



Decontamination of Vehicles Used for Transportation of Potential Ebola Virus Disease (EVD) Patients or Related Equipment

Technical Information Paper No. 13-031-1014

1. Purpose. This information paper provides guidance for decontaminating vehicles used to transport personnel or equipment in the Area of Operations (AO) impacted by Ebola virus disease (EVD). It is intended to provide decontamination information specific to Department of Defense (DoD/DOD) equipment deployed with U.S. troops to EVD affected areas. It is not intended to change any existing DoD directives, policies, or procedures provided by Combatant Commands, concept plans (CONPLANS), or Operation Orders (OPORDs) in the AO or the U.S. Africa Command (AFRICOM) Area of Responsibility (AOR).

2. Applicability. This information is applicable to DOD-owned vehicles and equipment. This is preliminary information based upon limited available data. This document is not intended to be a step-by-step instruction and should be read and understood in its entirety prior to commencing any vehicle decontamination activity. Hence, there is an expectation that personnel involved with decontamination activities have familiarity with the proper use of personnel protective equipment (PPE), respirator protection program, working with hazardous materials, hazards associated with working with infected persons and remains, and waste management and disposal practices.

3. Background. The U.S. Centers for Disease Control and Prevention (CDC) notes that the 2014 outbreak is the largest outbreak of EVD in history and the first in West Africa. There may be instances during responses to the outbreak when DOD vehicles may be used for the transport of suspected and/or confirmed EVD patients, equipment, or medical waste.

4. References. Established military procedures for decontamination of several types of military equipment are found in Field Manual (FM) 3-11.5/MCWP 3- 37.3/NTTP 3-11.26/AFTTP(I)3-2.60, CBRN Decontamination: Multiservice Tactics, Techniques, and Procedures for Chemical Biological Radiological and Nuclear Decontamination, April 2006. See Appendix A for additional references.

5. EVD Transmission.

a. Body fluids and tissue from individuals who develop symptoms of EVD are very infectious. EVD spreads in the community through

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human-to-human transmission, with infection resulting primarily from direct contact (through broken skin or mucous membranes) with the blood, secretions, organs or other bodily fluids of infected people, and indirect contact with environments contaminated with such fluids. According to the limited research available, isolation of cases, disease contact tracing, proper handling of blood/body fluids and remains of the deceased, and proper use of PPE when in contact with EVD-infected persons is required to stop further spread.

b. Persons in contact with suspected and/or confirmed EVD patients must consistently apply appropriate infection control procedures (standard, contact, and droplet precautions). These include basic hand hygiene, respiratory hygiene, PPE to reduce the risk from splashes or other contact with infected materials, and patient isolation. Prevention guidelines for medical and transport personnel who may come in contact with EVD patients or their bodily fluids are available at: <http://www.cdc.gov/vhf/ebola/hcp/index.html>.

c. Given the apparent low infectious dose, potential for high virus titers in the blood of ill patients, and disease severity, higher levels of precaution are warranted to reduce the potential risk posed by contaminated surfaces.¹

d. Infection control guidelines addressing procedures to disinfect healthcare settings are readily available from the CDC. The CDC also provides guidance for decontamination procedures for air medical transport of EVD patients and disinfection for airport cargo and cleaning personnel. This document is intended to augment these resources by providing decontamination information specific to DOD vehicles deployed to EVD affected areas.

e. Porous surfaces in the vehicle (cloth seats, worn or torn plastic seats, pillows, bedding) should be covered with plastic or other fluid-impermeable covering prior to transporting patients. Coverings must be disinfected after use or disposed.

6. Decontamination and Waste Management Process. The following processes are discussed in this paper.

a. Equipment to disinfect. Mission leadership in theater along with infection control will decide what equipment is reusable and can be disinfected and what equipment will be treated and disposed.

b. Select PPE.

c. Appropriate disinfection chemicals. The on-site Infection Control Officer (ICO) will select the disinfection method and chemicals.

- d. Positive control of reusable equipment
- e. Decontamination steps for porous and non-porous equipment.
- f. Disposal of solid waste and wastewater generated in the decontamination process.
- g. Management of contaminated items selected for disposal.
- h. In theater treatment and disposal of infectious waste.

7. Vehicles in the AO where EVD is Present or Suspected. Vehicles in the AO that do not come in contact with persons ill with EVD or items potentially contaminated with Ebola virus do not require special decontamination, but should follow normal protocols for washing military vehicles as established in DoD Regulation 4500.36, Management, Acquisition, and Use of Motor Vehicles.

