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Protective Clothing for Ebola Virus Disease (EVD)

This document provides general guidance for the use of DuPont Protective Apparel for Ebola virus disease response. Protective apparel is only one component of a comprehensive Personal Protective Equipment program recommended for Ebola response.
An evaluation of the performance of protective overalls against these criteria, as part of the overall risk assessment, can assist in selecting the right personal protective equipment to minimise the risk of infection.

These suggestions are based on recommendations of the World Health Organization (WHO), the U.S. Centers for Disease Control (CDC), and Médicins Sans Frontières (MSF). These organizations and resources offer extensive information on the Ebola outbreak:

United States Centers for Disease Control (CDC)
World Health Organization (WHO)
CDC Q&As
Médecins Sans Frontières International (MSF)

Protective clothing and protective equipment are only part of any comprehensive response to Ebola virus disease. Public health management of Ebola virus disease involves a combination of techniques: quarantines, avoidances, engineering controls, work practices, administrative controls, and proper use, donning and doffing of personal protective equipment. Consult with local authorities before undertaking any control or response activities. Ensure that the guidance is appropriate for the conditions and activities in which you will engage.

Once introduced into the human population, the Ebola virus is spread through direct contact with: a sick person's blood or body fluids, objects that have been contaminated with the virus, or infected animals.*

Exposure to Ebola viruses can occur in healthcare settings where hospital staff are not wearing appropriate protective equipment, such as masks, gowns, and gloves, according to the CDC.
For more information on how to prevent the spread of Ebola, visit:
CDC infection prevention and control recommendations

Personal Protective Equipment (PPE)

- All persons entering the patient room should wear at least:
  - Gloves
  - Gown (fluid resistant or impermeable)
  - Eye protection (goggles or face shield)
  - Facemask
- Additional PPE might be required in certain situations (e.g., copious amounts of blood, other body fluids, vomit, or feces present in the environment), including but not limited to:
  - Double gloving
  - Disposable shoe covers
  - Leg coverings

* "Questions and Answers on Ebola." CDC.gov. http://www.cdc.gov/vhf/ebola/pdf/ebola-qa.pdf
Field images courtesy of EU Humanitarian Aid and Civil Protection

Questions and Answers

1. What is Ebola virus disease?
Ebola virus is the cause of a viral hemorrhagic fever disease. Symptoms of Ebola include fever and additional symptoms like severe headache, muscle pain, vomiting, diarrhea, stomach pain, or unexplained bleeding or bruising. Symptoms may appear anywhere from 2 to 21 days after exposure to Ebola virus, although 8 to 10 days is most common.*

2. How is Ebola transmitted?
The virus is spread through direct contact (through broken skin or mucous membranes) with the body fluids (blood, urine, feces, saliva, and other secretions) of a person who is sick with Ebola, or with objects like needles that have been contaminated with the virus, or infected animals.*

3. Can DuPont recommend personal protective equipment (PPE) to use for Ebola virus disease?
The CDC and WHO websites above provide direction on infection prevention and control procedures related to Ebola. The selection of appropriate PPE (including respiratory, eye, head, foot and hand protection) is the responsibility of the end-user and must be made following a thorough hazard assessment of the work tasks and the environment. It must also be checked that the selected PPE meets relevant government and industry standards and that individuals are properly trained in the donning, doffing, use and disposal of PPE to avoid contamination.

The information provided by DuPont is not intended as a substitute for any hazard assessment testing that the end-user needs to conduct to determine the suitability of our products for their particular purposes. This information is offered for consideration and is not a recommendation.

4. Which DuPont garments are tested according to international standards for blood-borne pathogens (ISO 16603 and ISO 16604) ?
All DuPont™ Tychem® fabrics including Tychem® 2000 C have been tested and passed the ISO 16603 and ISO 16604 tests with no penetration at the highest pressure.

5. What does it mean to be compliant to EN 14126 ?
The European standard EN 14126 defines performance requirements for clothing materials to protect against infective agents and comprises 5 material tests conducted on garment fabrics. This European standard only refers to "materials" itself, with no infective-agent performance requirements on the seam. Since viruses, bacteria and spores are small enough to penetrate through the openings of sewn seams, suits with over-taped seams are recommended.

PLEASE NOTE: Fabrics are tested using recognized procedures to determine the level of barrier against proxy materials for blood-borne pathogens. They are not tested against specific viruses, such as Ebola.

Comparative performance of DuPont protective garments

Garment model		 Tyvek® 500 Xpert	 Tyvek® 600 Plus
Protection type		Type 5 & 6	Type 4, 5 & 6
Seam construction		Sewn	Stitched and over-taped
Breathability		Air and water vapour permeable	Air and water vapour permeable
Risk groups**		1	1, 2
EN 14126 - Performance requirements and test methods for protective clothing against infective agents			
Screening pressure test: Resistance to penetration by blood and body fluid using synthetic blood - ISO 16603	**Class**	3/6	3/6
	Exposure pressure [kPa]	3,5	3,5
Resistance penetration by blood-borne pathogens using a bacteriophage («virus» penetration simulation) - ISO 16604 Procedure D	**Class**	no classification	no classification
	Exposure pressure [kPa]	no classification	no classification
Resistance to penetration by biologically contaminated liquids (wet bacterial penetration) – EN ISO 22610	**Class**	1/6	1/6
	Bacterial penetration breakthrough time [min]	≤15	≤15
Resistance to penetration by biologically contaminated liquid aerosols – ISO/DIS 22611	**Class**	1/3	1/3
	Penetration ratio without /with test material [log]	>1	>1
Resistance to penetration by biologically contaminated solid particles (dry microbial penetration) – ISO 22612	**Class**	1/3	1/3
	Penetration ratio without /with test material [log cfu]	≤3	≤3

* Please note: Fabrics are tested using recognized procedures to determine the level of barrier against proxy materials for blood borne pathogens; they are not tested against specific viruses.
** DuPont suggestion based on garment barrier performance. Please note that selection of the appropriate garment remains the responsibility of the end-user and must be made following a thorough hazard assessment of the work tasks and the environment.

