the protective clothing. A new chapter was added to address interface items, specifically the protective hood and protective wristlets. Appendix material was developed on cleaning of garments and evaluating how materials can affect heat stress. The 1991 edition, the fourth edition, was presented to the NFPA membership at the Annual Meeting in Boston, MA, on May 19–23, 1991, and was issued with an effective date of August 16, 1991.

In October 1994, the NFPA Standards Council reorganized the Technical Committee on Fire Service Protective Clothing and Equipment as the Project on Fire and Emergency Services Protective Clothing and Equipment operating with seven technical committees and a technical correlating committee. NFPA 1971 was now the responsibility of the Technical Committee on Structural and Proximity Fire Fighting Protective Clothing and Equipment.

The 1997 edition of NFPA 1971, the fifth edition, combined four former standards on structural fire fighting protective clothing: NFPA 1971, *Standard on Protective Clothing for Structural Fire Fighting*,

NFPA 1972, *Standard on Helmets for Structural Fire Fighting*; NFPA 1973, *Standard on Gloves for Structural Fire Fighting*; and NFPA 1974, *Standard on Protective Footwear for Structural Fire Fighting*, into a single document entitled NFPA 1971, *Standard on Protective Ensemble for Structural Fire Fighting*.

The 2000 edition was the sixth edition and represented a complete revision to the fifth (1997) edition. Among other changes, the edition introduced new requirements for evaporative heat transfer through garments through a total heat loss test, for evaluating thermal insulation in areas of garments that are most likely to become compressed through a conductive and compressive heat resistance test, for evaluating hand dexterity with gloves through a new hand function test, and for evaluating the durability of barrier materials through additional preconditioning prior to selected physical tests of the barrier materials.

The sixth edition was presented to the Association membership at the 1999 Fall Meeting in New Orleans, LA, on November 17, 1999, and issued by the Standards Council with an effective date of February 11, 2000.

The 2007 edition of NFPA 1971, the seventh edition, represented a complete revision. The requirements of two former standards, the 2000 (sixth) edition of NFPA 1971, *Standard on Protective Ensemble for Structural Fire Fighting*, and the 2000 (second) edition of NFPA 1976, *Standard on Protective Ensemble for Proximity Fire Fighting*, were combined into a single document entitled NFPA 1971, *Standard on Protective Ensembles for Structural Fire Fighting and Proximity Fire Fighting*.

Other than combining the two documents, the major changes represented in the 2007 edition were the optional requirements for protection from CBRN terrorism agents (specified chemicals, biological agents, and radiological particulate) that could be released as a result of a terrorism attack. These optional requirements could be selected by fire departments that were concerned about first response of their personnel to such WMD incidents where “normal” fire fighting protective ensembles offer little or no protection from CBRN terrorism agents, and where supplementary protective ensembles that are certified as compliant with NFPA 1994, *Standard on Protective Ensembles for First Responders to CBRN Terrorism Incidents*, for protection from CBRN terrorism agents are unlikely to be provided to the vast majority of fire fighting first responders.

The CBRN optional protection can be applied only to an entire ensemble, including the specified CBRN SCBA for that ensemble, and cannot be applied to individual ensemble elements. The design and performance of the entire ensemble including the CBRN SCBA provides the CBRN protection for the wearer and depends on the proper use of the entire ensemble to accomplish this protection. No combination of individual ensemble elements short of the entire assembled ensemble will give CBRN protection.

These optional CBRN requirements that apply to both structural fire fighting protective ensembles and proximity fire fighting protective ensembles were built into the construction of the “basic” fire fighting protective ensemble elements so that nothing had to be added to or subtracted from the basic fire fighting protective clothing in order to achieve the protection from CBRN terrorism agents. The optional CBRN requirements did not decrease any of the protection for the fire fighting environments in which these ensembles are used.

The 2007 edition was presented to the Association membership at the 2006 Association Annual Meeting in Orlando, Florida, on June 7, 2006, and issued by the Standards Council with an effective date of August 17, 2006.

The 2013 edition of NFPA 1971 represented a complete revision of the document, incorporating many technical and editorial changes. In addition to several new definitions and revised labeling requirements, changes were made to the performance requirements in Chapter 7, including those for garment zippers, fastener tape, and helmets. Performance requirements for the radiant reflective protective areas of proximity fire fighting protective glove elements also were added. A number of tests in Chapter 8 were revised, including glove test areas, the flame resistance test procedure, the glove hand function test procedure, and the slip resistance test. The chemical permeation test and the man-in-simulant test (MIST) also were completely revised. New tests were added to Chapter 8, including a torque test, transmitted and stored thermal energy test, fastener tape strength test, and a glove tool test.

For the 2018 edition of the standard, CBRN was removed from NFPA 1971 and put into NFPA 1994, including definitions, design and performance requirements, and test methods related to CBRN. There is a new definition for *protective barrier hood*, the optional interface element of the protective ensemble that provides limited thermal, physical, and barrier protection to the coat/helmet/SCBA facepiece interface area. Both the Particulate Filtration Efficiency Test and Total Heat Loss Test are required for the new optional interface element. Current design requirements for hoods are left in as well (hood size opening, what it must cover, etc.). A new glove sizing system is an evenly graded system that readily lends itself to the use of a Brannock-style measuring device for estimating correct sizing (similar to footwear).

A new test method, Water Vapor Resistance Test (R_{et}), was created at First Draft but removed during Second Draft after lengthy discussion and presentation. The Technical Committee agrees that while this test may provide valuable information, there has only been limited data to support including this test in the standard during this revision cycle. The Technical Committee does want to encourage continued research on this test method and established a task group for work during the intervening years on this issue.

In Memoriam, 11 September 2001

We pay tribute to the 343 members of FDNY who gave their lives to save civilian victims on 11 September 2001, at the World Trade Center. They are true American heroes in death, but they were also American heroes in life. We will keep them in our memory and in our hearts. They are the embodiment of courage, bravery, and dedication. May they rest in peace.

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

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

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

Committee Scope: This committee shall have primary responsibility for documents on protective ensembles, except respiratory protection, that provides head, limb, hand, foot, torso, and interface protection for fire fighters and other emergency services responders during incidents involving structural fire fighting operations or proximity fire fighting operations. Structural fire fighting operations include the activities of rescue, fire suppression, and property conservation during incidents involving fires in buildings, enclosed structures, vehicles, marine vessels, or like properties. Proximity fire fighting operations include the activities of rescue, fire suppression, and property conservation during incidents involving commercial and military aircraft fires, bulk flammable gas fires, bulk flammable and combustible liquids fires, combustible metal fires, exotic fuel fires, and other such fires that produce very high levels of radiant heat as well as convective and conductive heat. Additionally, this committee shall have primary responsibility for documents on the selection, care, and maintenance of structural and proximity fire fighting protective ensembles by fire and emergency services organizations and personnel.

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NFPA 1971

Standard on

Protective Ensembles for Structural Fire Fighting and Proximity Fire Fighting

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 C. 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 C.

Chapter 1 Administration

1.1* Scope.

1.1.1 This standard shall specify the minimum design, performance, testing, and certification requirements for structural fire fighting protective ensembles and ensemble elements that include coats, trousers, coveralls, helmets, gloves, footwear, and interface components.

1.1.2 This standard shall specify the minimum design, performance, testing, and certification requirements for proximity fire fighting protective ensembles and ensemble elements that include coats, trousers, coveralls, helmets, gloves, footwear, and interface components.

N 1.1.2.1 This standard shall also specify optional requirements for particulate barrier protective hood interface components.

1.1.3* This standard shall also specify additional optional requirements for structural fire fighting protective ensembles and proximity fire fighting protective ensembles that will provide limited protection from liquid and particulate hazards.

1.1.3.1 This standard shall not specify requirements for protection against CBRN terrorism agents.

1.1.4 This standard shall specify requirements for new structural fire fighting protective ensembles, new proximity fire fighting protective ensembles, or new elements for both ensembles.

1.1.5* 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.

1.1.6 Other than for the certification of structural or proximity protective ensembles to the optional complete ensemble liquid and particulate hazard protection requirements, this standard shall not specify the respiratory protection that is necessary for proper protection with structural or fire fighting protective ensembles.

1.1.7 Certification of compliant structural fire fighting protective ensembles, compliant proximity fire fighting protective ensembles, and compliant elements of both ensembles to the requirements of this standard shall not preclude certification to additional appropriate standards where the ensemble or ensemble element meets all the applicable requirements of each standard.

1.1.8 This standard shall not be construed as addressing all of the safety concerns associated with the use of compliant protective ensembles or ensemble elements. It shall be the responsibility of the persons and organizations that use compliant protective ensembles or ensemble elements to establish safety and health practices and determine the applicability of regulatory limitations prior to use.

1.1.9 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 ensembles or ensemble elements to establish safety and health practices and determine the applicability of regulatory limitations prior to using this standard for any designing, manufacturing, and testing.

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

1.2* Purpose.

1.2.1 The purpose of this standard shall be to establish minimum levels of protection for fire fighting personnel assigned to fire department operations including but not limited to structural fire fighting, proximity fire fighting, rescue, emergency medical, and other emergency first responder functions.

1.2.1.1 To achieve this purpose, this standard shall establish minimum requirements for structural fire fighting protective ensembles and ensemble elements designed to provide fire fighting personnel limited protection from thermal, physical, environmental, and bloodborne pathogen hazards encountered during structural fire fighting operations.

1.2.1.2 To achieve this purpose, this standard shall establish minimum requirements for proximity fire fighting protective ensembles and ensemble elements designed to provide fire fighting personnel limited protection from thermal exposures where high levels of radiant heat as well as convective and conductive heat are released, and from physical, environmental, and bloodborne pathogen hazards encountered during proximity fire fighting operations.

1.2.2 The purpose of this standard shall also be to establish a minimum level of protection for structural and proximity fire fighting personnel from exposure to liquid and particulate contaminants as an option for compliant structural fire fighting ensembles, for compliant proximity fire fighting ensembles, and for compliant elements for both ensembles.

1.2.3* 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.

1.2.4 This standard shall not be utilized as a detailed manufacturing or purchasing 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, manufacturing, testing, and certification of new structural fire fighting protective ensembles, new proximity fire fighting protective ensembles, and new elements of both ensembles for protection from thermal, physical, environmental, and bloodborne pathogen hazards encountered during structural fire fighting operations.

▲ **1.3.2*** This standard shall apply to the design, manufacturing, testing, and certification of new structural fire fighting protective ensembles, new proximity fire fighting protective ensembles, and new elements of both ensembles for additional optional protection from liquid and particulate contaminants.

1.3.3 This standard shall not apply to any protective ensembles, ensemble elements, or protective clothing for any other types of fire fighting operations.

▲ **1.3.4** This standard shall not apply to structural fire fighting protective ensembles manufactured according to previous editions of NFPA 1971.

▲ **1.3.5** This standard shall not apply to structural fire fighting protective clothing and equipment manufactured according to past editions of NFPA 1971, NFPA 1972, NFPA 1973, and NFPA 1974.

▲ **1.3.6** This standard shall not apply to proximity fire fighting protective ensembles manufactured according to previous editions of NFPA 1976.

▲ **1.3.7** This standard shall not apply to proximity fire fighting protective clothing and equipment manufactured according to past editions of NFPA 1976.

1.3.8* 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.

▲ **1.3.9** This standard shall not apply to the use of structural fire fighting protective ensembles, proximity fire fighting protective

ensembles, or elements of these ensembles since these requirements are specified in NFPA 1500.

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

NFPA 1851, *Standard on Selection, Care, and Maintenance of Protective Ensembles for Structural Fire Fighting and Proximity Fire Fighting*, 2014 edition.

NFPA 1972, *Helmets for Structural Fire Fighting*, 1992 edition. (withdrawn)

NFPA 1973, *Gloves for Structural Fire Fighting*, 1993 edition. (withdrawn)

NFPA 1974, *Protective Footwear for Structural Fire Fighting*, 1992 edition. (withdrawn)

NFPA 1976, *Standard on Protective Ensemble for Proximity Fire Fighting*, 2000 edition. (withdrawn)

NFPA 1981, *Standard on Open-Circuit Self-Contained Breathing Apparatus (SCBA) for Emergency Services*, 2013 edition.

NFPA 1983, *Standard on Life Safety Rope and Equipment for Emergency Services*, 2017 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 35, *Water Resistance: Rain Test*, 2013.

AATCC 42, *Water Resistance: Impact Penetration Test*, 2013.

AATCC 61, *Colorfastness to Laundering: Accelerated*, 2013.

AATCC 70, *Water Repellency — Tumble Jar Dynamic Absorption Test*, 2015.

AATCC 135, *Dimensional Changes of Fabrics after Home Laundering*, 2004.

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

ASTM A666, *Standard Specification for Annealed or Cold Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar*, 2015.

ASTM B152/B152M, *Specification for Copper Sheet, Strip, Plate, and Rolled Bar*, 2013.

ASTM D471, *Standard Test Method for Rubber Property—Effect of Liquids*, 2016.

ASTM D751, *Standard Test Methods for Coated Fabrics*, 2011.

ASTM D1003, *Standard Test Method for Haze and Luminous Transmittance of Transparent Plastics*, 2013.

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

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

ASTM D3359, *Standard Test Methods for Measuring Adhesion by Tape Test*, 2009 e2.

ASTM D3940, *Standard Test Method for Bursting Strength (Load) and Elongation of Sewn Seams of Knit or Woven Stretch Textile Fabrics*, 1983.

ASTM D4157, *Standard Test Method for Abrasion Resistance of Textile Fabrics (Oscillatory Cylinder Method)*, 2013.

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

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

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 the Tearing Strength of Fabrics by Trapezoid Procedure*, 2015.

ASTM D6413/D6413M, *Standard Test Method for Flame Resistance of Textiles (Vertical Test)*, 2015.

ASTM D6775, *Standard Test Method for Breaking Strength and Elongation of Textile Webbing, Tape and Braided Material*, 2013.

ASTM D6797, *Standard Test Method for Bursting Strength of Fabrics Constant-Rate-of-Extension (CRE) Ball Burst Test*, 2015.

ASTM D7138, *Standard Test Method to Determine Melting Temperature of Synthetic Fibers*, 2016.

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

ASTM E991, *Standard Practice for Color Measurement of Fluorescent Specimens Using the One-Monochromator Method*, 2011.

ASTM E1164, *Standard Practice for Obtaining Spectrometric Data for Object-Color Evaluation*, 2012.

ASTM E2152, *Standard Practice for Computing the Colors of Fluorescent Objects from Bispectral Photometric Data*, 2012.

ASTM E2153, *Standard Practice for Obtaining Bispectral Photometric Data for Evaluation of Fluorescent Color*, 2011.

ASTM F903, *Standard Test Method for Resistance of Materials Used in Protective Clothing to Penetration by Liquids*, 2010.

ASTM F1060, *Standard Test Method for Thermal Protective Performance of Materials for Protective Clothing for Hot Surface Contact*, 2008.

ASTM F1215, *Test Method for Determining the Initial Efficiency of a Flatsheet Filter Medium in an Airflow Using Latex Spheres*, 1998.

ASTM F1342/F1342M, *Standard Test Method for Protective Clothing Material Resistance to Puncture*, 2013 e1.

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-X-174 Bacteriophage Penetration as a Test System*, 2013.

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

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

ASTM F1939, *Standard Test Method for Radiant Heat Resistance of Flame Resistant Clothing Materials with Continuous Heating*, 2015.

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

ASTM F2299/F2299M, *Standard Test Method for Determining the Initial Efficiency of Materials Used in Medical Face Masks to Penetration by Particulates Using Latex Spheres*, 2010.

ASTM F2412, *Standard Test Methods for Foot Protection*, 2011.

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

ASTM F2731, *Standard Test Method for Measuring the Transmitted and Stored Energy in Fire Fighter Protective Clothing Systems*, 2011.

ASTM F2894, *Standard Test Method for Evaluation of Materials, Protective Clothing and Equipment for Heat Resistance Using a Hot Air Circulating Oven*, 2014.

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.

ASTM G155, *Standard Practice for Operating Xenon Arc Light Apparatus for Exposure of Non-Metallic Materials*, 2013.

2.3.3 CIE Publications. U.S. National Committee of the Commission Internationale de l'Eclairage CIE, c/o Mr. Thomas M. Lemons, TLA — Lighting Consultants, Inc., 7 Pond Street, Salem, MA 01970-4819.

ISO/CIE 10526, *Colorimetric Illuminants*, 1999.

2.3.4 CSA Publications. Canadian Standards Association, 5060 Spectrum Way, Mississauga, ON, L4W 5N6, Canada.

CSA Z195, *Protective Footwear*, 2014.

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

FIA 1209, *Whole Shoe Flex*, 1984.

2.3.6 GSA Publications. U.S. General Services Administration, 1800 F Street, N.W., Washington, DC 20405.

Federal Test Method Standard 191A, *Textile Test Methods*, 20 July 1978.

2.3.7 ISEA Publications. International Safety Equipment Association, 1901 North Moore Street, Arlington, VA 22209-1762.

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

ANSI/ISEA Z87.1, *Occupational and Educational Personal Eye and Face Protection Devices*, 2015.

2.3.8 ISO Publications. International Organization for Standardization, ISO Central Secretariat, BIBC II, Chemin de Blandonnet 8, CP 401, 1214 Vernier, Geneva, Switzerland.

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

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

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

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

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

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

ISO 17492, *Clothing for protection against heat and flame — Determination of heat transmission on exposure to both flame and radiant heat*, 2003.

ISO/CIE 10526, *Calorimetric Illuminants*, 2007.

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

2.3.9 SAE Publications. SAE International, 400 Commonwealth Drive, Warrendale, PA 15096.

SAE J211-1, *Instrumentation for Impact Test, Part 1 — Electronic Instrumentation*, 2014.

2.3.10 U.S. Department of Defense Publications. Standardization Document Order Desk, Building 4/D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.

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

A-A-55634A, *Commercial Item Description, Zippers (Fasteners, Slide, Interlocking)*, March 23, 2004.

2.3.11 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, "Personal Protective Equipment: General Requirements," 1994.

2.3.12 U.S. Military Publications. U.S. Army Developmental Test Command, ATTN: CSTE-DTC-TT-S, Aberdeen Proving Ground, MD 21005-5055.

Federal Specification CCC-C-419, *Cloth, Duck, Unbleached, Plied-Yarns, Army and Numbered*, 1985.

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

Test Operations Procedure (TOP) 10-2-022, *Chemical Vapor and Aerosol System-Level Testing of Chemical/Biological Protective Suits*, 2013.

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. (See also definition 3.3.88, *Product Label*.)

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

3.2.5 Shall. Indicates a mandatory requirement.

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

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

3.3.2 Barrier Hood. See 3.3.136, Structural Fire Fighting Protective Hood.

3.3.3 Barrier Material. The part of the composite that limits transfer from the face of the layer to the other side.

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

3.3.5 Belt. An equipment item configured as a device that fastens around the waist only and is designated as a ladder belt or an escape belt.

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* Bitragion Coronal Arc. The arc between the right and left trignon as measured over the top of the head in a plane perpendicular to the midsagittal plane.

3.3.8* Bitragion Inion Arc. The arc between trignon as measured over the inion.

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

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

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

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

3.3.13 Brim Line. A horizontal plane intersecting the point of the front opening of the helmet at the midsagittal plane.

3.3.14 Cargo Pockets. Pockets located on the protective garment exterior.

3.3.15 CBRN. An abbreviation for chemicals, biological agents, and radiological particulates hazards. (See also 3.3.16, *CBRN Terrorism Agents*.)

3.3.16* CBRN Terrorism Agents. Chemicals, biological agents, and radiological particulates that could be released as the result of a terrorist attack. (See also 3.3.20, *Chemical Terrorism Agents*; 3.3.6, *Biological Terrorism Agents*; and 3.3.112, *Radiological Particulate Terrorism Agents*.)

3.3.17 Certification/Certified. A system whereby a certification organization determines that a manufacturer has demonstrated the ability to produce a product that complies with the requirements of this standard, authorizes the manufacturer to

use a label on listed products that comply with the requirements of this standard, and establishes a follow-up program conducted by the certification organization as a check on the methods the manufacturer uses to determine continued compliance of labeled and listed products with the requirements of this standard.

3.3.18 Certification Organization. An independent, third-party organization that determines product compliance with the requirements of this standard with a labeling/listing/follow-up program.

3.3.19 Char. The formation of a brittle residue when material is exposed to thermal energy.

3.3.20 Chemical Terrorism Agents. Liquid, solid, gaseous, and vapor chemical warfare agents and toxic industrial chemicals used to inflict lethal or incapacitating casualties, generally on a civilian population, as a result of a terrorist attack. (See also 3.3.21, *Chemical Warfare (CW) Agents*, and 3.3.146, *Toxic Industrial Chemicals*.)

3.3.21 Chemical Warfare (CW) Agents. Liquid, solid, and gaseous chemical agents (most are liquids) traditionally used during warfare or armed conflict to kill or incapacitate an enemy.

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

3.3.23 Coat. See 3.3.128, Structural Fire Fighting Protective Coat, and 3.3.102, Proximity Fire Fighting Protective Coat.

3.3.24 Collar. The portion of the coat or coverall that encircles the neck.

3.3.25 Collar Lining. The part of collar fabric composite that is next to the skin when the collar is closed in the raised position.

