NFPA 1999
Standard on Protective Clothing for Emergency Medical Operations

1997 Edition

National Fire Protection Association, 1 Batterymarch Park, PO Box 9101, Quincy, MA 02269-9101
An International Codes and Standards Organization

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Standard on

Protective Clothing for Emergency Medical Operations

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This edition of NFPA 1999, *Standard on Protective Clothing for Emergency Medical Operations,* was prepared by the Technical Committee on Emergency Medical Services Protective Clothing and Equipment, released by the Technical Correlating Committee on Fire and Emergency Services Protective Clothing and Equipment, and acted on by the National Fire Protection Association, Inc., at its Annual Meeting held 19–22 May 1997, in Los Angeles, CA. It was issued by the Standards Council on 24 July 1997, with an effective date of 15 August 1997, and supersedes all previous editions.

This edition of NFPA 1999 was approved as an American National Standard on 15 August 1997.

Origin and Development of NFPA 1999

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

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

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

Additional garment requirements cover overall liquidtight integrity, material strength, physical hazard resistance, seam strength, and closure strength.

Additional requirements for gloves cover minimum performance for tensile and elongation properties in an "as received" condition as well as following heat aging and isopropyl alcohol immersion, minimum sizing, and liquidtight integrity for intended areas of penetration.

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

The selection of test methods and performance requirements was based on surveys of emergency medical services (EMS) personnel and a technical study supported by the U.S. Fire Administration.

The Subcommittee on Hazardous Chemicals Protective Clothing began its work on the first edition in 1990 and passed its work on to the Technical Committee on Fire Service Protective Clothing and Equipment in January 1991. The first edition was presented to the Association at the 1992 Annual Meeting in New Orleans, LA.

Since the first 1992 edition, the entire project for fire service protective clothing and equipment was reorganized in January 1995 by the Standards Council. The new project has a Technical Correlating Committee on Fire and Emergency Services Protective Clothing and Equipment and seven technical committees operating within the project. A new Technical Committee on Emergency Medical Services Protective Clothing and Equipment is now responsible for NFPA 1999.

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

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

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

The second edition was presented to the Association at the 1997 Annual Meeting in Los Angeles, CA, on 22 May 1997.

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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 primary responsibility for documents on the selection, care, and maintenance of such protective clothing and protective equipment by fire and emergency services organizations and personnel.

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

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

These lists represent the membership at the time each Committee was balloted on the text of this edition. Since that time, changes in the membership may have occurred. A key to classifications is found at the back of this document.

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

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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 Appendix A.

Information on referenced publications can be found in Chapter 7 and Appendix B.

Chapter 1 Administration

1-1 Scope.

1-1.1* This standard shall specify the minimum documentation, design criteria, performance criteria, and test methods for new single-use and new multiple-use emergency medical protective clothing, including garments, gloves, and face protection devices, designed to provide a minimum level of protection to emergency medical services personnel as well as victims and patients from contact with liquid-borne pathogens during emergency medical operations.

1-1.2 This standard shall not apply to the use of emergency medical protective clothing; such use requirements are specified in NFPA 1500, *Standard on Fire Department Occupational Safety and Health Program,* and NFPA 1581, *Standard on Fire Department Infection Control Program.*

1-1.3* This standard shall not be interpreted as providing criteria for protection from radiological agents, from hazardous chemicals, from flammable or explosive atmospheres, or from thermal hazards associated with fire fighting.

1-1.4* This standard shall not be interpreted as providing criteria for protection from biological agents that are not liquid borne.

1-1.5* This standard shall not apply to cleaning gloves or structural fire-fighting gloves used in emergency medical operations.

1-1.6 Certification of emergency medical garments, emergency medical gloves, or emergency medical face protection devices to the requirements of this standard shall not preclude certification to additional appropriate standards where the garments, gloves, or face protection devices meet all applicable requirements of each standard.

1-1.7 The requirements of this standard shall not apply to accessories that might be attached to any emergency medical protective clothing unless specifically addressed herein.

1-1.8 Nothing herein shall restrict any jurisdiction or manufacturer from exceeding these minimum requirements.

1-2 Purpose.

1-2.1* The purpose of this standard shall be to provide minimum requirements for emergency medical protective clothing designed to minimize skin and mucous membrane contact with liquid-borne pathogens under the various conditions that might exist at the scene of an emergency.

1-2.2 Controlled laboratory tests used to determine compliance with the performance requirements of this standard shall not be deemed as establishing performance levels for all situations to which personnel can be exposed.

1-2.3* This standard shall not be interpreted or used as a detailed manufacturing or purchase specification, but shall be permitted to be referenced in purchase specifications as minimum requirements.

1-3 Definitions.

Accessories. Those items that are attached to emergency medical protective clothing elements, but are designed in such a manner as to be removable from the emergency medical protective clothing element and are not necessary to meet the requirements of this standard.

Approved.* Acceptable to the authority having jurisdiction.

Authority Having Jurisdiction.* The organization, office, or individual responsible for approving equipment, an installation, or a procedure.

Barrier Layer. The layer of garment material, glove material, or face protection device material designated as providing biopenetration resistance.

Biological Agents. Biological materials that are capable of causing an acute disease or long-term damage to the human body.

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

Certification/Certified. A system whereby a certification organization determines that a manufacturer has demonstrated the ability to produce a product that complies with the requirements of this standard, authorizes the manufacturer to use a label on listed products that comply with the requirements of this standard, and establishes a follow-up program conducted by the certification organization as a check on the methods the manufacturer uses to determine compliance with the requirements of this standard.

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

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

Component. Any material, part, or subassembly used in the construction of any element of emergency medical protective clothing.

Element(s). Items that comprise emergency medical protective clothing, including garments, gloves, and face protection devices.

Emergency Medical Face Protection Device. An element of emergency medical protective clothing that meets all applicable requirements of this standard. Such devices are designed to provide a minimum level of protection to the face, are configured to cover part or all of the wearer's face or head, and include, but are not limited to, splash-resistant eyewear, hooded visors, and masks. *(See also Emergency Medical Protective Clothing.)*

Emergency Medical Garment. An element of emergency medical protective clothing that can be a single garment or an assembly of multiple garments, and that meets all applicable requirements of this standard. Such garments are designed and configured to cover any part of the wearer's skin, excluding the hands, face, and feet. Such garments include, but are not limited to, full body clothing such as suits, coveralls, and patient/victim isolation bags; and non-full body clothing such as aprons and sleeve protectors. *(See also Emergency Medical Protective Clothing.)*

Emergency Medical Glove. A single-use element of emergency medical protective clothing that meets all applicable requirements of this standard and is designed and configured to cover the wearer's hand to at least the wrist. *(See also Emergency Medical Protective Clothing.)*

Emergency Medical Operations. Delivery of emergency patient care and transportation prior to arrival at a hospital or other health care facility.

Emergency Medical Protective Clothing. Multiple elements, including garments, gloves, and face protection devices, designed for the purpose of isolating parts of the wearer's body from contact with liquid-borne pathogens during delivery of emergency patient care and other emergency medical operations.

Emergency Patient Care. The provision of treatment to patients, including first aid, cardiopulmonary resuscitation, basic life support, advanced life support, and other medical procedures that occur prior to arrival at a hospital or other health care facility.

Face Protection Device. See Emergency Medical Face Protection Device.

Flammable or Explosive Atmospheres. Atmospheres containing substances or gases at concentrations that will burn or explode if ignited.

Follow-Up Program. The sampling, inspections, tests, or other measures conducted by the certification organization on a periodic basis to determine the continued compliance of labeled and listed products that are being produced by the manufacturer to the requirements of this standard.

Garment. See Emergency Medical Garment.

Garment Closure. The garment component designed and configured to allow the wearer to don (put on) and to doff (take off) the emergency medical garment.

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

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

Gauntlet. The circular, flared, or otherwise expanded part of the glove that extends beyond the opening of the glove body.

Glove. See Emergency Medical Glove.

Glove Body. The part of the glove that extends from the tip of the fingers to 25.4 mm (1 in.) beyond the wrist crease.

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

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

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

Liquid-Borne Pathogen. An infectious microorganism contained within a body fluid or liquid.

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 identified standards or has been tested and found suitable for a specified purpose.

Manufacturer. The entity that assumes the liability and provides the warranty for the compliant product.

Model. The collective term used to identify a group of individual elements of the same basic design and components from a single manufacturer produced by the same manufacturing and quality assurance procedures that are covered by the same certification.

Package. The wrapping or enclosure directly containing the emergency medical glove or face protection device.

Package Product Label. The product label that is printed on or attached to a package containing one or more emergency medical protective clothing elements. *(See also Product Label.)*

Product Label. A label or marking affixed to each compliant garment, glove, or face protection device by the manufacturer. Such labels contain compliance statements, certification statements, general information, care, maintenance, or similar data. The product label is not the certification organization's label, symbol, or identifying mark; however, the certification organization's label, symbol, or identifying mark is attached to or a part of the product label. *(See also Labeled and Package Product Label.)*

Radiological Agents. Radiation associated with X-rays, alpha and gamma emissions from radioactive isotopes, or other material in excess of normal radiation background levels.

Sample. The element, component, or composite that is conditioned for testing. *(See also Specimen.)*

Seam. Any permanent attachment of two or more garment or glove materials, excluding external fittings, pockets, gaskets, and garment closure assemblies, in a line formed by joining the separate material pieces.

Shall. Indicates a mandatory requirement.

Should. This term, as used in Appendix A, indicates a recommendation or that which is advised but not required.

Single-Use Element.* Elements that are designed to be used one time and then disposed of in accordance with applicable local, state, and federal guidelines.

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

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

Trace Number. A code that can be used to retrieve the production history of a product, for example, a lot or serial number.

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

Chapter 2 Certification

2-1 General.

2-1.1 Emergency medical garments, emergency medical gloves, and emergency medical face protection devices that are labeled as being compliant with this standard shall meet or exceed all applicable requirements specified in this standard and shall be certified.

2-1.2 All certification shall be performed by a certification organization that meets at least the requirements specified in Section 2-2, and that is accredited for personal protective equipment in accordance with ANSI Z34.1, *American National Standard for Third-Party Certification Programs for Products, Processes, and Services.*

2-1.3 Compliant emergency medical garments shall be labeled and listed. Such emergency medical garments shall also have a product label that meets the requirements specified in 3-1.1.

2-1.4 Compliant emergency medical gloves shall be labeled and listed. Such emergency medical gloves shall also have a product label that meets the requirements specified in 3-2.1.

2-1.5 Compliant emergency medical face protection devices shall be labeled and listed. Such emergency medical face protection devices shall also have a product label that meets the requirements specified in 3-3.1.

2-1.6* The certification organization's label, symbol, or identifying mark shall be attached to the product label or be part of the product label.

2-2 Certification Program.

