

# Personal Protective Equipment (PPE) for Ebola Virus Disease (EVD) Care in the United States Healthcare Facilities

## Purpose

3M has received a number of inquiries regarding the appropriate personal protective equipment for potential exposures to Ebola Virus Disease (EVD). Following are responses to many of the most commonly asked questions. It is important to note this FAQ is not a substitute for the guidance of the United States Centers for Disease Control and Prevention (CDC), World Health Organization (WHO), and your local health authority. Please consult their websites frequently for the most current information and infection control procedures regarding EVD.

## Websites for Reference

U.S. CDC	<a href="https://www.cdc.gov/vhf/ebola/index.html">https://www.cdc.gov/vhf/ebola/index.html</a>
WHO	<a href="http://www.who.int/csr/disease/ebola/en/">http://www.who.int/csr/disease/ebola/en/</a>
U.S. OSHA	<a href="https://www.osha.gov/SLTC/ebola/control_prevention.html">https://www.osha.gov/SLTC/ebola/control_prevention.html</a>

Please consult [3M Technical Data Bulletin Personal Protective Equipment \(PPE\) for Ebola Virus Disease \(EVD\)](#) regarding WHO and European Centres for Disease Prevention and Control (ECDC) information for EVD.

For further information related to PPE use, please contact your local 3M Personal Safety Division Technical Services team.

As selection of appropriate PPE should be based upon a site-specific risk assessment conducted by qualified individuals, there is no '3M recommended list' of PPE. Specific scenarios and PPE selection will differ depending on many factors including the location and type of work (e.g. caring for patients vs. laboratory tasks; hospitals outside of W Africa preparing for potential patients versus health care in W Africa). As with any use of PPE, there are no standardized solutions, and proper selection and use is critical to protection. There are a variety of options available within the different categories of PPE and associated advantages and disadvantages to the different types and models. It is the responsibility of each facility or organization to determine the appropriate level of protection by conducting a risk assessment which includes elements such as working conditions, tasks, and accessibility to decontamination facilities. As much as possible, engineering and administrative controls should be implemented. 3M cannot select PPE but can assist in helping purchasers identify the specific PPE models that meet or exceed the desired level of protection and the specifics of their situation.

## What is Ebola Virus Disease (EVD)?

Ebola Virus Disease (also known as Ebola hemorrhagic fever) is a severe, often-fatal disease caused by infection with a species of Ebola virus. EVD is a severe acute viral illness often characterized by the sudden onset of fever, intense weakness, muscle pain, headache and sore throat. This is followed by vomiting, diarrhea, rash, impaired kidney and liver function, and in some cases, both internal and external bleeding.

Outbreaks of Ebola have occurred sporadically in parts of Africa, South America, the Middle East and Eastern Europe, with fatality rates ranging up to 90%.

## How is it Transmitted?

Ebola is spread through direct contact with blood or body fluids (including, but not limited to urine, saliva, sweat, feces, vomit, breast milk and semen) of an infected person or animal, or through contact with objects that have been contaminated with the blood or other body fluids of an infected person, dead or alive. Transmission is believed to occur via contact with mucous membranes and non-intact skin (i.e., rashes, cuts, etc.). Risk of infection by inhalation of contaminated aerosols by healthcare workers has not been documented but is thought to be low at this time based on case history evidence.

Ebola virus is readily killed by soap, bleach, direct sunlight, or drying. Machine washing clothes that have been contaminated with fluids will destroy Ebola virus. Ebola virus survives only a short time on surfaces that are in the sun or have dried.<sup>1</sup>

## US Centers for Disease Control and Prevention PPE Recommendations Against Ebola Virus Disease for Health Care Workers

The prevention of Ebola virus infection depends on avoiding contact with blood and body fluids of infected individuals and with objects contaminated with these fluids. Barrier precautions are used to prevent skin or mucous membrane exposure of the eyes, nose, and mouth with blood, other body fluids, secretions (including respiratory droplets), or excretions.

On October 20, 2014 the US CDC published "[Guidance on Personal Protective Equipment To Be Used by Healthcare Workers During Management of Patients with Ebola Virus Disease in U.S. Hospitals, Including Procedures for Putting On \(Donning\) and Removing \(Doffing\)](#)".

The CDC document includes guidance on administrative and environmental controls; PPE selection, donning and doffing; training; and use of a trained observer. **It is important that anyone involved in infection control for Ebola Virus Disease (EVD) thoroughly read and understand this document.**

The following is a short summary of the CDC recommended PPE.