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

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

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

3.3.29 Coronal Plane. The anatomical plane perpendicular to both the basic and midsagittal planes and containing the midpoint of a line connecting the superior rims of the right and left auditory meatuses.

3.3.30 Coverall. See 3.3.129, Structural Fire Fighting Protective Coverall, and 3.3.103, Proximity Fire Fighting Protective Coverall.

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

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

3.3.33 Dielectric Test Plane. A plane that runs diagonally through the headform from the intersection of the test line and midsagittal plane in the front of the headform to the intersection of the reference plane and midsagittal plane in the rear of the headform.

3.3.34 Drip. To run or fall in drops or blobs.

3.3.35 Ear Covers. An interface component of the protective helmet element that provides limited protection to the helmet/coat interface area.

3.3.36 Element(s). See 3.3.39, Ensemble Elements.

3.3.37 Energy Absorbing System. Materials or systems used to attenuate impact energy.

3.3.38 Ensemble. See 3.3.130, Structural Fire Fighting Protective Ensemble, and 3.3.104, Proximity Fire Fighting Protective Ensemble.

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

3.3.40* Entry Fire Fighting. Extraordinarily specialized fire fighting operations that can include the activities of rescue, fire suppression, and property conservation at incidents involving fires producing extreme levels of radiant, conductive, and convective heat.

3.3.41* Faceshield. The component of the helmet that provides limited protection to a portion of the **wearer's** face.

3.3.42 Faceshield/Goggle. The term that applies to the helmet component that is a faceshield, or goggle, or both.

3.3.43 Facial Feature Headform. The medium size reference headform specified in ANSI/ISEA Z87.1, *Occupational and Educational Personal Eye and Face Protection Devices*.

3.3.44 Flame Resistance. The property of a material whereby combustion is prevented, terminated, or inhibited following the application of a flaming or nonflaming source of ignition, with or without subsequent removal of the ignition source. Flame resistance can be an inherent property of a material, or it can be imparted by specific treatment. (See also 3.3.67, *Inherent Flame Resistance*.)

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

3.3.46 Follow-Up Program. The sampling, inspection, 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.

3.3.47* Footwear. See 3.3.132, Structural Fire Fighting Protective Footwear, and 3.3.106, Proximity Fire Fighting Protective Footwear.

3.3.48 Functional. The ability of an element or component of an element to continue to be utilized for its intended purpose.

3.3.49 Garment(s). See 3.3.133, Structural Fire Fighting Protective Garments, and 3.3.107, Proximity Fire Fighting Protective Garments.

3.3.50 Gauntlet. An interface component of the protective glove element that provides limited protection to the coat/glove interface area.

3.3.51 Glove. See 3.3.134, Structural Fire Fighting Protective Gloves, and 3.3.108, Proximity Fire Fighting Protective Gloves.

3.3.52 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.

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

3.3.54 Glove Wristlet. See 3.3.153, Wristlet.

3.3.55 Goggles. The component of the helmet that provides protection to the **wearer's** eyes and a portion of the **wearer's** face.

3.3.56 Grading. The process of proportioning components for construction of an element.

3.3.57* 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.

3.3.58 Hardware. Nonfabric components of the protective clothing and equipment including, but not limited to, those made of metal or plastic.

3.3.59 Harness. An equipment item; an arrangement of materials secured about the body used to support a person.

3.3.60 Hazardous Materials Emergencies. Incidents involving the release or potential release of hazardous materials.

3.3.61 Headband. The portion of the helmet suspension that encircles the head.

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

3.3.63 Helmet. See 3.3.135, Structural Fire Fighting Protective Helmet, and 3.3.109, Proximity Fire Fighting Protective Helmet.

3.3.64 Helmet Cover. A removable helmet component that offers radiant reflective protection to the exterior of the helmet shell.

3.3.65 Helmet Shroud. The component element of the helmet that provides limited protection to the helmet/coat SCBA interface area.

3.3.66 Hood. See 3.3.136, Structural Fire Fighting Protective Hood.

3.3.67 Inherent Flame Resistance. Flame resistance that is derived from the essential characteristic of the fiber or polymer.

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

3.3.69 Interface Area. An area of the body where the protective garments, helmet, gloves, footwear, or SCBA facepiece meet. Interface areas include, but are not limited to, the coat/helmet/SCBA facepiece area, the coat/trouser area, the coat/glove area, and the trouser/footwear area.

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

3.3.71 Ladder Shank. See 3.3.122, Shank.

- 3.3.72 Liquid Borne Pathogen.** See 3.3.9, Body Fluid-Borne Pathogen.
- 3.3.73 Lower Torso.** The area of the body trunk below the waist, excluding the legs, ankles, and feet.
- 3.3.74 Major A Seam.** See 3.3.119.2.
- 3.3.75 Major B Seam.** See 3.3.119.3.
- Δ 3.3.76 Manufacturer.** The entity that assumes the liability for the compliant product.
- N 3.3.77 Manufacturing Facility.** A facility that is involved in the production, assembly, final inspection, or labeling of the compliant end product.
- 3.3.78 Melt.** A response to heat by a material resulting in evidence of flowing or dripping.
- 3.3.79 Midsagittal Plane.** The plane, perpendicular to the basic and coronal planes, that bisects the head symmetrically.
- 3.3.80 Minor Seam.** See 3.3.119.4.
- 3.3.81 Model.** The collective term used to identify a group of 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.
- 3.3.82 Moisture Barrier.** The component of an element or item that principally prevents the transfer of liquids.
- 3.3.83 Nape Device.** A component used to aid in helmet retention.
- 3.3.84 Outer Shell.** The outermost component of an element or item not including trim, hardware, reinforcing material, pockets, wristlet material, accessories, fittings, or suspension systems.
- N 3.3.85* Particulate Blocking Layer.** The layer(s) of an element or item that principally inhibits the ingress of particles.
- 3.3.86* Particulates.** Finely divided solid matter that is dispersed in air.
- 3.3.87 Percent Inward Leakage.** The ratio of vapor concentration inside the ensemble versus the vapor concentration outside the ensemble expressed as a percentage.
- 3.3.88 Product Label.** A marking provided by the manufacturer for each compliant product containing compliant statements, certification statements, manufacturer or model information, or similar data. The product label is not the certification organization's label, symbol, or identifying mark; however, the certification organization's label, symbol, or identifying mark is attached to or part of the product label.
- 3.3.89 Protective Clothing.** See 3.3.130, Structural Fire Fighting Protective Ensembles, and 3.3.104, Proximity Fire Fighting Protective Ensemble.
- Δ 3.3.90 Protective Coat.** See 3.3.128, Structural Fire Fighting Protective Coat, and 3.3.101, Proximity Fire Fighting Protective Coat.
- 3.3.91 Protective Coverall.** See 3.3.129, Structural Fire Fighting Protective Coverall, and 3.3.103, Proximity Fire Fighting Protective Coverall.
- 3.3.92 Protective Ensemble.** See 3.3.130, Structural Fire Fighting Protective Ensemble, and 3.3.104, Proximity Fire Fighting Protective Ensemble.
- 3.3.93 Protective Footwear.** See 3.3.132, Structural Fire Fighting Protective Footwear, and 3.3.106, Proximity Fire Fighting Protective Footwear.
- 3.3.94 Protective Garment.** See 3.3.133, Structural Fire Fighting Protective Garments, and 3.3.107, Proximity Fire Fighting Protective Garments.
- 3.3.95 Protective Gloves.** See 3.3.134, Structural Fire Fighting Protective Glove, and 3.3.108, Proximity Fire Fighting Protective Glove.
- 3.3.96 Protective Helmet.** See 3.3.135, Structural Fire Fighting Protective Helmet, and 3.3.109, Proximity Fire Fighting Protective Helmet.
- 3.3.97 Protective Hood.** See 3.3.136, Structural Fire Fighting Protective Hood.
- 3.3.98 Protective Trousers.** See 3.3.137, Structural Fire Fighting Protective Trousers, and 3.3.110, Proximity Fire Fighting Protective Trousers.
- 3.3.99 Protective Wristlet.** See 3.3.153, Wristlet.
- 3.3.100* Proximity Fire Fighting.** Specialized fire fighting operations that can include the activities of rescue, fire suppression, and property conservation at incidents involving fires producing high levels of radiant heat as well as conductive and convective heat.
- 3.3.101 Proximity Fire Fighting Protective Clothing.** See 3.3.104, Proximity Fire Fighting Protective Ensemble.
- 3.3.102 Proximity Fire Fighting Protective Coat.** The element of the protective ensemble that provides protection to upper torso and arms, excluding the hands and head.
- 3.3.103 Proximity Fire Fighting Protective Coverall.** The element of the protective ensemble that provides protection to the torso, arms, and legs, excluding the head, hands, and feet.
- 3.3.104 Proximity Fire Fighting Protective Ensemble.** Multiple elements of compliant protective clothing and equipment that when worn together provide protection from some risks, but not all risks, of emergency incident operations.
- 3.3.105 Proximity Fire Fighting Protective Ensemble with Optional Liquid and Particulate Contaminant Protection.** A compliant proximity fire fighting protective ensemble that is also certified as an entire ensemble to meet the optional requirements for protection from liquid and particulate contaminants.
- 3.3.106 Proximity Fire Fighting Protective Footwear.** The element of the protective ensemble that provides protection to the foot, ankle, and lower leg.
- 3.3.107 Proximity Fire Fighting Protective Garment.** The coat, trouser, and coverall elements of the protective ensemble.
- 3.3.108 Proximity Fire Fighting Protective Glove.** The element of the protective ensemble that provides protection to the hand and wrist.

3.3.109 Proximity Fire Fighting Protective Helmet. The element of the protective ensemble that provides protection to the head.

3.3.110 Proximity Fire Fighting Protective Trousers. The element of the protective ensemble that provides protection to the lower torso and legs, excluding the ankles and feet.

3.3.111 Puncture-Resistant Device. A reinforcement to the bottom of protective footwear that is designed to provide puncture resistance.

3.3.112* 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.

3.3.113 Recall System. Procedures by which a manufacturer identifies a product, provides notice or safety alert, and repairs or withdraws the product as the corrective action.

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

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

3.3.116 Retroreflection/Retroflective. 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.

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

3.3.118 Sample. (1) The ensemble, element, component, or composite that is conditioned for testing. (2) Ensembles, elements, items, or components that are randomly selected from the manufacturing facility's production line, from the manufacturer's or manufacturing facility's inventory, or from the open market.

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

3.3.119.1 Major Seam. Seam assemblies where rupture exposes the wearer to immediate danger.

3.3.119.2* Major A Seam. Outermost layer seam assemblies where rupture could reduce the protection of the garment by exposing the garment's inner layers.

3.3.119.3 Major B Seam. Inner layer seam assemblies where rupture could reduce the protection of the garment by exposing the next layer of the garment, the wearer's station/work uniform, other clothing, or skin.

3.3.119.4 Minor Seam. Remaining seam assemblies that are not classified as Major, Major A, or Major B seams.

3.3.120 Seam Assembly. The structure obtained when materials are joined by means of a seam.

3.3.121 Separate/Separation. A material response evidenced by splitting or delaminating.

3.3.122 Shank. The component of footwear that provides additional support to the instep.

3.3.123 Shell. See 3.3.84, Outer Shell.

3.3.124 Specimen. The conditioned ensemble, element, item, or component that is tested. Specimens are taken from samples. (See also 3.3.118, Sample.)

3.3.125 Structural Fire Fighting. The activities of rescue, fire suppression, and property conservation in buildings, enclosed structures, vehicles, marine vessels, or like properties that are involved in a fire or emergency situation.

N 3.3.126 Structural Fire Fighting Protective Barrier Hood. The optional interface element of the protective ensemble that provides limited thermal, physical, and barrier protection to the coat/helmet/SCBA facepiece interface area.

3.3.127 Structural Fire Fighting Protective Clothing. See 3.3.130, Structural Fire Fighting Protective Ensemble.

3.3.128 Structural Fire Fighting Protective Coat. The element of the protective ensemble that provides protection to the upper torso and arms, excluding the hands and head.

3.3.129 Structural Fire Fighting Protective Coverall. The element of the protective ensemble that provides protection to the torso, arms, and legs, excluding the head, hands, and feet.

3.3.130* Structural Fire Fighting Protective Ensemble. Multiple elements of compliant protective clothing and equipment that when worn together provide protection from some risks, but not all risks, of emergency incident operations.

3.3.131 Structural Fire Fighting Protective Ensemble with Optional Liquid and Particulate Contaminant Protection. A compliant structural fire fighting protective ensemble that is also certified as an entire ensemble to meet the optional requirements for protection from liquid and particulate contaminants.

3.3.132 Structural Fire Fighting Protective Footwear. The element of the protective ensemble that provides protection to the foot, ankle, and lower leg.

3.3.133 Structural Fire Fighting Protective Garment(s). The coat, trouser, and coverall elements of the protective ensemble.

3.3.134 Structural Fire Fighting Protective Glove. The element of the protective ensemble that provides protection to the hand and wrist.

3.3.135 Structural Fire Fighting Protective Helmet. The element of the protective ensemble that provides protection to the head.

3.3.136 Structural Fire Fighting Protective Hood. The interface element of the protective ensemble that provides limited protection to the coat/helmet/SCBA facepiece interface area.

3.3.137 Structural Fire Fighting Protective Trousers. The element of the protective ensemble that provides protection to the lower torso and legs, excluding the ankles and feet.

3.3.138 Suspension. The energy-attenuating system of the helmet that is made up of the headband and crown strap.

3.3.139 Sweatband. That part of a helmet headband, either integral or attached, that comes in contact with the wearer's forehead.

3.3.140 Textile Fabric. A planar structure consisting of yarns or fibers.

3.3.141 Thermal Barrier. The component of an element or item that principally provides thermal protection.

3.3.142 Toe Cap. A reinforcement to the toe area of footwear designed to protect the toes from impact and compression.

3.3.143* Tongue. The part of the protective footwear that is provided for lace up 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.

3.3.144 Top. The intersection between the midsagittal plane and the coronal plane extended to the helmet surface.

3.3.145 Top Line. The top edge of the protective footwear that includes the tongue, gusset, quarter, collar, and shaft.

3.3.146 Toxic Industrial Chemicals. Highly toxic solid, liquid, or gaseous chemicals that have been identified as mass casualty threats that could be used to inflict casualties, generally on a civilian population, during a terrorist attack.

3.3.147 Trim. Retroreflective and fluorescent materials attached to the outermost surface of the protective ensemble for visibility enhancement. Retroreflective materials enhance nighttime visibility, and fluorescent materials enhance daytime visibility. "Trim" is also known as "visibility markings."

3.3.148 Trouser. See 3.3.137, Structural Fire Fighting Protective Trousers, and 3.3.110, Proximity Fire Fighting Protective Trousers.

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

3.3.150 Upper Torso. The area of body trunk above the waist and extending to the shoulder, excluding the arms and wrists, and hands.

3.3.151 Wear Surface. The bottom of the footwear sole, including the heel.

3.3.152 Winter Liner. An optional component layer that provides added insulation against cold.

3.3.153 Wristlet. The interface component of the protective element or item that provides limited protection to the protective coat/glove interface area.

Chapter 4 Certification

4.1 General.

- ▲ **4.1.1** The process of certification for product as being compliant with NFPA 1971 shall meet the requirements of Section 4.1, General; Section 4.2, Certification Program; Section 4.3, Inspection and Testing; Section 4.4, Recertification; 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 products 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 only permit the certification of complete protective ensembles, which include protective garments, protective helmet, protective gloves, protective footwear, interface components where necessary for certification, and protective hood where the hood is not part of the protective garments, to the optional requirements for protection against liquid and particulate contaminants.

4.1.2.2 The certification organization shall further require that the protective ensemble manufacturer specify the respiratory protection component of the ensemble by manufacturer, type, and model in order for the ensembles to be certified to the optional requirements for protection against liquid and particulate contaminants.

- ▲ **4.1.2.3** The respiratory protection shall be a specific model self-contained breathing apparatus (SCBA) that is certified as compliant with NFPA 1981.

- ▲ **4.1.3** All certification shall be performed by a certification organization that meets at least the requirements specified in Section 4.2, Certification Program, and that is accredited for personal protective equipment in accordance with ISO/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*.

- ▲ **4.1.4*** 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 1971, in any statements about their respective products unless the products are certified as compliant to this standard.

4.1.5 All compliant products shall be labeled and listed.

4.1.6 All compliant products shall also have a product label that meets the requirements specified in Section 5.1, Product Label Requirements.

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

- ▲ **4.1.8** The certification organization shall not issue any new certifications to the 2013 edition of NFPA 1971 on or after the NFPA effective date for the 2018 edition, which is August 21, 2017.

- ▲ **4.1.9** The certification organization shall not permit any manufacturer to continue to label any products that are certified as compliant with the 2013 edition of NFPA 1971 on or after August 21, 2018.

- ▲ **4.1.10** The certification organization shall require manufacturers to remove all certification labels and product labels indicating compliance with the 2013 edition of NFPA 1971 from all products that are under the control of the manufacturer on August 21, 2018, and the certification organization shall verify 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.

Δ 4.2.3 The certification organization shall be accredited for personal protective equipment 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, Manufacturers' 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 manufacturer's manufacturing facilities of the compliant product with at least two random and unannounced visits per 12-month period to verify the product's continued compliance. Where portions of the production process are carried out by multiple facilities, the certification organization shall determine the appropriate follow-up program according to which facility or facilities most closely meet the definition provided in 3.3.77 (Manufacturing Facility).

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

4.2.9.2 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 initial 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 results to be in jeopardy of not complying with this standard, the certification organization shall conduct more frequent testing of sample product, components, and materials acquired in accordance with 4.2.9.1 against the applicable requirements of this standard.

4.2.10 The certification organization shall have in place a series of procedures, as specified in Section 4.6, Hazards Involving Compliant Product, that address reports of situations 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 compliant products, the certification organization shall conduct both inspection and testing as specified in this section.

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

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

4.3.2.2 The accreditation of a certification organization's testing laboratory shall be issued by an accreditation body operating in accordance with ISO 17011, *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 17025, *General requirements for the competence of testing and calibration laboratories*.

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

4.3.3.3 The accreditation of a manufacturer's testing laboratory shall be issued by an accreditation body operating in accordance with ISO 17011, *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.

4.3.4.1* For certification of structural fire fighting helmet elements, a test series shall consist of 14 helmets.

4.3.4.1.1 A minimum of three test series shall be required for certification.

4.3.4.1.2 Each helmet shall be subjected to the specified environmental conditioning and test or tests.

4.3.4.2* For certification of proximity fire fighting helmet elements, a test series shall consist of 14 helmets.

4.3.4.2.1 A minimum of three test series shall be required for certification.

4.3.4.2.2 Each helmet shall be subjected to the specified environmental conditioning and test or tests.

4.3.4.3 For certification of any ensembles with the optional liquid and particulate contaminant protection requirements, the ensembles and components shall be subjected to the specified environmental conditioning and test or tests.

4.3.5 Inspection and evaluation by the certification organization shall include a review of all product labels to ensure that all required label attachments, compliance statements, certification statements, and other product information are at least as specified for the products identified in Section 5.1, Product Label Requirements for Both Ensembles, Section 5.2, Addi-

tional Product Label Requirements for Structural Fire Fighting Ensemble Elements Only, and Section 5.3, Additional Product Label Requirements for Proximity Fire Fighting Ensemble Elements Only.

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

4.3.7 Inspection and evaluation by the certification organization shall include a review of the user information required by Section 5.4, User Information Requirements for Both Ensembles, to ensure that the information has been developed and is available.

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

4.3.9 Testing 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 compliant product.

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

4.3.11 The certification organization shall not allow any modifications, pretreatment, conditioning, or other such special processes of the product or any product component prior to the product's submission for evaluation and testing by the certification organization.

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

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

4.3.14 The certification organization shall test an ensemble element with the specific ensemble(s) with which it is to be certified.

4.3.15 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.

4.3.16 The manufacturer shall maintain all design and performance inspection and test data from the certification organization used in the certification of the manufacturer's

compliant product. The manufacturer shall provide such data, upon request, to the purchaser or authority having jurisdiction.

4.4 Recertification.

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. 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 with the following protocol:
 - (a) Where a test method incorporates testing both before and after laundering **conditioning** specified in 8.1.2 and the test generates quantitative results, recertification testing shall be limited to the conditioning that yielded the worst-case test result during the initial certification for the model or component.
 - (b) Where a test method incorporates testing both before and after laundering **conditioning** specified in 8.1.2 and the test generates non-quantitative results (e.g., pass/fail for melt/drip), recertification 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 of 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 At least one sample of each compliant product and component shall be tested for overall performance as specified in Chapter 7 according to the following protocol:

- (1) Where a test method incorporates testing both before and after laundering **conditioning** specified in 8.1.2 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.
- (2) Where a test method incorporates testing both before and after laundering **conditioning** specified in 8.1.2 and the test generates non-quantitative results (e.g., pass/fail for melt/drip), recertification 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.
- (3) Where a test method requires the testing of less than five specimens, a minimum of one specimen shall be tested for annual recertification.
- (4) Where a test method requires the testing of five or more specimens, a minimum of two specimens shall be tested for annual recertification.

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

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

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

4.4.6 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 Manufacturers' Quality Assurance Program.

