Standards for Isolation Gowns and Surgical Gowns and Their Medical Applications

ASTM International and Jordan Standards and Metrology Organization Webinar Series

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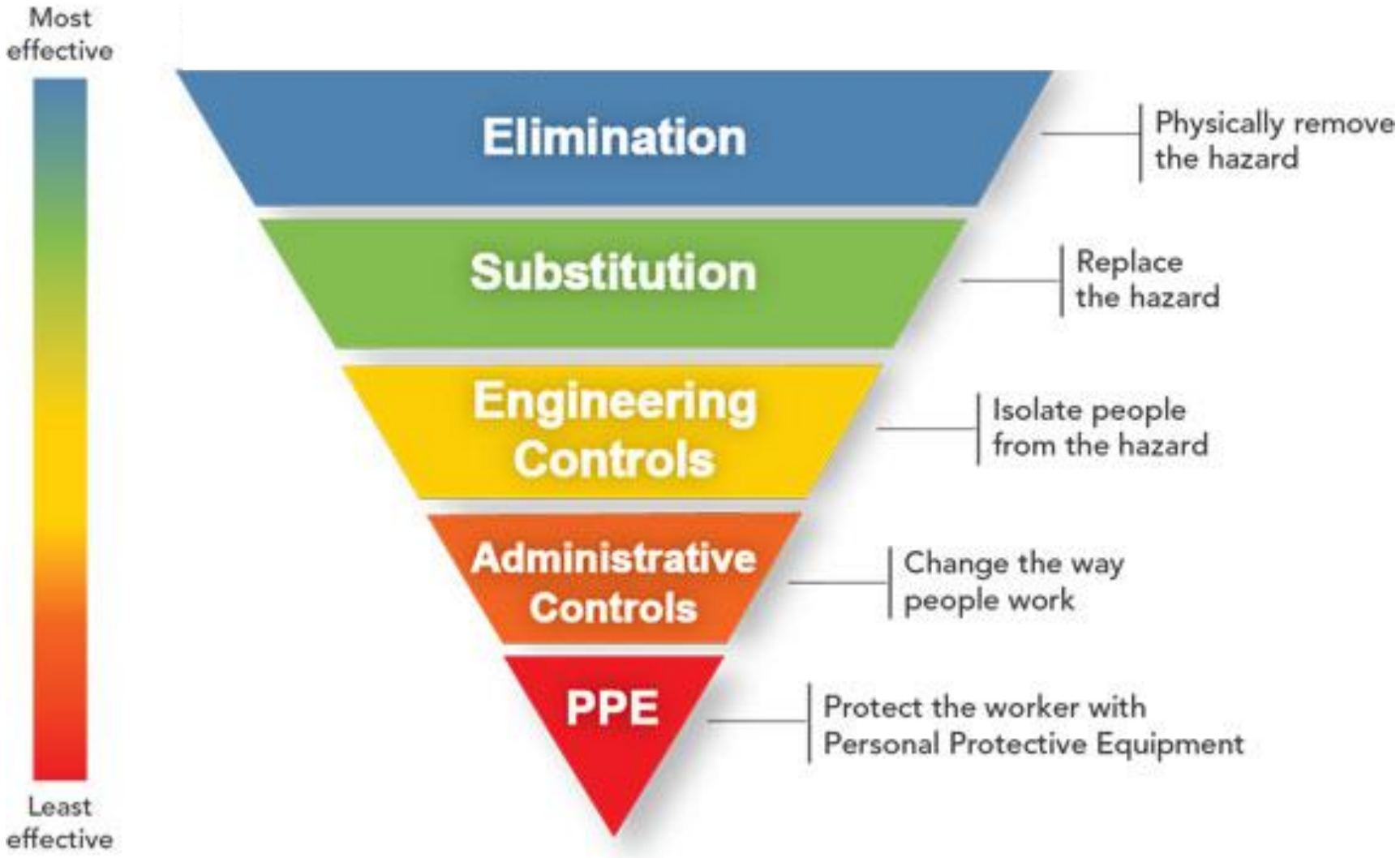
Hierarchy of Controls



Source: https://www.cdc.gov/niosh/topics/hierarchy/default.html

Personal Protective Equipment (PPE)

Specialized clothing or equipment worn by workers for protection against health and safety hazards. For healthcare workers (HCWs), PPE may include:

- Respirators
- Medical face masks
- Gloves
- Gowns
- Goggles
- Face shields
- Head and shoe coverings

Photo courtesy of NIOSH

Standard Precautions

- Used for all patient care
- Based on a risk assessment
- Make use of common-sense practices and PPE to protect HCW from infection and prevent the spread of infection from patient to patient

Wear a gown that is appropriate to the task, to protect skin and prevent soiling or contamination of clothing when contact with blood, body fluids, secretions, or excretions is anticipated.

https://www.cdc.gov/infectioncontrol/basics/standard-precautions.html

Protective Clothing Selection Process

Conduct Hazard Assessment

- Source
- Modes of transmission
- Pressure and type of contact
- Duration and type of tasks
- Stage of disease
- Severity of symptoms

Identify Standards or Specifications

- HCW gown and coverall classification standards, specifications, test methods
- National, international

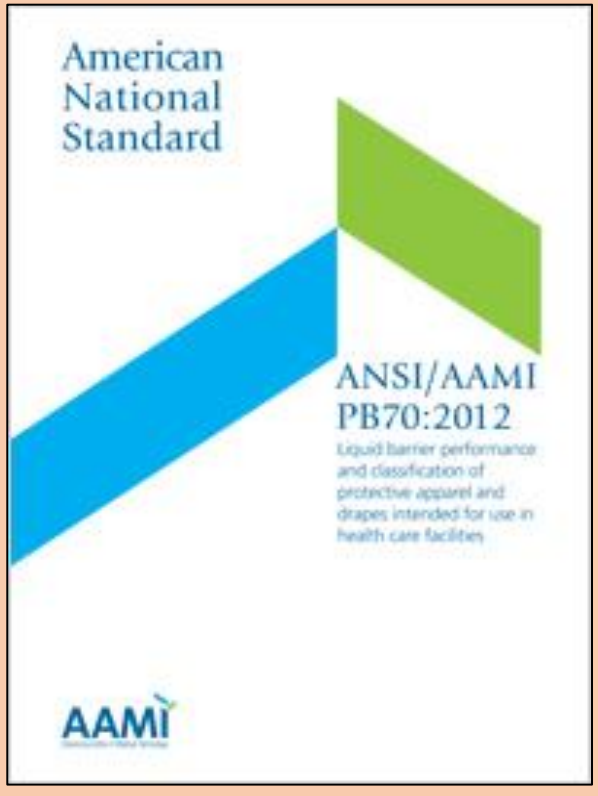
Select Appropriate Protective Clothing

- Regulations
- Practices

Photo courtesy of CDC PHIL 10816

Performance Standards

- **Barrier Performance:**
  - **ANSI/AAMI PB70:2012:** Liquid barrier performance and classification of **protective apparel and drapes** intended for use in healthcare facilities



- **Physical Performance:**
  - **ASTM F3352:** Standard specification for **isolation gowns** intended for use in healthcare facilities
  - **ASTM F2407:** Standard specification for **surgical gowns** intended for use in healthcare facilities


Designation: F3352 – 19

Standard Specification for
Isolation Gowns Intended for Use in Healthcare Facilities[1]

INTRODUCTION

Healthcare personal protective equipment, including isolation gowns, is worn by healthcare workers to protect the patient, the healthcare worker, and visitors from the transfer of microorganisms, blood and other body fluids, and other contaminants.

Healthcare workers and patients can be exposed to body fluids and other potentially infectious materials capable of transmitting diseases. These diseases, which may be caused by a variety of microorganisms, can pose significant risks to life and health. This is especially true of bloodborne pathogens, such as Hepatitis (Hepatitis B Virus (HBV) and Hepatitis C Virus (HCV)) and Human Immunodeficiency Virus (HIV), as well as other healthcare-associated infections. Since engineering controls cannot eliminate all possible exposures, attention is placed on reducing the potential for direct skin contact with microorganisms, blood or other body fluids, and other potentially infectious materials through the use of protective clothing.