2-2.1* The certification organization shall not be owned or controlled by manufacturers or vendors of the product being certified. The certification organization shall be primarily engaged in certification work and shall not have a monetary interest in the product's ultimate profitability.

2-2.2 The certification organization shall refuse to certify products to this standard that do not comply with all applicable requirements of this standard.

2-2.3* The contractual provisions between the certification organization and the manufacturer shall specify that certification is contingent on compliance with all applicable requirements of this standard. There shall be no conditional, temporary, or partial certifications. Manufacturers shall not be authorized to use any label or reference to the certification organization on products that are not manufactured in compliance with all applicable requirements of this standard.

2-2.4* The certification organization shall have laboratory facilities and equipment available for conducting proper tests, a program for calibration of all instruments shall be in place and operating, and procedures shall be in use to ensure proper control of all testing. Good practice shall be followed regarding the use of laboratory manuals, form data sheets, documented calibration and calibration routines, performance verification, proficiency testing, and staff qualification and training programs.

2-2.5 The certification organization shall require the manufacturer to establish and maintain a program of production inspection and testing that at least meets the requirements of Section 2-5. The certification organization shall audit the manufacturer's quality assurance program to ensure that the quality assurance program provides continued product compliance with this standard.

2-2.6 The certification organization and the manufacturer shall evaluate any changes affecting the form, fit, or function of the certified product to determine its continued certification to this standard.

2-2.7* The certification organization shall have a follow-up inspection program of the manufacturing facilities of the certified product, with at least two random and unannounced visits per 12-month period. As part of the follow-up inspection program, the certification organization shall select a sample product at random from the manufacturer's production line, from the manufacturer's in-house stock, or from the open market. Sample product shall be inspected and tested by the certification organization to verify the product's continued compliance.

2-2.8 The certification organization shall have a program for investigating field reports alleging malperformance or failure of listed products.

2-2.9* The certification organization shall require the manufacturer to have a product recall system as part of the manufacturer's quality assurance program.

2-2.10 The certification organization's operating procedures shall provide a mechanism for the manufacturer to appeal decisions. The procedures shall include the presentation of information from both sides of a controversy to a designated appeals panel.

2-2.11 The certification organization shall be in a position to use legal means to protect the integrity of its name and label. The name and label shall be registered and legally defended.

2-3 Inspection and Testing.

2-3.1 Sampling levels for testing and inspection shall be established by the certification organization and the manufacturer to ensure a reasonable and acceptable reliability at a reasonable and acceptable confidence level that products certified to this standard are compliant, unless such sampling levels are specified herein. This information shall be included in the manufacturer's technical data package.

2-3.2 Inspection by the certification organization shall include a review of all product labels to ensure that all required label attachments, compliance statements, certification statements, and other product information are at least as specified for the respective element in 3-1.1, 3-2.1, and 3-3.1.

2-3.3 Inspection by the certification organization shall include a review of the user information required by 3-1.2, 3-2.2, and 3-3.2 to ensure that the information has been developed and is available.

2-3.4 Inspection by the certification organization for determining compliance with the design requirements specified in Chapter 4 shall be performed on whole or complete products.

2-3.5 Testing conducted by the certification organization in accordance with the testing requirements of Chapter 6, for determining product compliance with the applicable performance requirements specified in Chapter 5, shall be performed on samples representative of materials and components used in the actual construction of the emergency medical garments, gloves, or face protection devices. The certification organization also shall be permitted to use sample materials cut from a representative product.

2-3.6 Where certification testing includes an element with one or more accessories, the element with each accessory shall be certified as complying with 4-1.6 and 4-1.7, or 4-2.7 and 4-2.8, or 4-3.4 and 4-3.5, as applicable.

2-3.7 Any change in the design, construction, or material of a compliant product shall necessitate new inspection and testing to verify compliance to all applicable requirements of this standard that the certification organization determines can be affected by such change. This recertification shall be conducted before labeling the modified product as being compliant with this standard.

2-3.8 The certification organization shall not allow any modifications, pretreatment, conditioning, or other such special processes of the product or any product component prior to the product's submission for evaluation and testing by the certification organization. The certification organization shall accept from the manufacturer, for evaluation and testing for certification, only product or product components that are the same in every respect to the actual final product or product component. The certification organization shall not allow the substitution, repair, or modification, other than as specifically permitted herein, of any product or any product component during testing.

2-4 Recertification.

2-4.1 All individual elements of emergency medical protective clothing that are labeled as being compliant with this standard shall undergo recertification on an annual basis. This recertification shall include inspection and evaluation to all design requirements and testing to all performance requirements as required by this standard on all manufacturer models and components.

2-4.1.1 Any change that affects the element's performance under the design or performance requirements of this standard shall constitute a different model.

2-4.1.2 For the purpose of this standard, models shall include each unique pattern, style, or design of an individual element.

2-4.2 Samples of manufacturer models and components for recertification shall be acquired from the manufacturer or component supplier during random and unannounced visits as part of the follow-up inspection program.

2-4.3 The manufacturer shall maintain all design and performance inspection and test data from the certification organization used in the recertification of manufacturer models and components. The manufacturer shall provide such data, upon request, to the purchaser or authority having jurisdiction.

2-5 Manufacturer's Quality Assurance Program.

2-5.1 The manufacturer shall provide and maintain a quality assurance program that includes a documented inspection and product recall system. The manufacturer shall have an inspection system to substantiate conformance to this standard.

2-5.2 The manufacturer shall maintain written inspection and testing instructions. The instructions shall prescribe inspection and test of materials, work in process, and completed articles. Criteria for acceptance and rejection of materials, processes, and the final product shall be part of the instructions.

2-5.3 The manufacturer shall maintain records of all pass/fail tests. Pass/fail records shall indicate the disposition of the failed material or product.

2-5.4 The manufacturer's inspection system shall provide for procedures that ensure that the latest applicable drawings, specifications, and instructions are used for fabrication, inspection, and testing.

2-5.5 The manufacturer shall, as part of the quality assurance program, maintain a calibration program of all instruments used to ensure proper control of testing. The calibration program shall be documented as to the date of calibration and performance verification.

2-5.6 The manufacturer shall maintain a system for identifying the appropriate inspection status of component materials, work in process, and finished goods.

2-5.7 The manufacturer shall establish and maintain a system for controlling nonconforming material, including procedures for the identification, segregation, and disposition of rejected material. All nonconforming materials or products shall be identified to prevent use, shipment, and intermingling with conforming materials or products.

2-5.8 The manufacturer's quality assurance program shall be audited by the certification organization to determine that the program is sufficient to ensure continued product compliance with this standard.

2-6 ISO Registration for Manufacturers.

2-6.1 The manufacturer shall provide and operate a quality assurance program that meets the requirements of this section and that includes a product recall system as specified in 2-2.9.

2-6.2 The manufacturer shall be registered to ISO 9001, *Quality Systems — Model for Quality Assurance in Design, Development, Production, Installation, and Servicing.*

2-6.3 All elements of the protective ensemble shall be required to be assembled in a facility that is registered at least to ISO 9002, *Quality Systems — Model for Quality Assurance in Production, Installation, and Servicing.*

2-6.4 The ISO registration requirements shall have an effective date of 1 September 1999.

2-6.5 Until 1 September 1999, or until the date the manufacturer becomes ISO-registered, whichever date occurs first, the manufacturer shall comply with Section 2-5.

Chapter 3 Labeling and Information

3-1 Emergency Medical Garments.

3-1.1 Product Label Requirements.

3-1.1.1 Each garment shall have a product label or labels permanently and conspicuously attached to the garment. At least one product label shall be conspicuously located inside each garment when the garment is properly assembled with all layers and components in place.

3-1.1.2 Multiple label pieces shall be permitted in order to carry all statements and information required to be on the product label; however, all label pieces comprising the entire product label shall be located adjacent to each other.

3-1.1.3 All worded portions of the required product label shall be at least in English.

3-1.1.4 Symbols and other pictorial graphic representations shall be permitted to be used to supplement worded statements on the product label(s).

3-1.1.5 The product label of each garment that has been designated by the manufacturer as a single-use garment, in accordance with 4-1.1, shall have the following statement printed in letters that are at least 3 mm ($^1/_{16}$ in.) high.

THIS GARMENT IS FOR SINGLE USE ONLY.

3-1.1.6 The certification organization's label, symbol, or identifying mark and at least the following statement shall be legibly printed on the product label. All letters shall be at least 1.5 mm ($^1/_{16}$ in.) high.

"THIS (insert name of garment type, e.g., coveralls, sleeve protector) MEETS THE EMERGENCY MEDICAL GARMENT REQUIREMENTS OF NFPA 1999, STANDARD ON PROTECTIVE CLOTHING FOR EMERGENCY MEDICAL OPERATIONS, 1997 EDITION."

3-1.1.7 The following information shall also be printed legibly on the product label. All letters shall be at least 1.5 mm ($^1/_{16}$ in.) high.

(a) Manufacturer's name, identification, or designation
(b) Manufacturer's address
(c) Country of manufacture
(d) Garment model and style
(e) Trace number
(f) Date of manufacture
(g) Size

3-1.2 User Information.

3-1.2.1 The garment manufacturer shall provide the following instructions and information with each garment, as applicable:

(a) Pre-use information
1. Safety considerations
2. Limitations of use
3. Garment-marking recommendations and restrictions
4. A statement that most performance properties of the garment cannot be tested by the user in the field
5. Warranty information

(b) Preparation for use
1. Sizing/adjustment
2. Recommended storage practices

(c) Inspection frequency and details

(d) Don/doff
1. Donning and doffing procedures
2. Sizing and adjustment procedures
3. Interface issues

(e) Proper use consistent with NFPA 1500, *Standard on Fire Department Occupational Safety and Health Program; NFPA 1581, Standard on Fire Department Infection Control Program; and OSHA 29 CFR 1910.132, General Requirements of Subpart I, Personal Protective Equipment*

(f) Maintenance and cleaning
1. Cleaning instructions and precautions with a statement advising users not to use garments that are not thoroughly cleaned and dried
2. Inspection details
3. Maintenance criteria and methods of repair where applicable
4. Decontamination procedures for biological contamination

(g) Retirement and disposal criteria and considerations

3-1.3 Technical Data Package.

3-1.3.1* Upon the request of the purchaser or end user, the manufacturer shall furnish a technical data package with each type of garment.

3-1.3.2 The technical data package shall contain all documentation required by this standard and the data showing compliance with this standard.

3-1.3.3 In the technical data package, the manufacturer shall describe the garment in terms of manufacturer trade name and model number, manufacturer-replaceable components, and available sizes, options, and accessories.

3-1.3.4 In the technical package, the manufacturer shall provide a list and descriptions of the following garment materials and components, if applicable:

(a) Garment materials
(b) Zipper/closure type and materials
(c) Material seam types and composition

(d) External fitting types and materials

(e) External gasket types and materials

3-1.3.4.1 All descriptions of material composition shall specify either the generic material names or the trade names if the composition of the material is proprietary.

