

NFPA® 1855

Standard on Selection, Care, and Maintenance of Protective Ensembles for Technical Rescue Incidents

2013 Edition



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NFPA® 1855

Standard on

Selection, Care, and Maintenance of Protective Ensembles for Technical Rescue Incidents

2013 Edition

This edition of NFPA 1855, *Standard on Selection, Care, and Maintenance of Protective Ensembles for Technical Rescue Incidents*, was prepared by the Technical Committee on Special Operations Protective Clothing and Equipment and released by the Technical Correlating Committee on Fire and Emergency Services Protective Clothing and Equipment. It was issued by the Standards Council on November 27, 2012, with an effective date of December 17, 2012.

This edition of NFPA 1855 was approved as an American National Standard on December 17, 2012.

Origin and Development of NFPA 1855

In March 2009, the NFPA Standards Council approved a request of the Technical Committee on Special Operations Protective Clothing and Equipment to develop a new standard on the selection, care, and maintenance of protective ensembles for technical rescue. The new standard was intended to be a companion document to 1951, *Standard on Protective Ensembles for Technical Rescue Incidents*.

Following Standards Council approval, the Technical Committee established a task group to develop the new standard. When the task group completed its work, the Technical Committee reviewed the draft document, and both the Technical Committee and the Technical Correlating Committee on Fire and Emergency Services Protective Clothing and Equipment were balloted. In October 2010, the draft standard, the results of the Technical Committee and Technical Correlating Committee ballot, and a request to enter a Fall 2012 revision cycle were submitted to the Standards Council.

The Standards Council approved the request, and the new standard, NFPA 1855, *Standard on Selection, Care, and Maintenance of Protective Ensembles for Technical Rescue Incidents*, opened for public proposals in January 2011. Seventy-eight proposals to the standard were received by the proposal closing date of May 23, 2011. The Technical Committee met in July 2011 to review the proposals, and the Report on Proposals (ROP) was published in December 2011. During the public comment period, 47 comments were received, and the Technical Committee met in March 2012 to review those comments. The Report on Comments (ROC) was published in August 2012.

This first edition of NFPA 1855, *Standard on Selection, Care, and Maintenance of Protective Ensembles for Technical Rescue Incidents*, features chapters on the program; selection; inspection; cleaning and decontamination; repair; storage; retirement, disposition, and special incident procedure; verification; and test procedures of protective ensembles related to technical rescue incidents.

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

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

This Committee shall also have primary responsibility for documents on station/work uniform garments that are not of themselves primary protective garments but can be combined with a primary protective garment to serve dual or multiple functions.

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

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

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

Chapter 1 Administration

1.1 Scope.

1.1.1 This standard shall specify the minimum selection, care, and maintenance requirements for utility technical rescue protective, rescue and recovery technical rescue protective, and chemicals, biological agents, and radiological particulate [also known as chemical, biological, radiological, and nuclear (CBRN) technical rescue] ensembles and the individual ensemble elements, including garments, helmets, gloves, footwear, and interface components, that are compliant with NFPA 1951, *Standard on Protective Ensembles for Technical Rescue Incidents*.

1.1.2 This standard shall also specify requirements for urban search and rescue (USAR) operation protective ensembles, ensemble elements, clothing, and equipment certified as compliant with the 2001 edition of NFPA 1951, *Standard on Protective Ensembles for Technical Rescue Incidents*.

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

1.1.4 This standard shall not apply to protective ensembles or protective clothing that is compliant with NFPA 1971, *Standard on Protective Ensembles for Structural Fire Fighting and Proximity Fire Fighting*; 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*.

1.1.5 This standard shall not be construed as addressing all the safety concerns associated with the use of compliant protective ensembles or ensemble elements. The persons and or-

ganizations that use compliant protective ensembles or ensemble elements shall be responsible for establishing safety and health practices and for determining the applicability of regulatory limitations prior to use.

1.1.6 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. The persons and organizations that use this standard shall be responsible for conducting testing of protective ensembles or ensemble elements to establish safety and health practices and for determining the applicability of regulatory limitations prior to using this standard for any designing, manufacturing, and testing.

1.1.7 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 utility technical rescue, rescue and recovery technical rescue, and CBRN technical rescue 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 utility technical rescue, rescue and recovery technical rescue, and CBRN technical rescue protective ensembles and ensemble elements.

1.3 Application.

1.3.1 This standard shall apply to technical rescue protective ensembles and ensemble elements certified as compliant with NFPA 1951, *Standard on Protective Ensembles for Technical Rescue Incidents*.

1.3.2 This standard shall also apply to urban search and rescue (USAR) operations protective ensembles and ensemble elements certified as compliant with the 2001 edition of NFPA 1951, *Standard on Protective Ensembles for Technical Rescue Incidents*.

1.3.3 This standard shall not apply to other organizational programs such as appropriate use of technical rescue protective ensembles for training, operations, or infection control, because such 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 CBRN technical rescue protective ensembles.

1.3.5 The requirements of this standard shall not apply to accessories attached to any element of the technical rescue 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 70E®, *Standard for Electrical Safety in the Workplace*®, 2012 edition.

NFPA 1500, *Standard on Fire Department Occupational Safety and Health Program*, 2013 edition.

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

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

NFPA 1971, *Standard on Protective Ensembles for Structural Fire Fighting and Proximity Fire Fighting*, 2013 edition.

NFPA 1977, *Standard on Protective Clothing and Equipment for Wildland Fire Fighting*, 2011 edition.

NFPA 1981, *Standard on Open-Circuit Self-Contained Breathing Apparatus (SCBA) for Emergency Services*, 2013 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*, 2012 edition.

NFPA 1994, *Standard on Protective Ensembles for First Responders to CBRN Terrorism Incidents*, 2012 edition.

NFPA 1999, *Standard on Protective Clothing for Emergency Medical Operations*, 2013 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. 0112, *2012 TLVs and BEIs*.

2.3.2 ISO Publications. International Organization for Standardization, 1, rue de Varembe, Case postale 56, CH-1211 Geneva 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.

USFA, *Protective Clothing and Equipment Need of Emergency Responders to US & R Missions*, 1993.

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)

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.

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 are not to be considered a part of the requirements of a standard and shall be located in an appendix, annex, footnote, informational note, or other means as permitted in the *Manual of Style for NFPA Technical Committee Documents*.

3.3 General Definitions.

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

3.3.2 Advanced Cleaning. See 3.3.20.1.

3.3.3 Biological Terrorism Agents. Liquid or particulate agents that 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 *ACGIH 2007 TLVs and BEIs*.

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



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.

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 Technical Rescue Protective Ensemble. Multiple elements of compliant protective clothing and protective equipment designed and configured as an ensemble to provide limited protection in operational settings where exposure to physical, thermal, liquid, and body fluid-borne pathogen hazards and to CBRN agents in vapor, liquid-splash, and particulate forms are expected.

3.3.10 CBRN Technical Rescue Protective Ensemble Elements. The parts that comprise the CBRN technical rescue protective ensemble, that include coats, trousers, coveralls, helmets, hoods, gloves, footwear, respirator, and interface components.

3.3.11 CBRN Technical Rescue Protective Footwear Element. The element of the certified CBRN technical rescue protective ensemble element that provides protection to the foot, ankle, and leg.

3.3.12 CBRN Technical Rescue Protective Garment Element. The coat, trouser, or coverall of the certified CBRN technical rescue protective ensemble that provides protection to the upper and lower torso, arms, and legs.

3.3.13 CBRN Technical Rescue Protective Glove Element. The element of the certified CBRN technical rescue protective ensemble that provides protection to the hand and wrist.

3.3.14 CBRN Technical Rescue Protective Helmet Element. The element of the certified CBRN technical rescue protective ensemble that provides protection to the head.

3.3.15 CBRN Technical Rescue Protective Hood Element. An interface element of the certified CBRN technical rescue protective ensemble that provides protection to the coat/helmet/respirator facepiece area.

3.3.16* CBRN Terrorism Agents. Chemicals, biological agents, and radiological particulates that could be released as the result of a terrorist attack. (*See also 3.3.3, Biological Terrorism Agents; 3.3.19, Chemical Terrorism Agents; 3.3.87, Radiological Particulate Terrorism Agents; and 3.3.119, Toxic Industrial Chemicals.*)

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

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

3.3.19 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.

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

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

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

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

3.3.21 Coat. See 3.3.12, CBRN Technical Rescue Protective Garment Element; 3.3.92, Rescue and Recovery Technical Rescue Protective Garment Element; and 3.3.126, Utility Technical Rescue Protective Garment Element.

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

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

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

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

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

3.3.27 Confined Space Entry. An activity of rescue that takes place in a space that is large enough and so configured that a person can bodily enter and perform assigned work, that has limited restricted means for entry or exit (e.g., tanks, vessels, silos, storage bins, hoppers, vaults, and pits), and that is not designed for continuous occupancy.

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

3.3.29 Coverall. See 3.3.12, CBRN Technical Rescue Protective Garment Element; 3.3.92, Rescue and Recovery Technical Rescue Protective Garment Element; and 3.3.126, Utility Technical Rescue Protective Garment Element.

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

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

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

3.3.33 Crown Straps. See 3.3.104.2.

3.3.34 Decontamination. The act of removing contaminants from protective clothing and equipment by a physical, chemical, or combined process.

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

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

3.3.37 Elements. See 3.3.42, Ensemble Elements.

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

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

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

3.3.41 Ensemble. See 3.3.9, CBRN Technical Rescue Protective Ensemble, 3.3.89, Rescue and Recovery Technical Rescue Protective Ensemble, and 3.3.123, Utility Technical Rescue Protective Ensemble.

3.3.42* Ensemble Elements. The certified (individually) products that provide protection to the upper and lower torso, arms, legs, head, hands, and feet.

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

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

3.3.45 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 3.3.64, Inherent Flame Resistance.*)

3.3.46 Flammable or Explosive Atmospheres. Atmospheres containing solids, liquids, vapors, or gases at concentrations that will burn or explode if ignited.