The ASTM F23.40 Biological Subcommittee work group surveyed infection preventionists to determine use/wear issues, familiarity with isolation gown performance standards, and to identify compliance perceptions and problems.[2] Results of this survey clearly indicated issues with the physical performance of the isolation gowns used in the healthcare settings. Development of this standard, which includes performance and design criteria for isolation gowns, is intended to assist end users in correct gown selection. The minimum criteria in this specification were established based on the findings of a study in collaboration with National Institute for Occupational Safety and Health[3] and committee discussions.

This specification addresses the performance of isolation gowns designed to protect the healthcare worker, the patient, and visitors from exposure to blood, body fluids, and other potentially infectious materials during patient care or patient procedures.

This specification establishes uniform testing and reporting requirements for isolation gown manufacturers in order to provide information to end users that can be used in making informed decisions in the evaluation, selection, and purchase of isolation gowns according to the anticipated exposures.

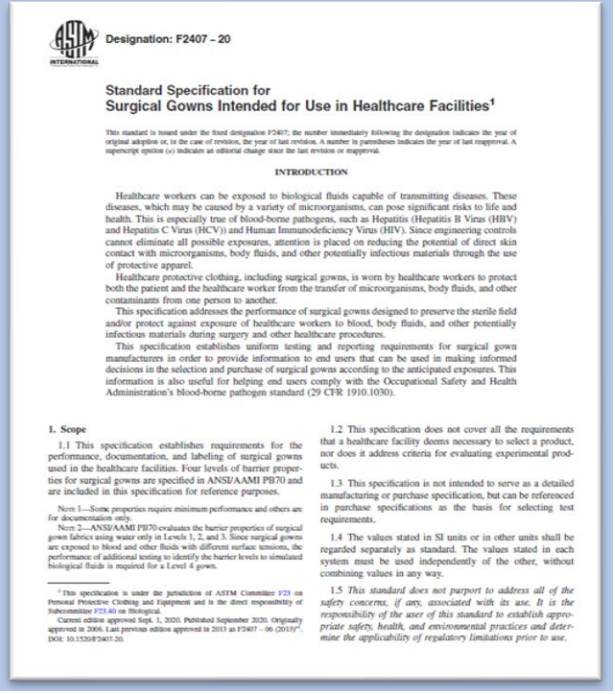
1. Scope

1.1 This specification establishes minimum requirements for the performance and labeling of isolation gowns intended for use by healthcare workers to provide protection for standard and transmission-based precautions. The intended use of this specification is to ensure the performance properties of isolation gowns for the protection of the wearer. Four levels of barrier properties for isolation gowns are specified in ANSI/AAMI PB 70, and are included in this specification for reference purposes.

1.2 There are other types of gowns that are used in healthcare settings, including: cover gowns, procedure gowns, comfort gowns, precaution gowns, and open-back gowns. All gowns not meeting the definition of isolation gown in 3.1.7 as defined by ANSI/AAMI PB70 are excluded from this standard.

1.3 This specification does not address protective clothing used for surgical applications, such as surgical gowns or decontamination gowns; protective clothing for the hands, such

[1] This specification is under the jurisdiction of ASTM Committee F23 on Personal Protective Clothing and Equipment and is the direct responsibility of Subcommittee F23.40 on Biological.
Current edition approved June 1, 2019. Published July 2019. Originally approved in 2019. DOI: 10.1520/F3352-19.
[2] Cloud, R., Favret, U. R., Cunningham, T., Daley, J., Harris, L. G., Kilinc Balci, F. S., and Lewis, J. A., "Isolation Gown Use, Performance and Potential Compliance Issues Identified by Infection Control Professionals," *American Journal of Infection Control*, Vol 41, No. 5, 2012, pp. 474-475.
[3] Kilinc Balci, F. S., Nwoko, J., and Hilliard, T., "Evaluation of the Performance of Isolation Gowns," *American Journal of Infection Control*, Vol 43, No. 6, 2015, p. 544.


Designation: F2407 – 20

Standard Specification for
Surgical Gowns Intended for Use in Healthcare Facilities[1]

INTRODUCTION

Healthcare workers can be exposed to biological fluids capable of transmitting diseases. These diseases, which may be caused by a variety of microorganisms, can pose significant risks to life and health. This is especially true of blood-borne pathogens, such as Hepatitis (Hepatitis B Virus (HBV) and Hepatitis C Virus (HCV)) and Human Immunodeficiency Virus (HIV). Since engineering controls cannot eliminate all possible exposures, attention is placed on reducing the potential of direct skin contact with microorganisms, body fluids, and other potentially infectious materials through the use of protective apparel.

Healthcare protective clothing, including surgical gowns, is worn by healthcare workers to protect both the patient and the healthcare worker from the transfer of microorganisms, body fluids, and other contaminants from one person to another.

This specification addresses the performance of surgical gowns designed to preserve the sterile field and/or protect against exposure of healthcare workers to blood, body fluids, and other potentially infectious materials during surgery and other healthcare procedures.

This specification establishes uniform testing and reporting requirements for surgical gown manufacturers in order to provide information to end users that can be used in making informed decisions in the selection and purchase of surgical gowns according to the anticipated exposures. This information is also useful for helping end users comply with the Occupational Safety and Health Administration's blood-borne pathogen standard (29 CFR 1910.1030).

1. Scope

1.1 This specification establishes requirements for the performance, documentation, and labeling of surgical gowns used in the healthcare facilities. Four levels of barrier properties for surgical gowns are specified in ANSI/AAMI PB70 and are included in this specification for reference purposes.

Note 1—Some properties require minimum performance and others are for documentation only.

Note 2—ANSI/AAMI PB70 evaluates the barrier properties of surgical gown fabrics using water only in Levels 1, 2, and 3. Since surgical gowns are exposed to blood and other fluids with different surface tensions, the performance of additional testing to identify the barrier levels to simulated biological fluids is required for a Level 4 gown.

1.2 This specification does not cover all the requirements that a healthcare facility deems necessary to select a product, nor does it address criteria for evaluating experimental products.

1.3 This specification is not intended to serve as a detailed manufacturing or purchase specification, but can be referenced in purchase specifications as the basis for selecting test requirements.

1.4 The values stated in SI units or in other units shall be regarded separately as standard. The values stated in each system must be used independently of the other, without combining values in any way.