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

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

4.5.3* All the following entities shall either be registered to ISO 9001, *Quality management systems — Requirements*, or shall be listed as a covered location under an ISO 9001 registered entity:

- (1) Manufacturer
- (2) Manufacturing facility
- (3) The entity that directs and controls compliant product design
- (4) The entity that directs and controls compliant product quality assurance
- (5) The entity that provides the warranty for the compliant product
- (6) The entity that puts their name on the product label and markets and sells the product as their own

Δ 4.5.3.1 Registration to the requirements of ISO 9001, *Quality management systems — Requirements*, shall be conducted by a registrar that is accredited for personal protective equipment in accordance with ISO 17021, *Conformity assessment — Requirements for bodies providing audit and certification of management systems*. The registrar shall affix the accreditation mark on the ISO registration certificate.

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

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

4.5.5 Where manufacturers construct custom sized or special fitting gloves for accommodating the special needs of individual **fire fighters**, the manufacturer shall employ the same manufacturing methods as used in the construction of required glove sizes.

4.5.5.1 The manufacturer shall notify the certification organization as required in 4.2.8 and shall obtain written approval from the certification organization prior to proceeding with any modifications to an existing certified glove design.

4.5.5.2 Custom fitting gloves shall be individually evaluated to verify the integrity of the glove moisture barrier using air or other similar method to ensure that the glove is constructed in a leak-free manner.

4.6 Hazards Involving Compliant Product.

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

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

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

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

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

4.6.6 The certification organization's investigation shall include, but not be limited to, the extent and scope of the problem as it might apply to other compliant 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 compliant product is gaining widespread use in applications not foreseen when the standard was written, such applications in turn being ones for which the product was not certified, and no specific scope of application has been provided in the standard, and no limiting scope of application was provided by the manufacturer in written material accompanying the compliant product at the point of sale.

4.6.8 The certification organization shall require the manufacturer of the compliant product, or 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.

Δ 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) Removing 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 Input 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 manufacturer 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 decision to issue a safety alert or to conduct a product recall, or after the manufacturer has been directed by the certification organization to issue a safety alert or conduct a product recall
- (3) Techniques for communicating accurately and understandably the nature of the safety alert or product recall and in particular the specific hazard or safety issue found to exist
- (4) Procedures for removing product that is recalled and for documenting the effectiveness of the product recall
- (5) A plan for either repairing, or replacing, or compensating purchasers for returned product
- (7) Size or size range
- (8) Principal material(s) of construction
- (9) Cleaning precautions

N 5.1.7.1 For garments only, where the principal material of construction is a component that is listed, the component name under which it is listed shall be identified.

N 5.1.7.2 For garments only, where the thermal liner, moisture barrier, and outer shell are separable, each separable layer shall also have a label containing the information required in 5.1.7(4) through 5.1.7(8).

N 5.1.7.3* For principal materials of construction of footwear, at least the outer shell, moisture barrier, and thermal liner shall be listed. Generic names of materials shall be permitted to be used. Additional materials that are used throughout the majority of the footwear shall also be listed on the label.

N 5.1.7.4* For principal materials of construction of helmets, the shell material shall be listed.

5.1.7.5* For principal materials of construction of gloves, at least the outer shell, moisture barrier, thermal liner, and glove interface component (wristlet) shall be listed. Generic names of materials shall be permitted to be used. If used, the type of leather shall be listed. Any additional materials that are used throughout the significant portion of the glove's construction shall also be listed on the label.

5.2 Additional Product Label Requirements for Structural Fire Fighting Ensemble Elements Only.

5.2.1 The following compliance statement shall be printed legibly on the product label for each structural fire fighting protective ensemble element, unless the requirements in 5.2.1.1 prevail. The appropriate term for the element type — garment, helmet, glove, footwear, hood — shall be inserted in the compliance statement text where indicated. All product label letters and figures shall be at least 2.5 mm ($\frac{3}{32}$ in.) in height.

“THIS STRUCTURAL FIRE FIGHTING PROTECTIVE (insert appropriate element term here) MEETS THE (insert appropriate element term here) REQUIREMENTS OF NFPA 1971, 2018 EDITION.

DO NOT REMOVE THIS LABEL.”

Δ 5.2.1.1 Where an entire ensemble is also certified as compliant with the optional requirements for protection against liquid and particulate contaminants, each element of the entire ensemble shall have at least the additional following compliance statement on the product label in place of the compliance statement specified in 5.2.1. The appropriate term for the element type — garment, helmet, glove, footwear, hood — shall be inserted in the compliance statement text where indicated. All product label letters and figures shall be at least 2.5 mm ($\frac{3}{32}$ in.) in height.

“LIQUID AND PARTICULATE PROTECTIVE ENSEMBLE

THIS ELEMENT IS NOT INTENDED AS PART OF A HAZARDOUS MATERIALS PROTECTIVE ENSEMBLE.

THIS STRUCTURAL FIRE FIGHTING PROTECTIVE (insert appropriate element term here) MEETS THE (insert appropriate element term here) REQUIREMENTS OF NFPA 1971, 2018 EDITION, AND THE OPTIONAL REQUIREMENTS FOR LIQUID AND PARTICULATE

Chapter 5 Labeling and Information

5.1 Product Label Requirements for Both Ensembles.

5.1.1* Each element of both protective ensembles shall have at least one product label permanently and conspicuously located inside each element when the element is properly assembled with all layers and components in place.

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

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

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

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

5.1.6 The compliance statements specified in Section 5.2 for structural fire fighting protective ensemble elements and in Section 5.3 for proximity fire fighting protective ensemble elements shall be printed legibly on the product label.

Δ 5.1.7 The following information shall also be printed legibly on each product label with all letters at least 1.5 mm ($\frac{1}{16}$ in.) in height:

- (1) Manufacturer's name, identification, or designation
- (2) Manufacturer's address
- (3) Country of manufacture
- (4) Manufacturer's element identification number, lot number, or serial number
- (5) Month and year of manufacture, not coded
- (6) Model name, number, or design

CONTAMINANT PROTECTION WHEN WORN TOGETHER WITH THE OTHER SPECIFIED ELEMENTS AND INTERFACE COMPONENTS OF THE ENSEMBLE.

DO NOT REMOVE THIS LABEL."

5.2.1.2 The garment element of the ensemble meeting the optional requirements for protection against liquid and particulate contaminants shall list those items of the certified ensemble by manufacturer name and model number on the product label.

5.2.2 Where other protective item(s) or detachable components must be used with structural fire fighting protective ensemble elements in order for an element to be compliant with this standard, at least the following statement and information shall also be printed legibly on the product label. All letters shall be at least 2.5 mm ($\frac{3}{32}$ in.) high. The appropriate term for the element type — garment, helmet, glove, footwear, hood — shall be inserted in the statement text where indicated. Following this statement, the additional protective items or detachable components shall be listed by type, identification, and how properly assembled.

"FOR COMPLIANCE WITH THE STRUCTURAL FIRE FIGHTING (insert appropriate element term here) REQUIREMENTS OF NFPA 1971, THE FOLLOWING PROTECTIVE ITEMS MUST BE WORN IN CONJUNCTION WITH THIS [insert appropriate element term here]:

(List additional items or detachable components here.)

DO NOT REMOVE THIS LABEL."

Δ 5.2.3 For helmets only, the helmet manufacturer shall place a unique manufacturer's part number, the symbol of the certification organization, and the words **"NFPA 1971, 2018 ED."** permanently on each replaceable performance critical part of the goggle lens or faceshield.

5.2.4 For hoods only, where the hood is designed to interface with a specific SCBA facepiece(s), the hood manufacturer shall add an item to the items specified in 5.1.7.

5.2.4.1 The hood manufacturer shall designate the specific SCBA facepiece(s), model(s) and size(s) in the new item of 5.1.7.

5.2.4.2 Where the hood is designed to be used with a specific SCBA facepiece(s), the hood manufacturer shall add to the hood product label the following statement:

"FOR COMPLIANCE WITH THE STRUCTURAL FIRE FIGHTING REQUIREMENTS OF NFPA 1971, THIS HOOD CAN ONLY BE USED WITH THE FOLLOWING NOTED SCBA FACEPIECE(S) [insert SCBA facepieces(s), model(s), and size(s) here]."

Δ 5.2.5 For garments only, the garment manufacturer shall place a manufacturer's identification number, lot number or serial number, the size or size range, the symbol of the certification organization, and the words **"NFPA 1971, 2018 ED."** on the drag rescue device (DRD).

N 5.2.6 For particulate blocking hoods only, the following additional language shall be provided on the product label:

"THIS HOOD PROVIDES LIMITED PARTICULATE BLOCKING PROTECTION."

5.3 Additional Product Label Requirements for Proximity Fire Fighting Ensemble Elements Only.

5.3.1 The following compliance statement shall be printed legibly on the product label for each proximity fire fighting protective ensemble element. The appropriate term for the element type — garment, helmet, glove, footwear — shall be inserted in the compliance statement text where indicated. All product label letters and figures shall be at least 2.5 mm ($\frac{3}{32}$ in.) in height.

"THIS PROXIMITY FIRE FIGHTING PROTECTIVE [insert appropriate element term here] MEETS THE [insert appropriate element term here] REQUIREMENTS OF NFPA 1971, 2018 EDITION.

DO NOT REMOVE THIS LABEL."

Δ 5.3.1.1 Where an entire ensemble is also certified as compliant with the optional requirements for protection against liquid and particulate contaminants, each element of the entire ensemble shall have at least the additional following compliance statement on the product label in place of the compliance statement specified in 5.3.1. The appropriate term for the element type — garment, helmet, glove, footwear — shall be inserted in the compliance statement text where indicated. All product label letters and figures shall be at least 2.5 mm ($\frac{3}{32}$ in.) in height.

"LIQUID AND PARTICULATE CONTAMINANT PROTECTIVE ENSEMBLE

THIS ELEMENT IS NOT INTENDED AS PART OF A HAZARDOUS MATERIALS PROTECTIVE ENSEMBLE.

THIS PROXIMITY FIRE FIGHTING PROTECTIVE [insert appropriate element term here] MEETS THE [insert appropriate element term here] REQUIREMENTS OF NFPA 1971, 2018 EDITION, AND THE OPTIONAL REQUIREMENTS FOR LIQUID AND PARTICULATE CONTAMINANT PROTECTION, WHEN WORN TOGETHER WITH THE OTHER SPECIFIED ELEMENTS AND INTERFACE COMPONENTS OF THE ENSEMBLE.

DO NOT REMOVE THIS LABEL."

5.3.1.2 The garment element of the ensemble meeting the optional requirements for protection against liquid and particulate contaminants shall list those items of the certified ensemble by manufacturer name and model number on the product label.

Δ 5.3.2 Where other protective item(s) or detachable components must be used with proximity fire fighting protective ensemble elements in order for an element to be compliant with this standard, at least the following statement and information shall also be printed legibly on the product label. All letters shall be at least 2.5 mm ($\frac{3}{32}$ in.) high. The appropriate term for the element type — garment, helmet, glove, footwear — shall be inserted in the statement text where indicated. Following this statement, the additional protective items or detachable components shall be listed by item/ component

identification or part number, and where applicable, how properly assembled.

“FOR COMPLIANCE WITH THE PROXIMITY FIRE FIGHTING (insert appropriate element term here) REQUIREMENTS OF NFPA 1971, THE FOLLOWING PROTECTIVE ITEMS MUST BE WORN IN CONJUNCTION WITH THIS [insert appropriate element term here]:

[List additional items or detachable components here.]

DO NOT REMOVE THIS LABEL.”

5.3.2.1 For proximity fire fighting helmets, the list of additional items or detachable components shall include, as a minimum, the shroud, cover (except where the helmet cover is part of the shroud), and faceshield.

Δ 5.3.3 For helmets only, the helmet manufacturer shall place a unique manufacturer's part number, the symbol of the certification organization, and the words **“NFPA 1971, 2018 ED.”** permanently on each replaceable performance critical part of the faceshield.

Δ 5.3.4* For the helmet shroud and cover (except where the helmet cover is part of the shroud), the manufacturer shall place a label on the shroud and cover (except where the helmet cover is part of the shroud) with a unique manufacturer's part number or identification and the following statement. The appropriate term for the item, shroud or cover, shall be inserted in the statement text where indicated.

“FOR COMPLIANCE WITH THE PROXIMITY FIRE FIGHTING REQUIREMENTS OF NFPA 1971-2018, THIS [insert appropriate item term here] CAN ONLY BE USED WITH THE FOLLOWING NOTED HELMET(S) AND ADDITIONAL ITEM(S): [insert helmet manufacturer's name and specific helmet model; and item name (shroud or cover) and shroud or cover part number, or identification where applicable].”

5.3.5 For garments only, the garment manufacturer shall place a manufacturer's identification number, lot number or serial number, the size or size range, the symbol of the certification organization, and the words **“NFPA 1971, 2018 ED.”** on the DRD.

5.4 User Information Requirements for Both Ensembles.

5.4.1 The manufacturer shall provide at least the user information that is specified in 5.4.4 with each structural and proximity fire fighting element.

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

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

5.4.4* The manufacturer shall provide at least the following instructions and information with each element:

- (1) Pre-use information
 - (a) Safety considerations
 - (b) Limitations of use

- (c) Marking recommendations and restrictions
 - (d) A statement that most performance properties of the element 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 and 29 CFR 1910.132, General Requirements of Subpart I, “Personal Protective Equipment”
- (6) Maintenance and cleaning
 - (a) Cleaning instructions and precautions with a statement advising users not to use an element that is not thoroughly cleaned and dried
 - (b) Inspection details
 - (c) Maintenance criteria and methods of repair where applicable
 - (d) Decontamination procedures for both chemical and biological contamination
- (7) Retirement and disposal criteria and considerations
- (8) A statement that the moisture barrier has not been evaluated for all chemicals that can be encountered during fire fighting operations and information that the effects of chemical exposure on the moisture barrier are to be evaluated per the inspection procedures in NFPA 1851

5.4.5 For the DRD only, the manufacturer shall provide specific information on the use, inspection, maintenance, cleaning, and retirement of the DRD. Additional instructions shall be provided on the removal and reinstallation of the DRD into the garment.

5.4.6 For footwear only, the manufacturer shall establish and provide, upon request, a size conversion chart for each model or style footwear element based on toe length, arch length, and foot width as measured on a Brannock Scientific Foot Measuring Device.

N 5.4.7 For helmets only, the manufacturer shall provide a list of items that are installed on, attached to, or packaged with the compliant helmet that meet the requirements of 6.4.8.

Δ 5.4.8 For protective ensembles certified to the optional liquid and particulate contaminant protection requirements, the manufacturer shall provide the following additional instruction and information with the ensemble:

- (1) A statement that only the ensemble and the specific elements with which the ensemble has been certified must be worn together to ensure that the optional liquid and particulate contaminant protection is provided
- (2) A list of the specific elements and interface components that must be worn as part of the liquid and particulate contaminant protective ensemble, including each type of CBRN SCBA that the ensemble has been certified with
- (3) A list of specific limitations associated with the use of the ensemble for a response involving liquid and particulate contaminant hazards, including but not limited to a statement that the ensemble is not a hazardous materials protective ensemble and that protection will not be provided from vapors or all liquids and particulates

- (4) Specific care and maintenance provisions associated with properly maintaining the unique performance properties of the ensemble, its elements, or interface components

N 5.4.9 When the optional requirements for liquid and particulate contaminant protection necessitate a specific action to engage interface areas, the manufacturer shall provide details explaining those procedures.

Chapter 6 Design Requirements

6.1* Protective Garment Element Design Requirements for Both Ensembles.

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

6.1.1.1 For coveralls, the portion of the coverall that corresponds to the coat shall meet all garment requirements and all requirements specified for coat elements of this section.

6.1.1.2 For coveralls, the portion of the coverall that corresponds to the trouser shall meet all garment requirements and all requirements specified for trouser elements of this section.

6.1.2* Garments shall consist of a composite of an outer shell, moisture barrier, and thermal barrier.

6.1.2.1 The composite specified in 6.1.2 shall be permitted to be configured as a single layer or multiple layers.

6.1.2.2 Supplemental garments that are provided to meet the performance requirements of this standard but are not intended to be worn continuously with the wearing of the garment element shall not be permitted.

6.1.3* Garments shall have a means of securing the moisture barrier and thermal barrier to the outer shell.

6.1.4 Garment moisture barriers and thermal barriers, or materials meeting the performance requirements of these components, shall extend at least to the neckline seam of coats, at least to the waistline seam of trousers, and shall extend at least to within 75 mm (3 in.) of the bottom outer shell hems of both coats and trousers.

6.1.4.1 For coats, the moisture barriers and thermal barriers, or materials meeting the performance requirements of these components, shall extend at least to within 25 mm (1 in.) of the sleeve ends of the outer shell and shall be attached at or adjacent to the end of the coat sleeves, unless those barrier layers terminate in a garment-glove interface.

6.1.4.2 For trousers, moisture barriers and thermal barriers, or materials meeting the performance requirements of these components, shall be attached to the trouser legs, unless those barrier layers terminate in booties.

6.1.4.3 Any mechanism used to attach the liner system to the coat sleeves or trouser legs shall not be greater than 25 mm (1 in.) between the attachment points, and the mechanism and attachment points shall not be expandable.

6.1.5 Garments and their closure systems, including the coat front and the trouser fly, shall be constructed in a manner that provides continuous moisture and thermal protection.

6.1.5.1 Such closure systems shall be secured with positive locking fasteners including, but not limited to, hooks and dees or zippers.

6.1.5.2 Nonpositive fasteners, such as snaps or hook and pile tape, shall not be used as positive locking fasteners but shall be permitted to be utilized as supplementary garment closure devices.

6.1.6 All garment hardware finishes shall be free of rough spots, burrs, or sharp edges.

6.1.7 All sewing thread utilized in the construction of garments and the drag rescue devices (DRDs) shall be made of an inherently flame-resistant fiber.

6.1.8* Garment cargo pockets, where provided, shall have a means to drain water and shall have a means of fastening in the closed position.

6.1.9 Coats shall be designed to provide protection to the upper torso, neck, arms, and wrists, excluding the hands and head.

6.1.9.1 Each coat element shall have a DRD installed in the upper torso portion of the element.

6.1.9.1.1 The DRD shall be accessible from the exterior of the garment.

6.1.9.1.2 The DRD shall be easily accessible for deployment, shall be designed to minimize the risk of accidental deployment, and shall allow for visual inspection.

6.1.9.1.3 The DRD shall be fully functional and shall not require any subsequent actions in order to be used, other than deploying the DRD, when the garment is donned in accordance with the manufacturer's instructions.

6.1.9.1.4 The DRD shall be designed to allow deployment and operation of the DRD while the incapacitated fire fighter is wearing an SCBA.

6.1.9.1.5 The DRD shall be designed so that when deployed, the DRD secures the fire fighter by the upper torso or shoulders so that the DRD pulls directly on the body and shall not pull only the garment.

6.1.9.2* Each coat sleeve shall have a protective wristlet or other interface component permanently attached to the coat sleeve.

6.1.9.2.1 The wristlet or other garment sleeve interface component shall be designed so that it will not permit a gap in thermal protection.

6.1.9.2.2 The wristlet or other garment sleeve interface component shall meet the requirements specified in Section 6.16, Protective Wristlet Interface Component Design Requirements for Both Ensembles.

6.1.9.3 Coats shall have a composite collar at least 75 mm (3 in.) in height at any point when measured from the top of the collar down.

6.1.9.3.1 The collar shall incorporate a closure system.

6.1.9.3.2 The collar and closure system shall consist of an outer shell, a moisture barrier, and a thermal barrier, or of a composite that meets all applicable performance requirements

specified in Section 7.1, Protective Garment Performance Requirements for Both Ensembles.

6.1.9.3.3 Where a hood is permanently attached to the coat, a collar shall not be required.

6.1.9.3.4 Where a hood is permanently attached to the coat, it shall meet the requirement of 6.1.9.3.1 and at least the bottom 75 mm (3 in.) of the hood shall meet the requirement of 6.1.9.3.2.

6.1.9.4 Coat hardware shall not penetrate through the outer shell, moisture barrier, and thermal barrier to contact the wearer's body when the coat is worn with the closures fastened, unless the hardware is completely covered by external closure flaps.

6.1.10 Trousers shall be designed to provide protection to the lower torso and legs, excluding the ankles and feet.

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

6.1.10.2 Where trousers incorporate booties, the booties shall be designed as an extension of the trouser leg and shall cover the entire foot and ankle.

6.1.10.3 Trouser hardware shall not penetrate through the outer shell, moisture barrier, and thermal barrier to come into contact with the wearer's body when the trouser is worn with the closures fastened, unless the hardware is located on or above the waistline or hardware is completely covered by external closure flaps.

6.1.11* In order to label a coat, trouser, or coverall as compliant with this standard, the manufacturer shall provide coats, trousers, or coveralls in the size ranges specified in Table 6.1.11.

6.1.11.1 The sizing increments for the ranges specified in Table 6.1.11 for men's and women's chest sizes shall be in increments no greater than 50 mm (2 in.), sleeve lengths shall be in increments no greater than 25 mm (1 in.), men's and women's waist sizes shall be in increments no greater than 50 mm (2 in.), and inseam lengths shall be in increments no greater than 50 mm (2 in.).