3.3.47 Flash Fire. A fire that rapidly spreads through a diffuse fuel, such as a dust, gas, or the vapors of an ignitable liquid, without the production of damaging pressure.

3.3.48 Footwear. See 3.3.11, CBRN Technical Rescue Protective Footwear Element, 3.3.91, Rescue and Recovery Technical Rescue Protective Footwear Element, and 3.3.125, Utility Technical Rescue Protective Footwear Element.

3.3.49 Footwear Upper. The portion of the protective footwear element above the sole, heel, and insole.

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

3.3.51 Garment. See 3.3.12, CBRN Technical Rescue Protective Garment Element; 3.3.92, Rescue and Recovery Technical Rescue Protective Garment Element; and 3.3.126, Utility Technical Rescue Protective Garment Element.

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

3.3.53 Glove. See 3.3.13, CBRN Technical Rescue Protective Glove Element; 3.3.111, Technical Rescue Protective Gloves; and 3.3.127, Utility Technical Rescue Protective Glove Element.

3.3.54 Glove Barrier. The innermost component of the glove body composite that comes in contact with the wearer's skin.

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

3.3.56 Glove Wristlet. See 3.3.134, Wristlet.

3.3.57* Goggles. The component that provides limited protection to the wearer's eyes.

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

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

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

3.3.61 Helmet. See 3.3.14, CBRN Technical Rescue Protective Helmet Element; 3.3.94, Rescue and Recovery Technical Rescue Protective Helmet Element; and 3.3.129, Utility Technical Rescue Protective Helmet Element.

3.3.62 Hood. See 3.3.15, CBRN Technical Rescue Protective Hood Element.

3.3.63 Independent Service Provider (ISP). See 3.3.130, Verified Independent Service Provider (ISP).

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

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

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

3.3.67* Item. The individual compliant products consisting of protective clothing, protective equipment, auxiliary equipment, and supplementary equipment or tools.

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

3.3.69 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.

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

3.3.71 Operations.

3.3.71.1 Search Operations. Any land-based operations involving the search for victims or body recovery.

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

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

3.3.72.1 Manufacturer Trained Organization. A nonverified organization trained by an element manufacturer of the same element type to conduct any one or a combination of advanced cleaning, advanced inspection, and basic repair of the organization's elements.



3.3.72.2 Verified Organization. An organization verified by a third party certification organization to conduct any one or a combination of advanced cleaning, advanced inspection, basic repair, and advanced repair of any organization's elements.

3.3.73 Outer Glove. A secondary glove worn over the glove ensemble element for the purpose of providing CBRN protection.

3.3.74 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.

3.3.75 Protective Clothing. See 3.3.9, CBRN Technical Rescue Protective Ensemble; 3.3.89, Rescue and Recovery Technical Rescue Protective Ensemble; and 3.3.123, Utility Technical Rescue Protective Ensemble.

3.3.76 Protective Coat. See 3.3.10, CBRN Technical Rescue Protective Ensemble Elements; 3.3.90, Rescue and Recovery Technical Rescue Protective Ensemble Elements; and 3.3.124, Utility Technical Rescue Protective Ensemble Elements.

3.3.77 Protective Coverall. See 3.3.10, CBRN Technical Rescue Protective Ensemble Elements; 3.3.90, Rescue and Recovery Technical Rescue Protective Ensemble Elements; and 3.3.124, Utility Technical Rescue Protective Ensemble Elements.

3.3.78 Protective Ensemble. See 3.3.9, CBRN Technical Rescue Protective Ensemble; 3.3.89, Rescue and Recovery Technical Rescue Protective Ensemble; and 3.3.123, Utility Technical Rescue Protective Ensemble.

3.3.79 Protective Footwear. See 3.3.11, CBRN Technical Rescue Protective Footwear Element; 3.3.91, Rescue and Recovery Technical Rescue Protective Footwear Element; and 3.3.125, Utility Technical Rescue Protective Footwear Element.

3.3.80 Protective Garment. See 3.3.12, CBRN Technical Rescue Protective Garment Element; 3.3.92, Rescue and Recovery Technical Rescue Protective Garment Element; and 3.3.126, Utility Technical Rescue Protective Garment Element.

3.3.81 Protective Glove. See 3.3.13, CBRN Technical Rescue Protective Glove Element; 3.3.111, Technical Rescue Protective Gloves; and 3.3.127, Utility Technical Rescue Protective Glove Element.

3.3.82 Protective Goggle. See 3.3.93, Rescue and Recovery Technical Rescue Protective Goggle Element, and 3.3.128, Utility Technical Rescue Protective Goggle Element.

3.3.83 Protective Helmet. See 3.3.14, CBRN Technical Rescue Protective Helmet Element; 3.3.94, Rescue and Recovery Technical Rescue Protective Helmet Element; and 3.3.9, Utility Technical Rescue Protective Helmet Element.

3.3.84 Protective Hood. See 3.3.15, CBRN Technical Rescue Protective Hood Element.

3.3.85 Protective Trouser. See 3.3.12, CBRN Technical Rescue Protective Garment Element; 3.3.92, Rescue and Recovery Technical Rescue Protective Garment Element; and 3.3.126, Utility Technical Rescue Protective Garment Element.

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

3.3.87* 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.

3.3.88 Recovery. An operation involving the retrieval of either the remains of a deceased victim or property, but in no case a living person.

3.3.89 Rescue and Recovery Technical Rescue Protective Ensemble. Multiple elements of compliant protective clothing and protective equipment designed and configured as an ensemble to provide limited protection in operational settings where exposure to physical, thermal, liquid, and body fluid-borne pathogen hazards is expected.

3.3.90 Rescue and Recovery Technical Rescue Protective Ensemble Elements. The parts that comprise the rescue and recovery technical rescue protective ensemble, that include coats, trousers, coveralls, helmets, gloves, footwear, and interface components.

3.3.91 Rescue and Recovery Technical Rescue Protective Footwear Element. The element of the certified rescue and recovery technical rescue protective ensemble that provides protection to the foot, ankle, and lower leg.

3.3.92 Rescue and Recovery Technical Rescue Protective Garment Element. The coat, trouser, or coverall element of the certified rescue and recovery technical rescue protective ensemble that provides protection to the upper and lower torso, arms, and legs.

3.3.93 Rescue and Recovery Technical Rescue Protective Goggle Element. The element of the certified rescue and recovery technical rescue protective ensemble that provides partial protection to the face and eyes.

3.3.94 Rescue and Recovery Technical Rescue Protective Helmet Element. The element of the certified rescue and recovery technical rescue protective ensemble that provides protection to the head.

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

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

3.3.96.1 Major A Seam. Outermost layer seam assemblies where rupture could reduce the protection of the garment by exposing the garment's inner layers, and/or the wearer's station/work uniform, other clothing, or skin.

3.3.96.2 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.

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

3.3.97 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.

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

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

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

3.3.101 Site Stabilization. Those activities directed at mitigating the dangerous elements of an emergency situation.

3.3.102 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.

3.3.103 Specialized Cleaning. See 3.3.20.3.

3.3.104 Strap.

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

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

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

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

3.3.107 Technical Rescue Incidents. Complex rescue incidents requiring specially trained personnel and special equipment to complete the mission.

3.3.108 Technical Rescue Protective Ensembles. See 3.3.9, CBRN Technical Rescue Protective Ensemble; 3.3.89, Rescue and Recovery Technical Rescue Protective Ensemble; and 3.3.123, Utility Technical Rescue Protective Ensemble.

3.3.109 Technical Rescue Protective Footwear. See 3.3.11, CBRN Technical Rescue Protective Footwear Elements; 3.3.91, Rescue and Recovery Technical Rescue Protective Footwear Element; and 3.3.125, Utility Technical Rescue Protective Footwear Element.

3.3.110 Technical Rescue Protective Garments. See 3.3.12, CBRN Technical Rescue Protective Garment Element; 3.3.92, Rescue and Recovery Technical Rescue Protective Garment Element; and 3.3.126, Utility Technical Rescue Protective Garment Element.

3.3.111 Technical Rescue Protective Gloves. See 3.3.13, CBRN Technical Rescue Protective Glove Element; and 3.3.127, Utility Technical Rescue Protective Glove Element.

3.3.112 Technical Rescue Protective Goggles. See 3.3.93, Rescue and Recovery Technical Rescue Protective Goggle Element, and 3.3.128, Utility Technical Rescue Protective Goggle Element.

3.3.113 Technical Rescue Protective Helmets. See 3.3.14, CBRN Technical Rescue Protective Helmet Element; 3.3.94, Rescue and Recovery Technical Rescue Protective Helmet Element; and 3.3.129, Utility Technical Rescue Protective Helmet Element.

3.3.114 Technical Rescue Protective Hood. See 3.3.15, CBRN Technical Rescue Protective Hood Element.

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

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

3.3.117 Toecap. A reinforcement to the toe area of footwear designed to protect the toes from impact and compression.

3.3.118 Torso.

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

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

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

3.3.120 Trouser. See 3.3.12, CBRN Technical Rescue Protective Garment Element; 3.3.92, Rescue and Recovery Technical Rescue Protective Garment Element; and 3.3.126, Utility Technical Rescue Protective Garment Element.

3.3.121* 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.

3.3.122 Utility Sink. A separate sink used for cleaning ensembles, and ensemble elements and items.

3.3.123 Utility Technical Rescue Protective Ensemble. Multiple elements of protective clothing and protective equipment designed and configured as an ensemble to provide limited protection in operational settings where exposure to physical and thermal hazards are expected.

3.3.124 Utility Technical Rescue Protective Ensemble Elements. The parts that comprise the utility technical rescue protective ensemble, that include coats, trousers, coveralls, helmets, gloves, footwear, and interface components.

3.3.125 Utility Technical Rescue Protective Footwear Element. An element of the utility technical rescue protective ensemble that provides protection to the foot, ankle, and lower leg that is certified to the utility protection requirements.

3.3.126 Utility Technical Rescue Protective Garment Element. The coat, trouser, or coverall of the certified utility technical rescue protective ensemble that provides protection to the upper and lower torso, arms, and legs.