3-1.3.4.2 Descriptions of respective garment materials and components shall include the following information, if applicable:

(a) Garment zipper or closure

1. The material(s) of construction for the closure, including chain, slide, pull, and tape for zippers

2. The location and the length of the completed closure assembly

3. A description of any protective covers or flaps

3-1.3.5 In the technical data package, the manufacturer shall describe the type of seams or methods of attachment for the following garment material and component combinations, if applicable:

(a) Garment material–garment material

(b) Garment material–visor

(c) Garment material–glove

(d) Garment material–garment closure

3-2 Emergency Medical Gloves.

3-2.1* Product and Package Product Label Requirements.

3-2.1.1 The package containing the smallest number of glove elements from which the user withdraws the product for use shall have a package product label.

3-2.1.2 The package product label shall be permanently and conspicuously located on the outside of the package or printed on the package. This label shall not be removed, obscured, or otherwise mutilated by the opening of the package when the package is opened as intended.

3-2.1.3 The certification organization's label, symbol, or identifying mark and at least the following statement shall be printed on the package product label. All letters and numbers shall be at least 3.0 mm ($^1/_8$ in.) high.

"THIS GLOVE MEETS THE EMERGENCY MEDICAL GLOVE REQUIREMENTS OF NFPA 1999, STANDARD ON PROTECTIVE CLOTHING FOR EMERGENCY MEDICAL OPERATIONS, 1997 EDITION.

THIS GLOVE IS FOR SINGLE USE ONLY."

3-2.1.4 The following information also shall be printed legibly on the package product label. This portion of the package product label shall not be removed, obscured, or otherwise mutilated by the opening of the package when the package is opened as intended. All letters and numbers shall be at least 1.5 mm ($^1/_{16}$ in.) high.

(a) Manufacturer's name, identification, or designation

(b) Manufacturer's address

(c) Country of manufacture

(d) Glove model and style

(e) Trace number

(f) Date of manufacture

(g) Size

3-2.1.5 All portions of the required product labels and package product labels shall be printed at least in English.

3-2.1.6 Symbols and other pictorial graphic representations shall be permitted to be used to supplement worded statements on the product labels and package product labels.

3-2.1.7 In addition to the required package product label, each glove shall be permitted to have a product label on the outside of the glove gauntlet.

3-2.1.8 Where each glove has a product label, the certification organization's label, symbol, or identifying mark and at least the following statement shall be legibly printed as the product label on each glove. All letters and numbers shall be at least 3.0 mm ($^1/_8$ in.) high.

"MEETS NFPA 1999 (1997 ED.)"

3-2.2 User Information.

3-2.2.1 The glove manufacturer shall provide the following instructions and information with each package of gloves, as applicable:

(a) Pre-use information

1. Safety considerations

2. Limitations of use

3. Glove-marking recommendations and restrictions

4. A statement that most performance properties of the glove cannot be tested by the user in the field

5. Warranty information

(b) Preparation for use

1. Sizing

2. Recommended storage practices

(c) Inspection frequency and details

(d) Don/doff

1. Donning and doffing procedures

2. Sizing procedures

3. Interface issues

(e) Proper use consistent with NFPA 1500, *Standard on Fire Department Occupational Safety and Health Program,* and NFPA 1581, *Standard on Fire Department Infection Control Program*

(f) Maintenance and cleaning

1. Inspection details

2. Decontamination procedures for biological contamination

(g) Disposal criteria and considerations

3-2.3 Technical Data Package.

3-2.3.1* Upon the request of the purchaser or end user, the manufacturer shall furnish a technical data package with each type of glove.

3-2.3.2 The technical data package shall contain all documentation required by this standard and the data showing compliance with this standard.

3-2.3.3 In the technical data package, the manufacturer shall provide the following information, if applicable:

(a) Name or designation of manufacturer

(b) Model number or design

(c) Material composition

(d) Description of material seams

(e) Type of linings or surface treatments

(f) Available glove sizes

3-2.3.4 The description of the material composition shall specify either the generic material name or the trade name if the composition of the material is proprietary.

3-3 Emergency Medical Face Protection Devices.

3-3.1* Product and Package Product Label Requirements.

3-3.1.1 The package containing the smallest number of face protection device elements from which the user withdraws the product for use shall have a package product label.

3-3.1.2 The package product label shall be permanently and conspicuously located on the outside of the package or printed on the package. This label shall not be removed, obscured, or otherwise mutilated by the opening of the package when the package is opened as intended.

3-3.1.3 The package product label of face protection devices that have been designated by the manufacturer as single-use devices, in accordance with 4-3.1, shall have the following statement printed in letters that are at least 3 mm ($^1/_8$ in.) high.

"THIS FACE PROTECTION DEVICE IS FOR SINGLE USE ONLY."

3-3.1.4 The certification organization's label, symbol, or identifying mark and at least the following statement shall be printed on the package product label. All letters and numbers shall be at least 3.0 mm ($^1/_8$ in.) high.

"THIS DEVICE MEETS THE EMERGENCY MEDICAL FACE PROTECTION REQUIREMENTS OF NFPA 1999, STANDARD ON PROTECTIVE CLOTHING FOR EMERGENCY MEDICAL OPERATIONS, 1997 EDITION."

3-3.1.5 The following information also shall be printed legibly on the package product label. This portion of the package product label shall not be removed, obscured, or otherwise mutilated by the opening of the package when the package is opened as intended. All letters and numbers shall be at least 1.5 mm ($^1/_{16}$ in.) high.

(a) Manufacturer's name, identification, or designation

(b) Manufacturer's address

(c) Country of manufacture

(d) Device model and style

(e) Trace number

(f) Date of manufacture

(g) Size

3-3.1.6 All portions of the required product labels and package product labels shall be printed at least in English.

3-3.1.7 Symbols and other pictorial graphic representations shall be permitted to be used to supplement worded statements on the product labels and package product labels.

3-3.1.8 Where face protection devices are intended for multiple use, each face protection device shall have a product label, in addition to the required package product label, in a conspicuous location on the device that shall not interfere with the wearer's vision.

3-3.1.9 The certification organization's label, symbol, or identifying mark and at least the following statement shall be legibly printed on the product label of each multiple-use face protection device. All letters and numbers shall be at least 1.5 mm ($^1/_{16}$ in.) high.

"MEETS NFPA 1999 (1997 ED.)"

3-3.1.10 Face protection devices that are intended for single use shall be permitted to have a product label, in addition to the required package product label, in a conspicuous location on the device that shall not interfere with the wearer's vision.

3-3.1.11 Where single-use face protection devices bear a product label, the certification organization's label, symbol, or identifying mark and at least the following statement shall be legibly printed on the product label of the face protection device. All letters and numbers shall be at least 1.5 mm ($^1/_{16}$ in.) high.

"MEETS NFPA 1999 (1997 ED.)"

3-3.2 User Information.

3-3.2.1 The face protection device manufacturer shall provide the following instructions and information with each package of face protection devices, as applicable:

(a) Pre-use information

1. Safety considerations

2. Limitations of use

3. Face protection device marking recommendations and restrictions

4. A statement that most performance properties of the face protection device cannot be tested by the user in the field

5. Warranty information

(b) Preparation for use

1. Sizing/adjustment

2. Recommended storage practices

(c) Inspection frequency and details

(d) Don/doff

1. Donning and doffing procedures

2. Sizing and adjustment procedures

3. Interface issues

(e) Proper use consistent with NFPA 1500, *Standard on Fire Department Occupational Safety and Health Program,* and NFPA 1581, *Standard on Fire Department Infection Control Program*

(f) Maintenance and cleaning

1. Cleaning instructions and precautions with a statement advising users not to use face protection devices that are not thoroughly cleaned and dried

2. Inspection details

3. Maintenance criteria and methods of repair where applicable

4. Decontamination procedures for biological contamination

(g) Retirement and disposal criteria and considerations

3-3.3 Technical Data Package.

3-3.3.1* Upon the request of the purchaser or end user, the manufacturer shall furnish a technical data package with each type of face protection device.

3-3.3.2 The technical data package shall contain all documentation required by this standard and the data showing compliance with this standard.

3-3.3.3 In the technical data package, the manufacturer shall provide the following information, if applicable:

(a) Name or designation of manufacturer
(b) Model number or design
(c) Material composition
(d) Description of any hardware
(e) Replaceable items
(f) Available sizes

3-3.3.4 The description of the material composition shall specify either the generic material name or the trade name if the composition of the material is proprietary.

Chapter 4 Design Requirements

4-1 Emergency Medical Garment Design Requirements.

4-1.1 The manufacturer shall designate whether the garment is designed to meet the single-use requirements or the multiple-use requirements.

4-1.2 Garments shall be designed to cover any part of the torso, excluding hands, face, and feet. Garments shall be permitted to be configured as, but are not limited to, full body clothing such as suits, coveralls, and patient/victim isolation bags; and non-full body clothing such as aprons and sleeve protectors.

4-1.3* All portions of the body covered by the garment element shall be protected by the barrier layer.

4-1.4* The barrier layer shall be a single, nonseparable layer.

4-1.5* All external fittings including, but not limited to, zippers, snaps, or other fasteners of specimen garments shall be examined and shall be free of rough spots, burrs, or sharp edges that could tear the garment or glove materials.

4-1.6 Any accessories attached to any garment shall not interfere with the function of that garment or with the function of any of the garment's component parts.

4-1.7 Where garments are provided with an accessory or accessories, the garment shall meet all of the design and performance requirements of this standard with accessories installed. In all cases, such accessories shall not degrade the performance of the garment.

4-2 Emergency Medical Glove Design Requirements.

4-2.1* Gloves shall be designated as single-use only.

4-2.2 Gloves shall be designed and configured to provide protection to the hand from the fingertips to at least 25.4 mm (1 in.) beyond the wrist crease.

4-2.3 The glove shall be permitted to have a gauntlet that extends beyond the opening of the glove body.

4-2.4* All compliant gloves shall be Class 1 Medical Devices and shall meet the requirements of 21 CFR 880.

4-2.5 In order to label or otherwise represent a glove as being compliant with the requirements of this standard, the manufacturer shall provide gloves in not less than five separate and distinct sizes. Gloves shall be permitted to be provided in ambidextrous sizing consistent with the following dimensions. The glove size on the product label shall be determined as specified in Table 4-2.5.

Table 4-2.5 Glove Sizing

Labeled Size to Fit	Hand Circumference	Hand Length
XS	178 to 203 mm (7–8 in.)	Up to 171.5 mm ($6\,^3/_4$ in.)
S	203 to 228.5 mm (8–9 in.)	Up to 181 mm ($7\,^1/_8$ in.)
M	228.5 to 254 mm (9–10 in.)	Up to 190.5 ($7\,^1/_2$ in.)
L	254 to 279.5 mm (10–11 in.)	Up to 203 mm (8 in.)
XL	279.5 to 305 mm (11–12 in.)	Up to 213 mm ($8\,^3/_8$ in.)

