NFPA® 1851

Standard on Selection, Care, and Maintenance of Protective Ensembles for Structural Fire Fighting and Proximity Fire Fighting

2008 Edition



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

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NFPA® 1851

Standard on

Selection, Care, and Maintenance of Protective Ensembles for Structural Fire Fighting and Proximity Fire Fighting

2008 Edition

This edition of NFPA 1851, *Standard on Selection, Care, and Maintenance of Protective Ensembles for Structural Fire Fighting and Proximity Fire Fighting*, was prepared by the Technical Committee on Structural and Proximity Fire Fighting Protective Clothing and Equipment and released by the Technical Correlating Committee on Fire and Emergency Services Protective Clothing and Equipment. It was issued by the Standards Council on June 4, 2007, with an effective date of June 24, 2007, and supersedes all previous editions.

This edition of NFPA 1851 was approved as an American National Standard on June 24, 2007.

Origin and Development of NFPA 1851

The first edition of NFPA 1851, in 2001, was titled *Standard on the Selection, Care, and Maintenance of Structural Fire Fighting Protective Ensembles*, and was developed to be a companion document for NFPA 1971, *Standard on Protective Ensemble for Structural Fire Fighting*. NFPA 1971, which has been in effect since 1975, specifies product design, performance, testing, and certification. NFPA 1971 is written for use by manufacturers to design and produce their products and by certification organizations to evaluate and test those products to determine compliance with the standard as well as to provide checks on production to ensure continuing compliance. While NFPA 1971 is primarily written for those groups, the standard is also used by fire departments and other organizations in developing purchase specifications for structural fire fighting protective ensembles and ensemble elements to ensure that the products they purchase are certified as being compliant with the standard.

NFPA 1851 is written for the organizations that evaluate the risks their emergency responders face and their particular needs for the protective clothing, that develop purchase specifications, and that purchase structural fire fighting protective ensembles and ensemble elements. It is also written for end users of structural fire fighting protective ensembles and ensemble elements to be able to inspect, maintain, and care for the protective ensembles and elements they use during structural fire fighting operations.

The overall protection and safety of fire fighting personnel depend not only on adequate protective clothing but equally on the organization's policies, training, and administration of the correct use of the proper protective ensemble in fire fighting situations. To satisfy the portion of the organization's overall protective clothing and equipment program that addresses structural fire fighting protective ensemble, this document provides criteria for the selection, care, and maintenance of the protective ensemble and ensemble elements.

In this standard, the requirements for several areas are written to begin with the person who actually uses the protective ensemble being constantly aware of the protective ensemble's condition and need for cleaning, repair, or more in-depth inspection. Users can perform the simple actions to improve the condition of the protective ensemble. The more involved actions of advanced inspection, evaluation, cleaning, decontamination, and repair are handled by the organization's designated staff who are trained and authorized to perform more advanced duties. In other areas, the requirements are written for the organization to perform the administrative functions of the program and periodic actions to evaluate the structural fire fighting protective ensemble program to ensure that the program is achieving its goals and that the quality of the protective ensembles and ensemble elements provides optimum safety to fire fighters.

This second edition of NFPA 1851 is a complete revision of the first edition. Because NFPA 1976, *Standard on Protective Ensemble for Proximity Fire Fighting*, was incorporated into the 2007 edition of NFPA 1971, *Standard on Protective Ensembles for Structural Fire Fighting*

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and Proximity Fire Fighting, under the Technical Committee on Structural and Proximity Fire Fighting Protective Clothing and Equipment, NFPA 1851 has been expanded to include both structural fire fighting ensembles and proximity fire fighting ensembles.

The complete revision follows the new standards format according to the *Manual of Style for NFPA Technical Committee Documents*, which has Chapter 1 covering scope, purpose, and application; Chapter 2 covering referenced publications; and Chapter 3 covering definitions. Chapter 4 covers the organization's program; Chapter 5, selection; Chapter 6, inspections; Chapter 7, cleaning and decontamination; Chapter 8, repairs; Chapter 9, storage; Chapter 10, retirement, disposition, and special incident procedures; Chapter 11, new requirements for independent service providers (ISPs); and Chapter 12, testing procedures.

New requirements in Chapter 11 for organizations and ISPs and for verification of the ISPs by independent, third-party certification organizations set the criteria for organizations and ISPs to perform the tasks of inspection, cleaning, and repairing of protective ensembles and ensemble elements. New requirements for testing methods for trained personnel in the organization as well as the ISPs set the criteria to determine the functionality and protection afforded by the ensembles and ensemble elements.

Revisions to Chapter 10 for retiring structural fire fighting ensembles and ensemble elements and proximity fire fighting ensembles and ensemble elements now require retirement not later than 10 years from the date the ensembles or ensemble elements were manufactured. The radiant reflective outer shell of proximity fire fighting ensembles and ensemble elements must be replaced a maximum of 5 years from the date the ensembles or ensemble elements were manufactured. More frequent replacement of fire fighting ensembles and ensemble elements is now required to better ensure that fire fighters have state-of-the-art protection from fire fighting environments. The significant changes that the technology undergoes within two editions of this standard (approximately 10 years), in addition to the normal "wear and tear" of fire fighting, other emergency incident responses, training, and other factors, dictate that protective ensembles and ensemble elements be replaced. Fire departments that respond to a higher than average number of emergency incidents or that have frequent or extensive "working fire" operations might want to plan for replacement of ensembles or ensemble elements on a more frequent cycle.

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

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Committee Scope: This Committee shall have primary responsibility for documents on protective ensembles, except respiratory protection, that provide head, limb, hand, foot, torso, and interface protection for fire fighters and other emergency services responders during incidents involving structural fire fighting operations or proximity fire fighting operations.

Structural fire fighting operations include the activities of rescue, fire suppression, and property conservation during incidents involving fires in buildings, enclosed structures, vehicles, marine vessels, or like properties.

Proximity fire fighting operations include the activities of rescue, fire suppression, and property conservation during incidents involving commercial and military aircraft fires, bulk flammable gas fires, bulk flammable and combustible liquids fires, combustible metal fires, exotic fuel fires, and other such fires that produce very high levels of radiant heat as well as convective and conductive heat.

Additionally, this Committee shall have primary responsibility for documents on the selection, care, and maintenance of structural and proximity fire fighting protective ensembles by fire and emergency services organizations and personnel.

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NFPA 1851

Standard on

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

Chapter 1 Administration

1.1 Scope.

1.1.1 This standard shall specify the minimum selection, care, and maintenance requirements for structural fire fighting protective ensembles and the individual ensemble elements that include garments, helmets, gloves, footwear, and interface components that are compliant with NFPA 1971, *Standard on Protective Ensembles for Structural Fire Fighting and Proximity Fire Fighting*.

1.1.2 This standard shall also specify the minimum selection, care, and maintenance requirements for proximity fire fighting protective ensembles and the individual ensemble elements that include garments, helmets, gloves, footwear, and interface components that are compliant with NFPA 1971, *Standard on Protective Ensembles for Structural Fire Fighting and Proximity Fire Fighting*.

1.1.3 This standard shall also specify requirements for both structural fire fighting and proximity fire fighting protective ensembles, ensemble elements, clothing, and equipment certified as compliant with previous editions of NFPA 1971, *Standard on Protective Ensembles for Structural Fire Fighting and Proximity Fire Fighting*; NFPA 1972, *Standard on Helmets for Structural Fire Fighting*; NFPA 1973, *Standard on Gloves for Structural Fire Fighting*; NFPA 1974, *Standard on Protective Footwear for Structural Fire Fighting*; or NFPA 1976, *Standard on Protective Ensembles for Proximity Fire Fighting*.

1.1.4 This standard shall also specify the minimum selection, care, and maintenance requirements for structural fire fighting protective ensembles with optional CBRN protection and for proximity fire fighting protective ensembles with optional CBRN protection.

1.1.5 This standard shall not specify requirements for other organizational programs such as appropriate use of structural fire fighting or proximity fire fighting protective ensembles for training, for operations, or for infection control, because these programs are under the jurisdiction of other NFPA standards.

1.1.6 This standard shall not apply to protective ensembles or protective clothing that are compliant with NFPA 1951, *Standard on Protective Ensembles for Technical Rescue Incidents*; NFPA 1977, *Standard on Protective Clothing and Equipment for Wildland Fire Fighting*; NFPA 1991, *Standard on Vapor-Protective Ensembles for Hazardous Materials Emergencies*; NFPA 1992, *Standard on Liquid Splash-Protective Ensembles and Clothing for Hazardous Materials Emergencies*; NFPA 1994, *Standard on Protective Ensembles for First Responders to CBRN Terrorism Incidents*; and NFPA 1999, *Standard on Protective Clothing for Emergency Medical Operations*.

1.1.7 This standard shall not be construed as addressing all 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 to determine the applicability of regulatory limitations prior to use.

1.1.8 This standard shall not be construed as addressing all the safety concerns, if any, associated with the use of this standard by testing or repair 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 to determine the applicability of regulatory limitations prior to using this standard for any designing, manufacturing, and testing.

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

1.2 Purpose.

1.2.1 The purpose of this standard shall be to establish a program for structural fire fighting protective ensembles and ensemble elements and for proximity fire fighting protective ensembles and ensemble elements to reduce the safety risks and potential health risks associated with poorly maintained, contaminated, or damaged protective ensembles and ensemble elements.

1.2.2 The purpose of this standard shall also be to establish basic criteria for selection, inspection, cleaning, decontamination, repair, storage, and retirement of structural fire fighting protective ensembles or ensemble elements and proximity fire fighting protective ensembles or ensemble elements.

1.3 Application.

1.3.1 This standard shall apply to structural fire fighting and proximity fire fighting ensembles and ensemble elements certified as compliant with NFPA 1971, *Standard on Protective Ensembles for Structural Fire Fighting and Proximity Fire Fighting*.

1.3.2 This standard shall also apply to structural fire fighting ensembles and ensemble elements and proximity fire fighting ensembles and ensemble elements certified as compliant with the previous editions of NFPA 1971, *Standard on Protective Ensembles for Structural Fire Fighting and Proximity Fire Fighting* or NFPA 1976, *Standard on Protective Ensembles for Proximity Fire Fighting*, and to protective clothing and equipment certified as compliant with previous editions of NFPA 1971, *Standard on Protective Ensembles for Structural Fire Fighting and Proximity Fire Fighting*; NFPA 1972, *Standard on Helmets for Structural Fire Fighting*; NFPA 1973, *Standard on Gloves for Structural Fire Fighting*; and NFPA 1974, *Standard on Protective Footwear for Structural Fire Fighting*.

1.3.2.1 This standard shall also apply to structural fire fighting protective ensembles with optional CBRN protection and

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to proximity fire fighting protective ensembles with optional CBRN protection.

1.3.3 This standard shall not apply to other organizational programs such as appropriate use of structural fire fighting or proximity fire fighting protective ensembles for training, operations, or infection control, because these programs are under the jurisdiction of other NFPA standards.

1.3.4 This standard shall not apply to respiratory protective equipment other than where such equipment interfaces with structural fire fighting protective ensembles with optional CBRN protection.

1.3.5 The requirements of this standard shall not apply to accessories attached to any element of the structural fire fighting protective ensemble unless specifically addressed herein.

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 because 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 600, *Standard on Industrial Fire Brigades,* 2005 edition.

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

NFPA 1951, *Standard on Protective Ensembles for Technical Rescue Incidents,* 2007 edition.

NFPA 1971, *Standard on Protective Ensembles for Structural Fire Fighting and Proximity Fire Fighting,* 2007 edition.

NFPA 1972, *Standard on Helmets for Structural Fire Fighting,*

NFPA 1973, *Standard on Gloves for Structural Fire Fighting,*

NFPA 1974, *Standard on Protective Ensembles for Proximity Fire Fighting,*

NFPA 1976, *Standard on Protective Ensembles for Proximity Fire Fighting,* 2000 edition.

NFPA 1977, *Standard on Protective Clothing and Equipment for Wildland Fire Fighting,* 2005 edition.

NFPA 1991, *Standard on Vapor-Protective Ensembles for Hazardous Materials Emergencies,* 2005 edition.

NFPA 1992, *Standard on Liquid Splash-Protective Ensembles and Clothing for Hazardous Materials Emergencies,* 2005 edition.

NFPA 1994, *Standard on Protective Ensembles for First Responders to CBRN Terrorism Incidents,* 2007 edition.

NFPA 1999, *Standard on Protective Clothing for Emergency Medical Operations,* 2003 edition.

2.3 Other Publications.

2.3.1 ACGIH Publications. American Conference of Governmental Industrial Hygienists, 1330 Kemper Meadow Drive, Cincinnati, OH 45240.

ACGIH Publication No. 0107, *2007 TLVs and BEIs.*

2.3.2 ISO Publications. International Organization for Standardization, 1, rue de Varembé, Case postale 56, CH-1211 Genève 20, Switzerland.

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

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

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

2.3.3 U.S. Government Publications. U.S. Government Printing Office, Washington, DC 20402-9325.

NIOSH Publication No 2005-149, *NIOSH Pocket Guide to Chemical Hazards,* September 2005.

2.3.4 Other Publications.

Lewis, R., *Hazardous Chemicals Desk Reference,* John Wiley & Sons, New York, 2002.

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

2.4 References for Extracts in Mandatory Sections. (Reserved)

Chapter 3 Definitions

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

3.2 NFPA Official Definitions.

3.2.1* Approved. Acceptable to the authority having jurisdiction.

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

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

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

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3.2.5 Shall. Indicates a mandatory requirement.

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

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

3.3 General Definitions.

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

3.3.2 Advanced Cleaning. See 3.3.13.1.

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

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

3.3.5 Carcinogen/Carcinogenic. A cancer-causing substance that is identified in one of several published lists, including, but not limited to, *NIOSH Pocket Guide to Chemical Hazards, Hazardous Chemicals Desk Reference,* and the ACGIH *2007 TLVs and BEIs.*

3.3.6 Care. Procedures for cleaning, decontamination, and storage of protective clothing and equipment.

3.3.7 CBRN. An abbreviation for chemicals, biological agents, and radiological particulate hazards. *(See also 3.3.9, CBRN Terrorism Agents.)*

3.3.8* CBRN Barrier Layer. The part of the composite that is intended to provide protection against CBRN terrorism agents.

3.3.9* CBRN Terrorism Agents. Chemicals, biological agents, and radiological particulates that could be released as the result of a terrorist attack. (See also 3.3.3, Biological Terrorism Agents; 3.3.12, Chemical Terrorism Agents; 3.3.74, Radiological Particulate Terrorism Agents; and 3.3.101, Toxic Industrial Chemicals.)

3.3.10 Certification/Certified. A system whereby a certification organization determines that a manufacturer has demonstrated the ability to produce a product that complies with the requirements of a specific standard(s), authorizes the manufacturer to use a label on listed products that comply with the requirements of that standard(s), 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 that standard(s).

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

3.3.12 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.

3.3.13 Cleaning. The act of removing soils and contaminants from ensembles and ensemble elements by mechanical, chemical, thermal, or combined processes.

3.3.13.1* *Advanced Cleaning.* The thorough cleaning of ensembles or elements by washing with cleaning agents.

3.3.13.2 *Contract Cleaning.* Cleaning conducted by a facility outside the organization that specializes in cleaning protective clothing.

3.3.13.3* *Routine Cleaning.* The light cleaning of ensembles or ensemble elements performed by the end user without taking the elements out of service.

3.3.13.4* *Specialized Cleaning.* Cleaning to remove hazardous materials or body fluids.

3.3.14 Coat. See 3.3.87, Structural Fire Fighting Protective Coat, and 3.3.64, Proximity Fire Fighting Protective Coat.

3.3.15 Contamination/Contaminated. The process by which ensembles and ensemble elements are exposed to hazardous materials, body fluids, or CBRN terrorism agents.

3.3.16 Coverall. See 3.3.88, Structural Fire Fighting Protective Coverall, and 3.3.65, Proximity Fire Fighting Protective Coverall.

3.3.17 Craze. The appearance of fine cracks in the surface of a helmet shell or other smooth surface of an ensemble element.

3.3.18 Cross-Contamination. The transfer of contamination from one item to another or to the environment.

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

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

3.3.21 Decontamination. The act of removing contaminates from protective clothing and equipment by a physical, chemical, or combined process. *(See also 3.3.13, Cleaning.).*

3.3.22 Disinfectant. An agent that destroys, neutralizes, or inhibits the growth of harmful biological agents.

3.3.23* Drag Rescue Device. A component integrated within the protective coat element to aid in the rescue of an incapacitated fire fighter.

3.3.24 DRD. See 3.3.23, Drag Rescue Device.

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

3.3.26 Elasticity. The ability of a material to return to its original form after being stretched.

3.3.27 Elements. See 3.3.32, Ensemble Elements.

3.3.28 Embrittlement. The hardening of a material that makes it susceptible to easy fracture.

3.3.29* Emergency Medical Operations. Delivery of emergency patient care, including patient transportation, provided prior to arrival at a hospital or other health care facility.

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

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3.3.31 Ensemble. See 3.3.89, Structural Fire Fighting Protective Ensemble, 3.3.66, and Proximity Fire Fighting Protective Ensemble.

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

3.3.33 Faceshield. The component of the helmet that provides limited protection to a portion of the wearer's face. Not primary eye protection.

3.3.34 Field Evaluation. The nonlaboratory assessment of an ensemble, ensemble element, or item.

3.3.35 Fit. The quality, state, and manner in which clothing and equipment, when worn, relate to the human body.

3.3.36 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 3.3.50, Inherent Flame Resistance.)*

3.3.37 Footwear. See 3.3.91, Structural Fire Fighting Protective Footwear, and 3.3.68, Proximity Fire Fighting Protective Footwear.

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

3.3.39 Garment. See 3.3.92, Structural Fire Fighting Protective Garments, and 3.3.69, Proximity Fire Fighting Protective Garments.

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

3.3.41 Glove. See 3.3.93, Structural Fire Fighting Protective Glove, and 3.3.70, Proximity Fire Fighting Protective Glove.

3.3.42 Glove Wristlet. See 3.3.107, Wristlet.

3.3.43* Goggles. Ensemble element or component that provides limited protection to the wearer's eyes. Goggles may or may not provide primary protection.

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

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

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

3.3.47 Helmet. See 3.3.94, Structural Fire Fighting Protective Helmet, and 3.3.71, Proximity Fire Fighting Protective Helmet.

3.3.48 Hood. See 3.3.95, Structural Fire Fighting Protective Hood.

3.3.49 Independent Service Provider (ISP). An independent third party utilized by an organization to perform any one or any combination of advanced inspection, advanced cleaning, or repair services.

3.3.50 Inherent Flame Resistance. Flame resistance that is derived from the essential characteristics of the fiber or polymer.

3.3.51 Integrity. The ability of an ensemble or ensemble element to remain intact and provide continued minimum performance.

3.3.52 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.

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

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

3.3.55 Maintenance. The inspection, service, and repair of protective clothing and equipment, including the determination for removal from service.

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

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

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

3.3.59* Organization. The entity that provides the direct management and supervision for the emergency services personnel.

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

3.3.61 Protective Clothing. See 3.3.89, Structural Fire Fighting Protective Ensemble, and 3.3.66, Proximity Fire Fighting Protective Ensemble.

3.3.62 Protective Ensemble. See 3.3.89, Structural Fire Fighting Protective Ensemble, and 3.3.66, Proximity Fire Fighting Protective Ensemble.

3.3.63 Proximity Fire Fighting. Specialized fire fighting operations that can include the activities of rescue, fire suppression, and property conservation at incidents involving fires producing high levels of radiant heat as well as conductive and convective heat.

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

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

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

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3.3.67 Proximity Fire Fighting Protective Ensemble with *Optional* CBRN Terrorism Agent Protection. A compliant proximity fire fighting protective ensemble that is also certified as an entire ensemble to meet the optional requirements for protection from specific CBRN terrorism agents.

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

3.3.69 Proximity Fire Fighting Protective Garments. The coat, trouser, and coverall elements of the protective ensemble.

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

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

3.3.72 Proximity Fire Fighting Protective Shroud. The component of the helmet that provides limited protection to the helmet/coat interface area.

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

3.3.74* 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.

3.3.75 Retirement. The process of permanently removing an ensemble element from emergency operations service in the organization.

3.3.76 Routine Cleaning. See 3.3.13.3.

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

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

3.3.77.2* *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.

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

3.3.78 Selection. The process of determining what protective clothing and equipment (PCE) is necessary for protection of fire and emergency services response personnel from an anticipated specific hazard or other activity, the procurement of the appropriate PCE, and the choice of the proper PCE for a specific hazard or activity at an emergency incident.

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

3.3.80 Service Life. The period for which compliant product can be useful before retirement.

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

3.3.82 Shroud. See 3.3.72, Proximity Fire Fighting Protective Shroud.

3.3.83 Soiled/Soiling. The accumulation of materials that are not considered hazardous materials, body fluids, or CBRN terrorism agents but that could degrade the performance of the ensemble or ensemble element.

3.3.84 Specialized Cleaning. See 3.3.13.4.

3.3.85 Stress Area. Those areas of the garment that are subjected to more wear, including, but not limited to, crotches, knees, elbows, and shoulders.

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

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

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

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

3.3.90 Structural Fire Fighting Protective Ensemble with *Optional* CBRN Terrorism Agent Protection. A compliant structural fire fighting protective ensemble that is also certified as an entire ensemble to meet the optional requirements for protection from specific CBRN terrorism agents.

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

3.3.92 Structural Fire Fighting Protective Garments. The coat, trouser, and coverall elements of the protective ensemble.

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

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

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

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

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

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

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

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

3.3.101 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.

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3.3.102 Trim. See 3.3.106, Visibility Markings.

3.3.103 Trouser. See 3.3.96, Structural Fire Fighting Protective Trouser, and 3.3.73, Proximity Fire Fighting Protective Trouser.

3.3.104* Universal Precautions. An approach to infection control in which human blood and certain human body fluids are treated as if known to be infectious for HIV, HBV, and other bloodborne pathogens.

3.3.105 Utility Sink. A separate sink used for cleaning ensembles and ensemble elements.

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

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

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

Chapter 4 Program

4.1 General.

4.1.1* The organization shall develop and implement a program for the selection, care, and maintenance of structural fire fighting ensembles and ensemble elements and proximity fire fighting ensembles and ensemble elements used by the members of the organization in the performance of their assigned functions.