3.3.127 Utility Technical Rescue Protective Glove Element. The element of the certified utility technical rescue protective ensemble that provides protection to the hand.

3.3.128 Utility Technical Rescue Protective Goggle Element. The element of the certified utility technical rescue protective ensemble that provides partial protection to the face and eyes.

3.3.129 Utility Technical Rescue Protective Helmet Element. The element of the certified utility technical rescue protective ensemble that provides protection to the head.

3.3.130 Verified Independent Service Provider (ISP). An independent service provider verified by a third party certification organization to conduct any one or a combination of advanced inspection, advanced cleaning, basic repair, or advanced repair service.



3.3.131 Verified/Verification. A system whereby a certification organization determines that an ISP or an organization has demonstrated the ability to conduct repairs that complies with the requirements of this standard, authorizes the ISP or organization to use a verification mark that complies with the requirements of this standard, and establishes a follow-up program conducted by the certification organization as a check on the methods of repair used to determine continued compliance with the requirements of this standard.

3.3.132* Visibility Markings. Retroreflective and fluorescent conspicuity enhancements.

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

3.3.134 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 utility technical rescue, rescue and recovery technical rescue, and CBRN technical rescue 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 technical rescue protective 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 technical rescue 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 technical rescue protective ensembles and ensemble elements shall be in accordance with Section 4.2.

4.2 Program Organization for Technical Rescue Protective 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.

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.

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.

Table 4.2.2 Required Program Parts for Technical Rescue Protective Ensembles and Elements

Program Part	Chapter/Section
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

4.2.3.1* 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* The organization shall use one of the following to perform advanced cleaning, advanced inspection, and repair services of ensembles and ensemble elements (*see Table 4.2.4*):

- (1) Manufacturer trained organization for their own organization's elements only
- (2) Verified organization
- (3) Verified ISP

4.2.4.1 Verified organizations and verified ISPs shall meet the requirements of Chapter 11, Verification, and shall be verified by a third party certification organization.

4.2.4.2 Where the organization is a verified organization or uses a verified ISP, approval from the element manufacturer shall not be required.

4.2.4.3* Verified organizations and verified ISPs shall receive written verification from the third party certification organization to conduct garment element advanced cleaning, advanced inspection or advanced cleaning, advanced inspection and advanced repair services.

4.2.4.4 The written verification shall indicate that the verified organization or the verified ISP has demonstrated a thorough knowledge of this standard as well as the design and performance requirements of NFPA 1951, *Standard on Protective Ensembles for Technical Rescue Incidents*

Table 4.2.4 Responsibilities for Garment Element Inspection, Cleaning, and Repair

Responsibilities	MFG	V ISP	V ORG	MT ORG	USER
Routine inspection (6.2)					X
Advanced inspection (6.3)	X	X	X	X	
Complete barrier inspection (6.4)	X	X	X	X	
Routine cleaning (7.2)					X
Advanced cleaning and decontamination (7.3)	X	X	X	X	
Basic repair (8.3)	X	X	X	X	
Advanced repair (8.4)	X	X	X		
Training	X	X			

MFG: Element manufacturer. V ISP: Verified ISP. V ORG: Verified organization. MT ORG: Manufacturer trained organization. USER: End user.

4.2.4.5 All garment advanced repairs shall be conducted by the garment manufacturer, a verified organization, or verified ISP.

4.2.4.6 Manufacturer trained organizations performing advanced cleaning and advanced inspection shall be trained by an element manufacturer of the same element type or by a verified ISP. The element manufacturer or verified ISP shall provide documentation that the organization has received the necessary training.

4.2.5* The organization shall develop specific criteria for removal of protective clothing and equipment from service, in accordance with Chapter 10. 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 manufacturer's instructions, and the experience of the organization.

4.3 Records.

4.3.1* The organization shall compile and maintain records on its technical rescue protective ensembles and ensemble elements.

4.3.2* The records specified in 4.3.1 shall apply to technical rescue protective ensembles and ensemble elements that are utilized by the organization, 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 CBRN technical rescue protective en-

sembles. The records shall include a list of specific required elements and interface components necessary for CBRN technical rescue protective ensembles.

4.4 Manufacturer's Instructions.

4.4.1 When issuing new technical rescue 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). Manufacturers shall not be permitted to override the requirements of this standard for third party verification.

4.4.3 The organization shall retain and make accessible to organization 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 technical rescue 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 organization 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 General.

5.1.1* The organization shall ensure that elements under consideration are certified as being compliant with NFPA 1951, *Standard on Protective Ensembles for Technical Rescue Incidents*, by a third party certification organization.

5.1.2* 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.

5.1.3* 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.

5.1.4 Where a utility ensemble is identified, all elements shall be compliant with appropriate utility standards at a minimum.

5.1.5 Where a rescue/recovery ensemble is identified, all elements shall be compliant with appropriate rescue/recovery standards at a minimum.

5.1.6 At a minimum, the organization shall ensure the proper overlap between ensemble elements being used, including, but not limited to, coat to hood and helmet, coat to pant, coat to glove, and pants to footwear. Any other specialty equipment being used shall also be considered to ensure the equipment does not interfere with the proper function and interface of the protective ensemble or ensemble elements.

5.2 Risk Assessments.

5.2.1* Prior to starting the selection process of technical rescue protective ensembles and ensemble elements, the organization shall perform a risk assessment.

5.2.2 The risk assessment shall include, but not be limited to, the hazards that can be encountered by technical rescue personnel based on the following items and as detailed in Table 5.2.2, which represents potential hazards identified in the USFA report, *Protective Clothing and Equipment Need of Emergency Responders to US&R Missions*:

- (1) Type of duties performed
- (2) Frequency of use of ensemble elements
- (3) Organization's experiences
- (4) Incident operations
- (5) Geographic location and climate
- (6)*Likelihood of or response to CBRN terrorism incident

5.2.3* The organization shall review the current edition of NFPA 1951, *Standard on Protective Ensembles for Technical Rescue Incidents*; 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 1670, *Standard*

on Operations and Training for Technical Search and Rescue Incidents; and any applicable federal or state OSHA standards relating to technical rescue protective ensembles and ensemble elements to determine how they affect the selection process.

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

5.2.5 Utility technical rescue ensembles shall be selected where there is no expectation of encountering liquid, body fluid, blood-borne pathogens, or CBRN hazard.

5.2.6 Rescue/recovery ensembles shall be selected where there is an expectation of liquid, body fluid, or bloodborne pathogen hazard but not CBRN hazard.

5.2.7 As part of the risk assessment, the organization shall determine which type of technical rescue protection is needed: utility technical rescue protective ensembles and ensemble elements, rescue and recovery technical rescue protective ensembles and ensemble elements, or CBRN technical rescue protective ensembles. The organization shall also determine in the risk assessment if consideration is required for NFPA 1999, *Standard on Protective Clothing for Emergency Medical Operations*, is also needed.

5.3 Purchase.

5.3.1* 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 1951, *Standard on Protective Ensembles for Technical Rescue Incidents*. Purchasers shall consider that certified CBRN technical rescue protective ensembles shall 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 1951, such criteria shall be stipulated in the purchase specifications.
- (3)*Purchase specifications shall require that manufacturer's 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.

5.3.2 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.

5.3.3 Organizations shall verify the quantity and sizes of the protective ensemble element(s) received.

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

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

Table 5.2.2 Risk Assessment

Hazards	Utility	Rescue/Recovery	CBRN
Falling objects	Helmet	Helmet	Helmet
Shrapnel from small tool usage	X	X	X
Projectiles or ballistic objects	—	—	—
Abrasive or rough surfaces	X	X	X
Sharp edges	X	X	X
Pointed objects	X	X	X
Slippery surfaces	Boots	Boots	Boots
Excessive vibration	—	—	—
High heat and humidity (heat stress)	Garment/best	Garment/better	Garment/good
Ambient cold	—	—	—
Wetness from tool work	—	X	X
Rain (inclement weather)	—	X	X
High wind	—	X	X
Insufficient or bright light	—	—	—
Excessive noise	—	—	—
Chemical inhalation	—	—	See NFPA 1981
Chemical skin absorption	—	Selected liquids	Selected vapors
Chemical ingestion or injection	—	—	X
Liquefied gas contact	—	—	—
Chemical flash fire	Good	Better	Good
Chemical explosions	—	—	—
High voltage	Boots	Boots	Boots
Electrical arc flash	X (see NFPA 70E)	X (see NFPA 70E)	X (see NFPA 70E)
Static charge buildup	Boots	Boots	Boots
Ionization radiation			
Alpha	X	X	X
Beta	Attenuates	Attenuates	Attenuates
Gamma	—	—	—
X-ray	—	—	—
Radiological particulates	—	—	X
Daytime visibility	X	X	X
Nighttime visibility	X	X	X
High convective heat	Garment/low	Garment/low	Garment/low
Low radiant heat	Garment/low	Garment/low	Garment/low
High radiant heat	—	—	—
Flame impingement	X	X	X
High pressure steam	—	—	—
Hot liquids	—	Selected	Selected
Molten metals	—	—	—
Hot solids	—	—	—
Hot surfaces	—	—	—
Bloodborne pathogens	—	X	X
Airborne pathogens	—	—	X (see NFPA 1981)
Biological particles (toxins and allergens)	—	—	X (see NFPA 1981)
Falling	—	—	—
Drowning	—	—	—
Material incompatibility	—	—	—
Ease of contamination	X	—	—
Thermal comfort	Garment/best	Garment/better	Garment/good
Range of motion	—	—	—
Hand function	Gloves	Gloves	Gloves
Ankle support	Boots	Boots	Boots
Back support	—	—	—
Vision protection	Goggles	Goggles	See NFPA 1981
Communications ease	—	—	—
Fit (poor)	X	X	X
Ease of donning and doffing	Gloves	Gloves	Gloves

Note: An “X” indicates that the ensemble element provides a level of protection from that hazard. An element name indicates that only that element provides a level of protection from that hazard. The terms “good, better, and best” indicate the level of performance in providing protection from that hazard. A “—” indicates the ensemble does not provide protection from that hazard based on the requirements in NFPA 1951, *Standard on Protective Ensembles for Technical Rescue Incidents*.