### Health Care Workers During Management of Ebola Patients

- Powered air purifying respirator (PAPR) with full facepiece, helmet, or hood; or N95 respirator. Any reusable PAPR headgear must be covered with a single-use (disposable) hood that extends to the shoulders, fully covers the neck and is compatible with the PAPR.

### IMPORTANT NOTE

For simplicity, users may likely prefer using disposable PAPR hoods instead of covering full facepiece and helmets with accessory disposable hoods. Disposable N95 respirators must be used with a single-use (disposable) surgical hood and a single use (disposable) full face shield. CDC notes that a face shield may not provide full face protection in the setting of significant splashing.

- Single-use (disposable) fluid-resistant or impermeable gown that extends to at least midcalf or coverall without integrated hood. Coveralls with or without integrated socks are acceptable. "If gowns or coveralls with thumb hooks are not available, personnel may consider taping the sleeve of the gown or coverall over the inner glove to prevent potential skin exposure from separation between sleeve and inner glove during activity."
- Two pairs of single-use (disposable) nitrile examination gloves with extended cuffs.
- Single-use (disposable) fluid-resistant or impermeable boot or shoe covers.
- Single-use (disposable), fluid-resistant or impermeable apron that covers the torso to the level of the mid-calf if patients have vomiting or diarrhea.

### Trained Observers During PPE Doffing

- Single-use (disposable) fluid-resistant or impermeable gown that extends to at least midcalf or coverall without integrated hood.

- Single-use (disposable) full face shield.
- Two pairs of single-use (disposable) nitrile examination gloves with extended cuffs.
- Single-use (disposable) fluid-resistant or impermeable shoe covers.

The CDC recommends that if facilities elect to use different PPE from what is outlined in their guidance, such as coveralls with an integrated hood, they must train workers in use and adjust the donning and doffing procedures.

The CDC emphasizes hand hygiene and instructs that hand hygiene be performed thoroughly and often including before and after donning and before and after doffing.

Please see appendices 1-3 for examples of 3M goggles, face shields, coveralls and respirators.

## Eye Protection

Eye protection provides a barrier to infectious materials from entering the eye and is often used in conjunction with other personal protective equipment (PPE) such as gloves, gowns, and masks or respirators. See Appendix 1.

### Goggles

Goggles are designed to fit snugly, but not necessarily seal around the wearer's eyes. NIOSH states<sup>2</sup>: "appropriately fitted, indirectly-vented goggles\* with a manufacturer's anti-fog coating provide the most reliable practical eye protection from splashes, sprays, and respiratory droplets. However, to be efficacious, goggles must fit snugly, particularly from the corners of the eye across the brow. While highly effective as eye protection, goggles do not provide splash or spray protection for other parts of the face.

\* Directly-vented goggles may allow penetration by splashes or sprays; therefore, indirectly-vented or non-vented goggles are preferred for infection control."

### Face Shields

Face shields are designed to help protect portions of the wearer's face to certain exposures. While goggles help protect a wearer's eyes from splashes, sprays, and droplets, a face shield can help reduce exposure to both the eyes and other facial areas.\* Face shields should have crown and chin protection and wrap around the face to the point of the ear. This will help reduce the possibility of splash, sprays and droplets from going around the edges of the shield and reaching the eyes or other facial areas.

\*The CDC notes that ANSI Z87.1 recommends face shields should be used in addition to goggles, not as a substitute for goggles, in a chemical exposure or industrial setting.

### Safety Glasses

Safety glasses provide impact protection but do not provide the same level of splash or droplet protection as goggles and generally should not be used for infection control purposes.

For more information, consult [3M Tech Data Bulletin #192 – Eye Protection for Infection Control](#).

## Protective Clothing

Selection of personal protection ensembles should be based on a site-specific PPE hazard assessment and consideration of recommendations made by health authorities. Performance criteria included in EN 14126:2006 - Performance Requirements and Test Methods for Protective Clothing Against Infective Agents should be considered. See Appendix 2.

In general, protective clothing offering the highest level of protection from infective agents, such as the 3M™ Protective Coverall 4570, is also the least breathable and may introduce hazards related to heat stress and dehydration.

Breathable protective clothing offers less protection but may be desired for tasks in extremely hot conditions where the risk of contacting infective agents is low, where sufficient decontamination facilities are available at the completion of work tasks, and where the risk of harm from heat stress and dehydration is high.

Selection for EVD should be based primarily on the potential exposures and need for protection against infective fluids and agents. However, work conditions, environmental conditions, tasks and accessibility to decontamination facilities should be considered.

## Respiratory Protection

Surgical/medical masks or respirators are another type of PPE recommended for those in contact with potential EVD cases. These products may need to be fluid resistant depending upon the eye and face protection being worn. This section discusses the use of respiratory protection.