4-2.5.1 Hand dimensions for selection of proper glove size shall consist of measuring two dimensions, as shown in Figure 4-2.5.1; the hand circumference and the length of the right hand.

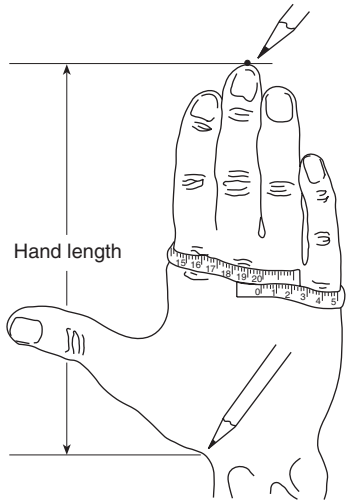

Figure 4-2.5.1 Method of measuring hand dimensions for selection of proper glove size.

4-2.5.2 Hand circumference shall be measured by placing the measuring tape on a table or other flat surface, with the numerals facing downward. The subject shall place the right hand, palm down and fingers together, in the middle of the tape so that the tape can pass straight across the hand just beneath the knuckles (metacarpal). The circumference shall be measured snugly to the nearest 3.2 mm ($^1/_8$ in.), as shown in Figure 4-2.5.1.

4-2.5.3 Hand length shall be measured by placing the subject's right hand, palm down, on a piece of paper with the fingers together and the hand and arm in a straight line. The thumb shall be fully adducted, extended away from the palm as far as possible. The paper shall be marked at the tip of the third or middle finger. The notch at the base of the thumb where the thumb joins the wrist shall be marked with a pencil. The straight-line distance between the two points shall be measured to the nearest 3.2 mm ($^1/_8$ in.), as shown in Figure 4-2.5.1.

4-2.6* Specimen gloves and related hardware of gloves shall be examined and shall be free of rough spots, burrs, or sharp edges that could tear the garment or glove material.

4-2.7 Any accessories attached to any glove shall not interfere with the function of that glove or with the function of any of the glove's component parts.

4-2.8 Where gloves are provided with an accessory or accessories, the glove shall meet all of the design and performance requirements of this standard with accessories installed. In all cases, such accessories shall not degrade the performance of the glove.

4-3 Emergency Medical Face Protection Device Design Requirements.

4-3.1 The manufacturer shall designate whether the face protection device is designated to meet the single-use requirements or the multiple-use requirements.

4-3.2 Face protection devices shall be designed to cover part or all of the face or head. Face protection devices shall be permitted to be configured as, but are not limited to, splash-resistant eyewear, hooded visors, and masks.

4-3.3 Face protection devices that are compliant with this standard are not intended to be primary eye protection but shall be permitted to be primary eye protection.

4-3.4* Specimen face protection devices and related hardware of specimen face protection devices shall be examined and shall be free of rough spots, burrs, or sharp edges that could tear garment or glove materials.

4-3.5 Any accessories attached to any face protection device shall not interfere with the function of that face protection device or with the function of any of the face protection device's component parts.

4-3.6 Where face protection devices are provided with an accessory or accessories, the face protection device shall meet all of the design and performance requirements of this standard with accessories installed. In all cases, such accessories shall not degrade the performance of the face protection device.

Chapter 5 Performance Requirements

5-1* Emergency Medical Garment Performance Requirements.

5-1.1 Specimen garments shall be tested for liquidtight integrity as specified in Section 6-2, Liquidtight Integrity Test One, and shall allow no water penetration.

5-1.2 Specimens of garment material and seams shall be tested for biopenetration resistance as specified in Section 6-3, Biopenetration Test One, and shall exhibit no penetration of the Phi-X-174 bacteriophage.

5-1.3 Specimens of each separable layer of garment material shall be tested for tensile strength as specified in Section 6-4, Tensile Strength Test, and shall have a tensile strength of not less than 133.5 N (30 lbf).

5-1.4 Specimens of each separable layer of garment material shall be tested for bursting strength as specified in Section 6-5, Burst Strength Test, and shall have a bursting strength of not less than 345 kPa (50 psi).

5-1.5 Specimens of each separable layer of garment material shall be tested for puncture resistance as specified in Section 6-6, Puncture Propagation Tear Resistance Test, and shall have a puncture resistance of not less than 24.5 N (5.5 lbf).

5-1.6 Specimens of each separable layer of garment material shall be tested for tear strength as specified in Section 6-7, Tear Resistance Test, and shall have a tear strength of not less than 35.6 N (8.0 lbf).

5-1.7 Specimens of seams from each separable layer of garment material shall be tested for breaking strength as specified in Section 6-8, Seam/Closure Breaking Strength Test, and shall have a breaking strength of not less than 66.7 N/50.8 mm (15 lbf/2 in.).

5-1.8 Specimens of garment closure assemblies shall be tested for breaking strength as specified in Section 6-8, Seam/Closure Breaking Strength Test, and shall have a breaking strength of not less than 66.7 N/50.8 mm (15 lbf/2 in.).

5-2* Emergency Medical Glove Performance Requirements.

5-2.1 Specimen gloves shall be tested for liquidtight integrity as specified in Section 6-9, Liquidtight Integrity Test Two, and shall have an Acceptable Quality Limit of 1.5 or better.

5-2.2 Specimen gloves shall be tested for biopenetration resistance as specified in Section 6-10, Biopenetration Test Two, and shall exhibit no penetration of the Phi-X-174 bacteriophage.

5-2.3 Specimens of a glove material shall be tested for strength as specified in Section 6-11, Ultimate Tensile Strength, Elongation, and Modulus Test, and shall have an ultimate tensile strength of not less than 13.8 MPa (2000 psi) and shall have a modulus of not more than 2.07 MPa (300 psi) at 300 percent elongation.

5-2.4 Specimens of a glove material shall be tested for elongation as specified in Section 6-12, Ultimate Elongation Test, and shall have an ultimate elongation of not less than 500 percent.

5-2.5 Specimens of a glove material shall be tested for puncture resistance as specified in Section 6-13, Puncture Resistance Test, and shall have a puncture resistance of not less than 4.45 N (1.0 lbf).

5-2.6 Specimen gloves shall be tested for dexterity as specified in Section 6-14, Dexterity Test, and shall have test times no greater than 106 percent of baseline test measurements.

5-2.7 Specimens of a glove material shall be tested for protein levels as specified in Section 6-15, Protein Content Test, and shall have protein levels no greater than 100 μg/g.

5-3* Emergency Medical Face Protection Device Performance Requirements.

5-3.1 Specimen face protection devices shall be tested for visual acuity as specified in Section 6-16, Visual Acuity Test, and the test subjects shall be able to read at least the 20/20 visual acuity line or better. The face protection device shall also remain functional, and shall be able to be donned and adjusted in accordance with the manufacturer's instructions.

5-3.2 Specimen face protection devices shall be tested for liquidtight integrity as specified in Section 6-17, Liquidtight Integrity Test Three, and shall allow no liquid penetration.

5-3.3 Specimens of representative materials and seams used in the actual construction of face protection devices shall be tested for biopenetration resistance as specified in Section 6-3, Biopenetration Test One, and shall exhibit no penetration of the Phi-X-174 bacteriophage.

Chapter 6 Test Methods

6-1 Sample Preparation Procedures.

6-1.1 Application.

6-1.1.1 The sample preparation procedures contained in this section shall apply to each test method in this chapter, as specifically referenced in the sample preparation section of each test method.

6-1.1.2 Only the specific sample preparation procedure or procedures referenced in the sample preparation section of each test method shall be applied to that test method.

6-1.2 Room Temperature Conditioning Procedure for Garments, Gloves, and Face Protection Devices.

6-1.2.1 Samples shall be conditioned at a temperature of 21°C, ± 3°C (70°F, ± 5°F) and a relative humidity of 65 percent, ± 5 percent, until equilibrium is reached, as determined in accordance with Section 4 of Federal Test Method Standard 191A, *Textile Test Methods,* or for at least 24 hr, whichever time period is shortest.

6-1.2.2 Specimens shall be tested within 5 min after removal from conditioning.

6-1.3 Washing and Drying Procedure for Garments.

6-1.3.1 Samples shall be subjected to 25 cycles of washing and drying in accordance with the procedure specified in Machine Cycle 3, Wash Temperature III, and Drying Procedure Aiii of ANSI/AATCC 135, *Dimensional Changes in Automatic Home Laundering of Woven and Knit Fabrics.*

6-1.3.2 A single garment, plus sufficient ballast if needed to create a minimum load of 1.8 kg, ± 0.1 kg (4.0 lb, ± 0.2 lb), shall be used.

6-1.3.3 The samples shall be prepared for washing in accordance with the manufacturer's instructions.

6-1.3.4 In all cases, a laundry bag shall not be used.

6-1.4 Flexural Fatigue Procedure for Gloves.

6-1.4.1 Sample gloves shall be subjected to one full cycle of testing for dexterity testing as specified in Section 6-14.

6-1.5 Isopropanol Immersion Procedure for Gloves.

6-1.5.1 Sample gloves shall be totally immersed in 100 percent isopropanol at room temperature for a period of 2 hr.

6-1.5.2 Sample gloves shall be removed from the isopropanol, hung in a vertical position for 5 min, laid horizontal with AATCC textile blotting paper both under and over the specimen, under a weight of 0.002 kg/cm^2, ± 0.0002 kg/cm^2 (0.5 psi ± 0.05 psi) for a period of 20 min as specified in ANSI/AATCC 70, *Test Method for Water Repellency: Tumble Jar Dynamic Absorption Test.*

6-1.5.3 Specimens then shall be cut from the sample after conditioning.

6-1.5.4 Specimens shall be tested within 5 min following blotting.

6-1.6 Heat Aging Procedure for Gloves.

6-1.6.1 Glove samples shall be subjected to heat aging in accordance with ASTM D 573, *Standard Test Method for Rubber-Deterioration in an Air Oven,* at a temperature of 70°C, ± 2°C (158°F, ± 3.6°F) for 166 hr, ±2 hr.

6-1.6.2 The sample gloves shall be allowed to cool for 10 min, ± 1 min prior to testing.

6-2 Liquidtight Integrity Test One.

6-2.1 Application.

6-2.1.1 This test method shall apply to garments.

6-2.1.2 Specimen garments that are designated for single use or multiple use in accordance with 4-1.1 shall be subjected to different sample preparation procedures specified in 6-2.3.

6-2.2 Specimens.

6-2.2.1 A minimum of one specimen shall be tested. Specimens shall consist of the entire garment with all layers assembled that are required for the garment to be compliant.