6.1.11.2 Men's and women's sizing shall be accomplished by men's and women's individual patterns.

6.1.12* When life safety harnesses, escape belts, and ladder belts penetrate the outer shell, are incorporated as part of a garment closure system, or are temporarily or permanently attached to the garment, the harness or belt components shall meet the applicable requirements of NFPA 1983, and the optional requirements for flame resistant life safety harnesses or optional requirements for flame resistant belts.

6.1.13 Liners that consist of a thermal barrier sewn to a moisture barrier shall include an inspection opening that permits the examination of the lining interior, including all moisture barrier seams.

6.2 Additional Design Requirements for Structural Fire Fighting Protective Garment Elements Only.

6.2.1 Structural fire fighting protective garment elements shall also have at least the applicable design requirements specified in this section in addition to the design requirements specified in Section 6.1, Protective Garment Element Design Requirements for Both Ensembles, where inspected and evaluated by the certification organization as specified in Section 4.3, Inspection and Testing.

6.2.2* Garments shall have fluorescent and retroreflective trim permanently attached to the outer shells of garments to meet visibility requirements.

6.2.2.1 Trim shall be at least 50 mm (2 in.) wide and shall have both retroreflective and fluorescent surfaces.

6.2.2.2 The retroreflective surface of trim shall be at least 16 mm (5/8 in.) wide.

6.2.2.3 Trim used to meet the minimum trim pattern requirements shall have a minimum fluorescent surface of 50 mm²/linear mm (2 in.²/linear in.) of trim.

6.2.2.4 The fluorescent and retroreflective areas of trim specified in 6.2.2.2 and 6.2.2.3 shall appear to be continuous at a distance of 30.5 m (100 ft) for the length of the trim, with gaps of not more than 3 mm (1/8 in.).

6.2.2.5 Trim used in excess of that required by the minimum trim pattern requirements specified and illustrated in Figure 6.2.3 shall be permitted to not meet the minimum fluorescent surface of 50 mm²/linear mm (2 in.²/linear in.) of trim and shall be permitted to be obscured by components including but not limited to pockets, storm flaps, and reinforcing patches as long as the minimum trim pattern is not obscured.

6.2.3* Coat trim configuration shall be in accordance with Figure 6.2.3. No vertical stripes of trim shall be permitted on the front of the coat.

6.2.3.1 The coat minimum trim pattern shall have one circumferential band of trim or a staggered 360-degree visibility pattern meeting or exceeding the surface area of a continuous circumferential band around the bottom of the coat. The front of the coat shall also have at least one band of horizontal trim at the chest level located within 75 mm (3 in.) above or below the sleeve-to-body underarm garment seam.

6.2.3.2 The lower edge of the circumferential band on the lower part of the coat shall be within 25 mm (1 in.) of the coat hem's highest point.

Table 6.1.11 Available Coat/Trouser Size Ranges

Dimension	Men		Women		Increment	
	mm	in.	mm	in.	mm	in.
Chest	865–1525	34–60	710–1270	28–50	50	2
Sleeve	820–965	32–38	710–865	28–34	25	1
Waist	760–1525	30–60	710–1270	28–50	50	2
Inseam	660–915	26–36	610–865	24–34	50	2

Shaded text = Revisions.  = Text deletions and figure/table revisions. • = Section deletions.  = New material



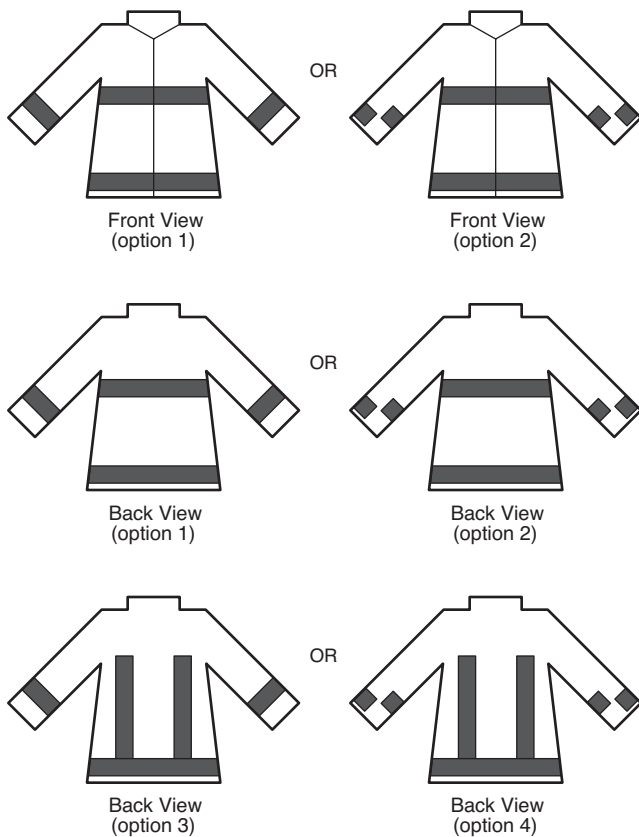


FIGURE 6.2.3 Minimum Required Structural Fire Fighting Coat Trim Patterns.

6.2.3.3 Where a staggered pattern is used in the lower circumferential trim band, the lower edge of the upper trim piece shall not be higher than the upper edge of the lower trim piece.

6.2.3.4 The back of the coat shall also have a minimum of either two vertical stripes of trim, perpendicular to the bottom band and with one strip located on both the left and right sides of the back of the coat, or a minimum of one horizontal band of trim at the chest/shoulder blade level located within 75 mm (3 in.) above or below the sleeve-to-body underarm garment seam.

6.2.3.5 The minimum trim configuration for each sleeve shall be one circumferential band, or a staggered 360-degree visibility pattern meeting or exceeding the surface area of a continuous circumferential band, between the wrist and elbow level.

6.2.3.5.1 Where trim on the coat intersects a zipper or where the trim intersects the innermost seam of each sleeve, a maximum gap in the trim of 25 mm (1 in.) shall be permitted.

6.2.4* Trousers trim configuration shall be in accordance with Figure 6.2.4.

6.2.4.1 The minimum trim pattern for the trousers shall consist of two circumferential bands of trim, with one band around each leg between the bottom hem and knee areas.

6.2.4.2 Where trim on the trouser element intersects a zipper or where the trim intersects the innermost seam of each trou-

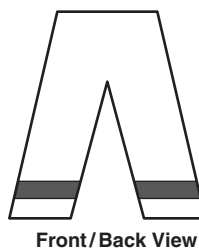


FIGURE 6.2.4 Minimum Required Structural Fire Fighting Trousers Trim Patterns.

ser leg, a maximum gap in the trim of 25 mm (1 in.) shall be permitted.

6.3 Additional Design Requirements for Proximity Fire Fighting Protective Garment Elements Only.

6.3.1 Proximity fire fighting protective garment elements shall also have at least the applicable design requirements specified in this section in addition to the design requirements specified in Section 6.1, Protective Garment Element Design Requirements for Both Ensembles, where inspected and evaluated by the certification organization as specified in Section 4.3, Inspection and Testing.

6.3.2 Garments shall not have materials that do not meet the radiant reflective requirements specified in 7.3.2 affixed to the outer shell radiant reflective surfaces of the garments unless such materials are covered in 6.3.3.

6.3.3 Reinforcing materials that do not meet the radiant reflective requirements specified in 7.3.2 shall be permitted to be affixed only to the garment outer shell radiant reflective surfaces as reinforcement of the sleeve cuffs and trouser leg cuffs where the following requirements are met:

- (1) The reinforcing materials shall meet the flame resistant requirements specified in 7.1.3.
- (2) The reinforcing materials shall meet the heat resistance requirements specified in 7.1.5.
- (3) Reinforcement areas shall not cover the radiant reflective surfaces of the garment by more than 25 mm (1 in.) when measured from the edge of the cuff back along the sleeve or leg.

6.3.4 The collar lining material shall not be reflective material.

6.4 Protective Helmet Element Design Requirements for Both Ensembles.

6.4.1 Protective helmet elements shall have at least the applicable design requirements specified in this section where inspected and evaluated by the certification organization as specified in Section 4.3, Inspection and Testing.

6.4.2 No openings shall penetrate the helmet shell other than those provided by the manufacturer for mounting energy absorbing systems, retention systems, and accessories.

6.4.3 The helmet retention system shall include a chin strap and a nape device. The chin strap shall have a minimum width of 19 mm (¾ in.).

6.4.4 All sewing thread used in the construction of helmets shall be made of inherently flame-resistant fiber.

6.4.5 The helmet faceshield or the faceshield/goggle component, when deployed, 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

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

6.4.5.2 The helmet with the faceshield or the faceshield/goggle component deployed shall be positioned in accordance with the HPI as described in 8.1.13 on a facial feature headform as defined in 3.3.43. Where the crown clearance of the helmet is adjustable, the helmet shall be mounted with the least amount of clearance.

6.4.6 The helmet faceshield or the faceshield/goggle component in the stowed position as described in 8.1.16 shall provide peripheral vision clearance of at least 94 degrees to each side.

6.4.6.1 The peripheral vision clearance shall be measured from the center of the eye, with the helmet positioned in accordance with the HPI as described in 8.1.13 on a facial feature headform as defined in 3.3.43. Where the crown clearance of the helmet is adjustable, the helmet shall be mounted with the least amount of clearance.

6.4.7 Where helmets are provided with an SCBA facepiece that is attached or integrated with the helmet, the helmet with the SCBA facepiece installed shall meet all applicable design and performance requirements of this standard.

N 6.4.8* For helmets with items installed or attached, the helmet with the items installed/attached shall meet the affected design and performance requirements of this standard.

6.5 Additional Design Requirements for Structural Fire Fighting Protective Helmet Elements Only.

6.5.1 Structural fire fighting protective helmet elements shall also have at least the applicable design requirements specified in this section in addition to the design requirements specified in Section 6.4, Protective Helmet Element Design Requirements for Both Ensembles, where inspected and evaluated by the certification organization as specified in Section 4.3, Inspection and Testing.

6.5.2* Helmets shall consist of at least all of the following assembled components:

- (1) Shell
- (2) Energy absorbing system
- (3) Retention system
- (4) Fluorescent and retroreflective trim
- (5) Ear covers
- (6) A faceshield or goggles, or both

Δ 6.5.2.1 Where a faceshield is selected in accordance with 6.5.2(6), the faceshield component shall be attached to the helmet.

Δ 6.5.2.2 Where the goggle component is selected in accordance with 6.5.2(6), the goggles shall be permitted to be unattached, not assembled, to the helmet.

N 6.5.2.3 Where the manufacturer provides or intends to provide both a faceshield and goggles with the helmet, whether the faceshield is or is not provided installed or attached to the

helmet, both the faceshield and the goggles shall be considered components of the helmet.

6.5.3 Helmets shall have fluorescent and retroreflective trim on the shell exterior.

6.5.3.1 A minimum of 2580 mm² (4 in.²) of the retroreflective and fluorescent trim shall be visible above the reference plane when the helmet, with the faceshield/goggle component in the stowed position as described in 8.1.16, is viewed at the following positions:

- (1) Left intersection of the coronal and reference planes at a distance of 2.4 m (8 ft)
- (2) Right intersection of the coronal and reference planes at a distance of 2.4 m (8 ft)
- (3) Rear intersection of the midsagittal and reference planes at a distance of 2.4 m (8 ft)

6.5.3.2 A minimum of 2580 mm² (4 in.²) of the retroreflective and fluorescent trim shall be visible when the helmet, with the faceshield/goggle component in the stowed position as described in 8.1.16, is viewed at the intersection of the midsagittal plane and the coronal plane at a distance of 2.4 m (8 ft).

6.5.3.3 The entire surface of the trim shall be permitted to be both fluorescent and retroreflective.

6.5.4 Helmet ear covers or the portion of the helmet providing the coverage of the ears, when deployed, shall provide at least the following coverage:

- (1) 95 mm (3¾ in.) measured 50 mm (2 in.) forward of the coronal plane
- (2) 120 mm (4¾ in.) measured 25 mm (1 in.) forward of the coronal plane
- (3) 130 mm (5⅛ in.) measured at the coronal plane
- (4) 130 mm (5⅛ in.) measured at the midsagittal plane at the rear of the headform

6.5.4.1 The helmet, with the ear covers or the portion of the helmet providing the ear coverage deployed, shall be positioned according to the HPI as described in 8.1.13 on an ISO size J headform as specified in Figure 8.16.4.1. Where the crown clearance of the helmet is adjustable, the helmet shall be mounted with the most amount of clearance.

6.5.4.2 In this position, the ear coverage shall be measured downward from the reference plane to the lower edge of the ear coverage at the specified points to determine the coverage specified in 6.5.4.

6.5.4.3 Where the helmet incorporates a ratchet-style headband, an opening in the covering surrounding the ratchet knob shall be permitted. The opening shall not extend more than 13 mm (½ in.) in any direction around the perimeter of the adjustment device.

6.5.5 Faceshield/goggle components shall meet the respective requirements for goggles or faceshields and be marked "Z87+" in accordance with ANSI/ISEA Z87.1, *Occupational and Educational Personal Eye and Face Protection Devices*.

6.6 Additional Design Requirements for Proximity Fire Fighting Helmet Elements Only.

6.6.1 Proximity fire fighting protective helmet elements shall also have at least the applicable design requirements specified in this section in addition to the design requirements specified in Section 6.4, Protective Helmet Element Design Require-

ments for Both Ensembles, where inspected and evaluated by the certification organization as specified in Section 4.3, Inspection and Testing.

6.6.2 Helmet elements shall consist of at least the following assembled components:

- (1) Shell
- (2) Energy absorbing system
- (3) Retention system
- (4) Faceshield
- (5) Shroud
- (6) Cover (where separate from the shroud)

6.6.3 Helmet faceshields shall be attached to the helmet.

6.6.4 Helmets shall be permitted to have an outer cover to provide the radiant reflective protection for the exterior of the helmet shell, including the upper surface of the brim, and the brim edge.

6.6.4.1 The helmet outer cover shall be permitted to be removable.

6.6.4.2 The helmet, and helmet outer cover where provided, shall be permitted to have fluorescent and retroreflective trim on the helmet exterior and on the helmet outer cover.

6.6.4.3 Identification markings or material including, but not limited to, trim, lettering, patches, name or number stencils, emblems, and paint shall be permitted *only* on the helmet outer cover, provided such materials are located above the corresponding helmet test line.

6.6.5 The shroud shall be attached to the helmet and shall be designed to cover and provide continuous radiant reflective protection for the head, face, and neck areas that do not receive primary protection from the helmet or faceshield.

6.6.5.1 Shrouds shall provide at least the following coverage:

- (1) 230 mm (9 $\frac{1}{8}$ in.) on each side measured downward from the reference plane at the coronal plane
- (2) 330 mm (13 in.) in the back measured downward from the reference plane at the rear midsagittal plane
- (3) 295 mm (11 $\frac{3}{8}$ in.) in the front measured downward from the reference plane at the front midsagittal plane, including the gap of material where the face opening is located

N 6.6.5.1.1 The helmet, with the shroud deployed, shall be positioned according to the HPA as described in 8.1.13 on an ISO size J headform as specified in Figure 8.16.4.1. Where the crown clearance of the helmet is adjustable, the helmet shall be mounted with the most amount of clearance.

N 6.6.5.1.2 With the helmet positioned as required by 6.6.5.1.1, the shroud coverage shall be measured downward from the reference plane to the lower edge of the shroud coverage at the specified points to determine the coverage specified in 6.6.5.1.

6.6.5.2 The shroud shall be permitted to be a part of a helmet outer cover, where provided.

6.6.5.3 The shroud shall be designed to interface with a specific helmet.

6.6.5.4 The helmet shroud, when deployed, shall provide at least the following field of vision:

- (1) Dihedral angle of at least 85 degrees
- (2) Upper dihedral angle of at least 7 degrees

(3) Lower dihedral angle of at least 40 degrees

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

6.6.5.4.2 The helmet with the shroud attached shall be positioned according to the HPI as described in 8.1.13 on a facial feature headform as defined in 3.3.43. Where the crown clearance of the helmet is adjustable, the helmet shall be mounted with the least amount of clearance.

6.6.6 No openings shall be permitted in the helmet shroud other than to meet the requirements of 6.6.5.

6.6.7 When the hood interface component is integrated with the protective garment, the shroud shall be permitted to consist of only the outer reflective layer and those other layers necessary to meet the requirements in 7.13.2 for thermal protective performance (TPP).

6.7 Protective Glove Elements Design Requirements for Both Ensembles.

6.7.1 Protective glove elements shall have at least the applicable design requirements specified in this section when inspected and evaluated by the certification organization as specified in Section 4.3, Inspection and Testing.

6.7.2 Gloves shall consist of a composite meeting the performance requirements of Section 7.7, Protective Glove Element Performance Requirements for Both Ensembles.

6.7.2.1 The composite shall be permitted to be configured as a continuous or joined single layer or as continuous or joined multiple layers.

6.7.2.2 Supplemental gloves that are provided to meet the performance requirements of this standard but are not intended to be worn continuously with the wearing of the gloves shall not be permitted.

6.7.2.3 Where a glove is made up of multiple layers, all layers of the glove shall be individually graded per size.

6.7.2.4 Where the coat sleeve end terminates in a garment-glove interface and the interface demonstrates liquid integrity and continuous thermal protection in accordance with Section 7.16, Protective Wristlet Interface Component Performance Requirements for Both Ensembles, gloves shall not be required to meet the requirements in 6.7.3 through 6.7.3.4.

6.7.3 The glove shall consist of a glove body.

6.7.3.1 The glove shall extend from the tip of the fingers to at least 50 mm (2 in.) beyond the wrist crease.

6.7.3.2 The portion of the glove that extends from the tip of the fingers to 50 mm (2 in.) beyond the wrist crease shall be considered to be the glove body and shall meet the glove body requirements in Sections 7.7, Protective Glove Elements Performance Requirements for Both Ensembles; 7.8, Additional Performance Requirements for Structural Fire Fighting Protective Glove Elements Only; and 7.9, Additional Performance Requirements for Proximity Fire Fighting Protective Glove Elements Only, as applicable.

6.7.3.3 The portion of the glove that extends greater than 50 mm (2 in.) beyond the wrist crease but less than or equal to 125 mm (5 in.) beyond the wrist crease, where present, shall be considered to be the glove interface component and shall meet

the glove interface component requirements in Sections 7.7, 7.8, and 7.9, as applicable.

6.7.3.4 The portion of the glove that extends greater than 125 mm (5 in.) beyond the wrist crease up to the end of the entire glove, where present, shall be considered to be the glove extension and shall meet the glove extension requirements in Sections 7.7, 7.8, and 7.9, as applicable.

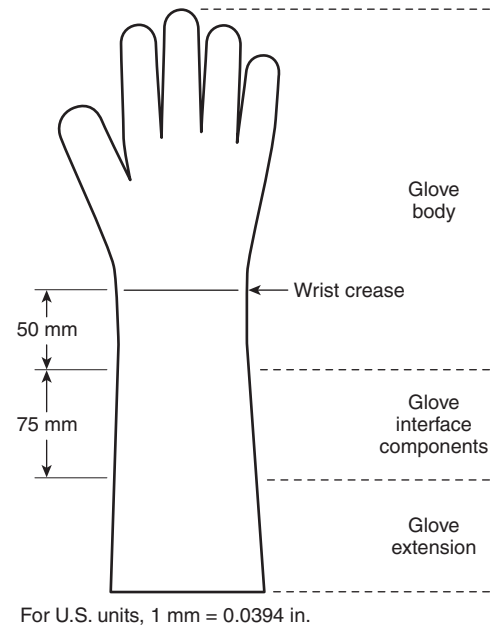
6.7.3.5* The location of the wrist crease shall be determined by the following procedures, as shown in Figure 6.7.3.5:

- (1) The location of the wrist crease shall be determined by first placing the glove on a measurement board palm down and securing (locking) the fingertips down onto the board.
- (2) A 1 lb weight shall be attached to the end of the glove body, glove interface component, or glove extension. The weight shall not be attached to a knitted wristlet glove interface component. The weight shall be applied evenly across the glove.
- (3) The weight shall be allowed to hang freely for 60 seconds prior to taking any measurements.
- (4)* The bottom of digit three shall be found by drawing a line on the back side of the glove from the finger crotches on either side of digit three. A point shall then be placed at the center of that line. Depending on the index finger length for the glove size, the distance to the wrist crease shall be determined by laying a ruler parallel with the length of the glove from the point representing the bottom of digit three to a second point using one of the following dimensions that corresponds to the index finger length. The second point shall be marked on the back of the glove.
 - (a) 64 [N (normal), W (wide), and XW (extra-wide)]: 8.36 cm (3.29 in.)
 - (b) 70 (N, W, and XW): 9.46 cm (3.72 in.)
 - (c) 76 (N, W, and XW): 10.68 cm (4.20 in.)
 - (d) 82 (N, W, and XW): 11.73 cm (4.62 in.)
- (5) A straight line shall be drawn across the back of the glove perpendicular to the two points. This line shall be extended around the side edges of the glove.
- (6) 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.
- (7) The resulting straight line around the circumference of the glove shall be the location of the wrist crease.