For more information on the differences between surgical masks and respirators, please consult [3M Technical Data Bulletin #231 - Respirators and Surgical Masks: A Comparison](#).

A **respirator** is a device designed to help provide the wearer with respiratory protection against inhalation of a hazardous atmosphere.

To help reduce nose, mouth and respiratory system exposures to airborne particles, particulate-filtering respirators are often recommended. Particulate respirators are available as:

1. A filtering half facepiece respirator, where the filter is the entire respirator
2. An elastomeric (reusable) half mask with a particulate filter
3. An elastomeric (reusable) full facepiece with a particulate filter
4. A powered air purifying respirator (PAPR) that includes a particulate filter
5. A supplied air respirator.

Particulate respirators are designed to help reduce the wearer's exposure to certain airborne particles. Currently, health authorities have not documented EVD as being transmitted from infected individuals via airborne Ebola virus. However, droplets containing the Ebola virus that have become aerosolized (e.g. from coughing, sneezing, vomiting, medical procedures, and surfaces etc.) may have the potential to come into contact with a person's mucous membranes in their nose or mouth or non-intact skin. Therefore, respiratory protection may be helpful in providing a barrier to help prevent infectious materials from contacting a wearer's mucous membranes. They may also help limit inadvertent touching of the nose, mouth and/or eyes (if a full-facepiece or powered-air respirator is used). Respiratory protection is recommended for workers performing certain tasks such as aerosol-generating procedures, laboratory procedures, and autopsies.

See Appendix 3 for examples of different types of respirators.

For more information consult [3M Tech Data Bulletin #174 – Respiratory Protection for Airborne Exposures to Biohazards](#).

## Advantages and Disadvantages of Different Types of Respirators

Respiratory protection may be a component of the PPE selected based upon the risk assessment. A control banding approach has been suggested for choosing between different levels of respiratory protection based on the organism, generation rate, level of control and respirator protection factor.

<http://www.cidrap.umn.edu/news-perspective/2014/09/commentary-healthworkers-need-optimal-respiratory-protection-ebola>

Following are some general advantages and disadvantages of different types of respirators.

### Disposable Filtering Facepiece Respirator

- Disposable, no maintenance
- Lightweight
- Less expensive
- Need separate eye and face protection
- Fit testing required in certain countries, including the US, to ensure respiratory protection

### Reusable Half mask or Full Facepiece Respirator

- Often available in multiple sizes
- Facepieces can be disinfected and reused
- Full facepieces may provide eye and face protection
- Fit testing required in certain countries, including the US, to ensure respiratory protection
- Facepieces must be maintained
- Unit needs to be maintained

### Powered Air Purifying (PAPR) Respirator

- Some elements can be disinfected and reused
- No fit testing required for systems with loose fitting head covers
- May not need separate eye and face protection depending on the head covering
- Batteries need to be charged and entire unit maintained
- Higher initial cost
- Unit needs to be maintained
- Wearer may not need to be clean-shaven, depending on the type of head cover and style of facial hair

### Supplied Air Respirators

- Some systems provide cooled air to the wearer
- Some components can be disinfected and reused
- No fit testing required for systems with loose fitting head covers
- May not need separate eye and face protection depending on the head covering
- Need adequate supply and pressure of compressed breathable air (Grade D)
- Unit needs to be maintained
- Higher initial cost

Please see [3M Technical Data Bulletin: Cleaning Reusable Respirators and Powered Air Purifying Respirator Assemblies](#) following potential exposure to the Ebola virus.

## Summary

Those who will be exposed to individuals with known or suspected cases of EVD should wear PPE that provides a barrier to help prevent infectious material from contacting mucous membranes (mouth, nose, eyes) and non-intact skin (i.e., rashes, cuts, etc.). Respiratory protection should be utilized if there is a risk of aerosolized particles (i.e. aerosol-generating procedures, certain laboratory tasks, autopsies), or according to local health authorities. Always ensure that PPE users are properly trained in the benefits and limitations of the equipment per all applicable guidance and regulations and the manufacturer's user instructions. Please consult your occupational safety and health professional, the appropriate health authority and the PPE manufacturer with questions.