4.1.2 This program shall have the goal of providing structural fire fighting ensembles and ensemble elements and proximity fire fighting ensembles and ensemble elements that are suitable and appropriate for the intended use; maintaining such protective ensembles and ensemble elements in a safe, usable condition to provide the intended protection to the user; removing from use such protective ensembles and ensemble elements that could cause or contribute to user injury, illness, or death because of their condition; and reconditioning, repairing, or retiring such protective ensembles and ensemble elements.

4.1.3 Where this program for the selection, care, and maintenance of structural and proximity fire fighting protective ensembles and ensemble elements is part of an organization's overall program on protective clothing and protective equipment, the portion of the organization's overall program that affects structural and proximity fire fighting protective ensembles and ensemble elements shall be in accordance with Section 4.2.

4.1.4 Manufacturers shall be allowed to exclude proprietary components or specific models from this care and maintenance program.

4.2 Program Organization for Structural Fire Fighting Ensembles and Ensemble Elements and Proximity Fire Fighting Ensembles and Ensemble Elements.

4.2.1 The organization's program specified in Section 4.1 shall incorporate at least the requirements in Chapters 4 through 12 of this standard.

4.2.2* The organization shall develop written standard operating procedures (SOPs) that shall identify and define the various parts of the program and the various roles and responsibilities of the organization and of the members in the program parts specified in Table 4.2.2.

Table 4.2.2 Required Program Parts for Structural and Proximity Fire Fighting Protective Ensembles and Elements

Program Part	Chapter/Section of NFPA 1851
Records	Section 4.3
Protecting the public and personnel from contamination	Section 4.5
Selection	Chapter 5
Inspection	Chapter 6
Cleaning and decontamination	Chapter 7
Repair	Chapter 8
Storage	Chapter 9
Retirement, disposition, and special incident procedures	Chapter 10

4.2.3* The organization shall not add or permit accessories to be added to any ensemble or ensemble element prior to the organization requesting approval in writing and receiving written approval from the ensemble or ensemble element manufacturer for each specific accessory.

4.2.3.1* The organization shall not add or permit accessories to be added to any ensemble or ensemble element where the organization's request for approval has been responded to in writing with a disapproval from the ensemble or ensemble element manufacturer.

4.2.3.2* In the event that the organization cannot make contact with the ensemble or ensemble element manufacturer for a specific accessory to be used on the ensemble or ensemble element, the organization shall be permitted to evaluate the accessory for attachment to an ensemble or ensemble element using recognized tests to determine that the accessory does not degrade the performance of the ensemble or ensemble element.

4.2.3.3* In the event the organization's written requests for permission have not received a reply from the ensemble or ensemble element manufacturer for a specific accessory to be used on the ensemble or ensemble element, the organization shall be permitted to evaluate the accessory for attachment to an ensemble or ensemble element using recognized tests to determine that the accessory does not degrade the performance of the ensemble or ensemble element.

4.2.4 Where the organization performs its own repairs or uses an independent service provider (ISP) to perform garment element repair services, the organization or ISP shall meet the requirements of Chapter 11, Verification, and shall be verified by a third-party certification organization. The repairs identified in Section 8.3 shall be excluded from this requirement.

4.2.4.1 The organization or ISP shall receive written verification from the certification organization to perform garment element repair services.

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4.2.4.2* The certification organization's written verification shall specify the categories of repair the organization or the ISP is verified to perform and the processes used to perform these services.

4.2.4.3 The written verification shall indicate that the organization or the ISP has demonstrated a working knowledge of Chapter 8, Repair, of this standard as well as the design and performance requirements of NFPA 1971, *Standard on Protective Ensembles for Structural Fire Fighting and Proximity Fire Fighting*.

4.2.5 Where the organization performs its own advanced inspection or advanced cleaning, the organization shall be trained by the ensemble or ensemble element manufacturer or an ISP. Where the organization uses an ISP to perform advanced inspection or advanced cleaning, the ISP shall be trained by the ensemble or ensemble element manufacturer.

4.2.5.1* The element manufacturer or ISP training provider shall have instructional delivery requisite knowledge and skills for an instructor. Documentation shall be provided upon request to the organization and, where applicable, to the certification organization.

4.2.6* The organization shall develop specific criteria for removal of protective clothing and equipment from service, in accordance with Chapter 10, Retirement, Disposition, and Special Incident Procedure. The criteria for retirement shall include, but not be limited, to issues that are specific to the ensembles or ensemble elements being used by the organization, the manufacturers' instructions, and the experience of the organization.

4.3 Records.

4.3.1* The organization shall compile and maintain records on its structural and proximity fire fighting protective ensembles and ensemble elements.

4.3.2* The records specified in 4.3.1 shall apply to fire fighting protective ensembles and ensemble elements that are utilized by the fire department, including rental or loaner protective ensembles and ensemble elements.

4.3.3 At least the following records shall be kept for each protective ensemble or ensemble element:

(1) Person to whom element is issued
(2) Date and condition when issued
(3) Manufacturer and model name or design
(4) Manufacturer's identification number, lot number, or serial number
(5) Month and year of manufacture
(6) Date(s) and findings advanced inspection(s)
(7) Date(s) and findings of advanced cleaning or decontamination
(8) Reason for advanced cleaning or decontamination and who performed cleaning or decontamination
(9) Date(s) of repair(s), who performed repair(s), and brief description of repair(s)
(10) Date of retirement
(11) Date and method of disposal

4.3.4 The organization shall compile and maintain records as required by 4.3.3 on fire fighting protective ensembles with CBRN protection. The records shall include a list of specific required elements and interface components necessary for structural fire fighting protective ensembles with optional CBRN terrorism agent protection and proximity fire fighting protective ensembles with optional CBRN terrorism agent protection.

4.4 Manufacturer's Instructions.

4.4.1 When issuing new structural fire fighting protective ensembles and ensemble elements or proximity fire fighting protective ensembles and ensemble elements, the organization shall provide users with the instructions provided by the manufacturer on the care, use, and maintenance of the protective ensembles or ensemble elements, including any warnings provided by the manufacturer.

4.4.2 Where the manufacturer's instructions regarding the care or maintenance of the protective ensembles or elements differ from a specific requirement(s) in this standard, the manufacturer's instructions shall be followed for that requirement(s).

4.4.3 The organization shall retain and make accessible to fire department personnel a copy of manufacturers' instructions regarding the care, use, and maintenance of the protective ensembles, for reference purposes.

4.5 Protecting the Public and Personnel from Contamination.

4.5.1 The organization shall develop written SOPs that minimize the public's and the fire department personnel's exposure to soiled or contaminated structural or proximity fire fighting protective ensembles and ensemble elements.

4.5.2* The SOPs shall require that protective ensembles or ensemble elements not be worn or stored in the living areas of fire department facilities.

4.5.3* The public shall not be exposed at any time, except during emergency operations, to soiled or potentially contaminated protective ensembles or ensemble elements.

4.5.4 Soiled or potentially contaminated ensembles or ensemble elements shall not be brought into the home, washed in home laundries, or washed in public laundries.

4.6 Reporting Personal Protective Equipment Health and Safety Concerns.

4.6.1* The organization shall report all personal protective equipment (PPE) health and safety concerns, if caused by a known or suspected element failure, to the element manufacturer and certification organization.

4.6.2* The organization shall notify the manufacturer and the certification organization in writing.

4.6.3 The organization shall request written acknowledgment from the element manufacturer and certification organization within 30 days.

Chapter 5 Selection

5.1* Selection and Purchase.

5.1.1* Prior to starting the selection process of structural fire fighting ensembles and ensemble elements and proximity fire fighting ensembles and ensemble elements, the organization shall perform a risk assessment.

5.1.2 The risk assessment shall include, but not be limited to, the hazards that can be encountered by structural or proximity fire fighters based on the following:

(1) Type of duties performed
(2) Frequency of use of ensemble elements
(3) Organization's experiences

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(4) Incident operations
(5) Geographic location and climate
(6)*Likelihood of or response to CBRN terrorism incident

5.1.3* The organization shall review the current edition of NFPA 1971, *Standard on Protective Ensembles for Structural Fire Fighting and Proximity Fire Fighting*; NFPA 1994, *Standard on Protective Ensembles for First Responders to CBRN Terrorism Incidents*; NFPA 1500, *Standard on Fire Department Occupational Safety and Health Program*; NFPA 600, *Standard on Industrial Fire Brigades*; and any applicable federal or state OSHA standards relating to structural fire fighting protective ensembles and ensemble elements to determine how they affect the selection process.

5.1.4* The organization shall ensure that elements under consideration are certified as being compliant with NFPA 1971, *Standard on Protective Ensembles for Structural Fire Fighting and Proximity Fire Fighting*, by a third-party certification organization.

5.1.5* Based on the risk assessment, the organization shall compile and evaluate information on the comparative strengths and weaknesses of the elements under consideration.

5.1.6* The organization shall ensure that the ensembles and ensemble elements under consideration interface properly with other personal protective items with which they will be used.

5.1.7* Where a field evaluation of an ensemble or ensemble element is conducted, the organization shall establish criteria to ensure a systematic method of comparing products in a manner related to their intended use and assessing their performance relative to the organization's expectations.

5.1.8* Where the organization develops purchase specifications, at least the following criteria shall be included:

(1) Purchase specifications shall require that the ensemble or ensemble element(s) to be purchased shall be compliant with the current edition of NFPA 1971, *Standard on Protective Ensembles for Structural Fire Fighting and Proximity Fire Fighting*. Purchasers shall consider that ensembles that are certified to the optional CBRN requirement are tested and certified as ensembles and must be worn as an ensemble with all elements and interface components present as stated on the element label.
(2)*Where the organization selects criteria that exceed the minimum requirements of the current edition of NFPA 1971, such criteria shall be stipulated in the purchase specifications.
(3)*Purchase specifications shall require that manufacturers' bids include substantiation of certification for each element and model stated in the bid.
(4)*Where applicable, the purchase specifications shall define the process for determining proper fit.
(5)*The organization shall compare each bid submittal against purchase specifications.

5.1.9 Upon receipt, organizations shall inspect purchased protective ensemble element(s) to determine that they meet their specifications and that they were not damaged during shipment. Organizations shall also verify the quantity and sizes of the protective ensemble element(s) received.

5.1.10 Organizations shall examine information supplied with the products, such as instructions, warranties, and technical data.

5.1.11 Procedures shall be established for returning unsatisfactory products if the organization's specifications are not met.

Chapter 6 Inspection

6.1 General.

6.1.1 Universal precautions shall be observed, as appropriate, when handling ensemble elements.

6.1.2 Any ensemble elements that are found to be soiled or contaminated shall be cleaned or decontaminated before any additional inspection is initiated. Where ensemble elements are found to be contaminated by CBRN agents, the ensemble shall be retired.

6.1.3* The organization shall establish guidelines for its members to follow in determining if an element is soiled to an extent that cleaning is necessary.

6.1.4 The organization shall determine appropriate actions to be taken if an element is found to be in need of cleaning, decontamination, or repair.

6.1.4.1 As a minimum, any necessary cleaning or decontamination shall be done in accordance with the requirements specified in Chapter 7.

6.1.4.2 As a minimum, any necessary repairs shall be made in accordance with the requirements specified in Chapter 8.

6.1.4.3 As a minimum, any necessary testing shall be conducted in accordance with the methods specified in Chapter 12.

6.2 Routine Inspection.

6.2.1 Individual members shall conduct a routine inspection of their protective ensembles and ensemble elements after each use.

6.2.2* The routine inspection shall include, as a minimum, the inspections specified in 6.2.2.1 through 6.2.2.7.

6.2.2.1 Coat and trouser garment elements shall be inspected for the following:

(1) Soiling
(2) Contamination
(3) Physical damage such as the following:
  (a) Rips, tears, and cuts
  (b) Damaged or missing hardware and closure systems
  (c) Thermal damage (charring, burn holes, melting, discoloration of any layer)
(4) Damaged or missing reflective trim
(5) Loss of seam integrity and broken or missing stitches
(6) Correct assembly and size compatibility of shell, liner, and the drag rescue device (DRD)

6.2.2.2 Hood elements shall be inspected for the following:

(1) Soiling
(2) Contamination
(3) Physical damage such as the following:
  (a) Rips, tears, and cuts
  (b) Thermal damage (charring, burn holes, melting, discoloration of any layer)
(4) Loss of face opening adjustment
(5) Loss of seam integrity and broken or missing stitches

6.2.2.3 Helmet elements shall be inspected for the following:

(1) Soiling
(2) Contamination

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(3) Physical damage to the shell such as the following:
   (a) Cracks, crazing, dents, and abrasions
   (b) Thermal damage to the shell (bubbling, soft spots, warping, discoloration)
(4) Physical damage to the earflaps such as the following:
   (a) Rips, tears, and cuts
   (b) Thermal damage (charring, burn holes, melting)
(5) Damaged or missing components of the suspension and retention systems
(6) *Damaged or missing components of the faceshield/goggle system, including discoloration, crazing, and scratches to the faceshield/goggle lens limiting visibility
(7) Damaged or missing reflective trim
(8) Loss of seam integrity and broken or missing stitches

6.2.2.4 Glove elements shall be inspected for the following:

(1) Soiling
(2) Contamination
(3) Physical damage such as the following:
   (a) Rips, tears, and cuts
   (b) Thermal damage (charring, burn holes, melting, discoloration of any layer)
   (c) Inverted liner
(4) Shrinkage
(5) Loss of elasticity or flexibility
(6) Loss of seam integrity and broken or missing stitches

6.2.2.5 Footwear elements shall be inspected for the following:

(1) Soiling
(2) Contamination
(3) Physical damage such as the following:
   (a) Cuts, tears, and punctures
   (b) Thermal damage (charring, burn holes, melting, discoloration of any layer)
   (c) Exposed or deformed steel toe, steel midsole, or shank
(4) Loss of water resistance
(5) Closure system component damage and functionality
(6) Loss of seam integrity and broken or missing stitches

6.2.2.6 Drag rescue device (DRD) components shall be inspected for the following:

(1) Installation in garment
(2) Soiling
(3) Contamination
(4) Physical damage such as the following:
   (a) Cuts, tears, punctures, cracking, or splitting
   (b) Thermal damage (charring, burn holes, melting, discoloration)
   (c) Loss of seam integrity and broken or missing stitches

6.2.2.7 Interface components shall be inspected for the following:

(1) Soiling
(2) Contamination
(3) Physical damage
(4) Loss or reduction of properties that allow component to continue as effective interface [e.g., loss of shape or inability to remain attached to the respective element(s) where attachment is required]
(5) Loss of seam integrity and broken or missing stitches

6.2.3 Additional Routine Inspection Requirements for Proximity Fire Fighting Protective Ensembles and Ensemble Elements.

6.2.3.1 Proximity fire fighting coat and trouser garment elements shall be inspected for the following:

(1) Loss of reflectivity
(2) Loss of reflective coating(s)

6.2.3.2 Proximity fire fighting helmet element overcover shall be inspected for the following:

(1) Loss of reflectivity
(2) Loss of reflective coating(s)
(3) Damaged or missing reflective trim, if applicable
(4) Damage and functionality of the overcover to helmet attachment

6.2.3.3 Proximity fire fighting shrouds shall be inspected for the following:

(1) Loss of reflectivity
(2) Loss of reflective coating(s)
(3) If applicable, damage and functionality of the shroud-to-helmet attachment
(4) Distortion of face opening resulting in gaps around the faceshield

6.2.3.4 Proximity fire fighting helmet elements shall be inspected for the following:

(1) Loss of faceshield reflectivity
(2) Loss of shell reflectivity, if applicable

6.2.3.5 Proximity fire fighting glove elements shall be inspected for the following:

(1) Loss of reflectivity
(2) Loss of reflective coating(s)

6.2.3.6 Proximity fire fighting footwear elements shall be inspected for the following:

(1) Loss of reflectivity
(2) Loss of reflective coating(s)

6.3 Advanced Inspection.

6.3.1 Advanced inspection and any necessary testing shall be performed by a verified ISP or the organization's trained personnel.

6.3.2 The member(s) of the organization who has received training in the advanced inspection of the ensembles or ensemble elements shall be responsible for performing or managing advanced inspections.

6.3.2.1* The ensemble or ensemble element manufacturer or a verified ISP and the organization shall determine the level of training required to perform advanced inspections. The ensemble or ensemble element manufacturer or verified ISP shall provide written verification of training.

6.3.3 Advanced inspections of all protective ensemble elements shall be conducted at a minimum of every 12 months, or whenever routine inspections indicate that a problem could exist.

6.3.4* The findings of the advanced inspection shall be documented on an inspection form.

6.3.5* The advanced inspection shall include, as a minimum, the inspections specified in 6.3.5.1 through 6.3.5.7 and for garment elements only the testing specified in Section 12.1 and Section 12.2.

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6.3.5.1* All separable layers of the garment elements shall be individually inspected for the following:

(1) Soiling
(2) Contamination
(3)*Physical damage to all layers, such as the following:
  (a) Rips, tears, cuts, and abrasions
  (b) Damaged or missing hardware
  (c) Thermal damage (charring, burn holes, melting, discoloration of any layer)
(4)*Loss of moisture barrier integrity as indicated by any of the following:
  (a) Rips, tears, cuts, or abrasions
  (b) Discoloration
  (c) Thermal damage
(5) Evaluation of system fit and coat/trouser overlap
(6) Loss of seam integrity and broken or missing stitches
(7)*Loss of material physical integrity [e.g., ultraviolet (UV) or chemical degradation] as evidenced by discoloration, significant changes in material texture, loss of material strength, loss of liner material, and shifting of liner material
(8) Loss of wristlet elasticity, stretching, runs, cuts, or burn holes
(9)*Reflective trim integrity, attachment to garment, reflectivity, or damage
(10)*Label integrity and legibility
(11) Hook and loop functionality
(12) Liner attachment systems
(13) Closure system functionality
(14) Accessories for compliance with 4.2.3
(15) Correct assembly and size compatibility of shell, liner, and DRD

6.3.5.2 Hood elements shall be inspected for the following:

(1) Soiling
(2) Contamination
(3) Physical damage such as the following:
  (a) Rips, tears, and cuts
  (b) Thermal damage (charring, burn holes, melting, discoloration of any layer)
(4) Shrinkage
(5) Loss of material elasticity or stretching out of shape
(6) Loss of seam integrity or broken or missing stitches
(7) Loss of face-opening adjustment

6.3.5.3 Helmet elements shall be inspected for the following:

(1) Soiling
(2) Contamination
(3) Physical damage to the shell such as the following:
  (a) Cracks, dents, and abrasions
  (b) Thermal damage to the shell (bubbling, soft spots, warping, or discoloration)
(4) Physical damage to the ear flaps such as the following:
  (a) Rips, tears, and cuts
  (b) Thermal damage (charring, burn holes, melting or discoloration of any layer)
(5) Damaged or missing components of the suspension and retention systems
(6) Functionality of suspension and retention systems
(7) Damaged or missing components of the faceshield/goggle system, including discoloration or scratches to the faceshield/goggle lens limiting visibility
(8) Functionality of faceshield/goggle system
(9) Damage to the impact cap
(10) Damaged or missing reflective trim
(11) Accessories for compliance with 4.2.3
(12) Loss of seam integrity and broken or missing stitches

6.3.5.4 Glove elements shall be inspected for the following:

(1) Soiling
(2) Contamination
(3)*Physical damage such as the following:
  (a) Rips, tears, and cuts
  (b) Thermal damage (charring, burn holes, melting or discoloration of any layer)
  (c) Inverted liner
  (d) Loss of seam integrity or broken or missing stitches
(4) Shrinkage
(5) Loss of flexibility
(6) Loss of elasticity and shape in wristlets
(7) Accessories for compliance with 4.2.3

6.3.5.5 Footwear elements shall be inspected for the following:

(1) Soiling
(2) Contamination
(3) Physical damage such as the following:
  (a) Cuts, tears, punctures, cracking, or splitting
  (b) Thermal damage (charring, burn holes, melting or discoloration of any layer)
  (c) Exposed or deformed steel toe, steel midsole, or shank
  (d) Loss of seam integrity, delamination, or broken or missing stitches
(4) Loss of water resistance
(5) Closure system component damage and functionality
(6)*Excessive tread wear
(7) Condition of lining such as the following:
  (a) Tears
  (b) Excessive wear
  (c) Separation from outer layer
(8) Heel counter failure
(9) Accessories for compliance with 4.2.3

6.3.5.6 Interface components shall be inspected for the following:

(1) Soiling
(2) Contamination
(3) Physical damage
(4) Loss or reduction of properties that allow component to continue as effective interface, such as loss of shape or inability to remain attached to the respective element(s), if attachment is required
(5) Loss of seam integrity and broken or missing stitches

6.3.5.7 DRD components shall be inspected for the following:

(1) Installation in garment
(2) Soiling
(3) Contamination
(4) Physical damage such as the following:
  (a) Cuts, tears, punctures, cracking, or splitting
  (b) Thermal damage (charring, burn holes, melting, or discoloration)
  (c) Loss of seam integrity and broken or missing stitches

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6.3.6 Additional Advanced Inspection Criteria for Proximity Fire Fighting Protective Ensembles and Ensemble Elements.

6.3.6.1 Proximity fire fighting garment elements shall be inspected for the following:

(1) Loss of radiant reflectivity
(2) Loss of radiant reflective coating(s)

6.3.6.2 Proximity fire fighting helmet overcover components shall be inspected for the following:

(1) Loss of radiant reflectivity
(2) Loss of radiant reflective coating(s)
(3) Damaged or missing reflective trim, if applicable
(4) Helmet attachment system for damage and functionality

6.3.6.3 Proximity fire fighting shroud components shall be inspected for the following:

(1) Loss of radiant reflectivity
(2) Loss of radiant reflective coating(s)
(3) Helmet attachment system, if applicable, for damage and functionality
(4) Distortion of face opening resulting in gaps around the faceshield

6.3.6.4 Proximity fire fighting helmet elements shall be inspected for the following:

(1) Loss of faceshield radiant reflectivity
(2) Loss of shell radiant reflectivity, if applicable

6.3.6.5 Proximity fire fighting glove elements shall be inspected for the following:

(1) Loss of radiant reflectivity
(2) Loss of radiant reflective coating(s)

6.3.6.6 Proximity fire fighting footwear shall be inspected for the following:

(1) Loss of radiant reflectivity
(2) Loss of radiant reflective coating(s)

6.3.7 Additional Advanced Inspection Criteria for Ensembles with Optional CBRN Protection.

6.3.7.1* CBRN protective ensembles shall be inspected according to the manufacturer's instructions.