6-2.2.2 The size of the garment comprising the specimen shall be chosen to conform with the dimensions of the mannequin, to ensure proper fit of the specimen on the mannequin, in accordance with the manufacturer's sizing system. The size of the garments comprising the specimen shall be the same size as the mannequin in terms of chest circumference, waist circumference, and inseam height.

6-2.3 Sample Preparation.

6-2.3.1 Samples for conditioning shall be complete garments.

6-2.3.2 Specimens for single-use garments shall be conditioned as specified in 6-1.2.

6-2.3.3 Specimens for multiple-use garments shall be conditioned as specified in 6-1.3 and then conditioned as specified in 6-1.2.

6-2.4 Apparatus.

6-2.4.1* The apparatus and supplies for testing shall be those specified in ASTM F 1359, *Standard Practice for Determining Liquid-Tight Integrity of Chemical Protective Suits or Ensembles under Static Conditions,* using the following modifications:

(a) The surface tension of the water used in testing shall be 35 dynes/cm, ± 5 dynes/cm.

(b) The mannequin used in testing shall have straight arms and legs, with the arms positioned downward at the mannequin's side.

6-2.5 Procedure.

6-2.5.1 Liquidtight integrity testing of garments shall be conducted in accordance with ASTM F 1359, *Standard Practice for Determining Liquid-Tight Integrity of Chemical Protective Suits or Ensembles under Static Conditions,* with the following modifications:

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

(b) * The method used for mounting of the mannequin in the spray chamber shall not interfere with the water spray.

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

(d) The suited mannequin shall be exposed to the liquid spray for a total of 20 min, 5 min in each of the four specified mannequin orientations.

(e) At the end of the liquid spray exposure period, excess liquid shall be removed from the surface of the specimen.

(f) Inspection of the liquid-absorptive garment on the mannequin shall be completed within 10 min of the end of the liquid spray exposure period.

6-2.6 Report.

6-2.6.1* A diagram shall be prepared for each test that identified the locations of any liquid leakage as detected on the liquid-absorptive garment.

6-2.7 Interpretation.

6-2.7.1 Any evidence of liquid on the liquid-absorptive garment, as determined by visual inspection, tactile inspection, or by absorbent toweling, shall constitute failure of the specimen.

6-3 Biopenetration Test One.

6-3.1 Application.

6-3.1.1 This test shall be applied to the barrier layer used in the construction of garments and face protection devices.

6-3.1.2 Specimen garments that are designated for single use or multiple use in accordance with 4-1.1 shall be subjected to different sample preparation procedures as specified in 6-3.3.

6-3.1.3 Specimen face protection devices that are designated for single use or multiple use in accordance with 4-3.1 shall be subjected to the sample preparation procedures specified for single- and multiple-use face protection devices in 6-3.3.

6-3.1.4 Modifications to this test method for testing garments shall be as specified in 6-3.7.

6-3.1.5 Modifications to this test method for testing face protection devices shall be as specified in 6-3.8.

6-3.2 Specimens.

6-3.2.1 A minimum of three specimens shall be tested. Specimens shall consist of three 76.2-mm (3.0-in.) squares for each material type.

6-3.3 Sample Preparation.

6-3.3.1 Samples of single-use garments shall be conditioned as specified in 6-1.2.

6-3.3.2 Samples of multiple-use garments, including seams, shall be conditioned as specified in 6-1.3 and then conditioned as specified in 6-1.2.

6-3.3.3 Samples of single- and multiple-use face protection devices shall be conditioned as specified in 6-1.2.

6-3.4 Procedure.

6-3.4.1 Liquid penetration resistance testing shall be conducted in accordance with ASTM F 1671, *Standard Test Method for Resistance of Materials Used in Protective Clothing to Penetration by Blood-Borne Pathogens Using Phi-X-174 Bacteriophage Penetration as a Test System.*

6-3.5 Report.

6-3.5.1 The pass/fail result for each specimen shall be reported.

6-3.6 Interpretation.

6-3.6.1 A failure of any specimen constitutes failure of the material.

6-3.7 Specific Requirements for Testing Garments.

6-3.7.1 Specimens for biopenetration testing shall consist of the barrier layer only.

6-3.8 Specific Requirements for Testing Face Protection Devices.

6-3.8.1 Samples for conditioning shall be whole-face protection devices.

6-3.8.2 Three specimens each shall be taken from materials used in the construction of the face protection device that are intended to act as the barrier material.

6-4 Tensile Strength Test.

6-4.1 Application.

6-4.1.1 This test shall be applied to each separable layer of materials used in the construction of garments.

6-4.1.2 Specimen garments and components that are designated for single use or for multiple use in accordance with 4-1.1 shall be subjected to different sample preparation procedures as specified in 6-4.3.

6-4.2 Specimens.

6-4.2.1 Five specimens in each of the warp and fill directions shall be tested from each sample unit.

6-4.3 Sample Preparation.

6-4.3.1 Samples for conditioning shall be the entire garment.

6-4.3.2 Samples for single-use garments shall be conditioned as specified in 6-1.2.

6-4.3.3 Samples for multiple-use garments shall be conditioned as specified in 6-1.3 and then conditioned as specified in 6-1.2.

6-4.4 Procedure.

6-4.4.1 Specimens shall be tested in accordance with Section 9, Breaking Strength, A — Grab Method, of ASTM D 751, *Standard Test Methods for Coated Fabrics.*

6-4.5 Report.

6-4.5.1 The tensile strength of each specimen shall be reported to the nearest 0.05 kg (0.1 lb) of force. An average tensile strength shall be calculated for warp and fill directions.

6-4.6 Interpretation.

6-4.6.1 Pass/fail performance shall be based on the average tensile strength in the warp and fill directions. Failure in any one direction constitutes failure for the material.

6-5 Burst Strength Test.

6-5.1 Application.

6-5.1.1 This test shall apply to materials used in the construction of garments. If the garment is constructed of several separable layers, each separable layer of garment material shall be tested.

6-5.1.2 Specimen garments and components that are designated for single use or for multiple use in accordance with 4-1.1 shall be subjected to different sample preparation procedures as specified in 6-5.3.

6-5.2 Specimens.

6-5.2.1 A total of 10 specimens shall be tested.

6-5.3 Sample Preparation.

6-5.3.1 Samples for conditioning shall be the entire garment.

6-5.3.2 Specimens for single-use garments shall be conditioned as specified in 6-1.2.

6-5.3.3 Specimens for multiple-use garments shall be conditioned as specified in 6-1.3 and then conditioned as specified in 6-1.2.

6-5.4 Procedure.

6-5.4.1 Specimens shall be tested in accordance with Section 15.3, Diaphragm Bursting Testing, of ASTM D 751, *Standard Test Methods for Coated Fabrics.*

6-5.5 Report.

6-5.5.1 The burst strength of each specimen shall be reported to the nearest 7.0 kPa (1 psi). The average burst strength of all specimens shall be calculated and reported.

6-5.6 Interpretation.

6-5.6.1 The average burst strength shall be used to determine pass/fail performance.

6-6 Puncture Propagation Tear Resistance Test.

6-6.1 Application.

6-6.1.1 This test shall apply to materials used in the construction of garments. If the garment is constructed of several layers, then all layers, assembled in the same order in which they appear in the garment, shall be tested as a composite. If the garment is constructed of several layers, then each separable layer of garment material shall be tested individually.

6-6.1.2 Specimen garments and components that are designated for single use or for multiple use in accordance with 4-1.1 shall be subjected to different sample preparation procedures as specified in 6-6.3.

6-6.2 Specimens.

6-6.2.1 Five specimens in each of the warp and fill directions shall be tested from each sample unit.

6-6.3 Sample Preparation.

6-6.3.1 Samples for conditioning shall be the entire garment.

6-6.3.2 Specimens for single-use garments shall be conditioned as specified in 6-1.2.

6-6.3.3 Specimens for multiple-use garments shall be conditioned as specified in 6-1.3 and then conditioned as specified in 6-1.2.

6-6.4 Procedure.

6-6.4.1 Specimens shall be tested in accordance with ASTM D 2582, *Standard Test Method for Puncture-Propagation Tear Resistance of Plastic Film and Thin Sheeting.*

6-6.5 Report.

6-6.5.1 The puncture propagation tear resistance of each specimen shall be reported to the nearest 0.05 kg (0.1 lb) of force. An average puncture propagation tear resistance shall be calculated for warp and fill directions.

6-6.6 Interpretation.

6-6.6.1 Pass/fail performance shall be based on the average puncture propagation tear resistance in the warp and fill directions. Failure in any one direction constitutes failure for the material.

6-7 Tear Resistance Test.

6-7.1 Application.

6-7.1.1 This test shall be applied to each layer of materials used in the construction of garments.

6-7.1.2 Specimen garments and components that are designated for single use or for multiple use in accordance with 4-1.1 shall be subjected to different sample preparation procedures as specified in 6-7.3.

6-7.2 Specimens.

6-7.2.1 Five specimens in each of the warp and fill directions shall be tested from each sample unit. Specimens shall be 76.2-mm × 152.4-mm (3-in. × 6-in.) rectangles. The long dimension shall be parallel to the warp for warp tests and parallel to the fill for filling tests. No two specimens for warp tests shall contain the same warp yarns, nor shall any two specimens for filling tests contain the same filling yarns. The specimen shall be taken no nearer the selvage than one-tenth of the width of the clothing.

6-7.2.2 An isosceles trapezoid having an altitude of 76.2 mm (3 in.) and bases of 25.4 mm and 101.6 mm (1 in. and 4 in.) in length, respectively, shall be marked on each specimen, with the aid of a template. A cut 9.5 mm ($^3/_8$ in.) in length then shall be made in the center of a line perpendicular to the 25.4-mm (1-in.) edge.

6-7.3 Sample Preparation.

6-7.3.1 Samples for conditioning shall be the entire garment.

6-7.3.2 Specimens for single-use garments shall be conditioned as specified in 6-1.2.

6-7.3.3 Specimens for multiple-use garments shall be conditioned as specified in 6-1.3 and then conditioned as specified in 6-1.2.

6-7.4 Apparatus.

6-7.4.1 Apparatus shall consist of a straining mechanism, two clamps for holding specimens, and load and elongation recording mechanisms, wherein the specimen is held between two clamps and strained by a uniform movement of the pulling clamp. The test machine shall be operated at a rate of 304.8 mm/min (12 in./min).

6-7.4.2 Straining mechanisms shall be of such capacity that the maximum load required to break the specimen shall be not greater than 85 percent or less than 15 percent of the manufacturer's rated capacity.

