NFPA® 1970

Standard on Protective Ensembles for Structural and Proximity Firefighting, Work Apparel, Open-Circuit Self-Contained Breathing Apparatus (SCBA) for Emergency Services, and Personal Alert Safety Systems (PASS)

2025 Edition

NFPA, 1 Batterymarch Park, Quincy, MA 02169-7471
An International Codes and Standards Organization

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NFPA® 1970

Standard on

Protective Ensembles for Structural and Proximity Firefighting, Work Apparel, Open-Circuit Self-Contained Breathing Apparatus (SCBA) for Emergency Services, and Personal Alert Safety Systems (PASS)

2025 Edition

This edition of NFPA 1970, *Standard on Protective Ensembles for Structural and Proximity Firefighting, Work Apparel, Open-Circuit Self-Contained Breathing Apparatus (SCBA) for Emergency Services, and Personal Alert Safety Systems (PASS)*, was prepared by the Technical Committee on Structural and Proximity Firefighting Protective Clothing and Equipment, and acted on by the NFPA membership during the 2024 NFPA Technical Meeting held June 20, 2024. It was issued by the Standards Council on August 29, 2024, with an effective date of September 18, 2024.

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 1970 was approved as an American National Standard on September 18, 2024.

Origin and Development of NFPA 1970

The first edition of NFPA 1970 consolidates four standards — NFPA 1971, *Standard on Protective Ensembles for Structural Firefighting and Proximity Firefighting*; NFPA 1975, *Standard on Emergency Services Work Apparel*; NFPA 1981, *Standard on Open-Circuit Self-Contained Breathing Apparatus (SCBA) for Emergency Services*; and NFPA 1982, *Standard on Personal Alert Safety Systems (PASS)* — as part of the emergency response and responder safety (ERRS) document consolidation project (nfpa.org/errs), which was approved by the NFPA Standards Council in April 2019.

NFPA 1970 comprises four chapters of general information and requirements applicable to the entire standard and four sets of five chapters applicable to each product type. Chapter 1 establishes administrative guidance for the entire standard, including an application statement in Section 1.3 that assists users with locating the specific content from each of the combined standards. Product-specific administrative information is found in the first chapter that applies to each product type (Chapters 5, 10, 15, and 20). Chapter 2 contains a list of all mandatory references, and Chapter 3 contains all definitions. Chapter 4 combines the certification requirements that are common to all product types, while the unique certification requirements for each product type are in dedicated chapters (Chapters 5, 10, 15, and 20).

The requirements for structural and proximity firefighting protective ensembles are in Chapters 5 through 9. Throughout the development of this edition, there was a determined focus on protection against exposure to hazardous substances and contamination, including new requirements for restricted substances, ease of cleaning, and ease of helmet disassembly for cleaning. Further, performance criteria and a test method for evaporative resistance (breathability) were added for certain ensemble elements to promote better cooling in warm environments. Liquid and particulate protection was applied to garments instead of ensembles, particulate protection was made mandatory for structural firefighting hoods, and a new liquid barrier test replaced the bacterial resistance test for garments. Glove sizing was revised to allow for better fit for women. In addition, there were many general improvements and clarifications throughout these chapters.

The requirements for emergency services work apparel are in Chapters 10 through 14. No significant changes over the last edition of NFPA 1975 were made.

The requirements for open-circuit self-contained breathing apparatus are in Chapters 15 through 19. Some of the changes over the last edition of NFPA 1981 include the addition of cleaning instructions in manufacturer information to complement those for textiles, new requirements to

ensure that wired connections are compatible with PASS devices, and updated EOSTI activation pressures and HUD interface icons.

The requirements for personal alert safety systems (PASS) are in Chapters 20 through 24. Some of the changes over the last edition of NFPA 1982 include revised label requirements to decrease the label font size to align with that for radios, a new allowance to provide user information digitally, and many improvements to clarity and consistency.

Finally, a tremendous accomplishment for this edition came through the Hazardous Locations Harmonization Task Group, which included committee members from the technical committees responsible for NFPA 1970 and NFPA 1930. The task group was able to align the requirements for nonincendive and intrinsically safe electronic equipment and systems worn or carried by firefighters, including protective clothing, SCBA, PASS devices, and portable radios.

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This list represents the membership at the time the Committee was balloted on the final text of this edition. Since that time, changes in the membership may have occurred. A key to classifications is found at the back of the document.

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 firefighters and other emergency services responders during incidents involving structural firefighting operations or proximity firefighting operations. Structural firefighting 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 firefighting 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 firefighting protective ensembles by fire and emergency services organizations and personnel.

Contents

NFPA 1970

Standard on

Protective Ensembles for Structural and Proximity Firefighting, Work Apparel, Open-Circuit Self-Contained Breathing Apparatus (SCBA) for Emergency Services, and Personal Alert Safety Systems (PASS)

2025 Edition

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. 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 and extracted publications can be found in Chapter 2 and Annex H.

Chapter 1 Administration

1.1 Scope.

1.1.1* This standard provides minimum design, performance, testing, and certification requirements for the following:

(1) New structural and proximity firefighting protective ensembles and ensemble elements that include coats, trousers, coveralls, helmets, gloves, footwear, and hoods, which further include optional requirements for structural firefighting protective garments and proximity firefighting garments that provide limited protection from liquid and particulate hazards

(2) New nonprimary work apparel and individual garments composing work apparel, which further include optional requirements for the following where such options are specified or claimed to be used in the construction of work apparel:
   (a) Flame resistance
   (b) Water resistance
   (c) Insect repellency

(3) New compressed breathing air open-circuit self-contained breathing apparatus (SCBA) and compressed breathing air combination open-circuit self-contained breathing apparatus and supplier air respirators (SCBA/SARs)

(4) New personal alert safety systems (PASS) for emergency services personnel that include stand-alone PASS, integrated PASS, and RF PASS in addition to PASS or RF PASS devices certified to an earlier edition of NFPA 1982 that incorporate parts, components, or software to meet the 2025 edition of NFPA 1970

1.1.1.1 This standard provides minimum design, performance, testing, and recognition requirements for new components that are utilized to construct structural and proximity firefighting ensembles and ensemble elements and nonprimary work apparel.

1.1.2 This standard shall also specify requirements for the thermal stability of textiles used in the construction of work apparel.

1.1.3 This standard shall also specify minimum requirements for the design, performance, and testing of replacement parts, components, and add-on accessories for SCBA and combination SCBA/SARs certified as compliant to earlier editions of NFPA 1981.

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

1.2 Purpose.

1.2.1 The purpose of this standard is to specify minimum requirements for the following:

(1) Establishing minimum levels of protection for firefighting personnel assigned to fire department operations, including but not limited to structural firefighting, proximity firefighting, rescue, emergency medical, and other emergency first responder functions

(2) Providing emergency services personnel with work apparel that will not contribute to burn injury severity, which further establishes the following:
   (a) Optional flame resistance requirements and tests to verify the flame resistance of textiles where the authority having jurisdiction specifies the use of flame-resistant textiles for the construction of work apparel, or where the manufacturer represents work apparel textiles as flame resistant
   (b) Optional liquid resistance requirements and tests to verify the liquid resistance of textiles where the authority having jurisdiction specifies the use of liquid-resistant textiles for the construction of work apparel, or where the manufacturer represents work apparel textiles as having liquid-resistant properties
   (c) Optional insect repellency requirements and tests to verify the insect repellency of textiles where the authority having jurisdiction specifies the use of insect-repellent textiles for the construction of work apparel, or where the manufacturer represents work apparel textiles as having insect-repellent properties

(3) Establishing minimum levels of protection for emergency services personnel from atmospheres that are categorized as immediately dangerous to life and health (IDLH)
(4) Establishing minimum requirements for PASS that are intended for use by emergency services personnel during emergency operations and that emit an audible signal to summon aid in the event the user becomes incapacitated or needs assistance, which further establishes minimum requirements for the following:
    (a) Optional RF PASS that are capable of transmitting an alarm signal and receiving an evacuation alarm via an RF signal
    (b) The base station used in optional RF PASS for the receipt of an alarm signal and the transmission of an evacuation alarm via an RF signal

1.2.2 This standard shall not be intended to serve as a detailed manufacturing or purchasing specification but shall be permitted to be referenced in purchase specifications as minimum requirements.

1.2.3* This standard shall address optional, nonmandatory testing for full structural and proximity firefighting protective ensembles in different areas of overall systems performance as addressed in Annex G.

1.3* Application. This standard shall be applied as follows:

(1) Chapters 1 through 9 and Annexes A, B, G, and H constitute NFPA 1971.
(2) Chapters 1 through 4, 10 through 14, and Annexes A, C, and H constitute NFPA 1975.
(3) Chapters 1 through 4, 15 through 19, and Annexes A, D, and H constitute NFPA 1981.
(4) Chapters 1 through 4, 20 through 24, and Annexes A, E, F, and H constitute NFPA 1982.

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 1550, *Standard for Emergency Responder Health and Safety*, 2024 edition.

NFPA 1802, *Standard on Two-Way, Portable RF Voice Communications Devices for Use by Emergency Services Personnel in the Hazard Zone*, 2021 edition.

NFPA 1851, *Standard on Selection, Care, and Maintenance of Protective Ensembles for Structural Fire Fighting and Proximity Fire Fighting*, 2020 edition.

NFPA 1852, *Standard on Selection, Care, and Maintenance of Open-Circuit Self-Contained Breathing Apparatus (SCBA)*, 2019 edition.

NFPA 1951, *Standard on Protective Ensembles for Technical Rescue Incidents*, 2020 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 1989, *Standard on Breathing Air Quality for Emergency Services Respiratory Protection*, 2019 edition.

NFPA 2500, *Standard for Operations and Training for Technical Search and Rescue Incidents and Life Safety Rope and Equipment for Emergency Services*, 2022 edition.

2.3 Other Publications.

2.3.1 AAMI Publications. Association for the Advancement of Medical Instrumentation, 901 N. Glebe Road, Suite 300, Arlington, VA 22203.

ANSI/AAMI PB70, *Liquid barrier performance and classification of protective apparel and drapes intended for use in health care facilities*, 2012.

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

AATCC LP1, *Home Laundering: Machine Washing*, 2021.

AATCC TM35, *Test Method for Water Resistance: Rain Test*, 2018e2.

AATCC TM42, *Test Method for Water Resistance: Impact Penetration Test*, 2017e.

AATCC TM61, *Test Method for Colorfastness to Laundering: Accelerated*, 2013, reaffirmed 2020.

AATCC TM70, *Test Method for Water Repellency: Tumble Jar Dynamic Absorption Test*, 2015, reaffirmed 2020.

AATCC TM127, *Test Method for Water Resistance: Hydrostatic Pressure*, 2018.

AATCC TM135, *Test Method for Dimensional Changes of Fabrics after Home Laundering*, 2018.

AATCC TM158, *Test Method for Dimensional Changes on Drycleaning in Perchloroethylene: Machine Method*, 2016e.

2.3.3 AFPS Publications. German Product Safety Committee (Ausschuss für Produktsicherheit, AfPS), Federal Institute for Occupational Safety and Health (BAuA), Postbox 17 02 02, D-44061 Dortmund, Germany.

AfPS GS 2019:01, *Testing and assessment of Polycyclic Aromatic Hydrocarbons (PAHs) in the awarding of GS Marks — Specification pursuant to Article 21 (1) No. 3 of the Product Safety Act (ProdSG)*, 2020.

2.3.4 ASA Publications. Acoustical Society of America, 1305 Walt Whitman Road, Suite 110, Melville, NY 11747-4300.

ANSI/ASA S1.4, *Specification for Sound Level Meters,* 1983, reaffirmed 2006.

ANSI/ASA S1.13, *Measurement of Sound Pressure Levels in Air*, 2020.

ANSI/ASA S3.2, *Method for Measuring the Intelligibility of Speech Over Communication Systems*, 2020.

2.3.5* 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 B117, *Standard Practice for Operating Salt Spray (Fog) Apparatus*, 2019.

ASTM B152/B152M, *Specification for Copper Sheet, Strip Plate, and Rolled Bar*, 2019.

ASTM D471, *Standard Test Method for Rubber Property — Effect of Liquids*, 2016a, reapproved 2021.

ASTM D737, *Standard Test Method for Air Permeability of Textile Fabrics*, 2018.

ASTM D751, *Standard Test Methods for Coated Fabrics*, 2019.

ASTM D975, *Standard Specification for Diesel Fuel*, 2021.

ASTM D1003, *Standard Test Method for Haze and Luminous Transmittance of Transparent Plastics*, 2021.

ASTM D1683/D1683M, *Standard Test Method for Failure in Sewn Seams of Woven Fabrics*, 2017, reapproved 2018.

ASTM D1776/D1776M, *Standard Practice for Conditioning and Testing Textiles*, 2020.

ASTM D1777, *Standard Test Method for Thickness of Textile Materials*, 1996, reapproved 2019.

ASTM D3359, *Standard Test Methods for Rating Adhesion by Tape Test,* 2017.

ASTM D3776/D3776M, *Standard Test Methods for Mass Per Unit Area (Weight) of Fabric*, 2020.

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, reapproved 2017.

ASTM D4966, *Standard Test Method for Abrasion Resistance of Textile Fabrics (Martindale Abrasion Test Method)*, 2012, reapproved 2016.

ASTM D5034, *Standard Test Method for Breaking Strength and Elongation of Textile Fabrics (Grab Test)*, 2021.

ASTM D5035, *Standard Test Method for Breaking Force and Elongation of Textile Fabrics (Strip Method)*, 2011, reapproved 2019.

ASTM D5169, *Standard Test Method for Shear Strength (Dynamic Method) of Hook and Loop Touch Fasteners*, 1998, reapproved 2021.

ASTM D5170, *Standard Test Method for Peel Strength ("T" Method) of Hook and Loop Touch Fasteners*, 1998, reapproved 2021.

ASTM D5587, *Standard Test Method for the Tearing Strength of Fabrics by Trapezoid Procedure*, 2015, reapproved 2019.

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, reapproved 2017.

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 D7359, *Standard Test Method for Total Fluorine, Chlorine and Sulfur in Aromatic Hydrocarbons and Their Mixtures by Oxidative Pyrohydrolytic Combustion followed by Ion Chromatography Detection (Combustion Ion Chromatography-CIC)*, 2023.

ASTM E162, *Standard Test Method for Surface Flammability of Materials Using a Radiant Heat Energy Source*, 2021.

ASTM E809, *Standard Practice for Measuring Photometric Characteristics of Retroreflectors*, 2021.

ASTM E991, *Standard Practice for Color Measurement of Fluorescent Specimens Using the One-Monochromator Method*, 2021.

ASTM E1164, *Standard Practice for Obtaining Spectrometric Data for Object-Color Evaluation*, 2012, reapproved 2017e1.

ASTM E2152, *Standard Practice for Computing the Colors of Fluorescent Objects from Bispectral Photometric Data*, 2012, reapproved 2017.

ASTM E2153, *Standard Practice for Obtaining Bispectral Photometric Data for Evaluation of Fluorescent Color*, 2001, reapproved 2017.

ASTM F392/F392M, *Standard Practice for Conditioning Flexible Barrier Materials for Flex Durability*, 2011, reapproved 2015.

ASTM F903, *Standard Test Method for Resistance of Materials Used in Protective Clothing to Penetration by Liquids*, 2018.

ASTM F1060, *Standard Test Method for Evaluation of Conductive and Compressive Heat Resistance (CCHR)*, 2018.

ASTM F1342/F1342M, *Standard Test Method for Protective Clothing Material Resistance to Puncture*, 2022.

ASTM F1359/F1359M, *Standard Test Method for Liquid Penetration Resistance of Protective Clothing or Protective Ensembles Under a Shower Spray While on a Manikin*, 2022.

ASTM F1671/F1671M, *Standard Test Method for Resistance of Materials Used in Protective Clothing to Penetration by Blood-Borne Pathogens Using Phi-X174 Bacteriophage Penetration as a Test System*, 2022.

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*, 2017.

ASTM F1939, *Standard Test Method for Radiant Heat Resistance of Flame Resistant Clothing Materials with Continuous Heating*, 2015, reapproved 2020.

ASTM F2010/F2010M, *Standard Test Method for Evaluation of Glove Effects on Wearer Finger Dexterity Using a Modified Pegboard Test*, 2018.

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*, 2003, reapproved 2017.

ASTM F2412, *Standard Test Methods for Foot Protection*, 2018a.

ASTM F2413, *Standard Specification for Performance Requirements for Protective (Safety) Toe Cap Footwear*, 2018.

ASTM F2731, *Standard Test Method for Measuring the Transmitted and Stored Energy of Firefighter Protective Clothing Systems*, 2018.

ASTM F2894, *Standard Test Method for Evaluation of Materials, Protective Clothing, and Equipment for Heat Resistance Using a Hot Air Circulating Oven*, 2021.

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*, 2019.

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

ASTM G155, *Standard Practice for Operating Xenon Arc Lamp Apparatus for Exposure of Materials*, 2021.

2.3.6 CENELEC Publications. CENELEC, European Committee for Electrotechnical Standardization, CEN-CENELEC Management Centre, Rue de la Science, B-1040, Brussels, Belgium.

BS EN 136, *Respiratory protective devices — Full face masks — Requirements, testing, marking*, 1998, Corrigendum, 2004.

2.3.7 CPSC Publications. Consumer Product Safety Commission, 4330 East-West Highway, Bethesda, MD 20814.

CPSC-CH-C1001-09.4, *Standard Operating Procedure for Determination of Phthalates*, January 17, 2018.

CPSC-CH-E1002-08.3, *Standard Operating Procedure for Determining Total Lead (Pb) in Nonmetal Children's Products*, Revision November 15, 2012.

2.3.8 CSA Group Publications. CSA Group, 178 Rexdale Blvd., Toronto, ON M9W 1R3, Canada.

CSA Z195, *Protective Footwear*, 2014.

2.3.9 DIN Publications. Deutsches Institut für Normung e.V. (German Institute for Standardization), Am DIN-Platz, Burggrafenstraße 6, 10787 Berlin.

DIN 54231, *Textiles — Detection of disperse dyestuffs*, 2005.

2.3.10 EBU Publications. EBU (European Broadcasting Union) Department of Technology & Innovation, L'Ancienne-Route 17A, Postal Box 45, 1218 Le Grand-Saconnex, Geneva, Switzerland.

EBU R 068, *Alignment level in digital audio production equipment and in digital audio recorders*, 2000.

2.3.11 EN Publications. European Committee for Standardization, Rue de la Loi 200, 1049 Bruxelles, Belgium.

EN 14582, *Characterization of waste — Halogen and sulfur content — Oxygen combustion in closed systems and determination methods*, 2016.

EN 16711-2, *Textiles — Determination of metal content — Part 2: Determination of metals extracted by acidic artificial perspiration solution*, 2016.

EN 17131, *Textiles and textile products — Determination of Dimethylformamide (DMF), method using gas chromatography*, 2013.

EN 17137, *Textiles — Determination of the content of compounds based on chlorobenzenes and chlorotoluenes*, 2018.

EN 17134-2, *Textiles and textile products — Determination of biocide additives — Part 2: Chlorophenol-based preservatives, method using gas chromatography*, 2023.

EN 17681-1, *Textiles and textile products — Organic fluorine — Part 1: Determination of non-volatile compounds by extraction method using liquid chromatography*, 2022.

EN 17681-2, *Textiles and textile products — Organic fluorine — Part 2: Determination of volatile compounds by extraction method using gas chromatography*, 2022.

EN 62321-6, *Determination of certain substances in electrotechnical products — Part 6: Polybrominated biphenyls and polybrominated diphenyl ethers in polymers by gas chromatography-mass spectrometry (GC-MS)*, 2015.

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

FIA 1209, *Whole Shoe Flex*, 1984.

2.3.13 IEC Publications. International Electrotechnical Commission, 3, rue de Varembé, P.O. Box 131, CH-1211 Geneva 20, Switzerland.

IEC 60268-16, *Sound System Equipment — Part 16: Objective Rating of Speech Intelligibility by Speech Transmission Index*, 2011.

2.3.14 ISEA Publications. International Safety Equipment Association, 1101 Wilson Boulevard, Suite #1425, Arlington, VA 22209-1762.

ANSI/ISEA 107, *High-Visibility Safety Apparel*, 2020.

ANSI/ISEA Z87.1, *Occupational and Educational Personal Eye and Face Protection Devices*, 2020.

2.3.15 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 3071, *Textiles — Determination of pH of aqueous extract*, 2020.

ISO 4649, *Rubber, vulcanized or thermoplastic — Determination of abrasion resistance using a rotating cylindrical drum device*, 2017.

ISO 6401, *Plastics — Poly (vinyl chloride) — Determination of residual vinyl chloride monomer — Gas chromatographic method*, 2022.

ISO 6530, *Protective clothing — Protection against liquid chemicals — Test method for resistance of materials to penetration by liquids*, 2005.

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

ISO/CIE 10526, *CIE standard illuminants for colorimetry*, 2007.

ISO 14184-1, *Textiles — Determination of formaldehyde — Part 1: Free and hydrolyzed formaldehyde (water extraction method)*, 2011.

ISO 14362-1, *Textiles — Methods for determination of certain aromatic amines derived from azo colorants — Part 1: Detection of the use of certain azo colorants accessible with and without extracting the fibres*, 2017.

ISO 14362-3, *Textiles — Methods for determination of certain aromatic amines derived from azo colorants — Part 3: Detection of the use of certain azo colorants, which may release 4-aminoazobenzene*, 2017.

ISO 14389, *Textiles — Determination of phthalate content — Tetrahydrofuran method*, 2014.

ISO 16900-5, *Respiratory protective devices — Methods of test and test equipment — Part 5: Breathing machine, metabolic simulator, RPD headforms and torso, tools and verification tools*, 2016.

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

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

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

ISO/IEC 17025, *General requirements for the competence of testing and calibration laboratories*, 2005, Technical Corrigendum, 2006.

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

ISO 17492, *Clothing for protection against heat and flame — Determination of heat transmission on exposure to both flame and radiant heat*, 2018.

ISO 17493, *Clothing and equipment for protection against heat — Test method for convective heat resistance using a hot air circulating oven*, 2016.

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

ISO 17881-1, *Textiles — Determination of certain flame retardants — Part 1: Brominated flame Retardants*, 2016.

ISO 17881-2, *Textiles — Determination of certain flame retardants — Part 2: Phosphorus flame retardants*, 2016.

ISO 18254-1, *Textiles — Method for the detection and determination of alkylphenol ethoxylates (APEO) — Part 1: Method using HPLC-MS*, 2016.

ISO 19577, *Footwear — Critical substances potentially present in footwear and footwear components — Determination of Nitrosamines*, 2019.

ISO 21084, *Textiles — Method for determination of alkylphenols (AP)*, 2019.

ISO 22818, *Textiles — Determination of short-chain chlorinated paraffins (SCCP) and middle- chain chlorinated paraffins (MCCP) in textile products out of different matrices by use of gas chromatography negative ion chemical ionization mass spectroscopy (GC-NCI&-MS)*, 2021.

ISO 23702, *Leather — Organic fluorine — Part 1: Determination of the non-volatile compound content by extraction method using liquid chromatography/tandem mass spectrometry detector (LC-MS/MS)*, 2023.

ISO/TS 16179, *Footwear — Critical substances potentially present in footwear and footwear components — Determination of organotin compounds in footwear materials*, 2012.

ISO/TS 16189, *Footwear — Critical substances potentially present in footwear and footwear components — Test method to quantitatively determine dimethylformamide in footwear materials*, 2013.

IEC 61000-4-21, *Testing and measurement techniques — Reverberation chamber test methods*, 2011.

2.3.16 PIA Publications. Parachute Industry Association, 6499 S Kings Ranch Road #6-12, Gold Canyon, AZ 85118.

PIA-C-419, *Cloth, duck, unbleached, plied-yarns, army and numbered, Revision B*, March 13, 2011.

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

SAE J211, *Instrumentation for Impact Test*, 2014.

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

UL 913, *Intrinsically Safe Apparatus and Associated Apparatus for Use in Class I, II, III, Division 1, Hazardous (Classified) Locations*, 6th edition, 2002.

UL 121201, *Nonincendive Electrical Equipment for Use in Class I and II, Division 2 and Class III, Divisions 1 and 2 Hazardous (Classified) Locations*, 9th edition, 2017.

2.3.19 US Department of Defense Publications. Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094.

A-A-55126C, *Commercial Item Description, Fastener Tapes, Hook and Loop, Synthetic*, December 21, 2016.

A-A-55634C, *Commercial Item Description, Zippers (Fasteners, Slide, Interlocking)*, October 30, 2019.

2.3.20 US Government Publications. US Government Publishing Office, 732 North Capitol Street, NW, Washington, DC 20401-0001.

Statement of Standard for NIOSH CBRN SCBA Testing, 2002.

Title 29, Code of Federal Regulations, Part 1910.132, "Personal Protective Equipment: General Requirements," 1994.

Title 42, Code of Federal Regulations, Part 84, "Respiratory Protective Devices, Tests for Permissibility."

Title 47, Code of Federal Regulations, Subchapter A, General, Telecommunications, Chapter I, Federal Communications Commission, Part 15, Radio Frequency Devices.

NIOSH Firefighter Anthropometric Data Base (www.cdc.gov/niosh/data/datasets/rd-1007-2015-0/default.html).

2.3.21 Other Publications.

Merriam-Webster's Collegiate Dictionary, 11th edition, Merriam-Webster, Inc., Springfield, MA, 2020.

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

US Department of Defense GL/PD 07-13C, *Purchase Description Coat, Army Combat Uniform,* US Army Natick Research, Development and Engineering Center, Attn: RDNS-WPW-C, Kansas Street, Natick, MA 01760-5019, 2011.

2.4 References for Extracts in Mandatory Sections.

NFPA 1801, *Standard on Thermal Imagers for the Fire Service,* 2021 edition.

Chapter 3 Definitions

3.1 General.

3.1.1 The definitions contained in this chapter shall apply to the terms used in this standard.

3.1.2 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.

3.1.3 *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 3.3.139, 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 phrases "standards development process" or "standards development activities," the term "standards" includes all NFPA standards, including codes, standards, recommended practices, and guides.

3.3* General Definitions.

3.3.1 Accessories (Accessory). An item or items that could be attached to a certified product but are not necessary for the certified product to meet the requirements of the standard.

3.3.2 Alarm Signal. An audible warning that is identifiable as an indication that an emergency services person is in need of assistance.

3.3.2.1 ***Evacuation Alarm.*** An alarm initiated by a base station, transmitted to an RF PASS via an RF signal. The evacuation alarm warns emergency services personnel to evacuate the premises.

3.3.2.2 ***Loss-of-Signal Alarm.*** A visual signal that is initiated automatically when the RF communication between a base station and RF PASS is lost

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

3.3.4 Atmosphere-Supplying Respirator. A respirator that supplies the respirator user with breathing air from a source independent of the ambient atmosphere and includes self-contained breathing apparatus (SCBA) and supplied air respirators (SAR). *[See also 3.3.34, Combination SCBA/SAR; 3.3.185, Self-Contained Breathing Apparatus (SCBA); and 3.3.208, Supplied Air Respirator (SAR).]*

3.3.5 Barrier Hood. See 3.3.205, Structural Firefighting Protective Hood.

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

3.3.7 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.