6.3.7.2 Complete liner inspection of all garment elements shall be conducted at a minimum after 2 years in service and annually thereafter or whenever advance inspections indicate that a problem may exist.

6.3.7.3* CBRN protective ensembles shall be inspected for loss of integrity, including but not limited to:

(1) Loss of interface functionality
(2) Excessive material or component shrinkage or stretching

6.4 Complete Liner Inspection.

6.4.1 Complete liner inspection of all garment elements shall be performed by a verified ISP or the organization's trained personnel.

6.4.2 The member(s) of the organization who has received training in the complete liner inspection of the garment element shall be responsible for performing or managing the complete liner inspection.

6.4.2.1 The garment element manufacturer or a verified ISP and the organization shall determine the level of training required to perform complete liner inspections. The garment element manufacturer or verified ISP shall provide written verification of training.

6.4.3* Complete liner inspection of all garment elements shall be conducted at a minimum after 3 years in service and annually thereafter or whenever advanced inspections indicate that a problem might exist. The liner system shall be opened to expose all layers for inspection and testing.

6.4.3.1 A complete liner inspection of all garment elements shall be conducted after 2 years in service and annually thereafter following replacement of the moisture barrier, the CBRN barrier, or both.

6.4.4 The findings of the complete liner inspection shall be documented.

6.4.5 The complete liner inspection shall include, as a minimum, the inspection specified in 6.4.5.1 through 6.4.5.3.

6.4.5.1 The moisture barrier and the thermal barrier shall be inspected for the following:

(1) Physical damage to all layers and sides of each layer such as the following:
   (a) Rips, tears, cuts, and abrasions
   (b) Thermal damage (charring, burn holes, melting, or discoloration of any layer)
(2) Loss of seam integrity, broken or missing stitches, and loose or missing moisture barrier seam tape
(3) Material physical integrity; UV or chemical degradation as evidenced by discoloration, significant changes in material texture, loss of material strength, loss of liner material, or shifting of liner material
(4) Delamination as evidenced by separation of film from substrate fabric, flaking, or powdering

6.4.5.2 The moisture barrier shall be tested using the hydrostatic test to evaluate the water penetration barrier, as specified in Section 12.3 and shall show no leakage.

6.4.5.3 The result of each water penetration barrier evaluation shall be recorded.

Chapter 7 Cleaning and Decontamination

7.1 General.

7.1.1* Organizations shall provide a means for having ensemble elements cleaned and decontaminated.

7.1.2 Ensembles and ensemble elements shall be evaluated by the wearer for application of appropriate cleaning level after each use.

7.1.3 Ensembles and ensemble elements contaminated by CBRN terrorism agents shall be immediately retired after confirmed exposure and shall not be subjected to cleaning or decontamination.

7.1.4* Ensembles and ensemble elements that are known or suspected to be contaminated with hazardous materials shall be evaluated on the incident scene by members of the organization authorized by the organization to conduct a preliminary assessment of the extent of contamination and the need for ensemble or ensemble elements to be isolated, tagged, and bagged on scene.

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7.1.4.1 Contaminated ensembles and ensemble elements shall be isolated during the incident personnel decontamination process and removed from service until the contaminant or suspected contaminant is identified and the elements can receive specialized cleaning as necessary to remove the specific contaminant(s).

7.1.4.2* Where possible and where the contaminant and its source have been identified, the organization shall consult the supplier of the contaminant and the manufacturer of the ensemble and ensemble elements for an appropriate decontamination agent and process.

7.1.4.3 A member(s) of the organization who has received training in the cleaning of ensembles and ensemble elements shall be responsible for performing or managing specialized cleaning of elements contaminated with hazardous materials.

7.1.5 Ensembles and ensemble elements that are known or suspected to be contaminated with body fluids shall be evaluated on the incident scene by members of the organization authorized to conduct a preliminary assessment of the extent of contamination and need for the ensemble or ensemble elements to be isolated, tagged, and bagged at the incident scene.

7.1.6* Organizations shall have written procedures detailing the decontamination and cleaning processes for ensembles and ensemble elements contaminated with body fluids. Universal precautions shall be observed at all times by members handling elements known or suspected to be contaminated with body fluids.

7.1.7 Soiled or contaminated elements shall not be brought into the home, washed in home laundries, or washed in public laundries unless the public laundry has a dedicated business to handle protective ensembles and ensemble elements.

7.1.8* Commercial dry cleaning shall not be used as a means of cleaning or decontaminating ensembles and ensemble elements unless approved by the ensemble or ensemble element manufacturer.

7.1.9* When contract cleaning or decontamination is used, the ISP shall demonstrate, to the organization's satisfaction, that the procedures for cleaning and decontamination do not compromise the performance of ensembles and ensemble elements.

7.2 Routine Cleaning.

7.2.1* The end users shall be responsible for the routine cleaning of their issued ensemble and ensemble elements.

7.2.2 Organizations shall examine the manufacturer's label and user information for instructions on cleaning and drying that the manufacturer provided with the ensemble or ensemble element. In the absence of manufacturer's instructions or manufacturer's approval of alternative procedures for the ensemble or ensemble element, the routine cleaning and drying procedures provided in this section shall be used.

7.2.3 Routine Cleaning Process.

7.2.3.1* Where possible, the contamination levels shall be evaluated and cleaning shall be initiated at the emergency scene.

7.2.3.2 Ensembles and element layers shall be isolated whenever possible to avoid cross contamination.

7.2.3.3 Any dry debris shall be brushed off.

7.2.3.4 Other debris shall be gently rinsed off with water. Heavy scrubbing or spraying with high-velocity water jets such as a power washer shall not be used.

7.2.3.5 Where necessary, a soft bristle brush shall be used to gently scrub, and the ensemble or element shall be rinsed off again.

7.2.3.6 Where necessary, elements for routine cleaning shall be cleaned in a utility sink designated for personal protective equipment (PPE) cleaning and decontamination using the following procedures:

(1)*Heavily soiled or spotted areas shall be pre treated. Chlorine bleach, chlorinated solvents, active-ingredient cleaning agents, or solvents shall not be used without the ensemble or element manufacturer's approval.
(2)*Water temperature shall not exceed 40°C (105°F).
(3) Mild detergents with a pH range of not less than 6.0 pH and not greater than 10.5 pH as indicated on the product MSDS or original product container shall be used.
(4)*Protective gloves and eye/face splash protection shall be worn.
(5) Element(s) shall be gently scrubbed using a soft bristle brush.
(6) Element(s) shall be thoroughly rinsed.
(7) Element(s) shall be inspected and, where necessary, shall be rewashed or submitted for advanced cleaning procedures. The manufacturer shall be consulted if stronger cleaning agents are required.
(8) Elements shall be dried in accordance with Section 7.4.
(9) Following the routine cleaning procedure, the utility sink shall be rinsed.

7.2.4 Additional Requirements for Routine Cleaning of Garment Elements.

7.2.4.1 Routine cleaning procedures for cleaning garment elements shall be used only for spot cleaning of the element and shall be performed in a utility sink.

7.2.4.2 To avoid cross contamination, garment element layers shall be isolated whenever possible.

7.2.4.3 Cleaning of the entire garment element shall be accomplished using advanced cleaning procedures.

7.2.5 Additional Requirements for Routine Cleaning of Helmet Elements.

7.2.5.1 If it is necessary to totally immerse the helmet, the impact cap shall be separated from the helmet shell. Each element component shall be washed and dried separately before reassembly.

7.2.5.2 Solvents shall not be used to clean or decontaminate helmets or helmet components. The manufacturer shall be consulted if stronger cleaning agents are required.

7.2.5.3 Helmets shall not be machine dried using equipment that produces mechanical action from tumbling or agitation.

7.2.6 Additional Requirements for Routine Cleaning of Glove Elements. Glove elements shall not be machine dried using equipment that produces mechanical action from tumbling or agitation.

7.2.7 Additional Requirements for Routine Cleaning of Footwear Elements. Footwear elements shall not be machine dried using equipment that produces mechanical action from tumbling or agitation.

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7.2.8 Additional Requirements for Routine Cleaning of Proximity Fire Fighting Ensembles and Ensemble Elements. Outer shell and other radiant reflective components of proximity fire fighting protective ensembles and ensemble elements shall not be cleaned with a brush or any other abrasive cleaning devices.

7.2.9 Where routine cleaning fails to render the ensemble or ensemble element(s) sufficiently clean for service, the ensemble or ensemble element(s) shall receive advanced cleaning.

7.3 Advanced Cleaning and Decontamination.

7.3.1 Advanced cleaning shall be performed by a verified ISP or the organization's trained personnel.

7.3.1.1 The advanced cleaning shall be managed by a member of the organization or conducted by members of the organization who have received training in the advanced cleaning of protective ensembles and ensemble elements. The ensemble or ensemble element manufacturer and the organization shall determine the level of training required to perform advanced cleaning. The ensemble or ensemble element manufacturer shall provide written verification of training.

7.3.2* Ensemble and ensemble elements that are soiled shall receive advanced cleaning prior to reuse.

7.3.3 Ensemble and ensemble elements that are issued and used shall receive advanced cleaning at the time of advanced inspection if not subjected to advanced cleaning in the preceding 12 months.

7.3.4 The training of the organization's personnel shall be performed by the element manufacturer or a verified ISP, who will provide written documentation of training.

7.3.5 Organizations shall examine the manufacturer's label and user information for instructions on cleaning and drying that the manufacturer provided with the element. In the absence of manufacturer's instructions or manufacturer's approval of alternative procedures for the ensemble or ensemble element, the advanced cleaning and drying procedures provided in this section shall be used.

7.3.6* Advanced cleaning of ensembles and ensemble elements shall be conducted by machine unless specifically prohibited.

7.3.7 The following procedures shall be used for machine washing:

(1)*The machine shall not be overloaded.
(2)*Heavily soiled or spotted areas shall be pretreated. Chlorine bleach, chlorinated solvents, active-ingredient cleaning agents, or solvents shall not be used without the ensemble or ensemble element manufacturer's approval.
(3) All closures, including pocket closures, hooks and loops, snaps, zippers, and hooks and dees shall be fastened.
(4)*Water temperature shall not exceed 40°C (105° F).
(5) A mild detergent with a pH range of not less than 6.0 pH and not greater than 10.5 pH as indicated on the product MSDS or original product container shall be used.
(6)*Washing machines with the capability of drum RPM adjustment shall be adjusted so the g-force does not exceed 100 g for all elements.
(7)*Machine manufacturer's instructions shall be followed for proper setting or program selection for the specific element being washed.
(8) The element shall be inspected and rewashed if necessary.
(9)*Where the machine is also used to wash items other than protective ensemble elements, it shall be rinsed out by running the machine without a laundry load through a complete cycle with detergent and filled to the maximum level with water at a temperature of 49°C to 52°C (120°F to 125°F).

7.3.8 Ensembles and ensemble elements shall be dried in accordance with Section 7.4.

7.3.9 Additional Requirements for Advanced Cleaning of Garment Elements.

7.3.9.1 If the coat element has a drag rescue device (DRD) and the DRD is removable, the DRD shall be removed prior to the coat being laundered. If the DRD also requires cleaning, it shall be placed in a separate mesh bag for washing and drying.

7.3.9.2* Where the shells and liners of protective garment elements are separable, those items shall be cleaned and decontaminated only with like items, other than as provided for in 7.3.13.

7.3.9.3 Separable liner systems shall be turned inside out so the moisture barrier is on the inside for both machine washing and machine drying.

7.3.10 Additional Requirements for Advanced Cleaning of Helmet Elements.

7.3.10.1* Detachable items shall be removed from the helmet and shall be washed and dried separately.

7.3.10.2 Helmets shall not be machine cleaned or dried using equipment that produces mechanical action by tumbling or agitation.

7.3.11* Additional Requirements for Advanced Cleaning of Glove Elements. Gloves shall not be machine dried using equipment that produces mechanical action by tumbling or agitation.

7.3.12* Additional Requirements for Advanced Cleaning of Footwear Elements. Footwear shall not be machine cleaned or dried using equipment that produces mechanical action by tumbling or agitation.

7.3.13 Additional Requirements for Advanced Cleaning of Hood Elements. Hoods shall be permitted to be machine washed and machine dried with garment liners.

7.3.14 Additional Requirements for Advanced Cleaning of Proximity Fire Fighting Ensembles and Ensemble Elements.

7.3.14.1 Outer shell and other radiant reflective components of proximity fire fighting protective ensembles and ensemble elements shall not be cleaned with a brush or other abrasive cleaning devices.

7.3.14.2 Outer shell and other radiant reflective components of proximity fire fighting protective ensembles and ensemble elements shall not be machine washed.

7.3.14.3 Outer shell and other radiant reflective components of proximity fire fighting protective ensembles and ensemble elements shall not be machine dried.

7.3.15 Additional Requirements for Advanced Cleaning of Ensembles Certified to the Optional CBRN Requirements of NFPA 1971. The manufacturer shall be consulted to determine if any special handling procedures or the removal of interface components or other components must be undertaken prior to advanced cleaning.

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7.4 Drying Procedures.

7.4.1* Organizations shall examine the manufacturer's label and user information for instructions on drying procedures that the manufacturer provided with the ensemble or ensemble element. In the absence of manufacturer's instructions or manufacturer's approval of alternative procedures, the drying procedures provided in this section shall be used.

7.4.2* The following procedures shall be used for air drying:

(1)*Place elements in an area with good ventilation.
(2)*Do not dry in direct sunlight.

7.4.3* The following procedures shall be used for machine drying:

(1) The recommended capacity of the machine shall not be exceeded.
(2) All closures, including pocket closures, hooks and loops, snaps, zippers, and hooks and dees shall be fastened.
(3)*A "no heat" or "air dry" option shall be used, if available.
(4)*In the absence of a "no heat" or "air dry" option, the basket temperature shall not exceed 40°C (105°F).
(5)*The use of a heat cycle shall be discontinued prior to the removal of all moisture from the ensemble or ensemble elements.
(6)*The remainder of the drying process shall be accomplished by a "no-heat" machine setting or removal of the ensemble or ensemble elements from the machine dryer to air dry.

Chapter 8 Repair

8.1 Requirements for All Ensembles and Ensemble Elements.

8.1.1 All repairs shall be performed by the original manufacturer, an ISP, or a member of the organization who has received training by the manufacturer or by an ISP in the repair of ensembles or ensemble elements.

8.1.2 The member(s) of the organization who has received training in the repair of the ensembles or ensemble elements shall be responsible for performing or managing repairs.

8.1.3 Ensembles or ensemble elements shall be subjected to advanced cleaning, when necessary, before any repair work is undertaken. Ensembles contaminated by CBRN terrorism agents shall be immediately retired after CBRN exposure is confirmed and shall not be reused.

8.1.4* All repairs and alterations to the ensemble or ensemble element shall be done in a manner and using like materials and components that are compliant with NFPA 1971, *Standard on Protective Ensembles for Structural Fire Fighting and Proximity Fire Fighting*.

8.1.5 Due to the different methods of construction, the ensemble or ensemble element manufacturer shall be contacted if the organization or ISP is unsure of whether a repair can be accomplished without adversely affecting the integrity of the ensemble or ensemble element.

8.1.6 Replacement interface components shall be installed in a manner consistent with the ensemble or ensemble element manufacturer's method of construction.

8.2 Requirements for Both Basic and Advanced Garment Element Repair.

8.2.1 All repairs and alterations shall be performed in the same manner and using like materials as the garment element manufacturer, including, but not limited to, fabric, thread type, seam construction, hardware, and hardware backing, unless approved by the garment element manufacturer.

8.2.2 Repairs shall be made to all components and to all layers of the composite that have been damaged or that have been affected by the repair.

8.2.3 Repairs of minor tears, char marks, ember burns, and abraded areas shall be limited to those where the damaged area can be covered by a maximum 32 cm^2 (5 $in.^2$) patch of the same material that is compliant with NFPA 1971, *Standard on Protective Ensembles for Structural Fire Fighting and Proximity Fire Fighting*.

8.2.3.1 The finished edges of the patch shall extend at least 25 mm (1 in.) in all directions beyond the damaged area.

8.2.3.2 To prevent fraying, the patch shall have no raw edges.

8.2.3.3 Where tears, holes, or abrasions are being repaired, the damaged areas shall be mended using flame-resistant (FR) thread that is compliant with NFPA 1971, *Standard on Protective Ensembles for Structural Fire Fighting and Proximity Fire Fighting*, to prevent further damage prior to application of the patch.

8.2.4* Replacement hardware shall be installed in a manner consistent with the garment element manufacturer's method of construction.

8.2.4.1 When hardware is replaced, the reinforcement backing material shall be reinstalled or, if it is no longer serviceable, the backing material shall be replaced.

8.2.5 If the complexity of the repair is uncertain, the garment element manufacturer shall be consulted.

8.2.6 Replacement visibility markings shall be installed in a manner consistent with the garment element manufacturer's method of construction, unless an alternative method is approved by the garment element manufacturer.

8.2.6.1 Visibility markings being replaced shall be completely removed so that no new visibility marking is sewn over older visibility marking.

8.2.6.2 No repair or alteration shall result in the reduction of the minimum required visibility marking pattern specified in Section 6.2 of NFPA 1971, *Standard on Protective Ensembles for Structural Fire Fighting and Proximity Fire Fighting*.

8.2.6.3 Visibility marking patches that do not exceed 75 mm (3 in.) in length shall be permitted. The visibility marking patch shall extend 25 mm (1 in.) beyond the damaged area. A maximum of two visibility marking patches per stripe shall be permitted.

8.2.6.4 Where a repair or alteration necessitates replacing visibility markings, an equal amount of visibility markings shall be installed.

8.2.6.5 Where the complexity of the visibility marking repair is uncertain, the garment element manufacturer shall be consulted.

8.3 Additional Requirements for Basic Garment Element Repair. The repairs specified in this section shall be performed by the element manufacturer, by both verified and nonverified organizations, or by both verified and nonverified ISPs. Basic repairs shall be limited to the following:

(1) Patching of minor tears, char marks, and ember burns to a separable outer shell

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(2) Repairing of skipped, broken, and missing stitches to a separable outer shell
(3) Replacement of missing hardware, excluding positive closure systems to a separable outer shell
(4) Reclosing of the liner of a garment after inspection

8.4 Additional Requirements for Advanced Garment Element Repair.

8.4.1 The repairs specified in this section shall be conducted *only* by the element manufacturer, a verified organization, or a verified ISP meeting the requirements as specified in Chapter 11, Verification.

8.4.2 Major repairs to the garment outer shell shall be performed only by the garment element manufacturer or by a verified ISP consistent with the garment element manufacturer's methods. The garment element manufacturer shall be contacted if the organization is unsure of whether a repair is major or minor.

8.4.3* All repairs to the garment moisture barrier shall be performed only by the garment element manufacturer or by a verified ISP consistent with the moisture barrier manufacturer's methods. The organization shall contact the original garment element manufacturer if the organization is unsure as to whether an area to be repaired contains a moisture barrier.

8.4.4* Repairs to garment thermal liners shall be permitted provided there is no stitching through the moisture barrier.

8.4.5 Due to labeling requirements, as well as the complexity and specialized equipment needed to replace entire garment element component layers (e.g., the outer shell), moisture barrier, or thermal liner, only the garment element manufacturer or the garment element manufacturer's designated verified ISP shall replace entire garment component layers.

8.4.6 Restitching of more than 25 continuous mm (1 continuous in.) of a Major A seam shall require consulting the garment element manufacturer or shall be performed by the garment element manufacturer or by a verified ISP in a manner consistent with the garment element manufacturer's methods.

8.4.7 Major B seams in the moisture barrier shall be repaired or altered only by the garment element manufacturer or by a verified ISP and shall not be repaired by the organization unless the organization is also a verified ISP.

8.4.7.1 Repairs to Major B seams in the thermal liner that do not affect any moisture barrier material shall be permitted. Restitching of more than 25 continuous mm (1 continuous in.) of any Major B seams shall require consulting the garment element manufacturer or shall be performed by the garment element manufacturer or by a verified ISP in a manner consistent with the garment element manufacturer's methods.

8.4.8* All repaired stress areas shall be reinforced in a manner consistent with the garment element manufacturer's methods.

8.4.9 If replacing trim necessitates sewing into a Major A seam, trim replacement shall be done only by the garment element manufacturer or by a verified ISP unless the organization is also a verified ISP.

8.4.10* Replacement zippers shall be installed in a manner consistent with the garment element manufacturer's method of construction. If the complexity of the repair is uncertain, the garment element manufacturer shall be consulted. Zippers that are part of a positive closure system shall not be replaced by the organization unless the organization is also a verified ISP.

8.4.11* Replacement hook-and-loop fastener tape shall be installed in a manner consistent with the garment element manufacturer's method of construction. If the complexity of the repair is uncertain, the garment element manufacturer shall be consulted.

8.4.12* Replacement reinforcement materials shall be installed in a manner consistent with the garment element manufacturer's method of construction.

8.5 Helmet Element Repair.

8.5.1 All repairs to helmet components other than as specified herein shall be performed in accordance with the helmet element manufacturer's instructions.

8.5.2* Where there is indication of a crack, dent, abrasion, bubbling, soft spot, discoloration, or warping in the helmet shell, the helmet element manufacturer or its designated ISP shall be contacted to determine serviceability.

8.5.3 Small surface nicks shall be repaired in accordance with the helmet element manufacturer's instructions.

8.5.4 Small scratches on the helmet shell shall be permitted to be removed by using mildly abrasive compounds recommended by the helmet element manufacturer.

8.5.5 Helmet faceshield and goggle components that become cracked or badly scratched shall be replaced.

8.6 Glove Element Repair. All repairs to glove components shall be performed in accordance with the glove element manufacturer's instructions.