6-7.4.3 Clamps shall be designed such that the 170 g (6 oz) weight is distributed evenly across the complete width of the sample. The clamps shall have two jaws on each clamp. The design of the clamps shall be such that one gripping surface or jaw shall be permitted to be an integral part of the rigid frame of the clamp or be fastened to allow a slight vertical movement, while the other gripping surface or jaw shall be completely movable. The dimensions of the immovable jaw of each clamp parallel to the application of the load shall measure 25.4 mm (1 in.), and the dimension of the jaw perpendicular to this direction shall measure 76.2 mm (3 in.) or more. The face of the movable jaw of each clamp shall measure 25.4 mm × 76.2 mm (1 in. × 3 in.). Each jaw face shall have a flat, smooth gripping surface. All edges that might cause a cutting action shall be rounded to a radius of not more than 0.4 mm ($^1/_{64}$ in.). In cases where a cloth tends to slip while being tested, the jaws shall be faced with rubber or other material to prevent slippage. The distance between the jaws shall be 25.4 mm (1 in.) at the start of the test.

6-7.4.4 The recorder shall consist of calibrated dial, scale, or chart used to indicate applied load and elongation. Error shall not exceed 2 percent up to and including a 222.5-N (50-lbf) load and 1 percent over a 222.5-N (50-lbf) load at any reading within its loading range. All machine attachments for determining maximum loads shall be disengaged during the test.

6-7.5 Procedure.

6-7.5.1 The specimen shall be clamped along the nonparallel sides of the trapezoids so that these sides lie along the lower edge of the upper clamp and the upper edge of the lower clamp with the cut halfway between the clamps. The short trapezoid base shall be held taut, and the long trapezoid base shall lie in the folds.

6-7.5.2 The strain mechanism shall be started and the force necessary to tear the cloth shall be observed by means of the recording device.

6-7.5.3 If a specimen slips between the jaws, breaks in or at the edges of the jaws, or if for any reason attributable to faulty technique, an individual measurement falls markedly below the average test results for the sample unit, such result shall be discarded and another specimen shall be tested.

6-7.6 Report.

6-7.6.1 The tear strength of an individual specimen shall be the average of the five highest peak loads of resistance registered for inches of separation of the tear. The tear strength of each specimen shall be reported to the nearest 0.44 N (0.1 lb) of force. An average tear strength shall be calculated for warp and fill directions.

6-7.7 Interpretation.

6-7.7.1 Pass/fail performance shall be based on the average tear strength in the warp and fill directions. Failure in any one direction constitutes failure for the material.

6-8 Seam/Closure Breaking Strength Test.

6-8.1 Application.

6-8.1.1 This test shall be applied to seams and closure assemblies used in the construction of garments. Where garments consist of multiple separable layers, the test shall be applied to the seams of each separable layer and closure assemblies.

6-8.1.2 Specimen garments and components that are designated for single use or for multiple use in accordance with 4-1.1 shall be subjected to different sample preparation procedures as specified in 6-8.3.

6-8.1.3 Modifications to this test method for testing seams shall be as specified in 6-8.7.

6-8.1.4 Modifications to this test method for testing closure assemblies shall be as specified in 6-8.8.

6-8.2 Specimens.

6-8.2.1 A minimum of five seams and five closure assembly specimens representative of the garment shall be tested for each seam and closure assembly type.

6-8.2.2 Straight-seam specimens and closure assembly specimens shall be cut from conditioned samples.

6-8.3 Sample Preparation.

6-8.3.1 Samples for conditioning shall be the entire garment.

6-8.3.2 Samples for single-use garments shall be conditioned as specified in 6-1.2.

6-8.3.3 Samples for multiple-use garments shall be conditioned as specified in 6-1.3 and then conditioned as specified in 6-1.2.

6-8.4 Procedure.

6-8.4.1 All seams and closure assemblies shall be tested in accordance with ASTM D 1683a, *Standard Test Method for Failure in Sewn Seams of Woven Fabrics*. The test machine shall be operated at a rate of 304.8 mm/min (12 in./min).

6-8.5 Report.

6-8.5.1 The breaking strength for each seam or closure assembly specimen shall be reported. The average breaking strength for each seam or closure assembly type shall also be reported.

6-8.6 Interpretation.

6-8.6.1 The average breaking strength for each seam or closure assembly type shall be used to determine pass/fail performance.

6-8.7 Specific Procedures for Testing Seams.

6-8.7.1 Specimens for testing shall include at least 101.6 mm (4 in.) of material on either side of the seam.

6-8.8 Specific Procedures for Testing Closure Assemblies.

6-8.8.1 Specimens for testing shall include at least 101.6 mm (4 in.) of material on either side of the closure.

6-9 Liquidtight Integrity Test Two.

6-9.1 Application.

6-9.1.1 This test shall be applied to whole gloves.

6-9.2 Specimens.

6-9.2.1 A minimum of 32 whole-glove specimens shall be tested.

6-9.3 Sample Preparation.

6-9.3.1 Samples for conditioning shall be whole gloves.

6-9.3.2 Specimens shall be conditioned as specified in 6-1.2.

6-9.4 Procedure.

6-9.4.1* Liquidtight integrity shall be conducted in accordance with ASTM D 5151, *Standard Test Method for Detection of Holes in Medical Gloves,* with the following modifications. Water shall be replaced with water treated with a surfactant to achieve a surface tension of 35 ± 5 dynes/cm.

6-9.5 Report.

6-9.5.1 The pass/fail result for each specimen shall be reported.

6-9.6 Interpretation.

6-9.6.1 Passing performance shall be considered for a set of glove specimens meeting an Acceptable Quality Limit of 1.5 or better.

6-10 Biopenetration Test Two.

6-10.1 Application.

6-10.1.1 This test shall be applied to whole gloves.

6-10.2 Specimens.

6-10.2.1 A minimum of five whole-glove specimens shall be tested.

6-10.3 Sample Preparation.

6-10.3.1 Samples for conditioning shall be whole gloves.

6-10.3.2 Specimens shall be conditioned as specified in 6-1.4.

6-10.4 Procedure.

6-10.4.1 Liquid penetration resistance testing shall be conducted in accordance with ASTM F 1671, *Standard Test Method for Resistance of Materials Used in Protective Clothing to Penetration by Blood-Borne Pathogens Using Phi-X-174 Bacteriophage Penetration as a Test System,* with the following modifications:

(a) The test shall be performed by placing 800 ml, ± 20 ml (27 fl oz, ± 0.7 fl oz) of Phi-X-174 Bacteriophage suspension into a 1000-ml (34-oz) Erlenmeyer flasks. The specimen shall be carefully immersed into the challenge suspension and shall be positioned such that the distance from the top of the flask to the middle finger of the glove is 180 mm (7 in.). The top of the specimen shall be stretched over the mouth of the flask.

(b) The specimen shall be filled with 250 ml, ± 20 ml (8.5 fl oz, ± 0.7 fl oz) of nutrient broth. Five ml (0.2 fl oz) of nutrient broth shall be removed from the interior of the specimen and assayed to determine that the specimen was not contaminated.

(c) The specimen cuff shall be sealed onto the flask using parafilm or tape. A sterile closure shall be placed on the top of the flask.

(d) The flask shall be placed onto the platform of an orbital shaker and adjusted to 100 rpm. The flask shall be shaken for a period of 1 hr, ± 5 min.

(e) At the end of 1 hr, the flask shall be removed from the orbital shaker and the contents from inside the specimen shall be carefully transferred to a sterile bottle and assayed for the presence of Phi-Z-174 Bacteriophage.

6-10.5 Report.

6-10.5.1 The pass/fail result for each specimen shall be reported.

6-10.6 Interpretation.

6-10.6.1 A failure of any specimen constitutes failure of the material.

6-11 Ultimate Tensile Strength, Elongation, and Modulus Test.

6-11.1 Application.

6-11.1.1 This test shall be applied to glove materials.

6-11.2 Specimens.

6-11.2.1 A minimum of 10 specimens shall be tested.

6-11.2.2 Specimens shall be taken from the palm and back of individual gloves.

6-11.3 Sample Preparation.

6-11.3.1 Samples for conditioning shall be whole gloves.

6-11.3.2 Specimens shall be tested for ultimate tensile strength after conditioning as specified in 6-1.2.

6-11.3.3 Specimens shall be tested for ultimate tensile strength after conditioning as specified in 6-1.6.

6-11.3.4 Specimens shall be tested for modulus at 300 percent elongation after conditioning as specified in 6-1.2.

6-11.4 Procedure.

6-11.4.1 Specimens shall be tested in accordance with Method A — Dumbbell Specimens, of ASTM D 412, *Standard Test Methods for Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers — Tension.*

6-11.5 Report.

6-11.5.1 The ultimate tensile strength before and after heat aging and modulus at 300 percent elongation shall be reported for each specimen to the nearest 138 kPa (20 psi). The average ultimate tensile strength before and after heat aging and modulus at 300 percent elongation shall be reported for all specimens tested.

6-11.6 Interpretation.

6-11.6.1 The average of three test sets for ultimate tensile strength before and after heat aging and the average of three test sets for modulus at 300 percent elongation shall be used to determine pass/fail performance.

6-12 Ultimate Elongation Test.

6-12.1 Application.

6-12.1.1 This test shall be applied to glove materials.

6-12.2 Specimens.

6-12.2.1 A minimum of 10 specimens shall be tested.

6-12.2.2 Specimens shall be taken from the palm and back of individual gloves.

6-12.3 Sample Preparation.

6-12.3.1 Samples for conditioning shall be whole gloves.

6-12.3.2 Specimens shall be tested after conditioning as specified in 6-1.5.

6-12.3.3 Specimens shall be tested after conditioning as specified in 6-1.6.

6-12.4 Procedure.

6-12.4.1 Specimens shall be tested in accordance with Method A — Dumbbell Specimens, of ASTM D 412, *Standard Test Methods for Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers — Tension.*

6-12.5 Report.

6-12.5.1 The ultimate elongation (percentage) shall be reported for each specimen to the nearest 0.1 percent. The average ultimate elongation (percentage) shall be reported for all specimens tested.

6-12.6 Interpretation.

6-12.6.1 The average ultimate elongation after heat aging and the average ultimate elongation after isopropanol immersion shall be used to determine pass/fail performance.

6-13 Puncture Resistance Test.

6-13.1 Application.

6-13.1.1 This test shall be applied to glove materials.

6-13.2 Specimens.

6-13.2.1 A minimum of three specimens measuring at least 76.2 mm (3 in.) square shall be tested.

6-13.2.2 Specimens shall be taken from the palm and back of individual gloves.

6-13.3 Sample Preparation.

6-13.3.1 Samples for conditioning shall be whole gloves.

6-13.3.2 Specimens shall be tested after conditioning as specified in 6-1.2.

6-13.4 Procedure.

6-13.4.1 Specimens shall be tested in accordance with ASTM F 1342, *Standard Test Method for Protective Clothing Material Resistance to Puncture.*

6-13.5 Report.