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

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

6.1.4.3 At 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 upon issue and after each use.

6.2.2* The routine inspection shall include, at 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 components (e.g., visibility markings)
- (5) Loss of seam integrity and broken or missing stitches
- (6) Damaged, detached, or missing visibility markings, when present

6.2.2.2 Helmet elements shall be inspected for the following:

- (1) Soiling
- (2) Contamination
- (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 any fabric components on the helmet 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 visibility markings, when present

6.2.2.3 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 barrier
- (4) Shrinkage
- (5) Loss of elasticity or flexibility
- (6) Loss of seam integrity and broken or missing stitches

6.2.2.4 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 protective toe, protective midsole, or shank
- (4) Closure system component damage and functionality
- (5) Loss of seam integrity and broken or missing stitches

6.2.2.5* Goggle elements shall be inspected for the following:

- (1) Damaged or missing components including discoloration, crazing, and scratches to the lens, limiting visibility
- (2) Physical damage to band or loss of elasticity

6.2.2.6 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

6.2.2.7 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

6.3 Advanced Inspection.

6.3.1 Advanced inspection and any necessary testing shall be performed by the element manufacturer, a manufacturer trained organization, a verified organization, or a verified ISP.

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, managing, or coordinating advanced inspections or the advanced inspection process.

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.

6.3.2.1.1 If the organization is a verified organization, they shall be permitted to determine the level of training necessary to perform the advanced inspection, without any further written verification.

6.3.3 Advanced inspections of all protective ensemble elements that are issued 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.

6.3.5* The advanced inspection shall include, at a minimum, the inspections specified in 6.3.5.1 through 6.3.5.7.

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 and sides of each layer, 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)*Physical damage to the barrier layer and each side of the barrier layer for loss of barrier performance properties as indicated by any of the following:
 - (a) Rips, tears, cuts, or abrasions
 - (b) Discoloration
 - (c) Thermal damage
 - (d) Loose or missing barrier material seam tape
 - (e) Delamination as evidenced by separation of the film from substrate fabric, flaking or powdering
 - (f) Contamination
 - (g) Age
- (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.
- (8) Loss of wristlet elasticity, stretching, runs, cuts, or burn holes
- (9)*Visibility marking integrity, attachment to garment, reflectivity, or damage
- (10)*Label integrity and legibility
- (11) Hook and loop functionality
- (12) Barrier attachment systems
- (13) Closure system functionality
- (14) Accessories for compliance with 4.2.3
- (15) Correct assembly and size compatibility of shell and barrier
- (16) Label integrity and legibility

6.3.5.2 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) Damaged or missing components of the suspension and retention systems
- (5) Functionality of suspension and retention systems
- (6) Damage to the impact cap
- (7) Damaged or missing visibility markings
- (8) Accessories for compliance with 4.2.3

6.3.5.3 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 barrier
 - (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

6.3.5.4 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 as determined by Section 12.2
- (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
- (10) Label integrity and legibility

6.3.5.5 Goggle elements shall be inspected for the following:

- (1) Soiling
- (2) Contamination
- (3) Thermal damage
- (4) Damaged or missing components of the goggle, including discoloration or scratches
- (5) Functionality of element components
- (6) Label integrity and legibility

6.3.5.6 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
- (8) Label integrity and legibility



6.3.5.7 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, 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

6.3.6 Additional Advanced Inspection Criteria for CBRN Technical Rescue Protective Ensembles.

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

6.3.6.2 Complete barrier 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 might exist.

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

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

6.4 Complete Barrier Inspection.

6.4.1 Complete barrier inspection of all rescue and recovery technical rescue garments and CBRN technical rescue garment elements shall be performed by the garment manufacturer, a manufacturer trained organization, a verified organization, or a verified ISP.

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

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 barrier inspections. The garment element manufacturer or verified ISP shall provide written verification of training.

6.4.2.1.1 If the organization is a verified organization, they shall be permitted to determine the level of training necessary to perform the complete liner inspection, without any further written verification.

6.4.2.2 The element manufacturer or verified ISP shall provide written verification of training.

6.4.3 Complete barrier inspection of all garment elements shall be conducted whenever advanced inspections indicate that a problem might exist. The barrier system shall be opened to expose all layers.

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

6.4.5 The complete barrier inspection shall include, at a minimum, the inspection specified in 6.4.5.1 and 6.4.5.2.

6.4.5.1 The barrier material shall be tested using the hydrostatic test to evaluate the water penetration barrier, as specified in Section 12.1, and shall show no leakage.

6.4.5.2 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.

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.

7.1.7 Universal precautions shall be observed at all times by members handling elements known or suspected to be contaminated with body fluids.

7.1.8 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.

7.1.9* 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.

7.1.10* When a verified ISP is used for cleaning or decontamination, the verified 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.

7.2.3 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.

7.2.4 Routine Cleaning Process.

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

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

7.2.4.3 Any dry debris shall be brushed off.

7.2.4.4 Other debris shall be gently rinsed off with water.

7.2.4.5 Heavy scrubbing or spraying with high-velocity water jets such as a power washer shall not be used.

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

7.2.4.7 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 pretreated. 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 material safety data sheet (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 not be machine dried using equipment that produces mechanical action from tumbling or agitation.
- (9) Following the routine cleaning procedure, the utility sink shall be rinsed.

7.2.5 Additional Requirements for Routine Cleaning of Garment.

7.2.5.1 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.

7.2.5.2 If garment requires more than spot cleaning, entire garment shall be cleaned using advanced cleaning procedures.

7.3 Advanced Cleaning and Decontamination.

7.3.1 Advanced cleaning shall be performed by the element manufacturer, a manufacturer trained organization, a verified organization, or a verified ISP.

7.3.1.1 The member(s) of the organization who has received training in the advanced cleaning of the ensembles or ensemble elements shall be responsible for performing, managing, or coordinating advanced cleaning or the advanced cleaning process.

7.3.1.2 The ensemble or ensemble element manufacturer or verified ISP and the organization shall determine the level of training required to perform advanced cleaning. The ensemble or ensemble element manufacturer or verified ISP 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.

7.3.4.1 If the organization is a verified organization, they shall be permitted to determine the level of training necessary to perform advanced cleaning without any further written verification.

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.

7.3.6 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.

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

7.3.8* 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) All garments and separable barriers shall be placed into a mesh laundry bag for machine cleaning.
- (5)*Water temperature shall not exceed 40°C (105°F).
- (6) 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.
- (7) All tools and accessories shall be removed and not machine washed.
- (8)*Washing machines with the capability of drum RPM adjustment shall be adjusted so the g-force does not exceed 100 g for all elements.



- (9)*Machine manufacturer's instructions shall be followed for proper setting or program selection for the specific element being washed.
- (10) The element shall be inspected and rewashed if necessary.
- (11) All tools and accessories shall be removed and not machine dried.
- (12)*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).
- (13) Cleaning and soaking agents shall not leave any residue or cause any degrading of the ensemble or ensemble elements.

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

7.3.10 Additional Requirements for Advanced Cleaning of Garment Elements.

7.3.10.1* Where the shells and barriers 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.

7.3.10.2 Separable barrier systems shall be turned inside out so the barrier material, where present, is on the inside for both machine washing and machine drying.

7.3.11 Additional Requirements for Advanced Cleaning of Helmet Elements.

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

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

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

7.3.13* 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.

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

7.3.15 Additional Requirements for Advanced Cleaning of CBRN Technical Rescue Protective Ensembles. 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.

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.

7.4.2 In the absence of manufacturer's instructions or manufacturer's approval of alternative procedures, the drying procedures provided in this section shall be used.

7.4.3* 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.

7.4.4* 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, a verified ISP who has received training, or a member of the organization who has received training. Training shall be provided by an element manufacturer or by a verified ISP in the repair of ensembles or ensemble elements.

8.1.1.1 Requirements for garment element repair shall be specified in Sections 8.2 through 8.4.

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.

8.1.3.1 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 1951, *Standard on Protective Ensembles for Technical Rescue Incidents*.

8.1.5 Due to the different methods of construction, the ensemble or ensemble element manufacturer shall be contacted if the organization or verified 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 or recommendation.

8.2 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 cm² (5 in.²) patch of the same material that is compliant with NFPA 1951, *Standard on Protective Ensembles for Technical Rescue Incidents*.

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 1951, *Standard on Protective Ensembles for Technical Rescue Incidents*, 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 or recommendation.

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 Visibility marking patches that do not exceed 75 mm (3 in.) in length shall be permitted.

8.2.6.2.1 The visibility marking patch shall extend 25 mm (1 in.) beyond the damaged area.

8.2.6.2.2 A maximum of two visibility marking patches per stripe shall be permitted.

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

8.2.6.4 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.

8.3.1 The repairs specified in this section shall be performed by the element manufacturer, the organization, manufacturer trained organizations, verified organizations, or verified ISPs.

8.3.2 Basic repairs shall be limited to the following:

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

8.3.3 Repairs to nonbarrier garment barrier materials shall be permitted, provided such repairs do not result in stitching through the barrier materials.

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 Repairs to the garment outer shell shall be performed consistent with the garment element manufacturer's methods. The garment element manufacturer shall be contacted if the organization is unsure of the complexity of the repair.

8.4.3* All repairs to the garment barrier materials shall be performed consistent with the barrier manufacturer's methods. The original garment element manufacturer shall be contacted if the organization is unsure as to whether an area to be repaired contains a barrier material.

8.4.4 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) or barrier materials, only the garment element manufacturer or the garment element manufacturer's designated verified ISP shall replace entire garment component layers.

8.4.5 Restitching of more than 25 mm (1 in.) continuous of a Major A seam and Major B seam shall require consulting the garment element manufacturer and shall be conducted in a manner consistent with the garment element manufacturer's methods.

8.4.6 Repairs to Major B seams in the moisture barrier shall require consulting the garment element manufacturer and shall be conducted in a manner consistent with the garment element manufacturer's methods.