8.7 Footwear Element Repair.

8.7.1 All repairs to footwear components shall be performed in accordance with the footwear manufacturer's instructions.

8.7.2 Other than the replacement of bootlaces and zipper assemblies, all repairs to boots shall be performed by the footwear element manufacturer or its designated ISP.

8.7.3 All replacement bootlaces and zippers shall be provided by the footwear element manufacturer.

8.8 Structural Fire Fighting Hood and Proximity Fire Fighting Helmet Overcover and Proximity Fire Fighting Shroud Repair. All repairs to hoods, helmet covers, and proximity shrouds shall be performed in accordance with the element manufacturers' instructions.

8.9 Additional Requirements for Structural Fire Fighting Ensembles and Proximity Fire Fighting Ensembles with Optional CBRN Protection. All repairs to ensembles with optional CBRN protection shall be referred to the ensemble manufacturer for repair.

Chapter 9 Storage

9.1* All Ensembles and Ensemble Elements.

9.1.1* Ensembles or ensemble elements shall not be stored in direct sunlight or exposed to direct sunlight while not being worn.

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9.1.2* Ensembles and ensemble elements shall be clean and dry before storage.

9.1.3 Ensemble and ensemble elements shall not be stored in airtight containers unless they are new and unissued.

9.1.4* Ensembles and ensemble elements shall not be stored at temperatures below –32°C (–25°F) or above 82°C (180°F).

9.1.5 Ensembles and ensemble elements shall not be stored or transported in compartments or trunks with sharp objects, tools, or other equipment that could damage the ensembles or ensemble elements. Where ensembles or ensemble elements must be transported or stored in such environments, the ensemble or element(s) shall be placed in a protective case or bag to prevent damage.

9.1.6* Soiled ensembles and ensemble elements shall not be stored in living quarters or with personal belongings or taken or transported in the passenger compartment of personal vehicles. Where ensembles or ensemble elements must be stored or transported in such environments, the ensembles or ensemble element(s) shall be placed in a protective case or bag to prevent cross contamination.

9.1.7* Ensembles and ensemble elements shall not be stored in contact with contaminants such as, but not limited to, oils, solvents, acids, or alkalis.

9.1.8 Proximity fire fighting protective coat and trouser elements shall be stored by hanging to limit the damage caused by creasing and shall not be stored folded.

9.1.9 Ensemble and ensemble element storage areas shall be clean, dry, and well ventilated.

Chapter 10 Retirement, Disposition, and Special Incident Procedure

10.1 Retirement.

10.1.1* The organization shall develop specific criteria for removal of structural fire fighting ensembles and ensemble elements and proximity fire fighting ensembles and ensemble elements from service, which includes, but is not limited to, issues that are specific to the ensembles or ensemble elements being used by the organization, the manufacturer's instructions, and the experience of the organization.

10.1.2* Structural fire fighting ensembles and ensemble elements shall be retired in accordance with 10.2.1, no more than 10 years from the date the ensembles or ensemble elements were manufactured.

10.1.3 Proximity fire fighting ensembles and ensemble elements shall be retired in accordance with 10.2.1, no more than 10 years from the date the ensembles or ensemble elements were manufactured.

10.1.3.1* In all cases, the radiant reflective outer shell shall be replaced at a maximum of 5 years.

10.1.4* Structural fire fighting ensembles and ensemble elements and proximity fire fighting ensembles and ensemble elements that are worn or damaged to the extent that the organization deems it not possible or cost effective to repair them shall be retired in accordance with 10.2.1.

10.1.5* Structural fire fighting ensembles and ensemble elements and proximity fire fighting ensembles and ensemble elements that were not in compliance with the edition of the applicable NFPA standard that was current when the ensembles and ensemble elements were manufactured shall be retired in accordance with 10.2.1.

10.1.6 Structural fire fighting ensembles and ensemble elements and proximity fire fighting ensembles and ensemble elements that are contaminated to the extent that the organization deems it not possible or cost effective to decontaminate them shall be retired in accordance with 10.2.1.

10.1.7 Structural fire fighting ensembles and ensemble elements and proximity fire fighting ensembles and ensemble elements that are contaminated by CBRN terrorism agents shall be immediately retired as specified in 10.2.1 after confirmed exposure and shall not be reused.

10.1.8* Structural fire fighting ensembles and ensemble elements and proximity fire fighting ensembles and ensemble elements that are no longer of use to the organization for emergency operations service but are not contaminated, defective, or damaged shall be retired in accordance with 10.2.1 or 10.2.2.

10.2 Disposition of Retired Elements.

10.2.1 Retired structural fire fighting ensembles and ensemble elements and proximity fire fighting ensembles and ensemble elements shall be destroyed or disposed of in a manner ensuring that they will not be used in any fire fighting or emergency activities, including live fire training.

10.2.2 Retired structural fire fighting ensembles and ensemble elements and proximity fire fighting ensembles and ensemble elements as determined in 10.1.8 shall be permitted to be used as follows:

(1) For training that does not involve live fire, provided the ensembles and ensemble elements are appropriately marked as being for non–live fire training only
(2) As determined by the organization

10.3 Special Incident Procedure.

10.3.1* The organization shall have procedures for the handling and custody of structural fire fighting ensembles and ensemble elements and proximity fire fighting ensembles and ensemble elements that were worn by fire fighters who were victims at incidents where serious injuries or fatalities to the fire fighters occurred.

10.3.2 In the absence of any other prevailing rules of evidence, the organization's procedures shall include at least the following:

(1) Provisions shall be made for the immediate removal from service and preservation of all structural fire fighting ensembles and ensemble elements and proximity fire fighting ensembles and ensemble elements utilized by the injured or deceased fire fighter.
(2) Custody of such ensembles and ensemble elements shall be maintained at a secure location with controlled, documented access.
(3) All such structural fire fighting ensembles and ensemble elements and proximity fire fighting ensembles and ensemble elements shall be nondestructively tagged and stored only in paper or cardboard containers to prevent further degradation or damage. Plastic or airtight containers shall not be used.

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(4) Examination of the structural fire fighting ensembles and ensemble elements and proximity fire fighting ensembles and ensemble elements shall be made by qualified members of the organization or by outside experts to determine the condition thereof.

10.3.3 The organization shall determine a specific period of time for retaining custody of structural fire fighting ensembles and ensemble elements and proximity fire fighting ensembles and ensemble elements.

Chapter 11 Verification

11.1 General.

11.1.1 In order for an organization or ISP to be verified, it shall meet the requirements of this chapter.

11.1.1.1 Verification of the organization or ISP shall be limited to repairs of garment elements only. Verification of the organization or ISP shall not apply to helmet elements, glove elements, footwear elements, hood element, or optional CBRN ensembles.

11.1.2 All verification of the organization or ISP shall be performed by a certification organization that meets at least the requirements specified in Section 11.2 and that is accredited for personal protective equipment in accordance with ISO Guide 65, *General requirements for bodies operating product certification systems*. The accreditation shall be issued by an accreditation body operating in accordance with ISO 17011, *Conformity assessment — General requirements for accreditation bodies accrediting conformity assessment bodies*.

11.1.3 The organization or ISP shall not use the NFPA name or the name or identification of this standard, NFPA 1851, in any statements about its services unless the services are verified as compliant to this standard.

11.1.4 All verified organizations or ISPs shall be listed. The listing shall contain the repair categories that the organization or the ISP is verified to conduct. Repair categories shall be garment outer shell repairs, garment moisture barrier repairs, and garment thermal barrier repairs.

11.2 Verification Program.

11.2.1* The certification organization shall not be owned or controlled by the organization or the ISP being verified.

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

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

11.2.4 The certification organization shall refuse to verify services to this standard that do not comply with all applicable requirements of this standard.

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

11.2.6 The certification organization shall not offer or confer any conditional or temporary verification.

11.2.7* The certification organization's shall have laboratory facilities and equipment available for conducting proper tests to determine organization or ISP compliance.

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

11.2.9 The certification organization's 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.

11.2.10 The certification organization shall require the organization or the ISP to establish and maintain a quality management program that meets the requirements of Section 11.4.

11.2.11 The certification organization and the organization or ISP shall evaluate any changes affecting function of the compliant services to determine continued certification to this standard.

11.2.12* The certification organization shall have a follow-up inspection program of the organization's or the ISP's facilities of the compliant services with at least one random and unannounced visit per 12-month period to verify continued compliance.

11.2.13 The certification organization shall be permitted to conduct specific testing to verify continued compliance.

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

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

11.3 Inspection and Testing.

11.3.1 For verification of the organization's or ISP's compliant repair services, the certification organization shall conduct both inspection and testing as specified in this section.

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

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

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

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11.3.5 A certification organization shall be permitted to utilize conditioning and testing results conducted by an organization or an ISP for verification provided the organization or the ISP testing laboratory meets the requirements specified in 11.3.5.1 through 11.3.5.5.

11.3.5.1 Where an organization or an ISP provides conditioning and testing results to the certification organization, the organization's or ISP's testing laboratory shall be accredited in accordance with the requirements of ISO 17025, *General requirements for the competence of testing and calibration laboratories.*

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

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

11.3.5.4 The certification organization shall also approve the organization's or ISP's testing laboratory.

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

11.3.6 Sampling levels for testing and inspection shall be established by the certification organization and the organization or the ISP to ensure reasonable and acceptable reliability at a reasonable and acceptable confidence level that repair services are compliant to this standard, unless such sampling levels are specified herein.

11.3.7 For verification of an organization's or an ISP's repair services, the following series of tests shall be required for each repair category for which the organization or the ISP is verified. Testing shall be conducted using new materials as outlined in Table 11.3.7(a) through Table 11.3.7(c).

11.3.7.1 For repairs to tears in the outer shell, moisture barrier, and thermal barrier, the certification organization shall create the tear in the material(s) to be repaired in accordance with Figure 11.3.7.1.

11.3.7.2 For moisture barrier hole repairs, the certification organization shall create the hole in the material(s) to be repaired in accordance with Figure 11.3.7.2.

11.3.8 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.

11.3.9 The organization or the ISP shall maintain all inspection and test data from the certification organization used in the verification of the organization's or the ISP's services. The organization or ISP shall provide such data, upon request, to the purchaser or authority having jurisdiction.

11.3.10 All repair categories that are verified in accordance with this standard shall undergo verification on an annual basis.

11.4 Organization or ISP Quality Management Program.

11.4.1 The organization's or the ISP's management shall define and document its policy and objectives for and commitment to quality and shall ensure that this policy is understood, implemented, and maintained at all levels in the organization or the ISP.

11.4.2 The organization or the ISP shall operate an effective quality system appropriate to the type, range, and volume of work performed.

11.4.3 The management of the organization or the ISP shall designate a person who, irrespective of other duties, shall have defined authority and responsibility for quality assurance within the organization or ISP. The quality system shall be maintained relevant and current under the responsibility of the same person.

Table 11.3.7(a) Outer Shell Repairs

Who Makes Repair	Sample	Material	Test
Organization	5 ft felled seam 5 ft overedge seam	Outer shell material(s) utilized by the organization	NFPA 1971 — 7.1.13
	Small tear patch	Patched tear made from the outer shell material utilized by the organization	NFPA 1851 — 8.2.3
ISP	5 ft felled seam 5 ft overedge seam	7.5 osy Nomex IIIa plain weave fabric	NFPA 1971 — 7.1.13
	Small tear patch	Patched tear made from 7.5 osy Nomex IIIa plain weave fabric	NFPA 1851 — 8.2.3

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Table 11.3.7(b) Thermal Liner Repairs

Who Makes Repair	Sample	Material	Test
Organization	5 ft felled seam 5 ft overedge seam	Thermal liner material(s) utilized by the organization	NFPA 1971 — 7.1.13
	Small tear patch	Patched tear made from the thermal liner material utilized by the organization	NFPA 1851 — 8.2.3
ISP	5 ft felled seam 5 ft overedge seam	Blended filament/spun face cloth quilted to two layers of E89	NFPA 1971 — 7.1.13
	Small tear patch	Patched tear made from blended filament/spun face cloth quilted to two layers of E89	NFPA 1851 — 8.2.3

Table 11.3.7(c) Moisture Barrier Repairs

Who Makes Repair	Sample	Material	Test
Organization	5 ft seam	Moisture barrier material(s) utilized by the organization	NFPA 1971 — 7.1.13
	Hole patch	Patched hole made from the moisture barrier material(s) utilized by the organization	NFPA 1851 — 8.2.3 and NFPA 1971 — 7.1.15 in the as-received condition
	Tear patch	Patched tear made from the moisture barrier material(s) utilized by the organization	NFPA 1851 — 8.2.3 and NFPA 1971 — 7.1.15 in the as-received condition
ISP	5 ft seam	All moisture barrier materials repaired by the ISP	NFPA 1971 — 7.1.13
	Hole patch	Patched hole made from the moisture barrier materials repaired by the ISP	NFPA 1851 — 8.2.3 and NFPA 1971 — 7.1.15 in the as-received condition
	Tear patch	Patched hole made from the moisture barrier materials repaired by the ISP	NFPA 1851 — 8.2.3 and NFPA 1971 — 7.1.15 in the as-received condition

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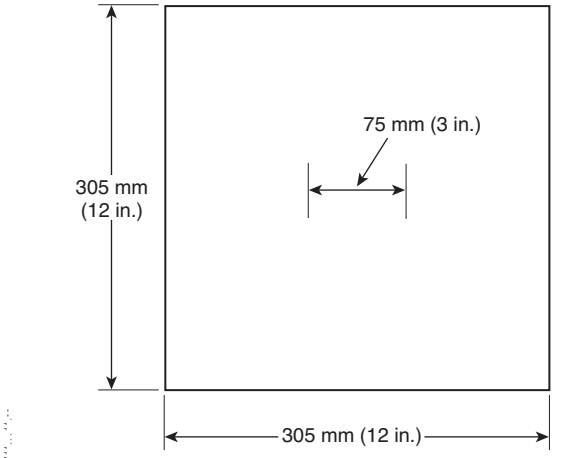


FIGURE 11.3.7.1 Tear Repairs.

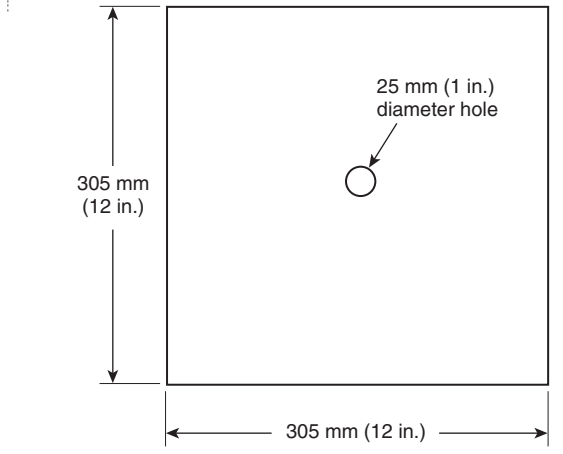


FIGURE 11.3.7.2 Hole Repairs.

11.4.4 The quality system shall be fully documented. There shall be a Quality Manual, which shall contain at least the following information:

(1) General information (name, addresses, phone numbers, and legal status)
(2) Management statement on the organization's or ISPs policy on, objectives for, and commitment to quality
(3) Management statement assigning a responsible person for quality assurance
(4) Description of the organization's or ISP's areas of activity and competence
(5) Organization chart(s)
(6) Relevant job descriptions
(7) Policy statement on qualification and training of personnel
(8) Procedures for control of documents
(9) Procedures for internal audits
(10) Procedures for feedback and corrective action
(11) Procedures for management review of the quality system
(12) Distribution list for the Quality Manual
(13) Work instructions or process manuals
(14) Procedure for handling returns and complaints

11.4.5 The organization or ISP shall maintain a system for control of all documentation relating to its activities and shall ensure the following:

(1) That the current revisions of the appropriate documentation are available at all relevant locations and to all relevant staff
(2) That all changes amendments to documents are authorized and processed in a manner that will ensure timely availability at the appropriate location
(3) That superseded documents are removed from use throughout the organization but that one copy is filed for a determined period
(4) That other parties, as necessary, are notified of changes

11.4.6 The organization or the ISP shall carry out a system of planned and documented internal quality audits to verify compliance with the criteria of this standard and the effectiveness of the quality system. The personnel performing the audits shall be suitably qualified and independent from the functions being audited.

11.4.7 The organization or the ISP shall have documented procedures for dealing with feedback and corrective action whenever discrepancies are detected in the quality system or in the performance of inspections.

11.4.8 The management of the organization or the ISP shall review the quality system at least annually to ensure its continuing suitability and effectiveness. The results of such reviews shall be recorded.

Chapter 12 Test Procedures

12.1 Light Evaluation of Liners.

12.1.1* Application. This evaluation method shall apply to liner composites found in structural and proximity fire fighting protective garment elements that are in service.

12.1.2 Evaluation Areas.

12.1.2.1 At a minimum, the front and back body panels of each protective garment element shall be evaluated.

12.1.2.1.1 Specific areas of the body panels that shall be evaluated include the upper back, shoulders, underarms, sleeves, waist area, and crotch area.

12.1.2.1.2 Liner evaluation areas shall also be any areas of the garment where damage or loss of thermal protection is detected or expected.

12.1.3 Evaluation Apparatus. The apparatus used to perform the light evaluation shall have the following characteristics:

(1) The apparatus shall consist of a light source that provides enough light to show the changes in density of the liner materials when viewed.
(2) The light source shall not produce enough heat to damage the liner composite.
(3) The light source shall be configured to prevent the bulbs from directly contacting the liner composite.
(4) The light source shall be appropriately sized to fit into the sleeves of the liner.

12.1.4 Procedure.

12.1.4.1 The evaluation procedure shall be performed at room temperature.

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12.1.4.2 The evaluation shall be conducted using the following procedure:

(1) If possible, separate the liner from the outer shell.
(2) Orient the liner such that the thermal barrier is on the outside.
(3) Position the light source near the moisture barrier such that the light passes through the moisture barrier and then through the thermal barrier.
(4) Evaluate the liner by examining the amount of light coming through the thermal liner.

12.1.5 Results.

12.1.5.1 Results shall be determined by evaluating areas where the light is brighter through some areas than others.

12.1.5.2 Brighter areas could be an indication of insulating material shifting or migrating, resulting in a thin or bare spot.

12.1.5.3 To further evaluate a suspected area of shifting or migration, an advanced inspection shall be performed.

12.2 Leakage Evaluation.

12.2.1* Application. This evaluation method shall apply to moisture and thermal barrier liners found in structural or proximity fire fighting protective garment elements that are in service.

12.2.2 Evaluation Areas.

12.2.2.1 At a minimum, the front and back body panels of each protective garment element shall be evaluated using three different moisture barrier material areas and three different moisture barrier areas with a seam.

12.2.2.1.1 Liner evaluation areas shall be from high-abrasion areas of the garment elements, including, but not limited to:

(1) Broadest part of the shoulders
(2) Back waist area of the coat
(3) Knees
(4) Crotch area
(5) Seat area

12.2.2.1.2 In addition to the areas listed in 12.2.2.1.1 where potential damage to the garment outer shell or thermal barrier has been detected, the evaluation shall be conducted on the corresponding area of the moisture barrier. Where potential damage to the garment moisture barrier has been detected, the evaluation shall also be conducted on that area.

12.2.2.2 The liner composite shall be positioned in the evaluation apparatus so that the moisture barrier is oriented upward and is contacted with the liquid exposure in the evaluation apparatus.

12.2.2.3 Moisture barrier material areas with seams shall be positioned on the evaluation apparatus so that the seam divides the specimen into two equal halves.

12.2.3 Evaluation Apparatus.

12.2.3.1* An alcohol–tap water mixture shall be made by combining 1 part rubbing alcohol, 70 percent isopropanol alcohol with 6 parts of tap water.

12.2.3.2 A 5 gal bucket or similar container shall be used to support the liner during evaluation.

12.2.4 Procedure.

12.2.4.1 The evaluation procedure shall be performed at room temperature.

12.2.4.2 The evaluation shall be conducted using the following procedure:

(1) If possible, separate the liner from the outer shell.
(2) Orient the liner such that the moisture barrier is on the outside.
(3) Position the dry liner over the bucket with the thermal barrier facing down and the moisture barrier side facing up.
(4) Cup the liner area that is being evaluated, so that it is lower than the surrounding liner.
(5) Pour 1 cup of the alcohol–tap water mixture specified in 12.2.3.1 onto the moisture barrier in the cupped area of the liner.

12.2.5 Results.

12.2.5.1 The liner shall be visually inspected for leakage on the thermal barrier side after 3 minutes.

12.2.5.2 If any liquid passes through the moisture barrier and wets the thermal barrier, the liner shall be removed from service and repaired or replaced.

12.2.5.3 After the evaluation procedure has been performed, the liner shall be cleaned and allowed to completely dry to remove all traces of the alcohol–tap water mixture.

12.3 Water Penetration Barrier Evaluation.

12.3.1 Application. This evaluation method shall apply to moisture barrier materials and moisture barrier seams found in structural or proximity fire fighting protective garment elements that are in service.

12.3.2 Evaluation Areas.

12.3.2.1 A minimum of three moisture barrier material areas and a minimum of three moisture barrier areas with a seam shall be tested on each garment element.

12.3.2.1.1 Moisture barrier material areas shall be from high-abrasion areas of the garment elements, including, but not limited to:

(1) Broadest part of the shoulders
(2) Back waist area of the coat
(3) Knees
(4) Crotch area
(5) Seat area

12.3.2.1.2 In addition to the areas listed in 12.3.2.1.1 where potential damage to the garment outer shell or the thermal barrier has been detected, the evaluation shall be conducted on the corresponding area of the moisture barrier. Where potential damage to the garment moisture barrier has been detected, the evaluation shall also be conducted on that area.

12.3.2.2 Moisture barrier material areas shall be positioned in the evaluation apparatus such that the side of the barrier that is against the outer shell faces the water in the evaluation apparatus.

12.3.2.3 Moisture barrier material areas with seams shall be positioned on the evaluation apparatus so that the seam divides the specimen into two equal halves.