6-13.5.1 The puncture force shall be reported for each specimen to the nearest 0.44 N (0.1 lbf) of force. The average puncture force shall be reported for all specimens tested.

6-13.6 Interpretation.

6-13.6.1 The average puncture force shall be used to determine pass/fail performance.

6-14 Dexterity Test.

6-14.1 Application.

6-14.1.1 This test shall be applied to whole gloves.

6-14.2 Specimens.

6-14.2.1 A minimum of three glove pairs each for size small and for size large shall be used for testing.

6-14.2.2 Each glove pair shall be tested as a complete set of gloves in new, as distributed, condition.

6-14.3 Sample Preparation.

6-14.3.1 Samples for conditioning shall be whole-glove pairs.

6-14.3.2 Glove pair specimens shall be preconditioned as specified in 6-1.2.

6-14.3.3 Glove pair specimens shall not receive special softening treatments prior to tests.

6-14.4 Procedure.

6-14.4.1 Dexterity shall be evaluated using the standardized procedure known as the Crawford Small Parts Dexterity Test, Screws Technique.

6-14.4.2 Test subjects shall be selected such that their hand dimensions are consistent with those specified in Table 4-2.5.

6-14.4.3 Each test subject used to perform the test shall practice until the baseline times of that person's last three repetitions vary no more than 6 percent.

6-14.4.4 Each test subject shall be tested with a minimum of three pairs of gloves. A minimum of six dexterity tests with gloves shall be conducted, with at least three dexterity tests with size small gloves and three dexterity test with size large gloves.

6-14.4.5 Dexterity test times with gloves shall be compared with baseline dexterity test times for specific test subjects. The percentage of dexterity test times with gloves to baseline dexterity test times shall be calculated as follows:

$$\text{percent of barehanded control} = \frac{\text{dextrity test time (with gloves)}}{\text{dexterity test time (baseline)}} \times 100$$

6-14.5 Report.

6-14.5.1 The percent of barehanded control shall be reported for each glove pair specimen and test subject tested.

6-14.6 Interpretation.

6-14.6.1 One or more glove pair specimens failing this test shall constitute failing performance.

6-15 Protein Content Test.

6-15.1 Application.

6-15.1.1 This test shall be applied to glove materials.

6-15.2 Specimens.

6-15.2.1 Specimens, measuring at least 25 mm (1.0 in.) square, shall be taken from a minimum of three different gloves for each glove type. A minimum of three specimens per glove shall be tested.

6-15.3 Sample Preparation.

6-15.3.1 Samples for conditioning shall be whole gloves and shall be conditioned as specified in 6-1.2.

6-15.3.2 Specimens shall be taken from conditioned samples.

6-15.4 Procedure.

6-15.4.1 Specimens shall be tested in accordance with ASTM D 5712, *Standard Test Method for Analysis of Protein in Natural Rubber and Its Products.*

6-15.5 Report.

6-15.5.1 The protein level of each specimen shall be reported to the nearest 10 µg per gram of glove material. The average protein level shall be calculated for all specimens.

6-15.6 Interpretation.

6-15.6.1 Pass/fail performance shall be based on the average reported protein level for each glove type.

6-16 Visual Acuity Test.

6-16.1 Application.

6-16.1.1 This test method shall apply to that portion of the face protection devices that covers the wearer's eyes.

6-16.2 Specimens.

6-16.2.1 A minimum of three specimens shall be tested. Specimens shall be complete face protection devices.

6-16.2.2 Specimens shall be selected to fit each test subject in accordance with the manufacturer's sizing guidelines.

6-16.3 Sample Preparation.

6-16.3.1 Samples for conditioning shall be complete face protection devices.

6-16.3.2 Samples of single- and multiple-use face protection devices shall be conditioned as specified in 6-1.2.

6-16.4 Procedure.

6-16.4.1 Testing shall be conducted using a minimum of three different test subjects. The test subjects shall have a minimum visual acuity of 20/20 in each eye uncorrected, or corrected with contact lenses, as determined by a visual acuity test or doctors examination.

6-16.4.2 Prior to evaluation for visual acuity, the face protection device shall be inspected for functionality and the ability to be donned and adjusted in accordance with the manufacturer's instructions.

6-16.4.3 To evaluate visual acuity, the face protection device shall be donned and adjusted in accordance with the manufacturer's instructions.

6-16.4.4 The test shall be conducted using a standard 6.1-m (20-ft) eye chart with a normal lighting range of 100 to 150 foot-candles at the chart and with test subjects positioned at a distance of 6.1 m (20 ft) from the chart.

6-16.4.5 Test subjects shall then read the standard eye chart through the face protection device and the visual acuity of each subject shall be determined.

6-16.5 Report.

6-16.5.1 The visual acuity of each test subject through the face protection device shall be reported.

6-16.6 Interpretation.

6-16.6.1 Failure of any one test subject to achieve the required visual acuity while wearing the face protection device shall constitute failure of the test.

6-17 Liquidtight Integrity Test Three.

6-17.1 Application.

6-17.1.1 This test shall apply to a complete face protection device.

6-17.2 Specimens.

6-17.2.1 A minimum of three specimens shall be tested. Specimens shall be complete face protection devices.

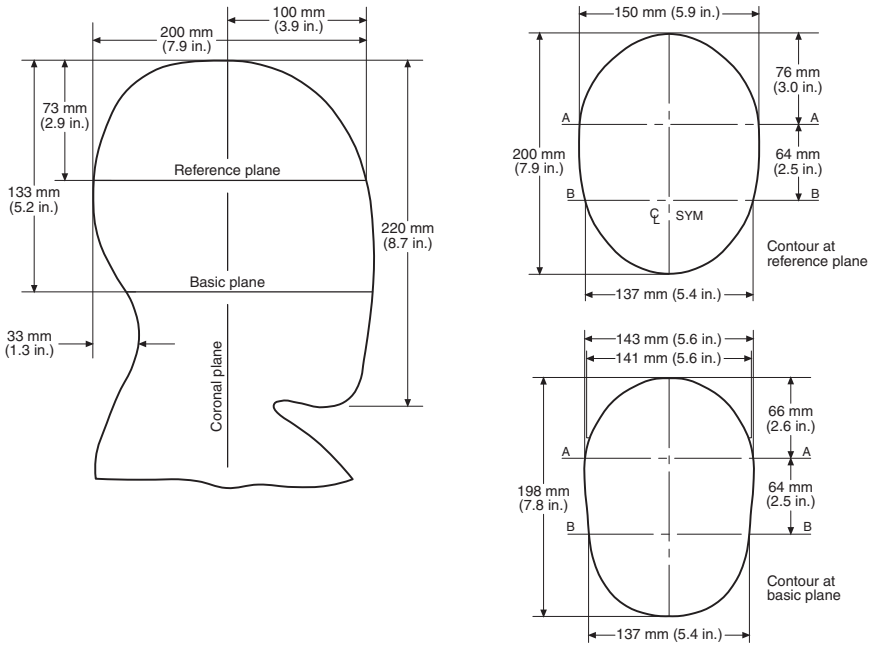

Figure 6-17.4.2 Nonmetallic head form.

6-17.3 Sample Preparation.

6-17.3.1 Samples for conditioning shall be complete face protection devices.

6-17.3.2 Samples shall be conditioned as specified in 6-1.2.

6-17.4 Apparatus.

6-17.4.1 The test apparatus shall consist of a head form, liquid-absorptive hood, and spray nozzle system.

6-17.4.2 The nonmetallic head form shall conform to the dimensions in Figure 6-17.4.2.

6-17.4.3 The liquid-absorptive hood shall be an item of protective material configured to cover those portions of the head form that are covered by the face protection device being tested and act as an aid to observe water penetration. The liquid-absorptive hood shall be of a size to conform to the head form specified in 6-17.4.1. The liquid-absorptive hood shall be constructed of a material that is easily watermarked.

6-17.4.4 The spray nozzle system shall consist of one or more spray nozzles, a positioning stand, and a liquid delivery system. The system shall be configured so that the spray nozzles are positioned with respect to the head form as shown in Figure 6-17.4.4.

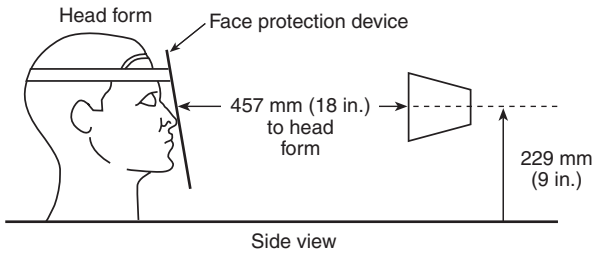

Figure 6-17.4.4 Test setup.

6-17.4.5 The spray nozzle(s) shall conform to the specifications in Figure 6-17.4.5.

6-17.4.6 The liquid delivery system shall deliver a minimum of 3 L/min (0.84 gpm) through each nozzle.

6-17.4.7* The water used for testing shall contain a nonfoaming surfactant that lowers the surface tension of the liquid to less than 35 dynes/cm, ± 5 dynes/cm.

6-17.5 Procedure.

6-17.5.1 The liquid-absorptive hood and head form shall be inspected for dryness prior to testing.

6-17.5.2 The liquid-absorptive hood shall be donned on the head form and the face protection device placed over the liquid-absorptive hood on the head form. The face protection device shall be adjusted in accordance with the manufacturer's instructions.

6-17.5.3 Any exposed areas of the liquid-absorptive hood shall be blocked off with duct tape or other suitable material. Blockage of the liquid-absorptive hood areas shall be permitted to extend no more than 10 mm ($^1/_8$ in.) inside the border or edge of the face protection device.

6-17.5.4 The surfactant-treated water shall be sprayed at the face protection device for a duration of 2 sec in each of the head form orientations specified in Figure 6-17.5.4.

6-17.5.5 Liquid penetration shall be determined by removing the face protection device and examining those areas of the liquid-absorptive hood that were underneath the face protection device during testing.

6-17.6 Report.

6-17.6.1 The locations of any liquid leakage detected on the liquid-absorptive hood shall be described.