6.7.4 All sewing thread utilized in the construction of gloves shall be made of an inherently flame-resistant fiber.

Δ 6.7.5* For selection of the proper glove size, the dimensions for index finger length and hand breadth shall be measured as follows:

- (1) Using a straight ruler, the index finger length shall be measured to the nearest 1 mm ($\frac{1}{16}$ in.) from the tip of the index finger to the base of the finger located by the crease as shown in Figure 6.7.5(a).
- (2) Using a set of calipers or similar measuring device, the hand breadth shall be measured to the nearest 1 mm ($\frac{1}{16}$ in.) across the back of the hand knuckles from metacarpale II landmark (thumb side of index finger or digit 2) to the metacarpale V landmark (outside of little finger, or digit 5), as shown in Figure 6.7.5(b).



Δ FIGURE 6.7.3.5 Location of Wrist Crease.

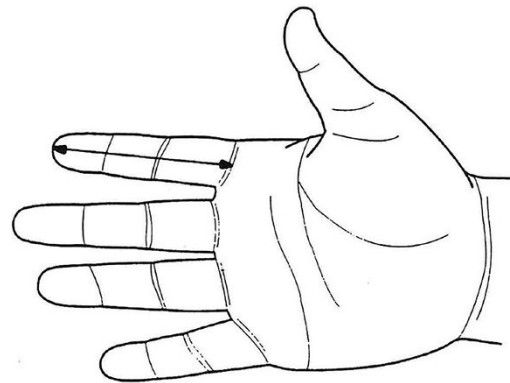


FIGURE 6.7.5(a) Measurement Location for Index Finger Length.

6.7.6* In order to label or otherwise represent a glove as compliant with the requirements of this standard, the manufacturer shall provide gloves in the following sizes:

- (1) 64N (normal)
- (2) 70N (normal)
- (3) 70W (wide)
- (4) 76N (normal)
- (5) 76W (wide)
- (6) 82N (normal)
- (7) 82W (wide)

Δ 6.7.6.1 The glove sizes from 64N through 82W indicated on the label shall be determined by the hand dimensions given in Figure 6.7.6.1.

Δ 6.7.7* The glove size indicated on the label shall be determined by the hand dimensions given in Figure 6.7.6.1.

Δ 6.7.7.1 Where custom sized or specially fitted gloves are provided, the glove size indicated on the label shall be determined

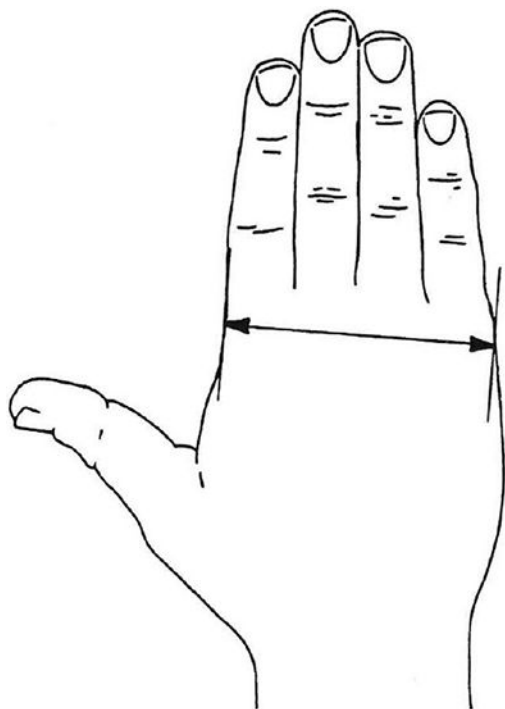
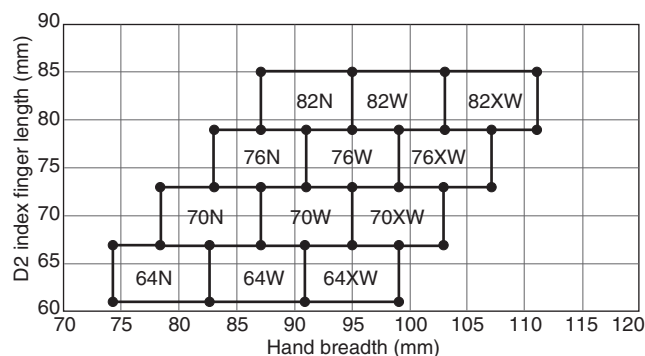


FIGURE 6.7.5(b) Measurement Location for Hand Breadth.



For U.S. units, 1 mm = 0.394 in.

N FIGURE 6.7.6.1 NFPA 1971 Size Definitions.

by the closest hand dimensions given in Figure 6.7.6.1, followed by the word "Custom."

6.8 Additional Design Requirements for Structural Fire Fighting Protective Glove Elements Only. (Reserved)

6.9 Additional Design Requirements for Proximity Fire Fighting Protective Glove Elements Only.

6.9.1 Proximity fire fighting protective glove elements shall also have at least the applicable design requirements specified in this section in addition to the design requirements specified in Section 6.7, Protective Glove Element Design Requirements for Both Ensembles, where inspected and evaluated by the certification organization as specified in Section 4.3.

6.9.2 Gloves shall not be permitted to have any hardware.

6.9.3 The outer shell of the back and portions of the sides of the glove body including the back of the digits shall be a radiant reflective material.

6.9.3.1 Glove fingers, thumb, and the back shall have radiant reflective protection of 210 degrees, $+20^\circ/-0^\circ$. The radiant reflective material shall provide coverage from 0 degrees to 105 degrees, $+10^\circ/-0^\circ$, and then from 255 degrees, $+10^\circ/-0^\circ$, to 360 degrees as specified in Figure 6.9.3.1.

6.9.3.2 The radiant reflective material shall provide coverage for the finger/thumb tip of at least 195 degrees, $+10^\circ/-0^\circ$, as specified in Figure 6.9.3.1.

6.9.3.3 The portion of the finger, thumb, and palm surfaces that are not covered by the radiant reflective protection shall be the gripping surface of the glove.

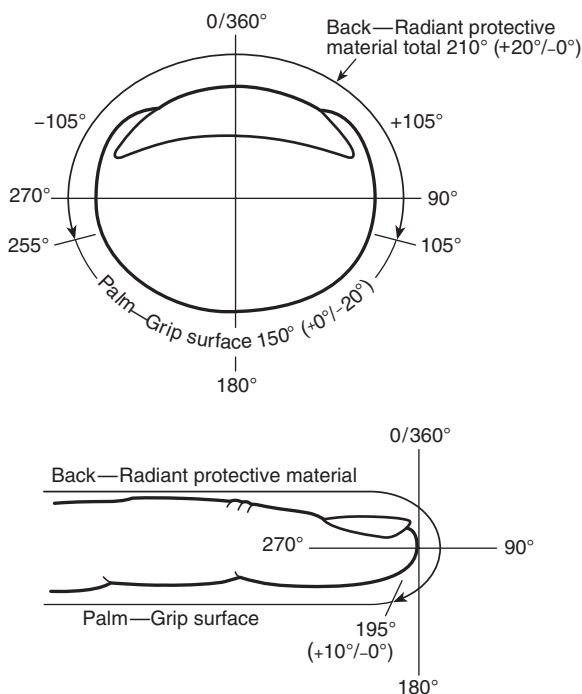
6.9.4 The outer shell of the glove interface component and glove extension, where provided, shall be a radiant reflective material, with the exception of a knitted wristlet as the interface component.

6.10 Protective Footwear Elements Design Requirements for Both Ensembles.

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

6.10.2 Footwear shall consist of at least the following assembled components: a sole with a heel, an upper with lining, a puncture resistant device, an insole, a ladder shank or whole sole equivalent, and an impact- and compression-resistant toe cap.

6.10.2.1 Where booties are incorporated as a component of the pant and are specified by the manufacturer as removable



Δ FIGURE 6.9.3.1 Glove Radiant Reflective Protection Areas.

for laundering or replacement only, the booties component shall meet the performance requirements of 7.1.12, 7.1.13, 7.1.14, 7.1.15, 7.1.16, and 7.1.17.

6.10.2.2 Where booties are incorporated as a component of the footwear, the combination of the bootie component incorporated in the footwear shall meet the performance requirements of 7.10 with the exception of 7.10.4 and 7.10.5.

6.10.2.3 Where booties are used, the outer footwear shall not be required to have a liner in the upper.

6.10.2.4 Supplemental footwear that is provided to meet the performance requirements of this standard but is not intended to be worn continuously with the wearing of the footwear element shall not be permitted.

6.10.3 Footwear height shall be a minimum of 250 mm (9.84 in.).

6.10.3.1 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 top line, excluding the tongue and gusset.

6.10.3.2 Removable insoles shall not be removed prior to measurement.

6.10.3.3 Thermal, physical, and moisture protection shall be continuous circumferentially to within 50 mm (2 in.) of the footwear top line at all locations, with the exception of the area inside of and within 13 mm (½ in.) around pull-up holes that fully penetrate the footwear from outside to inside. The height of thermal, physical, and moisture protection at all locations of the boot shall be no less than 250 mm (9.84 in.) when measured as described in 6.10.3.1.

6.10.4 The footwear heel breast shall not be less than 13 mm (½ in.) nor more than 25 mm (1 in.).

6.10.4.1 The heel breasting angle shall not be less than 90 degrees nor more than 135 degrees.

6.10.4.2 The heel edges shall not extend more than 13 mm (½ in.) laterally from the upper at any point.

6.10.4.3 The width of the footwear heel shall be equal to or greater than the width of the sole at the intersection of the heel breast and the sole bottom, excluding any calendar roll where present.

6.10.5 The puncture-resistant device shall cover the maximum area of the insole as specified in Section 3.3 of CSA Z195, *Protective Footwear*.

6.10.6 All hardware and external fittings shall be free of rough spots, burrs, or sharp edges that could tear primary materials.

6.10.6.1 Metal parts shall not penetrate from the outside into the lining or insole at any point.

6.10.6.2 No metal parts, including but not limited to nails or screws, shall be present or utilized in the construction or attachment of the sole with heel to the puncture-resistant device, insole, or upper.

6.10.7 All sewing thread utilized in the construction of footwear shall be made of an inherently flame-resistant fiber.

6.10.8 In order to label or otherwise represent footwear as compliant with the requirements of this standard, the manufacturer shall have footwear available in all of the following sizes:

- (1) Men's 5–16, including half sizes and a minimum of three widths
- (2) Women's 5–10, including half sizes and a minimum of three widths

6.10.8.1 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 Brannock Scientific Foot Measuring Device.

6.10.8.2 Full and half sizes in each of the three required widths shall be accomplished by individual and unique men's and women's lasts to provide proper fit. Dual sizing of the same pair of boots to cover men's and women's boot styles shall not be acceptable.

6.10.9 Footwear shall meet the performance requirements as specified in ASTM F2413, *Performance Requirements for Protective (Safety) Toe Cap Footwear*, for impact, compression, and puncture-resistance, with the exception that flex resistance to cracking shall be evaluated at 1,000,000 cycles.

6.11 Additional Design Requirements for Structural Fire Fighting Protective Footwear Only. (Reserved)

6.12 Additional Design Requirements for Proximity Fire Fighting Protective Footwear Only. (Reserved)

6.13 Protective Hood Interface Component Design Requirements for Both Ensembles.

6.13.1 Hood interface components shall have at least the applicable design requirements specified in this section where inspected and evaluated by the certification organization as specified in Section 4.3, Inspection and Testing.

6.13.2 Hoods shall be permitted to be integrated with the protective coat.

6.13.3 The hood shall be designed to cover and provide the limited protection, as specified within this section, to the head, face, and neck areas but not including the face opening specified in 6.13.6.

6.13.3.1 Where the hood is integrated with the protective coat, the hood shall not be required to meet the design requirement specified in 6.13.5.

6.13.4 All sewing thread utilized in the construction of hoods shall be made of an inherently flame-resistant fiber.

6.13.5 The hood shall be donned properly, in accordance with the manufacturer's instructions for wearing, on the ISO size J headform specified in Figure 8.16.4.1.

6.13.5.1 In this position, the hood shall provide a full coverage above the reference plane on each side measured downward from the reference plane at the coronal plane of 225 mm (9 in.), shall provide a minimum coverage in the back measured downward from the reference plane at the rear midsagittal plane of 330 mm (13 in.), and shall provide a minimum coverage in the front measured downward from the reference plane at the front midsagittal plane, including the face opening, of 305 mm (12 in.).

6.13.6 Hoods shall be designed with a face opening.

6.13.6.1 Other than where the hood face opening is designed to interface with a specific SCBA facepiece, or where the hood face opening is designed to be adjustable, the hood face opening shall be able to be stretched to a circumference of at least 800 mm (31 in.).

6.13.6.2 Where the hood face opening is designed to interface with a specific SCBA facepiece, the hood face opening shall overlap the outer edge of the specific SCBA facepiece-to-face seal perimeter by not less than 13 mm (½ in.). It shall be permitted to use the test equipment and approach specified in 8.47.4.2 and 8.47.4.5.

6.13.6.3* The interface and integration of the selected respirator with the protective ensemble shall not invalidate the NIOSH certification of the respective respirator.

6.14 Optional Protective Barrier Hood Interface Component Design Requirements.

N 6.14.1 Barrier hoods shall meet all design criteria specified in Section 6.13.

N 6.14.2 The portions of the particulate blocking hood interface component that include a particulate blocking material specifically for meeting the requirements of 7.14.1 shall include all areas of the hood to at least 37 mm (1.5 in.) above the reference plane when measured at the coronal plane and all areas of the hood to at least 200 mm (8 in.) at the sides when measured at the coronal plane and 225 mm (9 in.) at the front and rear when measured at the midsagittal plane below the reference plane as measured when the hood is placed on an ISO Size J headform.

N 6.14.3 Binding including the elastic and stitching around the particulate blocking hood face opening shall be permitted to exclude particulate blocking material specifically for meeting the requirements of 7.14.1 for a distance of 50 mm (2 in.) from the leading edge of the hood face opening. The distance shall be measured in eight separate locations with the hood lying on a flat surface with the face opening facing upwards and measured from the innermost row of stitching to the face opening leading edge.

6.15 Additional Design Requirements for Proximity Fire Fighting Protective Hood Interface Components Only. (Reserved)

6.16 Protective Wristlets Interface Component Design Requirements for Both Ensembles.

6.16.1 Wristlet interface components shall have at least the applicable design requirements specified in this section where inspected and evaluated by the certification organization as specified in Section 4.3, Inspection and Testing.

6.16.2* Wristlets shall be designed to cover and provide limited protection to the wrist areas.

6.16.3 Wristlets shall be permanently attached to the protective coat sleeve in a manner that will not permit a gap in the thermal protection.

6.16.4 All sewing thread utilized in the construction of wristlets shall be made of an inherently flame-resistant fiber.

6.17 Additional Design Requirements for Structural Fire Fighting Protective Wristlet Interface Components Only. (Reserved)

6.18 Additional Design Requirements for Proximity Fire Fighting Protective Wristlet Interface Components Only. (Reserved)

6.19 Optional Design Requirements for Protection from Liquid and Particulate Contaminants.

6.19.1 Liquid and Particulate Contaminants Protective Ensemble Design Requirements for Both Ensembles.

6.19.1.1 Liquid and particulate contaminant protective ensembles shall have at least the applicable design requirements specified in this section where inspected and evaluated by the certification organization as specified in Section 4.3, Inspection and Testing.

6.19.1.2 Liquid and particulate contaminant protective ensembles, including SCBA, shall be designed to protect the wearer's upper and lower torso, head, arms, legs, hands, and feet.

6.19.1.3 Liquid and particulate contaminant protective ensemble elements shall include garments, helmet, gloves, footwear, interface components, and hood when the hood is not already part of the protective garment.

Δ 6.19.1.4 The manufacturer shall specify each SCBA that is part of the liquid and particulate contaminant protective ensemble. All SCBA specified by the ensemble manufacturer for inclusion in the ensemble shall be certified to NFPA 1981.

6.19.1.5 Liquid and particulate contaminant ensembles shall be designed to accommodate the SCBA specified by the manufacturer for the specific ensemble.

6.19.2 Additional Liquid and Particulate Contaminant Protection Design Requirements for Structural Fire Fighting Protective Ensembles Only. (Reserved)

6.19.3 Additional Liquid and Particulate Contaminant Protection Design Requirements for Proximity Fire Fighting Protective Ensembles Only. (Reserved)

6.19.4 Liquid and Particulate Contaminant Protective Garment Element Design Requirements for Both Ensembles.

6.19.4.1 Liquid and particulate contaminant protective garments shall have at least the applicable design requirements specified in this subsection where inspected and evaluated by the certification organization as specified in Section 4.3, Inspection and Testing.

6.19.4.2 Liquid and particulate contaminant protective garments shall be designed and configured to protect at least the wearer's upper and lower torso, arms and legs, but excluding the hands, feet, and head.

6.19.4.2.1 Liquid and particulate contaminant protective garments shall be permitted to include integrated hoods to protect the wearer's head in conjunction with the SCBA specified by the ensemble manufacturer.

6.19.4.3 All hardware and external fittings shall be free of rough spots, burrs, or sharp edges that could tear primary materials.

6.19.5 Additional Liquid and Particulate Contaminant Protection Design Requirements for Structural Fire Fighting Protective Garment Elements Only. (Reserved)

6.19.6 Additional Liquid and Particulate Contaminant Protection Design Requirements for Proximity Fire Fighting Protective Garment Elements Only. (Reserved)

6.19.7 Liquid and Particulate Contaminant Protective Helmet Elements Design Requirements for Both Ensembles.

6.19.7.1 Helmets shall have at least the applicable design requirements specified in this subsection where inspected by the certification organization as specified in Section 4.3, Inspection and Testing.

Δ 6.19.7.2 Where the liquid and particulate protection is provided by the protective hood and provides an interface with the SCBA specified by the ensemble manufacturer, the manufacturer shall not be required to specify a specific helmet as part of the liquid and particulate contaminant protective ensemble.

6.19.8 Additional Liquid and Particulate Contaminant Protection Design Requirements for Structural Fire Fighting Protective Helmet Elements Only. (Reserved)

6.19.9 Additional Liquid and Particulate Contaminant Protection Design Requirements for Proximity Fire Fighting Protective Helmet Elements Only. (Reserved)

6.19.10 Liquid and Particulate Contaminant Protective Glove Elements Design Requirements for Both Ensembles.

6.19.11 Additional Liquid and Particulate Contaminant Protection Design Requirements for Structural Fire Fighting Protective Glove Elements Only. (Reserved)

6.19.12 Additional Liquid and Particulate Contaminant Protection Design Requirements for Proximity Fire Fighting Protective Glove Elements Only. (Reserved)

6.19.13 Liquid and Particulate Contaminant Protective Footwear Elements Design Requirements for Both Ensembles.

6.19.14 Additional Liquid and Particulate Contaminant Protection Design Requirements for Structural Fire Fighting Protective Footwear Elements Only. (Reserved)

6.19.15 Additional Liquid and Particulate Contaminant Protection Design Requirements for Proximity Fire Fighting Protective Footwear Elements Only. (Reserved)

6.19.16 Liquid and Particulate Contaminant Protective Hood Interface Component Design Requirements for Both Ensembles.

6.19.16.1 Liquid and particulate contaminant protective hood interface components shall have at least the applicable design requirements specified in this subsection where inspected by the certification organization as specified in Section 4.3, Inspection and Testing.

6.19.16.2 Liquid and particulate contaminant protective hood interface components shall be designed and configured to protect the wearer's head, neck, and face areas, excluding the portion of the face covered by the facepiece of the SCBA specified by the ensemble manufacturer.

6.19.16.3 Liquid and particulate contaminant protective hood interface components shall be permitted to be integrated with the protective garment.

6.19.17 Liquid and Particulate Contaminant Protective Hood Interface Component Design Requirements for Structural Fire Fighting Ensembles. (Reserved)

6.19.18 Liquid and Particulate Contaminant Protective Shroud Interface Component Design Requirements for Proximity Fire Fighting Ensembles. (Reserved)

Chapter 7 Performance Requirements

7.1 Protective Garment Elements Performance Requirements for Both Ensembles.

7.1.1* Protective garment elements composite consisting of outer shell, moisture barrier, and thermal barrier shall be tested for thermal insulation as specified in Section 8.10, Thermal Protective Performance (TPP) Test, and shall have an average TPP of not less than 35.0.

7.1.2 Garments shall be tested for overall liquid penetration resistance as specified in Section 8.48, Whole Garment and Ensemble Liquid Penetration Test, and shall allow no liquid penetration except as permitted in 8.48.8.2.

Δ 7.1.3 Garment outer shells, moisture barriers, thermal barriers, collar linings, winter liners where provided, drag rescue devices (DRDs), trim, lettering, and other materials used in garment construction including, but not limited to, padding, reinforcement, interfacing, binding, hanger loops, emblems, and patches shall be individually tested for resistance to flame as specified in Section 8.2, Flame Resistance Test 1, and shall not have a char length of more than 100 mm (4 in.) average, shall not have an afterflame of more than 2.0 seconds average, and shall not melt.

7.1.3.1 Labels shall meet the performance requirements specified in 7.1.3 only where placed on the exterior of the garment.

7.1.3.2 Zippers and seam-sealing materials shall meet the performance requirements specified in 7.1.3 only where located on the exterior of the garment or located where they will directly contact the wearer's body.

7.1.3.3 Elastic and hook and pile fasteners shall meet the performance requirements specified in 7.1.3 only where located where they will directly contact the wearer's body.

Δ 7.1.3.4 Small specimens such as hanger loops and emblems or patches that are not large enough to meet the specimen size requirements in 8.2.2.1 shall be tested for resistance to flame as specified in Section 8.2, Flame Resistance Test 1, and shall not be totally consumed, shall not have an afterflame of more than 2.0 seconds average, and shall not melt.