12.3.3 Evaluation Apparatus.

12.3.3.1* The apparatus used to evaluate water penetration shall have the following characteristics:

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(1) The apparatus shall consist of a means of clamping the area to be evaluated in a horizontal position, providing a watertight seal with the pressurized portion of the apparatus and water reservoir.
(2) The apparatus shall accommodate evaluations of moisture barriers and seams without the removal of the specimens.
(3) The apparatus shall have a clamping area that provides a water exposure and viewing area that is at least 50 mm (2 in.) in diameter.
(4) The apparatus shall have a water reservoir containing sufficient water for carrying out the evaluation.
(5) The apparatus shall provide for the pressurization of water against the garment element moisture barrier area at a pressure of 6.9 kPa (1 psi) for at least 15 seconds. The 6.9 kPa (1 psi) pressure shall be achieved within 10 seconds.
(6) The apparatus shall be equipped with a pressure gauge that is accurate to the nearest 0.2 kPa (0.1 psi).
(7) The apparatus shall be equipped with a means of bleeding air pressure and permit the drainage of water from the pressurized portion of the apparatus.

12.3.3.2 A stopwatch or other timer shall be used to ensure that pressure is applied for the specified duration of 15 seconds.

12.3.4 Procedure.

12.3.4.1 The evaluation shall be conducted using the following procedure:

(1) Place the selected area of moisture barrier in the apparatus and clamp to provide a watertight seal with the apparatus.
(2) Introduce a water pressure of 1 psi against the moisture barrier for a period of not less than 15 seconds.
(3) Visually inspect the visible side of the moisture barrier after 15 seconds to determine if water penetration has occurred.

12.3.5 Results.

12.3.5.1 If any water passes through the moisture barrier or moisture barrier seam, the liner shall be removed from service and repaired or replaced.

12.3.5.2 If no water passes through the moisture barrier or moisture barrier seam, the liner shall be allowed to dry completely before being returned to service.

Annex A Explanatory Material

Annex A is not a part of the requirements of this NFPA document but is included for informational purposes only. This annex contains explanatory material, numbered to correspond with the applicable text paragraphs.

A.3.2.1 Approved. The National Fire Protection Association does not approve, inspect, or certify any installations, procedures, equipment, or materials; nor does it approve or evaluate testing laboratories. In determining the acceptability of installations, procedures, equipment, or materials, the authority having jurisdiction may base acceptance on compliance with NFPA or other appropriate standards. In the absence of such standards, said authority may require evidence of proper installation, procedure, or use. The authority having jurisdiction may also refer to the listings or labeling practices of an organization that is concerned with product evaluations and is thus in a position to determine compliance with appropriate standards for the current production of listed items.

A.3.2.2 Authority Having Jurisdiction (AHJ). The phrase "authority having jurisdiction," or its acronym AHJ, is used in NFPA documents in a broad manner, since jurisdictions and approval agencies vary, as do their responsibilities. Where public safety is primary, the authority having jurisdiction may be a federal, state, local, or other regional department or individual such as a fire chief; fire marshal; chief of a fire prevention bureau, labor department, or health department; building official; electrical inspector; or others having statutory authority. For insurance purposes, an insurance inspection department, rating bureau, or other insurance company representative may be the authority having jurisdiction. In many circumstances, the property owner or his or her designated agent assumes the role of the authority having jurisdiction; at government installations, the commanding officer or departmental official may be the authority having jurisdiction.

A.3.2.4 Listed. The means for identifying listed equipment may vary for each organization concerned with product evaluation; some organizations do not recognize equipment as listed unless it is also labeled. The authority having jurisdiction should utilize the system employed by the listing organization to identify a listed product.

A.3.3.8 CBRN Barrier Layer. While it is recognized that the entire composite will affect the performance of the ensemble in preventing the penetration of CBRN agents, the identification of the CBRN barrier layer is intended to assist application of specific ensemble and element tests.

A.3.3.9 CBRN Terrorism Agents. Chemical terrorism agents include solid, liquid, and gaseous chemical warfare agents and toxic industrial chemicals. Chemical warfare agents include, but are not limited, to GB (Sarin), GD (Soman), HD (sulfur mustard), VX, and specific toxic industrial chemicals. Many toxic industrial chemicals (e.g., chlorine and ammonia) are identified as potential chemical terrorism agents because of their availability and the degree of injury they could inflict.

Biological terrorism agents are bacteria, viruses, or toxins derived from biological material. The CBRN ensemble protects against biological particles dispersed as aerosols and liquid-borne pathogens. Airborne biological terrorism agents could be dispersed in the form of liquid aerosols or solid aerosols (e.g., a powder of bacterial spores). Liquid-borne pathogens could be encountered during a terrorism incident as a result of deliberate disposal or from body fluids released by victims of other weapons (e.g., explosives, firearms).

CBRN ensembles protect from radiological particulates dispersed as aerosols. The protection is defined for blocking or filtering airborne particulate matter and liquid and solid aerosols but not for radiological gases or vapors. Airborne particulates have the ability to emit alpha and beta particles and ionizing radiation from the decay of unstable isotopes.

A.3.3.13.1 Advanced Cleaning. Advanced cleaning usually requires that ensemble elements be temporarily taken out of service. Examples include hand washing, machine washing, and contract cleaning.

A.3.3.13.3 Routine Cleaning. Examples include brushing off dry debris, rinsing off debris with a water hose, and spot cleaning.

A.3.3.13.4 Specialized Cleaning. This level of cleaning involves specific procedures and specialized cleaning agents and processes.

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A.3.3.23 Drag Rescue Device. The drag rescue device (DRD) is intended solely to assist in pulling or dragging an incapacitated fire fighter and is not intended for vertical rescue operations where the victim fire fighter would be raised or lowered.

A.3.3.29 Emergency Medical Operations. Patient care includes, but is not limited to, first aid, cardiopulmonary resuscitation, basic life support, and advanced life support.

A.3.3.32 Ensemble Elements. The proximity fire fighting protective ensemble includes, but is not limited to, garments, helmets, shrouds, gloves, and footwear. The structural fire fighting protective ensemble includes, but is not limited to, garments, helmets, hoods, gloves, and footwear.

A.3.3.43 Goggles. To provide primary protection, goggles must be certified to ANSI/ASSE Z87.1, *Occupational and Educational Personal Eye and Face Protection Devices*.

A.3.3.45 Hazardous Materials. Hazardous materials are any solid, particulate, liquid, gas, aerosol, or mixture thereof that can cause harm to the human body through respiration, ingestion, skin absorption, injection, or contact.

A.3.3.53 Interface Component(s). Interface components are evaluated and tested individually or are evaluated and tested as a part of the protective element.

A.3.3.59 Organization. Examples of organizations include, but are not limited to, fire departments, police and other law enforcement departments, rescue squads, EMS providers, and hazardous materials response teams.

A.3.3.66 Proximity Fire Fighting Protective Ensemble. A proximity fire fighting protective ensemble includes, but is not limited to, garments, helmets, shrouds, gloves, and footwear.

A.3.3.74 Radiological Particulate Terrorism Agents. This standard addresses protective ensembles that provide only partial protection from certain radiation sources. By their nature, these ensembles provide protection from alpha particles; the element materials and distance will significantly attenuate beta particles. These ensembles do not provide any protection from ionizing radiation such as gamma- and X-rays other than to keep the actual radiological particulates from direct skin contact.

A.3.3.77.1 Major A Seam. Outermost layer seam assemblies include outer shell seams. Rupture of the outer shell could reduce the protection of the garment by exposing inner layers such as the moisture barrier and the thermal barrier.

A.3.3.77.2 Major B Seam. Inner layer seam assemblies include moisture barrier and thermal barrier seams.

A.3.3.89 Structural Fire Fighting Protective Ensemble. A structural fire fighting protective ensemble includes, but is not limited to, garments, helmets, hoods, gloves, and footwear.

A.3.3.104 Universal Precautions. Under circumstances in which differentiation between body fluids is difficult or impossible, all body fluids should be considered potentially infectious materials.

A.4.1.1 NFPA 1500, *Standard on Fire Department Occupational Safety and Health Program*, and NFPA 1581, *Standard on Fire Department Infection Control Program*, also provide requirements and information on cleaning and decontamination.

Protective ensembles and ensemble elements are important tools that enable fire fighters to perform their jobs in a safe and effective manner. Organizations need to recognize that these items do not have an indefinite life span and that regular inspections are a necessary part of any protective equipment program.

A.4.2.2 The following sample outline for an SOP is provided as a guide to aid organizations in the development of their program SOPs. Organizations should consider addressing each point in the outline based on their types of protective clothing, operations, situation, needs, and so forth. The SOP should also include the responsibilities of the organization and the responsibilities of the individual members for each point in outline.

(1) Records
  (a) Issued
  (b) Manufacturer information
  (c) Maintenance
  (d) Retirement
(2) Protecting the public and personnel from contamination
  (a) Risk assessment
  (b) Contamination containment
  (c) Public access
  (d) Procedures
    i. Public areas
    ii. Living areas
    iii. Food preparation and eating areas
    iv. Training areas
    v. Other
(3) Selection
  (a) Risk assessment
  (b) Compliance with NFPA 1971, *Standard on Protective Ensembles for Structural Fire Fighting and Proximity Fire Fighting*
  (c) Element evaluation
(4) Inspection
  (a) Routine inspection
  (b) Routine inspection procedure points
  (c) Advanced inspection
  (d) Advanced inspection procedure points
(5) Cleaning and decontamination
  (a) Routine cleaning
  (b) Routine cleaning procedure points
  (c) Advanced cleaning and decontamination
  (d) Advanced cleaning and decontamination procedure points
  (e) Drying procedures points
(6) Repair
  (a) Basic repairs
  (b) Advanced repairs
  (c) Moisture barrier repairs
(7) Storage
  (a) Unissued Storage
  (b) Issued Storage
(8) Retirement, disposition, and special incident procedures
  (a) Condition
  (b) Age
  (c) Disposal method

A.4.2.3 Emergency response organizations are cautioned that accessories could degrade the protection or performance of the certified ensemble or ensemble element; interfere with form, fit, or function of the certified ensemble or ensemble element; or become a hazard to the wearer.

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Accessories are not part of the certified ensemble or ensemble element but could be attached to a certified ensemble or ensemble element by means not engineered, manufactured, or authorized by the certified ensemble or ensemble element manufacturer. If an accessory or its means of attachment causes the structural integrity of the certified ensemble or ensemble element to be compromised, the certified ensemble or ensemble element might not be compliant with the standard with which it was originally certified.

Additionally, if an accessory or the accessory's means of attachment is not designed and manufactured from suitable materials for the hazardous environments of emergency incidents, the failure of the accessory or the means of attachment could cause injury to the emergency responder.

Users are also cautioned that the means of attachment for an accessory that fails to safely and securely attach the accessory to a certified ensemble or ensemble element can allow the accessory to become inadvertently dislodged from the certified ensemble or ensemble element, possibly posing a risk to emergency response personnel in the vicinity.

Organizations should consider evaluating the ensemble with tests provided in NFPA 1971, *Standard on Protective Ensembles for Structural Fire Fighting and Proximity Fire Fighting*, in which the accessory could negatively impact the performance of the ensemble element, when in place. One test that is not part of NFPA 1971 but could be used to evaluate the performance of an externally placed accessory is ASTM F 1930, *Standard Test Method for Evaluation of Flame Resistant Clothing for Protection Against Flash Fire Simulations Using an Instrumented Manikin*. This test provides a simulation of a flash fire exposure using a static manikin. The effects of the flash fire on the accessory can be determined and compared to an ensemble that does not have the accessory in place. A minimum exposure time of 10 seconds is recommended for evaluating structural or proximity fire fighting ensembles. While this test provides a demonstration of ensemble/accessory performance under emergency conditions, it does not simulate all fire ground hazards, and other evaluations should be considered.

A.4.2.3.1 See A.4.2.3.

A.4.2.3.2 Organizations should consider evaluating the ensemble or ensemble element with tests provided in NFPA 1971, *Standard on Protective Ensembles for Structural Fire Fighting and Proximity Fire Fighting*, in which the accessory could negatively affect the performance of the ensemble or ensemble element, depending on how the element might be affected by the attachment of the accessory (see Table A.4.2.3.2).

Another test that can be used to evaluate the performance of an externally placed accessory is ASTM F 1930, *Standard Test Method for Evaluation of Flame Resistant Clothing for Protection Against Flash Fire Simulations Using an Instrumented Manikin*. This test simulates a flash fire exposure using a static manikin. The effects of the flash fire on an ensemble or ensemble element with the accessory can be determined and compared to the effects on an ensemble or ensemble element that does not have the accessory in place. A minimum exposure time of 10 seconds is recommended when evaluating structural or proximity fire fighting ensembles. While this test demonstrates ensemble/accessory performance under emergency conditions, it does not simulate all fire ground hazards, and other evaluations should be considered.

A.4.2.3.3 See A.4.2.3.2.

Table A.4.2.3.2 Evaluating Possible Negative Effects of Accessory Attachments on Ensembles or Ensemble Elements

Ensemble and Ensemble Element Properties	Applicable Sections of NFPA 1971
Garments	
Flame resistance	Section 8.2
Heat resistance	Section 8.6
Whole-garment liquid integrity	Section 8.48
Helmets	
Flame resistance	Section 8.3
Heat resistance	Section 8.6
Top-impact resistance	Section 8.15
Impact resistance	Section 8.16
Electrical insulation	Section 8.31
Gloves	
Flame resistance	Section 8.4
Heat resistance	Section 8.6
Overall liquid integrity	Section 8.33
Glove–hand function	Section 8.38
Grip	Section 8.39
Footwear	
Flame resistance	Section 8.5
Heat resistance	Section 8.6
Electrical insulation	Section 8.48
Slip resistance	Section 8.41
Overall liquid integrity	Section 8.71
Hoods	
Flame resistance	Section 8.2
Heat resistance	Section 8.6
CBRN protective ensembles	
Man-in-simulant test (MIST)	Section 8.66

A.4.2.4.2 The end user should always request a product verification list from the ISP.

A.4.2.5.1 Requirements for instructional delivery requisite knowledge and skills can be found in NFPA 1041, *Standard for Fire Service Instructor Professional Qualifications*. An Instructor II level or equivalent is recommended.

A.4.2.6 Retirement criteria should be based on a number of factors, including, but not limited to, the overall condition of the item, specific deterioration of materials or components beyond their repair economically, or the inability to adequately remove hazardous materials and other contaminants. Physical damage from use or improper cleaning are other factors that can affect when an item should be retired. The actual service life of ensembles and ensemble elements varies, depending on the amount of their use and the care they receive.

A.4.3.1 Records are an important part of an overall protective ensemble management program. Records can be used to provide information about the life cycle of protective ensembles and ensemble elements, to document repair and decontamination efforts, and to compare the effectiveness of elements that are made of different materials or by different manufacturers. These records can be compiled and maintained by the organization, the ISP, another third party selected by the organization, or any combination thereof.

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A.4.3.2 Some departments utilize rental or loaner gear. Records should also be maintained on these ensembles and ensemble elements in order to maintain a history on the care and maintenance of the products. The fire department should require that the entity providing the gear provide the records of prior care and maintenance at the time of rental.

A.4.5.2 Living areas include kitchen and dining areas, dayrooms, sleeping areas and dormitories, dedicated fitness rooms, bath and shower areas, office areas, and meeting and conference rooms.

A.4.5.3 Extra caution should be practiced to avoid exposing children to soiled protective equipment because they usually are more interested in actually touching or handling the equipment than are adults. Children are also less likely to wash off any dirt or soot that they might pick up from handling ensembles or ensemble elements. Departments should consider dedicating PPE solely for use at public education events to minimize public exposure to soils and contaminants.

Fire fighters often have a need to enter public facilities such as restaurants, grocery stores, and other businesses as part of their routine activities. PPE should not be worn during those times.

A.4.6.1 The purpose of this subsection is to require notification to the manufacturer and the certification organization of all health and safety concerns related to PPE identified through use or inspection. If a known or suspected failure of an ensemble element is identified, the element manufacturer and certification organization are the appropriate parties to be notified.

PPE health and safety concerns include, but are not limited to, the following:

(1) An occurrence resulting in loss of life or that which is likely to cause loss of life
(2) An injury resulting in permanent bodily damage, which can be instantaneous or cause a life-limiting disease or disorder eventually resulting in death
(3) An injury that requires hospitalization or medical or surgical treatment and that is not likely to result in a permanent disorder but is likely to necessitate loss of work for more than one day

A.4.6.2 The manufacturer and the certification organization information can be found on the product label.

A.5.1 The organization should consider establishing a committee to oversee the process of selecting ensembles or ensemble elements. The committee should consist of interested individuals representing a cross section of the organization (i.e., from both labor and management who collectively have several years of experience in fire fighting activities). The role of the committee should be to set and define goals and requirements and identify areas of responsibility for each member, plus provide recommendations to the authority making the final decisions.

Copies of specifications on the organization's current ensembles and ensemble elements should be distributed to the committee as a point of reference. The committee should consider if there are possible areas for improvement to the existing specifications. Examples of improvement criteria over existing specifications include heat stress, weight, design, style, interface with other components, durability, comfort, flexibility, safety, performance, price, customer service, delivery, compliance, reliability, and warranty.

A.5.1.1 In general, some hazards that can be encountered include, but are not limited to, physical, environmental, thermal, chemical, biological, electrical, radiation, operational, and ergonomic hazards. The organization should also consider the frequency and severity of the identified hazards when conducting the risk assessment.

The safety officer is the logical individual to perform this function since that is his or her role in the organization. The safety officer should consider national trends when performing this task. NFPA 1500, *Standard on Fire Department Occupational Safety and Health Program*, substantiates OSHA's regulations as follows:

(1) Section 4.3: Mandatory evaluation of safety and health programs
(2) Subsection 4.4.2: Mandatory compliance with state and federal laws
(3) Section 4.7: Safety officer's responsibilities also defined in NFPA 1521, *Standard for Fire Department Safety Officer*
(4) Section 7.1: Requirements for ensembles and ensemble elements

In the identification of hazards, the organization should consider those hazards that fire fighters are likely to encounter. A list of hazards is provided in Table A.5.1.1. In determining risk, the organization should consider the frequency or likelihood of exposure to the hazard along with its potential severity (consequence) if exposure occurs.

Table A.5.1.1 List of Potential Fire Ground and Other Related Emergency Hazards

Physical Hazards	***Chemical Hazards***
Falling objects	Inhalation
Flying debris	Skin absorption or contact
Projectiles or ballistic objects	Chemical ingestion or injection
Abrasive or rough surfaces	Liquefied gas contact
Sharp edges	Chemical flashover
Pointed objects	Chemical explosions
Slippery surfaces	***Electrical Hazards***
Excessive vibration	High voltage
Environmental Hazards	Electrical arc flashover
High heat and humidity	Static charge buildup
Ambient cold	***Radiation Hazards***
Wetness	Ionizing radiation
High wind	Non-ionizing radiation
Insufficient or bright light	***Person–Position Hazards***
Excessive noise	Daytime visibility
Thermal Hazards	Nighttime visibility
High convective heat	Falling
Low radiant heat	Drowning
High radiant heat	***Person–Equipment Hazards***
Flame impingement	Material biocompatibility
Steam	Ease of contamination
Hot liquids	Thermal comfort
Molten metals	Range of motion
Hot solids	Hand function
Hot surfaces	Ankle and back support
Biological Hazards	Vision clarity
Bloodborne pathogens	Communications ease
Airborne pathogens	Fit (poor)
Biological toxins	Ease of donning and doffing
Biological allergens	

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A.5.1.2(6) In determining the need for CBRN protection, the organization should determine homeland security priorities for their jurisdiction, including, but not limited to, whether the organization would be responding to a CBRN terrorism incident, the specific roles and missions to be undertaken in response to a CBRN terrorism incident, the expected types of hazards that might be encountered for its members during a CBRN terrorism incident, and the capabilities of the organization to provide sufficient training and support for the use of CBRN protective ensembles (e.g., decontamination for safe doffing of ensemble elements). If it is determined that CBRN protection is needed, the organization should review both the CBRN terrorism agent protection option in NFPA 1971, *Standard on Protective Ensembles for Structural Fire Fighting and Proximity Fire Fighting*, the different classes of ensembles addressed in NFPA 1994, *Standard on Protective Ensembles for First Responders to CBRN Terrorism Incidents*, and the protective ensemble defined in NFPA 1991, *Standard on Vapor-Protective Ensembles for Hazardous Materials Emergencies*, together with its intended CBRN terrorism agent response or action plan to determine the suitability of requiring protective ensembles meeting the CBRN terrorism agent protection option of NFPA 1971 versus obtaining separate ensembles that comply with specific classes of ensembles for NFPA 1994 or ensembles meeting NFPA 1991.

A.5.1.3 These standards provide minimum requirements. In order to fully utilize this standard, organizations should be familiar with the performance requirements in NFPA 1971. Additional requirements can be necessary. Organizations should also solicit information from and exchange information with other organizations.

A.5.1.4 Certification of protective elements can be checked by examination of the product label for the mark of the certification organization. The organization should further check the certification of the specific protective element by contacting the certification organization and asking if the item is listed as being certified as compliant with NFPA 1971, *Standard on Protective Ensembles for Structural Fire Fighting and Proximity Fire Fighting*. Finally, the organization can check the legitimacy of the certification organization by asking for documentation that shows that the certification organization has been accredited to ISO Guide 65, *General requirements for bodies operating product certification systems*.