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

8.4.8 If replacing visibility markings necessitates sewing into a Major A seam, visibility markings replacement shall be done only by the garment element manufacturer or by a verified ISP unless the organization is also a verified ISP and conducted in a manner consistent with the garment element manufacturer's methods.

8.4.9* 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.

8.4.10* 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.

8.4.11* 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 In addition to the requirements in Section 8.1, 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 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.

8.6 Glove Element Repair. In addition to the requirements in Section 8.1, all repairs to glove components shall be performed in accordance with the glove element manufacturer's instructions. The glove manufacturer shall be contacted to determine feasibility of the repair.

8.7 Footwear Element Repair.

8.7.1 In addition to the requirements in Section 8.1, 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 lace-in zipper assemblies, the footwear manufacturer shall be contacted to determine feasibility of the repair.

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

8.8 Goggle Element Repair. Goggle lens components that become cracked or badly scratched shall be replaced.

8.9 Hood Interface Component Repair. In addition to the requirements in Section 8.1, all repairs to hoods shall be performed in accordance with the element manufacturer's instructions.

8.10 Additional Requirements for CBRN Technical Rescue Protective Ensembles. All repairs to CBRN technical rescue protective ensembles 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.

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

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

9.1.4 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.

9.1.5* 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 en-

semble element(s) shall be placed in a protective case or bag to prevent cross contamination.

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

9.1.7 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 technical rescue protective 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* Technical rescue protective ensembles and ensemble elements shall be retired in accordance with 10.2.1, no later than the number of years after date of manufacture indicated in Table 10.1.2.

Table 10.1.2 Mandatory Retirement

Type	Number of Years After Date of Manufacture			
	Garment	Gloves	Helmet	Boots
Utility	15	5	15	15
Rescue/Recovery	10	10	15	15
CBRN	10	10	15	15

10.1.3* Technical rescue protective 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.

10.1.4* Technical rescue protective 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.

10.1.5 Technical rescue protective 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.

10.1.6 Technical rescue protective 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.

10.1.7* Technical rescue protective 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 technical rescue protective ensembles and ensemble elements shall be destroyed or disposed of in a manner ensuring that they will not be used in any emergency activities.

10.2.2 Retired technical rescue protective ensembles and ensemble elements as determined in 10.1.7 shall be permitted to be used as follows:

- (1) For training, provided the ensembles and ensemble elements are appropriately marked as being for nonemergency 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 technical rescue protective ensembles and ensemble elements that were worn by emergency response personnel who were victims at incidents where serious injuries or fatalities to the emergency responders 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 technical rescue protective ensembles and ensemble elements utilized by the injured or deceased emergency responder.
- (2) Custody of such ensembles and ensemble elements shall be maintained at a secure location with controlled, documented access.
- (3) All such technical rescue protective 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.
- (4) Examination of the technical rescue protective 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 technical rescue protective 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 include advanced inspection, advanced cleaning, and advanced repairs of garment elements only. Verification of the organization or ISP shall not apply to helmet elements, glove elements, footwear elements, hood elements, or optional CBRN ensembles.

11.1.1.2 An organization or ISP shall be permitted to be verified for advanced cleaning and advanced inspection only.

11.1.1.3 Where an organization or ISP is verified for conducting repairs, the organization or ISP shall also be verified for advanced cleaning and advanced inspection.

11.1.1.4 The verified organization or ISPs shall be listed. The listing shall contain advanced cleaning; advanced inspection; and/or the repair categories that the organization or the ISP is verified to conduct. Repair categories shall be garment outer shell repairs and garment barrier material repairs.

11.1.1.5 Where the certification listing includes the barrier material repair category, the listing shall include the barrier material manufacturer and trade name designation.

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

11.1.3.1 No provider of the services covered by this standard shall claim to be an ISP, a verified ISP, or a verified organization unless they comply with all of the requirements in this standard and are third party verified in accordance with the requirements of this chapter.

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 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 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 (PPE).

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*.

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 PPE.

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 advanced cleaning services, the certification organization shall evaluate the organization's or ISP's procedures in accordance with Section 7.3 of this standard.

11.3.8 For verification of an organization's or an ISP's advanced inspection services, the certification organization shall evaluate the organization's or ISP's procedures in accordance with Sections 6.3 and 6.4 of this standard.

11.3.9 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 11.3.9(a) and Table 11.3.9(b).

Table 11.3.9(a) Outer Shell Repairs

Who Makes Repair	Sample	Material	Test
Organization	5 ft felled seam	Outer shell material(s) utilized by the organization	NFPA 1951, 7.1.1.6
	5 ft overedge seam Small tear patch	Patched tear made from the outer shell material utilized by the organization	NFPA 1855, 8.2.3
ISP	5 ft felled seam	7.5 osy Nomex IIIa plain weave fabric	NFPA 1951, 7.1.1.6
	5 ft overedge seam Small tear patch	Patched tear made from 7.5 osy Nomex IIIa plain weave fabric	NFPA 1855, 8.2.3

Table 11.3.9(b) Barrier Material Repairs

Who Makes Repair	Sample	Material	Test
Organization	5 ft seam	Barrier material(s) utilized by the organization	NFPA 1951, 7.2.1.6
	Hole patch	Patched hole made from the barrier material(s) utilized by the organization	NFPA 1855, 8.2.3, and NFPA 1951, 7.2.1.14, in the as-received condition
	Tear patch	Patched tear made from the barrier material(s) utilized by the organization	NFPA 1855, 8.2.3, and NFPA 1951, 7.2.1.14, in the as-received condition
ISP	5 ft seam	All barrier material(s) repaired by the ISP	NFPA 1951, 7.2.1.6
	Hole patch	Patched hole made from all barrier material(s) repaired by the ISP	NFPA 1855, 8.2.3 and NFPA 1951, 7.2.1.14 in the as-received condition
	Tear patch	Patched tear made from all barrier material(s) utilized by the organization	NFPA 1855, 8.2.3, NFPA 1951, 7.2.1.14 in the as-received condition

11.3.9.1 For repairs to tears in the outer shell, barrier material, and lining material, the certification organization shall create the tear in the material(s) to be repaired in accordance with Figure 11.3.9.1.

11.3.9.2 For barrier material hole repairs, the certification organization shall create the hole in the material(s) to be repaired in accordance with Figure 11.3.9.2.

11.3.9.3 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.

11.3.10 For verification of an organization's or ISP's advanced inspection services, the documentation and measurements specified in Table 11.3.10 shall be evaluated and verified to be compliant by the certification organization.

11.3.11 For verification of an organization's or ISP's advanced cleaning services, the documentation and measurements specified in Table 11.3.11 shall be evaluated and verified to be compliant by the certification organization.

11.3.12 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.

11.3.13 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

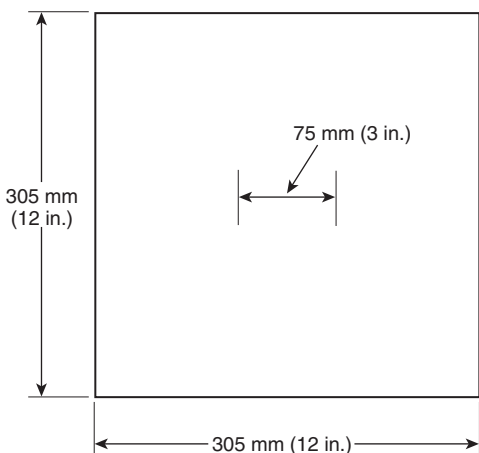
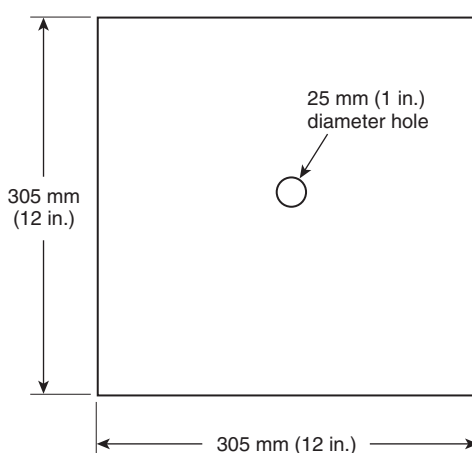
**FIGURE 11.3.9.1 Tear Repairs.****FIGURE 11.3.9.2 Hole Repairs.**

Table 11.3.10 Advanced Inspection Evaluation

NFPA 1855 Requirement to Be Evaluated	Method of Evaluation
6.3.2	Audit or review of organization's or ISP's procedures and documentation by certification organization
6.3.4	Audit or review of organization's or ISP's procedures and documentation by certification organization
6.3.5.1(1)–(4) and (6)–(15)	Audit or review of organization's or ISP's procedures and documentation by certification organization
6.4.2	Audit or review of organization's or ISP's procedures and documentation by certification organization
6.4.4	Audit or review of organization's or ISP's procedures and documentation by certification organization
6.4.5	Audit or review of organization's or ISP's procedures and documentation by certification organization

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.

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 that the following occur:

- (1) The current revisions of the appropriate documentation are available at all relevant locations and to all relevant staff.

Table 11.3.11 Advanced Cleaning Evaluation

NFPA 1855 Requirement to Be Evaluated	Method of Evaluation
7.3.4	Audit or review of organization's or ISP's procedures and documentation by certification organization
7.3.5	Audit or review of organization's or ISP's procedures and documentation by certification organization
7.3.6	Audit or review of organization's or ISP's procedures and documentation by certification organization
7.3.7	Audit or review of organization's or ISP's procedures and documentation by certification organization
7.3.8(1)–(4) and (6)–(13)	Audit or review of organization's or ISP's procedures and documentation by certification organization
7.3.8(5)	Direct measurement or observation by a representative of the certification organization
7.3.10	Audit or review of organization's or ISP's procedures and documentation by certification organization
7.3.14	Audit or review of organization's or ISP's procedures and documentation by certification organization
7.4.1	Audit or review of organization's or ISP's procedures and documentation by certification organization
7.4.2	Audit or review of organization's or ISP's procedures and documentation by certification organization
7.4.4(1)–(3) and (5)–(6)	Audit or review of organization's or ISP's procedures and documentation by certification organization
7.4.4(4)	Direct measurement or observation by a representative of the certification organization

- (2) All amendments to documents are authorized and processed in a manner that will ensure timely availability at the appropriate location.
- (3) Superseded documents are removed from use throughout the organization but that one copy is filed for a determined period.
- (4) 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 Water Penetration Barrier Evaluation.