7.1.3.5 Life safety harnesses, escape belts, and ladder belts shall meet the performance requirements specified in 7.1.3 only when they penetrate the outer shell, are incorporated as part of a garment closure system, or are attached to the garment.

7.1.4 Garment outer shells, moisture barriers, thermal barriers, winter liners where provided, and collar linings shall be individually tested for resistance to heat as specified in Section 8.6, Heat and Thermal Shrinkage Resistance Test, and shall not shrink more than 10.0 percent in any direction.

7.1.5 Garment outer shells, moisture barriers, thermal barriers, collar linings, winter liners where provided, DRDs, trim,

lettering, and other materials used in garment construction, including, but not limited to, padding, reinforcement, labels, interfacing, binding, hanger loops, emblems, or patches, but excluding elastic and hook and pile fasteners where these items are placed so that they will not directly contact the wearer's body, shall be individually tested for resistance to heat as specified in Section 8.6, Heat and Thermal Shrinkage Resistance Test, and shall not melt, separate, or ignite.

7.1.6 Garment moisture barrier seams shall be individually tested for resistance to heat as specified in Section 8.6, Heat and Thermal Shrinkage Resistance Test, and shall not drip or ignite.

7.1.7 Garment outer shells and collar linings shall be individually tested for resistance to heat as specified in Section 8.6, Heat and Thermal Shrinkage Resistance Test, and shall not char.

7.1.8 All garment hardware, excluding hook and pile fasteners, where placed so that they will not directly contact the wearer's body, shall be individually tested for resistance to heat as specified in Section 8.6, Heat and Thermal Shrinkage Resistance Test, and shall not ignite and shall remain functional.

7.1.9 The garment composite from the shoulder areas and the knee areas shall be tested for resistance to heat transfer as specified in Section 8.51, Conductive and Compressive Heat Resistance (CCHR) Test, and shall demonstrate passing performance.

7.1.10 All sewing thread utilized in the construction of garments and DRDs shall be tested for resistance to melting as specified in Section 8.11, Thread Melting Test, and shall not melt at or below 260°C (500°F).

7.1.11 Garment outer shells and collar linings shall be individually tested for resistance to tearing as specified in Section 8.12, Tear Resistance Test, and shall have a tear strength of not less than 100 N (22 lbf).

7.1.12 Garment moisture barriers, thermal barriers, and winter liners, where provided, shall be tested for resistance to tearing as specified in Section 8.12, Tear Resistance Test, and shall have a tear strength of not less than 22 N (5 lbf).

7.1.13 All garment seam assemblies shall be tested for strength as specified in Section 8.14, Seam-Breaking Strength Test.

7.1.13.1 Woven garment seam assemblies and specimens of seam assemblies that contain at least one woven material shall demonstrate a sewn seam strength equal to or greater than 667 N (150 lbf) force for Major A seams, 334 N (75 lbf) force for Major B seams, and 180 N (40 lbf) force for Minor seams when tested using the method specified in 8.14.3.2.1.

7.1.13.2 Seam breaking strength shall be considered acceptable where the fabric strength is less than the required seam strength specified in 7.1.13.1, providing the fabric fails without failure of the seam below the applicable forces specified in 7.1.13.1.

7.1.13.3 All knit or stretch woven garment seam assemblies shall demonstrate a sewn seam strength equal to or greater than 180 N (40 lbf) when tested using the method specified in 8.14.3.2.2.

7.1.13.4 All combination woven and knit or stretch knit seam specimens shall meet the requirements specified in 7.1.13.1.

7.1.14 Garment moisture barriers shall be tested for resistance to water penetration as specified in Section 8.26, Water Penetration Resistance Test, and shall have a minimum water penetration resistance of 172 kPa (25 psi).

7.1.15* Garment moisture barrier materials and seams shall be tested for resistance to liquid penetration as specified in Section 8.27, Liquid Penetration Resistance Test, and shall show no penetration of the test liquids for at least 1 hour.

7.1.16 Garment moisture barriers and moisture barrier seams shall be tested for resistance to liquid or bloodborne pathogens as specified in Section 8.28, Viral Penetration Resistance Test, and shall allow no penetration of the Phi-X-174 bacteriophage for at least 1 hour.

7.1.17 Garment moisture barriers, thermal barriers, winter liners where provided, and collar linings shall be individually tested for resistance to shrinkage as specified in Section 8.24, Cleaning Shrinkage Resistance Test, and shall not shrink more than 5 percent in any direction.

7.1.18 Garment outer shells and collar linings shall be individually tested for resistance to water absorption as specified in Section 8.25, Water Absorption Resistance Test, and shall not have more than 15 percent water absorption.

7.1.19 All garment metal hardware and specimens of all garment hardware that include metal parts shall be individually tested for resistance to corrosion as specified in Section 8.29, 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.

7.1.20 Labels shall be tested for durability and legibility as specified in Section 8.41, Label Durability and Legibility Test 1, shall remain in place, and shall be legible.

7.1.21 DRD materials, seams, splices, and joints shall be tested for material strength as specified in Section 8.58, Drag Rescue Device (DRD) Materials Strength Test, and shall have a minimum tensile strength of 7 kN (1573 lbf).

7.1.22 Garments with the DRD installed shall be tested for functionality as specified in Section 8.59, Drag Rescue Device (DRD) Function Test, and shall allow for the mannequin to be dragged for a minimum of 2.5 m (98 in.), the DRD shall be deployed within 10 seconds, the SCBA shall not move higher on the torso from the donned position, and the SCBA shall not separate from the mannequin.

7.1.23 Garment moisture barrier materials shall be tested for resistance to light degradation as specified in Section 8.62, Light Degradation Resistance Test, and water shall not appear on the surface of the specimen.

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

7.1.25 Fastener tape shall be tested for breaking strength as specified in Section 8.69, Fastener Tape Strength Test, and shall meet or exceed the minimum breaking strength require-

ments as established in Table 1 of A-A 55126B, *Commercial Item Description, Fastener Tapes, Hook and Loop, Synthetic*.

7.1.26 Fastener tape shall be tested for shear strength as specified in Section 8.69, Fastener Tape Strength Test, 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*.

7.1.27 Fastener tape shall be tested for peel strength as specified in Section 8.69, Fastener Tape Strength Test, 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*.

7.2 Additional Performance Requirements for Structural Fire Fighting Protective Garment Elements Only.

7.2.1 Structural fire fighting protective garment elements shall also meet the performance requirements specified in this section in addition to the performance requirements specified in Section 7.1, Protective Garment Elements Performance Requirements for Both Ensembles.

7.2.2* Garment composite consisting of the outer shell, moisture barrier, and thermal barrier shall be tested for evaporative heat transfer as specified in Section 8.33, Total Heat Loss (THL) Test, and shall have a THL of not less than 205 W/m².

7.2.3 Garment trim shall be tested for retroreflectivity and fluorescence as specified in Section 8.45, Retroreflectivity and Fluorescence Test, and shall have a coefficient of retroreflection (R_r) of not less than 100 cd/lux/m² (100 cd/ft²), and shall have the color be fluorescent yellow-green, fluorescent orange-red, or fluorescent red.

7.2.4 Garment outer shells shall be individually tested for resistance to shrinkage as specified in Section 8.24, Cleaning Shrinkage Resistance Test, and shall not shrink more than 5 percent in any direction.

7.2.5 Garment outer shells and collar linings shall be individually tested for strength after washing as specified in Section 8.50, Breaking Strength Test, and shall have a breaking strength of not less than 623 N (140 lbf).

7.2.6 Garment element sleeves that include enhancements exterior to the outer shell shall be considered enhanced composites. Enhancements shall include items such as visibility markings and other materials used in construction, including, but not limited to, padding, reinforcements, emblems, patches, and logos, but excluding reinforcement materials that do not extend more than 25 mm (1 in.) when measured from the edge of the cuff along the sleeve. The enhanced composite shall be tested for transmitted and stored thermal energy as specified in Section 8.67, Transmitted and Stored Thermal Energy Test, and shall have an average predicted time to second-degree burn of 130 seconds or greater.

7.3 Additional Performance Requirements for Proximity Fire Fighting Protective Garment Elements Only.

7.3.1 Proximity fire fighting protective garment elements shall also meet the performance requirements specified in this section, in addition to the performance requirements specified in Section 7.1, Protective Garment Elements Design Requirements for Both Ensembles.

7.3.2 Garment outer shells shall be tested for radiant reflective capability as specified in Section 8.52, Radiant Protective Performance Test, and shall have an intersect time of not less than 20 seconds.

7.3.3 Garment outer shells shall be tested for resistance to delamination as specified in Section 8.54, Wet Flex Test, and shall show no signs of cracking on the face or delamination.

7.3.4 Garment outer shells shall be tested for adhesion durability as specified in Section 8.55, Adhesion After Wet Flex-Tape Method, and shall show no evidence of separation or removal of the surface coating.

7.3.5 Garment outer shells shall be tested for flex durability as specified in Section 8.56, Flex at Low Temperature Test, and shall show no evidence of breaking, shattering, or cracking of the coating, laminate, or fabric.

7.3.6 Garment outer shells shall be tested for blocking durability as specified in Section 8.57, Resistance to High-Temperature Blocking, and shall show no blocking.

7.4 Protective Helmet Elements Performance Requirements for Both Ensembles.

7.4.1 Protective helmet elements shall be tested for resistance to impact as specified in Section 8.15, Top Impact Resistance Test (Force), and shall have no sample transmit a force of more than 3780 N (850 lbf).

7.4.2 Helmets shall be tested for resistance to impact as specified in Section 8.16, Impact Resistance Test (Acceleration), and shall have no specimen exceed the maximum acceleration specified in Table 7.4.2. Any acceleration above 200 Gn shall not exceed a duration of 3 milliseconds, and an acceleration above 150 Gn shall not exceed a duration of 6 milliseconds. Helmets shall maintain sufficient structural integrity to withstand impacts in all five locations.

7.4.3 Helmets shall be tested for resistance to penetration as specified in Section 8.19, Physical Penetration Resistance Test, and shall exhibit no electrical or physical contact between the penetration test striker and the headform.

7.4.4 Helmets shall be tested for resistance to heat as specified in Section 8.6, Heat and Thermal Shrinkage Resistance Test. The following results shall be considered unacceptable:

- (1) Parts of the complete helmet assembly that do not contact the headform before this test come in contact with the headform as a result of this test
- (2) Distortion of the back of the helmet shell extending more than 40 mm (1 5/8 in.) below the original position of the helmet shell

Table 7.4.2 Impact Acceleration

Impact Location	Maximum		
	Acceleration	m · sec/sec	ft · sec/sec
Top	150 × Gn	1471.5	4830
Front	300 × Gn	2943.0	9660
Sides	300 × Gn	2943.0	9660
Back	300 × Gn	2943.0	9660

Note: Gn denotes gravitational acceleration, which is defined as 9.81 m · sec/sec (32.2 ft · sec/sec).

- (3) Distortion of the front and sides of the helmet shell extending more than 30 mm (1 ³/₁₆ in.) below the original position of the helmet shell
- (4) Separation, melting, or dripping of the retention system, energy absorption system, or ear covers
- (5) Dysfunctional chin strap closure device
- (6) Ignition of any part of the helmet assembly
- (7) Ignition or melting of the product labels
- (8)* Any component of the helmet assembly, including but not limited to supplemental faceshields, extending more than 30 mm (1 ³/₁₆ in.) below the initial lowest point of the helmet shell in the front area, both before and after oven exposure
- (9) Dripping of the faceshield/goggle component

7.4.5 Helmets shall be tested for resistance to flame as specified in Section 8.3, Flame Resistance Test 2, Procedures A and C, and shall not show any visible afterflame or glow 5.0 seconds after removal from the test flame in each test.

7.4.6 Helmet ear covers and helmet shrouds shall be tested for thermal insulation as specified in Section 8.10, Thermal Protective Performance (TPP) Test, and shall have an average TPP rating of at least 20.0.

7.4.7 Helmets shall be tested for retention ability as specified in Section 8.34, Retention System Test, without any break occurring and without any resulting slip or stretch of more than 20 mm (1 ³/₁₆ in.).

7.4.8 Helmet suspension systems shall be tested for retention ability as specified in Section 8.35, Suspension System Retention Test, and shall not separate from the helmet.

7.4.9 Helmets shall be tested for shell retention ability as specified in Section 8.43, Shell Retention Test, and shall not have the helmet shell separate from the helmet suspension and retention systems.

7.4.10 All materials utilized in the construction of helmet chin straps, excluding elastic and hook and pile fasteners where these items are placed so that they will not directly contact the wearer's body or hood, shall be individually tested for resistance to flame as specified in Section 8.2, Flame Resistance Test 1, and shall not have a char length greater than 100 mm (4 in.), shall not show any visible afterflame 2.0 seconds after removal from the test flame, and shall not melt or drip.

7.4.11 All materials utilized in the construction of helmet chin straps, excluding elastic and hook and pile fasteners where these items are placed so that they will not directly contact the wearer's body or hood, shall be individually tested for resistance to heat as specified in Section 8.6, Heat and Thermal Shrinkage Resistance Test, and shall not shrink more than 10 percent in any direction, and shall not melt, separate, or ignite. Helmet chin strap material shall meet the thermal shrinkage requirement for the length dimension only.

7.4.12 All sewing thread used in the construction of helmets shall be tested for melting resistance as specified in Section 8.11, Thread Melting Test, and shall not melt below 260°C (500°F).

7.4.13 All helmet metal hardware and specimens of all helmet hardware that include metal parts shall be individually tested for resistance to corrosion as specified in Section 8.29, 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.

7.4.14 Labels shall be tested for durability and legibility as specified in Section 8.42, Label Durability and Legibility Test 2, shall remain in place, and shall be legible.

7.4.15 Faceshield/goggle components shall be tested for resistance to impact as specified in Section 8.17, Faceshield/Goggle Component Lens Impact Resistance Test, Tests One and Two, and shall not have any faceshield/goggle component contact an "eye" of the headform, and shall not have any parts or fragments be ejected from the component that could contact the eye of the headform.

7.4.16 Faceshield/goggle components shall be tested for flame resistance as specified in Section 8.3, Flame Resistance Test 2, Procedure B, and shall not show any visible afterflame 5.0 seconds after removal of the test flame.

7.5 Additional Performance Requirements for Structural Fire Fighting Protective Helmet Elements Only.

7.5.1 Structural fire fighting protective helmet elements shall also meet the performance requirements specified in this section in addition to the performance requirements specified in Section 7.4, Protective Helmet Elements Performance Requirements for Both Ensembles.

7.5.2 All fabrics utilized in construction of faceshield/goggle components shall be tested for flame resistance as specified in Section 8.2, Flame Resistance Test 1, and all fabrics shall not have a char length of more than 100 mm (4 in.) average, and shall not have an afterflame of more than 5.0 seconds average after removal of the test flame.

7.5.3 Faceshield/goggle component lenses shall be tested for resistance to scratching as specified in Section 8.22, Faceshield/Goggle Component Lens Scratch Resistance Test, and shall not exhibit a delta haze of greater than 25 percent.

7.5.4 Faceshield/goggle component lenses shall be tested for transmittance of light as specified in Section 8.44, Luminous (Visible) Transmittance Test, and shall have clear lenses transmit a minimum of 85 percent of the incident visible radiation, and shall have colored lenses transmit a minimum of 43 percent of the incident visible radiation.

7.5.5 Where provided, the faceshield/goggle component attachment hardware shall be tested for flame resistance as specified in Section 8.3, Flame Resistance Test 2, Procedure D, and shall not show any visible afterflame 5.0 seconds after removal of the test flame.

7.5.6 Helmets shall be tested for resistance to electricity as specified in both Procedure A and Procedure B of Section 8.30, Electrical Insulation Test 1, and shall not have leakage current exceeding 3.0 mA in each test.

7.5.7 All materials utilized in the construction of helmet ear covers, excluding elastic and hook and pile fasteners where these items are placed so that they will not directly contact the wearer's body or hood, shall be individually tested for resistance to flame as specified in Section 8.2, Flame Resistance Test 1, shall not have a char length greater than 100 mm (4 in.), shall not show any visible afterflame 2.0 seconds after removal from the test flame, and shall not melt or drip.

7.5.8 All materials utilized in the construction of helmet ear covers, excluding elastic and hook and pile fasteners where these items are placed so that they will not directly contact the wearer's body or hood, shall be individually tested for resistance to heat as specified in Section 8.6, Heat and Thermal Shrinkage Resistance Test, and shall not shrink more than 10 percent in any direction, and shall not melt, separate, or ignite.

7.5.9 Helmet visibility markings shall be tested for retroreflectivity and fluorescence as specified in Section 8.45, Retroreflectivity and Fluorescence Test, and shall have a coefficient of retroreflection (Ra) of not less than 100 cd/lux/m² (100 cd/ft²), and shall have the color be fluorescent yellow-green, fluorescent orange-red, or fluorescent red.

7.5.10 Helmet ear covers shall be capable of being detached from and reinstalled on the helmet per the manufacturer's instructions within a period of 20 minutes.

7.6 Additional Performance Requirements for Proximity Fire Fighting Helmet Elements Only.

7.6.1 Proximity fire fighting protective helmet elements shall also meet the performance requirements specified in this section in addition to the performance requirements specified in Section 7.4, Protective Helmet Elements Performance Requirements for Both Ensembles.

7.6.2 Helmets shall be tested for radiant heat resistance as specified in Section 8.53, Radiant Heat Resistance Test 3, and shall not have a temperature rise of more than 25°C (45°F).

7.6.3 Helmet shrouds shall be tested for radiant reflective capability as specified in Section 8.52, Radiant Protective Performance Test, and shall have an intersect time of not less than 20 seconds.

7.6.4 Helmet shrouds with a laminate base fabric shall be tested for resistance to delamination as specified in Section 8.54, Wet Flex Test, and shall show no signs of cracking on the face or delamination.

7.6.5 Helmet shrouds shall be tested for adhesion durability as specified in Section 8.55, Adhesion After Wet Flex–Tape Test, and shall show no evidence of separation or removal of the surface coating.

7.6.6 Helmet shrouds shall be tested for flex durability as specified in Section 8.56, Flex at Low Temperature Test, and shall show no evidence of breaking, shattering, or cracking of the coating, laminate, or fabric.

7.6.7 Helmet shrouds shall be tested for blocking durability as specified in Section 8.57, Resistance to High-Temperature Blocking Test, and shall show no blocking.

7.6.8 All materials utilized in the construction of proximity helmet covers and shrouds, excluding elastic and hook and pile fasteners where these items are placed so that they will not directly contact the wearer's body or hood, shall be individually tested for resistance to heat as specified in Section 8.6, Heat and Thermal Shrinkage Resistance Test, and shall not shrink more than 10 percent in any direction, and shall not melt, separate, or ignite.

7.6.9 Helmet shroud outer shell material shall be individually tested for resistance to tearing as specified in Section 8.12, Tear

Resistance Test, and shall have a tear strength of not less than 100 N (22 lbf).

7.6.10 Helmet faceshield component lenses shall be tested for transmittance of light as specified in Section 8.44, Luminous (Visible) Transmittance Test, and shall transmit not less than 30 percent of the incident visible radiation.

7.6.11 Helmet faceshields shall be tested for radiant reflective capability as specified in Section 8.52, Radiant Protective Performance Test, and shall have an intersect time of not less than 30 seconds.

7.6.12 Helmet outer covers, where provided, shall be tested for radiant reflective capability as specified in Section 8.52, Radiant Protective Performance Test, and shall have an intersect time of not less than 20 seconds.

7.6.13 Helmet outer covers, where provided, shall be tested for resistance to delamination as specified in Section 8.54, Wet Flex Test, and shall show no signs of cracking on the face or delamination.

7.6.14 Helmet outer covers, where provided, shall be tested for adhesion durability as specified in Section 8.55, Adhesion After Wet Flex–Tape Method Test, and shall show no evidence of separation or removal of the surface coating.

7.6.15 Helmet outer covers, where provided, shall be tested for flex durability as specified in Section 8.56, Flex at Low Temperature Test, and shall show no evidence of breaking, shattering, or cracking of the coating, laminate, or fabric.

7.6.16 Helmet outer covers, where provided, shall be tested for blocking durability as specified in Section 8.57, Resistance to High-Temperature Blocking Test, and shall show no blocking.

7.6.17 Helmet outer covers, where provided, shall be tested for resistance to tearing as specified in Section 8.12, Tear Resistance Test, and shall have a tear strength of not less than 22 N (5 lbf).

7.6.18 All materials utilized in the construction of proximity helmet covers and shrouds, excluding elastic and hook and pile fasteners where these items are placed so that they will not directly contact the wearer's body or hood, shall be individually tested for resistance to flame as specified in Section 8.2, Flame Resistance Test 1, and shall not have a char length greater than 100 mm (4 in.), shall not show any visible afterflame 2.0 seconds after removal from the test flame, and shall not melt or drip.

7.6.19 Helmet faceshield component lenses shall be tested for resistance to scratching as specified in Section 8.22, Faceshield/Goggle Component Lens Scratch Resistance Test, and shall not exhibit a delta haze of greater than 5 percent.

7.6.20 Proximity faceshields shall be tested for adhesion of reflective coating as specified in Section 8.46, Adhesion of Reflective Coating on Proximity Faceshield — Tape Method, and shall show evidence of removal not to exceed 2B classification (i.e., 15 percent to 35 percent removal).