A.5.1.5 The majority of tests in NFPA 1971 provide quantitative results; however, some tests are established on the basis of pass or fail results and cannot be readily compared. Specific tests that offer comparative performance results include, but are not limited to, the following:

(1) Protective garment elements
   (a) Thermal protective performance of the material composite
   (b) Total heat loss of the material composite
   (c) Conductive and compressive heat resistance of reinforcements
   (d) Thermal shrinkage of the material layers (outer shell, moisture barrier, thermal barrier)
   (e) Flame resistance of material layers and other components (outer shell, moisture barrier, thermal barrier, other material layers and components)
   (f) Tear resistance of the material layers (outer shell, moisture barrier, thermal barrier)
   (g) Cleaning shrinkage of the material layers (outer shell, moisture barrier, thermal barrier)
   (h) Water absorption resistance of the outer shell
   (i) Tensile strength of the outer shell
   (j) Seam strength of outer shell, moisture barrier, and thermal barrier layers
   (k) Visibility properties of the trim
   (l) Radiant reflectance of the outer shell (for proximity fire fighting protective clothing)
(2) Protective helmet elements
   (a) Impact resistance (top and acceleration) after selected preconditions
   (b) Flame resistance
   (c) Heat resistance (level of sagging)
(3) Protective glove elements
   (a) Thermal protective performance of glove body and, if present, wristlet
   (b) Conductive heat resistance of glove body
   (c) Thermal shrinkage of glove and innermost material
   (d) Cut resistance of glove body
   (e) Puncture resistance of glove body
   (f) Burst strength of wristlet material
   (g) Dexterity of whole gloves
   (h) Grip of whole gloves
(4) Protective footwear elements
   (a) Flame resistance
   (b) Radiant heat resistance of upper
   (c) Conductive heat resistance of sole and upper
   (d) Puncture resistance of sole and upper
   (e) Cut resistance of upper
   (f) Abrasion resistance of sole
(5) Protective hood interface elements
   (a) Thermal protective performance of hood material
   (b) Flame resistance of hood material
   (c) Thermal shrinkage of hood material
   (d) Burst strength of hood material
   (e) Cleaning shrinkage of hood material

Additional testing can also be specified for performance properties not addressed in NFPA 1971 based on the organization's hazard and risk assessment. When additional testing is specified, standard test methods should be used when available, and testing should be conducted at accredited, independent laboratories.

Organizations should consider the use of an RFI (Request for Information) or an RFP (Request for Proposal) format when soliciting quotations for structural or proximity fire fighting protective ensemble elements. The advantage of an RFI or an RFP proposal is that it allows manufacturers the option of providing all of the most current technologies for organization review (the offering is then not limited to the requirements of the specification). The organization can then choose among proposals for offered items finally accepted. Typically an RFI and an RFP have the following characteristics:

(1) Minimum requirements, such as NFPA product certification, required materials, or available options
(2) Inclusion of current specifications and a requirement that each manufacturer explain how its offering differs from the currently specified product
(3) Background on the offering firm's finances, capabilities, and references
(4) Field test procedures and results (see 5.1.6) of offered products

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Using this approach, the organization can then employ a rating system that assigns values and weights to several factors, including but not limited to product design, manufacturer references, and field test results.

In this approach, a separately sealed cost proposal is opened only after the point ratings have been assigned to each offering. The organization can then apply separate criteria considering both technical merits and cost. This approach allows fire departments to compare prices and product acceptability.

Organizations should also consider integrated personal protective equipment programs that address various levels of care and maintenance as provided by or coordinated by the manufacturer of the fire fighter personal protective equipment. These programs can address many of the aspects of care and maintenance that are addressed in this standard, including, but not limited to, cleaning, inspection, and repairs, in addition to the offer of program guidance and reporting and documentation of procedures.

A.5.1.6 The organization should consider the interface of items, such as helmets with hoods and SCBA; gloves and hoods with coats; trousers with boots; and so forth.

A.5.1.7 Organizations should contact manufacturers or vendors about field evaluation programs. Many provide sample items for tests. The following criteria should be used to conduct an effective field evaluation:

(1) Test participants should be selected based on a cross section of personnel, willingness to participate, objectivity, and level of operational activity.
(2) Participants should conduct field evaluations of each different product model being evaluated from each manufacturer for a particular ensemble element. Participants should be fitted for each product model being evaluated from each manufacturer. Evaluations should be conducted with the same participants to use and evaluate each ensemble.
(3) A product evaluation form should be developed for each element and interface area. The form should include a rating system for those characteristics considered important to the organization, facilitating a quantitative evaluation. Evaluation forms should include general performance criteria, a specific length of time for the field evaluation, and criteria addressing ease of movement, ability to work, and so forth. Size and fit issues should be addressed since they relate to comparative evaluation of ensembles and ensemble elements. Evaluation forms that provide only narrative responses should be avoided.
(4) The organization should solicit periodic reports from participants in the field evaluation. At least three evaluation reports should be completed and filled out independently.
(5) The organization should conclude the evaluation process in a timely manner and analyze the results.

A.5.1.8 Specifications translate the organization's needs into performance or design requirements that can be met by manufacturers of protective equipment. Specifications should clearly address every aspect of the department's needs and expectations in regard to both the performance and the delivery of the ensembles or ensemble elements.

Organizations should specify delivery time requirements and, if appropriate, penalty assessments for not meeting delivery dates. Warehousing requirements, if desired, should also be established in the procurement specification.

Organizations should be careful not to write specifications that are redundant or contradictory or that cannot be met by manufacturers of ensembles or ensemble elements. For example, the organization should be sure the thermal protection performance (TPP) specified can be achieved with the materials specified. A prebid meeting with participation by potential bidders or manufacturers is useful in eliminating inconsistencies and explaining requirements that might be unclear in the specifications.

Organizations should continuously review and document how their specifications and ensembles and ensemble elements meet their needs and applicable standards. There are many ways to improve the quantity and quality of information received from prospective bidders. Additionally, increased purchasing power potential can be gained by forming collective buys with other organizations for possible volume discounts.

Purchase specifications should indicate the organization's selection of choice for the following required NFPA 1971 ensemble element components:

(1) Garments
  (a) Outer shell material: fabric, weight, color
  (b) Thermal liner material
  (c) Moisture barrier material: base fabric, film, or coating
  (d) Trim: configuration, material, color
  (e) Closure system
  (f) Wristlets: material, design
(2) Hoods
  (a) Material
  (b) Face opening design
(3) Gloves
  (a) Composite materials
  (b) Wristlet or gauntlet
  (c) Wristlet material
(4) Helmets
  (a) Material
  (b) Color
  (c) Retention system
  (d) Trim configuration
  (e) Trim color
  (f) Ear cover material
  (g) Ear cover dimension
  (h) Eye protection
(5) Boots: composite materials

A.5.1.8(2) An organization should consider its needs for performance or features in excess of the minimum requirements of NFPA 1971, *Standard on Protective Ensembles for Structural Fire Fighting and Proximity Fire Fighting*, such as the following:

(1) Garment elements
  (a) Any styling issues
  (b) Any specific range-of-motion requirements
  (c) Any sleeve retraction requirements
  (d) Any garment rise with overhead reach requirements
  (e) Any winter liner requirements
  (f) Any additional reinforcement needs (recognizing that multiple layering can modify protective performance in several areas, especially breathability)
  (g) Any specific additional thread requirements
  (h) Any specific additional requirements for stitch characteristics

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(i) Any customized sizing requirements
(j) Any attachment requirements for liners and outer shells
(k) Any specific requirements for placement of visibility marking, visibility marking materials, and reflective lettering
(l) Any specific material choices
(m) Any requirements for weight reduction
(n) Any specific details of required suspender construction or suspender/garment interface
(o) Any requirements for spot or localized enhanced insulative performance
(p) Any requirements for field interchangeability or replacement of reinforcement pieces
(q) Any requirements for enhanced flexibility at movement-sensitive areas
(r) Any requirements for notification systems to indicate liner absence
(s) Any requirements for moisture barrier substrate or thermal fill accessibility to allow field inspection
(t) Any requirements for lumbar support systems
(u) Any customization requirements
(v) Any passport or accountability system requirements
(w) Any specialized or additional pocketing requirements
(x) Any flashlight clips required
(y) Any PASS (personal alert safety system) interface features required
(z) Any requirements for personal escape or rescue features
(aa) Any requirements for sizing adjustment
(bb) Any requirements for temperature-sensing features
(cc) Any requirements for interface area compatibilities

(2) Helmet elements
(a) Any styling requirements
(b) Any customization requirements
(c) Any faceshield or goggles requirements
(d) Any reflective marking requirements
(e) Any customized sizing requirements
(f) Any specific material choices
(g) Any specific requirements for earflaps (design, materials, dimensions, attachment to shell specifics)
(h) Any specific requirements for suspension construction
(i) Any requirements for weight reduction

(3) Glove elements
(a) Any specific material choices
(b) Any overall styling requirements
(c) Any details of cuff styling (wristlet or gauntlet)

(4) Boot elements
(a) Any specific material choices
(b) Any overall styling requirements
(c) Any trouser interface requirements

(5) Hood interface elements
(a) Any specific material choices
(b) Any styling requirements
(c) Any coverage requirements

(6) All ensemble elements
(a) Any additional certification requirements (e.g., Project FIRES, state OSHA, federal OSHA)
(b) Any requirements for interface with existing elements of the protective ensemble
(c) Any warranty requirements
(d) Any requirements for cleaning and repair support
(e) Any requirements for manufacturer or dealer references

(7) CBRN ensembles
(a) Method of deploying the CBRN protection
(b) Position of CBRN barrier layer in the material systems of each element and its ease of its inspection
(c) Manner in which ensemble interfaces are designed to prevent inward leakage
(d) Specialized donning or doffing procedures in the wearing of the ensemble
(e) Ensemble resistance to contamination and ease of ensemble doffing for safe exit of wearer from ensemble
(f) Specific types of SCBA for which ensemble is certified

A.5.1.8(3) Depending on the items being purchased and the size of the order, organizations should consider requiring product representatives to provide samples with their proposals. Manufacturers should also be required to provide complete user instructions and warranty information with each bid. Organizations should review the past record of each manufacturer concerning length of time for delivery, repair turnaround times, and similar customer service issues.

A.5.1.8(4) Organizations can obtain assistance in garment sizing from ASTM F 1731, *Standard Practice for Body Measurements and Sizing of Fire and Rescue Services Uniforms and Other Thermal Hazard Protective Clothing*. Helmets are adjustable and fit a wide range of sizes. If a helmet is not adjusted correctly, it might not stay on the user's head during periods of active wear. In addition to the sizing and depth adjustments, many models are available with quick adjusters to accommodate varying conditions for proper fitting (e.g., with or without SCBA facepiece).

A.5.1.8(5) Organizations should consider comparing a preproduction sample from the apparent winning submitter against the purchase specifications before awarding the bid.

A.6.1.3 It is not the intent of this standard to require the cleaning of ensembles and ensemble elements if the elements are not soiled. Organizations should establish guidelines for judging the extent of soiling that requires cleaning based on the organization's needs and experience. In applying such judgment, organizations should take into consideration the importance of keeping ensembles and ensemble elements clean. Soiled ensemble elements can pose a health risk to the wearer and the levels of protective performance.

A.6.2.2 Table A.6.2.2 provides a quick reference guide to routine inspection criteria.

A.6.2.2.3(6) The inspection should ensure that the sides and edges of faceshields and goggles are maintained to preserve peripheral vision.

A.6.3.2.1 For any inspection program to be effective, ensembles and ensemble elements should be evaluated by trained individuals. The individuals evaluating the ensembles and ensemble elements should understand the limitations of each element and recognize the signs of failure. Utilizing trained individuals provides consistency on whether an item should be repaired or retired. The manufacturer and organization should determine the level of training required to perform advanced inspections. Resources for training that should be considered, as a minimum, are the manufacturer(s) of the elements in use; the Fire and Emergency Manufacturers and Services Association (FEMSA) user guides; NFPA 1500, *Standard on Fire Department Occupational Safety and Health Program*; and professional cleaning and repair facilities.

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Table A.6.2.2 Routine Inspection Criteria

Criteria	Coats and Trousers	Hoods	Helmets	Gloves	Footwear	DRD
Soiling	X	X	X	X	X	X
Contamination	X	X	X	X	X	X
Tears and cuts	X	X	X	X	X	X
Damaged missing hardware or closure system	X					
Charring, burn holes, melting	X	X	X	X	X	X
Shrinkage	X	X	X	X	X	
Material discoloration	X	X	X	X	X	X
Damaged or missing visibility markings	X					
Loss of face opening elasticity or adjustability		X				
Cracks, dents, abrasions			X	X		
Bubbling, soft spots, warping			X			
Damaged or missing components of suspension or retention systems			X			
Damaged or missing components of faceshield/goggle system, including discoloration and scratched lenses			X			
Inverted liner				X		
Exposed or deformed steel toe, steel midsole, or shank					X	
Loss of water resistance					X	
Closure system component damage and functionality					X	
Earflaps: rips, tears, or cuts; thermal damage such as charring, burn holes, or melting			X			
Size compatibility	X					X

A.6.3.4 The following inspection grading scale is designed to assist fire department personnel in identifying and documenting the condition of ensembles and ensemble elements:

(1) *New or as-new condition.* Newly purchased items that are in like-new condition.
(2) *Good condition.* Items in good serviceable condition; might show wear, but replacement or repair is not necessary.
(3) *Maintenance needed.* Items in need of repair. The organization determines if an item is to be retired. Maintenance details are described in the "Comments" section of the inspection form.
(4) *Immediate replacement.* Unsafe items that should be removed from service.

A.6.3.5 Table A.6.3.5 provides a quick reference guide to advanced inspection criteria.

A.6.3.5.1 It is important to realize during the inspection of different layers of garment elements that some portions of the material might be more susceptible to damage than others. For example, one side of a multilayer laminate material or quilted material might show damage while the other side might not. Moreover, certain fibers in a single-layer material might be more susceptible to damage than other fibers. Each of these effects could be cause for repair or retirement of the garment element, depending on the extent of observed damage. When garments have an optional winter liner, the winter liner should be inspected during each advanced inspection.

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Table A.6.3.5 Advanced Inspection Criteria

Criteria	Coats and Trousers	Hoods	Helmets	Gloves	Footwear	DRD
Soiling	X	X	X	X	X	X
Contamination	X	X	X	X	X	X
Tears and cuts	X	X	X	X	X	X
Damaged or missing hardware or closure system	X	X	X	X	X	
Charring, burn holes, melting	X	X	X	X	X	X
Shrinkage				X		
Material degradation (UV or chemical damage)	X	X	X	X	X	X
Material discoloration	X	X	X	X	X	X
Visibility marking integrity, attachment to garment, reflectivity damage	X		X			
Loss of face opening elasticity or adjustability		X				
Cracks, dents, abrasions			X		X	
Bubbling, soft spots, warping			X		X	
Damaged or missing components of the suspension and retention systems			X			
Earflaps: rips, tears or cuts, thermal damage (charring, burn holes, melting)			X			
Damaged or missing components of faceshield/goggle system, including discoloration and scratched lenses			X			
Inverted glove liner				X		
Exposed or deformed steel toe, steel midsole, or shank					X	
Loss of water resistance				X	X	
Evaluation of system fit and coat/trouser overlap	X					
Loss of seam integrity				X		X
Broken or missing stitches		X		X		X
Loss or shifting of liner material	X			X		
Loss of wristlet elasticity, stretching of wristlet				X		
Label integrity and legibility	X	X	X	X	X	X
Hook and loop functionality	X		X		X	X
Liner attachment system	X					X
Material elasticity, stretching out of shape		X				
Damage to the impact cap			X			
Loss of flexibility			X			
Punctures, cracking, or splitting		X			X	X
Excessive tread wear					X	
Condition of lining: tears, excessive wear, separation from outer layer					X	
Size compatibility	X					X

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A.6.3.5.1(3) All charred, burned, or discolored areas should be thoroughly checked for strength and integrity by aggressive flexing of the material and attempts to push a finger or thumb through the fabric. Any loss of strength or weakening of the materials to the degree that the material can be torn with manual pressure is a sign of deterioration, and the garment should be removed from service.

A.6.3.5.1(4) While all materials and components in garment elements are susceptible to different types of damage from wear or abuse, the moisture barrier is one of the most difficult parts of the garment element to inspect and evaluate. That is because the film or coating side of most moisture barriers faces the interior of the liner and is hidden from easy examination. Even if a garment element is equipped with a means of opening the liner to view the film or coating side, it is difficult to conduct a visual evaluation of the moisture barrier film or coating. Even a physical examination of the moisture barrier film or coating side will not detect all types of damage or defects that can lead to loss of liquid penetration resistance for the garment element.

Moisture barrier coatings or films can become abraded, tear, or have pinholes from use. In severe cases, the degradation in some moisture barrier materials can take the form of separation, cracking, or flaking. Tapes used on moisture barrier seams, to ensure garment element integrity against liquid penetration, can crack, lift, or completely separate. Because only the most obvious damage is usually observable, the field evaluation procedures in Sections 12.2 and 12.3 are necessary.

A.6.3.5.1(7) Material discoloration can indicate many types of possible damage, including, but not limited, to dye loss, heat degradation, UV damage, and chemical contamination.

A.6.3.5.1(9) Visibility markings can appear to the human eye to be undamaged when actually they have lost much of their ability to reflect. Retroreflective properties can be checked with the following simple flashlight test:

(1) Stand approximately 12 m (40 ft) from a sample of the trim being tested and a sample of new trim.
(2) Hold a bright, focused flashlight at eye level, either next to the temple or on the bridge of the nose, and aim the light beam at the samples.
(3) Compare the brightness of the reflected lights. If the reflected light from the trim being tested is substantially less than the light reflected from the new trim, the trim should be replaced.

While this simple test provides a practical evaluation of trim retroreflective performance, it does not evaluate trim fluorescence or mean that the trim will provide adequate fire fighter visibility. Trim can lose fluorescence (daytime visibility) and still remain retroreflective. Trim can also appear to be retroreflective and not have sufficient intensity for nighttime visibility at far distances. Only testing under laboratory conditions can provide an accurate determination of trim visibility properties.

A.6.3.5.1(10) If a label problem is identified, the organization should contact the manufacturer of the ensemble or ensemble element.

A.6.3.5.4(3) The watertight integrity of gloves can be evaluated by the following test. Have a test subject wear the gloves with lightweight cotton gloves under the gloves being inspected.The test subject then immerses the groves in water up to the wrist crease, repeatedly flexes his or her hands for 2 minutes, and then takes them out of the water. Remove the test gloves and examine the cotton gloves for signs of watermarks. Gloves showing signs of leakage should be removed from service.

A.6.3.5.5(6) Excessive tread wear significantly reduces traction and safe footing on many surfaces such as wet flooring and roads, roofs, ladder rungs, and apparatus steps and platforms. Inspection of tread wear should focus on the heel and the ball of foot areas since those two areas carry the majority of a fire fighter's body weight and are the most critical in maintaining adequate traction. The organization should consult with the manufacturer and set guidelines for a minimum tread depth that has to be present for footwear to remain in service.

A.6.3.7.1 Organizations should consult with the manufacturer of the ensemble with optional CBRN protection for any additional or specific advanced inspection requirements for this type of ensemble.

A.6.3.7.3 Loss of integrity can be determined by evaluating the inward leakage for representative CBRN protective ensembles. One evaluation method that could be used is the CBRN Ensemble Inward Leakage Resistance Evaluation. The procedure in this section is based on procedures established by the Occupational Safety and Health Administration (OSHA) for the evaluation of totally encapsulated suits, as found in Appendix A of OSHA 29 CFR 1910.120, "Hazardous Waste Operations and Emergency Response." Modifications to the procedures have been made to evaluate structural fire fighting protective ensembles that do not encapsulate both the wearer and the breathing apparatus.

For this testing, the entire CBRN protective ensemble should be evaluated, including protective garments, gloves, footwear, and hood. The protective helmet should be included, if it is part of the CBRN protective ensemble. The appropriate CBRN SCBA should be included as specified as part of the CBRN ensemble.

The suggested test procedure involves placement of commercially available colorimetric dosimeters (sensors) on the ensemble wearer's body at different locations at or near interface areas of the ensemble. An ammonia challenge atmosphere is then created by the placement of a volume of household ammonia (aqueous ammonium hydroxide, approximately 58 percent by weight) in a shallow pan in a closed room, such as a large closet. The procedure generates an ammonia atmosphere of approximately 500 to 1500 ppm; the test concentration can be assessed using length of stain detection tubes specific for ammonia. After the placement of the colorimetric dosimeters, the ensemble wearer dons the ensemble and respirator well away from the test area, enters the test area, and goes through a series of exercises to stress various parts of the ensemble. Following the exercises, the ensemble wearer goes to an area well away from the test area, the ensemble is removed, and the colorimetric dosimeters are examined for color changes. Indications of color change for any of the colorimetric dosimeters that cannot be rationalized from cross contamination or error in procedure are then deemed as requiring the ensemble to be removed for reevaluation, inspected, and repaired, if necessary.

The CBRN ensemble should be evaluated as specified in Test B, Totally-Encapsulating Chemical Protective Suit Qualitative Leak Test in Appendix A of 29 CFR 1910.120, with the following modifications:

(1) All safety precautions must be followed.

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(2) The CBRN protective ensemble should be substituted for the totally encapsulating chemical protective suit.
(3) Specific colorimetric dosimeters should be used in lieu of bromophenol blue–indicating paper that have a specific range of sensitivity of at least 1 ppm when exposed to ammonia for a period of 2 minutes.
(4) Eight colorimetric dosimeters should be placed on the test subject at the following locations under the CBRN ensemble:
   (a) Neck area
   (b) Center lower front chest near waist
   (c) Center lower back near waist
   (d) Each wrist
   (e) Front of each leg above the ankle
   (f) Forehead above where the SCBA facepiece and the test subject's face form the seal

   These placements are intended to evaluate possible inward leakage in interface areas. Additional colorimetric dosimeters can be added at other locations where inward leakage is suspected to occur. Colorimetric indicators that have been found suitable are the Permea-Tec™ aliphatic amine sensors, part no. 3005, available from CLI Laboratories, 1261A Rand Road, Des Plaines, Illinois 60016-3402, 847-803-3737, www.clilabs.com. These adhesive bandage–like sensors are placed on the skin at the recommended locations. The sensors turn a reddish-purple if ammonia at concentrations over 1 ppm is detected.
(5) Performance is deemed as passing if no color changes are noted for any of the colorimetric dosimeters. If color changes are found, a determination should be made that the procedures were done correctly and that no cross contamination of the colorimetric dosimeters occurred. If the results are determined to be valid, the ensemble should be removed from service, repaired, or replaced.

A.6.4.3 It should be noted that this standard's requirement that a complete liner inspection be performed after the first 3 years of service and every year thereafter should not negate the necessity of conducting a complete liner inspection sooner than the required time frame if circumstances or appearances dictate. For example, inside layers that show marked discoloration or physical deterioration should trigger a complete liner inspection.

A.7.1.1 The importance of maintaining the cleanliness of ensembles and ensemble elements should not be underestimated. Soiled or contaminated ensembles and ensemble elements are a hazard to fire fighters because soils and contaminants can be flammable, toxic, or carcinogenic. Additionally, soiled or contaminated ensembles and ensemble elements can have reduced protective performance. Clean ensembles and ensemble elements offer the emergency responder better protection and can add to the life of the ensemble and ensemble elements. Ensembles and ensemble elements should be cleaned whenever they become soiled.