1.5 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

[1] This specification is under the jurisdiction of ASTM Committee F23 on Personal Protective Clothing and Equipment and is the direct responsibility of Subcommittee F23.40 on Biological.
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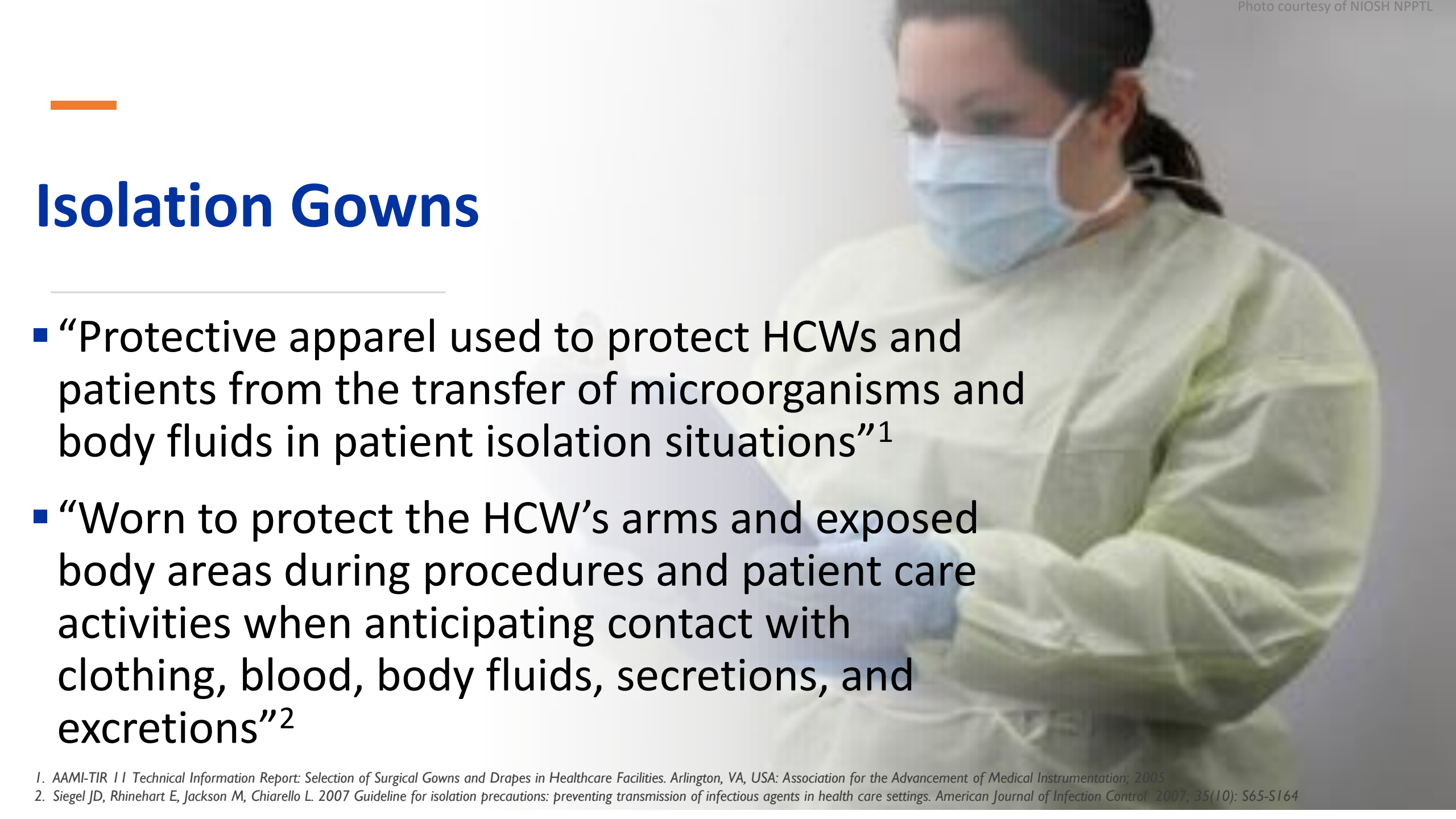


Isolation Gowns

- "Protective apparel used to protect HCWs and patients from the transfer of microorganisms and body fluids in patient isolation situations"[1]
- "Worn to protect the HCW's arms and exposed body areas during procedures and patient care activities when anticipating contact with clothing, blood, body fluids, secretions, and excretions"[2]

1. *AAMI-TIR 11 Technical Information Report: Selection of Surgical Gowns and Drapes in Healthcare Facilities. Arlington, VA, USA: Association for the Advancement of Medical Instrumentation; 2005*
2. *Siegel JD, Rhinehart E, Jackson M, Chiarello L. 2007 Guideline for isolation precautions: preventing transmission of infectious agents in health care settings. American Journal of Infection Control 2007; 35(10): S65-S164*

Surgical Gowns

- “Type of devices that are intended to be worn by operating room personnel during surgical procedures to protect both the surgical patient and the operating room personnel from the transfer of microorganisms, body fluids, and particulate matter” (21 CFR 878.4040)

Photo courtesy of Shutterstock

AAMI PB70 Level

AAMI

ASSOCIATION FOR THE ADVANCEMENT
OF MEDICAL INSTRUMENTATION

isolation gown

Photo courtesy of NIOSH EPRO

surgical gown

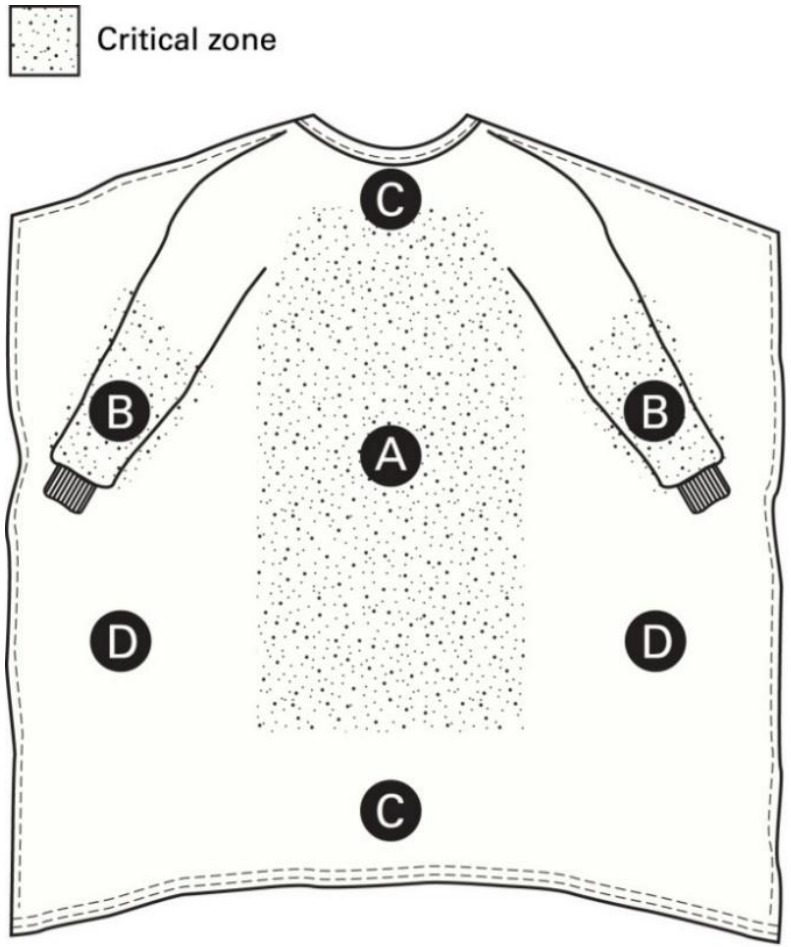
Photo courtesy of Shutterstock

ANSI/AAMI PB70:12 Classification Requirements

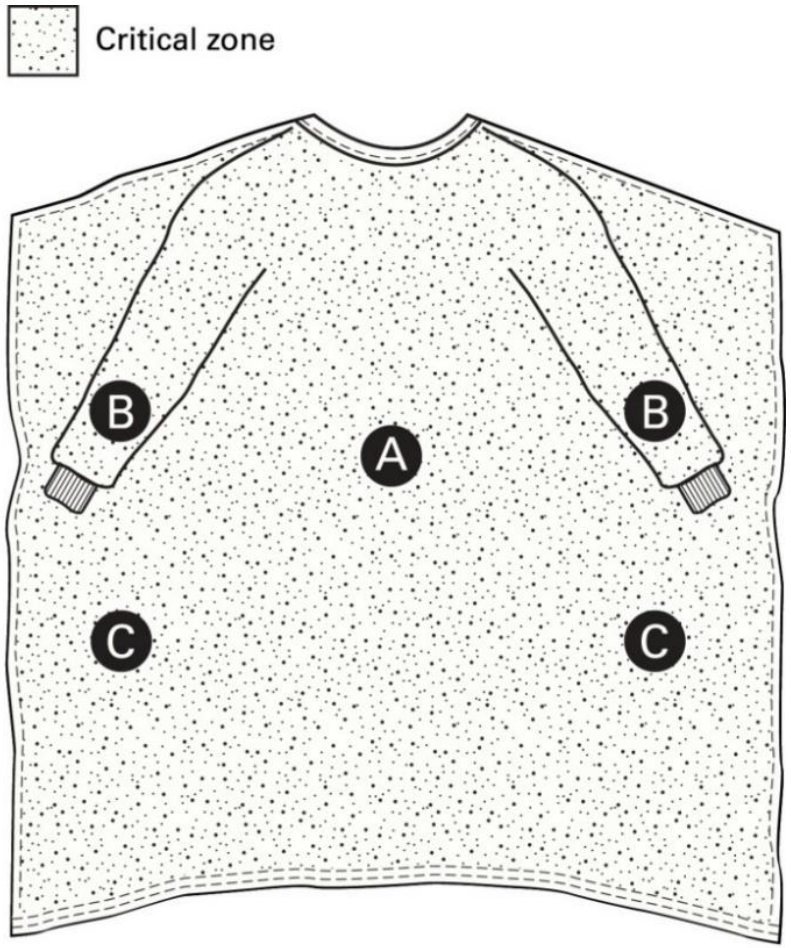
Level	Test	Liquid Challenge	Result*	Expected Barrier Effectiveness
1	AATCC 42	Water	≤ 4.5 g	Minimal water resistance (some resistance to water spray)
2	AATCC 42 AATCC 127	Water Water	≤ 1.0 g ≥ 20cm	Low water resistance (resistant to water spray and some resistance to water penetration under constant contact with increasing pressure)
3	AATCC 42 AATCC 127	Water Water	≤ 1.0 g ≥ 50cm	Moderate water resistance (resistant to water spray and some resistance to water penetration under constant contact with increasing pressure)
4	ASTM F1670 (for surgical drapes) ASTM F1671 (for gowns and other protective apparel)	Surrogate blood Bacteriophage Phi-X174	Pass Pass	Blood and viral penetration resistance (2 psi)