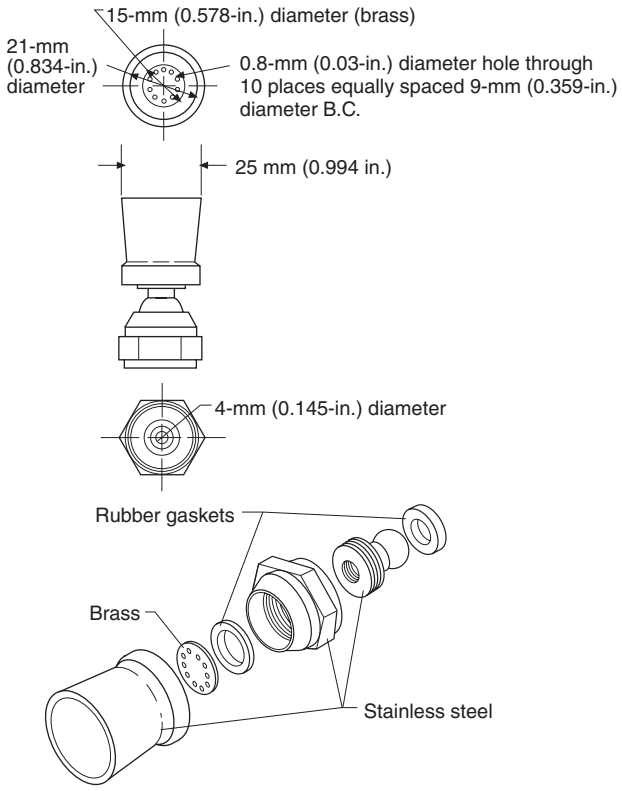

Figure 6-17.4.5 Spray nozzle.

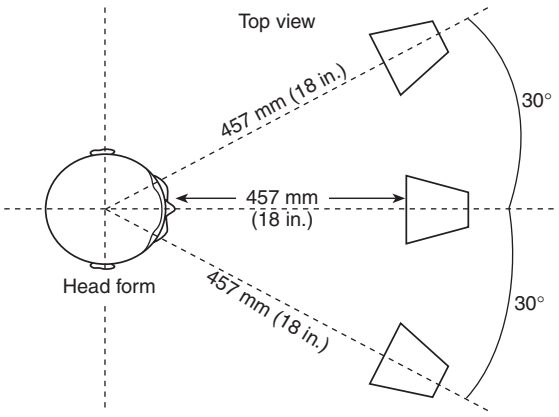

Figure 6-17.5.4 Spray nozzle orientation.

6-17.7 Interpretation.

6-17.7.1 Any evidence of liquid on the liquid-absorptive hood, as determined by visual inspection, tactile inspection, or absorbent toweling, shall constitute failure of the specimen.

Chapter 7 Referenced Publications

7-1 The following documents or portions thereof are referenced within this standard as mandatory requirements and shall be considered part of the requirements of this standard. The edition indicated for each referenced mandatory document is the current edition as of the date of the NFPA issuance of this standard. Some of these mandatory documents might also be referenced in this standard for specific informational purposes and, therefore, are also listed in Appendix B.

7-1.1 NFPA Publications. National Fire Protection Association, 1 Batterymarch Park, P.O. Box 9101, Quincy, MA 02269-9101.

NFPA 1500, *Standard on Fire Department Occupational Safety and Health Program,* 1997 edition.

NFPA 1581, *Standard on Fire Department Infection Control Program,* 1995 edition.

7-1.2 Other Publications.

7-1.2.1 ANSI Publication. American National Standards Institute, 11 West 42nd Street, New York, NY 10036.

ANSI Z34.1, *American National Standard for Third-Party Certification Programs for Products, Processes, and Services,* 1993.

7-1.2.2 ANSI/AATCC Publications. American Association of Textile Chemists and Colorists, P. O. Box 12215, Research Triangle Park, NC 27709.

ANSI/AATCC 70, *Test Method for Water Repellency: Tumble Jar Dynamic Absorption Test,* 1988.

ANSI/AATCC 135, *Dimensional Changes in Automatic Home Laundering of Woven and Knit Fabrics,* 1989.

7-1.2.3 ASTM Publications. American Society for Testing and Materials, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.

ASTM D 412, *Standard Test Methods for Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers — Tension,* 1992.

ASTM D 573, *Standard Test Method for Rubber-Deterioration in an Air Oven,* 1988.

ASTM D 751, *Standard Test Methods for Coated Fabrics,* 1995.

ASTM D 1683a, *Standard Test Method for Failure in Sewn Seams of Woven Fabrics,* 1995.

ASTM D 2582, *Standard Test Method for Puncture-Propagation Tear Resistance of Plastic Film and Thin Sheeting,* 1993.

ASTM D 5151, *Standard Test Method for Detection of Holes in Medical Gloves,* 1992.

ASTM D 5712, *Standard Test Method for Analysis of Protein in Natural Rubber and Its Products,* 1995.

ASTM F 392, *Standard Test Method for Flex Durability of Flexible Barrier Materials,* 1993.

ASTM F 1342, *Standard Test Method for Protective Clothing Material Resistance to Puncture,* 1991.

ASTM F 1359, *Standard Practice for Determining Liquid-Tight Integrity of Chemical Protective Suits or Ensembles under Static Conditions,* 1991.

ASTM F 1671, *Standard Test Method for Resistance of Materials Used in Protective Clothing to Penetration by Blood-Borne Pathogens Using Phi-X-174 Bacteriophage Penetration as a Test System,* 1995.

7-1.2.4 GSA Publication. General Services Administration, Specifications Activity, Printed Materials Supply Division, Building 197, Naval Weapons Plant, Washington, DC 20407.

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

7-1.2.5 ISO Publications. ISO Central Secretariat; 1 Rue de Varembè; Case postale 56; CH 1211 GENÉVE 20; Switzerland.

ISO 9001, *Quality Systems — Model for Quality Assurance in Design, Development, Production, Installation, and Servicing,* 1994.

ISO 9002, *Quality Systems — Model for Quality Assurance in Production, Installation, and Servicing,* 1994.

7-1.2.6 Psychological Corporation Publication. Psychological Corporation, 555 Academic Court, San Antonio, TX 78204.

Crawford Small Parts Dexterity Test, 1981.

7-1.2.7 U.S. Government Publications. Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.

Title 21, *Code of Federal Regulations,* Part 880 (21 CFR 880), "Medical Devices; Patient Examination Glove; Revocation of Exemptions from the Premarket Notification Procedures and the Current Good Manufacturing Practice Regulations; Final Rule," 13 January 1989.

Title 29, *Code of Federal Regulations,* Part 1910.1030 (29 CFR 1910.1030), *Protecting Health Care Workers from Occupational Exposure to Blood-Borne Pathogens,* 6 March 1992.

Title 29, *Code of Federal Regulations,* Part 1910.132 (29 CFR 1910.132), *General Requirements of Subpart I, Personal Protective Equipment,* 27 August 1971.

Appendix A Explanatory Material

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

A-1-1.1 This standard only addresses emergency medical products and the design, performance, testing, and certification of specific products. The use criteria for emergency medical protective clothing is covered in NFPA 1500, *Standard on Fire Department Occupational Safety and Health Program,* and NFPA 1581, *Standard on Fire Department Infection Control Program.*

A-1-1.3 Organizations responsible for fire-fighting operations, for chemical response functions, and other hazard protection, including radiological, cryogenic, or hazardous chemical, should use protective clothing and equipment specifically designed for those activities. Criteria for protection from hazardous chemicals are provided in the following standards:

(a) NFPA 1991, *Standard on Vapor-Protective Suits for Hazardous Chemical Emergencies*

(b) NFPA 1992, *Standard on Liquid Splash-Protective Suits for Hazardous Chemical Emergencies*

(c) NFPA 1993, *Standard on Support Function Protective Clothing for Hazardous Chemical Operations*

A-1-1.4 Biological agents can also be transmitted via aerosols.

A-1-1.5 This standard does not address cleaning gloves or structural fire-fighting gloves. NFPA 1581, *Standard on Fire Department Infection Control Program,* distinguishes the two types of gloves as follows:

Cleaning Gloves. Multipurpose, multiple-use gloves that provide limited protection from abrasion, cuts, snags, and punctures during cleaning and that are designed to provide a barrier against body fluids, cleaning fluids, and disinfectants.

Structural Fire-Fighting Gloves. Gloves meeting the requirements of NFPA 1973, *Standard on Gloves for Structural Fire Fighting.*

NOTE: Since NFPA 1581 was published in 1995, NFPA 1973 has been replaced by NFPA 1971, *Standard on Protective Ensemble for Structural Fire Fighting,* which now contains the structural fire-fighting glove requirements.

NFPA 1581, *Standard on Fire Department Infection Control Program,* requires that structural fire-fighting gloves be worn in any situation where sharp or rough surfaces or a potentially high-heat exposure is likely to be encountered, such as in patient extrication. NFPA 1971, *Standard on Protective Ensemple for Structural Fire Fighting,* provides minimum design and performance requirements for certification of these gloves.

NFPA 1581 requires that cleaning gloves be reusable, heavy duty, mid-forearm length, and designed to provide limited protection from abrasions, cuts, snags, and punctures, and that they provide a barrier against body fluids, cleaning fluids, and disinfectants. NFPA 1581 also specifies that cleaning gloves are to be worn during cleaning or disinfecting of clothing or equipment that might potentially be contaminated during emergency medical operations.

A-1-2.1 The federal OSHA standard, 29 CFR 1910.1030 (c) (3) (i), defines personal protective equipment as appropriate "only if it does not permit blood or other potentially infectious materials to pass through or reach the employee's work clothes, street clothes, undergarments, skin, eyes, mouth, or other mucous membranes under normal conditions of use and for the duration of time which the protective equipment will be used." NFPA 1999 has established the minimum performance standard for personal protective equipment for use during emergency medical operations.

The choice of which elements of personal protective clothing to use will be based on an assessment of the risk of exposure at the emergency scene.

Various conditions that exist at the scene of an emergency are uniquely different to those of a hospital-based practice.

Such conditions are characterized by the uncontrolled environment of an emergency scene.

A-1-2.3 Purchasers should specify desired features that are not in conflict with the design requirements of this standard. It is recommended that purchasers of emergency medical garments should consider the following:

(a) Personnel could be wearing many items of protective clothing and equipment. Any interference by one item of another item's use might result in inefficient operations or unsafe situations.

(b) Different breathing apparatus, communications systems, cooling devices, and other protective equipment might not be accommodated by the emergency medical garments equally.

(c) Specifications of additional reinforcement in high-wear or load-bearing areas such as the knees, elbows, shoulders, and back might be necessary. Reinforcing materials should be the same as the garment material. Purchasers are cautioned that additional weight caused by excessive reinforcement could lead to fatigue or injury.

A-1-3 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-1-3 Authority Having Jurisdiction. The phrase "authority having jurisdiction" 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-1-3 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-1-3 Single-Use Element. What constitutes a "use" will be defined by the product manufacturer. A single use could include unpackaging, or one donning, or one wearing while responding. In the absence of any manufacturer's specific information, one "use" should be considered any wearing of the element. Inspection of any element should be conducted in accordance with the manufacturer's instructions and should assess the overall condition and suitability of an element for a specified use.

A-2-1.6 The National Fire Protection Association (NFPA) from time to time has received complaints that certain items of fire and emergency services protective clothing or protective equipment might be carrying labels falsely identifying them as compliant with an NFPA standard. The requirement for placing the certification organization's mark on or next to the product label is to help ensure than the purchaser can readily determine compliance of the respective product through independent third-party certification.