Protective clothing according to EN 14126:2003

TYPES 1a-B, 1b-B, 1c-B : Gas-tight / EN 943-1:2002, EN 943-2:2002

TYPES 2-B : Non-gas-tight / EN 943-1:2002, EN 943-2:2002

TYPES 3-B : Protection against pressurised liquid chemicals / EN 14605:2005 + A1:2009

TYPES 4-B : Protection against liquid aerosols (spray tight) / EN 14605:2005 + A1:2009

TYPES 5-B : Protection against airborne solid particulates / EN ISO 13982-1:2004 + A1:2010

TYPES 6-B : Limited protection against liquid chemicals (light spray) / EN 13034:2005 + A1:2009

What are the biological agent risk groups?

The aforementioned directive requires the classification of biological agents into four risk groups, according to their level of risk of infection:

Risk Group 1:
Biological agents unlikely to cause sickness in humans.

Risk Group 2:
Biological agents that could cause sickness in humans and represent a danger to employees; substance dispersal among the population is unlikely; effective preventive measures or treatment is normally possible.

Risk Group 3:
Biological agents that can cause severe illness in humans and represent a serious risk for employees; a risk of dispersal among the population may occur, but effective preventive measures of treatment are normally possible.

Risk Group 4:
Biological agents that cause severe illness in humans and represent a serious risk for employees; the risk of dispersal among the population is high under some circumstances; effective preventive measures or treatment are not normally possible.
A comprehensive classification of biological agents into risk groups is given in the annex of the EU directive 2000/54/EC.

 Tyvek® 800 J	 Tychem® 2000 C	 Tychem® 2000 C Apron	 Tychem® 4000 S	 Tychem® 6000 F	 Tychem® 6000 F Apron
Type 3, 4, 5 & 6	Type 3, 4, 5 & 6	Type 3, 4, 5 & 6	Type 3, 4, 5 & 6	Type 3, 4, 5 & 6	Type 3, 4, 5 & 6
Stitched and over-taped	Stitched and over-taped	Stitched and over-taped	Stitched and over-taped	Stitched and over-taped	Stitched and over-taped
Water vapour permeable	Impermeable	Impermeable	Impermeable	Impermeable	Impermeable
1, 2, 3	1, 2, 3, 4	1, 2, 3, 4	1, 2, 3, 4	1, 2, 3, 4	1, 2, 3, 4
6/6	6/6	6/6	6/6	6/6	6/6
20	20	20	20	20	20
4/6	6/6	6/6	6/6	6/6	6/6
7	20	20	20	20	20
6/6	6/6	6/6	6/6	6/6	6/6
>75	>75	>75	>75	>75	>75
3/3	3/3	3/3	3/3	3/3	3/3
>5	>5	>5	>5	>5	>5
3/3	3/3	3/3	3/3	3/3	3/3
≤1	≤1	≤1	≤1	≤1	≤1

Where do biological substances occur, what are they, and what diseases can they trigger?

Sector	Biological substances	Possible diseases
Agriculture	Moulds	Allergies
	Bacteria *(actinomycetes)*	Farmer's lung *(EAA)*
	Microorganisms *(e.g. Erwinia herbicola)*	Organic dust toxic syndrome *(humidifier fever)*
	Bacteria *(e.g. Listeria monocytogenes)* Pathogens *(e.g. Coxiella burnetii)* Fungi *(e.g. Dermatophytes)*	Zoonotic diseases *(sickness transmitted from animals to humans)*, e.g. Q fever, listeriosis or skin mycoses
Handling of veterinary waste (e.g. waste separation/recycling facilities, composting facilities)	Moulds *(e.g. Aspergillus fumigatus)*	Allergies Aspergillosis, aspergilloma
	Bacteria *(Actimomycetes)*	Extrinsic allergic alveolitis *(EAA)*
	Gram-negative bacteria	Organic dust toxic syndrome *(humidifier fever)*
	Enteric viruses, enteric bacteria	Infections *(e.g. gastroenteritis)*
Wastewater treatment plants, sewer system work	HAV virus	Hepatitis A
	Salmonella	Salmonellosis
	Echo, rota virus	Enterovirosis *(virus infection)*
	Bacteria *(e.g. Leptospirosis)*	Leptospira interrogans
Hospitals, healthcare, laboratories, police, emergency services	Ebola, Lassa	Fevers
	HIV virus	AIDS
	Bordetella pertussis	Whooping cough
	Mycobacterium tuberculosis	Tuberculosis
	HBV virus	Hepatisis B
Food industry	Moulds/yeast	Allergies, skin irritations
	Bacteria	
	Endotoxins	Organic dust toxic syndrome *(ODTS)*

Source : BG and OSHA documentation

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