(*) All have an Acceptance Quality level (AQL) of 4% and Rejectable Quality Level (RQL) of 20%

ANSI/AAMI PB70 Critical Zones for Gowns



Surgical gown



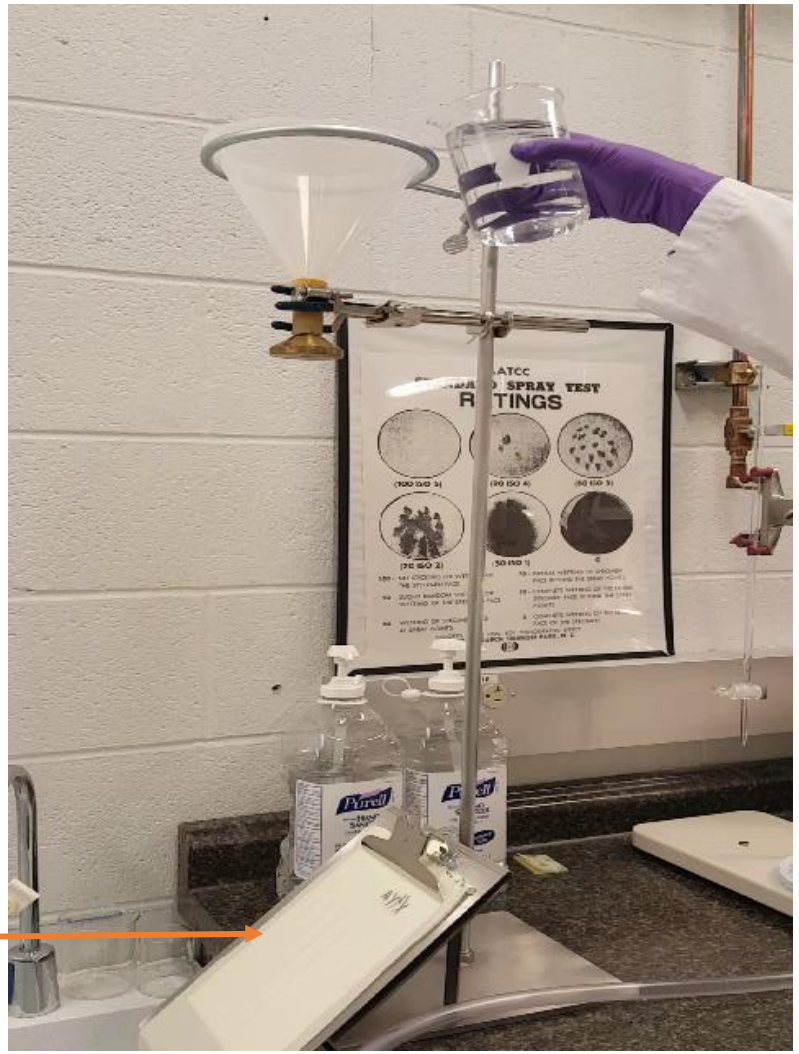
Isolation gown

Adapted with permission from ANSI/AAMI PB70:2012, "Liquid barrier performance and classification of protective apparel and drapes intended for use in health care facilities"

Barrier Performance Test Methods - Impact Penetration Test

AATCC 42: Water Resistance: Impact Penetration Test

- Used to determine the material's ability to resist water penetration under single spray contact
- Sample is oriented at a 45-degree angle and clamped in place over a piece of preweighed blotter paper
- Water is released from a funnel
- Blotter paper is weighed again
- Weight gain ↓ water resistivity ↑



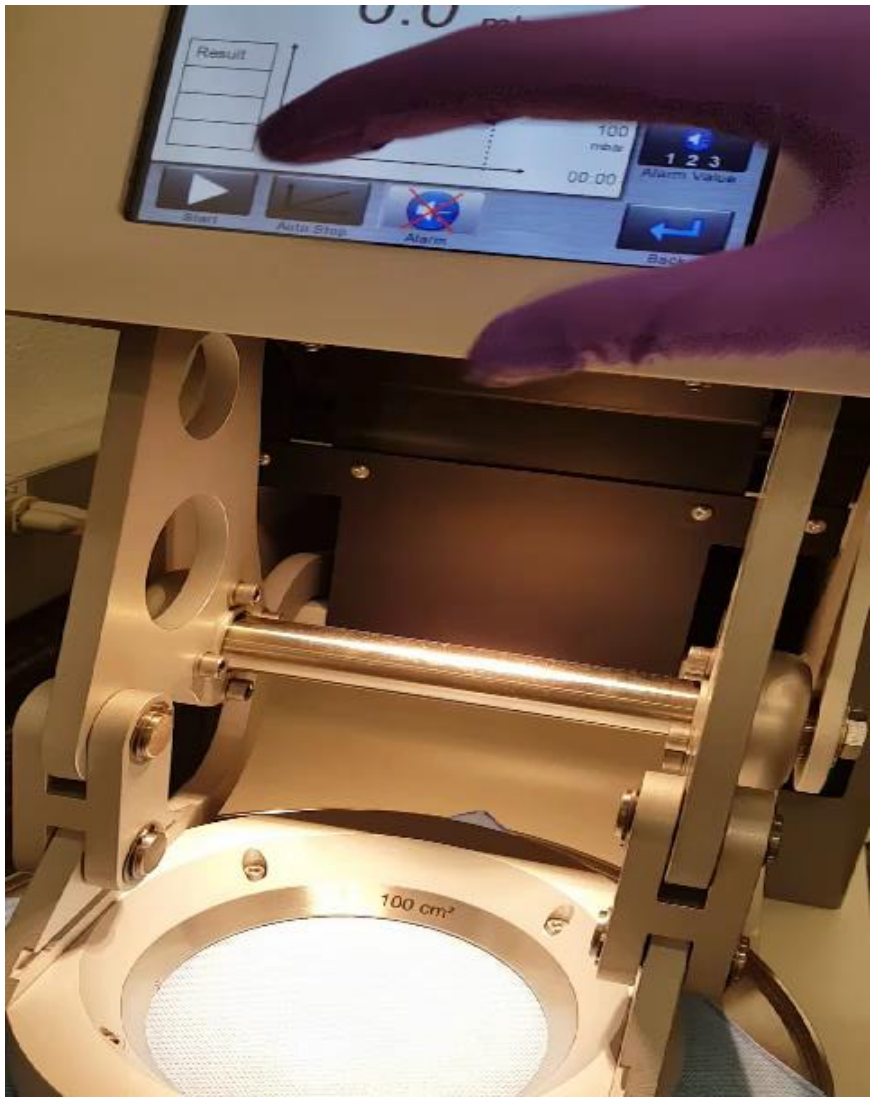
AATCC: American Association for Textile Chemists and Colorists