## References

1. ECDC Information to Travellers. [http://www.ecdc.europa.eu/en/healthtopics/ebola\\_marburg\\_fever/informationtravellers/Pages/information-travellers.aspx](http://www.ecdc.europa.eu/en/healthtopics/ebola_marburg_fever/informationtravellers/Pages/information-travellers.aspx)
2. National Institute for Occupational Safety and Health (NIOSH). Eye Protection for Infection Control. September 2004. <http://www.cdc.gov/niosh/topics/eye/eye-infectious.html>
3. US CDC <http://www.cdc.gov/vhf/ebola/index.html>
4. WHO <http://who.int/mediacentre/factsheets/fs103/en/>
5. WHO "Interim Infection Prevention and Control Guidance for Care of Patients with Suspected or Confirmed Filovirus Hemorrhagic Fever in Health-Care Settings, with Focus on Ebola." [http://www.who.int/csr/resources/publications/ebola/filovirus\\_infection\\_control/en/](http://www.who.int/csr/resources/publications/ebola/filovirus_infection_control/en/)
6. US CDC "Infection Prevention and Control Recommendations for Hospitalized Patients with Known or Suspected Ebola Hemorrhagic Fever in U.S. Hospitals." <http://www.cdc.gov/vhf/ebola/hcp/infectionprevention-and-control-recommendations.html>
7. "Health workers need optimal respiratory protection for Ebola" Lisa Brosseau, Rachael Jones. Center for Infectious Disease Research and Policy Sept. 7, 2014. <http://www.cidrap.umn.edu/newsperspective/2014/09/commentary-health-workers-need-optimal-respiratory-protection-ebola>
8. ECDC Critical aspects of the safe use of personal protective equipment. <http://www.ecdc.europa.eu/en/publications/Publications/safe-use-of-ppe.pdf>








## Appendix 1 - Examples of 3M Protective Eyewear

	Goggles				Face Shields
Image					
Product	GG501SGAF	GG501NSGAF	40671-00000-10	GG2891-SGAF	82501-00000 and 82582-00000
Description	3M™ GoggleGear™ 500 Series, Clear Scotchgard™ Anti-fog		3M™ Maxim™ Splash Goggle Over-the-Glass (OTG) AS/AF (anti-scratch/anti-fog)	3M™ GoggleGear™ GG2891-SGAF, Indirect vent, Clear Scotchgard™ Anti-fog lens, 10ea/case	3M™ Ratchet Headgear H8A with 3M™ Clear Polycarbonate Faceshield WP96X
Eye Protection (Splashes, sprays, and droplets)	Yes	Yes	Yes	Yes	Yes (Secondary Protector)
Face Protection (Splashes, sprays, and droplets)	No	No	No	No	Yes

## Appendix 2 - Examples of 3M Protective Apparel

### **i** IMPORTANT NOTE

These products will not eliminate the risk of infection. Currently there is no established guidance specifying performance criteria for protective clothing specific to EVD. This information is presented to help safety professionals make informed decisions as part of a site and task specific PPE hazard assessment.

		3M™ Protective Coverall 4570	3M™ Protective Coverall 4565	3M™ Protective Coverall 4545	3M™ Protective Coverall 4540+	3M™ Protective Coverall 4535	3M™ Protective Coverall 4510	3M™ Overboot 440/450
PPE Directive Approval		CE Category 3	CE Category 3	CE Category 3	CE Category 3	CE Category 3	CE Category 3	N/A
Fabric Type		Multi-layered laminate	Non-breathable laminate	Micro-porous laminate	SMMMS/Micro-porous laminate Hybrid	SMMMS/Micro-porous laminate Hybrid	Micro-porous laminate	Micro-porous laminate
Image								
<b>General Data</b>	<b>Test Method</b>							
Suit Type	ISO 16602:2007	Type 3	Type 4	Type 5/6	Type 5/6	Type 5/6	Type 5/6	N/A
Hood/collar options		Hood only	Hood only	Hood only	Hood or collar	Hood only	Hood or collar	N/A
Seam construction	N/A	Serged & Taped	Serged & Taped	Serged	Serged	Serged	Serged	Serged
<b>Material Data per EN 14325</b>								
Abrasion resistance Method 2	EN 530:1994	5/6	1/6	1/6	1/6	1/6	1/6	N/A
FlexCracking Resistance, Method B	ISO 7854	1/6	1/6	3/6	4/6	5/6	5/6	N/A
Trapezoid tear resistance	EN ISO 9073-4:1997	2/6	1/6	1/6	1/6	1/6	1/6	N/A
Tensile strength	EN ISO 13934-1:1999	1/6	1/6	1/6	1/6	1/6	1/6	N/A
Puncture resistance	EN 863:1996	2/6	1/6	1/6	1/6	1/6	1/6	N/A
Seam Strength	EN ISO 13935-2:1999	3/6	2/6	2/6	1/6	2/6	1/6	N/A
<b>Protection against Infective Agents</b>								
Synthetic blood penetration resistance	ISO 16603:2004	6/6	6/6	3/6	N/A	N/A	N/A	N/A
Blood-borne pathogen penetration resistance	ISO 16604:2004	6/6	0	0	N/A	N/A	N/A	N/A
Contaminated solid particle penetration resistance	EN ISO 22612:2005	3/3	3/3	3/3	N/A	N/A	N/A	N/A
Contaminated liquid aerosol penetration resistance	ISO/DIS 22611:2003	3/3	3/3	3/3	N/A	N/A	N/A	N/A
Wet bacteria penetration resistance	EN ISO 22610:2006	6/6	6/6	6/6	N/A	N/A	N/A	N/A
<b>Liquid Chemical Permeation</b>								
Chemical permeation resist. - H2SO4 98%	EN 374:2003	6/6	5/6	N/A	N/A	N/A	N/A	N/A
Chemical permeation resist. - NaOH 40%	EN 374:2003	6/6	6/6	N/A	N/A	N/A	N/A	N/A