12.1.1 Application. This evaluation method shall apply to barrier materials and barrier seams found in rescue and recovery technical rescue and CBRN technical rescue protective garment elements that are in service.

12.1.2 Evaluation Areas.

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

12.1.2.1.1 Barrier material areas shall be from high-abrasion areas of the garment elements, including, but not limited to, the following:

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

12.1.2.1.2 In addition to the areas listed in 12.1.2.1.1 where potential damage to the garment outer shell or barrier has been detected, the evaluation shall be conducted on the corresponding area of the barrier material.

12.1.2.2 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.

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

12.1.3 Evaluation Apparatus.

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

- (1) The apparatus shall consist of a means of clamping the area to be evaluated in a roughly horizontal position, providing a watertight seal with the pressurized portion of the apparatus and water reservoir.
- (2) The apparatus shall accommodate evaluations of barrier materials 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 75 mm (3 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 barrier material 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.

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

12.1.4 Procedure. The evaluation shall be conducted using the following procedure:

- (1) Place the selected area of barrier material in the apparatus and clamp to provide a watertight seal with the apparatus
- (2) Introduce a water pressure of 6.9 kPa (1 psi) against the barrier material for a period of not less than 15 seconds

- (3) Visually inspect the visible side of the barrier material after 15 seconds to determine if water penetration has occurred

12.1.5 Results.

12.1.5.1 If any water passes through the barrier material or barrier material seam, the barrier shall be removed from service and repaired or replaced.

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

12.2 Footwear Water Resistance Evaluation.

12.2.1 Application. This evaluation method shall apply to footwear.

12.2.2 Procedure. The evaluation shall be conducted using the following procedure:

- (1) Paper toweling shall be placed inside the footwear specimen such that the paper toweling intimately contacts all areas inside the footwear specimen to a minimum height of 200 mm (8 in.).
- (2) The footwear specimen shall be placed upright in a container that allows the entire footwear specimen to be immersed in tap water.
- (3) The container shall be filled with tap water to a height of 200 mm, +0/–25 mm (8 in., +0/–1 in.).
- (4) After 3 minutes, the paper toweling shall be removed and examined for evidence of liquid leakage.

12.2.3 Results.

12.2.3.1 If any water passes through the footwear, the footwear shall be removed from service and repaired or replaced.

12.2.3.2 If no water passes through the footwear, the footwear 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.3.3.2.4 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.3.3.3.8 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.3.3.3.16 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.3.3.20.1 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.3.3.20.2 Routine Cleaning. Examples include brushing off dry debris, rinsing off debris with a water hose, and spot cleaning.

A.3.3.20.3 Specialized Cleaning. This level of cleaning involves specific procedures and specialized cleaning agents and processes.

A.3.3.3.39 Emergency Medical Operations. Patient care includes, but is not limited to, first aid, cardiopulmonary resuscitation, basic life support, and advanced life support.

A.3.3.4.2 Ensemble Elements. The CBRN technical rescue protective ensemble includes, but is not limited to, garments, helmets, hoods, gloves, footwear, and interface components. The rescue and recovery technical rescue protective ensemble includes, but is not limited to, garments, helmets, goggles, gloves, and footwear. The utility technical rescue protective ensemble includes, but is not limited to, garments, helmets, goggles, gloves, and footwear. The utility and rescue and recovery elements are certified individually, whereas CBRN elements must at least be certified as part of an ensemble. How-

ever, CBRN elements can be certified individually to be used as replacement elements for the CBRN ensemble with which they were originally certified.

A.3.3.3.57 Goggles. To provide primary protection, goggles must be certified to ANSI/ISEA Z87.1, *Occupational and Educational Eye and Face Protection Devices*.

A.3.3.3.59 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.3.3.3.66 Interface Component(s). Interface components are evaluated and tested individually or are evaluated and tested as a part of the protective element.

A.3.3.3.67 Item. An item is a noncertified part of an element or an ensemble that must be used with the complete certified element or certified ensemble.

A.3.3.3.72 Organization. Examples of organizations include, but are not limited to, fire departments, police and other law enforcement departments, rescue squads, place EMS providers, and hazardous materials response teams.

A.3.3.3.87 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.3.3.3.96.3 Minor Seam. An example of a minor seam could be a seam in a comfort layer or a nonbarrier layer.

A.3.3.3.121 Universal Precautions. Under circumstances in which differentiation between body fluids is difficult or impossible, all body fluids should be considered potentially infectious materials.

A.3.3.3.132 Visibility Markings. Retroreflective enhancements improve nighttime conspicuity, and fluorescent enhancements improve daytime conspicuity.

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 emergency response personnel 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 the following 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 1951, *Standard on Protective Ensembles for Technical Rescue Incidents*
 - (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 procedure points
- (6) Repair
 - (a) Basic repairs
 - (b) Advanced repairs
 - (c) Barrier layer 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.

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 1951, *Standard on Protective Ensembles for Technical Rescue Incidents*, in which the accessory could negatively

impact the performance of the ensemble element, when in place. One test that is not part of NFPA 1951 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 6 seconds is recommended for evaluating technical rescue protective ensembles. While this test provides a demonstration of technical rescue protective element 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 1951, *Standard on Protective Ensembles for Technical Rescue Incidents*, 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 technical rescue protective 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.

A.4.2.4 A manufacturer trained organization receives training from an element manufacturer or a verified ISP in cleaning, inspection, and repair services for that organization's own elements. For garment elements, this entity has not received any formal verification from a third party certification organization.

A verified organization has demonstrated the ability to conduct cleaning, inspection, and repairs to a third party certification organization in accordance with this standard and is not required to have the approval of the element manufacturer to perform these services. Verified organizations are permitted to conduct these services for other organizations.

A verified ISP has demonstrated the ability to conduct cleaning, inspection, and repairs to a third party certification organization in accordance with this standard and is not required to have the approval of the element manufacturer to perform these services.

A.4.2.4.3 The end user should always request the list of repair categories for which the verified ISP is approved to perform.

A.4.2.5 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.



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

Ensemble and Ensemble Element Properties	Applicable Section of NFPA 1951
Garments	
Flame resistance	8.4
Heat resistance	8.5
Whole-garment liquid integrity	8.3 (rescue and recovery; CBRN only)
Helmets	
Flame resistance	8.18
Heat resistance	8.5
Top-impact resistance	8.19
Electrical insulation	8.51
Gloves	
Flame resistance	8.24
Heat resistance	8.5
Overall liquid integrity	8.31 (rescue and recovery; CBRN only)
Glove–hand function	8.28
Grip	8.29
Footwear	
Flame resistance	8.32
Heat resistance	8.5
Electrical insulation	8.38
Slip resistance	8.37
Hoods (CBRN only)	
Flame resistance	8.4
Heat resistance	8.5
CBRN protective ensembles	
Man-in-simulant test (MIST)	8.44

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.

A.4.3.2 Some organizations 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 organization should require that the entity providing the gear provide the records of prior care and maintenance at the time of rental.

A.4.4.2 It should be noted that the intent of this requirement is not to allow manufacturers to dictate which verified ISP an organization must use. The organization is allowed a choice in service providers for cleaning, inspection, and repairs.

A.4.5.2 Living areas include kitchen and dining areas, day-rooms, 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 that they might pick up from handling ensembles or ensemble elements. Organizations should consider dedicating PPE solely for use at public education events to minimize public exposure to soils and contaminants.

Emergency response personnel 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 4.6.1 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.5.1.1 Organizations responsible for selecting certified products are the best vehicle for enforcing correct representations of products. Organizations need to understand the correct way to refer to certified products and to be informed of the ways that uncertified products can be misrepresented, and to require suppliers to accurately communicate which products are certified versus products that are not certified.

The best expression to use when referring to compliant products is “The product is certified by (*insert name of certification organization*) to be compliant with NFPA 1951 (*current edition*).” Other shorter but acceptable expressions are “The product is certified to be compliant with NFPA 1951,” or “The product is certified to NFPA 1951,” or “the certified NFPA 1951 product.” If it is certified, the certification organization that is certifying the compliance will have the product “listed.” Any organization selecting certified products should confirm that the certification organization has the product listed. NFPA itself does not do the certifying, so an expression like “NFPA certified” is incorrect.

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

Expressions that do not use the term “certified” leave a lot of doubt about the status of the product. Frequently expressions are used that include the word *compliant* instead, for example “the product is compliant to NFPA 1951” or “the NFPA 1951 compliant product,” and so forth. If the product is

truly compliant then it is also certified because certification is part of the provisions of the standard. However, if the product is not truly compliant, then describing the product as certified will be illegal, but describing the product as compliant will only be misleading. Sometimes noncertifiable products are intentionally described as compliant to misinform the purchaser without incurring liability. It leaves open the uncertainty about who is claiming the compliance, and what the compliance is measured against. Some of the most egregious examples of this kind of practice are expressions like “the product complies with the viral penetration test requirements (or any other individual part) of NFPA 1951,” or “the product complies with the footwear requirements (or other respective component parts) of NFPA 1951.”

Certified NFPA products have many benefits over noncertified or noncertifiable products. Suppliers who can achieve the required level of product performance and quality are proud of this achievement. If they have achieved it, they will communicate it proudly and correctly. It has cost them considerable effort to achieve it. If the product is not represented as certified, it most likely is not and cannot be certified. The authority having jurisdiction should appreciate the advantages it is getting in product performance, product quality, and product assurance with certified products and that it is a significant factor in providing safety for its personnel. It should endorse the use of certified NFPA compliant products over noncertified products.