Video courtesy of NIOSH NPPTL

Barrier Performance Test Methods - Hydrostatic Pressure Test

AATCC 127: Water Resistance: Hydrostatic Pressure Test

- Used to determine the material's ability to resist water penetration under constant contact with increasing pressure
- Sample is clamped in place horizontally, and the hydrostatic pressure is steadily increased by raising the height of the water column
- Terminated when visible penetration of water droplets occur
- Hydrostatic pressure ⬆ water resistivity ⬆



Video courtesy of NIOSH NPPTL

Barrier Performance Test Methods – Viral Penetration Test

ASTM F1671, Standard Test Method for Resistance of Materials Used in Protective Clothing to Penetration by Blood-Borne Pathogens Using Phi-X174 Bacteriophage Penetration

- Used to determine the ability of a material to resist the penetration by bloodborne pathogens using a surrogate virus under continuous liquid contact
- A specimen is subjected to a nutrient broth containing a surrogate virus (Phi-X174) for a specified time and pressure sequence
- Time and temperature are specified at 6 minutes, 2.0 psi for 1 minute, and atmospheric pressure for 54 minutes
- Terminated if visible liquid penetration occurs before or at 60 minutes
- This is a pass/fail test
- Primary bloodborne pathogens considered in the test method are Hepatitis B Virus (HBV), Hepatitis C Virus (HCV), and Human Immunodeficiency Virus (HIV). Other microorganisms must be considered on a case-by-case basis

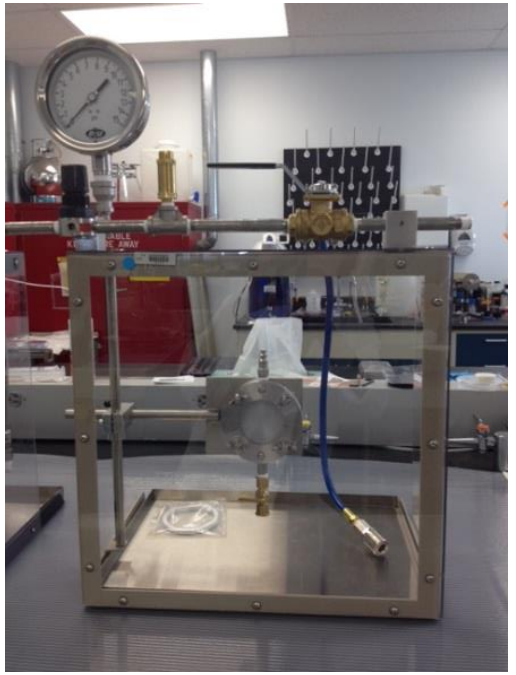
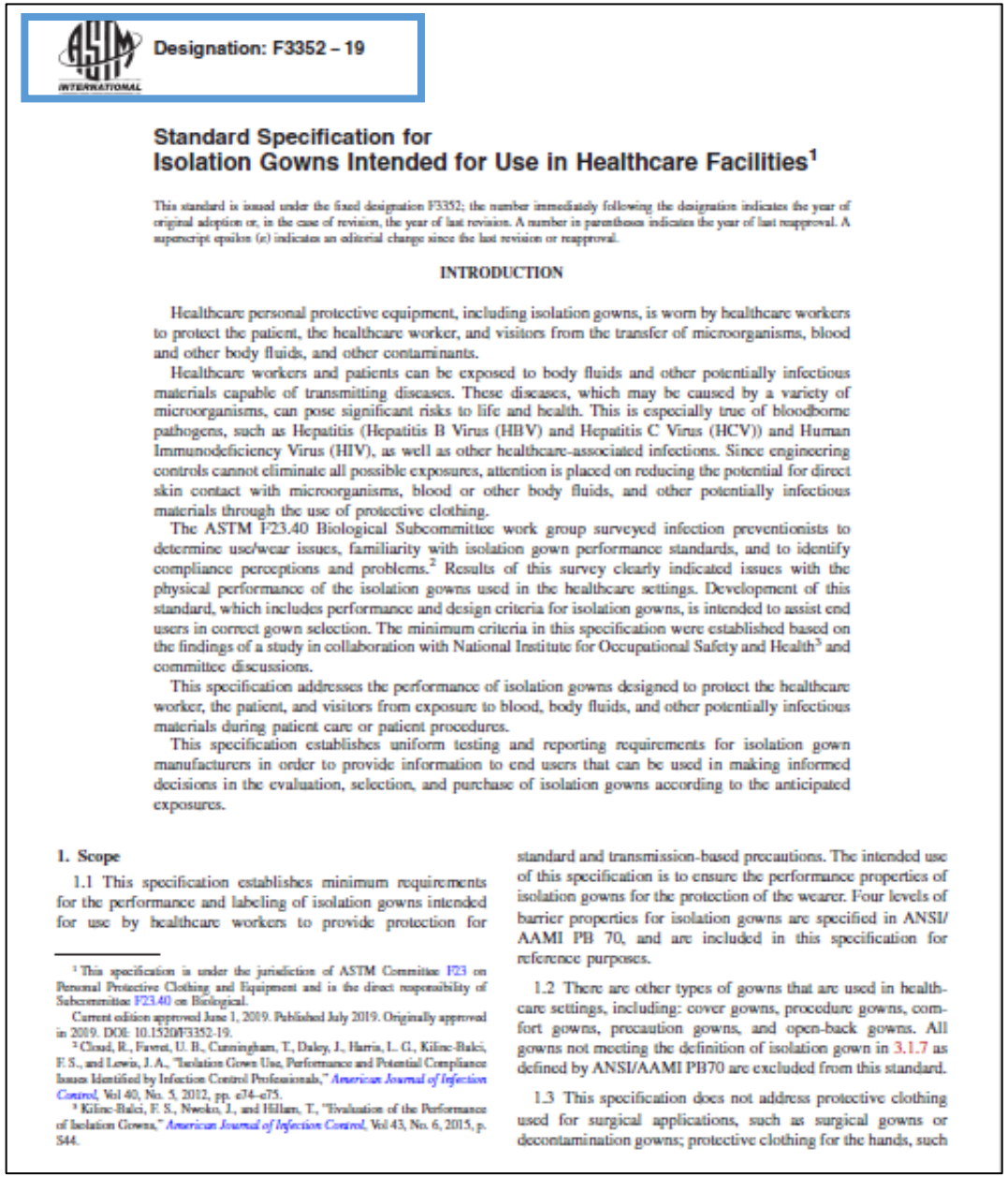


Photo courtesy of NIOSH NPPTL

Standard for Isolation Gowns

- ASTM F3352, published in 2019, that lists minimum performance and design requirements for isolation gowns

Photo courtesy of NIOSH EPRO



Designation: F3352 – 19

Standard Specification for
Isolation Gowns Intended for Use in Healthcare Facilities[1]

This standard is issued under the fixed designation F3352; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

INTRODUCTION

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Healthcare workers and patients can be exposed to body fluids and other potentially infectious materials capable of transmitting diseases. These diseases, which may be caused by a variety of microorganisms, can pose significant risks to life and health. This is especially true of bloodborne pathogens, such as Hepatitis (Hepatitis B Virus (HBV) and Hepatitis C Virus (HCV)) and Human Immunodeficiency Virus (HIV), as well as other healthcare-associated infections. Since engineering controls cannot eliminate all possible exposures, attention is placed on reducing the potential for direct skin contact with microorganisms, blood or other body fluids, and other potentially infectious materials through the use of protective clothing.

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This specification addresses the performance of isolation gowns designed to protect the healthcare worker, the patient, and visitors from exposure to blood, body fluids, and other potentially infectious materials during patient care or patient procedures.

This specification establishes uniform testing and reporting requirements for isolation gown manufacturers in order to provide information to end users that can be used in making informed decisions in the evaluation, selection, and purchase of isolation gowns according to the anticipated exposures.

1. Scope

1.1 This specification establishes minimum requirements for the performance and labeling of isolation gowns intended for use by healthcare workers to provide protection for standard and transmission-based precautions. The intended use of this specification is to ensure the performance properties of isolation gowns for the protection of the wearer. Four levels of barrier properties for isolation gowns are specified in ANSI/AAMI PB 70, and are included in this specification for reference purposes.