3.3.8 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.

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

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

3.3.11* Bitragion Inion Arc. The arc between tragion as measured over the inion.

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

3.3.13 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.

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

3.3.15 Breathing Air. See 3.3.41, Compressed Breathing Air.

3.3.16 Breathing Air Cylinder. The pressure vessel or vessels that are an integral part of the SCBA and that contain the breathing gas supply; can be configured as a single cylinder or other pressure vessel, or as multiple cylinders or pressure vessels.

3.3.17 Breathing Air/Gas Container. See 3.3.16, Breathing Air Cylinder.

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

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

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

3.3.21 CBRN. An abbreviation for chemicals, biological agents, and radiological particulates hazards. *(See also 3.3.22, CBRN Terrorism Agents.)*

3.3.22* CBRN Terrorism Agents. Chemicals, biological agents, and radiological particulates that could be released as the result of a terrorist attack. *(See also 3.3.27, Chemical Terrorism Agents; 3.3.9, Biological Terrorism Agents; and 3.3.163, Radiological Particulate Terrorism Agents.)*

3.3.23 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. *(See also 3.3.121, NIOSH Certified.)*

3.3.24 Certification Mark or Label. The authorized identification symbol or logo of the certification organization.

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

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

3.3.27 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 3.3.28, Chemical Warfare (CW) Agents, and 3.3.221, Toxic Industrial Chemicals.)*

3.3.28 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.

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

3.3.30 Closed-Circuit SCBA. A recirculation-type SCBA in which the exhaled gas is rebreathed by the wearer after the carbon dioxide has been removed from the exhalation gas and the oxygen content within the system has been restored from sources such as compressed breathing air, chemical oxygen, liquid oxygen, or compressed gaseous oxygen.

3.3.31 Coat. See 3.3.197, Structural Firefighting Protective Coat, and 3.3.153, Proximity Firefighting Protective Coat.

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

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

3.3.34* Combination SCBA/SAR. An atmosphere-supplying respirator that supplies a respirable atmosphere to the user from a combination of two breathing air sources that both are independent of the ambient environment. *[See also 3.3.4, Atmosphere-Supplying Respirator; 3.3.185, Self-Contained Breathing Apparatus (SCBA); and 3.3.208, Supplied Air Respirator (SAR).]*

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

3.3.36 Compliant Product(s). Garments or equipment that are certified to the applicable NFPA standard.

3.3.37* Component. Any material, part, or subassembly used in the construction of the compliant product.

3.3.38 Component Supplier. The entity that manufactures a material, part, or subassembly used in the construction of the compliant product.

3.3.39 Component Supplier Facility. A facility that is involved in the production of a material, part, or subassembly used in the construction of the compliant product.

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

3.3.41* Compressed Breathing Air. A respirable gas mixture derived from either normal atmospheric air or from manufactured synthetic air, stored in a compressed state in storage cylinders and respirator breathing air cylinders, and supplied to the user in a gaseous form.

3.3.42 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.

3.3.43 Coverall. See 3.3.198, Structural Firefighting Protective Coverall, and 3.3.154, Proximity Firefighting Protective Coverall.

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

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

3.3.46 Cylinder. See 3.3.16, Breathing Air Cylinder.

3.3.47 Demand SCBA. See 3.3.120, Negative Pressure SCBA.

3.3.48 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.

3.3.49* Drag Rescue Device (DRD). A component integrated within the protective coat element to aid in the rescue of an incapacitated firefighter.

3.3.50 DRD. See 3.3.49, Drag Rescue Device (DRD).

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

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

3.3.53 Element(s). See 3.3.58, Ensemble Elements.

3.3.54* Emblems. Shields, heraldry, lettering, or printing that designates a product, a governmental entity, or a specific organization, rank, title, position, or other professional status that is painted, screened, embroidered, sewn, glued, bonded, or otherwise attached to a product in a permanent manner.

3.3.55 End-of-Service-Time Indicator (EOSTI). A warning device on an SCBA that alerts the user that the reserve air supply is being utilized.

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

3.3.57 Ensemble. See 3.3.199, Structural Firefighting Protective Ensemble, and 3.3.155, Proximity Firefighting Protective Ensemble.

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

3.3.59* Entry Firefighting. Extraordinarily specialized firefighting 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.

3.3.60 Fabric Component. Any single or combination of natural or synthetic material(s) that are pliable and that are made by weaving, felting, forming, or knitting.

3.3.61 Facepiece. The component of an SCBA that covers the wearer's nose, mouth, and eyes.

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

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

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

3.3.65 Findings. All materials used in the construction of items, excluding textiles and interlinings.

3.3.66* 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 3.3.96, Inherent Flame Resistance.)*

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

3.3.68 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.

3.3.69* Footwear. See 3.3.201, Structural Firefighting Protective Footwear, and 3.3.157, Proximity Firefighting Protective Footwear.

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

3.3.71 Garment(s). See 3.3.202, Structural Firefighting Protective Garment(s), 3.3.158, Proximity Firefighting Protective Garment, and 3.3.235, Work Apparel Garment.

3.3.72 Gas. Matter in a gaseous state at standard temperature and pressure.

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

3.3.74 Glove. See 3.3.203, Structural Firefighting Protective Glove, and 3.3.159, Proximity Firefighting Protective Glove.

3.3.75 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.

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

3.3.77 Glove Wristlet. See 3.3.236, Wristlet.

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

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

3.3.80* 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.

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

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

3.3.83* Hazardous (Classified) Location (HazLoc). A location where fire or explosion hazards might exist due to flammable or combustible material (e.g., flammable gases, flammable liquid-produced vapors, combustible liquid-produced vapors, combustible dusts, or ignitible fibers/flyings).

3.3.83.1 ***Intrinsic Safety (IS).*** Type of protection where any spark or thermal effect is incapable of causing ignition of a

mixture of flammable or combustible material in air under prescribed test conditions.

3.3.83.1.1 ***Associated Apparatus.*** Electrical equipment that contains both intrinsically safe circuits and nonintrinsically safe circuits and is constructed so that the nonintrinsically safe circuits cannot adversely affect the intrinsically safe circuits.

3.3.83.1.2 ***Intrinsically Safe Apparatus.*** Electrical equipment in which all the circuits are intrinsically safe circuits.

3.3.83.1.3 ***Intrinsically Safe Circuit.*** A circuit in which any spark or thermal effect is incapable of causing ignition of a mixture of flammable or combustible material in air under prescribed test conditions.

3.3.83.1.4 ***Intrinsically Safe System.*** An assembly of interconnected intrinsically safe apparatus, associated apparatus, and interconnecting cables, in that those parts of the system that are used in hazardous (classified) locations are intrinsically safe circuits.

3.3.83.2 ***Nonincendive (NI).*** Type of protection applied to electrical equipment such that, in normal operation and in certain specified regular expected occurrences, it is not capable of igniting a surrounding atmosphere of flammable or combustible material.

3.3.83.2.1 ***Associated Equipment.*** Electrical equipment that contains both nonincendive circuits and other than nonincendive circuits and is constructed so that the other than nonincendive circuits cannot adversely affect the nonincendive circuits.

3.3.83.2.2 ***Maximum External Capacitance, Co.*** Maximum value of capacitance in a circuit that can be connected to the connection facilities of associated equipment functioning as a source.

3.3.83.2.3 ***Maximum External Inductance, Lo.*** Maximum value of inductance in a circuit that can be connected to the connection facilities of associated equipment functioning as a source.

3.3.83.2.4 ***Maximum Input Current, Ii.*** Maximum current that can be applied to the connection facilities of nonincendive equipment functioning as a sink.

3.3.83.2.5 ***Maximum Input Voltage, Ui.*** Maximum voltage that can be applied to the connection facilities of nonincendive equipment functioning as a sink.

3.3.83.2.6 ***Maximum Internal Capacitance, Ci.*** Total equivalent internal capacitance that is considered as appearing across the connection facilities of nonincendive equipment functioning as a sink.

3.3.83.2.7 ***Maximum Internal Inductance, Li.*** Total equivalent internal inductance that is considered as appearing at the connection facilities of nonincendive equipment functioning as a sink.

3.3.83.2.8 ***Maximum Output Current, Io.*** Maximum output current in a circuit that can be provided by the connection facilities of associated equipment functioning as a source under normal operation.

3.3.83.2.9 ***Maximum Output Voltage, Uo.*** Maximum output voltage in a circuit that can appear under open-circuit conditions at the connection facilities of associated equipment functioning as a source under normal operation.

3.3.83.2.10 ***Nonincendive Circuit.*** A circuit, other than nonincendive field wiring, in which any arc or thermal effect produced under normal operating conditions is not capable of igniting a specified flammable or combustible material in air. The circuit is evaluated under prescribed test conditions.

3.3.83.2.11 ***Nonincendive Equipment.*** Equipment having electrical/electronic circuitry that is incapable, under normal operating conditions, of causing ignition of a specified flammable or combustible material in air due to arcing or thermal means.

3.3.83.2.12 ***Nonincendive System.*** An assembly of interconnected nonincendive equipment, associated equipment, and interconnecting cables, in that those parts of the system that are used in hazardous (classified) locations are nonincendive circuits.

3.3.84* Hazardous Materials. Substances (i.e., solid, liquid, or gas) that when released are capable of causing harm to people, the environment, and property.

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

3.3.86 Haze. Light that is scattered as a result of passing through a transparent object.

3.3.87 Head and Torso Simulator (HATS). A manikin with built-in ear and mouth simulators that provides a realistic reproduction of the acoustic properties of an average adult human head and torso.

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

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

3.3.90 Heads-Up Display (HUD). Visual display of information and system condition status visible to the wearer.

3.3.91 Helmet. See 3.3.204, Structural Firefighting Protective Helmet, and 3.3.160, Proximity Firefighting Protective Helmet.

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

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

3.3.94 Hood. See 3.3.205, Structural Firefighting Protective Hood.

3.3.95 Identical SCBA. SCBA that are produced to the same engineering and manufacturing specifications.

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

3.3.97 Insect Repellency. A finish applied to textiles to provide a deterrent against bites from mosquitoes, midges, ants, ticks, and chiggers.

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

3.3.99 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.

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

3.3.101 Interlining. Any textile that is incorporated into any garment as a layer between outer and inner layers.

3.3.102 Label. See 3.3.139, Product Label.

3.3.103 Ladder Shank. See 3.3.189, Shank.

3.3.104 Liner System. The moisture and thermal barrier components as used in a garment.

3.3.105 Liquid Borne Pathogen. See 3.3.12, Body Fluid–Borne Pathogen.

3.3.106 Lower Torso. The area of the body trunk below the waist, excluding the legs, ankles, and feet.

3.3.107 Major A Seam. See 3.3.183.1.

3.3.108 Major B Seam. See 3.3.183.2.

3.3.109 Major Seams. Classes of seams that designate minimum sewn seam requirements.

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

3.3.111 Manufacturing Facility. A facility that is involved in the production, assembly, final inspection, or labeling of the compliant end product.

3.3.112 Melt. A response to heat by a material resulting in evidence of flowing or dripping.

3.3.113 Microphone Measurement Point (MMP). A point 1.5 m in front of and on the axis of the lip position of typical human mouth (or artificial mouth) and 1.5 m above the floor.

3.3.114 Midsagittal Plane. The plane, perpendicular to the basic and coronal planes, that bisects the head symmetrically.

3.3.115 Minor Seam. See 3.3.183.4, Minor Seam.

3.3.116 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.

3.3.117 Moisture Barrier. The component of an element or item that principally prevents the transfer of liquids.

3.3.118 Mouth Reference Point (MRP). A point 50 mm in front of and on the axis of the lip position of a typical human mouth (or artificial mouth).

3.3.119 Nape Device. A component used to aid in helmet retention.

3.3.120 Negative Pressure SCBA. An SCBA in which the pressure inside the facepiece, in relation to the pressure surrounding the outside of the facepiece, is negative during any part of the inhalation or exhalation cycle when tested by NIOSH in accordance with 42 CFR 84.

3.3.121* NIOSH Certified. Tested and certified by the National Institute for Occupational Safety and Health (NIOSH) of the US Department of Health and Human Services in accordance with the requirements of 42 CFR 84, Subpart H.

3.3.122 Nonprimary Protective Garment. A garment or clothing that is not designed nor intended to be the barrier of protection from a specific hazard exposure.

3.3.123 Open-Circuit SCBA. An SCBA in which exhalation is vented to the atmosphere and not rebreathed.

3.3.124 Outer Shell. The outermost component of an element or item not including trim, hardware, reinforcing material, pockets, wristlet material, accessories, fittings, or suspension systems.

3.3.125* Particulate Blocking Layer. The layer(s) of an element or item that principally inhibits the ingress of particles.

3.3.126* Particulates. Finely divided solid matter that is dispersed in air.

3.3.127 PASS. Acronym for Personal Alert Safety Systems. See also 3.3.132, Personal Alert Safety Systems (PASS).

3.3.128 PASS Annunciator. The component designed to emit audible signals.

3.3.129* Passive Electrical Circuitry. Electrical circuitry that has no integral power source and is energized by a supplemental device.

3.3.130 Patches. See 3.3.54, Emblems.

3.3.131 Percent Inward Leakage. The ratio of vapor concentration inside the ensemble versus the vapor concentration outside the ensemble expressed as a percentage.

3.3.132 Personal Alert Safety Systems (PASS). A device that continually senses for lack of movement of the wearer and automatically activates the alarm signal, indicating the wearer is in need of assistance; can also be manually activated to trigger the alarm signal.

3.3.132.1 ***Integrated PASS.*** A removable or nonremovable PASS that is an integral part of another item or items of protective clothing, protective equipment, or both.

3.3.132.1.1 ***Nonremovable.*** An integrated PASS that is not removable and cannot be used independently of the item or items with which it is integrated.

3.3.132.1.2 ***Removable.*** An integrated PASS that is removable so that it can be used independently of the item or items with which it is integrated.

3.3.132.2 ***RF PASS.*** A PASS that contains an optional RF transceiver that enables the PASS to automatically transmit an alarm signal and receive evacuation alarms via RF signals; responds to an evacuation alarm with an audible and visual signal.

3.3.132.2.1 ***Base Station.*** An RF transceiver used in conjunction with an RF PASS that monitors for an alarm signal and emits a visual signal when this alarm is received. The base station is capable of sending an evacuation alarm to the RF PASS.

3.3.132.3 ***Stand-Alone PASS.*** A PASS that is not an integral part of any other item of protective clothing or protective equipment.

3.3.133* PFAS. An abbreviation for perfluoroalkyl and polyfluoroalkyl substances, which are a class of organic chemicals containing at least one fully fluorinated carbon atom.

3.3.134 Pink Noise. Noise that contains constant energy per octave band.

3.3.135 Positive Pressure SCBA. An SCBA in which the pressure inside the facepiece, in relation to the pressure surrounding the outside of the facepiece, is positive during both inhalation and exhalation when tested by NIOSH in accordance with 42 CFR 84, Subpart H.

3.3.136 Prealarm Signal. An audible warning that is identifiable as an indication that a PASS is about to sound the alarm signal.

3.3.137 Pressure Demand SCBA. See 3.3.135, Positive Pressure SCBA.

3.3.138 Primary Protective Garment. A garment that is designed, certified, and intended to be the barrier of protection from a specific hostile environment.

3.3.139* 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.

3.3.140 Protective Clothing. See 3.3.196, Structural Firefighting Protective Clothing, and 3.3.155, Proximity Firefighting Protective Ensemble.

3.3.141 Protective Coat. See 3.3.197, Structural Firefighting Protective Coat, and 3.3.153, Proximity Firefighting Protective Coat.

3.3.142 Protective Coverall. See 3.3.198, Structural Firefighting Protective Coverall, and 3.3.154, Proximity Firefighting Protective Coverall.

3.3.143 Protective Ensemble. See 3.3.199, Structural Firefighting Protective Ensemble, and 3.3.155, Proximity Firefighting Protective Ensemble.

3.3.144 Protective Footwear. See 3.3.201, Structural Firefighting Protective Footwear, and 3.3.157, Proximity Firefighting Protective Footwear.

3.3.145 Protective Garment. See 3.3.202, Structural Firefighting Protective Garment(s), and 3.3.158, Proximity Firefighting Protective Garment.

3.3.146 Protective Gloves. See 3.3.203, Structural Firefighting Protective Glove, and 3.3.159, Proximity Firefighting Protective Glove.

3.3.147 Protective Helmet. See 3.3.204, Structural Firefighting Protective Helmet, and 3.3.160, Proximity Firefighting Protective Helmet.

3.3.148 Protective Hood. See 3.3.205, Structural Firefighting Protective Hood.

3.3.149 Protective Trousers. See 3.3.206, Structural Firefighting Protective Trousers, and 3.3.161, Proximity Firefighting Protective Trousers.

3.3.150 Protective Wristlet. See 3.3.236, Wristlet.

3.3.151* Proximity Firefighting. Specialized firefighting 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.

3.3.152 Proximity Firefighting Protective Clothing. See 3.3.155, Proximity Firefighting Protective Ensemble.

3.3.153 Proximity Firefighting Protective Coat. The element of the protective ensemble that provides protection to upper torso and arms, excluding the hands and head.

3.3.154 Proximity Firefighting Protective Coverall. The element of the protective ensemble that provides protection to the torso, arms, and legs, excluding the head, hands, and feet.

3.3.155 Proximity Firefighting 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.

3.3.156 Proximity Firefighting Protective Ensemble with Optional Liquid and Particulate Contaminant Protection. A compliant proximity firefighting protective ensemble that is also certified as an entire ensemble to meet the optional requirements for protection from liquid and particulate contaminants.

3.3.157 Proximity Firefighting Protective Footwear. The element of the protective ensemble that provides protection to the foot, ankle, and lower leg.

3.3.158 Proximity Firefighting Protective Garment. The coat, trouser, and coverall elements of the protective ensemble.

3.3.159 Proximity Firefighting Protective Glove. The element of the protective ensemble that provides protection to the hand and wrist.

3.3.160 Proximity Firefighting Protective Helmet. The element of the protective ensemble that provides protection to the head.

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

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

3.3.163* 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.

3.3.164 Rapid Intervention Crew/Company Universal Air Connection (RIC UAC). A system that allows emergency replenishment of breathing air to the SCBA of disabled or entrapped fire or emergency services personnel.

3.3.165 Rated Service Time. The period of time, stated on the SCBA's NIOSH certification label, that the SCBA supplied air to the breathing machine when tested to 42 CFR 84, Subpart H.

3.3.166 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.

3.3.167* Recognized Component. Any material, part, or subassembly used in the construction of the compliant product that has undergone an evaluation by a certification organization that allows the manufacturer to label the item as recognized.

3.3.168 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.

3.3.169 Reserve Air Supply. The period of time available for emergency egress, self-rescue, or assisted rescue.

3.3.170* Restricted Substance. A specific substance that poses a potential threat to human health or the environment, which can include, but is not limited to, an ingredient, treatment, or byproduct of manufacturing that is subject to specific concentration limits or being present in a material or component used in the construction of a protective element.

3.3.171* Restricted Substance Attestation Organization. An independent organization that provides test services for assuring supplier conformity of materials or components used in protective elements against the criteria in a recognized restricted substances list.

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

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

3.3.174 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.

3.3.175 RF Interference. An unwanted radio-frequency signal that is present in the vicinity of an RF PASS system that could impede reception of an alarm signal or evacuation alarm.

3.3.176 RF Transceiver. A radio system capable of both transmitting and receiving a modulated radio-frequency (RF) signal that is then converted to an audio and/or data signal; used to transmit and receive signals such as the alarm signal and the evacuation alarm for RF PASS.

3.3.177 RIC. Abbreviation for rapid intervention crew/company.

3.3.178 Safety Alert. The procedure by which a manufacturer notifies users, the marketplace, and distributors of potential safety concerns regarding a product.

3.3.179 Sample. (1) The ensemble, element, component, or composite that is conditioned for testing *(see also 3.3.192, Specimen)*; (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.

3.3.180 SAR. Abbreviation for supplied air respirator. *[See 3.3.208, Supplied Air Respirator (SAR).]*

3.3.181 SCBA. Abbreviation for self-contained breathing apparatus. *[See 3.3.185, Self-Contained Breathing Apparatus (SCBA).]*

3.3.182 SCBA/SAR. Abbreviation for combination open-circuit SCBA and supplied air respirator. *[See 3.3.34, Combination SCBA/SAR; 3.3.185, Self-Contained Breathing Apparatus (SCBA); and 3.3.208, Supplied Air Respirator (SAR).]*

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

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

3.3.183.2 *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.

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

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

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

3.3.185* Self-Contained Breathing Apparatus (SCBA). An atmosphere-supplying respirator that supplies a respirable air atmosphere to the user from a breathing air source that is independent of the ambient environment and designed to be carried by the user.

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

3.3.187 Service Life. The period for which compliant product may be useful before retirement.

3.3.188 Service Time. See 3.3.165, Rated Service Time.

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

3.3.190 Shell. See 3.3.124, Outer Shell.

3.3.191 Sound Pressure Level (SPL). The local pressure deviation from the ambient (average, or equilibrium) atmospheric pressure caused by a sound wave.

3.3.192 Specimen. The conditioned ensemble, element, item, or component that is tested. Specimens are taken from samples. *(See also 3.3.179, Sample.)*

3.3.193 Speech Transmission Index (STI). A measure of intelligibility of speech quality on a scale of intelligibility, whose values vary from 0 (completely unintelligible) to 1 (perfect intelligibility).

3.3.194 Structural Firefighting. 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.

3.3.195 Structural Firefighting 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.

3.3.196 Structural Firefighting Protective Clothing. See 3.3.199, Structural Firefighting Protective Ensemble.

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

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

3.3.199* Structural Firefighting 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.

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

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

3.3.202 Structural Firefighting Protective Garment(s). The coat, trouser, and coverall elements of the protective ensemble.

3.3.203 Structural Firefighting Protective Glove. The element of the protective ensemble that provides protection to the hand and wrist.

3.3.204 Structural Firefighting Protective Helmet. The element of the protective ensemble that provides protection to the head.

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

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

3.3.207 Supplementary Voice Communications System. An optional electronic voice amplification communication system in addition to a nonelectronic transmission system.

3.3.208* Supplied Air Respirator (SAR). An atmosphere-supplying respirator for which the source of breathing air is not designed to be carried by the user; also known as an *airline respirator. [See also 3.3.4, Atmosphere-Supplying Respirator; 3.3.34, Combination SCBA/SAR; and 3.3.185, Self-Contained Breathing Apparatus (SCBA).]*

3.3.209 Surrogate Cylinder. A breathing air cylinder for testing only in which the mass of the breathing air is replaced by a substitute mass.

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

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

3.3.212 Synthetic Breathing Air. A manufactured breathing air that is produced by blending nitrogen and oxygen. *(See also 3.3.41, Compressed Breathing Air.)*

3.3.213 Tensile Strength. The force at which a fiber or fabric will break when pulled in one dimension.

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

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

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

3.3.217* 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.

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

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

3.3.220* Total Fluorine. A measurement that includes organic and inorganic fractions of fluorine.

3.3.221 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.

3.3.222* Trim. Retroreflective and fluorescent materials attached to the outermost surface of the protective ensemble for visibility enhancement.

3.3.223 Trouser. See 3.3.206, Structural Firefighting Protective Trousers, and 3.3.161, Proximity Firefighting Protective Trousers.

3.3.224 UAC. Abbreviation for universal air connection.

3.3.225 Universal Air Connection (UAC). The male fitting, affixed to the SCBA, and the female fitting, affixed to the filling hose, to provide emergency replenishment of breathing air to an SCBA breathing air cylinder. Also known as Rapid Intervention Crew/Company Universal Air Connection.

3.3.226 Universal Emergency Breathing Safety System (UEBSS). A device on an SCBA that allows users to share their available air supply in an emergency situation through a standardized interoperable connection.

3.3.227* 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.

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

3.3.229* Visibility Markings. Retroreflective and fluorescent conspicuity enhancements.

3.3.230 Voice Communications System. Nonelectronic transmission system to project sound.

3.3.231 Water Resistance. A finish or an inherent property that limits the absorption of water.

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

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

3.3.234 Work Apparel. Nonprimary protective garments certified as compliant with this standard that are intended to be worn by emergency services personnel while on duty.

3.3.235 Work Apparel Garment. Textile apparel that cover the torso and limbs or parts of limbs, excluding heads, hands, and feet.

3.3.236 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 Certification Requirements (NFPA 1971; NFPA 1975; NFPA 1981; NFPA 1982).

4.1.1 The process of certification of products as being compliant with NFPA 1971, NFPA 1975, NFPA 1981, or NFPA 1982, as incorporated within NFPA 1970 shall meet the requirements of Chapter 4, along with the associated certification requirements in Chapter 5, Chapter 10, Chapter 15, or Chapter 20.

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* Manufacturers shall not claim compliance with a portion(s) or segment(s) of the applicable requirements of this standard and shall not use the name or identification of this standard, NFPA 1971, NFPA 1975, NFPA 1981, or NFPA 1982, in any statements about their respective products unless the product is certified to the applicable standard incorporated in NFPA 1970.

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

4.1.4 All compliant products shall be labeled and listed. The listing shall uniquely identify the certified product by, at a minimum, style, model number, or part number.

4.1.4.1 The certification organization shall be required to identify the element or component in the certification listing as used by the manufacturer to identify the product to end users.

4.1.5 All compliant products shall also have a product label that meets the requirements specified in the applicable product label requirements.

4.1.6 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.

4.2 Certification Program.

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

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

4.2.3 The certification organization shall be accredited for 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/IEC 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 tests to determine product compliance.

4.2.6.1 The certification organization laboratory facilities shall have in place a program and functioning for calibration of all instruments, and procedures shall be in use to ensure 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, Compliant Product Manufacturers' Quality Assurance Program.

4.2.7.1* The certification organization shall require the manufacturer to have a product recall system as specified in Section 4.9, 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 for *manufacturing facility*, provided in 3.3.111.

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 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 annual verification.

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 4.7, Hazards Involving Compliant Product, that address report(s) of situation(s) in which a compliant product is subsequently found to be hazardous.

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

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

4.3* Inspection and Testing.

4.3.1 For both initial certification and annual verification of compliant products, the certification organization shall conduct both inspection and testing as specified in Section 4.3, Inspection and Testing.

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

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

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

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

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

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

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

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

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

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

4.3.5 Inspection and evaluation by the certification organization shall include a review of all product labels to ensure that all required label attachments, compliance statements, certification statements, and other product information are at least as specified for the products identified in Chapter 6 (NFPA 1971), Chapter 11 (NFPA 1975), Chapter 16 (NFPA 1981), or Chapter 21 (NFPA 1982).