When a product claims to be certified to NFPA 1951, it will have a certification organization’s mark indicating the same. The consumer enjoys the following benefits when selecting a certified product:

- (1) The mark and identification of the independent third party organization that certified the product and that supports the current listing.
- (2) Confirmation that the certification is maintained and to the current edition of the standard.
- (3) All the data generated to demonstrate passing results of all the design and performance requirements is available upon request.
- (4) Details of all the test methods are documented and the number of specimens required for each test is known.
- (5) Preconditioning of all the specimens is required and known.
- (6) Confidence that the specimens are representative of or taken from finished product.
- (7) Specimens subject to assembly operations are also tested (e.g. seams, not just pristine specimens).
- (8) Products are tested repeatedly, initially and every year according to a known schedule.
- (9) Products are tested in an accredited laboratory whose results can be relied on.
- (10) Products are produced in a manufacturing plant with good manufacturing practices in place and that comply with ISO 9000, *Quality management systems — Fundamentals and vocabulary*, quality manufacturing practices and are subject to random audits.
- (11) Faulty products are subject to a recall.

When a product merely claims to be “compliant” with specific performance requirements of NFPA 1951, the manufacturer should at a minimum be able to provide a written report verifying the product’s compliance from a certifying agency. This report might include the date of the test, laboratory performing the test, the test method, and the results data. However, there might not be information on the number of specimens tested, whether the test is statistically repeatable, the

condition of the specimen, or the origin of that specimen, nor the competence of the laboratory in producing the data. It might even be a report generated about a product or material used in a different element or style than the one of interest to the consumer. When these types of claims are made it should be noted that the product might not actually be able to be certified to the standard.

Even weaker is a manufacturer or salesperson making a marketing or verbal claim that a product complies with any requirements of NFPA 1951 without even providing evidence of a written report or other documentation supporting that claim. The consumer should expect that the product does not comply with any of the requirements of NFPA 1951. Reputable manufacturers, salespeople, and certifying labs will only make these claims when they can support their claims with documentation.

A.5.1.2 The organization should consider the interface of items, such as helmets with respirators, gloves and hoods with coats, trousers with boots, and so forth.

A.5.1.3 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 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.5.2.1 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) Mandatory evaluation of safety and health programs (*see Section 4.3 from NFPA 1500*)
- (2) Mandatory compliance with state and federal laws (*see 4.4.2 from NFPA 1500*)



- (3) Safety officer's responsibilities also defined in NFPA 1521, *Standard for Fire Department Safety Officer* (see Section 4.7 from NFPA 1500)
- (4) Requirements for ensembles and ensemble elements (see Section 7.1 from NFPA 1500)

In the identification of hazards, the organization should consider those hazards that emergency response personnel are likely to encounter. 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.

Potential technical rescue incident and other related emergency hazards are as follows:

- (1) Physical hazards
 - (a) Falling objects
 - (b) Flying debris
 - (c) Projectiles or ballistic objects
 - (d) Abrasive or rough surfaces
 - (e) Sharp edges
 - (f) Pointed objects
 - (g) Slippery surfaces
 - (h) Excessive vibration
- (2) Environmental hazards
 - (a) High heat and humidity
 - (b) Ambient cold
 - (c) Wetness
 - (d) High wind
 - (e) Insufficient or bright light
 - (f) Excessive noise
- (3) Thermal hazards
 - (a) High convective heat
 - (b) Low radiant heat
 - (c) High radiant heat
 - (d) Flame impingement
 - (e) Steam
 - (f) Hot liquids
 - (g) Molten metals
 - (h) Hot solids
 - (i) Hot surfaces
- (4) Biological hazards
 - (a) Bloodborne pathogens
 - (b) Airborne pathogens
 - (c) Biological toxins
 - (d) Biological allergens
- (5) Chemical hazards
 - (a) Inhalation
 - (b) Skin absorption or contact
 - (c) Chemical ingestion or injection
 - (d) Liquefied gas contact
 - (e) Chemical flashover
 - (f) Chemical explosions
- (6) Electrical hazards
 - (a) High voltage
 - (b) Electrical arc flashover
 - (c) Static charge buildup
- (7) Radiation hazards
 - (a) Ionizing radiation
 - (b) Nonionizing radiation
- (8) Person-position hazards
 - (a) Daytime visibility
 - (b) Nighttime visibility

- (c) Falling
- (d) Drowning
- (9) Person-equipment hazards
 - (a) Material biocompatibility
 - (b) Ease of contamination
 - (c) Thermal comfort
 - (d) Range of motion
 - (e) Hand function
 - (f) Ankle and back support
 - (g) Vision clarity
 - (h) Communications ease
 - (i) Fit (poor)
 - (j) Ease of donning and doffing

A.5.2.2(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 the CBRN protective ensemble requirements in NFPA 1951, *Standard on Protective Ensembles for Technical Rescue Incidents*, 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 1951 versus obtaining separate ensembles that comply with specific classes of ensembles for NFPA 1994 or ensembles meeting NFPA 1991 or NFPA 1971.

A.5.2.3 These standards provide minimum requirements. In order to fully utilize this standard, organizations should be familiar with the performance requirements in NFPA 1951. Additional requirements can be necessary. Organizations should also solicit information from and exchange information with other organizations.

A.5.2.4 The majority of tests in NFPA 1951 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) Total heat loss of the material composite
 - (b) Tear resistance of the material layers (outer shell and lining fabrics)
 - (c) Breaking strength of the outer shell
 - (d) Abrasion resistance of the outer shell
 - (e) Cleaning shrinkage of the material layers (outer shell and lining fabrics)
 - (f) Seam strength of outer shell and lining layers
 - (g) Flame resistance of material layers and other components (outer shell, lining fabrics, other material layers and components)

- (h) Thermal shrinkage of the material layers (outer shell and lining fabrics)
 - (i) Thermal protective performance of the material composite
 - (j) Water absorption resistance of the outer shell
- (2) Protective helmet elements
 - (a) Flame resistance
 - (b) Heat resistance (level of sagging)
 - (c) Impact resistance (top) after selected preconditions
- (3) Protective glove elements
 - (a) Cut resistance of the glove composite
 - (b) Puncture resistance of the glove composite
 - (c) Abrasion resistance of the glove composite
 - (d) Dexterity of whole gloves
 - (e) Grip of whole gloves
 - (f) Flame resistance of the glove composite
 - (g) Conductive heat resistance of the glove composite
 - (h) Burst strength of wristlet material
 - (i) Thermal protective performance of the glove composite
- (4) Protective footwear elements
 - (a) Abrasion resistance of the footwear sole and upper
 - (b) Cut resistance of the footwear upper
 - (c) Puncture resistance of the footwear sole and upper
 - (d) Slip resistance of the footwear sole
 - (e) Flame resistance of whole footwear
 - (f) Thermal protective performance of the footwear upper
 - (g) Conductive heat resistance of the footwear upper
- (5) Protective hood interface elements
 - (a) Thermal protective performance of the hood material
 - (b) Flame resistance of the hood material
 - (c) Thermal shrinkage of the hood material
 - (d) Burst strength of the hood material
 - (e) Cleaning shrinkage of the hood material
- (6) CBRN protective ensemble: Man-in-simulant test (MIST) of overall ensemble

Additional testing can also be specified for performance properties not addressed in NFPA 1951 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 a request for information (RFI) or a request for proposal (RFP) format when soliciting quotations for technical rescue 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

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 organizations 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 emergency response 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.5.3.1 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 pre-bid 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 NFPA 1951 ensemble element components:

- (1) Garments
 - (a) Outer shell material: fabric, weight, and color
 - (b) Barrier material (rescue and recovery or CBRN): base fabric, film, or coating
 - (c) Visibility markings (if present): configuration, material, and color
 - (d) Closure system
 - (e) Wristlets: material, design, if present
- (2) Helmets
 - (a) Material
 - (b) Color
 - (c) Retention system
 - (d) Visibility markings (if present): configuration, material, and color



- (3) Gloves
 - (a) Composite materials
 - (b) Wristlet or gauntlet; type of material
 - (c) Wristlet material
- (4) Boots: composite materials
- (5) Eye protection (goggles)
 - (a) Type, ventilated, not ventilated, indirect ventilation
 - (b) Type of band
- (6) Hoods (CBRN only)
 - (a) Material
 - (b) Face opening design to accommodate respirator
- (7) CBRN protective ensemble
 - (a) Types of interfaces between elements
 - (b) Respirators accommodated by design and certification

A.5.3.1(2) An organization should consider its needs for performance or features in excess of the minimum requirements of NFPA 1951, 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 additional barrier material 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
 - (i) Any customized sizing requirements
 - (j) Any attachment requirements for barriers 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 field interchangeability or replacement of reinforcement pieces
 - (p) Any requirements for enhanced flexibility at movement-sensitive areas
 - (q) Any requirements for notification systems to indicate barrier absence
 - (r) Any requirements for barrier material substrate accessibility to allow field inspection
 - (s) Any requirements for lumbar support systems
 - (t) Any customization requirements
 - (u) Any passport or accountability system requirements
 - (v) Any specialized or additional pocketing requirements
 - (w) Any flashlight clips required
 - (x) Any PASS (personal alert safety system) interface features required
 - (y) Any requirements for personal escape or rescue features
 - (z) Any requirements for sizing adjustment
 - (aa) Any requirements for temperature-sensing features
 - (bb) Any requirements for interface area compatibilities
- (2) Helmet elements
 - (a) Any styling requirements
 - (b) Any customization requirements
 - (c) Any reflective marking requirements
 - (d) Any customized sizing requirements
 - (e) Any specific material choices
 - (f) Any specific requirements for earflaps (design, materials, dimensions, attachment to shell specifics), if the organization determines ear flaps are required as they are not required in NFPA 1951
 - (g) Any specific requirements for suspension construction
 - (h) 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) Goggles elements
 - (a) Any specific lens types and size
 - (b) Any type of ventilation
 - (c) Any type of strap material
 - (d) Overall styling requirements
- (6) Hood interface elements (CBRN only)
 - (a) Any specific material choices
 - (b) Any styling requirements
 - (c) Any coverage requirements
- (7) All ensemble elements
 - (a) Any additional certification requirements (e.g., 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
- (8) 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 respirator for which ensemble is certified

A.5.3.1(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.5.3.1(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 respirator and goggles).