In everyday use, personal protective equipment gets dirty by the absorption of sweat from the wearer and of soils, soot, and so forth from the outside environment. Cleaning of ensembles and ensemble elements removes those substances. Ensembles and ensemble elements can also become contaminated with other substances, principally hazardous materials, particulates, and body fluids. The removal of those substances is most often referred to as *decontamination*. In structural and proximity fire fighting, both general cleaning and decontamination of ensembles and ensemble elements might be necessary.

Health risks of soiled or contaminated ensembles and ensemble elements. Soiled or contaminated ensembles and ensemble elements can expose fire fighters to toxins and carcinogens that enter the body through ingestion, inhalation, or absorption. Repeated small exposures to some contaminants can add up over time and cause health problems.

Although emphasis is placed on safety to avoid injury or inhalation hazards to personnel working on the fire ground, many of the toxins that lead to health risks are carried away from the fire scene on the personal protective equipment used by the fire fighters.

Toxins that fire fighters come into contact with can be trapped in the fibers of soiled ensembles and ensemble elements or absorbed into the materials themselves. Contact with the soiled ensembles and ensemble elements increases the risk of the toxic contaminants being introduced into the body.

Ensembles and ensemble elements contaminated with body fluids present a potential risk of a communicable disease being transmitted to persons coming into contact with the contaminated ensembles or ensemble elements.

Reduced performance hazards of contaminated ensembles and ensemble elements. Ensembles or ensemble elements laden with particles and chemicals present problems in addition to exposure to toxins, such as the following:

(1) Soiled ensembles and ensemble elements typically reflect less radiant heat. Materials that are saturated with hydrocarbons tend to absorb rather than reflect the radiant heat from a surrounding fire.
(2) Ensembles and ensemble elements heavily contaminated with hydrocarbons are more likely to conduct electricity, increasing the danger to fire fighters entering a building or vehicle where wiring can still be live.
(3) Ensembles and ensemble elements impregnated with oil, grease, and hydrocarbon deposits from soot and smoke can ignite and cause severe burns and injuries, even if the materials are normally flame resistant.

Even though the number of specialized hazardous materials response teams is growing, individual fire fighters still encounter various chemicals in their normal fire fighting activities. Exposure to oils, gasolines, and lubricants can occur around fire station vehicles. During responses, exposure to liquids ranging from pesticides to acids to chemical solvents can occur, knowingly or unknowingly. In addition to being hazardous, such contaminants can also degrade ensembles and ensemble elements as follows:

(1) Fabrics can become weakened and tear more easily.
(2) Thread or seam sealing tape can become loose.
(3) Flame-retarding or water-repelling treatments can be removed.
(4) Visibility markings can lose reflective properties or markings, becoming less visible.
(5) Helmet shells, helmet faceshields, or goggles can pit or craze.
(6) Ensemble and ensemble elements hardware can become corroded.

A.7.1.4 Organizations should consult the local hazardous materials team or health department and seek their assistance in determining what the contaminant(s) is and if the contamination is a true hazardous materials situation. Should it be determined that the contamination is not a hazardous material, advanced cleaning should be performed.

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A.7.1.4.2 Organizations should be aware that decontamination of protective equipment is a complicated process and that there is no guarantee that the protective elements will be free from contamination.

While the purpose of decontamination is to remove all contaminant(s) from an ensemble element, decontamination procedures or cleaning processes are not always 100 percent effective in removing all contamination. The actual success of a decontamination process can be determined only by measuring the concentration of the contaminant(s) in the element before and after the selected decontamination or cleaning process. The majority of tests that can be applied for measuring the concentration of contaminant(s) in the element require destructive sampling of the element that may render the element unusable or nonrepairable. The sole evaluation of contamination levels in rinse water is not an appropriate measure of decontamination effectiveness. Claims for protective elements being contaminant free based on statements from ISPs or from the use of specific cleaning products should be viewed with caution.

Procedures used for measuring contamination levels should be specific for the contaminant(s), if known. Useful analytical procedures for measuring levels of semivolatile organic chemicals in materials are found in EPA SW-846, *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods*: Method 3540, "Soxhlet Extraction," and Method 8270, "Semivolatile Organic Compounds by Gas Chromatography/Mass Spectrometry (GC/MS)." These procedures involve extracting a small piece of fabric in a solvent such as methylene chloride and analyzing the extract solution using gas chromatography in conjunction with mass spectrometry. The gas chromatography separates chemical contaminants and quantifies their amount, while the mass spectrometry identifies the specific chemical.

Similar analytical procedures for measuring levels of inorganic chemicals (such as heavy metal contaminants like chromium and lead) in materials are found in EPA SW-846: Method 3015, "Microwave Assisted Acid Digestion of Aqueous Samples and Extracts," and Method 6010, "Inductively Coupled Plasma-Atomic Emission Spectrometry." These procedures similarly involve analysis of a small material specimen: the specimen is digested in nitric acid and then treated with 50 percent hydrogen peroxide. The solution of the digested specimen is then diluted for analysis by atomic absorption or ion coupled plasma spectroscopy to identify and determine the amount of different inorganic substances.

Because these procedures are very sensitive for quantifying many forms of contamination, any testing for measuring contamination levels should involve control tests. Control tests are separate measurements used to determine other background contamination that might be present in the material or in residue left from the cleaning agents or cleaning procedures. Failure to consider such chemicals can interfere with the accuracy of measurements for actual contaminants. In general, the following control tests are needed:

(1) A test of the same material being analyzed without the contaminant present (this could be taken from personal protective equipment that has a similar history but that was unexposed to the contaminants)
(2) A test of the same material after washing that has been subjected to the cleaning process (this could be accomplished on a piece of new material that has been cleaned using the subject cleaning agent and procedures)

The levels of residual contaminants from these control tests should be subtracted from the after-cleaning samples. The residual contamination from the first control test should be subtracted from the before-cleaning samples.

Decontamination effectiveness can be determined by calculating the proportion of contaminant removed using the following equation:

$$\text{Percent decontamination efficiency} = \frac{\text{Initial level of } C - \text{Final level of } C}{\text{Initial level of } C} \times 100$$

where:
C = contaminant

The decontamination effectiveness will vary with each contaminant because some contaminants can be removed more easily than other contaminants, given differences in the properties of the contaminant and the properties of the contaminated element materials. For example, chemicals such as hexane and benzene that evaporate easily usually will be removed relatively easily compared with nonvolatile (nonevaporating) chemicals found in tars and oily chemicals.

The remaining level of contaminant in a protective element can be used to determine the potential risk to the wearer. However, there are no established safe levels of surface concentration for most contaminants. The decision to reuse a protective element based on known, measured levels of contamination should be undertaken by a trained professional familiar with the properties and hazards of the contaminant. Any uncertainty in the risk presented by residual contamination in the protective element can be cause for retirement and disposal of the protective item.

The procedures for measuring contamination levels in protective elements are usually destructive in that they require that a specimen be taken from the protective element and subjected to extraction or digestion with a solvent. This requirement, in addition to the expense of the analytical testing, can make the decision to investigate contamination levels in protective elements cost prohibitive.

Specimens of protective elements taken for determination of contamination levels cannot be representative for all areas of the protective element being sampled. For example, a specimen taken from the pocket of the coat will not reflect the contamination level for the back of the coat or the bottom of the trousers. In addition, sampling of one protective element will not be representative of all elements from a certain group that are or are suspected of being contaminated. Contamination levels for different protective elements of the same type depend on the type of exposure, the condition of the protective element, and the care provided to the protective element.

Concerns over protective element contamination can arise from a single incident involving a contamination event or can be an ongoing consideration as contaminants from routine situations accumulate in the ensemble element(s). Organizations can periodically sample ensemble elements to determine the effectiveness of cleaning processes in removing harmful contaminants, but they should understand the limitations of the approach, specifically that sampling cannot be representative of all the protective ensemble elements in use.

Further details about this information are provided in the report for the U.S. Fire Administration, "Research, Testing, and Analysis on the Decontamination of Fire Fighting Protective Clothing and Equipment." A synopsis of that report is provided in ASTM STP 1237, *Performance of Protective Clothing*.

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A.7.1.6 Members should follow universal precautions when handling cleaning and decontamination of any ensemble or ensemble element contaminated by body fluids. Universal precautions include member self-protection with the use of gloves, aprons, full torso covers, arm covers, and eye/face protection. In addition, cleaning of contaminated ensembles and ensemble elements should take place in a designated area with sinks and counters made of materials, such as stainless steel, that can be adequately decontaminated following an element-cleaning procedure. Organizations should ensure that appropriate decontamination agents are available for member use as well as applicable procedures for each type of ensemble and ensemble element. NFPA 1581, *Standard on Fire Department Infection Control Program*, should be consulted for additional guidance. As a minimum, persons involved in cleaning contaminated ensembles and ensemble elements should wear cleaning gloves, an apron, and a faceshield that conform to NFPA 1999, *Standard on Protective Clothing for Emergency Medical Operations*.

A.7.1.8 Some dry cleaning solvents that are used in lieu of water can damage components of the ensembles and ensemble elements. Reflective trim, helmets, and leather gloves, in particular, can be adversely affected by such solvents. The manufacturer should be consulted prior to dry cleaning to confirm that ensembles and ensemble elements will not be damaged.

A.7.1.9 For ensembles and ensemble elements that are to be cleaned or decontaminated by contract cleaning, the following questions should be asked to determine if the ISP is knowledgeable enough to provide adequate service and not cause damage to the ensembles and ensemble elements:

(1) Can the ensembles or ensemble elements be effectively cleaned or decontaminated? *(See information following this list.)*
(2) Does the ISP have references for cleaning and/or decontamination of ensembles and ensemble elements?
(3) Does the ISP have liability insurance to clean protective clothing (i.e., for the repair or replacement of ensembles and ensemble elements damaged in laundry, from wash water contamination, etc.)?
(4) Does the ISP take reasonable precautions to protect its personnel from contaminant exposures while handling ensembles and ensemble elements?
(5) Is the ISP familiar with the requirements of NFPA 1971, *Standard on Protective Ensembles for Structural Fire Fighting and Proximity Fire Fighting*, and NFPA 1581, *Standard on Fire Department Infection Control Program*, as well as federal, state, and local regulations?
(6) Does the ISP have a quality assurance program?
(7) What type of process does the ISP use? Are Material Safety Data Sheets (MSDS) available? If the process is proprietary, is it approved by the manufacturer of the ensemble or the ensemble element?
(8) Does the ISP take appropriate steps to prevent cross contamination between any and all products laundered in the facility?
(9) How does the ISP demonstrate the effectiveness of the cleaning process?
(10) What testing or evaluation method(s) are used to ensure that decontaminated ensembles or ensemble elements are truly decontaminated and safe to wear?
(11) Does the ISP comply with applicable federal, state, and local wastewater discharge regulations and standards?
(12) Does the ISP provide delivery and pick-up services for soiled and/or contaminated ensembles and ensemble elements?
(13) Does the ISP have the capability to restore water-repellent properties of ensembles and ensemble elements?
(14) What is the turnaround time?

It is important that the organization request information from the ISP or the cleaning agent supplier about the effectiveness of cleaning agents and cleaning procedures and about the effects of the cleaning agents and cleaning procedures on ensembles and ensemble elements. Although there are few established procedures for making these determinations, the following guidelines are offered.

Request information about the cleaning effectiveness of the process or the cleaning agent. Actual cleaning effectiveness should be demonstrated by washing ensembles or ensemble elements that either have become soiled from use or have been intentionally soiled. Cleaning effectiveness is typically confirmed by a visual comparison of the before and after cleaned samples. It is important to note that ensembles and ensemble elements that appear clean might not be fully clean and can contain chemical contaminants.

Request data about the effects of the cleaning process or cleaning agent on protective ensembles or ensemble elements. The effects of the cleaning agent or cleaning process should be judged on the basis of tests performed on representative material samples following several cleaning cycles (washing and drying). The samples should be subjected to at least 10 cleaning cycles; however, organizations might want suppliers or the ISP to demonstrate effects after as many as 25 cleaning cycles. Ideally, ensemble element(s) should be evaluated for each of the performance properties listed in NFPA 1971, *Standard on Protective Ensembles for Structural Fire Fighting and Proximity Fire Fighting*; however, key properties can be selected. Table A.7.1.9 provides a recommended list of key properties for evaluation.

Other properties can be evaluated that are of interest to the organization, including the following:

(1) Composite weight
(2) Composite thickness
(3) Composite total heat loss (breathability)
(4) Outer shell colorfastness to washing
(5) Outer shell colorfastness to light exposure
(6) Outer shell or thermal barrier abrasion resistance

The effects of cleaning properties are evaluated by comparing the measured property after washing with the same property measured for new material. It is important to review both the after-cleaning level and the change for the measured property. Properties should remain at or above the minimum performance requirements established in NFPA 1971, *Standard on Protective Ensembles for Structural Fire Fighting and Proximity Fire Fighting*. It is also important to take note of large changes in clothing material properties. For example, the tear strength of a material can be measured at a level of 11.4 kg (25 lb) before cleaning and then 10 kg (22 lb) after several cycles, whereas a different material could begin at 18.2 kg (40 lb) and drop to 11.4 kg (25 lb) after the same number of cleaning cycles. This particular case points out that one material might be more susceptible to cleaning.

It is also possible for some measured properties to increase after multiple cleaning cycles. For example, thermal insulation as measured in the thermal protective performance test often

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Table A.7.1.9 Recommended Performance Tests for Evaluating Effects of Cleaning Agents or Cleaning Procedures

Performance Property	Test Method*	Type of Sample(s)	Specimens Required†
Thermal protective performance	Section 8.10	Composite	Three 150 mm (6 in.) squares
Flame resistance	Section 8.2	Outer shell, moisture barrier, thermal barrier	Five 75 mm × 305 mm (3 in. × 12 in.) rectangles (in each material direction)
Tear strength	Section 8.12	Outer shell, moisture barrier, thermal barrier	Five 75 mm × 150 mm (3 in. × 6 in.) rectangles (in each material direction)
Tensile strength	Section 8.50	Outer shell	Five 100 mm × 200 mm (4 in. × 8 in.) rectangles (in each material direction)
Water absorption	Section 8.26	Outer shell	Three 200 mm (8 in.) squares
Cleaning shrinkage	Section 8.25	Outer shell, moisture barrier, thermal barrier	Five 375 mm (15 in.) squares
Fuel C penetration resistance	Section 8.28	Moisture barrier seams	Three 75 mm (3 in.) squares
Viral penetration	Section 8.29	Moisture barrier seams	Four 75 mm (3 in.) squares
Retroreflectivity and fluorescence	Section 8.46	Trim sections	Four 305 mm (12 in.) lengths

*Sections are from NFPA 1971, *Standard on Protective Ensembles for Structural Fire Fighting and Proximity Fire Fighting.*
†Either specimens removed from ensemble elements or representative material samples.

improves after cleaning because the thickness (or loft) of the materials increases. Conversely, the total heat loss (THL) value of the same ensemble can decrease as a result of cleaning.

The loss of water absorption resistance for an outer shell can be reduced by the reapplication of water-repellent finishes. It is essential that chemicals used in this process be determined to be safe and without any adverse effects on the ensemble element(s).

In evaluating the effects of cleaning agents or cleaning procedures on ensembles and ensemble elements, it is important to realize that applying multiple cleaning cycles does not simulate its use. Cleaning is but one factor in the "wear" of protective ensemble and ensemble elements. Cleaning when properly applied might also extend the life of the ensemble and ensemble element.

A.7.2.1 Routine cleaning is a light cleaning of ensembles and ensemble elements performed by the end user without the elements being taken out of service. Routine cleaning can be accomplished by brushing off dry debris, rinsing off debris with a water hose, and spot cleaning.

A.7.2.3.1 Routine cleaning immediately after the termination of an incident can remove substantial amounts of surface contaminants before they have a chance to set in and can help limit the transfer of contaminants to apparatus and stations. Many of the contaminants that can cause damage to visibility markings also can be removed if routine cleaning is done as soon as possible after an exposure to those contaminants.

A.7.2.3.6(1) Care must be exercised in the use of aggressive cleaning agents that contain active ingredients such as sodium percarbonate, found in oxy-type additives, and d-limonene, found in citrus-type additives and degreasers, as well as other solvents. Chlorine will damage the fibers of the protective fabrics used in ensemble elements. Use of aggressive cleaning agents must be accomplished in strict accordance with manufacturer's instructions for such chemicals, or serious damage to the elements can result. Elements that contain leather, such as footwear, helmets, and gloves, are extremely susceptible to damage from such chemicals. In addition, use of those chemicals with more absorbent element materials without extreme care taken to fully rinse out the chemical can create an extremely hazardous condition for the member by impregnating protective elements with a flammable substance.

A.7.2.3.6(2) Water above 40°C (105°F) can cause scalding of the hands when washing is performed in a utility sink. Water above 40°C (105°F) can also cause damage to some components on protective ensemble element(s).

A.7.2.3.6(4) Appropriate precautions should be taken to provide protection from possible exposure to contaminants during the cleaning process.

A.7.3.2 Advanced cleaning is a thorough cleaning of ensembles and ensemble elements accomplished by washing them with cleaning agents. Advanced cleaning usually requires elements to be temporarily taken out of service. Advanced cleaning can be accomplished by hand washing in a utility sink, by machine washing, or by an ISP.

Soiling is not always visible and can be difficult to observe on darkly colored materials. In addition, exposure can occur where ensemble elements are contaminated with fire gases, resulting in ensemble elements that can be relatively unsafe for use. Ensemble elements that have not been cleaned and appear to be unsoiled have been shown to contain numerous fire gas chemicals, including carcinogenic polynuclear aromatic compounds. Periodic cleaning is required to avoid use of ensemble elements that could be contaminated without visible evidence of soiling.

A.7.3.6 Machine cleaning is the most effective method for cleaning ensemble elements such as coats, trousers, coveralls, and hoods. It is the most effective means of loosening and removing dirt, soot, and other debris. Two basic types of automatic washing machines are commonly available for use by end users: top- loading agitator style machines and front-loading

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washer/extractors. New technologies are emerging every day in the cleaning industry that will affect the options available to both the end user as well as the ISP. It is generally accepted that front-loading machines are more appropriate for protective ensembles and ensemble elements, where allowed by the element manufacturer. It is very important for machine operators to ensure correct water temperatures and proper detergent and additive selection and to carefully monitor and adjust the g forces of the spinning/extraction cycle for each element type being laundered. Careful adherence to manufacturers' recommendations of cleaning processes has a significant impact on cleaning thoroughness and maintenance of protection factors inherent in each element, as well as extending the life expectancy of elements. Some of the advantages and disadvantages of each type of machine follow.

Top-Loading Washers. Top-loading machines are similar to those used in most homes. They use a center post agitator to whisk water through the fibers of garments. They are designed to clean multiple garments of minimum bulk. As a result of the center post agitation, it is generally accepted that top-loading machines are more damaging to ensembles and ensemble elements than front-loading machines. Top-loading, agitating machines have the potential to reduce the longevity of garments due to mechanical damage. If top-loading machines are used, stainless steel wash tubs are recommended to protect against rusting, chipping, and the associated wear on garments.

Front-Loading Washers. Front-loading washers have a door on the front of the machine through which garments are loaded. They clean by lifting garments out of the water and gently dropping them back into the water. These units provide better mechanical action because of the size and type of rotation, as well as the degree of extraction. They have various capacities and are designed to handle heavy loads of bulky items and also to save water and energy. For those reasons, it is generally accepted that front-loading machines are more appropriate for protective clothing.

A.7.3.7(1) For example, no more than one set of garments should be placed in a top-loading machine, and machine manufacturer's instructions should be followed for front-loading machines. Proper load size is essential for effective cleaning.

A.7.3.7(2) The garments should be soaked according to the detergent manufacturer's instructions. The garment should be removed and the soak water should be drained. If necessary, a soft bristle brush should be used to gently scrub the garment. Extra care should be taken with liner assembles.

A.7.3.7(4) It is important to check with the manufacturer as to the appropriate wash temperature for machine washing of protective garments, because different materials and components in the garment can have different susceptibilities to wash temperatures and other washing conditions. For example, leather, rubber-coated materials, and some fluorescent film-based materials can be affected by relatively high wash temperatures and can degrade prematurely when repeatedly washed under those conditions.

A.7.3.7(6) Preliminary research suggests excessive *g* forces created by washing machine drums that spin at high RPMs can damage protective garments. The type and severity of damage will depend on the *g* forces created, exposure time, the number of exposures, condition of the ensemble or ensemble element, and the materials used to construct the ensemble or element. Thermal and moisture barriers are the most vulnerable. Thermal barriers can hold several times their weight in water. Extracting at high RPMs creates very high *g* forces, resulting in the shifting of nonwoven insulating materials. Moisture barrier materials and seams by their very nature are designed to impede the flow of liquid water. Extraction at excessively high RPMs can severely damage moisture barriers and moisture barrier seams as water pushes against the barriers in an attempt to escape toward the outer perimeter of the drum. A vast majority of ISPs are monitoring extraction RPMs and have adjusted their commercial machines to create less than 100 g when cleaning all protective ensembles and ensemble elements. End users should make every effort to control and lower the RPM of laundering machines used for protective ensemble and ensemble elements laundering to preserve the integrity and increase the longevity of PPE elements.

A.7.3.7(7) If the machine does not automatically have a second rinse, an additional complete cycle without detergent should be run.

A.7.3.7(9) When possible, organizations should provide a washing machine(s) for the sole purpose of cleaning protective ensemble elements.

A.7.3.9.2 Ensembles and ensemble elements should be cleaned and decontaminated only with like elements, including but not limited to outer shells with outer shells, liners with liners, hoods with hoods, gloves with gloves, and boots with boots. It is highly recommended that garment liner systems be removed if possible and cleaned separately to avoid contamination with the debris found in the shell. Because the moisture barrier will limit the flow of water through the outer shell fabric, removing the liner will result in better cleaning. Separating the liner from the outer shell will also reduce drying time.