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 6.1.5 (NFPA 1971), 11.1.8 (NFPA 1975), 16.1.5 (NFPA 1981), or 21.1.4 (NFPA 1982) to ensure that the symbols are explained in the product's user information package.

4.3.7 Inspection by the certification organization shall include a review of the user information required by Sections 6.5 (NFPA 1971), 11.2 (NFPA 1975), 16.2 (NFPA 1981), or 21.2 (NFPA 1982) 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 7 (NFPA 1971), Chapter 12 (NFPA 1975), Chapter 17 (NFPA 1981), or Chapter 22 (NFPA 1982) shall be performed on whole or complete products.

4.3.9 Inspection and evaluation by the certification organization for determining compliance of recognized components per the requirements specified in 7.1.14, 7.4.9, 7.7.6, 7.10.10, and 7.13.7 shall be permitted to consist of a review of any available test data provided by the component supplier.

4.3.9.1 Data submitted by the component supplier shall be evaluated against the requirements in Table 8.21(a) to determine compliance of the recognized component.

4.3.9.2* This evaluation shall be required only for initial certification or if there is a change to the materials used in the recognized component.

4.3.9.3 The data submitted by the component supplier for the purposes of demonstrating compliance to these requirements must not be greater than five years from the initial certification date of that component to this standard.

4.3.9.4 The test data submitted by the component supplier for demonstrating compliance with the requirements in 7.1.14, 7.4.9, 7.7.6, 7.10.10, and 7.13.7 generated by a testing laboratory shall be accredited to ISO 17025, *General requirements for the competence of testing and calibration laboratories*.

4.3.9.5 Any test data that is required to demonstrate compliance with 7.1.14, 7.4.9, 7.7.6, 7.10.10, 7.13.7, and Section 8.21 that is not submitted by the component supplier shall be subjected to the requirements as outlined in those paragraphs.

4.3.9.6 Suppliers of recognized components shall be permitted to make specific claims related to the PFAS levels in their specific materials or components according to 6.1.7.5, which in turn can be applied by protective elements manufacturers as the basis of their optional claims according to 6.1.7.5.

4.3.9.6.1 Suppliers of recognized components shall be permitted to provide a certificate with test results demonstrating compliance with the optional claim where the organization performing the testing meets the following requirements:

(1) The test organization shall be independent from the supplier.
(2) The test organization is accredited in accordance with the requirements of ISO 17025, *General requirements for the competence of testing and calibration laboratories*, for performing total fluorine by combustion ion chromatography.
(3) The test organization shall provide a separate test report along with the certificate that meets the requirements of 6.5.11 and 6.5.11.1.

4.3.10* In lieu of the requirements in 4.3.9, compliance of recognized components to the requirements specified in 7.1.14, 7.4.9, 7.7.6, 7.10.10, 7.13.7, and Section 8.21 shall be permitted to be based on a certificate provided by a restricted substance attestation organization that meets the following requirements:

(1) The restricted substance attestation organization shall be independent from the supplier.
(2) The restricted substance attestation organization shall use a restricted substance list that is equivalent to or more rigorous than the specific criteria for restricted substances in Section 8.21.
(3) Laboratories conducting the evaluations of restricted substances shall be accredited in accordance with the requirements of ISO 17025, *General requirements for the competence of testing and calibration laboratories*, with analytical testing for restricted substances as part of its scope.
(4) A separate test report shall be provided, along with the certificate, that provides the results of all applicable restricted substances evaluations.

4.3.10.1* The certificate in 4.3.10 shall be required only for initial certification or if there is a change to the materials used in the recognized component.

4.3.11 Where the compliant product manufacturer utilizes a proprietary material or materials, the required testing shall be permitted to be part of the compliant product certification in lieu of the component being recognized.

4.4 Annual Verification. All products that are labeled as being compliant with this standard shall, on an annual basis, undergo a verification evaluation to all requirements as required by this standard.

4.5 Compliant Product Manufacturers' Quality Assurance Program.

4.5.1 The compliant product manufacturer shall provide and operate a quality assurance program that meets the requirements of Section 4.5, Compliant Product Manufacturers' Quality Assurance Program, and that includes a product recall system as specified in 4.2.7.1 and Section 4.9, 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) Compliant product manufacturer
(2) Compliant product manufacturing facility
(3) Entity that directs and controls compliant product design
(4) Entity that directs and controls compliant product quality assurance
(5) Entity that provides the warranty for the compliant product
(6) Entity that puts their name on the product label and markets and sells the product as their own

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* Any entity that meets the definition of *manufacturer* specified in 3.3.110, and therefore is considered to be the "manufacturer" but that does not manufacture or assemble the compliant product, shall meet the requirements specified in Section 4.5, Compliant Product Manufacturers' Quality Assurance Program.

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

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

4.5.6.1 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.

4.5.6.2 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* Recognized Component Supplier Quality Assurance Program.

4.6.1 General.

4.6.1.1 The supplier shall provide and maintain a quality assurance program that includes a documented inspection and product recall system.

4.6.1.2 The supplier shall have an inspection system to substantiate conformance to this standard.

4.6.1.3 The supplier shall be permitted to be registered to ISO 9001, *Quality Management Systems — Requirements,* in lieu of meeting the requirements of 5.4.2 through 5.4.6.

4.6.2 Instructions.

4.6.2.1 The supplier shall maintain written inspection and testing instructions.

4.6.2.2 The instructions shall prescribe inspection and test of materials, work in process, and completed articles.

4.6.2.3 Criteria for acceptance and rejection of materials, processes, and final product shall be part of the instructions.

4.6.3 Records.

4.6.3.1 The supplier shall maintain records of all "pass" and "fail" tests.

4.6.3.2 Records shall indicate the disposition of the failed materials or products.

4.6.4 Inspection System. The supplier's inspection system shall provide for procedures that assure the latest applicable drawings, specifications, and instructions are used for fabrication, inspection, and testing.

4.6.5 Calibration Program. The supplier shall maintain, as part of the quality assurance program, a calibration program of all instruments used to ensure control of testing.

4.7 Hazards Involving Compliant Product.

4.7.1 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.

4.7.2* 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.

4.7.3 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.

4.7.4 Where a specific hazard is identified, the determination of the 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.

4.7.5 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.

4.7.6 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.

4.7.7 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.

4.7.8 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, Hazards Involving Compliant Product.

4.7.9 Where the facts indicating a need for corrective action are scientifically supported and there is a manufacturer to be held responsible that has exhausted all appeal rights, the certification organization shall initiate corrective action immediately.

4.7.10* Where the facts are scientifically supported and corrective action is indicated but there is no manufacturer to be held responsible, the certification organization shall immediately notify relevant governmental and regulatory agencies and issue a notice to the user community about the hazard.

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

(1) Parties authorized and responsible for issuing a safety alert shall be notified when, in the opinion of the certification organization, such a safety alert is necessary to inform the users.
(2) Parties authorized and responsible for issuing a product recall shall be notified when, in the opinion of the certification organization, such a recall is necessary to protect the users.
(3) The mark of certification shall be removed from the product.
(4) Where a hazardous condition exists and it is not practical to implement 4.7.11(1), 4.7.11(2), or 4.7.11(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.

4.7.12 The certification organization shall provide a report to the organization or individual identifying the reported hazard-

ous condition and notify them of the corrective action indicated or that no corrective action is indicated.

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

4.8 Manufacturers' Investigation of Complaints and Returns.

4.8.1 Manufacturers shall provide corrective action in accordance with ISO 9001, *Quality management systems — Requirements,* for investigating written complaints and returned products.

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

4.8.3 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 its review to assist the certification organization with its investigation.

4.9 Manufacturers' Safety Alert and Product Recall Systems.

4.9.1 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.

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

(1) The establishment of a coordinator and responsibilities by the manufacturer for the handling of safety alerts and product recalls
(2) A method of notifying all dealers, distributors, purchasers, users, and NFPA about the safety alert or product recall that can be initiated within a 1-week period following the manufacturer's decision to issue a safety alert or to conduct a product recall, or after the manufacturer has been directed by the certification organization or NIOSH/NPPTL if the product is certified to NFPA 1981, to issue a safety alert or conduct a product recall
(3) Techniques for communicating 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 repairing, or replacing, or compensating purchasers for returned product

Chapter 5 Scope and Certification Requirements (NFPA 1971)

5.1 Administration.

5.1.1* Scope.

5.1.1.1 Chapters 5 through 9 of this standard shall specify the minimum design, performance, testing, and certification requirements for structural firefighting protective ensembles and ensemble elements that include coats, trousers, coveralls, helmets, gloves, footwear, interface components, and other components utilized to construct these elements.

5.1.1.2 Chapters 5 through 9 of this standard shall specify the minimum design, performance, testing, and certification requirements for proximity firefighting protective ensembles and ensemble elements that include coats, trousers, coveralls, helmets, gloves, footwear, and interface components, and other components utilized to construct these elements.

5.1.1.3* Chapters 5 through 9 of this standard shall also specify additional optional requirements for structural firefighting protective ensembles and proximity firefighting protective garments that will provide limited protection from liquid and particulate hazards.

5.1.1.3.1 Chapters 5 through 9 of this standard shall not specify requirements for protection against CBRN terrorism agents.

5.1.1.4 Chapters 5 through 9 of this standard shall specify requirements for new structural firefighting protective ensembles, new proximity firefighting protective ensembles, or new elements for both ensembles.

5.1.1.5* Chapters 5 through 9 of this standard shall not apply to firefighting overhaul operations as it relates to protective coats and trousers. Coats and trousers for overhaul shall meet the requirements of NFPA 1951. All other elements of the protective ensemble for structural firefighting shall apply.

5.1.1.6* Chapters 5 through 9 of 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.

5.1.1.7* This standard shall not specify PPE requirements for nonstructural fire responses.

5.1.1.8 Other than the testing for certification of structural or proximity protective garments to the optional liquid and particulate hazard protection requirements, Chapters 5 through 9 shall not specify the respiratory protection that is necessary for protection with structural or firefighting protective ensembles.

5.1.1.9 Certification of compliant structural firefighting protective ensembles, compliant proximity firefighting protective ensembles, and compliant elements of both ensembles to the requirements of Chapters 5 through 9 of this standard shall not preclude certification to additional standards where the ensemble or ensemble element meets all the applicable requirements of each standard.

5.1.1.10 Chapters 5 through 9 of 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.

5.1.1.11 Chapters 5 through 9 of 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 Chapters 5 through 9 for any designing, manufacturing, and testing.

5.1.1.12 Nothing in this standard shall restrict any jurisdiction or manufacturer from exceeding these minimum requirements.

5.1.2* Purpose.

5.1.2.1 The purpose of Chapters 5 through 9 of this standard shall be to establish minimum levels of protection for firefighting personnel assigned to fire department operations including, but not limited to, structural firefighting, proximity firefighting, rescue, emergency medical, and other emergency first responder functions.

5.1.2.1.1* To achieve this purpose, Chapters 5 through 9 of this standard shall establish minimum requirements for structural firefighting protective ensembles and ensemble elements designed to provide firefighting personnel limited protection from thermal, physical, environmental, biological, chemical, electrical, person-position, person-equipment, and other hazards encountered during structural firefighting operations.

5.1.2.1.2 To achieve this purpose, Chapters 5 through 9 of this standard shall establish minimum requirements for proximity firefighting protective ensembles and ensemble elements designed to provide firefighting 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, biological, chemical, electrical, person-position, person-equipment, and other hazards encountered during proximity firefighting operations. *(See also, A.5.1.2.1.1.)*

5.1.2.2 The purpose of Chapters 5 through 9 of this standard shall also be to establish a minimum level of protection for structural and proximity firefighting personnel from exposure to liquid and particulate contaminants as an option for compliant structural firefighting garments, for compliant proximity firefighting garments, and for compliant elements for both garments.

5.1.2.3* Controlled laboratory tests used to determine compliance with the performance requirements of Chapters 5 through 9 of this standard shall not be deemed as establishing performance levels for all situations to which personnel can be exposed.

5.1.2.4 Chapters 5 through 9 of 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.

5.1.2.5 The purpose of this standard shall not be to establish minimum levels of protection for non-firefighting incidents such as, but not limited to, technical rescue, vehicle extrication, medical, search and rescue, wildland and urban interface, and nonfire roadway incidents.

5.1.3 Application.

5.1.3.1 Chapters 5 through 9 of this standard shall apply to the design, manufacturing, testing, and certification of new structural firefighting protective ensembles, new proximity firefighting protective ensembles, and new elements of both ensembles for protection from thermal, physical, environmental, and bloodborne pathogen hazards encountered during structural firefighting operations.

5.1.3.2* Chapters 5 through 9 of this standard shall apply to the design, manufacturing, testing, and certification of new structural firefighting protective ensembles, new proximity firefighting protective ensembles, and new garment elements of both ensembles for additional optional protection from liquid and particulate contaminants.

5.1.3.2.1 This standard shall also apply to the design, manufacturing, testing, and certification of new structural firefighting protective hoods and new proximity firefighting protective hoods for additional protection from particulate contaminants.

5.1.3.3 Chapters 5 through 9 of this standard shall not apply to any protective ensembles, ensemble elements, or protective clothing for any other types of firefighting operations.

5.1.3.4 Chapters 5 through 9 of this standard shall not apply to structural firefighting protective ensembles manufactured according to previous editions of NFPA 1971.

5.1.3.5 Chapters 5 through 9 of this standard shall not apply to structural firefighting protective clothing and equipment manufactured according to past editions of NFPA 1971, NFPA 1972, NFPA 1973, and NFPA 1974.

5.1.3.6 Chapters 5 through 9 of this standard shall not apply to proximity firefighting protective ensembles manufactured according to previous editions of NFPA 1976.

5.1.3.7 Chapters 5 through 9 of this standard shall not apply to proximity firefighting protective clothing and equipment manufactured according to past editions of NFPA 1976.

5.1.3.8 Chapters 5 through 9 of 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 Chapters 5 through 9. *(See A.5.1.1.6.)*

5.1.3.9 Chapters 5 through 9 of this standard shall not apply to the use of structural firefighting protective ensembles, proximity firefighting protective ensembles, or elements of these ensembles since these requirements are specified in NFPA 1550.

5.1.4 Units.

5.1.4.1 In Chapters 5 through 9 of this standard, values for measurement are followed by an equivalent in parentheses, but only the first stated value shall be regarded as the requirement.

5.1.4.2 Equivalent values in parentheses shall not be considered as the requirement, as these values are approximate.

5.2 General.

5.2.1 The process of certification for structural and proximity ensembles as being compliant with Chapters 5 through 9 of this standard shall meet the requirements of Sections 4.1 through 4.9.

5.2.2 All compliant products that are labeled as being compliant with Chapters 5 through 9 of this standard shall meet or exceed all applicable requirements specified in Chapters 5 through 9 and shall be certified.

5.2.3 The certification organization shall not issue any new certifications based on the 2018 edition of NFPA 1971 after the NFPA effective date of the 2025 edition of NFPA 1970.

5.2.4 The certification organization shall not permit any manufacturer to continue to label any products that are certified as compliant with the 2018 edition of NFPA 1971 on the effective date of the 2025 edition of NFPA 1970, plus 12 months.

5.2.5 The certification organization shall require manufacturers to remove all certification labels and product labels indicating compliance with the 2018 edition of NFPA 1971 from all products that are under the control of the manufacturer on the effective date of the 2025 edition of NFPA 1970, plus 12 months, and the certification organization shall verify that this action is taken.

5.2.6 For calculating the results of garment composite testing in accordance with Section 9.7.2, the requirements of 5.2.6.1 through 5.2.6.11 shall apply. *(See also A.9.7.2.1.2.)*

5.2.6.1 A control fabric consisting of a 254 g/m^2 (7.5 oz/yd^2) woven 93 percent meta-aramid, 5 percent para-aramid, and 2 percent antistat fiber shall be tested in accordance with 9.7.2.5 and referred to as "Result A."

5.2.6.2 The moisture barrier layer and thermal barrier layer for a specific garment composite shall be tested in conjunction with the control fabric in accordance with 9.7.2.5 with all layers arranged in the order and orientation as worn.

5.2.6.3 The evaporative resistance of the control fabric with moisture barrier layer and thermal barrier layer shall be recorded and referred to as "Result B."

5.2.6.4 If a specific moisture barrier layer and thermal barrier layer combination has been previously tested, it shall not be necessary to perform the steps in 5.2.6.1 through 5.2.6.2 .

5.2.6.5 The outer shell layer for a specific composite shall be individually tested in accordance with 9.7.2.5 and referred to as "Result C."

5.2.6.6 If a specific outer shell has been previously tested, it shall not be necessary to perform the step in 5.2.6.5.

5.2.6.7 The difference, "Difference D," between the control fabric evaporative resistance of "Result A" and the garment composite evaporative resistance "Result B" shall be calculated according to the following equation:

[5.2.6.7]

$$\text{Difference D} = \text{Result B} - \text{Result A}$$

5.2.6.8 The sum, "Sum E," of the garment outer shell evaporative resistance "Result C" and calculated moisture barrier layer

and thermal barrier layer combination evaporative resistance of "Difference D" shall be calculated according to the following equation:

[5.2.6.8]

$$\text{Sum E} = \text{Result C} + \text{Difference D}$$

5.2.6.9 The individual replicate evaporative resistances in m^2Pa/W shall be calculated, recorded, and reported along with the identification of the specific layers as follows:

(1) For "Result A": recorded and reported
(2) For "Result B": recorded and reported
(3) For "Result C": recorded and reported
(4) For "Difference D": calculated, recorded, and reported
(5) For "Sum E": calculated, recorded, and reported

5.2.6.10* The average evaporative resistance in m^2Pa/W for the garment outer shell "Result C," combination of moisture barrier layer and thermal barrier layer "Difference D," and calculated garment composite "Sum E" shall be calculated, recorded, and reported.

5.2.6.11 If the "Sum E" value compared to the original certification value is within 10 percent, the following shall apply:

(1) The model calculation shall be considered acceptable for the purposes of annual verification.
(2) Testing of the actual composite shall not be required.

5.3 Inspection and Testing.

5.3.1 Testing to determine product compliance with the performance requirements specified in Chapter 8 shall be conducted by the certification organization in accordance with the specified testing requirements of Chapter 9.

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

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

5.3.2 Where the certification organization has findings of noncompliance during initial certification or annual verification testing, the certification organization shall have procedures in place requiring the manufacturer to undertake a root cause analysis, providing a rationale for their noncompliant results, and a corrective action for how the subject element, material, or component is changed or specific problems with the testing that must be addressed in any retesting.

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

5.3.4 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.

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

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

5.3.7 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.

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

5.3.9 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 annual verification shall be conducted before labeling the modified product as being compliant with this standard.

5.3.9.1 The manufacturer shall require the component manufacturer to provide a new unique product or component name and apply a separate listing for any retesting of an already qualified product that results in new performance properties that represents a significant change from the original test properties.

5.3.10 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.

5.3.11* For certification of structural firefighting helmet elements, a test series shall consist of 14 helmets.

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

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

5.3.12* For certification of proximity firefighting helmet elements, a test series shall consist of 14 helmets.

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

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

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

5.4 Annual Verification.

5.4.1 The annual verification shall include the following:

(1) Inspection and evaluation to all design requirements as required by this standard on all manufacturer models and components, as follows:
    (a) For ensembles and ensemble elements being evaluated in accordance with Chapter 7, one specimen of each model containing a representation of available components shall be submitted.

(b) Where the ensemble or ensemble element is manufactured at multiple manufacturing facilities and the design is the same at all of those facilities, one sample from any one manufacturing facility shall be submitted.

(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 9.1.12 and the test generates quantitative results, annual verification 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 9.1.12 and the test generates nonquantitative results (e.g., pass/fail for melt/drip), annual verification shall be limited to a single conditioning procedure in any given year, with subsequent annual verifications cycling 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 verification.

(d) Where a test method requires the testing of five or more specimens, a minimum of two specimens shall be tested for annual verification.

(e) Minor seams shall only be tested in accordance with Section 9.3.4 during initial certification.

5.4.2 At least one sample of each compliant product and component shall be tested for overall performance as specified in Chapter 8 according to the following protocol:

(1) Where a test method incorporates testing both before and after laundering conditioning specified in 9.1.12 and the test generates quantitative results, annual verification 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 9.1.12 and the test generates nonquantitative results (e.g., pass/fail for melt/drip), annual verification shall be limited to a single conditioning procedure in any given year. Subsequent annual verifications 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 verification, unless otherwise specified in this standard.

(4) Where a test method requires the testing of five or more specimens, a minimum of two specimens shall be tested for annual verification, unless otherwise specified in this standard.

(5) Testing of garments for the optional liquid and particulate contaminant protection shall only be performed during initial certification.

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

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

5.4.5 Samples of manufacturer models and components for annual verification shall be acquired as part of the follow-up program in accordance with 4.2.9 and shall be permitted to be used toward annual verification.

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

5.5 Additional General Certification Requirements. The certification organization shall include, as part of the product listing, the required user information and any other information or test results for the respective certified ensemble element or recognized component identified in Chapters 1 through 8.

Chapter 6 Labeling and Information (NFPA 1971)

6.1 Product Label Requirements for Both Ensembles.

6.1.1* 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.

6.1.1.1 Recognized components shall have identifiable markings either on the product itself, or on the smallest unit packaging.

6.1.2 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.

6.1.3* 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.

6.1.3.1 Where the product is labeled as a recognized component, the certification organization's label, symbol, or identifying mark shall be distinct from the certification organization's label, symbol, or identifying mark used on ensemble elements.

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

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

6.1.6 The compliance statements specified in Section 6.2, Additional Product Label Requirements for Structural Firefighting Ensemble Elements Only, for structural firefighting protective ensemble elements and in Section 6.3, Additional Product Label Requirements for Proximity Firefighting Ensemble Elements Only, for proximity firefighting protective ensemble elements shall be printed legibly on the product label.

6.1.7 The information contained in Table 6.1.7 shall be printed on each product label or printed directly on the product, or product packaging, where permissible, with all letters at least 1.5 mm ($\frac{1}{16}$ in.) in height.

6.1.7.1 Principal materials shall include the individual layers or components as identified for the respective element as follows:

(1) For garments, at least the outer shell, moisture barrier, and thermal barrier
(2)* For helmets, at least the shell
(3)* For gloves, at least the outer shell, moisture barrier, thermal barrier, and glove interface component (wristlet)
(4)* For footwear, at least the outer shell, moisture barrier, and thermal barrier
(5) For hoods, the outer shell, particulate-blocking layer, and any lining material

6.1.7.2 Where the thermal liner, moisture barrier, and outer shell of a garment are separable, each separable layer shall also have a label containing the information required in item (4) through item (8) of Table 6.1.7.

Table 6.1.7 Information Required to Be Present on Product Labeling

Labeling Item	Ensemble Elements	Components
(1) Manufacturer's name, identification, or designation	X	X
(2) Manufacturer's address	X	
(3) Country of manufacturer	X	X
(4) Manufacturer's element identification number, lot number, or serial number	X	X
(5) Month and year of manufacturer, not coded	X	X
(6) Model name, number, or design	X	X
(7) Size or size range	X	
(8) Principal materials(s) of construction	X	X
(9) Cleaning precautions	X	

6.1.7.3 The identification of textile-based principal materials shall indicate the fiber composition of the fabric, list any coatings or films present, and specify the type and purpose of any finishes that are also present.

6.1.7.3.1 Where available, trade names of materials shall be used.

6.1.7.4 Where leather is used as a principal material, the type of leather shall be listed.

6.1.7.5* Manufacturers shall be permitted to include the following statement as part of their product label where the required evidence is provided as specified in 6.5.11 for indicating PFAS levels in the respective protective element:

THIS *[type of protective element]* UPON CERTIFICATION HAS A PFAS (TOTAL FLUORINE) CONCENTRATION OF NO MORE THAN 100 PPM.

6.1.7.6* For helmet labels only, a label limited to the information required in item (1), item (4), and item (5) of Table 6.1.7 and the words **"NFPA 1970 (1971), 2025 ED"** shall be placed securely against the inner surface of the helmet.

6.1.8* Nonvisual/machine-readable tags providing a means for electronic dissemination or tracking of information shall be permitted in addition to the labels required in Section 6.1, Product Label Requirements for Both Ensembles.

6.1.8.1 Nonvisual/machine-readable tags shall be permitted to include all or a portion of the information required in Section 6.1, Product Label Requirements for Both Ensembles.

6.1.8.2 Nonvisual/machine-readable tags shall meet the applicable requirements in Chapter 8.

6.2 Additional Product Label Requirements for Structural Firefighting Ensemble Elements Only.

6.2.1 The following compliance statement shall be printed on the product label for each structural firefighting protective ensemble element, unless the requirements in 6.2.1.1 prevail. The 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 (3⁄32 in.) in height.

THIS STRUCTURAL FIREFIGHTING PROTECTIVE (insert element term here) MEETS THE (insert element term here) REQUIREMENTS OF NFPA 1970 (1971), 2025 EDITION.

DO NOT REMOVE THIS LABEL.

6.2.1.1 Where the garment is also certified as compliant with the optional requirements for protection against liquid and particulate contaminants, the garment element shall have the following compliance statement on the product label in place of the compliance statement specified in 6.2.1. All product label letters and figures shall be at least 2.5 mm (3⁄32 in.) in height.

LIQUID AND PARTICULATE PROTECTIVE GARMENT

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

THIS STRUCTURAL FIREFIGHTING PROTECTIVE (insert term COAT OR PANT here) MEETS THE (insert term COAT OR PANT here) REQUIREMENTS OF NFPA 1970 (1971), 2025 EDITION, AND THE OPTIONAL REQUIREMENTS FOR LIQUID AND PARTICULATE CONTAMINANT PROTECTION. THIS (insert term COAT OR PANT here) MUST BE WORN WITH A (insert term COAT OR PANT here) THAT IS ALSO CERTIFIED AS MEETING THE OPTIONAL REQUIREMENTS FOR LIQUID AND PARTICULATE CONTAMINANT PROTECTION.

DO NOT REMOVE THIS LABEL.

6.2.2 Where other protective item(s) or detachable components must be used with structural firefighting protective ensemble elements for an element to be compliant with this standard, at least the following statement and information shall also be printed on the product label. All letters shall be at least 2.5 mm (3⁄32 in.) high. The 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 to assemble.

FOR COMPLIANCE WITH THE STRUCTURAL FIREFIGHTING (insert element term here) REQUIREMENTS OF NFPA 1970 (1971), THE FOLLOWING PROTECTIVE ITEMS MUST BE WORN IN CONJUNCTION WITH THIS [insert element term here]:

(List additional items or detachable components here.)

DO NOT REMOVE THIS LABEL.

6.2.3 For helmets only, the helmet manufacturer shall place a unique manufacturer's part number, the symbol of the certification organization, and the words **"NFPA 1970 (1971), 2025 ED."** permanently on each replaceable performance-critical part of the goggle lens or faceshield.

6.2.4 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 6.1.7.