1.2 There are other types of gowns that are used in healthcare settings, including: cover gowns, procedure gowns, comfort gowns, precaution gowns, and open-back gowns. All gowns not meeting the definition of isolation gown in 3.1.7 as defined by ANSI/AAMI PB70 are excluded from this standard.

1.3 This specification does not address protective clothing used for surgical applications, such as surgical gowns or decontamination gowns; protective clothing for the hands, such

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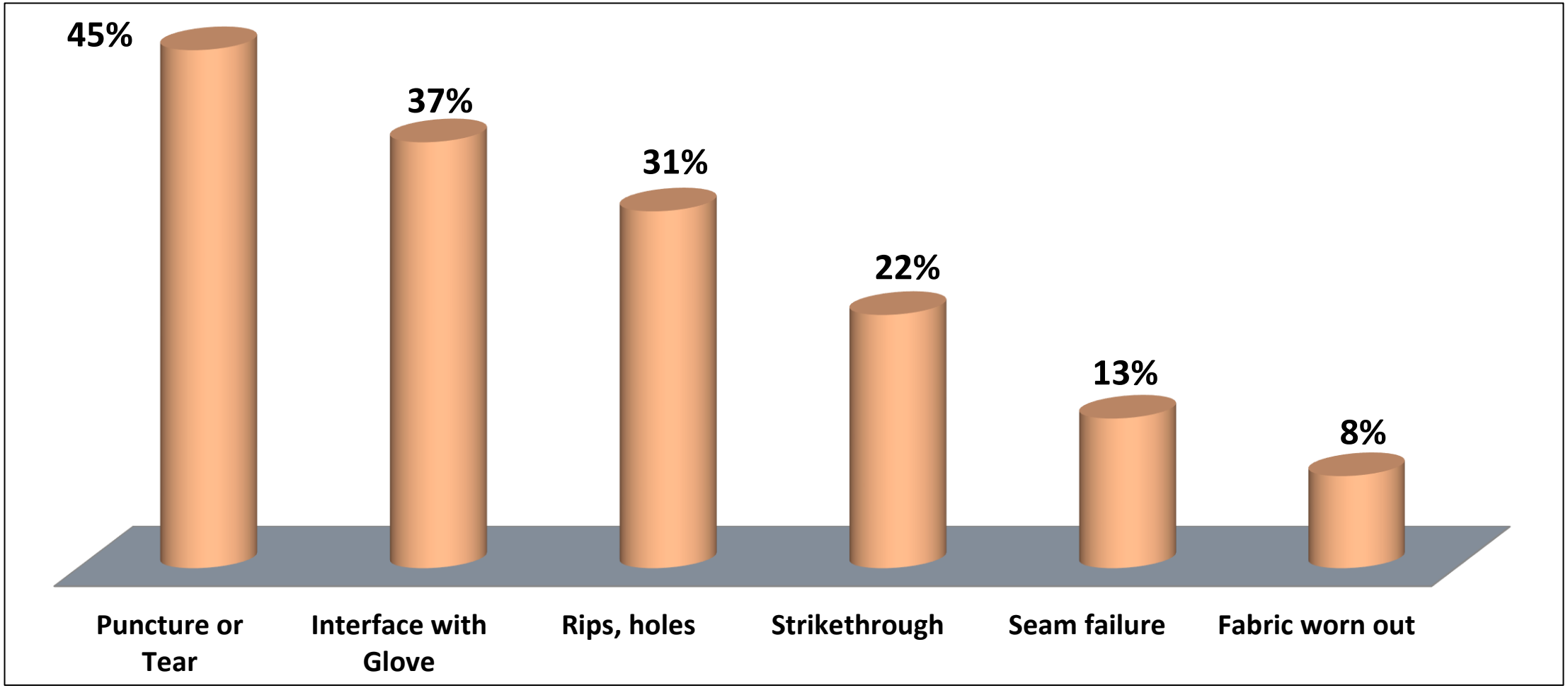
[2] Cloud, R., Fawcett, U. B., Cunningham, T., Daley, J., Harris, L. G., Kilinc-Balci, F. S., and Lewis, J. A., "Isolation Gown Use, Performance and Potential Compliance Issues Identified by Infection Control Professionals," *American Journal of Infection Control*, Vol 40, No. 5, 2012, pp. e74–e75.

[3] Kilinc-Balci, F. S., Nwokoh, J., and Hillan, T., "Evaluation of the Performance of Isolation Gowns," *American Journal of Infection Control*, Vol 43, No. 6, 2015, p. S44.

Gown Failures Encountered by Infection Preventionists



(*) Cloud, Rinn, Uncas B. Favret, Terrell Cunningham, Jacqueline Daley, Linda G. Harris, F. S. Kilinc-Balci, and Janet A. Lewis. "Isolation Gown Use, Performance and Potential Compliance Issues Identified by Infection Control Professionals." American Journal of Infection Control 40, no. 5 (2012): e74-e75.

Scope of ASTM F3352

Scope: Single use and multiple use isolation gowns

isolation gown, n—item of protective clothing/apparel used to protect healthcare personnel, visitors, and patients from the transfer of microorganisms and body fluids in patient isolation situations

Exclusions: Other types of gowns that are used in healthcare settings, including: cover gowns, procedure gowns, comfort gowns, precaution gowns, surgical gowns, decontamination gowns, and open-back gowns and other PPE items

ASTM F3352 Requirements

- **Barrier performance:** ANSI/AAMI PB70
- **Single use and multiple use gowns**
  - — Anticipated care and maintenance were considered
- **Design requirements**
  - — 360° coverage
  - — Means or area for recording/marking the # of processing cycles (multiple-use)
- **Biocompatibility requirements**
  - — Non-sensitizing and non-irritating (ISO 10993-10)

ASTM F3352 Requirements-cont'd

- **Performance requirements (***considers both material and seams***)**
  - Tensile strength
  - Tear resistance
  - Seam strength
- **Additional gown properties for reporting only (***optional***)**
  - Lint generation
  - Evaporation resistance/water vapor transmission rate
  - Abrasion resistance (Martindale)
  - Flex durability

Physical Property Performance Requirements of Single and Multiple-Use Isolation Gowns

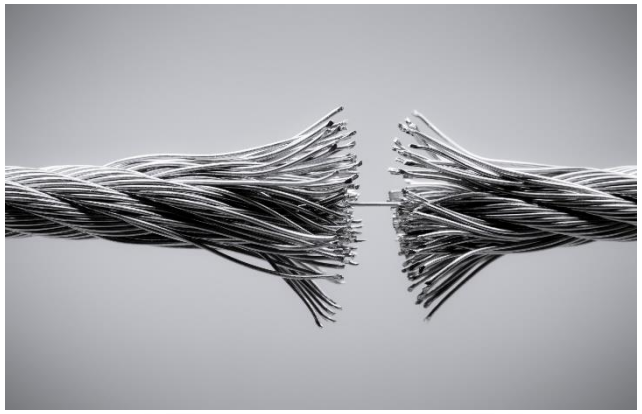


Photo courtesy of NIOSH/NPPTL

Property	Material	Test Method	AAMI PB70 Level 1,2,3,and 4
Tensile Strength	All	ASTM D5034	≥30 N (≥7 lbf)
Tear Strength	Woven textiles	ASTM D5587	≥10 N (≥2.3 lbf)
	Nonwoven textiles, films, nonwoven and film composites	ASTM D5733	≥10 N (≥2.3 lbf)
Seam Strength	All	ASTM D1683/D1683M	≥30 N (≥7 lbf)

Determine the seam strength of isolation gown knit or stretch woven materials as specified in ASTM D751, using the tension testing machine with ring clamp

- *Barrier performance is determined according to ANSI/AAMI PB70 with 4% acceptable quality level (AQL), 20 % rejectable quality level (RQL)*