A.5.3.1(5) Organizations should consider comparing a pre-production sample from the apparent winning submitter against the purchase specifications before awarding the bid.

A.6.1.2 When inspecting elements for soiling, consideration should be given to the accumulation of dirt, mud, or other grime that could cause degradation of the element. Perspiration and its remains could also degrade the element or components of the element and should be considered when evaluating for soiling.

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.6.2.2.5 The inspection should ensure that the sides and edges of 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 the organization, the verified ISP and the organization, or a verified organization should determine the level of training required to perform advanced inspections. Resources for training that should be considered, at 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.

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. Items 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 might show damage while the other side might not. Moreover, certain fibers in a single-layer material might be more susceptible

Table A.6.2.2 Routine Inspection Criteria

Criteria	Garments	Helmets	Gloves	Footwear	Goggles
Soiling	X	X	X	X	
Contamination	X	X	X	X	
Tears and cuts	X	X	X	X	
Damaged missing hardware or closure system	X				
Charring, burn holes, melting	X	X	X	X	
Shrinkage	X	X	X	X	
Material discoloration	X	X	X	X	
Damaged or missing visibility markings	X	X			
Loss of face opening elasticity or adjustability					
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 including discoloration and scratched lenses					X
Damaged strap or loss of elasticity					X
Inverted glove barrier			X		
Exposed or deformed protective toe, protective midsole, or shank				X	
Loss of water resistance				X	
Closure system component damage and functionality				X	
Size compatibility	X				

Table A.6.3.5 Advanced Inspection Criteria

Criteria	Garments	Barrier	Helmets	Gloves	Footwear	Goggles	Hoods	Interface Devices
Soiling	X	X	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	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		X	X		X			
Abrasions	X	X	X		X			
Bubbling, soft spots, warping			X		X			
Damaged or missing components of the suspension and retention systems			X			X		
Damaged or missing components including discoloration and scratched lenses			X			X		
Inverted glove barrier				X				
Exposed or deformed protective toe, protective midsole, or shank					X			
Loss of water resistance		X		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 barrier material				X				
Loss of wristlet elasticity, stretching of wristlet				X				
Label integrity and legibility	X		X	X	X		X	
Hook and loop functionality	X		X		X			
Barrier 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 barrier: tears, excessive wear, separation from outer layer					X			
Delamination, separation	X	X		X				
Size compatibility	X							

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.

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 barrier material is one of the most difficult parts of the rescue and recovery technical rescue protective (or CBRN technical rescue) garment element to inspect and evaluate, because the film or coating side of most barrier materials might be hidden from easy examination. Even if a garment element is equipped with a means of viewing the film or coating side, it might be difficult to conduct a visual evaluation of the barrier material film or coating. Even a physical examination of the barrier material 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. Barrier material coatings or films can become abraded, tear, or have pinholes from use. In severe cases, the degradation in some barrier materials can take the form of separation, cracking, or flaking. Tapes used on barrier material 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 following field evaluation procedure can be used. In addition to potential areas of damage to the garment, the front and back body panels of each protective garment element should be evaluated using three different barrier material areas and three different barrier areas with a seam. Evaluation areas should be from high-abrasion areas of the garment elements, including, but not limited to the following:

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

An alcohol–tap water mixture should be made by combining 1 part rubbing alcohol (70 percent isopropyl alcohol) with 6 parts of tap water. A 5 gal bucket or similar container with a 12 in. diameter should be used to support the barrier during evaluation. The evaluation procedure should be performed at room temperature. The evaluation should be conducted using the following procedure:

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

The barrier should be visually inspected for leakage on the innermost layer side after 1 minute. If any liquid passes through the barrier material and wets the barrier material or other interior layer, the barrier should be removed from service and evaluated per Section 6.4. After the evaluation procedure has been performed, the barrier should be cleaned and allowed to completely dry to remove all traces of the alcohol–tap water mixture.

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 visibility marking retroreflective performance, it does not evaluate visibility marking fluorescence or mean that the visibility marking will provide adequate emergency responder visibility. Visibility markings can lose fluorescence (daytime visibility) and still remain retroreflective. Visibility markings 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 material 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.6.3.5.3(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 gloves 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.6.3.5.4(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 emergency responder'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.6.3.6.1 Organizations should consult with the manufacturer of the CBRN technical rescue protective ensemble for any additional or specific advanced inspection requirements for this type of ensemble.

A.6.3.6.3 Loss of integrity can be determined by evaluating the inward leakage for representative CBRN technical rescue 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 CBRN technical rescue protective ensembles that do not encapsulate both the wearer and the breathing apparatus.

For this testing, the entire CBRN technical rescue 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 technical rescue protective ensemble. The appropriate CBRN respirator should be included as specified as part of the CBRN technical rescue protective 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 re-evaluation, inspected, and repaired, if necessary.

The CBRN technical rescue 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.
- (2) The CBRN technical rescue 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 technical rescue protective 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 respirator facepiece (if used) 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 con-

tamination of the colorimetric dosimeters occurred. If the results are determined to be valid, the ensemble should be removed from service, repaired, or replaced.

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 emergency response personnel 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 technical rescue incidents, 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 emergency response personnel 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 emergency scene on the personal protective equipment used by the emergency response personnel.

Toxins that emergency response personnel 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 increase 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 emergency response personnel 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 emergency responders still

encounter various chemicals during technical rescue incidents. Exposure to oils, gasolines, and lubricants can occur around emergency 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 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.

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 could 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:

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

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*.

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. At 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.7.1.9 Some dry cleaning solvents that are used in lieu of water can damage components of the ensembles and ensemble elements. Visibility markings, 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.7.1.10 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?
- (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 1951, *Standard on Protective Ensembles for Technical Rescue Incidents*, 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:

- (1) 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.
- (2) 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 1951; however, key properties can be selected. Table A.7.1.10 provides a recommended list of key properties for evaluation. Other properties can be evaluated that are of interest to the organization, including the following:
 - (a) Composite weight
 - (b) Composite thickness

Table A.7.1.10 Recommended Performance Tests for Evaluating Effects of Cleaning Agents or Cleaning Procedures

Performance Property	Test Method ^a	Type of Sample(s)	Specimens Required ^b
Thermal protective performance	8.2	Composite	Three 150 mm (6 in.) squares
Flame resistance	8.4	Outer shell, lining fabrics, barrier material	Five 75 mm × 305 mm (3 in. × 12 in.) rectangles (in each material direction)
Tear strength	8.7	Outer shell, lining fabrics, barrier material	Five 75 mm × 150 mm (3 in. × 6 in.) rectangles (in each material direction)
Tensile strength	8.8	Outer shell	Five 100 mm × 200 mm (4 in. × 8 in.) rectangles (in each material direction)
Water absorption	8.13	Outer shell	Three 200 mm (8 in.) squares
Cleaning shrinkage	8.10	Outer shell, lining fabrics, barrier material	Five 375 mm (15 in.) squares
Fuel C penetration resistance	8.16	Barrier material seams ^c	Three 75 mm (3 in.) squares
Viral penetration	8.17	Barrier material seams ^c	Four 75 mm (3 in.) squares

^aSections from NFPA 1951, *Standard on Protective Ensembles for Technical Rescue Incidents*.

^bSpecimens removed from ensemble elements or representative material samples.

^cApplies only to rescue and recovery technical rescue garments and CBRN technical rescue garments.

- (c) Composite total heat loss (breathability)
- (d) Outer shell colorfastness to washing
- (e) Outer shell colorfastness to light exposure
- (f) Outer shell or lining fabric 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 1951. 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 35N (7.87 lbf) before cleaning and then 30N (6.75 lbf) after several cycles, whereas a different material could begin at 50N (11.24 lbf) and drop to 35N (7.87 lbf) 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 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.7.2.4.1 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.7.2.4.7(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.7.2.4.7(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.7.2.4.7(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 and usually requires elements to be temporarily taken out of service and 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.7.3.7 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. Presently there are two basic types of automatic washing machines commonly available for use by end users: top-loading agitator style machines and front-loading 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 for all ensemble elements. At this time, 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 free of rough spots, burrs, or sharp edges are recommended to protect against rusting, chipping, and the associated wear on and damage of 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 these reasons, it is generally accepted that front-loading machines are more appropriate for protective clothing. If front-loading machines are used, stainless steel wash tubs free of rough spots, burrs, or sharp edges are recommended to protect against rusting, chipping, snags, and the associated wear on and damage of garments.

A.7.3.8 Washing and drying should be conducted to be as little physically damaging as possible. Precautions, such as re-

moving hardware and tools from pockets, separating shells from barriers, closing all closures, laundering in a laundry bag, and so forth, are all designed to reduce physical damage. Hard heavy accessories (e.g., harnesses and carabiners) and findings (e.g., D-rings) beating on the garments against the washer and dryer drums can be very damaging to garments, especially barriers. Any and all precautions should be taken to avoid this source of damage.

A.7.3.8(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.7.3.8(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 barrier assemblies.

A.7.3.8(5) 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.7.3.8(8) 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. Lining and barrier materials are the most vulnerable. Lining materials 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. Barrier materials and seams by their very nature are designed to impede the flow of water. Extraction at excessively high RPMs can severely damage barrier materials and barrier material 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.7.3.8(9) If the machine does not automatically have a second rinse, an additional complete cycle without detergent should be run.

A.7.3.8(12) When possible, organizations should provide a washing machine(s) for the sole purpose of cleaning protective ensemble elements.

A.7.3.10.1 Ensembles and ensemble elements should be cleaned and decontaminated only with like elements, including but not limited to outer shells with outer shells, barriers with barriers, hoods with hoods, gloves with gloves, and boots with boots. It is highly recommended that garment barrier systems be removed if possible and cleaned separately to avoid contamination with the debris found in the shell. Because any