6.2.4.1 The hood manufacturer shall designate the specific SCBA facepiece(s), model(s) and size(s) in the new item of 6.1.7.

6.2.4.2 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 FIREFIGHTING REQUIREMENTS OF NFPA 1970 (1971), THIS HOOD CAN ONLY BE USED WITH THE FOLLOWING NOTED SCBA FACEPIECE(S) [insert SCBA facepieces(s), model(s), and size(s) here].

6.2.5 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 1970 (1971), 2025 ED."** on the drag rescue device (DRD).

6.3 Additional Product Label Requirements for Proximity Firefighting Ensemble Elements Only.

6.3.1 The following compliance statement shall be printed on the product label for each proximity firefighting protective ensemble element. The 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 (3⁄32 in.) in height.

THIS PROXIMITY FIREFIGHTING PROTECTIVE [insert element term here] MEETS THE [insert element term here] REQUIREMENTS OF NFPA 1970 (1971), 2025 EDITION.

DO NOT REMOVE THIS LABEL.

6.3.1.1 Where the garment is also certified as compliant with the optional requirements for protection against liquid and particulate contaminants, the garment element shall have the following compliance statement on the product label in place of the compliance statement specified in 6.3.1. All product label letters and figures shall be at least 2.5 mm (3⁄32 in.) in height.

LIQUID AND PARTICULATE CONTAMINANT PROTECTIVE GARMENT

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

THIS PROXIMITY FIREFIGHTING PROTECTIVE [insert term COAT OR PANT here] MEETS THE [insert term COAT OR PANT here] REQUIREMENTS OF NFPA 1970 (1971), 2025 EDITION, AND THE OPTIONAL REQUIREMENTS FOR LIQUID AND PARTICULATE CONTAMINANT PROTECTION. THIS (insert term COAT OR PANT here) MUST BE WORN WITH A (insert term COAT OR PANT here) THAT IS ALSO CERTIFIED AS MEETING THE OPTIONAL REQUIREMENTS FOR LIQUID AND PARTICULATE CONTAMINANT PROTECTION.

DO NOT REMOVE THIS LABEL.

6.3.2 Where other protective item(s) or detachable components must be used with proximity firefighting protective ensemble elements for an element to be compliant with this standard, at least the following statement and information shall also be printed on the product label. All letters shall be at least 2.5 mm (3⁄32 in.) high. The 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 to assemble.

FOR COMPLIANCE WITH THE PROXIMITY FIREFIGHTING (insert element term here) REQUIREMENTS OF NFPA 1970 (1971), THE FOLLOWING PROTECTIVE ITEMS MUST BE WORN IN CONJUNCTION WITH THIS [insert element term here]:

[List additional items or detachable components here.]

DO NOT REMOVE THIS LABEL.

6.3.2.1 For proximity firefighting 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.

6.3.3 For helmets only, the helmet manufacturer shall place a unique manufacturer's part number, the symbol of the certification organization, and the words **"NFPA 1970 (1971), 2025 ED."** permanently on each replaceable performance-critical part of the faceshield.

6.3.4* 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 term for the item, shroud or cover, shall be inserted in the statement text where indicated.

FOR COMPLIANCE WITH THE PROXIMITY FIREFIGHTING REQUIREMENTS OF NFPA 1970 (1971)-2025, THIS [insert 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].

6.3.5 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 1970 (1971), 2025 ED.**" on the DRD.

6.4 Additional Product Label Requirements for Structural and Proximity Firefighting Protective Ensembles and Ensemble Elements Containing Electrical Circuitry.

6.4.1* Nonincendive Equipment and Systems. The following additional compliance statement shall be printed on the product label for each structural and proximity firefighting protective ensemble and ensemble element containing electrical circuitry that complies with 7.20.2. The 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 (3⁄32 in.) in height.

THIS (insert STRUCTURAL or PROXIMITY) FIREFIGHTING PROTECTIVE (insert element term here) CONTAINS ELECTRICAL CIRCUITRY MEETING THE REQUIREMENTS OF UL 121201, 2017, FOR CLASS I & II, DIVISION 2, GROUPS C, D, F, G, AND CLASS III, (insert temperature class).

DO NOT REMOVE THIS LABEL.

6.4.2 Intrinsically Safe Apparatus and Systems. The following additional compliance statement shall be printed on the product label for each structural and proximity firefighting protective ensemble and ensemble element containing electrical circuitry that complies with Section 7.19. The 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 (3⁄32 in.) in height.

THIS (insert STRUCTURAL or PROXIMITY) FIREFIGHTING PROTECTIVE (insert element term here) CONTAINS ELECTRICAL CIRCUITRY MEETING THE REQUIREMENTS OF UL 913, SIXTH EDITION, FOR CLASS I & II, DIVISION 1, GROUPS C, D, E, F, G, AND CLASS III, (insert temperature class).

DO NOT REMOVE THIS LABEL.

6.5 User Information Requirements for Both Ensembles.

6.5.1 The manufacturer shall provide at least the user information that is specified in 6.5.4 with each structural and proximity firefighting element. This information shall be permitted to be delivered from the manufacturer in various formats, including, but not limited to, printed materials or instructions to access the information electronically/digitally.

6.5.2* 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.

6.5.3 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.

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

(1) Pre-use information, as follows:
   (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
   (f) Instructions for users to refer to and comply with NFPA 1851 requirements that do not contradict any subject user information or instructions provided by the manufacturer
(2) Preparation information for use, as follows:
   (a) Sizing/adjustment
   (b) Recommended storage practices
(3) Inspection frequency and details
(4) Donning/doffing information, as follows:
   (a) Donning and doffing procedures
   (b) Sizing and adjustment procedures
   (c) Interface issues
(5) Proper use consistent with NFPA 1550 and 29 CFR 1910.132, "Personal Protective Equipment: General Requirements"

(6) Maintenance and cleaning instructions, as follows:
   (a) Cleaning instructions and precautions that address preliminary exposure reduction, advanced cleaning, sanitization, and specialized cleaning in accordance with NFPA 1851; a warning for the hazards associated with wearing contaminated protective clothing; and statements advising users not to use an element that is not thoroughly cleaned and dried, and to practice good hygiene when handling and wearing protective clothing before and after structural and proximity firefighting and other emergency responses
   (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 firefighting operations, and that the effects of chemical exposure on the moisture barrier are to be evaluated in accordance with the inspection procedures in NFPA 1851

6.5.5 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.

6.5.6* For gloves only, manufacturers shall provide a chart and other information such that the end user can select the appropriate size based on hand measurements or other approaches to ensure adequate fit and function of the gloves.

6.5.6.1 If hand measurements are used, this information shall include diagrams or descriptions for how the hand measurements are to be made.

6.5.7 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.

6.5.8 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 7.4.8.

6.5.9 For protective garments certified to the optional liquid and particulate contaminant protection requirements, the manufacturer shall provide the following additional instruction and information with the garment:

(1) A statement that the garment is not to be used as part of a hazardous materials protective ensemble and that liquid and particulate contaminant protection is not inclusive of all vapors nor all liquids and particulates
(2) Specific care and maintenance provisions associated with maintaining the unique performance properties of the garment if such provisions are necessary beyond normal care and maintenance instructions.
(3)* The manufacturer shall provide a list of the specific elements, including manufacturer and model or style number, used in the ensemble testing for garment certification and any specific interfacing or donning instructions applied during that testing.
(4) The manufacturer shall indicate that the full test reports for both the overall liquid integrity and inward particulate leakage tests are available to the purchaser upon request.

6.5.10 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.

6.5.11* If the manufacturer makes the claim permitted in 6.1.7.5, then the claim shall be based on test results when their protective elements are evaluated as specified in 9.10.2, Test for Total Fluorine.

6.5.11.1 If the manufacturer makes the claim permitted in 6.1.7.5, then the manufacturer shall make the report specified in 9.10.2.6.3 available to the authority having jurisdiction upon request. *(See also A.6.1.7.5.)*

6.5.12* Where specific requirements exist in Chapters 1 through 8 for conducting testing and reporting the results of those tests, the results shall be made available as part of the user information.

Chapter 7 Design Requirements (NFPA 1971)

7.1* Protective Garment Element Design Requirements for Both Ensembles.

7.1.1 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, and Section 5.3, Inspection and Testing.

7.1.1.1 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.

7.1.1.2 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.

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

7.1.2.1 The composite specified in 7.1.2 shall be permitted to be configured as a single layer or multiple layers.

7.1.2.2 Supplemental garments that are provided to meet the performance requirements of Chapters 4 through 9 of this standard but are not intended to be worn continuously with the wearing of the garment element shall not be permitted.

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

7.1.4 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.

7.1.4.1 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.

7.1.4.2 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.

7.1.4.3 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.

7.1.5 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.

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

7.1.5.2 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.

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

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

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

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

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

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

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

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

7.1.9.1.4 The DRD shall be designed to allow deployment and operation of the DRD while the incapacitated firefighter is wearing an SCBA. *(See A.7.1.9.1.2.)*

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

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

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

7.1.9.2.2 The wristlet or other garment sleeve interface component shall meet the requirements specified in Section 7.16, Protective Wristlet Interface Component Design Requirements for Both Ensembles.

7.1.9.3 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.

7.1.9.3.1 The collar shall incorporate a closure system.

7.1.9.3.2 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 8.1, Protective Garment Performance Requirements for Both Ensembles.

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

7.1.9.3.4 Where a hood is permanently attached to the coat, it shall meet the requirement of 7.1.9.3.1 and at least the bottom 75 mm (3 in.) of the hood shall meet the requirement of 7.1.9.3.2.

7.1.9.4 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.

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

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

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

7.1.10.3 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.

7.1.11* In order to label a coat, trouser, or coverall as compliant with Chapters 4 through 9 of this standard, the manufacturer shall provide coats, trousers, or coveralls in the size ranges specified in Table 7.1.11.

7.1.11.1 The sizing increments for the ranges specified in Table 7.1.11 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.).

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

7.1.12* 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 Chapters 24 through 28 of NFPA 2500 and the optional requirements for flame-resistant life safety harnesses or optional requirements for flame-resistant belts.

7.1.13 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.

7.1.14 Garment outer shells, moisture barriers, thermal barriers, and wristlet/garment–glove interface components shall be recognized components that meet levels of restricted substances as specified in Section 8.21, Acceptable Levels of Restricted Substances in Specified Protective Element Recognized Components.

7.1.15 The shoulder areas shall consist of reinforcement composite meeting the requirements of 8.1.9.

7.1.15.1 The composite shall be at least 100 mm (4 in.) wide on the crown of each shoulder as defined in 7.1.15.3.

7.1.15.2 The composite shall extend down from the crown, as defined in 7.1.15.3, on both the front and back of the garment by at least 50 mm (2 in.).

7.1.15.3 The crown of the shoulder shall be the uppermost line of the shoulder when the garment is lying flat on an inspection surface with all closures fastened.

7.1.16 The knee areas shall consist of reinforcement composite meeting the requirements of 8.1.9.

7.1.16.1 The composite shall measure at least 150 mm × 150 mm (6 in. × 6 in.).

7.2 Additional Design Requirements for Structural Firefighting Protective Garment Elements Only.

7.2.1 Structural firefighting 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 7.1, 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, and Section 5.3, Inspection and Testing.

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

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

7.2.2.2 The retroreflective surface of trim shall be at least 16 mm (⅝ in.) wide.

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

7.2.2.4 The fluorescent and retroreflective areas of trim specified in 7.2.2.2 and 7.2.2.3 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 (⅛ in.).

7.2.2.5 Trim used in excess of that required by the minimum trim pattern requirements specified and illustrated in Figure 7.2.3 shall be permitted to not meet the minimum fluorescent surface of 50 mm^2/linear mm (2 $in.^2$/linear in.) of trim and shall be permitted to be obscured by components including

Table 7.1.11 Available Coat/Trouser Size Ranges

	Men		Women		Increment	
Dimension	**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

but not limited to pockets, storm flaps, and reinforcing patches as long as the minimum trim pattern is not obscured.

7.2.3* Coat trim configuration shall be in accordance with Figure 7.2.3. No vertical stripes of trim shall be permitted on the front of the coat.

7.2.3.1 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.

7.2.3.2 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.

7.2.3.3 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.

7.2.3.4 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.

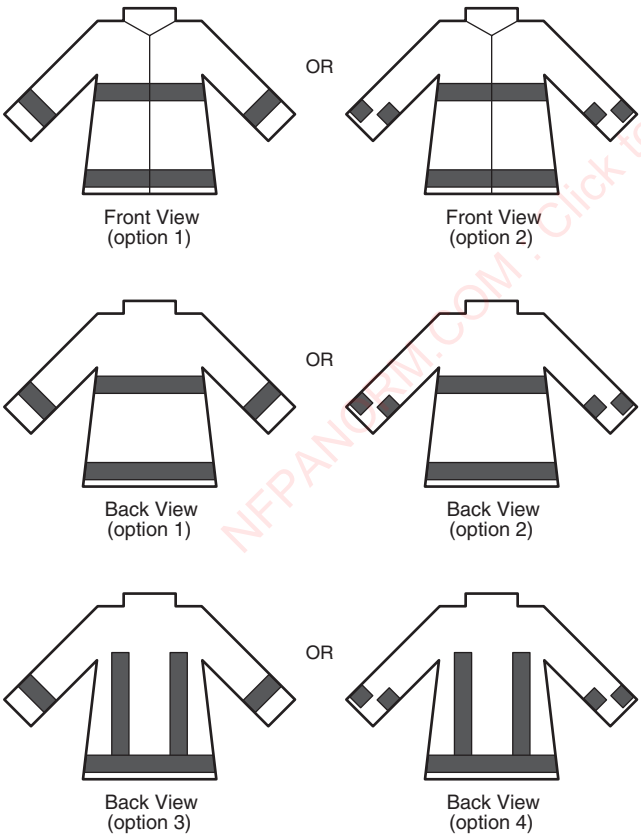


FIGURE 7.2.3 Minimum Required Structural Firefighting Coat Trim Patterns.

7.2.3.5 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.

7.2.3.5.1 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.

7.2.4* Trouser trim configuration shall be in accordance with Figure 7.2.4.

7.2.4.1 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.

7.2.4.2 Where trim on the trouser element intersects a zipper or where the trim intersects the innermost seam of each trouser leg, a maximum gap in the trim of 25 mm (1 in.) shall be permitted.

7.3 Additional Design Requirements for Proximity Firefighting Protective Garment Elements Only.

7.3.1 Proximity firefighting 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 7.1, 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.

7.3.2 Garments shall not have materials that do not meet the radiant reflective requirements specified in 8.3.2 affixed to the outer shell radiant reflective surfaces of the garments unless such materials are covered in 7.3.3.

7.3.3 Reinforcing materials that do not meet the radiant reflective requirements specified in 8.3.2 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 8.1.3.
(2) The reinforcing materials shall meet the heat resistance requirements specified in 8.1.5.
(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.

7.3.4 The collar lining material shall not be reflective material.

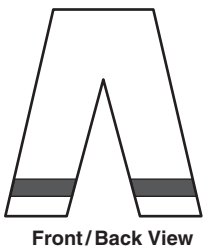


FIGURE 7.2.4 Minimum Required Structural Firefighting Trouser Trim Patterns.

7.4 Protective Helmet Element Design Requirements for Both Ensembles.

7.4.1 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.

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

7.4.3 The helmet retention system shall include a chin strap and a nape device. The chin strap shall have a minimum width of 16 mm (⅝ in.).

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

7.4.5 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

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

7.4.5.2 The helmet with the faceshield or the faceshield/goggle component deployed shall be positioned in accordance with the HPI as described in 9.1.13 on a facial feature headform as defined in 3.3.64. Where the crown clearance of the helmet is adjustable, the helmet shall be mounted with the least amount of clearance.

7.4.6 The helmet faceshield or the faceshield/goggle component in the stowed position as described in 9.1.16 shall provide peripheral vision clearance of at least 94 degrees to each side.

7.4.6.1 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 9.1.13 on a facial feature headform as defined in 3.3.64. Where the crown clearance of the helmet is adjustable, the helmet shall be mounted with the least amount of clearance.

7.4.7 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 Chapters 4 through 9 of this standard.

7.4.8* For helmets with items installed or attached, the helmet with the items installed/attached shall meet the affected design and performance requirements of Chapters 4 through 9 of this standard.

7.4.9 Helmet ear cover fabric material layers, textile-based suspension materials, and textile-based retention system materials shall be recognized components and meet the levels of restricted substances as specified in Section 8.21, Acceptable Levels of Restricted Substances in Specified Protective Element Recognized Components.

7.5 Additional Design Requirements for Structural Firefighting Protective Helmet Elements Only.

7.5.1 Structural firefighting 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 7.4, 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, and Section 5.3, Inspection and Testing.

7.5.2* 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

7.5.2.1 Where a faceshield is selected in accordance with 7.5.2(6), the faceshield component shall be attached to the helmet.

7.5.2.2 Where the goggle component is selected in accordance with 7.5.2(6), the goggles shall be permitted to be unattached, not assembled, to the helmet.

7.5.2.3 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.

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

7.5.3.1 A minimum of 2580 mm^2 (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 9.1.16, 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)

7.5.3.2 A minimum of 2580 mm^2 (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 9.1.16, is viewed at the intersection of the midsagittal plane and the coronal plane at a distance of 2.4 m (8 ft).

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

7.5.4 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

7.5.4.1 The helmet, with the ear covers or the portion of the helmet providing the ear coverage deployed, shall be posi-

tioned according to the HPI as described in 9.1.13 on an ISO size J headform as specified in Figure 9.3.6.4.1. Where the crown clearance of the helmet is adjustable, the helmet shall be mounted with the most amount of clearance.

7.5.4.2 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 7.5.4.

7.5.4.3 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.

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

7.5.6 Faceshield components shall meet the respective requirements for faceshields and be marked either "Z87+" or "Z87+O2" in accordance with ANSI/ISEA Z87.1, *Occupational and Educational Personal Eye and Face Protection Devices*.

7.6 Additional Design Requirements for Proximity Firefighting Helmet Elements Only.

7.6.1 Proximity firefighting 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 7.4, 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.

7.6.2 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)

7.6.3 Helmet faceshields shall be attached to the helmet.

7.6.4 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.

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

7.6.4.2 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.

7.6.4.3 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.

7.6.5 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.

7.6.5.1 Shrouds shall provide at least the following coverage:

(1) 230 mm (9⅛ 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 (11⅝ 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

7.6.5.1.1 The helmet, with the shroud deployed, shall be positioned according to the HPA as described in 9.1.13 on an ISO size J headform as specified in Figure 9.3.6.4.1. Where the crown clearance of the helmet is adjustable, the helmet shall be mounted with the most amount of clearance.

7.6.5.1.2 With the helmet positioned as required by 7.6.5.1.1, 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 7.6.5.1.

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

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

7.6.5.4 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

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

7.6.5.4.2 The helmet with the shroud attached shall be positioned according to the HPI as described in 9.1.13 on a facial feature headform as defined in 3.3.64. Where the crown clearance of the helmet is adjustable, the helmet shall be mounted with the least amount of clearance.

7.6.6 No openings shall be permitted in the helmet shroud other than to meet the requirements of 7.6.5.

7.6.7 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 8.13.2 for thermal protective performance (TPP).

7.7 Protective Glove Elements Design Requirements for Both Ensembles.

7.7.1 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, and Section 5.3, Inspection and Testing.

7.7.2 Gloves shall consist of a composite meeting the performance requirements of Section 8.7, Protective Glove Elements Performance Requirements for Both Ensembles.

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

7.7.2.2 Supplemental gloves that are provided to meet the performance requirements of Chapters 4 through 9 of this standard but are not intended to be worn continuously with the wearing of the gloves shall not be permitted.

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

7.7.2.4 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 8.16, Protective Wristlet and Garment-Glove Interface Components Performance Requirements for Both Ensembles, gloves shall not be required to meet the requirements in 7.7.3 through 7.7.3.4.

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

7.7.3 The glove shall consist of a glove body.

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

7.7.3.2 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 Section 8.7, Protective Glove Elements Performance Requirements for Both Ensembles; Section 8.8, Additional Performance Requirements for Structural Firefighting Protective Glove Elements Only; and Section 8.9, Additional Performance Requirements for Proximity Firefighting Protective Glove Elements Only, as applicable.

7.7.3.3 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 Section 8.7, Protective Glove Elements Performance Requirements for Both Ensembles; Section 8.8, Additional Performance Requirements for Structural Firefighting Protective Glove Elements Only; and Section 8.9, Additional Performance Requirements for Proximity Firefighting Protective Glove Elements Only, as applicable.

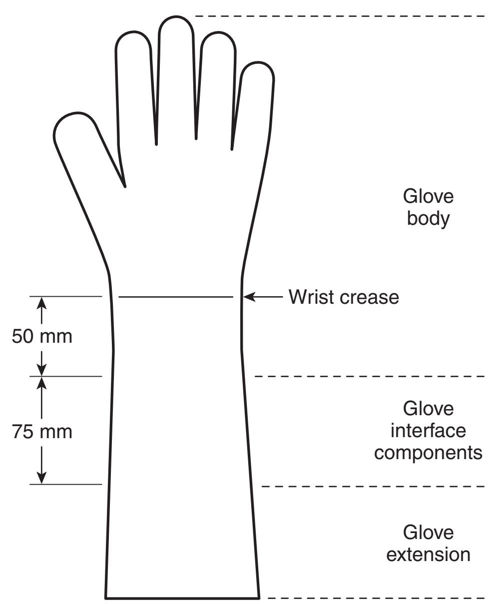
7.7.3.4 The portion of the glove that extends greater than 125 mm (5 in.) beyond the wrist crease up to the end of the entire glove, where present, shall be considered to be the glove extension and shall meet the glove extension requirements in Section 8.7, Protective Glove Elements Performance Requirements for Both Ensembles; Section 8.8, Additional Performance Requirements for Structural Firefighting Protective Glove Elements Only; and Section 8.9, Additional Performance Requirements for Proximity Firefighting Protective Glove Elements Only, as applicable.

7.7.3.5* The location of the wrist crease shall be determined by the following procedures, as shown in Figure 7.7.3.5:

(1) The location of the wrist crease shall be determined by first placing the glove on a measurement board palm down and securing (i.e., locking) the fingertips down onto the board.
(2) A 0.45 kg (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.

7.7.4* For selection of the glove size for testing and when the glove manufacturer uses the default sizing system provided in this standard, 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 ($^1/_{16}$ in.) from the tip of the index finger to the base of the finger located by the crease as shown in Figure 7.7.4(a).



For U.S. units, 1 mm = 0.0394 in.

FIGURE 7.7.3.5 Location of Wrist Crease.

(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 metacarpal II landmark (thumb side of index finger or digit 2) to the metacarpal V landmark (outside of little finger, or digit 5), as shown in Figure 7.7.4(b).

7.7.4.1 For testing purposes or when the default system is used for labeling the size of gloves, gloves shall be classified as the following sizes in accordance with dimensional ranges for both index finger length and hand breath as shown in Figure 7.7.4.1:

(1) 64N (normal), 64W (wide), 64XW (extra-wide)
(2) 70N (normal), 70W (wide), 70XW (extra-wide)
(3) 76N (normal), 76W (wide), 76XW (extra-wide)
(4) 82N (normal), 82W (wide), 82XW (extra-wide)

7.7.5* To be labeled as compliant with this standard, gloves shall be provided and labeled in at least the following seven sizes as determined by accommodating the respective index finger length and hand breadth ranges established in Figure 7.7.4.1:

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

7.7.5.1 Alternatively, gloves shall be provided in a minimum of seven unique sizes that accommodate a range of specific hand sizes for both men and women based on achieving accommodation of the 5th to 95th percentile dimensions in both hand breadth and hand length as established in the NIOSH Firefighter Anthropometric Data Base.

7.7.5.1.1* Manufacturers shall be permitted to establish their own unique sizing system and method of designating glove sizing based on their respective glove designs.

7.7.5.1.2 Manufacturers shall be required to designate which of their unique sizes conform to the individual sizes defined in 7.7.5 as required for testing purposes.

7.7.5.1.3* Manufacturers shall provide the certification organization with the specific details for how a glove wearer can determine size.

7.7.5.1.4 Manufacturers shall label their gloves consistent with the unique size as indicated by their sizing system.

7.7.6* Glove principal textile-based fabric materials, including shells, moisture barriers, linings, and wristlets, shall be recognized components that meet levels of restricted substances as specified in Section 8.21, Acceptable Levels of Restricted Substances in Specified Protective Element Recognized Components.

7.7.6.1 A moisture barrier that does not include a textile layer shall still be a recognized component that meets levels of restricted substances as specified in Section 8.21, Acceptable Levels of Restricted Substances in Specified Protective Element Recognized Components.

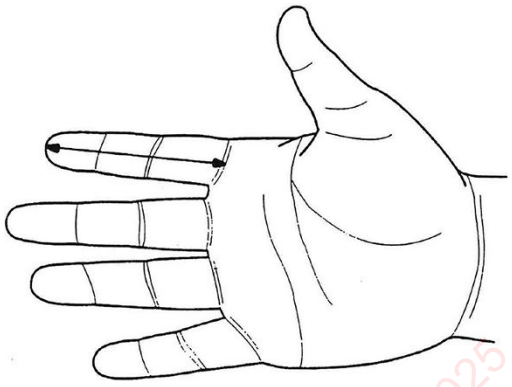


FIGURE 7.7.4(a) Measurement Location for Index Finger Length.

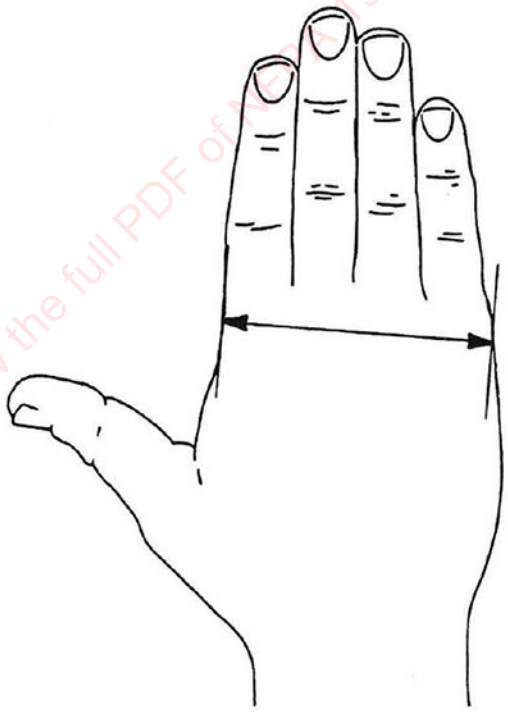
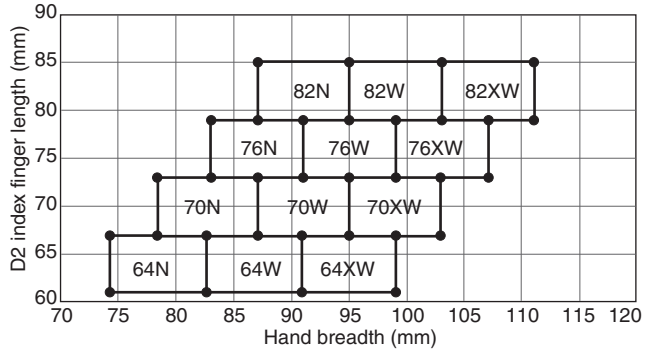


FIGURE 7.7.4(b) Measurement Location for Hand Breadth.