7.7 Protective Glove Elements Performance Requirements for Both Ensembles.

7.7.1 The glove body composite shall be tested for thermal insulation as specified in Section 8.10, Thermal Protective

Performance (TPP) Test, and shall have an average TPP rating of at least 35.0.

- **7.7.2** The glove interface component composite shall be tested for thermal insulation as specified in Section 8.10, Thermal Protective Performance (TPP) Test, and shall have an average TPP rating of at least 20.0.

7.7.3 Gloves shall be tested for resistance to heat as specified in Section 8.6, Heat and Thermal Shrinkage Resistance Test, and shall not melt, separate, or ignite; shall not shrink more than 8 percent in length or width; shall be donnable; and shall be flexible.

7.7.3.1 Hook and pile fasteners on gloves shall be excluded from these requirements where these items are placed such that they will not directly contact the wearer's body.

7.7.3.2 Where hook and pile fasteners are placed on the gloves such that they will directly contact the wearer's body, they shall not melt, separate, or ignite when tested as part of the whole glove.

7.7.4 The glove lining materials of the glove body shall be individually tested for resistance to heat as specified in Section 8.6, Heat and Thermal Shrinkage Resistance Test, and shall not melt, separate, or ignite.

- Δ **7.7.5** Portions of the glove body composite representative of the palm of the glove shall be tested for conductive heat resistance as specified in Section 8.7, Conductive Heat Resistance Test 1, and shall have a second-degree burn time of not less than 10.0 seconds and shall have a pain time of not less than 6.0 seconds.

7.7.6 The glove body composite, including, but not limited to, trim, external labels, and external tags, but excluding hardware, and excluding hook and pile fasteners that do not directly contact the wearer's body, shall be tested for resistance to flame as specified in Section 8.4, Flame Resistance Test 3, and shall not have an average char length of more than 100 mm (4 in.), shall not have an average afterflame of more than 2.0 seconds, shall not melt or drip, and shall not have the amount of consumed materials exceed 5 percent.

- Δ **7.7.7** The glove interface component composite, including but not limited to trim, external labels, and external tags, but excluding hardware and hook and pile fasteners that do not directly contact the wearer's body, shall be tested for resistance to flame as specified in Section 8.4, Flame Resistance Test 3, and shall not have an average char length of more than 100 mm (4 in.), shall not have an average afterflame of more than 2.0 seconds, shall not melt or drip, and shall not have the amount of consumed materials exceed 5 percent.

- Δ **7.7.8** The glove extension composite, including but not limited to trim, external labels, and external tags, but excluding hardware and hook and pile fasteners that do not directly contact the wearer's body, shall be tested for resistance to flame as specified in Section 8.4, Flame Resistance Test 3, and shall not have an average char length of more than 100 mm (4 in.), shall not have an average afterflame of more than 2.0 seconds, shall not melt or drip, and shall not have the amount of consumed materials exceed 5 percent.

7.7.9* All sewing thread utilized in the construction of gloves shall be tested for melting resistance as specified in Section 8.11, Thread Melting Test, and shall not melt at or below 260°C (500°F).

7.7.10 The glove body seams shall be tested for resistance to liquid-borne or blood-borne pathogens as specified in Section 8.28, Viral Penetration Resistance Test, and shall allow no penetration of the Phi-X-174 bacteriophage for at least 1 hour.

7.7.11* Glove body seams shall be tested for resistance to liquid penetration as specified in Section 8.27, Liquid Penetration Resistance Test, and shall allow no penetration of test liquids for at least 1 hour.

7.7.12 The glove body composite shall be tested for resistance to cut as specified in Section 8.21, Cut Resistance Test, and shall have a distance of blade travel of more than 20 mm (0.8 in.).

7.7.13 The glove interface component shall be tested for resistance to cut as specified in Section 8.21, Cut Resistance Test, and shall have a distance of blade travel of more than 20 mm (0.8 in.).

7.7.14 The glove body composite shall be tested for resistance to puncture as specified in Section 8.20, Puncture Resistance Test, and shall not be punctured under an average applied force of 40 N (8.8 lbf).

7.7.15* Gloves shall be tested for hand function as specified in Section 8.37, Glove Hand Function Test, and shall have an average percent of bare-handed control not exceeding 220 percent.

7.7.16 Knit glove wristlet material(s) shall be tested for material strength as specified in Section 8.13, Burst Strength Test, and shall have a burst strength of not less than 225 N (51 lbf).

7.7.17 Glove body to glove interface component major seams shall be tested for seam strength as specified in Section 8.14, Seam-Breaking Strength Test, and shall have a burst strength of not less than 182 N (41 lbf).

7.7.18* Gloves shall be tested for resistance to leakage as specified in Section 8.32, Overall Liquid Integrity Test 1, and shall show no leakage.

7.7.19* Gloves shall be tested for ease of donning as specified in Section 8.36, Glove Donning Test, and shall have the dry hand donning time not exceed 10 seconds, shall have the wet hand donning time not exceed 30 seconds, shall have no detachment of the inner liner, shall have no detachment of the moisture barrier, and shall allow full insertion of all digits.

7.7.20 Gloves shall be tested for retention of the glove liner as specified in Section 8.63, Liner Retention Test, and shall have no detachment of the inner liner or moisture barrier.

7.7.21 Labels shall be tested for durability and legibility as specified in Section 8.41, Label Durability and Legibility Test 1, shall remain in place, and shall be legible.

7.7.22 Gloves shall be tested for grip as specified in Section 8.38, Grip Test, and shall not have a drop of force of more than 30 percent in any 0.2-second interval.

7.7.23 Gloves shall be tested using the torque test as specified in Section 8.68, Torque Test, and shall have an average percent of bare-handed control not less than 80 percent.

7.7.24 Gloves shall be tested for hand function as specified in Section 8.70, Glove Tool Test, and shall have an average percent of bare-handed control not exceeding 175 percent.

N 7.7.25 The glove body composite at the back of the glove shall be tested for radiant heat resistance as specified in Section 8.67, Transmitted and Stored Thermal Energy Test, and shall have a second-degree burn time of not less than 130 seconds.

7.8 Additional Performance Requirements for Structural Fire Fighting Protective Glove Elements Only.

7.8.1 Structural fire fighting protective glove elements shall also meet the performance requirements specified in this section in addition to the performance requirements specified in Section 7.7, Protective Glove Elements Performance Requirements for Both Ensembles.

7.8.2 All glove metal hardware and all glove hardware that include metal parts shall be individually tested for resistance to corrosion as specified in Section 8.29, 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.

7.9 Additional Performance Requirements for Proximity Fire Fighting Protective Glove Elements Only.

7.9.1 Proximity fire fighting protective glove elements shall also meet the performance requirements specified in this section in addition to the performance requirements specified in Section 7.7, Protective Glove Elements Performance Requirements for Both Ensembles.

7.9.2 The radiant reflective protective areas as required in Section 6.9, Additional Design Requirements for Proximity Fire Fighting Protective Glove Elements Only, of the glove body, glove interface component, and glove extension shall be tested for radiant reflective capability as specified in Section 8.53, Radiant Protective Performance Test, and shall have an intersect time of not less than 20 seconds.

7.9.3 The radiant reflective protective areas as required in Section 6.9, Additional Design Requirements for Proximity Fire Fighting Protective Glove Elements Only, of the glove body, glove interface component, and glove extension shall be tested for resistance to delamination as specified in Section 8.55, Wet Flex Test, and shall show no signs of cracking on the face or delamination.

7.9.4 The radiant reflective protective areas as required in Section 6.9, Additional Design Requirements for Proximity Fire Fighting Protective Glove Elements Only, of the glove body, glove interface component, and glove extension shall be tested for adhesion durability as specified in Section 8.55, Adhesion After Wet Flex-Tape Method Test, and shall show no evidence of separation or removal of the surface coating.

7.9.5 The radiant reflective protective areas as required in Section 6.9, Additional Design Requirements for Proximity Fire Fighting Protective Glove Elements Only, of the glove body, glove interface component, and glove extension shall be tested for flex durability as specified in Section 8.56, Flex at Low Temperature, and shall show no evidence of breaking, shattering, or cracking of the coating, laminate, or fabric.

7.9.6 The radiant reflective protective areas as required in Section 6.9, Additional Design Requirements for Proximity Fire Fighting Protective Glove Elements Only, of the glove body,

glove interface component, and glove extension shall be tested for blocking durability as specified in Section 8.57, Resistance to High-Temperature Blocking Test, and shall show no blocking.

7.10 Protective Footwear Elements Performance Requirements for Both Ensembles.

7.10.1 Protective footwear elements shall be tested for thermal insulation as specified in Section 8.8, Conductive Heat Resistance Test 2, and the temperature of the insole surface in contact with the foot shall not exceed 44°C (111°F).

7.10.2 Footwear, with components in place, shall be tested for resistance to flame as specified in Section 8.5, Flame Resistance Test 4, shall not have an afterflame of more than 5.0 seconds, shall not melt or drip, and shall not exhibit any burn-through.

7.10.3 All sewing thread utilized in the construction of footwear shall be tested for melt resistance as specified in Section 8.11, Thread Melting Test, and shall not melt below 260°C (500°F).

7.10.4 The footwear upper material composite and footwear seams shall be tested for resistance to liquid penetration as specified in Section 8.27, Liquid Penetration Resistance Test, and shall allow no penetration of the test liquids for at least 1 hour.

7.10.5 The footwear upper material composite and footwear seams shall be tested for resistance to liquid- or blood-borne pathogens as specified in Section 8.28, Viral Penetration Resistance Test, and shall allow no penetration of the Phi-X-174 bacteriophage for at least 1 hour.

7.10.6 Footwear shall be tested for resistance to puncture as specified in Section 8.20, Puncture Resistance Test, and shall not puncture the footwear upper under an average applied force of 60 N (13 lbf).

7.10.7 Footwear uppers shall be tested for resistance to cut as specified in Section 8.21, Cut Resistance Test, and shall have a cut distance resistance of more than 20 mm (0.8 in.).

7.10.8 Footwear shall be tested for slip resistance as specified in Section 8.40, Slip Resistance Test, and shall have a coefficient of friction of 0.40 or greater.

7.10.9 Footwear soles and heels shall be tested for resistance to abrasion as specified in Section 8.23, Abrasion Resistance Test, and the relative volume loss shall not be greater than 250 mm³ (0.015 in.³).

7.10.10* Footwear shall be tested for resistance to electricity as specified in Section 8.31, Electrical Insulation Test 2, and shall have no current leakage in excess of 3.0 mA.

7.10.11 Footwear ladder shanks or whole sole equivalents shall be tested for resistance to bending as specified in Section 8.39, Ladder Shank Bend Resistance Test, and shall not deflect more than 6 mm (¼ in.).

7.10.12 Footwear stud posts and eyelets shall be tested for attachment strength as specified in Section 8.49, Eyelet and Stud Post Attachment Test, and shall have a minimum detachment strength of 294 N (66 lbf).

Δ 7.10.13 All footwear metal hardware and specimens of all footwear hardware that include metal parts, including but not limited to toe cap, ladder shank, and components, shall be

individually tested for resistance to corrosion as specified in Section 8.29, 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.

▲ **7.10.14** Labels shall be tested for durability and legibility as specified in Section 8.41, Label Durability and Legibility Test 1, shall remain in place, and shall be legible.

7.10.15 Footwear shall be tested for resistance to heat as specified in Section 8.6, Heat and Thermal Shrinkage Resistance Test, and shall not have any part of the footwear melt, separate, or ignite; shall show no water penetration; and shall have all components remain functional.

7.11 Additional Performance Requirements for Structural Fire Fighting Protective Footwear Elements Only.

7.11.1 Structural fire fighting protective footwear elements shall also meet the performance requirements specified in this section in addition to the performance requirements specified in Section 7.10, Protective Footwear Elements Performance Requirements for Both Ensembles.

7.11.2 Footwear shall be tested for thermal insulation as specified in Section 8.9, Radiant Heat Resistance Test 1, and the temperature of the upper surface in contact with the skin shall not exceed 44°C (111°F).

7.11.3 Footwear shall be tested for thermal insulation as specified in Section 8.7, Conductive Heat Resistance Test 1, and the temperature of the upper lining surface in contact with skin shall have a second-degree burn time of not less than 10.0 seconds, and shall have a pain time of not less than 6.0 seconds.

7.12 Additional Performance Requirements for Proximity Fire Fighting Protective Footwear Elements Only.

7.12.1 Proximity fire fighting protective footwear elements shall also meet the performance requirements specified in this section in addition to the performance requirements specified in Section 7.10, Protective Footwear Elements Performance Requirements for Both Ensembles.

7.12.2 Footwear shall be tested for thermal insulation as specified in Section 8.60, Conductive Heat Resistance Test 3, and the temperature of the upper lining surface in contact with skin shall not reach 44°C (111°F) in 10 minutes or less.

7.12.3 Footwear shall be tested for thermal insulation as specified in Section 8.61, Radiant Heat Resistance Test 2, and the temperature of the upper lining surface in contact with the skin shall not exceed 44°C (111°F).

7.13 Protective Hood Interface Component Performance Requirements for Both Ensembles.

7.13.1 Fire fighting protective hood face openings that are not designed for interface with a specific SCBA facepiece shall be tested for shape retention as specified in Section 8.47, Hood Opening Size Retention Test, and shall slide freely over the top half of the hood measuring device while in the relaxed state and shall not show any gaps when placed on the lower half of the hood measuring device.

7.13.1.1 Where hood face openings are designed to interface with a specific SCBA facepiece, specimens of such hood face openings shall be tested for shape retention as specified in Section 8.47, Hood Opening Size Retention Test, and shall overlap the outer edge of the specific SCBA facepiece-to-face seal perimeter by not less than 13 mm (½ in.).

7.13.2 Hoods shall be tested for thermal insulation as specified in Section 8.10, Thermal Protective Performance (TPP) Test, and shall have an average TPP rating of not less than 20.0.

7.13.3 Hood material(s), including labels but excluding hook and pile fasteners and elastic when not placed in direct contact with the body, shall be individually tested for resistance to flame as specified in Section 8.2, Flame Resistance Test 1, and shall not have a char length of more than 100 mm (4 in.) average, shall not have an afterflame of more than 2.0 seconds average, and shall not melt or drip.

7.13.4 Hoods, excluding labels, hook and pile fasteners, and elastic, shall be individually tested for resistance to heat as specified in Section 8.6, Heat and Thermal Shrinkage Resistance Test, and shall slide freely over the top half of the hood measuring device while in the relaxed state, shall not show any gaps when placed on the lower half of the hood measuring device, and shall not shrink more than 10 percent.

7.13.5 Hoods, including labels but excluding hook and pile fasteners and elastic when these items are placed where they will not directly contact the wearer's body, shall be individually tested for resistance to heat as specified in Section 8.6, Heat and Thermal Shrinkage Resistance Test, and shall not melt, separate, or ignite.

▲ **7.13.6** Hoods with elastic or manually adjustable face openings shall be individually tested for resistance to shrinkage as specified in Section 8.24, Cleaning Shrinkage Resistance Test, and shall slide freely over the top half of the hood measuring device while in the relaxed state, shall not show any gaps when placed on the lower half of the hood measuring device, and shall not have the measurements made from the top of the hood to the marks at the back and both sides of the hood exhibit shrinkage of more than 5 percent.

■ **7.13.6.1** Hoods designed to interface with a specific SCBA facepiece shall be individually tested for resistance to shrinkage as specified in Section 8.24, Cleaning Shrinkage Resistance Test, and the overlap of the outer edge of the hood and the specific SCBA facepiece shall not shrink more than 5 percent. The measurements from the top of the hood to the marks at the back and both sides of the hood shall not exhibit shrinkage of more than 5 percent.

7.13.7 All sewing thread utilized in the construction of hoods shall be tested for melting resistance as specified in Section 8.11, Thread Melting Test, and shall not melt below 260°C (500°F).

7.13.8 The outermost hood material shall be tested for material strength as specified in Section 8.13, Burst Strength Test, and shall have a burst strength of not less than 225 N (51 lbf). All additional hood material layers shall be tested for material strength as specified in Section 8.13, Burst Strength Test, and shall have a burst strength of not less than 225 N (51 lbf).

7.13.9 Hood seams shall be tested for seam strength as specified in Section 8.14, Seam-Breaking Strength Test, and shall have a burst strength of not less than 181 N (41 lbf).

Δ 7.13.10 Labels shall be tested for durability and legibility as specified in Section 8.41, Label Durability and Legibility Test 1, shall remain attached to the hood, and shall be legible.

7.14* Additional Performance Requirements for Optional Structural Fire Fighting Protective Hood Interface Components Providing Particulate Protection.

N 7.14.1 Hood composite materials shall meet all performance criteria specified in Section 7.13, Protective Hood Interface Component Performance Requirements for Both Ensembles.

N 7.14.2 Hood composite materials that incorporate a particulate blocking layer shall be tested for particulate blocking as specified in Section 8.71, Particulate Blocking Test, and shall have a particulate filtration efficiency of 90 percent or greater for each particle size from 0.1 μm to 1.0 μm.

N 7.14.3* Hood composites including a particulate blocking layer shall be tested for evaporative heat transfer as specified in Section 8.33, Total Heat Loss (THL) Test, and shall have a THL of not less than 325 W/m².

7.15 Additional Performance Requirements for Proximity Fire Fighting Protective Hood Interface Components Only. (Reserved)

7.16 Protective Wristlet and Garment-Glove Interface Component Performance Requirements for Both Ensembles.

7.16.1 Protective wristlet interface components shall be tested for thermal insulation as specified in Section 8.10, Thermal Protective Performance (TPP) Test, and shall have an average TPP rating of not less than 20.0.

7.16.1.1 Where the coat sleeve end terminates in a garment-glove interface, the interface composite shall be tested for thermal insulation as specified in Section 8.10, Thermal Protective Performance (TPP) Test, and shall have an average TPP rating of not less than 35.0.

7.16.2 Wristlet material(s) shall be individually tested for resistance to flame as specified in Section 8.2, Flame Resistance Test 1, and shall not have a char length of more than 100 mm (4 in.) average, shall not have an afterflame of more than 2.0 seconds average, and shall not melt or drip.

7.16.3 Wristlet material(s) shall be individually tested for resistance to heat as specified in Section 8.6, Heat and Thermal Shrinkage Resistance Test, and shall not shrink more than 10 percent in any direction.

7.16.4 Wristlet material(s) shall be individually tested for resistance to heat as specified in Section 8.6, Heat and Thermal Shrinkage Resistance Test, and shall not melt, separate, or ignite.

7.16.5 Wristlet material(s) shall be individually tested for resistance to shrinkage as specified in Section 8.24, Cleaning Shrinkage Resistance Test, and shall not shrink more than 5 percent in any direction.

7.16.6 All sewing thread utilized in the construction of wristlets shall be tested for melting resistance as specified in Section 8.11, Thread Melting Test, and shall not melt at or below 260°C (500°F).

7.16.7 Knit wristlet material(s) shall be tested for material strength as specified in Section 8.13, Burst Strength Test, and shall have a burst strength of not less than 225 N (51 lbf).

7.16.8 Knit wristlet seams shall be tested for seam strength as specified in Section 8.14, Seam-Breaking Strength Test, and shall have a breaking strength of not less than 181 N (41 lbf).

7.16.9 Where the coat sleeve end terminates in a garment-glove interface, the interface area shall be tested in accordance with Section 8.48, Whole Garment and Ensemble Liquid Penetration Test, and shall allow no liquid penetration.

7.17 Additional Performance Requirements for Structural Fire Fighting Protective Wristlet Interface Components Only. (Reserved)

7.18 Additional Performance Requirements for Proximity Fire Fighting Protective Wristlet Interface Components Only. (Reserved)

7.19 Reserved.

7.20 Optional Performance Requirements for Protection from Liquid and Particulate Contaminants.

7.20.1 Liquid and Particulate Contaminant Protective Ensemble Performance Requirements for Both Ensembles.

Δ 7.20.1.1 The entire protective ensemble shall be tested for overall particulate inward leakage as specified in Section 8.66, Particle Inward Leakage Test, and shall allow no visual particulate inward leakage.

7.20.1.2 The entire CBRN ensemble shall be tested as specified in Section 8.48, Whole Garment and Ensemble Liquid Penetration Test, and shall show no liquid penetration.