A.7.3.10.1 Advanced cleaning includes washing both the inside and outside surfaces of the helmet carefully, using a soft brush to reach between components and into difficult-to-access spaces, and washing the eye/face protection. It is usually not necessary to completely submerge a helmet for cleaning unless it is being inspected for damage or repairs are being performed in conjunction with the cleaning. The helmet should be thoroughly washed prior to disassembly to prevent the migration of dirt and contamination.

A.7.3.11 The thermal protective capability of leather gloves is seriously degraded when gloves are washed in any machine that develops excessive *g* forces to extract water from the materials. Studies indicate that the outer leather shell material becomes compressed and does not fully recover once dry. This loss of thickness directly relates to a loss of thermal protection as well as a loss of dexterity, both important factors of fire fighter PPE safety. Alternative commercial machine technologies are available that are suitable for gloves but should be used only with approval of the glove manufacturer.

A.7.3.12 Unless specifically approved by the manufacturer, footwear should not be machine laundered. Damage to both the footwear and the machine can result. Alternative commercial machine technologies as well as specific procedures for different footwear materials and construction are available but should be used only after consultation with and approval from the footwear manufacturer.

A.7.4.1 The decision of how to dry ensembles and ensemble elements after cleaning should be made with the following factors in mind:

(1) Time constraints

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(2) Effect of the drying method on the ensembles and ensemble elements

A.7.4.2 Air drying is the most appropriate method for drying ensembles and ensemble elements. It causes no mechanical damage and little or no shrinkage. The most efficient method of air drying involves forced air ventilation. This method of drying can be achieved by simply using fans to recirculate air in the room with the ensembles and ensemble elements. The basic drying room should include floor drains, a method to exchange the air to the outside environment, and drying racks for hanging ensembles and ensemble elements to provide maximum air exposure. Overall drying time will depend on the efficiency of the drying room and the ambient conditions. Heating the room or the inlet air up to 38°C (100°F) can further improve the efficiency of the drying process. Drying ensembles and ensemble elements in ambient air, as opposed to drying rooms, takes a considerable length of time, depending on the ambient environmental conditions.

A.7.4.2(1) The use of racks to provide maximum air exposure of the ensembles and ensemble elements will decrease the overall drying time.

A.7.4.2(2) Exposure to direct sunlight will cause degradation of fibers in protective garments, resulting in loss of fabric strength.

A.7.4.3 Machine drying of ensembles and ensemble elements is generally not recommended. Dryers can reach very high basket temperatures during operation, potentially damaging ensemble elements. Machine drying also includes mechanical action that can cause damage to ensembles and ensemble elements.

A.7.4.3(3) "No heat" is the preferred method of machine drying because it effectively accomplishes forced air ventilation.

A.7.4.3(4) Excessive temperatures can cause damage to ensembles and ensemble elements, excessive garment shrinkage, and potentially premature failure and retirement of protective equipment. Temperatures can rise as the garments in the basket dry out.

A.7.4.3(5) Removal of garments before they are completely dry prevents exposure to excessive heat and reduces the potential for premature retirement of ensemble and ensemble elements. Ensembles and ensemble elements should be air dried to complete the drying process. Mechanical dryers may be used on a "no heat" setting.

A.7.4.3(6) Ensembles and ensemble elements should be completely dry before reuse to avoid the potential for steam burns caused by moisture remaining in the layers of the ensemble or ensemble element.

A.8.1.4 Although repairs can bring ensembles or ensemble elements back to a serviceable level of performance, repaired ensembles or ensemble elements may not provide the same levels of protection and performance as new ensembles or ensemble elements.

A.8.2.4 Although some hardware can be replaced in the field, it should be noted that field application might not be as permanent or as strong as when the hardware is replaced at the factory or by a verified ISP.

A.8.4.3 Due to the complexity and specialized equipment needed to conduct moisture barrier repairs, it is mandated that the garment be returned to the manufacturer or to a verified ISP. The equipment needed to conduct these repairs is typically not found in the field but in specialized repair facilities or manufacturing facilities. Moisture barrier materials are found in collars, collar closure systems, and other assemblies, including, but not limited to, storm flaps and sleeve wells.

A.8.4.4 While some loss of quilting threads on thermal liners is the normal result of wear, excessively large areas where quilt stitching is broken or missing can indicate the need to replace the liner.

A.8.4.8 Stress areas are generally considered to be the corners of pockets and flaps, the base of the fly, the top and bottom of the storm flap, and any place where the stitching begins or ends.

A.8.4.10 Depending on the method of construction, broken zippers can be replaced in the field, providing it can be accomplished without causing a breach to any moisture barrier material and without affecting the garment integrity.

A.8.4.11 Depending on the method of construction, hooks and loops can be replaced in the field, providing doing so can be accomplished without causing a breach to any moisture barrier material and without affecting the garment integrity.

A.8.4.12 Reinforcing materials are those fabrics, including, but not limited to, suede leather and outer shell fabrics, that are used to reinforce specific areas of an element, for example, a knee or elbow on a garment.

A.8.5.2 The manufacturer's literature supplied with the helmet should be consulted for disassembly instructions. If the manufacturer's instructions cannot be located, the manufacturer should be contacted for a new set of inspection and maintenance instructions. Accessories to structural fire fighting helmets should include only those items that are provided by or recommended by the manufacturer. Because aftermarket accessories affect the weight and balance of the helmet, they should not be utilized unless they have the approval of the manufacturer. Pre-existing holes should never be enlarged to accommodate aftermarket accessories.

A.9.1 Proper storage of ensembles and ensemble elements extends their life, maintains their performance, and reduces potential health risks. Improper storage can result in damage to the ensemble or ensemble element and can compromise the fire fighter's safety. Certain conditions can result in deterioration of performance of the ensemble or element or create potential health hazards.

A.9.1.1 Ultraviolet (UV) light, especially from sunlight, is a known cause of protective ensemble degradation. Storage in direct sunlight causes degradation of fibers in protective garments, resulting in fabric strength loss, and can cause accelerated aging of other equipment. In addition, other UV light sources, such as fluorescent light, can cause similar degradation, although ongoing research suggests that the degradation from fluorescent light is far less severe than exposure to direct sunlight. Therefore, ensembles and ensemble elements should be stored to minimize exposure to all sources of UV light.

A.9.1.2 Storage of wet or moist ensembles and ensemble elements promotes the growth of mildew and bacteria, which can lead to skin irritation, rashes, or more serious medical conditions. Mildew and bacteria growth can also affect the strength of some materials.

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A.9.1.4 Storage in extreme temperatures for extended periods can accelerate deterioration of ensembles and ensemble elements. A cold performance parameter of –32°C (–25°F) is used in NFPA 1971, *Standard on Protective Ensembles for Structural Fire Fighting and Proximity Fire Fighting*. Temperatures above 82°C (180°F) can cause some adhesives to lose their integrity.

A.9.1.6 Soiled ensembles and ensemble elements can present a health risk to individuals who come into contact with them and need to be segregated. To prevent the spread of disease or infections through cross contamination, soiled elements should not be cleaned with other items of clothing or laundry.

A.9.1.7 Storage in contact with hydraulic fluids, solvents, hydrocarbons, hydrocarbon vapors, or other contaminants can cause material degradation, transfer toxins to individuals, and reduce self-extinguishing properties of ensembles and ensemble elements.

A.10.1.1 Retirement criteria should be based on a number of factors, including, but not limited to, the following:

(1) Overall condition of the item
(2) Specific deterioration of materials or components beyond their economic repair
(3) Ability to adequately remove hazardous materials and other contaminants
(4) Age of structural or proximity ensemble or ensemble elements

Physical damage from use, detrimental effects from improper cleaning procedures, and fabric failure of an ensemble and ensemble elements that can make repairs impossible are other factors that can affect when an item should be retired.

Where ensembles and ensemble elements are worn, damaged, or contaminated, organizations should determine if it would be more appropriate for them to be repaired, decontaminated, or replaced. One general guideline is if the cost of the repair or decontamination is greater than 50 percent of the replacement cost of the ensemble or ensemble elements, replacement should be considered. A typical guideline that can be used involves the use of a matrix that takes into account the current age of the gear and the cost of the repair versus the replacement cost of the item. *(See A.10.1.4.)*

Experience suggests that ensembles and ensemble elements that are approaching 10 years since the date of their manufacture have a high likelihood of performance deficiencies in multiple areas that can often be detected only by destructive testing. Additionally, experience suggests that the reflective outer shell of proximity elements that are approaching 5 years since the date of their manufacture have a high likelihood of performance failures that can be detected only by destructive testing. Such performance failures could compromise fire fighter safety.

It is important to understand that the actual service life of ensembles and ensemble elements varies depending on the amount of their use and the care they receive. Factors such as the size of the department, area covered, types of exposures, and the aggressiveness of the individual fire fighter are all considerations in how long any ensemble element will last. It is possible that a protective element could be exposed to circumstances that totally destroy it the first time it is utilized. Since the purpose of fire fighters' protective elements is to protect the wearer, if the element has saved a life or prevented serious injury, even just once, it has done its job. In many cases, an ensemble or ensemble element will need to be retired sooner than 10 years (or 5 years for the proximity reflective outer shell component).

Organizations should use members who have received training in the inspection of ensembles and ensemble elements, who understand the limitations of each ensemble and ensemble element, and who recognize the signs of failure to help make decisions as to the integrity of an ensemble or ensemble element.

An additional consideration that can influence the decision to repair or replace an ensemble or ensemble element centers on the advances in technology that occur through each revision of NFPA 1971, *Standard on Protective Ensembles for Structural Fire Fighting and Proximity Fire Fighting*. These technological advances might be deemed important enough by an organization to influence its criteria for replacement of ensembles or ensemble elements.

A.10.1.2 After discussion of the concept of mandatory retirement for protective elements, the consensus of the technical committee, led by the fire service segment, is that the life of a turnout suit is generally less than 10 years. Regardless of when the element was originally produced, it is imperative that the protective elements be routinely inspected to ensure that they are clean, well maintained, and still safe. Just knowing the age of the elements cannot do that.

A.10.1.3.1 Specific to proximity elements, the consensus of the technical committee is that the life of a proximity outer shell is considerably less than that of a structural shell and that the life span is entirely dependent on the type and amount of field use to which each separate element has been exposed. Given the characteristics of the aluminized outer materials necessary to obtain the required radiant and reflective properties, this type of fabric is especially susceptible to abrasion, which can result in a loss of the protective qualities in a very short time. Regardless of when the element was originally produced, it is imperative that the protective elements be routinely inspected to ensure that they are clean, well maintained, and still safe. Just knowing the age of the elements cannot do that.

A.10.1.4 Organizations can use various methods to determine whether it is cost effective to repair or replace structural ensembles or ensemble elements and proximity ensembles or ensemble elements. One commonly used method involves the use of a matrix that compares factors such as the age of the gear, the cost of the repair, and the replacement cost or the original cost of the ensemble. Table A.10.1.4 is an example of such a matrix.

A.10.1.5 All structural fire fighting ensembles and ensemble elements and proximity fire fighting ensembles and ensemble elements are required by NFPA 1971, *Standard on Protective Ensembles for Structural Fire Fighting and Proximity Fire Fighting*, to be certified by an independent, third-party certification organization. For an ensemble or ensemble element to meet the requirements of NFPA 1971, the item should carry a statement on the product label stating compliance and the label, symbol, or other identifying mark of that certifying organization.

Third-party certification is an important means of ensuring the quality of ensembles and ensemble elements. To be certain than an item is properly certified, labeled, and listed, NFPA strongly recommends that prospective purchasers require appropriate evidence of certification for the specific product and model from the manufacturer before purchase. Prospective purchasers also should contact the certification

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Table A.10.1.4 Sample Calculator for Turnout Gear Repair Limits

Year of Service	Year-of-Service End Date	Amount of Original Cost ($1000) Allowed for Repair	Amount Allowed per Set
1st year	01/11/05	70%	$700
2nd year	01/11/04	50%	$500
3rd year	01/11/03	40%	$400
4th year	01/11/02	25%	$250
5th year	01/11/01	20%	$200
6th year	01/11/00	15%	$150
7th year	01/11/99	10%	$100
8th year	01/11/98	5%	$ 50
9th year	01/11/97	5%	$ 50
10th year	01/11/96	0%	$ 0

organizations and request copies of the certification organization's list of certified products to the appropriate NFPA standard. This listing is required for third-party certification by NFPA 1971 and is a service performed by the certification organization.

Details about certification and product labeling can be found in Chapters 4 and 5 of NFPA 1971. Also, the definitions of *certification/certified* in NFPA 1971, Section 3.3, and *labeled* and *listed* in Section 3.2 of this standard should be reviewed.

From time to time, NFPA receives complaints that certain items of structural fire fighting ensembles and ensemble elements and proximity fire fighting ensembles and ensemble elements might be carrying labels falsely identifying them as compliant with an NFPA standard. NFPA advises those purchasing structural fire fighting ensembles and ensemble elements and proximity fire fighting ensembles and ensemble elements to be aware that any structural fire fighting ensemble or ensemble element or proximity fire fighting ensemble or ensemble element that does not bear the appropriate compliance statement AND the mark of an independent, third-party certification organization is NOT COMPLIANT with NFPA 1971, even if the product label states that the ensemble or ensemble element is compliant.

When an organization is in doubt as to the authenticity of a certification claim, the certification organization or the consumer protection agency of the state/provincial government should be contacted *directly*.

A.10.1.8 Changes in the type of structural fire fighting ensembles and ensemble elements and proximity fire fighting ensembles and ensemble elements used by a fire department can result in the retirement of elements that have not yet reached the end of their service life. Items of no further use to the organization in front line service might be of use for training or donation to other organizations.

A.10.3.1 When developing these procedures, the organization should coordinate with other agencies such as the medical examiner, law enforcement, or other experts to determine what actions are appropriate. Organizations can find additional guidance related to the processing of structural ensembles and ensemble elements and proximity ensembles and ensemble elements that are directly related to serious fire fighter injuries and fire fighter fatalities in the International Association of Fire Fighters manual, "Line of Duty Notification, Assistance, and Investigation Policy," available at www.iaff.org/safe/lodd.html, and the International Association of Fire Chiefs guide for investigating a line-of-duty death, "LODD Response Plan," available at www.iafc.org.

A.11.2.1 The certification organization should have a sufficient breadth of interest and activity so that the loss or award of a specific business contract would not be a determining factor in the financial well-being of the agency.

A.11.2.5 The contractual provisions covering verification programs should contain clauses advising the organization or ISP that, if requirements change, the process should be brought into compliance with the new requirements by a stated effective date through a compliance review program involving all currently verified repairs. Without such clauses, certification organizations would not be able to move quickly to protect their names, marks, or reputations. A verification program would be deficient without these contractual provisions and the administrative means to back them up.

A.11.2.7 Investigative procedures are important elements of an effective and meaningful verification program. A preliminary review should be carried out on processes submitted to the agency before any major testing is undertaken.

A.11.2.12 Such inspections should include witnessing of repairs and review of the quality management system.

A.12.1.1 Interior portions of the liner are difficult to inspect and evaluate because the portions can be hidden from view. From the exterior, a thermal barrier may appear to be acceptable for use, but it might be unsafe due to shifting or migration of the insulating material.

A.12.2.1 It is important to realize that this field evaluation procedure can produce results that are inconsistent with more comprehensive or sophisticated testing and might detect only the worst-case failure areas. To perform more comprehensive or sophisticated testing of the moisture barrier, the garment manufacturer should be contacted for advice.

A.12.2.3.1 If there are questions about using an alcohol–tap water mixture for evaluating the protective garment, the garment manufacturer should be contacted directly for advice.

A.12.3.3.1 An evaluation apparatus meeting these requirements is specified in AATCC 127, *Water Resistance: Hydrostatic Pressure Test*. The method of pressurization can be automatic or manual.

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Annex B Informational References

B.1 Referenced Publications. The documents or portions thereof listed in this annex are referenced within the informational sections of this standard and are not part of the requirements of this document unless also listed in Chapter 2 for other reasons.

B.1.1 NFPA Publications. National Fire Protection Association, 1 Batterymarch Park, Quincy, MA 02169-7471.

NFPA 1041, *Standard for Fire Service Instructor Professional Qualifications*, 2007 edition.

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

NFPA 1521, *Standard for Fire Department Safety Officer*, 2008 edition.

NFPA 1581, *Standard on Fire Department Infection Control Program*, 2005 edition.

NFPA 1971, *Standard on Protective Ensembles for Structural Fire Fighting and Proximity Fire Fighting*, 2007 edition.

NFPA 1991, *Standard on Vapor-Protective Ensembles for Hazardous Materials Emergencies*, 2005 edition.

NFPA 1994, *Standard on Protective Ensembles for First Responders to CBRN Terrorism Incidents*, 2007 edition.

NFPA 1999, *Standard on Protective Clothing for Emergency Medical Operations*, 2003 edition.

B.1.2 Other Publications.

B.1.2.1 AATCC Publications.

AATCC 127, *Water Resistance: Hydrostatic Pressure Test*, 2003.

B.1.2.2 ANSI Publications. American National Standards Institute, Inc., 25 West 43rd Street, 4th Floor, New York, NY 10036.

ANSI/ASSE Z87.1, *Occupational and Educational Personal Eye and Face Protection Devices*, 2003.

B.1.2.3 ASTM Publications. ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959.

ASTM F 1731, *Standard Practice for Body Measurements and Sizing of Fire and Rescue Services Uniforms and Other Thermal Hazard Protective Clothing*, 1996 (2002) edition.

ASTM F 1930, *Standard Test Method for Evaluation of Flame Resistant Clothing for Protection Against Flash Fire Simulations Using an Instrumented Manikin*, 2000.

ASTM STP 1237, *Performance of Protective Clothing*, 5th Volume, 1996.

B.1.2.4 EPA Publications. U.S. Environmental Protection Agency publications provided by the U.S. Government Printing Office, Superintendent of Documents, Washington, DC 20402-9325.

EPA SW-846, *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods* (The specific methods cited can be downloaded at http://www.epa.gov/epaoswer/hazwaste/test/SW846.htm): Method 3015, "Microwave Assisted Acid Digestion of Aqueous Samples and Extracts," September 1994; Method 3540, "Soxhlet Extraction," Revision 3, December 1996; Method 6010, "Inductively Coupled Plasma-Atomic Emission Spectrometry," Revision 2, December 1996; and Method 8270, "Semivolatile Organic Compounds by Gas Chromatography/Mass Spectrometry (GC/MS)," Revision 3, December 1996.

B.1.2.5 IAFC Publications. International Association of Fire Chiefs, 4025 Fair Ridge Drive, Suite 300, Fairfax, VA 22033-2868, www.iafc.org.

"LODD Response Plan" (downloadable from IAFC website; click on Resources, Download Documents, Health & Safety, Line of Duty Deaths, Investigation).

B.1.2.6 IAFF Publications. International Association of Fire Fighters, 1750 New York Avenue, N.W., Washington, DC 20006.

"Line of Duty Notification, Assistance, and Investigation Policy," www.iaff.org/safe/lodd.html.

B.1.2.7 ISO Publications. International Organization for Standardization, 1, rue de Varembé, Case postale 56, CH-1211 Geneve 20, Switzerland.

ISO/IEC Guide 65, *General requirements for bodies operating product certification systems*, 1996 edition.

B.1.2.8 USFA Publications. U.S. Fire Administration, 16825 South Seton Avenue, Emmitsburg, MD 21727.

Research, Testing, and Analysis on the Decontamination of Fire Fighting Protective Clothing and Equipment.

B.1.2.9 U.S. Government Publications. U.S. Government Printing Office, Superintendent of Documents, Washington, DC 20402-9325, Phone: 202-512-1800 (www.gpo.gov)

Title 29, Code of Federal Regulations, Part 1910.120, "Hazardous Waste Operations and Emergency Response," August 22, 1994.

B.2 Informational References. (Reserved)

B.3 References for Extracts in Informational Sections. (Reserved)

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Sequence of Events Leading to Issuance of an NFPA Committee Document

Step 1: Call for Proposals

- Proposed new Document or new edition of an existing Document is entered into one of two yearly revision cycles, and a Call for Proposals is published.

Step 2: Report on Proposals (ROP)

- Committee meets to act on Proposals, to develop its own Proposals, and to prepare its Report.
- Committee votes by written ballot on Proposals. If two-thirds approve, Report goes forward. Lacking two-thirds approval, Report returns to Committee.
- Report on Proposals (ROP) is published for public review and comment.

Step 3: Report on Comments (ROC)

- Committee meets to act on Public Comments to develop its own Comments, and to prepare its report.
- Committee votes by written ballot on Comments. If two-thirds approve, Report goes forward. Lacking two-thirds approval, Report returns to Committee.
- Report on Comments (ROC) is published for public review.

Step 4: Technical Report Session

- "*Notices of intent to make a motion"* are filed, are reviewed, and valid motions are certified for presentation at the Technical Report Session. ("Consent Documents" that have no certified motions bypass the Technical Report Session and proceed to the Standards Council for issuance.)
- NFPA membership meets each June at the Annual Meeting Technical Report Session and acts on Technical Committee Reports (ROP and ROC) for Documents with "certified amending motions."
- Committee(s) vote on any amendments to Report approved at NFPA Annual Membership Meeting.

Step 5: Standards Council Issuance

- Notification of intent to file an appeal to the Standards Council on Association action must be filed within 20 days of the NFPA Annual Membership Meeting.
- Standards Council decides, based on all evidence, whether or not to issue Document or to take other action, including hearing any appeals.

Committee Membership Classifications

The following classifications apply to Technical Committee members and represent their principal interest in the activity of the committee.

M *Manufacturer:* A representative of a maker or marketer of a product, assembly, or system, or portion thereof, that is affected by the standard.

U *User:* A representative of an entity that is subject to the provisions of the standard or that voluntarily uses the standard.

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I *Insurance:* A representative of an insurance company, broker, agent, bureau, or inspection agency.

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(b) Section/Paragraph 3.3

2. Proposal Recommends (check one): ☐ new text ☒ revised text ☐ deleted text

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Revise definition of effective ground-fault current path to read:

3.3.78 Effective Ground-Fault Current Path. An intentionally constructed, permanent, low impedance electrically conductive path designed and intended to carry ~~underground~~ electric fault current ~~conditions~~ from the point of a ground fault on a wiring system to the electrical supply source.

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Change uses proper electrical terms.

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