ASTM F3352 Labeling Requirements

- **Product labeling**
  - Product or style name
  - Barrier performance level
  - Product lot or serial number
  - Size
- **Package labeling**
  - Manufacturer name
  - Product or style name
  - Barrier performance level
  - Product lot or serial number
  - Size
  - Meets requirements of Specification ASTM F3352
  - Use-by date
  - Manufacturer address and phone number
  - For multiple-use products, processing instructions including the # max processing cycles
  - A caution statement if contains natural rubber latex

Standard for Surgical Gowns

- **ASTM F2407** lists suggested performance and design parameters
- It was revised in 2020 to include minimum performance and design criteria

Photo courtesy of Shutterstock

Designation: F2407 – 20

Standard Specification for Surgical Gowns Intended for Use in Healthcare Facilities[1]

This standard is issued under the fixed designation F2407; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

INTRODUCTION

Healthcare workers can be exposed to biological fluids capable of transmitting diseases. These diseases, which may be caused by a variety of microorganisms, can pose significant risks to life and health. This is especially true of blood-borne pathogens, such as Hepatitis (Hepatitis B Virus (HBV) and Hepatitis C Virus (HCV)) and Human Immunodeficiency Virus (HIV). Since engineering controls cannot eliminate all possible exposures, attention is placed on reducing the potential of direct skin contact with microorganisms, body fluids, and other potentially infectious materials through the use of protective apparel.

Healthcare protective clothing, including surgical gowns, is worn by healthcare workers to protect both the patient and the healthcare worker from the transfer of microorganisms, body fluids, and other contaminants from one person to another.

This specification addresses the performance of surgical gowns designed to preserve the sterile field and/or protect against exposure of healthcare workers to blood, body fluids, and other potentially infectious materials during surgery and other healthcare procedures.

This specification establishes uniform testing and reporting requirements for surgical gown manufacturers in order to provide information to end users that can be used in making informed decisions in the selection and purchase of surgical gowns according to the anticipated exposures. This information is also useful for helping end users comply with the Occupational Safety and Health Administration's blood-borne pathogen standard (29 CFR 1910.1030).

1. Scope

1.1 This specification establishes requirements for the performance, documentation, and labeling of surgical gowns used in the healthcare facilities. Four levels of barrier properties for surgical gowns are specified in ANSI/AAMI PB70 and are included in this specification for reference purposes.

NOTE 1—Some properties require minimum performance and others are for documentation only.

NOTE 2—ANSI/AAMI PB70 evaluates the barrier properties of surgical gown fabrics using water only in Levels 1, 2, and 3. Since surgical gowns are exposed to blood and other fluids with different surface tensions, the performance of additional testing to identify the barrier levels to simulated biological fluids is required for a Level 4 gown.

1.2 This specification does not cover all the requirements that a healthcare facility deems necessary to select a product, nor does it address criteria for evaluating experimental products.

1.3 This specification is not intended to serve as a detailed manufacturing or purchase specification, but can be referenced in purchase specifications as the basis for selecting test requirements.

1.4 The values stated in SI units or in other units shall be regarded separately as standard. The values stated in each system must be used independently of the other, without combining values in any way.

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Scope of ASTM F2407

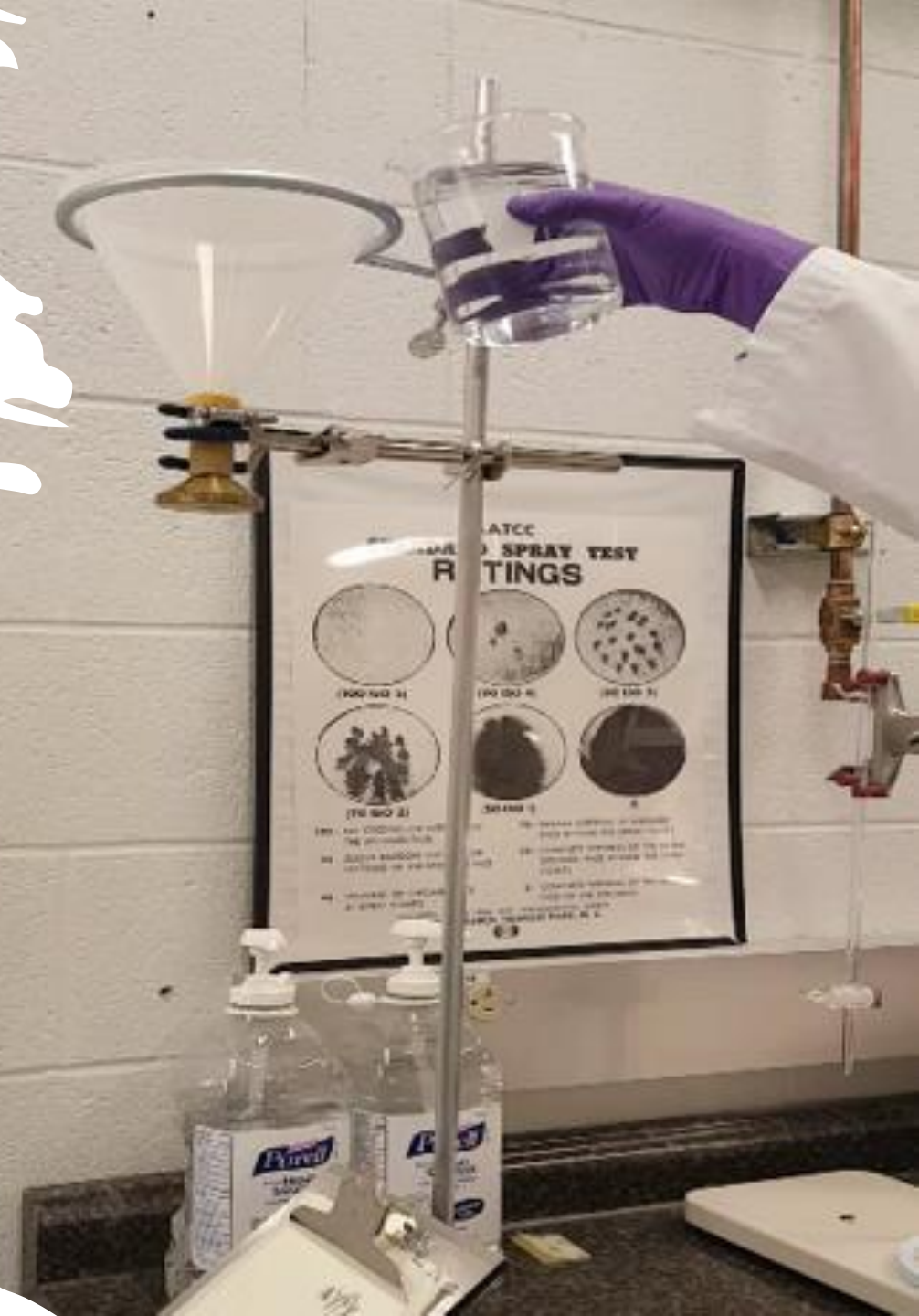
Scope: Single use and multiple use surgical gowns

surgical gown, *n*—protective clothing that is intended to be worn by *operating room* personnel during surgical procedures to protect both the surgical patient and the *operating room* personnel from the transfer of microorganisms, body fluids, and particulate matter

Exclusions: Other types of gowns that are used in healthcare settings, including: isolation gowns, decontamination gowns, surgical masks, operating room shoes, shoe covers, and other PPE items

ASTM F2407 Requirements

- **Barrier performance:** ANSI/AAMI PB70
- **Single use and multiple use gowns**
  - Anticipated care and maintenance were considered
- **Design requirements**
  - Means or area for recording/marking the # of processing cycles (multiple-use)
  - The sizes of the critical zone(s) defined by anatomical reference in accordance with ANSI/AAMI PB70
- **Biocompatibility requirements**
  - Pass AAMI BE78 or ISO 10993-10
- **Sterility assurance level requirements**
  - At least 10-6 (moist heat, EtO, Gamma)
- **Flame spread**
  - Class 1 Normal Flammability according to 16 CFR 1610 before and after conditioning