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

FIGURE 7.7.4.1 NFPA 1971 Size Definitions.

7.8 Additional Design Requirements for Structural Firefighting Protective Glove Elements Only. (Reserved)

7.9 Additional Design Requirements for Proximity Firefighting Protective Glove Elements Only.

7.9.1 Proximity firefighting 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 7.7, Protective Glove Elements Design Requirements for Both Ensembles, where inspected and evaluated by the certification organization as specified in Section 4.3, Inspection and Testing, and Section 5.3, Inspection and Testing.

7.9.2 Gloves shall not be permitted to have any hardware.

7.9.3 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.

7.9.3.1 Glove fingers, thumb, and the back shall have radiant reflective protection of 210 degrees, +20°/–0°. The radiant reflective material shall provide coverage from 0 degrees to 105 degrees, +10°/–0°, and then from 255 degrees, +10°/–0°, to 360 degrees as specified in Figure 7.9.3.1.

7.9.3.2 The radiant reflective material shall provide coverage for the finger/thumb tip of at least 195 degrees, +10°/–0°, as specified in Figure 7.9.3.1.

7.9.3.3 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.

7.9.4 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.

7.10 Protective Footwear Elements Design Requirements for Both Ensembles.

7.10.1 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, and Section 5.3, Inspection and Testing.

7.10.2 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.

7.10.2.1 Where booties are incorporated as a component of the pant and are specified by the manufacturer as removable for laundering or replacement only, the booties component shall meet the performance requirements of 8.1.12, 8.1.13, 8.1.14, 8.1.15, 8.1.16, and 8.1.17.

7.10.2.2 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 Section 8.10, Protective Footwear Elements Performance Requirements for Both Ensembles, with the exception of 8.10.4 and 8.10.5.

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

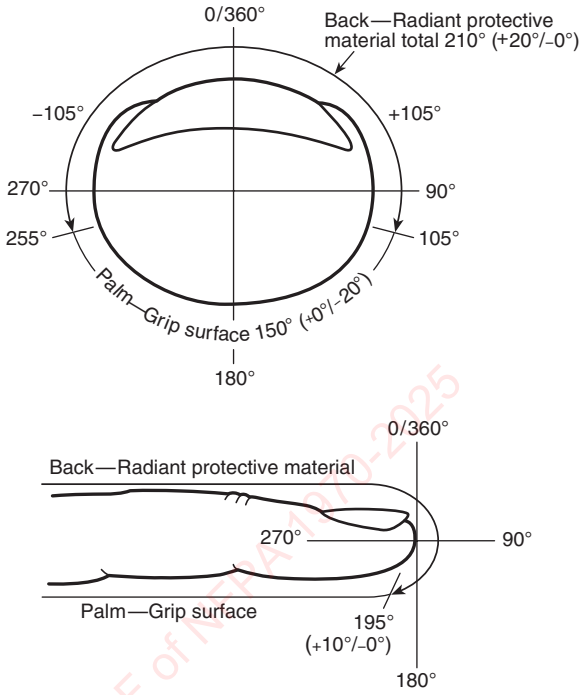


FIGURE 7.9.3.1 Glove Radiant Reflective Protection Areas.

7.10.2.4 Supplemental footwear that is provided to meet the performance requirements of Chapters 4 through 9 of this standard but is not intended to be worn continuously with the wearing of the footwear element shall not be permitted.

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

7.10.3.1 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 as specified in 9.1.22.

7.10.3.2 Removable insoles shall not be removed prior to measurement.

7.10.3.3 Moisture protection shall be continuous circumferentially to within 50 mm (2 in.) of the footwear top line at all locations except 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 7.10.3.1. The technique specified in 9.1.22 shall be used for making these measurements, particularly when it is not obvious where the moisture protection location ends in the top of the footwear.

7.10.3.4 Thermal and physical protection shall be continuous circumferentially to within 50 mm (2 in.) of the footwear top line at all locations except the gusset and 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 and physical protection at all locations of the boot except the gusset shall be no less than 250 mm (9.84 in.) when measured as described in 7.10.3.1.

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

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

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

7.10.4.3 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.

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

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

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

7.10.6.2 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.

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

7.10.8 In order to label or otherwise represent footwear as compliant with the requirements of Chapters 4 through 9 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

7.10.8.1 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.

7.10.8.2 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.

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

7.10.10* Footwear upper principal textile-based fabric material layers, including any exterior layer(s), barrier layers(s), and lining(s), shall be recognized components that meet levels of restricted substances as specified in Section 8.21, Acceptable Levels of Restricted Substances in Specified Protective Element Recognized Components.

7.10.10.1 If the barrier layers do not include a textile layer, they shall still be recognized components that meet levels of restricted substances as specified in Section 8.21, Acceptable Levels of Restricted Substances in Specified Protective Element Recognized Components.

7.11 Additional Design Requirements for Structural Firefighting Protective Footwear Only. (Reserved)

7.12 Additional Design Requirements for Proximity Firefighting Protective Footwear Only. (Reserved)

7.13 Protective Hood Interface Component Design Requirements for Both Ensembles.

7.13.1 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, and Section 5.3, Inspection and Testing.

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

7.13.3 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 7.13.6.

7.13.3.1 Where the hood is integrated with the protective coat, the hood shall not be required to meet the design requirement specified in 7.13.5.

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

7.13.5* The hood shall be donned properly, in accordance with the manufacturer's instructions for wearing, on the ISO size J headform specified in Figure 9.3.6.4.1.

7.13.5.1 A single size or multiple sizes of the protective hoods shall be permitted.

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

7.13.5.3* Hoods shall be provided in sizes that accommodate the range of head sizes for both men and women as shown in Table 7.13.5.3.

7.13.6 Hoods shall be designed with a face opening.

7.13.6.1 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 open-

Table 7.13.5.3 Sizing Requirements for Hoods

Measurement location	Men's sizing (mm)	Women's sizing (mm)
Bitragion arc length, sitting	343–384	327–366
Head arc length, sitting	328–386	306–371
Head circumference, sitting	553–601	538–582

ing shall be able to be stretched to a circumference of at least 800 mm (31 in.).

7.13.6.2 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.). Using the test equipment and approach specified in 9.8.10.4.2 and 9.8.10.4.5 shall be permitted.

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

7.13.7 Hood fabric materials, including the outer layer, inner layer (where different), and particulate-blocking layers, as applicable, shall be recognized components that meet levels of restricted substances as specified in Section 8.21, Acceptable Levels of Restricted Substances in Specified Protective Element Recognized Components.

7.14 Additional Design Requirements for Structural Firefighting Protective Hood Interface Components Only.

7.14.1 The hood interface component shall include a particulate-blocking material specifically for meeting the requirements of 8.14.1 that includes all areas of the hood except as specified in 7.14.2 and 7.14.3.

7.14.2 The particulate-blocking hood material shall be extended at least to within 19 mm (¾ in.) of any hem of the hood bib.

7.14.3 Binding, including the elastic and stitching around the hood face opening, shall be permitted to exclude particulate-blocking material specifically for meeting the requirements of 8.14.1 for a distance of 19 mm (¾ 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 and the face opening facing upward, and measured from the innermost row of stitching to the face opening leading edge.

7.15 Additional Design Requirements for Proximity Firefighting Protective Hood Interface Components Only. (Reserved)

7.16 Protective Wristlets Interface Component Design Requirements for Both Ensembles.

7.16.1 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.

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

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

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

7.17 Additional Design Requirements for Structural Firefighting Protective Wristlet Interface Components Only. (Reserved)

7.18 Additional Design Requirements for Proximity Firefighting Protective Wristlet Interface Components Only. (Reserved)

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

7.19.1 Liquid and Particulate Contaminants Protective Ensemble Design Requirements for Both Ensembles. (Reserved)

7.19.2 Additional Liquid and Particulate Contaminant Protection Design Requirements for Structural Firefighting Protective Ensembles Only. (Reserved)

7.19.3 Additional Liquid and Particulate Contaminant Protection Design Requirements for Proximity Firefighting Protective Ensembles Only. (Reserved)

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

7.19.4.1 Liquid and particulate contaminant protective garments shall have at least the applicable design requirements specified in this subsection in addition to the design requirements specified in Section 7.1, Protective Garment Element Design Requirements for Both Ensembles, and Section 7.2, Additional Design Requirements for Structural Firefighting Protective Garment Elements Only, or as in Section 7.3, Additional Design Requirements for Proximity Firefighting Protective Garment Elements Only, where inspected and evaluated by the certification organization as specified in Section 4.3, Inspection and Testing, and Section 5.3, Inspection and Testing.

7.19.4.1.1* For the requirement in 7.19.4.1, a garment design shall be considered unique based on the following factors:

(1) Type and orientation of front closure system(s) on coats and trousers
(2) Type of coat collar, collar closure, and interface with hood
(3) Type of coat sleeve end and wristlet interface component for creating an interface with protective gloves
(4) Type of trouser leg construction for creating an interface with protective footwear
(5) Type of coat and trouser interface and overlap
(6) Type of interface materials

7.19.4.1.2 Liquid and particulate contaminant protective garments subject to the requirements in 7.19.4.1 and 7.19.4.1.1 shall include either a specific set of coats and trousers, or consist of a coverall.

7.19.4.2 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.

7.19.4.2.1 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.

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

7.19.4.4* The manufacturer shall be permitted to specify undergarments or other related garments worn as part of the ensemble when the identified items are required to be worn with the ensemble as indicated on the product label for particulate and liquid protection as specified in 6.2.1.1 and 6.2.2. The undergarments shall also be used in the evaluation of the garment for overall liquid integrity and particulate inward leak-

age, and must be worn for the garment to function for providing the wearer protection from liquid and particulate exposure. The use of undergarments shall also be included in the user information required in Chapter 6.

7.19.4.4.1 The undergarments or related garments shall be certified to Chapters 10 through 14.

7.19.4.4.2 The undergarments or related garments shall collectively cover the torso, arms, and legs of the wearer, and extend at least to the wearer's wrists on the arms and down to the ankles on the legs.

7.19.4.4.3 The additional undergarments or other related garments shall be permitted to contribute to the performance of other ensemble requirements in other parts of this standard only if integrated with the garment such that the overall garment cannot be worn without the respective undergarment or related garment.

7.19.5 Additional Liquid and Particulate Contaminant Protection Design Requirements for Structural Firefighting Protective Garment Elements Only. (Reserved)

7.19.6 Additional Liquid and Particulate Contaminant Protection Design Requirements for Proximity Firefighting Protective Garment Elements Only. (Reserved)

7.19.7 Liquid and Particulate Contaminant Protective Helmet Elements Design Requirements for Both Ensembles. (Reserved)

7.19.8 Additional Liquid and Particulate Contaminant Protection Design Requirements for Structural Firefighting Protective Helmet Elements Only. (Reserved)

7.19.9 Additional Liquid and Particulate Contaminant Protection Design Requirements for Proximity Firefighting Protective Helmet Elements Only. (Reserved)

7.19.10 Liquid and Particulate Contaminant Protective Glove Elements Design Requirements for Both Ensembles. (Reserved)

7.19.11 Additional Liquid and Particulate Contaminant Protection Design Requirements for Structural Firefighting Protective Glove Elements Only. (Reserved)

7.19.12 Additional Liquid and Particulate Contaminant Protection Design Requirements for Proximity Firefighting Protective Glove Elements Only. (Reserved)

7.19.13 Liquid and Particulate Contaminant Protective Footwear Elements Design Requirements for Both Ensembles. (Reserved)

7.19.14 Additional Liquid and Particulate Contaminant Protection Design Requirements for Structural Firefighting Protective Footwear Elements Only. (Reserved)

7.19.15 Additional Liquid and Particulate Contaminant Protection Design Requirements for Proximity Firefighting Protective Footwear Elements Only. (Reserved)

7.19.16 Liquid and Particulate Contaminant Protective Hood Interface Component Design Requirements for Both Ensembles. (Reserved)

7.19.17 Liquid and Particulate Contaminant Protective Hood Interface Component Design Requirements for Structural Firefighting Ensembles. (Reserved)

7.19.18 Liquid and Particulate Contaminant Protective Shroud Interface Component Design Requirements for Proximity Firefighting Ensembles. (Reserved)

7.20 Design Requirements for Electrical Circuitry.

7.20.1 General. Structural and proximity firefighting protective ensembles and ensemble elements involving electrical circuitry shall only use circuitry that meets the requirements of this standard for one of the following types of explosion protection:

(1) Nonincendive equipment, stand-alone type (i.e., individual pieces of equipment separately certified for Class I and II, Division 2 and Class III applications, without any external electrical interconnection means, and intended for stand-alone use)
(2) Nonincendive equipment, electrically interconnected type (i.e., individual pieces of equipment separately certified for Class I and II, Division 2 and Class III applications, with external electrical interconnection means involving plugs and jacks, and intended for electrical interconnection to other separately certified nonincendive equipment, electrically interconnected types)
(3) Nonincendive system (i.e., multiple pieces of nonincendive equipment certified together for Class I and II, Division 2 and Class III applications, with electrical interconnection means, and intended for dedicated system use)
(4) Intrinsically safe apparatus, stand-alone type (i.e., individual pieces of apparatus separately certified for Class I and II, Division 1 and Class III applications, without any external electrical interconnection means, and intended for stand-alone use)
(5) Intrinsically safe system (i.e., multiple pieces of intrinsically safe apparatus certified together for Class I and II, Division 1 and Class III applications, with electrical interconnection means, and intended for dedicated system use)

7.20.1.1* Passive electrical circuitry that relies on a supplemental device to energize it shall be exempt from explosion protection if the requirement in 7.20.1.2 is met.

7.20.1.2 The instructions supplied with ensembles and ensemble elements involving passive electrical circuitry shall indicate that the supplemental device used to energize the circuitry shall not be used or stored in a hazardous location.

7.20.2 Nonincendive Equipment and Systems.

7.20.2.1* General. Electrical circuitry contained within structural and proximity firefighting protective ensembles and ensemble elements shall, at a minimum, be suitable for use in Class I, Division 2, Groups C and D; Class II, Division 2, Groups F and G; and Class III, Divisions 1 and 2 hazardous (classified) locations, with a temperature class within the range of T3 through T6 inclusive, in accordance with UL 121201, *Nonincendive Electrical Equipment for Use in Class I and II, Division 2 and Class III, Divisions 1 and 2 Hazardous (Classified) Locations.*

7.20.2.2 Interconnection of Nonincendive Equipment, Electrically Interconnected Types.

7.20.2.2.1 Interconnection of electrical circuits that are separately certified as nonincendive equipment, electrically interconnected types, shall occur by means of a plug and jack that comply with the device connector requirements specified in Section 6.10 of NFPA 1802.

7.20.2.2.2 The electrical parameters for interconnection shall comply with Table 7.20.2.2.2.

7.20.2.2.3 The instructions supplied with the ensembles and ensemble elements shall identify the circuits as nonincendive equipment, electrically interconnected types, and indicate the ability to interconnect the circuitry with any other circuitry also identified as nonincendive equipment, electrically interconnected types, in accordance with this standard.

7.20.2.3 Interconnection of Nonincendive Systems.

7.20.2.3.1 Electrical circuits that are certified as part of a nonincendive system shall only be interconnected with other electrical circuits also certified as part of the same nonincendive system.

7.20.2.3.2 The instructions supplied with the ensembles and ensemble elements shall identify the circuits as part of a nonincendive system and indicate the other circuits that comprise the nonincendive system in accordance with this standard.

Table 7.20.2.2.2 Electrical Parameters for Interconnection of Separately Certified Nonincendive Equipment, Electrically Interconnected Types

Device Connector as Source	Required Relationship	Device Connector as Sink
Uo ≤ 8 V	Uo ≤ Ui	Ui ≥ 10 V
Io ≤ 500 mA	Io ≤ Ii	Ii ≥ 1 A
Co ≥ 69 µF	Co ≥ Ci + Ccable*	Ci ≤ 68 µF
Lo ≥ 320 µH	Lo ≥ Li +Lcable*	Li ≤ 315 µH

*Assumption for cable capacitance (Ccable) and cable inductance (Lcable): 200 pF/m and 1 µH/m.

7.20.3 Intrinsically Safe Apparatus and Systems.

7.20.3.1* General. Electrical circuitry contained within structural and proximity firefighting protective ensembles and ensemble elements shall be permitted to be certified at a minimum for use in Class I, Division 1, Groups C and D; Class II, Division 1, Groups E, F, and G; and Class III, Divisions 1 and 2 hazardous locations, with a temperature class within the range of T3 through T6 inclusive, in accordance with UL 913, *Intrinsically Safe Apparatus and Associated Apparatus for Use in Class I, II, and III, Division 1 Hazardous (Classified) Locations.*

7.20.3.2 Interconnection of Intrinsically Safe Systems.

7.20.3.2.1 Electrical circuits that are certified as part of an intrinsically safe system shall only be interconnected with other electrical circuits certified as part of the same intrinsically safe system.

7.20.3.2.2 The instructions supplied with the ensembles and ensemble elements shall identify the circuits as part of an intrinsically safe system and indicate the other circuits that comprise the intrinsically safe system in accordance with this standard.

Chapter 8 Performance Requirements (NFPA 1971)

8.1 Protective Garment Elements Performance Requirements for Both Ensembles.

8.1.1* Protective garment elements composite consisting of outer shell, moisture barrier, and thermal barrier shall be tested for thermal insulation as specified in Section 9.2.16, Thermal Protective Performance (TPP) Test, and shall have an average TPP of not less than 35.0.

8.1.2 Garments shall be tested for overall liquid penetration resistance as specified in Section 9.5.1, Whole Garment and Ensemble Liquid Penetration Test, and shall allow no liquid penetration except as permitted in 9.5.1.8.2.

8.1.3 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 9.2.1, 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.

8.1.3.1 Labels and nonvisual/machine-readable tags shall meet the performance requirements specified in 8.1.3 only where placed on the exterior of the garment.

8.1.3.2 Zippers and seam-sealing materials shall meet the performance requirements specified in 8.1.3 only where located on the exterior of the garment or located where they will directly contact the wearer's body.

8.1.3.3 Elastic and hook and pile fasteners shall meet the performance requirements specified in 8.1.3 only where located where they will directly contact the wearer's body.

8.1.3.4 Small specimens such as hanger loops and emblems or patches that are not large enough to meet the specimen size requirements in 9.2.1.2.1 shall be tested for resistance to flame as specified in Section 9.2.1, 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.

8.1.3.5 Life safety harnesses, escape belts, and ladder belts shall meet the performance requirements specified in 8.1.3 only when they penetrate the outer shell, are incorporated as part of a garment closure system, or are attached to the garment.

8.1.4 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 9.2.4, Heat and Thermal Shrinkage Resistance Test, and shall not shrink more than 10.0 percent in any direction.

8.1.5 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, nonvisual/machine-readable tags, 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 9.2.4, Heat and Thermal Shrinkage Resistance Test, and shall not melt, separate, or ignite.

8.1.6 Garment moisture barrier seams shall be individually tested for resistance to heat as specified in Section 9.2.4, Heat and Thermal Shrinkage Resistance Test, and shall not drip or ignite.

8.1.7 Garment outer shells and collar linings shall be individually tested for resistance to heat as specified in Section 9.2.4, Heat and Thermal Shrinkage Resistance Test, and shall not char.

8.1.8 All garment hardware, including zippers but 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 9.2.4, Heat and Thermal Shrinkage Resistance Test, and shall not ignite and shall remain functional.

8.1.9 The garment composite from the shoulder areas and the knee areas shall be tested for resistance to heat transfer as specified in Section 9.2.10, Conductive and Compressive Heat Resistance (CCHR) Test, and shall demonstrate passing performance.

8.1.10 All sewing thread utilized in the construction of garments and DRDs shall be tested for resistance to melting as specified in Section 9.2.5, Thread Melting Test, and shall not melt at or below 260°C (500°F).

8.1.11 Garment outer shells and collar linings shall be individually tested for resistance to tearing as specified in Section 9.3.1, Tear Resistance Test, and shall have a tear strength of not less than 100 N (22 lbf).

8.1.12 Garment moisture barriers, thermal barriers, and winter liners, where provided, shall be tested for resistance to tearing as specified in Section 9.3.1, Tear Resistance Test, and shall have a tear strength of not less than 22 N (5 lbf).

8.1.13 All garment seam assemblies shall be tested for strength as specified in Section 9.3.4, Seam-Breaking Strength Test.

8.1.13.1 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 9.3.4.3.2.1.

8.1.13.2 Seam breaking strength shall be considered acceptable where the fabric strength is less than the required seam strength specified in 8.1.13.1, providing the fabric fails without failure of the seam below the applicable forces specified in 8.1.13.1.

8.1.13.3 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 9.3.4.3.2.2.

8.1.13.4 All combination woven and knit or stretch knit seam specimens shall meet the requirements specified in 8.1.13.1.

8.1.14 Garment moisture barriers shall be tested for resistance to water penetration as specified in Section 9.4.2, Water Penetration Resistance Test, and shall have a minimum water penetration resistance of 172 kPa (25 psi).

8.1.15* Garment moisture barrier materials and seams shall be tested for resistance to liquid penetration as specified in Section 9.4.3, Liquid Penetration Resistance Test, and shall show no penetration of the test liquids for at least 1 hour.

8.1.16 Garment moisture barriers and moisture barrier seams shall be tested for liquid barrier performance and meet the Level 3 barrier requirements of ANSI/AAMI PB70, *Liquid barrier performance and classification of protective apparel and drapes intended for use in health care facilities*, as specified in Section 9.11, Liquid Barrier Performance Test.

8.1.16.1 In lieu of testing according to 8.1.16, garment moisture barriers and moisture barrier seams shall be permitted to be tested for resistance to liquid-borne or blood-borne pathogens according to 9.4.5 Viral Penetration Resistance, and shall allow no penetration of the Phi X-174 bacteriophage above the test interpretation threshold for at least 1 hour.

8.1.17 Garment moisture barriers, thermal barriers, winter liners where provided, and collar linings shall be individually tested for resistance to shrinkage as specified in Section 9.9.1, Cleaning Shrinkage Resistance Test, and shall not shrink more than 5 percent in any direction.

8.1.18 Garment outer shells and collar linings shall be individually tested for resistance to water absorption as specified in Section 9.4.1, Water Absorption Resistance Test, and shall not have more than 15 percent water absorption.

8.1.19 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 9.4.6, 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.

8.1.20 Labels shall be tested for durability and legibility as specified in Section 9.8.12, Label Durability and Legibility Test 1, shall remain in place, and shall be legible.

8.1.20.1 Nonvisual/machine-readable tags shall be tested for durability as specified in Section 9.8.12, Label Durability and Legibility Test 1, and shall remain functional, including the ability to scan and read the tag according to the manufacturer's instructions.

8.1.21 DRD materials, seams, splices, and joints shall be tested for material strength as specified in Section 9.3.20, Drag Rescue Device (DRD) Materials Strength Test, and shall have a minimum tensile strength of 7 kN (1573 lbf).

8.1.22 Garments with the DRD installed shall be tested for functionality as specified in Section 9.8.11, Drag Rescue Device (DRD) Function Test, and shall allow for the manikin 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 manikin.

8.1.23 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-55634C, *Commercial Item Description, Zippers (Fasteners, Slide, Interlocking)*.

8.1.24 Fastener tape shall be tested for breaking strength as specified in Section 9.3.19, Hook and Loop Fastener Tape Strength Test, and shall meet or exceed the minimum breaking strength requirements as established in Table 1 of A-A 55126C, *Commercial Item Description, Fastener Tapes, Hook and Loop, Synthetic*.

8.1.25 Fastener tape shall be tested for shear strength as specified in Section 9.3.19, Hook and Loop Fastener Tape Strength Test, and shall meet or exceed the minimum shear strength requirements as established in Table 1 of A-A 55126C, *Commercial Item Description, Fastener Tapes, Hook and Loop, Synthetic*.

8.1.26 Fastener tape shall be tested for peel strength as specified in Section 9.3.19, Hook and Loop Fastener Tape Strength Test, and shall meet or exceed the minimum peel strength requirements as established in Table 1 of A-A 55126C, *Commercial Item Description, Fastener Tapes, Hook and Loop, Synthetic*.

8.1.27* Garment moisture barrier materials shall be tested for resistance to light degradation as specified in 9.4.10, Light Degradation Resistance Test, and demonstrate passing performance.

8.2 Additional Performance Requirements for Structural Firefighting Protective Garment Elements Only.

8.2.1 Structural firefighting protective garment elements shall also meet the performance requirements specified in this section in addition to the performance requirements specified in Section 8.1, Protective Garment Elements Performance Requirements for Both Ensembles.

8.2.2* Garment composite consisting of the outer shell, moisture barrier, and thermal barrier shall be tested for evaporative heat transfer as specified in Section 9.7.1, Total Heat Loss (THL) Test, and shall have a THL of not less than 205 W/m^2.

8.2.2.1* Garment composites consisting of the outer shell, moisture barrier, and thermal barrier shall be tested for evaporative resistance a specified in Section 9.7.2, Evaporative Resistance Test 1,and shall have an evaporative resistance value of less than or equal to 45 $Pa \cdot m^2/W$.

8.2.2.2 Certain garment composites shall be permitted to be excluded from direct testing for evaporative resistance and instead calculated when testing is conducted by a sequence of tests as specified in 9.7.2.1.2.

8.2.3 Garment trim shall be tested for retroreflectivity and fluorescence as specified in Section 9.8.1, Trim Retroreflectivity and Fluorescence Test, and shall have a coefficient of retroreflection (R_a) of not less than 100 $cd/lux/m^2$ (100 $cd/fc/ft^2$), and shall have the color be fluorescent yellow-green, fluorescent orange-red, or fluorescent red.

8.2.4 Garment outer shells shall be individually tested for resistance to shrinkage as specified in Section 9.9.1, Cleaning Shrinkage Resistance Test, and shall not shrink more than 5 percent in any direction.

8.2.5 Garment outer shells and collar linings shall be individually tested for strength after washing as specified in Section 9.3.2, Breaking Strength Test, and shall have a breaking strength of not less than 623 N (140 lbf).

8.2.6 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 9.2.15, Transmitted and Stored Thermal Energy Test, and shall have an average predicted time to second-degree burn of 130 seconds or greater.