• **7.20.2 Additional Liquid and Particulate Contaminant Protection Performance Requirements for Structural Fire Fighting Protective Ensembles Only. (Reserved)**

7.20.3 Additional Liquid and Particulate Contaminant Protection Performance Requirements for Proximity Fire Fighting Protective Ensembles Only. (Reserved)

7.20.4 Liquid and Particulate Contaminant Protective Garment Element Performance Requirements for Both Ensembles. (Reserved)

• **7.20.5 Additional Liquid and Particulate Contaminant Protection Performance Requirements for Structural Fire Fighting Protective Garment Elements Only. (Reserved)**

7.20.6 Additional Liquid and Particulate Contaminant Protection Performance Requirements for Proximity Fire Fighting Protective Garment Elements Only. (Reserved)

7.20.7 Protective Helmet Element Liquid and Particulate Contaminant Protection Performance Requirements for Both Ensembles. (Reserved)

7.20.8 Additional Liquid and Particulate Contaminant Protection Performance Requirements for Structural Fire Fighting Protective Helmet Elements Only. (Reserved)

7.20.9 Additional Liquid and Particulate Contaminant Protection Performance Requirements for Proximity Fire Fighting Protective Helmet Elements Only. (Reserved)

7.20.10 Protective Glove Elements Liquid and Particulate Contaminant Protection Performance Requirements for Both Ensembles. (Reserved)

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7.20.11 Additional Liquid and Particulate Contaminant Protection Performance Requirements for Structural Fire Fighting Protective Glove Elements Only. (Reserved)

7.20.12 Additional Liquid and Particulate Contaminant Protection Performance Requirements for Proximity Fire Fighting Protective Glove Elements Only. (Reserved)

7.20.13 Protective Footwear Elements Liquid and Particulate Contaminant Protection Performance Requirements for Both Ensembles. (Reserved)

7.20.14 Additional Liquid and Particulate Contaminant Protection Performance Requirements for Structural Fire Fighting Protective Footwear Elements Only. (Reserved)

7.20.15 Additional Liquid and Particulate Contaminant Protection Performance Requirements for Proximity Fire Fighting Protective Footwear Elements Only. (Reserved)

7.20.16 Protective Hood Interface Component Liquid and Particulate Contaminant Protection Performance Requirements for Both Ensembles. (Reserved)

7.20.17 Additional Liquid and Particulate Contaminant Protection Performance Requirements for Structural Fire Fighting Protective Hood Interface Components Only. (Reserved)

7.20.18 Additional Liquid and Particulate Contaminant Protection Performance Requirements for Proximity Fire Fighting Protective Hood Interface Components Only. (Reserved)

Chapter 8 Test Methods

8.1 Sample Preparation Procedures.

8.1.1 Application.

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

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

Δ 8.1.2 Washing and Drying Procedure for Garments, Gloves, Hoods, and Wristlets. Specimens shall be subjected to five cycles of washing and drying in accordance with the procedure specified in Machine Cycle I, Wash Temperature V, and Drying Procedure Ai of AATCC 135, *Dimensional Changes of Fabrics after Home Laundering*. A 1.82 kg ± 0.1 kg (4.0 lb ± 0.2 lb) load shall be used. A laundry bag shall not be used. Gloves shall be tumble dried for 60 minutes and shall be removed immediately at the end of the drying cycle. At the conclusion of the final drying cycle, the gloves shall be direct dried on a forced-air non-tumble-drying mechanism operated at 10°C ± 5°C (18°F ± 9°F) above current room temperature until dry but for not less than 8 hours.

8.1.3 Room Temperature Conditioning Procedure for Garments, Trim, Helmets, Gloves, Footwear, and Faceshield/Goggle Components.

Δ 8.1.3.1 Garment, glove, trim, and footwear samples shall be conditioned at a temperature of 21°C ± 3°C (70°F ± 5°F) and a relative humidity of 65 percent ± 5 percent 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. Specimens shall be tested within 5 minutes after removal from conditioning.

Δ 8.1.3.2 Helmet and faceshield/goggle component samples shall be conditioned at a temperature of 21°C ± 3°C (70°F ± 5°F) and a relative humidity of 25 percent to 50 percent for at least 4 hours. Specimens shall be tested within 5 minutes after removal from conditioning.

Δ 8.1.4 Low Temperature Environmental Conditioning Procedure for Helmets and Faceshield/Goggle Components. Samples shall be conditioned by exposing them to a temperature of -32°C ± 1°C (-25°F ± 2°F) for at least 4 hours. The impact/penetration test shall be completed within 15 seconds ± 5 seconds after removal from the cold temperature environment, or the specimens shall be reconditioned before testing.

Δ 8.1.5 Convective Heat Conditioning Procedure for Helmets, Faceshield/Goggle Components, Gloves, Footwear, Moisture Barriers, Moisture Barrier Seams, Labels, Particulate Blocking Layer(s), and Trim. Samples shall be conditioned by exposing them to the procedures specified in 8.6.4 and in 8.6.5.2 through 8.6.5.3, with the following modifications:

- (1) The oven temperature shall be stabilized at 140°C, +6/-0°C (285°F, +10/-0°F), for helmets, footwear, moisture barriers, moisture barrier seams, labels, particulate blocking layer(s), and trim, and the test exposure time shall be 10 minutes, +15/-0 seconds.
- (2) The oven temperature shall be stabilized at 177°C, +6/-0°C (350°F, +10/-0°F), for gloves only; the exposure time shall be 10 minutes, +15/-0 seconds; and the procedures specified in 8.6.13.4 shall be followed.
- (3) The exposure time shall begin when the test thermocouple reading has stabilized at the required exposure temperature.
- (4) The requirements of 8.6.5.4 and 8.6.5.5 shall be disregarded.
- (5) Helmet specimens shall be placed on a room temperature nonconductive headform conforming to the dimensions in Figure 8.6.12.3 before being placed in the oven. After oven exposure, the required testing shall be performed within 15 seconds ± 5 seconds, or the specimen shall be discarded and a new specimen shall be conditioned and tested as specified in this subsection. Only one helmet shall be conditioned at a time.
- (6) For gloves, footwear, trim, labels, moisture barriers, and moisture barrier seam specimens, the required conditioning shall be performed no sooner than 24 hours after removal from conditioning. Samples shall be suspended in the oven such that there is a distance of at least 150 mm (6 in.) between items.
- (7) For faceshield/goggle components, these components, attached to the helmet, shall be conditioned by placing them on a room temperature, solid, nonmetallic headform conforming to the dimensions in Figure 8.6.12.3 and by exposing them to a temperature of 108°C, +2/-0°C (225°F, +3/-0°F), for 20 minutes, +15/-0 seconds. Goggles shall be permitted to be placed directly on the headform without being attached to the helmet. The impact test shall be completed within 15 seconds ± 5 seconds, after removal from the environmental chamber, or the faceshield/goggle components shall be reconditioned and retested.

- (8) The oven temperature shall be stabilized at 177°C, +6/-0°C (350°F, +10/-0°F), for glove moisture barriers, and the exposure time shall be 10 minutes, +15/-0 seconds. The glove moisture barrier sample pouch shall be filled to capacity with nominal 4 mm ($\frac{3}{32}$ in.) sized perforated soda-lime or borosilicate glass beads. The beads shall be room temperature. The opening of the pouch shall be folded over and clamped together, the specimen shall be suspended by the clamp in the oven so that the entire specimen is not less than 50 mm (2 in.) from any oven surface and not less than 150 mm (6 in.) from any other specimen, and airflow is parallel to the plane of the material. Not more than three samples shall be placed in the test oven at one time. The samples shall be suspended such that each sample is the same distance from the airflow source, so that no sample is blocking the airflow to other samples.

8.1.6 Radiant and Convective Heat Environmental Conditioning Procedure for Helmets.

8.1.6.1 Sample helmets shall be conditioned by exposing the area to be impacted/penetrated to a radiant heat source. The top, sides, front, and back test areas to be impacted/penetrated shall be as specified in Figure 8.1.6.1.

8.1.6.2 The area to be impacted/penetrated shall be exposed to an irradiance of $1.0 \text{ W/cm}^2 \pm 0.1 \text{ W/cm}^2$, for a length of time determined by exposure of a radiant heat transducer. The heat source shall be removed and the helmet shall be tested. The helmet shall be impacted/penetrated in 15 seconds ± 5 seconds, after removal from the conditioning environment, or the helmet shall be cooled to room temperature and reconditioned before testing.

8.1.6.3 The radiometer shall be a Schmidt-Boelter or Gardon type radiant heat flux transducer with a diameter of 25 mm, a minimum viewing angle of 150 degrees, a minimum spectral response flat within 3 percent over a range of at least 1.0 to

10.0 μm , and an overall accuracy of at least ± 5 percent of the reading.

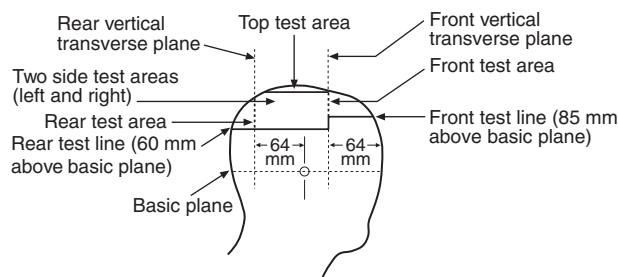
8.1.6.4 The radiant panel shall have an effective radiating surface of $150 \text{ mm} \pm 6 \text{ mm}$ (6 in. ± 0.25 in.) square. The spectral radiant emittance curve of the radiant panel shall be that of a black body at a temperature of $1000^\circ\text{K} \pm 200^\circ\text{K}$ ($1340^\circ\text{F} \pm 360^\circ\text{F}$).

8.1.6.5 The radiant heat transducer shown in Figure 8.1.6.5 shall be constructed from sheet copper, ASTM B152/B152M, Specification for Copper Sheet, Strip Plate, and Rolled Bar, Type 110 ETP, half hard, $0.64 \text{ mm} \pm 0.05 \text{ mm}$ (0.025 in. ± 0.002 in.), thick and $50 \text{ mm} \pm 0.5 \text{ mm}$ (2 in. $\pm \frac{1}{64}$ in.) square. A constantan wire $0.81 \text{ mm} \pm 0.05 \text{ mm}$ (0.032 in. ± 0.002 in.) in diameter and an iron wire of the same diameter shall be silver soldered $15 \text{ mm} \pm 1 \text{ mm}$ (0.6 in. ± 0.39 in.) from the edges of the copper sheet on the same side, as shown in Figure 8.1.6.5. The side of the copper sheet opposite that with the wires attached shall be painted flat black. The resulting transducer is a Type J thermocouple that shall be used in conjunction with appropriate instrumentation to monitor the heat exposure to which the helmet is to be subjected.

8.1.6.6 Sample helmets shall be mounted in the position to be conditioned. The point of impact or penetration on the helmet shell shall be determined in accordance with the specific test to be performed. The helmet shall be removed temporarily, and a radiometer shall be located at that point perpendicular to and facing away from the helmet surface.

8.1.6.7 The radiant panel shall be introduced in front of the radiometer with its effective radiating surface parallel to the plane tangent to the helmet surface at the center of the impact/penetration site on the helmet. The radiant panel shall be adjusted to obtain a stable uniform irradiance of $1.0 \text{ W/cm}^2 \pm 0.1 \text{ W/cm}^2$ over a minimum 75 mm (3 in.) diameter circle located on the above plane and centered at the center of impact or penetration. Stability shall be achieved when the irradiance changes by less than 10 percent during a 3-minute period.

8.1.6.8* The radiometer shall be replaced with the radiant heat transducer. The center of the transducer shall be positioned with its center coincident with the center of the impact/penetration site on the helmet and parallel to the plane tangent to the helmet surface at that point. The flat black surface of the transducer shall face the radiant panel. The time required for the transducer to reach a temperature of 260°C (500°F) shall be recorded. That time shall be 2.5 minutes



For U.S. units, 1 mm = 0.0394 in.

FIGURE 8.1.6.1 Helmet Test Areas and Landmarks.

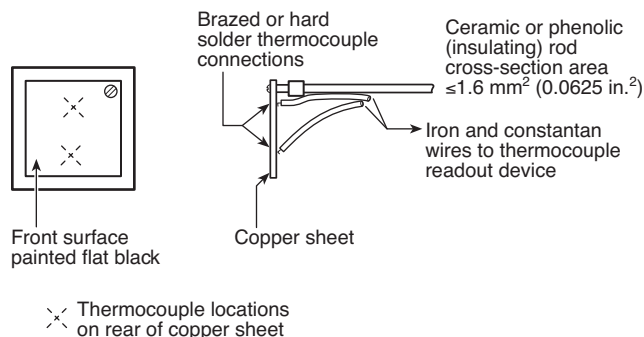


FIGURE 8.1.6.5 Radiant Heat Transducer.

± 15.0 seconds. A closed, insulated chamber shall be required to achieve this exposure time.

8.1.6.9 The chamber and helmet shall be stabilized at 25°C ± 5°C (77°F ± 9°F). The helmet shall be positioned in the chamber in the same position specified in 8.1.6.6. The helmet shall be subjected to the exposure conditions specified in 8.1.6.2 for the time recorded in 8.1.6.8. The exposure time shall be not less than the time recorded in 8.1.6.8, nor more than 5 seconds longer than that time.

8.1.7 Wet Conditioning Procedure for Helmets and Face-shield/Goggle Components. Samples shall be conditioned by immersing them in water at a temperature of 20°C to 28°C (68°F to 82°F) for at least 4 hours but not more than 24 hours. The specimen shall be allowed to drain and be tested within 10 minutes after removal from water.

8.1.8 Wet Conditioning Procedure for Glove Composites.

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

Δ 8.1.8.2 Samples shall be removed from water, hung in a vertical position with glove pouch opening facing down for 5 minutes, and laid horizontal with AATCC textile blotting paper both under and over the specimen under a pressure of 0.035 kg/cm² ± 0.003 kg/cm² (0.50 psi ± 0.05 psi), for a period of 20 minutes in accordance with paragraph 7.2 of AATCC 70, *Test Method for Water Repellency: Tumble Jar Dynamic Absorption Test*.

N 8.1.9* Wet Conditioning Procedure 2 for Glove Composites.

N 8.1.9.1 Samples shall be conditioned by being subjected to a water spray that evenly deposits a mist of water on the thermal barrier layer of the composite using the apparatus and procedures described in 8.1.9.2 through 8.1.9.7.

N 8.1.9.2 A means of spraying water at a rate of 4.4 g ± 1.0 g (0.16 oz ± 0.04 oz) over a 20 second period or at an average rate of 0.22 g/s ± 0.5 g/s (0.008 oz/s ± 0.02 oz/s) uniformly over a 150 mm × 150 mm (6 in. × 6 in.) sample while measuring the weight of the sample shall be employed.

N 8.1.9.2.1 The nozzle shall be positioned directly over the sample.

N 8.1.9.2.2 The nozzle for applying the water spray shall be designed not to drip on the sample before the onset or after the completion of the designated water spray period.

N 8.1.9.2.3 The spraying shall be conducted in a closed chamber or area that limits disturbance of the mist deposition of the sample from air currents.

N 8.1.9.2.4 The sample shall be positioned on a balance that is capable of measuring the sample weight to the nearest 0.1 g (0.004 oz). The balance pan shall have a minimum pan dimension of 150 mm × 150 mm (6 in. × 6 in.).

N 8.1.9.2.5 The uniformity of the water spray shall be determined (calibration) by measuring the mass of water deposited into nine cups that measure 50 mm × 50 mm (2 in. × 2 in.) square that are positioned where water collects on the sample, as shown in Figure 8.1.9.2.5. Uniformity of the spray pattern shall be determined by measuring the weight of each dry cup prior to the calibration and then measuring the weight of the cup following the application of the spray for a period of

20 seconds where the coefficient of variance of the weight gained by the nine cups is no more than 20 percent.

N 8.1.9.3 Samples for conditioning shall be the innermost layer of the glove composite that are cut to 150 mm × 150 mm (6 in. × 6 in.).

N 8.1.9.4 The dry weight of the glove composite innermost layer sample to be wetted shall be measured on a spray chamber balance to the nearest 0.1 g (0.004 oz).

N 8.1.9.5 Separate sets of samples shall have a mass of 2.0 g / ± 0.1 g (0.070 oz / ± 0.004 oz), 2.5 g ± 0.1 g (0.09 oz ± 0.004 oz), and 3.0 g / ± 0.1 g (0.11 oz / ± 0.004 oz) of water sprayed on the innermost layer of the glove composite as confirmed by the measurement of its weight on the balance.

N 8.1.9.6 Following the application of the water spray, the innermost layer of the glove shall be handled by the edges and assembled in a composite sample representative of the glove's construction for the area of the glove to be evaluated.

N 8.1.9.7 Samples subjected to this conditioning shall be evaluated within 5 minutes following the wetting.

8.1.10 Wet Conditioning Procedure for Whole Gloves.

Δ 8.1.10.1 Test subjects shall be selected so that their hand dimensions are as close as possible to the middle of the range for hand length and hand circumference as specified in Figure 6.7.6.1 for size 70W (wide) and size 76W (wide) gloves.

8.1.10.2 The test subject shall don the test specimen gloves.



FIGURE 8.1.9.2.5 Glove Composite Wetting Method.

8.1.10.3 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 a height of 25 mm, $+12.5/-0$ mm (1 in., $+0.5/-0$ in.) above (away from the fingers) the end of the glove, including glove interface components or extensions, for 2 minutes, $+12/-0$ seconds.

8.1.10.4 The gloves shall then be removed and hung vertically by digit 5 with the glove opening facing down for 2 minutes ± 12 seconds.

8.1.10.5 The glove specimens shall then be tested within 1 minute.

8.1.11 Flexing Procedure for Gloves.

8.1.11.1 Glove samples shall be selected to fit the individual test subject.

8.1.11.2 The test subject shall don the glove sample.

8.1.11.3 Glove specimens shall be flexed by making a tight fist 10 times during a 30-second period.

8.1.12 Washing and Drying Procedure for Garments, Gloves, and Glove Pouches.

8.1.12.1 The complete garment shall be washed with all closures fastened and the garment in its "as-worn" orientation. Garments with separable liners shall not have the liners separated.

8.1.12.2 A front-loading washer/extractor shall be used. The capacity shall be between 16 kg (35 lb) and 24.9 kg (55 lb).

8.1.12.3 The wash load shall be two-thirds the rated capacity of the washer. If ballast is needed to reach two-thirds capacity, similar material or outer shell material shall be used for garment samples, and 212.6 g/m^2 (7.5 oz/yd^2) woven 93 percent meta-aramid, 5 percent para-aramid, 2 percent anti-static fiber ballast shall be used for glove or glove pouch samples.

8.1.12.4 The wash cycle procedure and water levels specified in Table 8.1.12.4(a) and Table 8.1.12.4(b) shall be followed. In addition, the g force shall not exceed 100 g throughout the wash cycle.

8.1.12.5 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.

8.1.12.6 Samples shall be tumbled for 60 minutes and shall be removed immediately at the end of the drying cycle. At the conclusion of the final drying cycle, the garment samples shall be allowed to air dry for at least 48 hours prior to conducting the test and the use of a forced-air dryer operated at ambient temperature, $-0^{\circ} \pm 5^{\circ}\text{C}$ ($-0^{\circ} \pm 10^{\circ}\text{F}$) shall be permitted. At the conclusion of the final drying cycle, glove or glove pouch samples shall be dried on a forced-air, non-tumble-drying mechanism operated at $10^{\circ}\text{C} \pm 5^{\circ}\text{C}$ ($50^{\circ}\text{F} \pm 9^{\circ}\text{F}$) above current room temperature until dry but not for less than 8 hours.

8.1.12.7 Garments, gloves, and glove pouches shall be washed and dried for a total of five cycles.

8.1.13 Helmet Positioning.

8.1.13.1 The helmet shall be seated firmly on the applicable test headform in accordance with the helmet positioning index (HPI).

Table 8.1.12.4(a) Wash Cycle Procedure for Whole Garments and CBRN Materials

Operation	Time (min)	Temperature		Water Level
		$\pm 3^{\circ}\text{C}$	$\pm 5^{\circ}\text{F}$	
Suds using AATCC detergent #1993, 1.0 g/gal water	10	49	120	Low*
Drain	1	—	—	—
Carry-over	5	49	120	Low*
Drain	1	—	—	—
Rinse	2	38	100	High*
Drain	1	—	—	—
Rinse	2	38	100	High*
Drain	1	—	—	—
Rinse	2	38	100	High*
Drain	1	—	—	—
Extract	5	—	—	—

*See Table 8.1.12.4(b) for high and low water levels.

Table 8.1.12.4(b) Water Level for Whole Garments, Gloves, and Glove Pouches Operation Wash Cycle Procedure

Low Water Level $\pm 1 \text{ cm}$ ($\frac{3}{8} \text{ in.}$)		High Water Level $\pm 1 \text{ cm}$ ($\frac{3}{8} \text{ in.}$)	
cm	in.	cm	in.
12.7	5.0	25.4	10.0

8.1.13.2 The HPI shall be the vertical distance, as specified by the helmet manufacturer, from the lowest point of the front lateral midpoint of the helmet shell aligned with the midsagittal plane to the basic plane of an ISO size J headform conforming to the nominal dimensions in Figure 8.16.4.1, with the helmet firmly positioned on the headform.

8.1.13.3 When positioning the helmet for testing on headforms other than the ISO size J, the basic plane used for the HPI positioning shall be located 130 mm below and parallel to the crown of the headform and shall be marked on the headform.

8.1.14 Pouch Construction for Glove Composite Samples One.

8.1.14.1 The pouch shall be 200 mm $\times$ 200 mm (8 in. $\times$ 8 in.). A smaller pouch size shall be permitted provided that the resulting test specimens are of sufficient size for the test. However, for the tests specified in Sections 8.7, Conductive Heat Resistance Test 1, and 8.10, Thermal Protective Performance (TPP), the pouch size shall not be reduced.

8.1.14.2 The pouch shall be made of two glove composite swatches.

8.1.14.3 The two glove composites shall be of the same materials and construction.

8.1.14.4 The two glove composite swatches shall be constructed to simulate the actual layers of the glove body, glove interface component, or glove extension as appropriate, arranged in proper order.