ASTM F2407 Requirements-cont'd

- **Performance requirements** (*considers both material and seams*)
  - Tensile strength
  - Tear resistance
  - Seam strength
- **Additional gown properties for reporting only** (*optional*)
  - Lint generation
  - Evaporation resistance/water vapor transmission rate
  - Abrasion resistance (Martindale)
  - Flex durability

Physical Property Performance Requirements of Single and Multiple-Use Surgical Gowns

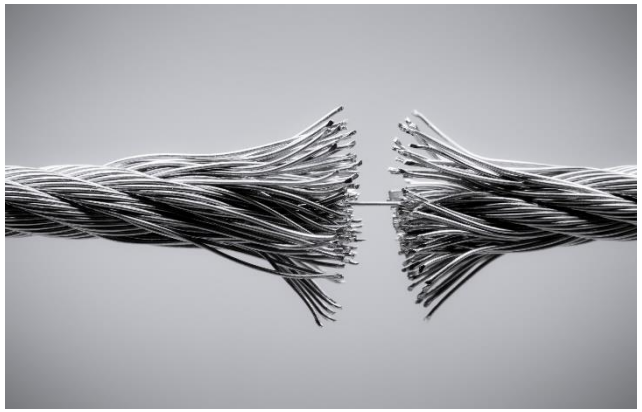


Photo courtesy of NIOSH/NPPTL

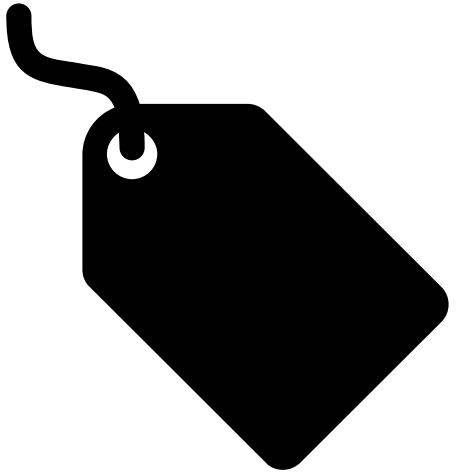
Property	Material	Test Method	AAMI PB70 Level 1,2,3,and 4
Tensile Strength	All	ASTM D5034	≥30 N (≥7 lbf)
Tear Strength	Woven textiles	ASTM D5587	≥10 N (≥2.3 lbf)
	Nonwoven textiles, films, nonwoven and film composites	ASTM D5733	≥10 N (≥2.3 lbf)
Seam Strength	All	ASTM D1683/D1683M	≥30 N (≥7 lbf)

Determine the seam strength of isolation gown knit or stretch woven materials as specified in ASTM D751, using the tension testing machine with ring clamp

- *Barrier performance is determined according to ANSI/AAMI PB70 with 4% acceptable quality level (AQL), 20 % rejectable quality level (RQL)*

ASTM F2407 Labeling Requirements

- **Product labeling**
  - Manufacturer name
  - Product or style name
  - Barrier performance level
  - Product lot or serial number
  - Size
  - Integral tracking mechanism (for multiple-use products)
- **Package labeling**
  - Manufacturer name
  - Product or style name
  - Barrier performance level
  - Product lot or serial number
  - Size
  - Meets requirements of Specification ASTM F2407
  - Use-by date
  - Manufacturer address and phone number
  - For multiple-use products, processing instructions including the max # processing cycles
  - Label as “sterile” if sold sterilized
  - A caution statement if contains natural rubber latex



Summary

- Several protective clothing options are available in the marketplace for healthcare workers
- A key step in the protective clothing selection process is to understand hazards, exposures, the relevant standards, test methods and their intended use
- Multiple test methods and classification standards exist to determine the barrier effectiveness and physical performance of gowns.
- NIOSH will continue supporting ASTM International by:
  - —generating technical information for different types of PPE used by healthcare workers and emergency responders to protect against microorganisms in blood and body fluids, and
  - —participating in consensus standard development process

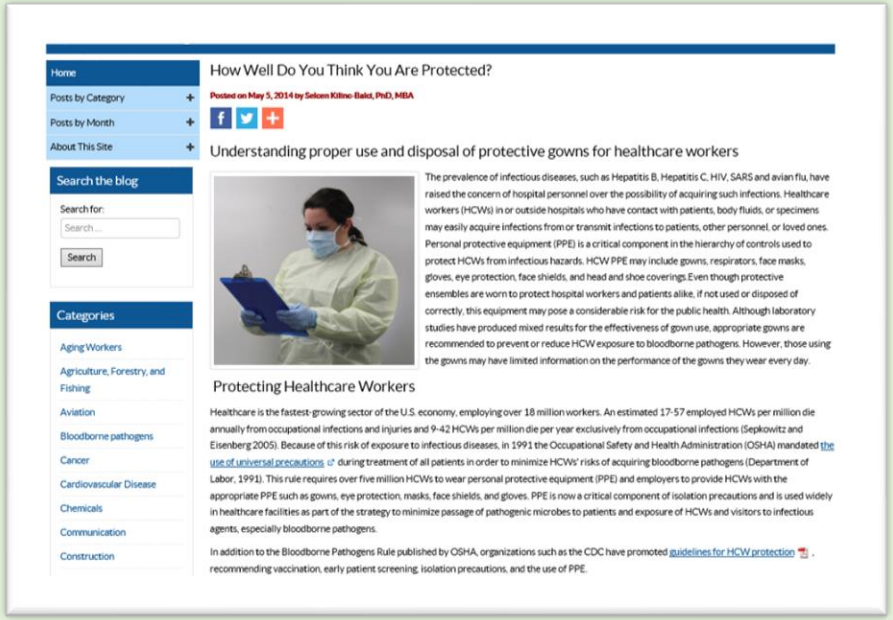
Some NIOSH Sources

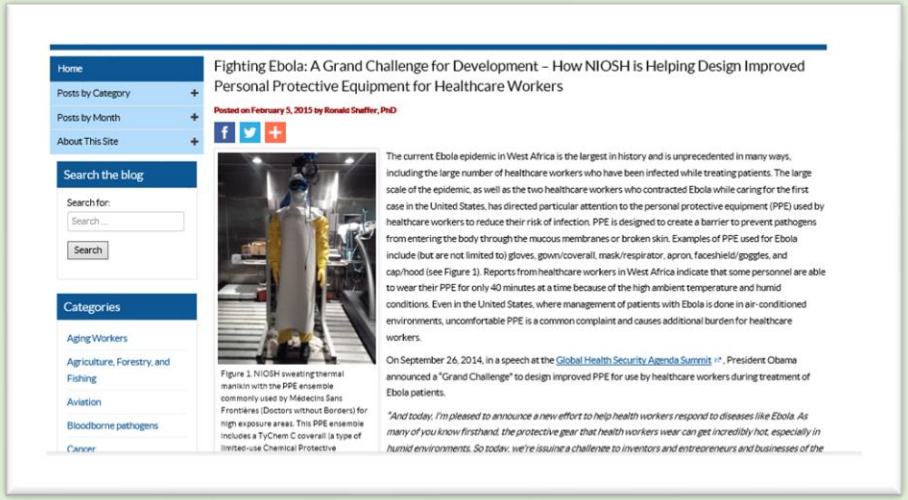
- Considerations for Selecting Protective Clothing used in Healthcare for Protection against Microorganisms in Blood and Body Fluids
  http://www.cdc.gov/niosh/npptl/topics/protectiveclothing/

- Fighting Ebola: A Grand Challenge for Development – How NIOSH is Helping Design Improved Personal Protective Equipment for Healthcare Workers
  https://blogs.cdc.gov/niosh-science-blog/2015/02/05/ebola-ppe/

- How Well Do You Think You Are Protected? Understanding proper use and disposal of protective gowns for healthcare workers
  https://blogs.cdc.gov/niosh-science-blog/2014/05/05/gowns/

- NIOSH Research Highlights Importance of Rigorous Standards for Gowns Used to Protect Healthcare Workers
  https://blogs.cdc.gov/niosh-science-blog/2015/07/22/isolation-gowns/





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- https://www.cdc.gov/niosh/npptl/default.html

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Thank You!

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