## Appendix 3 - Overview of 3M Respiratory Protective Devices

	Half-face		Full Face	PAPR	
	Filtering Facepiece	Elastomeric Facepiece	Elastomeric Facepiece	Loose Fitting Head gear	Loose Fitting Hood/Helmet
Image					
Eye Protection (splashes, sprays, and respiratory droplets)	No	No	Yes	Limited	Limited
Face Protection (splashes, sprays, and respiratory droplets)	No	No	Limited	Limited	Limited
Head Protection (splashes, sprays, and respiratory droplets)	No	No	No	Limited	Limited
Respiratory Protection* (airborne aerosols and respiratory droplets)	Yes	Yes	Yes	Yes	Yes

\* When equipped with appropriate and approved filter and/or cartridge.

### Examples of 3M Disposable Respirators

				
Product	3M™ Particulate Respirator 8210	3M™ Particulate Respirator 8511	3M™ Health Care Particulate Respirator and Surgical Mask 1860	3M™ Aura™ Health Care Particulate Respirator and Surgical Mask 1870+
Valve	Unvalved	Valved	Unvalved	Unvalved
Size	8210 - one size	8511- one size	1860 - regular 1860S - small	1870+ - one size
Classification	N95	N95	N95	N95
Fluid Resistant	No	No	Yes	Yes
FDA Clearance	No	No	Yes	Yes

Note: Other models of 3M disposable respirators are available, but supply may be constrained if demand increases.








## Examples of 3M Reusable Respirators

	Half Facepiece Respirator			Full Facepiece Respirator			Particulate Filters	
Image								
Product	3M™ Half Facepiece 6000 Series	3M™ Half Facepiece 6500 Series	3M™ Half Facepiece 7500 Series	3M™ Full Facepiece 6000 Series	3M™ Full Facepiece FF-400 Series	3M™ Full Facepiece 7800 Series	3M™ 2291 P100	3M™ 7093 P100
Description	6100 - small 6200 - medium 6300 - large	6501 - small 6502 - medium 6503 - large	7501 - small 7502 - medium 7503 - large	6700 - small 6800 - medium 6900 - large	FF-401 - small FF-402 - medium FF-403 - large	7800S-S - small 7800S-M - medium 7800S-L - large	Particulate filter	Encased particulate filter

Note: Chemical cartridges are available to help reduce exposures to chemical disinfectants (e.g. chlorine).

## Examples of 3M Powered Air Purifying Respirators (PAPRs)

	BE-Series	S-Series			M-Series
					
<b>Models</b>	BE-10	S-403, S-433, S-533	S-655/S-657	S-855/S-857	M-405
<b>Assigned Protection Factor</b>	1000	1000	1000	1000	1000
		Breathing Tube			
 3M™ Versaflo™ TR-300 PAPR with TR-3712N HEPA Filter		 3M™ Versaflo™ Breathing Tube BT-20, BT-30, BT-40			
 3M™ Versaflo™ Powered Air Turbo TR-600 with TR-6710N Filter		 3M™ Versaflo™ Breathing Tube Disposable Cover BT-922			

	BE-Series	S-Series			M-Series
					
<b>Models</b>	BE-10	S-403, S-433, S-533	S-855/S-857	M-405	
<b>Assigned Protection Factor</b>	1000	1000	1000	1000	
 Breathe Easy with 450-00-01R12 HEPA Filter	 520-01-00R01	 BE-324			

Note: Other PAPR's, hoods, helmets and headcovers are available.

## Bulletin Change Summary

Release 2, July 2017

- Updated hyperlinks throughout document.
- Updated available and approved products.
- Updated format.

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