8.2.7 Garment outer shells shall be evaluated for flame resistance following fuel exposure and cleaning as specified in Section 9.9.4, Flame Resistance Following Fuel Exposure and Cleaning Test, with the following results reported in the user information:

(1) Indices of repellency, penetration, and absorption following exposure to diesel fuel
(2) Indices of repellency, penetration, and absorption following exposure to diesel fuel and after being subjected to laundering conditioning
(3) Flame resistance following exposure to diesel fuel
(4) Flame resistance following exposure to diesel fuel and the application of one cleaning cycle

8.2.8 Where the garment manufacturer or component supplier is required to report the contaminant removal efficiency for semivolatile organic compounds and heavy metals in the user information, outer shells, moisture barriers, and thermal barriers shall be evaluated for ease of cleaning as specified in 9.9.3, Contamination Removal Efficiency Tests.

8.3 Additional Performance Requirements for Proximity Firefighting Protective Garment Elements Only.

8.3.1 Proximity firefighting protective garment elements shall also meet the performance requirements specified in this section, in addition to the performance requirements specified in Section 8.1, Protective Garment Elements Design Requirements for Both Ensembles.

8.3.2 Garment outer shells shall be tested for radiant reflective capability as specified in Section 9.2.14, Radiant Protective Performance Test, and shall have an intersect time of not less than 20 seconds.

8.3.3 Garment outer shells shall be tested for resistance to delamination as specified in Section 9.4.7, Coating/Laminate Wet Flex Test, and shall show no signs of cracking on the face or delamination.

8.3.4 Garment outer shells shall be tested for adhesion durability as specified in Section 9.4.8, Coating/Laminate Adhesion After Wet Flex, and shall show no evidence of separation or removal of the surface coating.

8.3.5 Garment outer shells shall be tested for flex durability as specified in Section 9.4.9, Coating/Laminate Flex Resistance at Low Temperature Test, and shall show no evidence of breaking, shattering, or cracking of the coating, laminate, or fabric.

8.3.6 Garment outer shells shall be tested for blocking durability as specified in Section 9.2.6, Resistance to High-Temperature Blocking Test, and shall show no blocking.

8.4 Protective Helmet Elements Performance Requirements for Both Ensembles.

8.4.1 Protective helmet elements shall be tested for resistance to impact as specified in Section 9.3.5, Helmet Top Impact Resistance Test (Force), and shall have no sample transmit a force of more than 3780 N (850 lbf).

8.4.2 Helmets shall be tested for resistance to impact as specified in Section 9.3.6, Helmet Impact Resistance Test (Acceleration), and shall have no specimen exceed the maximum acceleration specified in Table 8.4.2. Any acceleration above 200 g_n shall not exceed a duration of 3 milliseconds, and an acceleration above 150 g_n shall not exceed a duration of 6 milliseconds. Helmets shall maintain sufficient structural integrity to withstand impacts in all five locations.

8.4.3 Helmets shall be tested for resistance to penetration as specified in Section 9.3.7, Helmet Physical Penetration Resistance Test, and shall exhibit no electrical or physical contact between the penetration test striker and the headform.

8.4.4 Helmets shall be tested for resistance to heat as specified in Section 9.2.4, 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 (1⅝ in.) below the original position of the helmet shell
(3) Distortion of the front and sides of the helmet shell extending more than 30 mm (1³⁄₁₆ 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 and where used, nonvisual/machine-readable tags
(8)* Any component of the helmet assembly, including, but not limited to, supplemental faceshields, extending more than 30 mm (1³⁄₁₆ 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

8.4.5 Helmets shall be tested for resistance to flame as specified by Procedure A and Procedure C in Section 9.2.2, Flame Resistance Test 2,and shall not show any visible afterflame or glow 5.0 seconds after removal from the test flame in each test.

8.4.6 Helmet ear covers and helmet shrouds shall be tested for thermal insulation as specified in Section 9.2.16, Thermal Protective Performance (TPP) Test, and shall have an average TPP rating of at least 20.0.

8.4.7 Helmets shall be tested for retention ability as specified in Section 9.3.9, Helmet Retention System Test, without any

Table 8.4.2 Impact Acceleration

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

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

break occurring and without any resulting slip or stretch of more than 20 mm ($^{13}/_{16}$ in.).

8.4.8 Helmet suspension systems shall be tested for retention ability as specified in Section 9.3.10, Helmet Suspension System Retention Test, and shall not separate from the helmet.

8.4.9 Helmets shall be tested for shell retention ability as specified in Section 9.3.8, Helmet Shell Retention Test, and shall not have the helmet shell separate from the helmet suspension and retention systems.

8.4.10 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 9.2.1, 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.

8.4.11 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 9.2.4, 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.

8.4.12 All sewing thread used in the construction of helmets shall be tested for melting resistance as specified in Section 9.2.5, Thread Melting Test, and shall not melt below 260°C (500°F).

8.4.13 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 9.4.6, 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.

8.4.14 Labels shall be tested for durability and legibility as specified in Section 9.8.13, Label Durability and Legibility Test 2, shall remain in place, and shall be legible.

8.4.14.1 Nonvisual/machine-readable tags shall be tested for durability as specified in Section 9.8.13, Label Durability and Legibility Test 2, and shall remain functional, including the ability to scan and read the tag according to the manufacturer's instructions.

8.4.15 Faceshield/goggle components shall be tested for resistance to impact as specified in Section 9.3.11, 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.

8.4.16 Faceshield/goggle components shall be tested for flame resistance as specified in Section 9.2.2, Flame Resistance Test 2, Procedure B, and shall not show any visible afterflame 5.0 seconds after removal of the test flame.

8.5 Additional Performance Requirements for Structural Firefighting Protective Helmet Elements Only.

8.5.1 Structural firefighting protective helmet elements shall also meet the performance requirements specified in this section in addition to the performance requirements specified in Section 8.4, Protective Helmet Elements Performance Requirements for Both Ensembles.

8.5.2 All fabrics utilized in construction of faceshield/goggle components shall be tested for flame resistance as specified in Section 9.2.1, 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.

8.5.3 Faceshield/goggle component lenses shall be tested for resistance to scratching as specified in Section 9.3.12, Faceshield/Goggle Component Lens Scratch Resistance Test, and shall not exhibit a delta haze of greater than 25 percent.

8.5.4 Faceshield/goggle component lenses shall be tested for transmittance of light as specified in 9.8.2, Faceshield/Goggle Component Lens 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.

8.5.5 Where provided, the faceshield/goggle component attachment hardware shall be tested for flame resistance as specified in Section 9.2.2, Flame Resistance Test 2, Procedure D, and shall not show any visible afterflame 5.0 seconds after removal of the test flame.

8.5.6 Helmets shall be tested for resistance to electricity as specified in both Procedure A and Procedure B of Section 9.6.1, Electrical Insulation Test 1, and shall not have leakage current exceeding 3.0 mA in each test.

8.5.7 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 9.2.1, 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.

8.5.8 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 9.2.4, Heat and Thermal Shrinkage Resistance Test, and shall not shrink more than 10 percent in any direction, and shall not melt, separate, or ignite.

8.5.9 Helmet visibility markings shall be tested for retroreflectivity and fluorescence as specified in Section 9.8.1, Retroreflectivity and Fluorescence Test, and shall have a coefficient of retroreflection (*Ra*) of not less than 100 cd/lux/m^2 (100 cd/fc/ft^2), and shall have the color be fluorescent yellow-green, fluorescent orange-red, or fluorescent red.

8.5.10 Helmet ear covers, sweatbands, chin straps, nape device coverings, if provided, and any other textile-based soft goods, excluding suspension soft goods, that come in contact with the wearer's head shall be evaluated for ease of removal and rein-

stallation as specified in Section 9.9.2, Helmet Soft Goods Ease of Removal and Reinstallation Test, and have a test time of 20 minutes or less.

8.5.11 Where the helmet manufacturer or component supplier is required to report the contaminant removal efficiency for semivolatile organic compounds and heavy metals in the user information, helmet ear cover materials, textile-based suspension system materials, and textile-based retention system materials that come in contact with the wearer's head or neck without a protective hood shall be evaluated for ease of cleaning as specified in 9.9.3, Contamination Removal Efficiency Tests.

8.6 Additional Performance Requirements for Proximity Firefighting Helmet Elements Only.

8.6.1 Proximity firefighting protective helmet elements shall also meet the performance requirements specified in this section in addition to the performance requirements specified in Section 8.4, Protective Helmet Elements Performance Requirements for Both Ensembles.

8.6.2 Helmets shall be tested for radiant heat resistance as specified in Section 9.2.13, Radiant Heat Resistance Test 3, and shall not have a temperature rise of more than 25°C (45°F).

8.6.3 Helmet shrouds shall be tested for radiant reflective capability as specified in Section 9.2.14, Radiant Protective Performance Test, and shall have an intersect time of not less than 20 seconds.

8.6.4 Helmet shrouds with a laminate base fabric shall be tested for resistance to delamination as specified in Section 9.4.7, Coating/Laminate Wet Flex Test, and shall show no signs of cracking on the face or delamination.

8.6.5 Helmet shrouds shall be tested for adhesion durability as specified in Section 9.4.8, Coating/Laminate Adhesion After Wet Flex, and shall show no evidence of separation or removal of the surface coating.

8.6.6 Helmet shrouds shall be tested for flex durability as specified in Section 9.4.9, Coating/Laminate Flex Resistance at Low Temperature Test, and shall show no evidence of breaking, shattering, or cracking of the coating, laminate, or fabric.

8.6.7 Helmet shrouds shall be tested for blocking durability as specified in Section 9.2.6, Resistance to High-Temperature Blocking Test, and shall show no blocking.

8.6.8 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 9.2.4, Heat and Thermal Shrinkage Resistance Test, and shall not shrink more than 10 percent in any direction, and shall not melt, separate, or ignite.

8.6.9 Helmet shroud outer shell material shall be individually tested for resistance to tearing as specified in Section 9.3.1, Tear Resistance Test, and shall have a tear strength of not less than 100 N (22 lbf).

8.6.10 Helmet faceshield component lenses shall be tested for transmittance of light as specified in 9.8.2, Faceshield/Goggle Component Lens Luminous (Visible) Transmittance Test, and shall transmit not less than 30 percent of the incident visible radiation.

8.6.11 Helmet faceshields shall be tested for radiant reflective capability as specified in Section 9.2.14, Radiant Protective Performance Test, and shall have an intersect time of not less than 30 seconds.

8.6.12 Helmet outer covers, where provided, shall be tested for radiant reflective capability as specified in Section 9.2.14, Radiant Protective Performance Test, and shall have an intersect time of not less than 20 seconds.

8.6.13 Helmet outer covers, where provided, shall be tested for resistance to delamination as specified in Section 9.4.7, Coating/Laminate Wet Flex Test, and shall show no signs of cracking on the face or delamination.

8.6.14 Helmet outer covers, where provided, shall be tested for adhesion durability as specified in Section 9.4.8, Coating/Laminate Adhesion After Wet Flex Test, and shall show no evidence of separation or removal of the surface coating.

8.6.15 Helmet outer covers, where provided, shall be tested for flex durability as specified in Section 9.4.9, Coating/Laminate Flex Resistance at Low Temperature Test, and shall show no evidence of breaking, shattering, or cracking of the coating, laminate, or fabric.

8.6.16 Helmet outer covers, where provided, shall be tested for blocking durability as specified in Section 9.2.6, Resistance to High-Temperature Blocking Test, and shall show no blocking.

8.6.17 Helmet outer covers, where provided, shall be tested for resistance to tearing as specified in Section 9.3.1, Tear Resistance Test, and shall have a tear strength of not less than 22 N (5 lbf).

8.6.18 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 9.2.1, 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.

8.6.19 Helmet faceshield component lenses shall be tested for resistance to scratching as specified in Section 9.3.12, Faceshield/Goggle Component Lens Scratch Resistance Test, and shall not exhibit a delta haze of greater than 5 percent.

8.6.20 Proximity faceshields shall be tested for adhesion of reflective coating as specified in Section 9.3.13, Proximity Faceshield Reflective Coating Adhesion Test, and shall show evidence of removal not to exceed 2B classification (i.e., 15 percent to 35 percent removal).

8.7 Protective Glove Elements Performance Requirements for Both Ensembles.

8.7.1 The glove body composite shall be tested for thermal insulation as specified in Section 9.2.16, Thermal Protective Performance (TPP) Test, and have an average TPP rating of at least 35.0.

8.7.2 The glove interface component composite shall be tested for thermal insulation as specified in Section 9.2.16,

Thermal Protective Performance (TPP) Test, and shall have an average TPP rating of at least 20.0.

8.7.3 Gloves shall be tested for resistance to heat as specified in Section 9.2.4, 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.

8.7.3.1 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.

8.7.3.2 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.

8.7.4 The glove lining materials of the glove body shall be individually tested for resistance to heat as specified in Section 9.2.4, Heat and Thermal Shrinkage Resistance Test, and shall not melt, separate, or ignite.

8.7.5 Portions of the glove body composite representative of the palm of the glove shall be tested for conductive heat resistance as specified in Section 9.2.7, 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.

8.7.6 The glove body composite, including, but not limited to, trim, external labels, external nonvisual/machine-readable tags, 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 9.2.17, 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.

8.7.7 The glove interface component composite, including, but not limited to, trim, external labels, external nonvisual/machine-readable tags, 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 9.2.17, 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.

8.7.8 The glove extension composite, including, but not limited to, trim, external labels, external nonvisual/machine-readable tags, 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 9.2.17, 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.

8.7.9* All sewing thread utilized in the construction of gloves shall be tested for melting resistance as specified in Section 9.2.5, Thread Melting Test, and shall not melt at or below 260°C (500°F).

8.7.10 The glove body seams shall be tested for resistance to liquid-borne or blood-borne pathogens as specified in Section 9.4.5, Viral Penetration Resistance Test, and shall allow no penetration of the Phi-X-174 bacteriophage above the test interpretation threshold for at least 1 hour.

8.7.11* Glove body seams shall be tested for resistance to liquid penetration as specified in Section 9.4.3, Liquid Penetration Resistance Test, and shall allow no penetration of test liquids for at least 1 hour.

8.7.12 The glove body composite shall be tested for resistance to cut as specified in Section 9.3.15, Glove and Footwear Cut Resistance Test, and shall have a distance of blade travel of more than 20 mm (0.8 in.).

8.7.13 The glove interface component shall be tested for resistance to cut as specified in Section 9.3.15, Glove and Footwear Cut Resistance Test, and shall have a distance of blade travel of more than 20 mm (0.8 in.).

8.7.14 The glove body composite shall be tested for resistance to puncture as specified in Section 9.3.14, Glove and Footwear Puncture Resistance Test, and shall not be punctured under an average applied force of 40 N (8.8 lbf).

8.7.15* Gloves shall be tested for hand function as specified in Section 9.8.4, Glove Hand Function Test, and shall have an average percent of bare-handed control not exceeding 220 percent.

8.7.16 Knit glove wristlet material(s) shall be tested for material strength as specified in Section 9.3.3, Burst Strength Test, and shall have a burst strength of not less than 225 N (51 lbf).

8.7.17 Glove body to glove interface component major seams shall be tested for seam strength as specified in Section 9.3.4, Seam-Breaking Strength Test, and shall have a burst strength of not less than 182 N (41 lbf).

8.7.18* Gloves shall be tested for resistance to leakage as specified in Section 9.5.2, Whole Glove Liquid Integrity Test 1, and shall show no leakage.

8.7.19* Gloves shall be tested for ease of donning as specified in Section 9.8.3, 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.

8.7.20 Gloves shall be tested for retention of the glove liner as specified in Section 9.3.16, Liner Retention Test, and shall have no detachment of the inner liner or moisture barrier.

8.7.21 Labels shall be tested for durability and legibility as specified in Section 9.8.12, Label Durability and Legibility Test 1, shall remain in place, and shall be legible.

8.7.21.1 Nonvisual/machine-readable tags shall be tested for durability as specified in Section 9.8.12, Label Durability and Legibility Test 1, shall remain functional, including the ability to scan and read the tag according to the manufacturer's instructions.

8.7.22 Gloves shall be tested for grip as specified in Section 9.8.5, Glove Grip Test, and shall not have a drop of force of more than 30 percent in any 0.2-second interval.

8.7.23 Gloves shall be tested using the torque test as specified in Section 9.8.6, Glove Torque Test, and shall have an average percent of bare-handed control not less than 80 percent.

8.7.24 Gloves shall be tested for hand function as specified in Section 9.8.7, Glove Tool Test, and shall have an average percent of bare-handed control not exceeding 175 percent.

8.7.25 The glove body composite at the back of the glove shall be tested for radiant heat resistance as specified in Section 9.2.15, Transmitted and Stored Thermal Energy Test, and shall have a second-degree burn time of not less than 130 seconds.

8.8 Additional Performance Requirements for Structural Firefighting Protective Glove Elements Only.

8.8.1 Structural firefighting protective glove elements shall also meet the performance requirements specified in this section in addition to the performance requirements specified in Section 8.7, Protective Glove Elements Performance Requirements for Both Ensembles.

8.8.2 All glove metal hardware and all glove hardware that include metal parts shall be individually tested for resistance to corrosion as specified in Section 9.4.6, 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.

8.9 Additional Performance Requirements for Proximity Firefighting Protective Glove Elements Only.

8.9.1 Proximity firefighting protective glove elements shall also meet the performance requirements specified in this section in addition to the performance requirements specified in Section 8.7, Protective Glove Elements Performance Requirements for Both Ensembles.

8.9.2 The radiant reflective protective areas as required in Section 7.9, Additional Design Requirements for Proximity Firefighting 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 9.2.14, Radiant Protective Performance Test, and shall have an intersect time of not less than 20 seconds.

8.9.3 The radiant reflective protective areas as required in Section 7.9, Additional Design Requirements for Proximity Firefighting 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 9.4.7, Coating/Laminate Wet Flex Test, and shall show no signs of cracking on the face or delamination.

8.9.4 The radiant reflective protective areas as required in Section 7.9, Additional Design Requirements for Proximity Firefighting Protective Glove Elements Only, of the glove body, glove interface component, and glove extension shall be tested for adhesion durability as specified in Section 9.4.8, Coating/Laminate Adhesion After Wet Flex Test, and shall show no evidence of separation or removal of the surface coating.

8.9.5 The radiant reflective protective areas as required in Section 7.9, Additional Design Requirements for Proximity Firefighting Protective Glove Elements Only, of the glove body, glove interface component, and glove extension shall be tested for flex durability as specified in Section 9.4.9, Coating/Laminate Flex Resistance at Low Temperature Test, and shall show no evidence of breaking, shattering, or cracking of the coating, laminate, or fabric.

8.9.6 The radiant reflective protective areas as required in Section 7.9, Additional Design Requirements for Proximity Firefighting Protective Glove Elements Only, of the glove body, glove interface component, and glove extension shall be tested for blocking durability as specified in Section 9.2.6, Resistance to High-Temperature Blocking Test, and shall show no blocking.

8.10 Protective Footwear Elements Performance Requirements for Both Ensembles.

8.10.1 Protective footwear elements shall be tested for thermal insulation as specified in Section 9.2.8, Conductive Heat Resistance Test 2, and the temperature of the insole surface in contact with the foot shall not exceed 44°C (111°F).

8.10.2 Footwear, with components in place, shall be tested for resistance to flame as specified in Section 9.2.3, 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.

8.10.2.1* Components that do not contribute to the required footwear protection that demonstrate melt, drip, or burn-through (but not afterflame) shall not be considered in the evaluation of the footwear performance.

8.10.3 All sewing thread utilized in the construction of footwear shall be tested for melt resistance as specified in Section 9.2.5, Thread Melting Test, and shall not melt below 260°C (500°F).

8.10.4 The footwear upper material composite and footwear seams shall be tested for resistance to liquid penetration as specified in Section 9.4.3, Liquid Penetration Resistance Test, and shall allow no penetration of the test liquids for at least 1 hour.

8.10.5 The footwear upper material composite and footwear seams shall be tested for resistance to liquid-borne or blood-borne pathogens as specified in Section 9.4.5, Viral Penetration Resistance Test, and shall allow no penetration of the Phi-X-174 bacteriophage above the test interpretation threshold for at least 1 hour.

8.10.6 Footwear shall be tested for resistance to puncture as specified in Section 9.3.14, Glove and Footwear Puncture Resistance Test, and shall not puncture the footwear upper under an average applied force of 60 N (13 lbf).

8.10.7 Footwear uppers shall be tested for resistance to cut as specified in Section 9.3.15, Glove and Footwear Cut Resistance Test, and shall have a cut distance resistance of more than 20 mm (0.8 in.).

8.10.8 Footwear shall be tested for slip resistance as specified in Section 9.8.9, Footwear Slip Resistance Test, and shall have a coefficient of friction of 0.40 or greater.

8.10.9 Footwear soles and heels shall be tested for resistance to abrasion as specified in Section 9.3.17, Footwear Sole Abrasion Resistance Test, and the relative volume loss shall not be greater than 250 mm^3 (0.015 $in.^3$).

8.10.10* Footwear shall be tested for resistance to electricity as specified in Section 9.6.2, Electrical Insulation Test 2, and shall have no current leakage in excess of 3.0 mA.

8.10.11 Footwear ladder shanks or whole sole equivalents shall be tested for resistance to bending as specified in Section 9.8.8, Footwear Ladder Shank Bend Resistance Test, and shall not deflect more than 6 mm (¼ in.).

8.10.12 Footwear stud posts and eyelets shall be tested for attachment strength as specified in Section 9.3.18, Footwear Eyelet and Stud Post Attachment Test, and shall have a minimum detachment strength of 294 N (66 lbf).

8.10.13 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 9.4.6, 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.

8.10.14 Labels shall be tested for durability and legibility as specified in Section 9.8.12, Label Durability and Legibility Test 1, shall remain in place, and shall be legible.

8.10.14.1 Nonvisual/machine-readable tags shall be tested for durability as specified in Section 9.8.12, Label Durability and Legibility Test 1, and shall remain functional, including the ability to scan and read the tag according to the manufacturer's instructions.

8.10.15 Footwear shall be tested for resistance to heat as specified in Section 9.2.4, 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.

8.11 Additional Performance Requirements for Structural Firefighting Protective Footwear Elements Only.

8.11.1 Structural firefighting protective footwear elements shall also meet the performance requirements specified in this section in addition to the performance requirements specified in Section 8.10, Protective Footwear Elements Performance Requirements for Both Ensembles.

8.11.2 Footwear shall be tested for thermal insulation as specified in Section 9.2.11, Radiant Heat Resistance Test 1, and the temperature of the upper surface in contact with the skin shall not exceed 44°C (111°F).

8.11.3 Footwear shall be tested for thermal insulation as specified in Section 9.2.7, 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.

8.12 Additional Performance Requirements for Proximity Firefighting Protective Footwear Elements Only.

8.12.1 Proximity firefighting protective footwear elements shall also meet the performance requirements specified in this section in addition to the performance requirements specified in Section 8.10, Protective Footwear Elements Performance Requirements for Both Ensembles.

8.12.2 Footwear shall be tested for thermal insulation as specified in Section 9.2.9, 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.

8.12.3 Footwear shall be tested for thermal insulation as specified in Section 9.2.12, 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).

8.13 Protective Hood Interface Component Performance Requirements for Both Ensembles.

8.13.1 Firefighting 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 9.8.10, Hood Opening Size Retention Test, 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.

8.13.1.1 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 9.8.10, 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.).

8.13.2 Hoods shall be tested for thermal insulation as specified in Section 9.2.16, Thermal Protective Performance (TPP) Test, and shall have an average TPP rating of not less than 20.0.

8.13.3 Hood material(s), excluding hook and pile fasteners, nonvisual/machine-readable tags, and elastic when not placed in direct contact with the body, shall be individually tested for resistance to flame as specified in Section 9.2.1, Flame Resistance Test 1, 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 and drip.

8.13.3.1 Hood labels, lettering, and emblems shall be individually tested for resistance to flame as specified in Section 9.2.1, Flame Resistance Test 1, shall not have an afterflame of more than 2.0 seconds average, shall not melt and drip, and shall not be totally consumed.

8.13.4 Hoods, excluding labels, hook and pile fasteners, nonvisual/machine-readable tags, and elastic, shall be individually tested for resistance to heat as specified in Section 9.2.4, Heat and Thermal Shrinkage Resistance Test, 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.

8.13.5 Hoods shall be individually tested for resistance to heat as specified in Section 9.2.4, Heat and Thermal Shrinkage Resistance Test, and shall not melt, separate, or ignite.

8.13.5.1 Components attached to hoods, including labels, lettering, and emblems but excluding hook and pile fasteners, nonvisual/machine-readable tags, 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 9.2.4, Heat and Thermal Shrinkage Resistance Test, and shall not melt, separate, or ignite.

8.13.6 Hoods with elastic or manually adjustable face openings shall be individually tested for resistance to shrinkage as specified in Section 9.9.1, Cleaning Shrinkage Resistance Test, 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.

8.13.6.1 Hoods designed to interface with a specific SCBA facepiece shall be individually tested for resistance to shrinkage as specified in Section 9.9.1, 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.

8.13.7 All sewing thread used in the construction of hoods shall be tested for melting resistance as specified in Section 9.2.5, Thread Melting Test, and shall not melt below 260°C (500°F).

8.13.8 The outermost hood material shall be tested for material strength as specified in Section 9.3.3, 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 9.3.3, Burst Strength Test, and shall have a burst strength of not less than 225 N (51 lbf).

8.13.9 Hood seams shall be tested for seam strength as specified in Section 9.3.4, Seam-Breaking Strength Test, and shall have a burst strength of not less than 181 N (41 lbf).

8.13.10 Labels shall be tested for durability and legibility as specified in Section 9.8.12, Label Durability and Legibility Test 1, shall remain attached to the hood, and shall be legible.

8.13.10.1 Nonvisual/machine-readable tags shall be tested for durability as specified in Section 9.8.12, Label Durability and Legibility Test 1, and shall remain functional, including the ability to scan and read the tag according to the manufacturer's instructions.

8.14 Additional Performance Requirements for Structural Firefighting Protective Hood Interface Components Only.

8.14.1 Hood composite materials and seams including a particulate blocking layer shall be tested for particulate blocking as specified in Section 9.4.4, 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.

8.14.2 Hood composites including a particulate blocking layer shall be tested for evaporative heat transfer as specified in Section 9.7.1, Total Heat Loss (THL) Test, and shall have a THL of not less than 325 W/m^2.

8.14.3 Where the manufacturer is required to report the results in the user information, hood composite materials including a particulate blocking layer shall be tested for transmitted and stored thermal energy as specified in Section 9.2.15, Transmitted and Stored Thermal Energy Test.

8.14.4 Where the hood manufacturer is required to report the contaminant removal efficiency for semivolatile organic compounds and heavy metals in the user information, hood composites shall be evaluated for ease of cleaning as specified in 9.9.3, Contamination Removal Efficiency Tests.

8.15 Additional Performance Requirements for Proximity Firefighting Protective Hood Interface Components Only. (Reserved)

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

8.16.1 Protective wristlet interface components shall be tested for thermal insulation as specified in Section 9.2.16, Thermal Protective Performance (TPP) Test, and shall have an average TPP rating of not less than 20.0.

8.16.1.1 Where the coat sleeve end terminates in a garment-glove interface, the interface composite shall be tested for thermal insulation as specified in Section 9.2.16, Thermal Protective Performance (TPP) Test, and shall have an average TPP rating of not less than 35.0.

8.16.2 Wristlet material(s) shall be individually tested for resistance to flame as specified in Section 9.2.1, 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.

8.16.3 Wristlet material(s) shall be individually tested for resistance to heat as specified in Section 9.2.4, Heat and Thermal Shrinkage Resistance Test, and shall not shrink more than 10 percent in any direction.

8.16.4 Wristlet material(s) shall be individually tested for resistance to heat as specified in Section 9.2.4, Heat and Thermal Shrinkage Resistance Test, and shall not melt, separate, or ignite.

8.16.5 Wristlet material(s) shall be individually tested for resistance to shrinkage as specified in Section 9.9.1, Cleaning Shrinkage Resistance Test, and shall not shrink more than 5 percent in any direction.

8.16.6 All sewing thread utilized in the construction of wristlets shall be tested for melting resistance as specified in Section 9.2.5, Thread Melting Test, and shall not melt at or below 260°C (500°F).

8.16.7 Knit wristlet material(s) shall be tested for material strength as specified in Section 9.3.3, Burst Strength Test, and shall have a burst strength of not less than 225 N (51 lbf).

8.16.8 Knit wristlet seams shall be tested for seam strength as specified in Section 9.3.4, Seam-Breaking Strength Test, and shall have a breaking strength of not less than 181 N (41 lbf).

8.16.9 Where the coat sleeve end terminates in a garment-glove interface, the interface area shall be tested in accordance with Section 9.5.1, Whole Garment and Ensemble Liquid Penetration Test, and shall allow no liquid penetration.

8.17 Additional Performance Requirements for Structural Firefighting Protective Wristlet Interface Components Only. (Reserved)

8.18 Additional Performance Requirements for Proximity Firefighting Protective Wristlet Interface Components Only. (Reserved)

8.19 Reserved.

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

8.20.1 Liquid and Particulate Contaminant Protective Ensemble Performance Requirements for Both Ensembles. (Reserved)

8.20.2 Additional Liquid and Particulate Contaminant Protection Performance Requirements for Structural Firefighting Protective Ensembles Only. (Reserved)

8.20.3 Additional Liquid and Particulate Contaminant Protection Performance Requirements for Proximity Firefighting Protective Ensembles Only. (Reserved)

8.20.4 Liquid and Particulate Contaminant Protective Garment Element Performance Requirements for Both Ensembles.

8.20.4.1 Liquid and particulate contaminant garments shall meet the performance requirements of 8.20.4 in addition to meeting the performance requirements as specified in Section 8.1, Protective Garment Elements Performance Requirements for Both Ensembles, and Section 8.2, Additional Performance Requirements for Structural Firefighting Protective Garment Elements Only, or in Section 8.3, Additional Performance Requirements for Proximity Firefighting Protective Garment Elements Only.

8.20.4.2 The protective garment shall be tested for overall particulate inward leakage with other ensemble elements as specified in Section 9.5.3, Particle Inward Leakage Test, and shall allow no visual particulate inward leakage on the test subject black indicator garment.

8.20.4.3 The protective garments shall be tested as specified in Section 9.5.1, Whole Garment and Ensemble Liquid Penetration Test, and shall show no liquid penetration.

8.20.5 Additional Liquid and Particulate Contaminant Protection Performance Requirements for Structural Firefighting Protective Garment Elements Only. (Reserved)

8.20.6 Additional Liquid and Particulate Contaminant Protection Performance Requirements for Proximity Firefighting Protective Garment Elements Only. (Reserved)

8.20.7 Protective Helmet Element Liquid and Particulate Contaminant Protection Performance Requirements for Both Ensembles. (Reserved)

8.20.8 Additional Liquid and Particulate Contaminant Protection Performance Requirements for Structural Firefighting Protective Helmet Elements Only. (Reserved)

8.20.9 Additional Liquid and Particulate Contaminant Protection Performance Requirements for Proximity Firefighting Protective Helmet Elements Only. (Reserved)

8.20.10 Protective Glove Elements Liquid and Particulate Contaminant Protection Performance Requirements for Both Ensembles. (Reserved)

8.20.11 Additional Liquid and Particulate Contaminant Protection Performance Requirements for Structural Firefighting Protective Glove Elements Only. (Reserved)

8.20.12 Additional Liquid and Particulate Contaminant Protection Performance Requirements for Proximity Firefighting Protective Glove Elements Only. (Reserved)

8.20.13 Protective Footwear Elements Liquid and Particulate Contaminant Protection Performance Requirements for Both Ensembles. (Reserved)

8.20.14 Additional Liquid and Particulate Contaminant Protection Performance Requirements for Structural Firefighting Protective Footwear Elements Only. (Reserved)

8.20.15 Additional Liquid and Particulate Contaminant Protection Performance Requirements for Proximity Firefighting Protective Footwear Elements Only. (Reserved)

8.20.16 Protective Hood Interface Component Liquid and Particulate Contaminant Protection Performance Requirements for Both Ensembles. (Reserved)

8.20.17 Additional Liquid and Particulate Contaminant Protection Performance Requirements for Structural Firefighting Protective Hood Interface Components Only. (Reserved)

8.20.18 Additional Liquid and Particulate Contaminant Protection Performance Requirements for Proximity Firefighting Protective Hood Interface Components Only. (Reserved)

8.21* Acceptable Levels of Restricted Substances in Specified Protective Element Recognized Components. Components that are required to be certified for individual protective elements shall meet the acceptable restricted substances as established in Table 8.21(a) when tested as specified in 9.10.1, Test Method for Acceptable Levels of Specific Restricted Substances, subject to the following applications or exceptions:

(1) Testing for acetophenone and 2-Phenyl-2-propanol shall only be applied to polymers that contain ethylene vinyl acetate.
(2) Testing for acidic or alkaline substances (pH) shall be excluded for materials and components that are plastics, rubber, or polymers.
(3) Testing for azo-amines and aryl amine salts shall be excluded for materials and components that are plastics, rubber, or polymers.
(4) Testing for bisphenols shall only be applied to materials and components that are plastics, rubber, or polymers, including elastomers.
(5) Testing for chlorobenzenes and chlorotoluenes shall only be applied to materials and components that include synthetic fibers, natural and synthetic fiber blends, or artificial leather.
(6) A maximum level of 30 mg/kg of 1,2-Dichlorobenzene shall be permitted when C.I. Pigment Violet 23 (CAS No. 6358-30-1), Yellow 93 (CAS No. 5580-57-4), Orange 61 (CAS No. 40716-47), and Red 214 (CAS No. 82643-43-4) solution-dyed fibers are used.
(7) Testing for chlorinated paraffins shall be excluded for materials that include natural or synthetic fibers.
(8) Testing for chlorophenols shall be only applied to materials and components that include natural fibers, synthetic fibers, or natural and synthetic fiber blends.
(9) Testing for dyes shall only be applied to materials and components that include synthetic fibers or natural and synthetic fiber blends.
(10) Testing for formaldehyde shall be excluded for materials and components that are plastics or polymers.

(11) Testing for heavy metal Chromium VI shall be only applied to materials and components that consist of natural fibers or synthetic fibers.
(12) Testing for total heavy metal content that includes arsenic, cadmium, lead, and mercury shall be excluded for materials and components that include synthetic fibers.
(13) Testing for monomers shall be only applied to materials and components that include artificial leather or are plastics, rubber, and polymers.
(14) Testing for nitrosamines shall be only applied to materials and components that are rubber.
(15) Testing for ortho-phenylphenol shall be excluded for materials and components that are plastics, rubber, or polymers.
(16) Testing for phthalates shall be excluded for materials and components that include natural fibers, synthetic fibers, and natural and synthetic fiber blends.
(17) Testing for polycyclic aromatic hydrocarbons shall be excluded for materials and components that include natural fibers, synthetic fibers, and natural and synthetic fiber blends.
(18) Testing for quinoline shall be applied to materials and components that include synthetic fibers or natural and synthetic fiber blends.
(19) Testing for solvent residuals shall be applied to materials and components that include synthetic coated fabrics or artificial leather or that are polyurethane-based plastics or polymers.
(20) A maximum level of 1000 mg/kg for Dimethylacetamide (DMAC), Dimethylformamide (DMF), and N-Methyl-2-pyrrolidone (NMP) shall be permitted for materials made of acrylic, elastane, polyurethane, polyimide, aramids, and coated textiles.
(21) A maximum level of 3.0 weight percent for Dimethylacetamide (DMAC), Dimethylformamide (DMF), and N-Methyl-2-pyrrolidone (NMP) shall be permitted for material products that must undergo further industrial production stages, such as fibers that are spun with the aid of DMAC, DMF, or NMP.
(22) Testing for UV stabilizers shall be applied to materials and components that include plastics, rubber, or polymers.
(23) Testing for volatile organic compounds shall be applied to materials and components that include artificial leather or are polyurethane-based plastics or polymers.
(24) Perfluorinated and polyfluorinated alkyl substances shall be tested in relevant materials and components for both total PFAS and individual PFAS chemicals.

Table 8.21(a) Acceptable Levels of Restricted Substances in Specified Protective Element Recognized Components

Chemical Class or Group	Restricted Substance(s)	Maximum Level
Acetophenone and 2-Phenyl-2-propanol	Acetophenone and 2-Phenyl-2-propanol	10 mg/kg
Acidity and alkaline substances	Measured by reporting pH	Acceptable range 4.0–7.5
Akyl phenols and ethoxylates	Sum of 4-tert butylphenol, nonylphenol, octylphenol, heptaphenol, and pentylphenol	10.0 mg/kg
	Sum of 4-tert butylphenol, nonylphenol, octylphenol, heptaphenol, pentylphenol, nonylphenolethoxylates, and octylphenol-ethoxylates	100.0 mg/kg
Azo-amines and aryl amine salts	Each individual substance in Table 8.21(b)	20 mg/kg
Bisphenols	Bisphenol A, Bisphenol B, and Bisphenol S, each	1000 mg/kg
Chlorinated benzenes and toluenes	Sum of all chemicals in Table 8.21(c), except Chlorobenzene	1.0 mg/kg
	Chlorobenzene	30 mg/kg[a]
Chlorinated paraffins	Short-chain chlorinated paraffins (SCCPs) (C10–C13)	1000 mg/kg
Chlorinated phenols	Pentachlorophenol	0.5 mg/kg
	Tetrachlorophenols	0.5 mg/kg
	Trichlorophenols	2.0 mg/kg
	Dichlorophenols	3.0 mg/kg
	Monochlorophenols	3.0 mg/kg
Dyes	Each individual substance in Table 8.21(d)	50 mg/kg
	Navy blue	Not present
Flame retardants	Each individual substance in Table 8.21(e)	10 mg/kg
	Sum of all chemicals in Table 8.21(e)	50 mg/kg
Formaldehyde	Free and partially releasable	75 mg/kg
Heavy metals, extractable	Antimony	30.0 mg/kg
	Arsenic	1.0 mg/kg
	Barium	1000 mg/kg
	Cadmium	0.1 mg/kg
	Chromium	2.0 mg/kg
	Chromium VI	0.5 mg/kg
	Cobalt	4.0 mg/kg
	Copper	50.0 mg/kg
	Lead	1.0 mg/kg
	Mercury	0.02 mg/kg
	Nickel	4.0 mg/kg
	Selenium	100 mg/kg
Heavy metals, total content	Arsenic	100 mg/kg
	Cadmium	40.0 mg/kg
	Lead	90.0 mg/kg
	Mercury	0.5 mg/kg
Monomers	Styrene	0.005 kg/m^3
	Vinyl chloride	0.002 kg/m^3
Nitrosamines	Each individual substance in Table 8.21(f)	0.5 mg/kg
	Sum of N-nitrosatable substances	5 mg/kg
Organotin compounds	Tributyltin (TBT)	1.0 mg/kg
	Triphenyltin (TPhT)	1.0 mg/kg
	Each individual substance in Table 8.21(g)	2.0 mg/kg
Ortho-phenylphenol	Ortho-phenylphenol	25 mg/kg

(continues)

Table 8.21(a) *Continued*

Chemical Class or Group	Restricted Substance(s)	Maximum Level
Perfluorinated and polyfluorinated alkyl substances (PFC/PFAS)	Total fluorine content [includes non-PFAS]	Report
	Sum of C9-C14 PFCA-related substances	260 µg/kg
	Sum of PFOS, PFOSA, PFOSF, N-Me-FOSA, N-Et-FOSA, N-Me-FOSE, NEt-FOSE	1 µg/m^2
	Each and sum of PFHpA, PFNA, PFDA, PFUdA, PFDoA, PFTrDA, PFTeDA and further perfluorinated carboxylic acids in Table 8.21(j)	25 µg/kg
	Sum of perfluorinated sulfonic acids in Table 8.21(j)	250 µg/kg
	Each partially fluorinated carboxylic/sulfonic acids in Table 8.21(j)	250 µg/kg
	Sum of partially fluorinated linear alcohols in Table 8.21(j)	250 µg/kg
	Sum of esters of fluorinated alcohols with acrylic acid in Table 8.21(j)	250 µg/kg
	Sum of PFOA and salts	25 µg/kg
	Sum of PFOA-related substances	250 µg/kg
Phthalates	Sum of substances listed in Table 8.21(h)	500 mg/kg
Polycyclic aromatic hydrocarbons (PAH)	Benzo(a)pyrene	1.0 mg/kg
	Benzo(e)pyrene	1.0 mg/kg
	Benzo(a)anthracene	1.0 mg/kg
	Chrysene	1.0 mg/kg
	Benzo(b)fluoroanthrene	1.0 mg/kg
	Benzo(j)fluoroanthrene	1.0 mg/kg
	Benzo(k)fluoroanthrene	1.0 mg/kg
	Dibenzo(a,h)anthracene	1.0 mg/kg
	Sum of substances listed in Table 8.21(i)	10.0 mg/kg
Quinoline	Quinoline	50.0 mg/kg
Solvent residues	Dimethylacetamide (DMAC)	500 mg/kg 1000 mg/kg[b]
	Dimethylformamide (DMF)	500 mg/kg 1000 mg/kg[b] 3.0%[c]
	Formamide	1000 mg/kg
	N-Methyl-2-Pyrrolidone (NMP)	500 mg/kg 1000 mg/kg[b] 3.0%[c]
UV absorbers or stabilizers	2-Benzotriazol-2-yl-4,6-di-tert-butylphenol (UV 320)	1000 mg/kg
	2,4-Di-tert-butyl-6-(5-chlorobenzotriazol-2-yl) phenol (UV 327)	1000 mg/kg
	2-(2H-Benzotriazol-2-yl)-4,6-di-tert-penthylphenol (UV 328)	1000 mg/kg
	2-(2H-Benzotriazol-2-yl)-4-(tert-butyl)-6-(sec-butyl)phenol (UV 350)	1000 mg/kg
Volatile organic compounds (VOCs)	Benzene	5 mg/kg
	Each VOC listed in Table 8.21(k)	10 mg/kg

[a]A maximum level of 30 mg/kg of 1,2-Dichlorobenzene applies when C.I. Pigment Violet 23 (CAS No. 6358-30-1), Yellow 93 (CAS No. 5580-57-4), Orange 61 (CAS No. 40716-47), and Red 214 (CAS No. 82643-43-4) solution-dyed fibers are used *[see 8.21 (6)]*.

[b]A maximum level of 1000 mg/kg applies to materials made of acrylic, elastane, polyurethane, polyimide, aramids, and coated textiles *[see 8.21(20)]*.

[c]A maximum level of 3.0 weight percent applies to material products that must undergo further industrial production stages, such as fibers that are spun with the aid of DMAC, DMF, or NMP *[see 8.21(21)]*.

Table 8.21(b) List of Restricted Azo-amines and Aryl Amine Salts

Azo-amine or Aryl Amine Salt Chemical	CAS Number
4-Aminobiphenyl	92-67-1
Benzidine	92-87-5
4-Chloro-o-toluidine	95-69-2
2-Naphthylamine	91-59-8
o-Aminoazotoluene	97-56-3
2-Amino-4-nitrotoluene	99-55-8
p-Chloraniline	106-47-8
2,4-Diaminoanisole	615-05-4
4,4'-Diaminodiphenylmethane	101-77-9
3,3'-Dichlorobenzidine	91-94-1
3,3'-Dimethoxybenzidine	119-90-4
3,3'-Dimethylbenzidine	119-93-7
3,3'-dimethyl-4,4'-diaminodiphenylmethane	838-88-0
p-Cresidine	120-71-8
4,4'-Methylen-bis(2-chloraniline)	101-14-4
4,4'-Oxydianiline	101-80-4
4,4'-Thiodianiline	139-65-1
o-Toluidine	95-53-4
2,4-Toluenediamine	95-80-7
2,4,5-Trimethylaniline	137-17-7
2,4 Xylidine	95-68-1
2,6 Xylidine	87-62-7
2-Methoxyaniline (= o-Anisidine)	90-04-0
p-Aminoazobenzene	60-09-3
4-Chloro-o-toluidinium chloride	3165-93-3
2-Naphthylammoniumacetate	553-00-4
4-Methoxy-m-phenylene diammonium sulphate	39156-41-7
2,4,5-Trimethylaniline hydrochloride	21436-97-5

Table 8.21(c) List of Restricted Chlorinated Benzenes and Toluenes

Chlorinated Benzene or Toluene Chemical	CAS Number
2-Chlorotoluene	95-49-8
3-Chlorotoluene	108-41-8
4-Chlorotoluene	106-43-4
2,3-Dichlorotoluene	32768-54-0
2,4-Dichlorotoluene	95-73-8
2,5-Dichlorotoluene	19398-61-9
2,6-Dichlorotoluene	118-69-4
3,4-Dichlorotoluene	95-75-0
3,5-Dichlorotoluene	25186-47-4
2,3,5-Trichlorotoluene	56961-86-5
2,3,6-Trichlorotoluene	2077-46-5
2,4,5-Trichlorotoluene	6639-30-1
3,4,5-Trichlorotoluene	21472-86-6
2,4,6-Trichlorotoluene	23479-65-7
2,3,4,5-Tetrachlorotoluene	76057-12-0
2,3,4,6-Tetrachlorotoluene	875-40-1
2,3,5,6-Tetrachlorotoluene	1006-31-1
2,3,4,5,6-Pentachlorotoluene	877-11-2
1,2-Dichlorobenzene	95-50-1
1,3-Dichlorobenzene	541-73-1
Dichlorobenzenes	25321-22-6
1,4-Dichlorobenzene	106-46-7
1,2,3-Trichlorobenzene	87-61-6
1,2,4-Trichlorobenzene	120-82-1
1,3,5-Trichlorobenzene	108-70-3
Trichlorobenzenes	12002-48-1
1,2,3,4-Tetrachlorobenzene	634-66-2
1,2,3,5-Tetrachlorobenzene	634-90-2
1,2,4,5-Tetrachlorobenzene	95-94-3
Pentachlorobenzene	608-93-5
Hexachlorobenzene	118-74-1
p-Chlorobenzotrichloride	5216-25-1
Benzotrichloride	98-07-7
Benzyl chloride	100-44-7

Table 8.21(d) List of Restricted Dyes

Dye Chemical	CAS Number
C.I. Acid Red 26	3761-53-3
C.I. Acid Red 114	6459-94-5
C.I. Basic Blue 26	2580-56-5
C.I. Basic Green 4	569-4-2, 10309-95-2, and 2437-29-8
C.I. Basic Red 9	569-61-9
C.I. Basic Violet 3	548-62-9
C.I. Basic Violet 14	632-99-5
C.I. Basic Yellow 2	2465-27-2 and 492-80-9
C.I. Direct Black 38	1937-37-7
C.I. Direct Blue 6	2602-46-2
C.I. Direct Blue 15	2429-74-5
C.I. Direct Brown 95	16071-86-6
C.I. Direct Red 28	573-58-0
C.I. Disperse Blue 1	2475-45-8
C.I. Disperse Blue 3	2475-46-9
C.I. Disperse Blue 7	3179-90-6
C.I. Disperse Blue 26	3860-63-7
C.I. Disperse Blue 35	12222-75-2
C.I. Disperse Blue 102	12222-97-8
C.I. Disperse Blue 106	12223-01-7
C.I. Disperse Blue 124	61951-51-7
C.I. Disperse Brown 1	23355-64-8
C.I. Disperse Orange 1	2581-69-3
C.I. Disperse Orange 3	730-40-5
C.I. Disperse Orange 11	82-28-0
C.I. Disperse Orange 37/59/76	12223-33-5, 13301-61-6, and 51811-42-8
C.I. Disperse Orange 149	85136-74-9
C.I. Disperse Red 1	2872-52-8
C.I. Disperse Red 11	2872-48-2
C.I. Disperse Red 17	3179-89-3
C.I. Disperse Red 60	12223-37-9 and 17418-58-5
C.I. Disperse Yellow 1	119-15-3
C.I. Disperse Yellow 3	2832-40-8
C.I. Disperse Yellow 9	6373-73-5
C.I. Disperse Yellow 23	6250-23-3
C.I. Disperse Yellow 49	54824-37-2
C.I. Pigment Red 104 (lead chromate molybdate sulphate red)	12656-85-8
C.I. Pigment Yellow 34 (lead sulfochromate yellow)	1344-37-2
C.I. Solvent Blue 4	6786-83-0
C.I. Solvent Yellow 1 (4-Aminoazobenzene)	60-09-2
C.I. Solvent Yellow 3 (2-Aminoazobenzene)	97-56-3
4,4'-bis(dimethylamino)-4''-(methylamino)trityl alcohol	561-41-1

Table 8.21(e) List of Restricted Flame Retardant Substances

Flame Retardant Chemical	CAS Number
Decabromodiphenyl ethane (DBDPE)	84852-53-9
Pentabromodiphenyl ether (PentaBDE)	32534-81-9
Octabromodiphenyl ether (OctaBDE)	32536-52-0
Decabromodiphenyl ether (DecaBDE)	1163-19-5
All other polybrominated diphenyl ethers (PBDEs)	Various
Tetrabromobisphenol A (TBBP A)	79-94-7
Polybromobiphenyls (PBB)	59536-65-1
Hexabromocyclododecane (HBCDD)	3194-55-6
2,2-bis(bromomethyl)-1,3-propanediol (BBMP)	3296-90-0
Tris(1,3-dichloro-isopropyl) phosphate (TDCPP)	13674-87-8
Trixylyl phosphate (TXP)	25155-23-1
Tris(2,3,-dibromopropyl) phosphate (TRIS)	126-72-7
Tris(1-aziridinyl)phosphine oxide) (TEPA)	545-55-1
Tris(2-chloroethyl)phosphate (TCEP)	115-96-8
Bis(2,3-dibromopropyl) phosphate (BIS)	5412-25-9

Table 8.21(f) List of Restricted Nitrosamines

Nitrosamine Chemical	CAS Number
N-nitrosodimethylamine (NDMA)	62-75-9
N-nitrosodiethylamine (NDEA)	55-18-5
N-nitrosodipropylamine (NDPA)	621-64-7
N-nitrosodibutylamine (NDBA)	924-16-3
N-nitrosopiperidine (NPIP)	100-75-4
N-nitrosopyrrolidine (NPYR)	930-55-2
N-nitrosomorpholine (NMOR)	59-89-2
N-nitroso N-methyl N-phenylamine (NMPhA)	614-00-6
N-nitroso N-ethyl N-phenylamine (NEPhA)	612-64-6

Table 8.21(g) List of Restricted Organotin Substances

Organotin Chemical	CAS Number
Dibutyltin (DBT)	Various
Dimethyltin (DMT)	Various
Dicotyltin (DOT)	Various
Diphenyltin (DPhT)	Various
Dipropyltin (DPT)	Various
Monobutyltin (MBT)	Various
Monooctyltin (MOT)	Various
Monomethyltin (MMT)	Various
Monophenyltin (MPhT)	Various
Tetrabutyltin (TeBT)	Various
Tetraethyltin (TeET)	Various
Tetraoctyltin (TeOT)	Various
Tricylohexyltin (TCyHT)	Various
Trimethyltin (TMT)	Various
Trioctyltin (TOT)	Various
Triproyltin (TPT)	Various

Table 8.21(h) List of Restricted Phthalate Substances

Phthalate Chemical	CAS Number
Butylbenzylphthalate (BBP)	85-68-7
Dibutylphthalate (DBP)	84-74-2
Diethylphthalate (DEP)	84-66-2
Dimethylphthalate (DMP)	131-11-3
Di-(2-ethylhexyl)-phthalate (DEHP)	117-81-7
Di-(2-methoxyethyle)-phthalate (DMEP)	117-82-8
Di-C6-8 branched alkylphthalates (DIHP)	71888-89-6
Di-C7-11 branched and linear alkylphthalates (DHNUP)	68515-42-4
Di-cyclohexyl phthalate (DCHP)	84-61-7
Di-hexylphthalates, branched and linear (DHxP)	68515-50-4
Di-iso-butylphthalate (DIBP)	84-69-5
Di-iso-hexyl phthalate (DIHxP)	71850-09-4
Di-iso-octyl phthalate (DIOP)	27554-26-3
Di-iso-nonylphthalate (DINP)	28553-12-0, 68515-48-0
Di-iso-decylphthalate (DIDP)	26761-40-0, 68515-49-1
Di-n-propyl phthalate (DPrP)	131-16-8
Di-n-hexylphthalate (DHP)	84-75-3
Di-n-octylphthalate (DNOP)	117-84-0
Di-n-nonylphthalate (DNP)	84-76-4
Di-n-pentyl phthalate (DPP)), also iso- or mixed	131-18-0, 605-50-5, 776297-69-9, and 84777-06-0
1,2-Benzenedicarboxylic acid, di-C6-10-alkyl esters	68515-51-5
1,2-Benzenedicarboxylic acid, mixed decyl and hexyl and octyl diesters	68648-93-1

Table 8.21(i) List of Restricted Polycyclic Aromatic Hydrocarbon (PAH) Substances

PAH Chemical	CAS Number
Acenaphtene	83-32-9
Acenaphthylene	208-96-8
Anthracene	120-12-7
Benzo[a]anthracene	56-55-3
Benzo[a]pyrene	50-32-8
Benzo[b]fluoranthene	205-99-2
Benzo[e]pyrene	192-97-2
Benzo[g,h,i]perylene	191-24-2
Benzo[j]fluoranthene	205-82-3
Benzo(k)fluoranthene	207-08-9
Chrysene	218-01-9
Cyclopenta[c,d]pyrene	27208-37-3
Dibenzo[a,h]anthracene	53-70-3
Dibenzo[a,e]pyrene	192-65-4
Dibenzo[a,h]pyrene	189-64-0
Dibenzo[a,i]pyrene	189-55-9
Dibenzo[a,l]pyrene	191-30-0
Fluoranthene	206-44-0
Fluorene	86-73-7
Indeno(1,2,3-cd)pyrene	193-39-5
1-Methylpyrene	2381-21-7
Naphthalene	91-20-3
Phenanthrene	85-01-8
Pyrene	129-00-0

Table 8.21(j) List of Perfluorinated and Polyfluorinated Compounds (PFCs)

PFC Chemical	CAS Number	Acronym
C9-C14 PFCA-related substances		
Perfluorooctane sulfonic acid and sulfonates	1763-23-1, et. al.	PFOS
Perfluorooctane sulfonamide	754-91-6	PFOSA
Perfluorooctane sulfonfluoride	307-35-7	PFOSF/POSF
N-Methyl perfluorooctane sulfonamide	31506-32-8	N-Me-FOSA
N-Ethyl perfluorooctane sulfonamide	4151-50-2	N-Et-FOSA
N-Methyl perfluorooctane sulfonamide ethanol	24448-09-7	N-Me-FOSE
N-Ethyl perfluorooctane sulfonamide ethanol	1691-99-2	N-Et-FOSE
Perfluoroheptanoic acid and salts	375-85-9, et al.	PFHpA
Perfluorooctanoic acid and salts	335-67-1, et al.	PFOA
Perfluorononanoic acid and salts	375-95-1, et al.	PFNA
Perfluorodecanoic acid and salts	335-76-2, et al.	PFDA
Henicosafluoroundecanoic acid and salts	2058-94-8, et al.	PFUdA
Tricosafluorododecanoic acid and salts	307-55-1, et al.	PFDoA
Pentacosafluorotridecanoic acid and salts	72629-94-8, et al.	PFTrDA
Heptacosafluorotetradecanoic acid and salts	376-06-7, et al.	PFTeDA
Further perfluorinated carboxylic acids		
Perfluorobutanoic acid and salts	375-22-4, et al.	PFBA
Perfluoropentanoic acid and salts	2706-90-3, et al.	PFPeA
Perfluorohexanoic acid and salts	307-24-4, et al.	PFHxA
Perfluoro(3,7-dimethyloctanoic acid) and salts	172155-07-6, et al.	PF-3,7-DMOA
Perfluorinated carboxylic and sulfonic acids under observation		
2,3,3,3-tetrafluoro-2-(heptafluoro propoxy) propionic acid, its various salts and its acyl halides	various	
Perfluorinated sulfonic acids		
Perfluorobutane sulfonic acid and salts	375-73-5, 59933-66-3, et al.	PFBS
Perfluorohexane sulfonic acid and salts	355-46-4, et al.	PFHxS
Perfluoroheptane sulfonic acid and salts	375-92-8, et al.	PFHpS
Henicosafluorodecane sulfonic acid and salts	335-77-3, et al.	PFDS
Partially fluorinated carboxylic/sulfonic acids		
7H-Perfluoro heptanoic acid and salts	1546-95-8, et al.	7HPFHpA
2H,2H,3H,3H-Perfluoroundecanoic acid and salts	34598-33-9, et al.	4HPFUnA
1H,1H,2H,2H-Perfluorooctane sulfonic acid and salts	27619-97-2, et al.	6:2 FTS
PFOA-related substances		
1H,1H,2H,2H-Perfluordecyl acrylate	27905-45-9	8:2 FTA
1H,1H,2H,2H-Perfluoro-1-decanol	678-39-7	8:2 FTOH
1H,1H,2H,2H-Perfluorodecanesulphonic acid and its salts	39108-34-4, et al.	8:2 FTS
Partially fluorinated linear alcohols		
1H,1H,2H,2H-Perfluoro-1-decanol	678-39-7	8:2 FTOH
1H,1H,2H,2H-Perfluoro-1-dodecanol	865-86-1	10:2 FTOH
Esters of fluorinated alcohols with acrylic acid		
1H,1H,2H,2H-Perfluorooctyl acrylate	17527-29-6	6:2 FTA
1H,1H,2H,2H-Perfluorodecyl acrylate	27905-45-9	8:2 FTA
1H,1H,2H,2H-Perfluorododecyl acrylate	17741-60-5	10:2 FTA

Table 8.21(k) List of Restricted Volatile Organic Compounds

Volatile Organic Compound	CAS Number
Carbon disulfide	71-43-2
Carbon tetrachloride	75-15-0
Chloroform	67-66-3
Cyclohexanone	108-94-1
1,2-Dichloroethane	107-06-2
1,2-Dichlorethylene	75-35-4
Ethylbenzene	100-41-4
Pentachloroethane	76-01-7
1,1,1,2-Tetrachloroethane	630-20-6
1,1,2,2-Tetrachloroethane	73-34-5
Tetrachloroethylene	127-18-4
Toluene	108-88-3
1,1,1-Trichloroethane	71-55-6
1,1,2-Trichloroethane	79-00-5
Trichloroethylene	79-01-6
Xylenes (meta-, ortho-, para-)	1330-20-7, 108-38-3, 95-47-6, and 106-24-3

Chapter 9 Test Methods (NFPA 1971)

9.1* Sample Preparation Procedures.

9.1.1 Application.

9.1.1.1 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.

9.1.1.2 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.

9.1.2 Top-Loading Washing and Drying Procedure.

9.1.2.1 Unless otherwise specified, specimens shall be subjected to five cycles of washing and drying in accordance with the procedure specified in Machine Cycle 1, Wash Temperature V, and Drying Procedure Ai of AATCC LP1, *Home Laundering: Machine Washing*. A 1.82 kg ± 0.1 kg (4.0 lb ± 0.2 lb) load shall be used. A laundry bag shall not be used.

9.1.2.2 Gloves shall be tumble dried for 60 minutes and 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 for at least 8 hours and until dry.

9.1.3 Room Temperature Conditioning Procedure for Garments, Trim, Helmets, Gloves, Footwear, and Faceshield/Goggle Components.

9.1.3.1 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.

9.1.3.2 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.

9.1.4 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.

9.1.5 Convective Heat Conditioning Procedure for Helmets, Faceshield/Goggle Components, Gloves, Footwear, Moisture Barriers, Moisture Barrier Seams, Labels, Particulate Blocking Layer(s), Trim, and Outer Shells. Samples shall be conditioned by exposing them to the procedures specified in 9.2.4.4 and 9.2.4.5.2 through 9.2.4.5.3, with the following modifications:

(1) The oven temperature shall be stabilized at 140°C, +6/−0°C (285°F, +10°/−0°F), and the test exposure time shall be 10 minutes, +15/−0 seconds for the following:
   (a) Helmets
   (b) Footwear
   (c) Moisture barriers
   (d) Moisture barrier seams
   (e) Labels
   (f) Particulate blocking layers
   (g) Trim
   (h) Outer shells for conditioning in accordance with 9.1.21
(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 9.2.4.13.4 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 9.2.4.5.4 and 9.2.4.5.6 shall be disregarded.
(5) Helmet specimens shall be placed on a room temperature nonconductive headform conforming to the dimensions in Figure 9.2.4.12.3 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, the components shall be attached to the helmet and conditioned by placing them on a room temperature, solid, nonmetallic headform conforming to the dimensions in Figure 9.2.4.12.3 and 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 (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, and 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 so that 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.

9.1.6 Radiant and Convective Heat Environmental Conditioning Procedure for Helmets.

9.1.6.1 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 9.1.6.1.

9.1.6.2 The area to be impacted/penetrated shall be exposed to an irradiance of 1.0 W/cm^2 ± 0.1 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.

9.1.6.3 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.

9.1.6.4 The radiant panel shall have an effective radiating surface of 150 mm ± 6 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°K ± 200°K (1340°F ± 360°F).

9.1.6.5 The radiant heat transducer shown in Figure 9.1.6.5 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 mm ± 0.05 mm (0.025 in. ± 0.002 in.), thick and 50 mm ± 0.5 mm (2 in. ± $\frac{1}{64}$ in.) square. A constantan wire 0.81 mm ± 0.05 mm (0.032 in. ± 0.002 in.) in diameter and an iron wire of the same diameter shall be silver soldered 15 mm ± 1 mm (0.6 in. ± 0.39 in.) from the edges of the copper sheet on the same side, as shown in Figure 9.1.6.5. 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.

9.1.6.6 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.

9.1.6.7 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 W/cm^2 ± 0.1 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.

9.1.6.8* 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 ± 15.0 seconds. A closed, insulated chamber shall be required to achieve this exposure time.

9.1.6.9 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 9.1.6.6. The helmet shall be subjected to the exposure conditions specified in 9.1.6.2 for the time recorded in 9.1.6.8. The exposure time shall be not less than the time recorded in 9.1.6.8, nor more than 5 seconds longer than that time.

9.1.7 Wet Conditioning Procedure for Helmets and Faceshield/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.

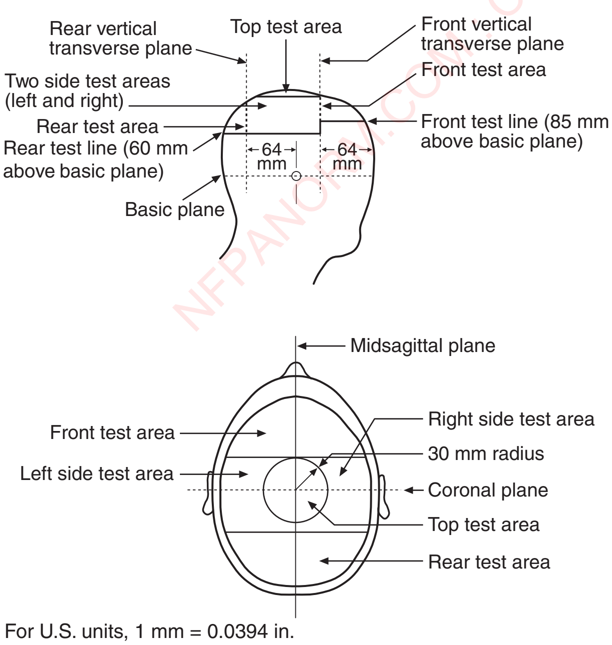


FIGURE 9.1.6.1 Helmet Test Areas and Landmarks.

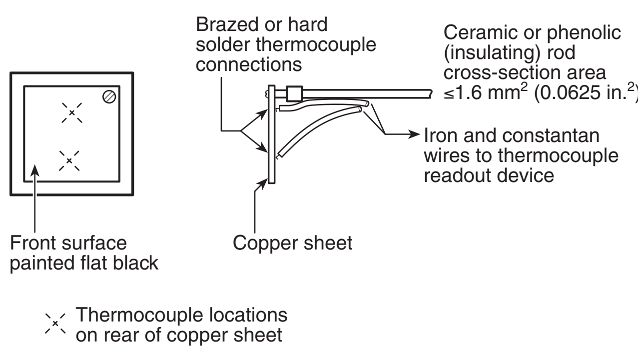


FIGURE 9.1.6.5 Radiant Heat Transducer.

9.1.8 Wet Conditioning Procedure for Glove Composites.

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

9.1.8.2 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/cm^2 ± 0.003 kg/cm^2 (0.50 psi ± 0.05 psi), for a period of 20 minutes in accordance with paragraph 7.2 of AATCC TM70, *Test Method for Water Repellency: Tumble Jar Dynamic Absorption Test.*

9.1.9* Wet Conditioning Procedure 2 for Glove Composites.

9.1.9.1 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 9.1.9.2 through 9.1.9.7.

9.1.9.2 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.

9.1.9.2.1 The nozzle shall be positioned directly over the sample.

9.1.9.2.2 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.

9.1.9.2.3 The spraying shall be conducted in a closed chamber or area that limits disturbance of the mist deposition of the sample from air currents.

9.1.9.2.4 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.).

9.1.9.2.5 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 9.1.9.2.5. 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.

9.1.9.3 Samples for conditioning shall be the innermost layer of the glove composite that are cut to 150 mm × 150 mm (6 in. × 6 in.).

9.1.9.4 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).

9.1.9.5 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.

FIGURE 9.1.9.2.5 Glove Composite Wetting Method.

9.1.9.6 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.

9.1.9.7 Samples subjected to this conditioning shall be evaluated within 5 minutes following the wetting.

9.1.10 Wet Conditioning Procedure for Whole Gloves.

9.1.10.1 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 7.7.4.1 for size 70W (wide) and size 76W (wide) gloves.

9.1.10.2 The test subject shall don the test specimen gloves.

9.1.10.3 The test subject shall immerse the donned specimens straight down into two containers of water at a temperature of 21°C ± 3°C (70°F ± 5°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.

9.1.10.4 The gloves shall then be removed and hung vertically by digit 5 with the glove opening facing down for 2 minutes ± 12 seconds.

9.1.10.5 The glove specimens shall then be tested within 1 minute.

9.1.11 Flexing Procedure for Gloves.

9.1.11.1 Glove samples shall be selected to fit the individual test subject.

9.1.11.2 The test subject shall don the glove sample.

9.1.11.3 Glove specimens shall be flexed by making a tight fist 10 times during a 30-second period.

9.1.12 Front-Loading Washing and Drying Procedure.

9.1.12.1 A front-loading washer/extractor shall be used. The capacity shall be between 16 kg (35 lb) and 24.9 kg (55 lb).

9.1.12.2 The wash load shall be 55 to 65 percent of an adjusted washer capacity where the volume-to-weight ratio equals 5.7 lb/ft^3. The capacity can be calculated as follows:

[9.1.12.2]

$$5.7\left(\frac{lb}{ft^3}\right) X\ Washer\ Volume\ \left(ft^3\right) = Washer\ Capacity\ (lb)$$

9.1.12.2.1 If ballast is needed to reach capacity, similar material or outer shell material consisting of 212 g/m^2 (7.5 oz/yd^2) woven 93 percent meta-aramid, 5 percent para-aramid, and 2 percent antistatic fiber shall be used.

9.1.12.3 The wash cycle procedure and water levels specified in Table 9.1.12.3(a) and Table 9.1.12.3(b) shall be followed. In addition, the *g* force shall not exceed 125 *g* throughout the wash cycle.

9.1.12.4 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.

9.1.12.5 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°+ 5°C (–0°+ 10°F) shall be permitted.

Table 9.1.12.3(a) Front-Loading Wash Cycle

Operation	Time (min)	Temperature ±3°C	Temperature ±5°F	Water Level
Suds using AATCC detergent #1993 without optical brighteners, 1.0 g/gal ±1% water	10	49	120	Low*
Drain	1	—	—	—
Carryover	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 9.1.2.3(b) for high and low water levels.

Table 9.1.12.3(b) Water Level for Front-Loading Wash Cycle Procedure

Low Water Level ±1 cm (3/18 in.)		High Water Level ±1 cm (3/18 in.)	
cm	in.	cm	in.
12.7	5.0	25.4	10.0

9.1.12.5.1 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 10ºC ± 5°C (18°F ± 9°F) above current room temperature until dry but not less than 8 hours.

9.1.12.6 Garments, garment materials, wristlets, hoods, gloves, and glove pouches shall be washed and dried for a total of five cycles unless otherwise specified.

9.1.12.7 Where washing complete garments all closures shall be fastened in its "as-worn" orientation. Garments with separable liners shall not have the liners separated.

9.1.13 Helmet Positioning.

9.1.13.1 The helmet shall be seated firmly on the applicable test headform in accordance with the helmet positioning index (HPI).

9.1.13.2* 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 9.3.6.4.1, with the helmet firmly positioned on the headform.

9.1.13.3 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 (5 in.) below and parallel to the crown of the headform and shall be marked on the headform.

9.1.13.4 The same HPI shall be used for all performance requirements where helmet positioning is used for each unique model or style of a helmet. If the HPI is adjusted for one test, then all other tests shall be repeated using the adjusted HPI.

9.1.13.5 The manufacturer shall provide the certification organization used as the basis for how they established the HPI for each unique model or style of helmet being certified. This information shall be documented in the certification test report for the respective helmet.

9.1.13.6 The HPI shall be reported with the test results for each test where helmet positioning is applied.

9.1.14 Pouch Construction for Glove Composite Samples One.

9.1.14.1 The pouch shall be 200 mm × 200 mm (8 in. × 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 9.2.7, Conductive Heat Resistance Test 1, and 9.2.16, Thermal Protective Performance (TPP) Test, the pouch size shall not be reduced.

9.1.14.2 The pouch shall be made of two glove composite swatches.

9.1.14.3 The two glove composites shall be of the same materials and construction.

9.1.14.4 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.

9.1.14.5 Each of the two glove composite swatches shall be stitched on all four sides using the same thread as used in the glove construction.

9.1.14.6 The two glove composite swatches shall then be sewn together, inner liner to inner liner, on three sides using the same thread as used in the glove construction.

9.1.14.7 The two glove composite swatches and resulting pouch shall be permitted to not be stitched or to have reduced stitching if a laundering or wetting conditioning is not required to be performed on the composite samples.

9.1.15 Pouch Construction for Glove Composite Samples Two.

9.1.15.1 The pouch shall be 200 mm × 200 mm (8 in. × 8 in.). A smaller pouch size shall be permitted provided that the resulting test specimens are of sufficient size for the test.

9.1.15.2 The pouch shall be made of two composite swatches.

9.1.15.3 The two composite swatches shall each consist of a composite constructed to simulate a glove body composite using the following layers and construction in order:

(1) Layer 1: 3.0 to 3.5 oz/yd^2 cow split leather
(2) Layer 2: Glove moisture barrier
(3) Layer 3: 7 to 10 oz/yd^2 modacrylic knit

9.1.15.4 Where the thermal liner and barrier are combined, the modacrylic knits shall be permitted to be omitted from the composite.

9.1.15.5 Where the moisture barrier material seam is being tested, the moisture barrier layer shall contain a straight seam. The seam shall run within 25 mm (1 in.) of the center and shall extend across the entire width of the specimen.

9.1.15.6 Each of the two glove composite swatches shall be stitched on all four sides using the same thread as used in the glove construction.

9.1.15.7 The two glove composite swatches shall then be sewn together, inner liner to inner liner, on three sides using the same thread as used in the glove construction.

9.1.15.8 Where a glove is made of materials other than leather and modacrylic, the composite swatches shall be permitted to be constructed of materials that are used in the actual glove.

9.1.16 Faceshield/Goggle Component Stowed Position.

9.1.16.1 The stowed position of the faceshield/goggle component shall be determined by the manufacturer.

9.1.16.1.1 The stowed position shall not be beyond the point of any resistance when the faceshield/goggle component is pushed up and back from the deployed position, such as coming into contact with the helmet or any helmet attachments.

9.1.16.1.2 In cases in which the faceshield/goggle component can be stowed on the front or rear of the helmet, the following positions shall be used:

(1) In the situations described in 7.4.6 and 9.2.4.12.3, the front position shall be used.
(2) In situations described in 7.5.3.1 and 7.5.3.2, the front and rear positions shall be used.

9.1.17* Glove Test Areas. The glove test areas shall be as described in this paragraph and as shown in Figure 9.1.17, with the glove test area abbreviations designated as follows:

(1) P = palm; B = back; S = side.
(2) A-P: Palm side of hand from finger crotch line to ⅓ of the way down (grasp area)
(3) B-P: Palm side of hand from ⅓ of the way down (grasp area) to the wrist crease
(4) C-P: Palm side of hand from the wrist crease to 50 mm (2 in.) past the wrist crease
(5) D-P: Palm side of thumb
(6) E-P: Palm side of tip of thumb
(7) F-P: Palm side of index finger
(8) G-P: Palm side of fingertip of index finger
(9) H-P: Palm side of nonindex fingers
(10) I-P: Palm side of fingertip of nonindex fingers
(11) A-PS: Sides of hand adjacent to area A-P
(12) B-PS: Outside of hand adjacent to section B-P
(13) C-PS: Sides of hand adjacent to area C-P
(14) D-PS: Outside of thumb adjacent to area D-P
(15) E-PS: Inside of thumb adjacent to area D-P
(16) F-PS: Outside of index finger adjacent to area F-P
(17) H-PS: Between fingers adjacent to areas F-P and H-P
(18) I-PS: Outside of and adjacent to the smallest finger
(19) A-B: Back side of hand from finger crotch line to ⅓ of the way down (knuckle area)
(20) B-B: Back side of hand from ⅓ of the way down (knuckle area) to the wrist crease
(21) C-B: Back side of hand from the wrist crease to 50 mm (2 in.) past the wrist crease
(22) D-B: Back side of thumb
(23) E-B: Back side of tip of thumb
(24) F-B: Back side of index finger
(25) G-B: Back side of fingertip of index finger
(26) H-B: Back side of nonindex fingers
(27) I-B: Back side of fingertip of nonindex fingers
(28) A-BS: Sides of hand adjacent to area A-B
(29) B-BS: Outside of hand adjacent to area B-B
(30) C-BS: Sides of hand adjacent to area C-B
(31) D-BS: Outside of thumb adjacent to area D-B
(32) E-BS: Inside of thumb adjacent to area D-B
(33) F-BS: Outside of index finger adjacent to area F-B
(34) H-BS: Between fingers adjacent to areas F-B and H-B

9.1.18 Flexural Fatigue Procedure for Outer Shells.

9.1.18.1 Samples shall be subjected to flexural fatigue in accordance with ASTM F392/F392M, *Standard Practice for Conditioning Flexible Barrier Materials for Flex Durability*, with the modifications in 9.1.18.2 through 9.1.18.5.

9.1.18.2 Samples shall be flexed within 4 hours of removal of the conditions specified in 9.1.21.2(3).

9.1.18.3 In lieu of flexing Condition A, Condition B, Condition C, Condition D, or Condition E, test samples shall be flexed for the specified number of cycles at 45 cycles/min.

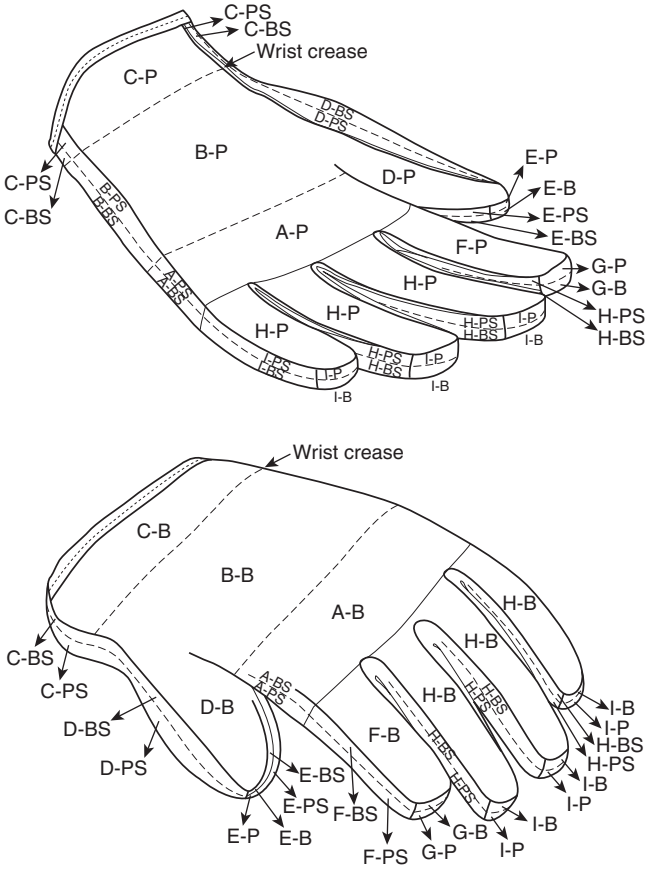


FIGURE 9.1.17 Glove Test Areas.

9.1.18.4* The mandrels shall be spaced at a distance of 204 mm ± 6 mm (8 in. ± ¼ in.) in the starting position and 50 mm (2 in.) at the closed position when measured from the back sample holding area of each mandrel.

9.1.18.5 One cycle shall consist of a full flex and twisting action.

9.1.19 Flexing Conditioning for Complete Footwear. Footwear samples shall be flexed for 100,000 cycles in accordance with Appendix B of FIA 1209, *Whole Shoe Flex*, with the following modifications:

(1) Water shall not be used.
(2) The flex speed shall be 60 cycles/min ± 2 cycles/min.
(3) Alternative flexing equipment meeting the following criteria shall be permitted to be used:
   (a) Is capable of providing the angle of flex as described in FIA 1209
   (b) Is capable of a flex speed of 60 cycles/min ± 2 cycles/min
   (c) Has a means of securing the footwear during flexing
(4) The means for securing the footwear sample in the equipment shall not cause damage to the footwear.

9.1.20 Abrasion Procedure. Samples shall be abraded in accordance with ASTM D4157, *Standard Test Method for Abrasion Resistance of Textile Fabrics (Oscillatory Cylinder Method)*, under the following conditions:

(1) A 2.3 kg (5 lb) tension weight shall be used.
(2) A 1.6 kg (3.5 lb) head weight shall be used.
(3) The abradants shall be each of the material layers in the composite.
(4) Samples shall be abraded for the specified number of cycles.
(5) Samples shall be abraded for half of the cycles against the outer layer of the composite, with the specimen facing the outer layer in its normal "as-worn" orientation.
(6) Samples shall be then abraded for the remaining cycles against the inner layer of the composite with the specimen facing the inner layer in its normal "as-worn" orientation.

9.1.21 Multienvironmental Conditioning Procedure.

9.1.21.1 Samples of outer shell measuring 381 mm × 381 mm (15 in. × 15 in.) shall be prepared by cutting and sewing or serging the edges to prevent fraying.

9.1.21.2 Outer shell samples shall be subject to the various conditions in the following order:

(1) Outer shell samples shall be laundered a total of 20 laundering cycles as specified in 9.1.2.
(2) Outer shell samples shall be subjected to convective heat conditioning procedures as specified in 9.1.5.
(3) Outer shell samples shall be conditioned for a minimum of 4 hours as specified in 9.1.3.
(4) Outer shell samples shall be subject to repeated flexing for 3000 cycles as specified in 9.1.18.
(5) Outer shell specimens for testing shall be taken so that one warp and one fill specimen is cut from the center of the conditioned samples.

9.1.21.3 Specimens of the respective composite or material shall then be removed from the fully conditioned sample and subject to the test method as specified by the respective procedures of that test method.

9.1.22* Measurement and Marking of Footwear Top Line, Internal Layer Height, and Liquid Test Level.

9.1.22.1 A representative sample shall be cut in half vertically front to back to provide a cross-section through the boot that allows the direct observation of internal layers.

9.1.22.2 The center of the heel shall be located using a square set against the bottom surface of the footwear sample and marked on the heel portion of the vertical cross-section.

9.1.22.3 A marking fixture that consists of a ring stand with a vertically adjustable clamp for holding an ink marker pen horizontally shall be used to draw a line across the lowest point at the top line of the cut footwear sample.

9.1.22.4 A height fixture shall be constructed to provide vertical alignment of the ruler used for measuring footwear sample height and shall consist of two vertical stands that support a horizontal bar that measures at least 400 mm (16 in.) in height with width to accommodate the half-cut footwear sample.

9.1.22.5 The height of the boot shall be determined by using a ruler to measure the vertical distance between the center of the heel between the top of the insole and the line representing the top line drawn on the interior of the cut footwear sample.