8. Vehicles that have Transported a Suspected and/or Confirmed EVD Patient. Vehicles used to transport a suspected and/or confirmed Ebola patient must be decontaminated as soon as possible after use.

9. Select PPE. Personnel cleaning and disinfecting equipment must wear PPE. The on-site ICO will determine the appropriate level of PPE for disinfection of vehicles. Disposable PPE will not be reused. The ICO will also determine which PPE can be reused and the disinfection procedures necessary. Reusable PPE items will require proper cleaning and disinfection after each use.

a. Donning and doffing of PPE are critical steps in the prevention of exposure. It is imperative that personnel carefully remove PPE after working in potentially contaminated environments to avoid exposure of non-protected skin and mucous membranes. It is highly recommended that donning and doffing of PPE is performed in pairs or with supervision to minimize potential for unintentional exposures. Instructions for putting on and removing PPE are available at <http://www.cdc.gov/HAI/prevent/ppe.html> and <http://www.cdc.gov/vhf/ebola/pdf/ppe-poster.pdf>.

b. The onsite ICO will determine the PPE necessary for the disinfection process. At a minimum, PPE should include doubled disposable gloves with the inner glove taped to the suit, fluid resistant/impermeable gown, eye protection (face shield), and N95 respirator to protect against direct skin and mucous membrane exposure of cleaning chemicals, contamination, and splashes or spatters during cleaning and disinfection

activities. Additional barriers (e.g., leg covers, shoe covers) may be required for disinfection process requiring a low pressure sprayer.

c. When there is a greater risk of splashes or splatters, use full Tyvek[®] coverall suit, and overboots, heavy gauge rubber gloves over disposable gloves taped to the coverall suit, along with personal air purifying respirator (PAPR) during cleaning and disinfection activities. (Tyvek[®] is a registered trademark of E.I. DuPont de Nemours and Company.)

10. Selection of Decontamination Method. There are a number of procedures and materials that can be used to decontaminate surfaces suspected of Ebola virus contamination. Not all decontamination methods are suitable or amenable to the material/item that is suspected of contamination. The best method to use depends on the type of material that is contaminated, how the material is contaminated, the ability to obtain decontamination supplies, and other factors specific to the AO. One key element impacting decontamination is the porosity of the material and whether electronic components are present. Establish a decontamination area according to in FM 3-11.5/MCWP 3-37.3/NTTP 3-11.26/AFTTP(I)3-2.60, *CBRN Decontamination: Multiservice Tactics, Techniques, and Procedures for Chemical Biological Radiological and Nuclear Decontamination*, April 2006.

a. Porous materials. These are materials that will allow liquid and gas to pass through them. These will vary in hardness, density, and porosity. As a result, liquids spilled or applied to these will absorb into the material making it more difficult to remove or decontaminate. Examples of porous materials include paper, fabric, and wood.

b. Non-porous materials. These are materials that will limit or prevent liquid and gas from passing through them. Liquids spilled or applied to these materials will pool or run off the material. Examples of non-porous materials include glass, metals, and plastics.

c. Electronics. These are items containing electronic circuitry, switches, batteries, wiring, and so forth. These items may or may not be installed or manufactured in a manner to prevent exposure to vapors and liquids, such as contaminants and decontamination products.

d. Heavily soiled items. Even at the higher concentration of bleach solution, disinfection will be more successful if gross debris is removed prior to disinfection. Organic matter will neutralize bleach solution. Use disposable cleaning cloths, mop cloths, and wipes to manually clean the surfaces with a bleach and soap and water solution. This step should be followed with disinfection with one of the following disinfectants.

11. Chemical Decontamination. Selected disinfectants and bleach are recommended for killing the Ebola virus. Note that while alcohol is part of any hand sanitation/infection control program (alcohol-based hand sanitizer), it is not effective for decontaminating objects that have been in contact with the Ebola virus.

a. Commercial disinfectants. The U.S. Environmental Protection Agency (EPA) has identified a number of disinfectants suitable for Ebola virus decontamination (Table 1). The disinfectants on *List G: EPA’s Registered Antimicrobial Products Effective Against Norovirus* have been identified as being acceptable for use against Ebola virus. A large number of these are peroxide and acidic/alkaline-based cleaners.² Prepare and use commercial disinfectant per the directions on the package.

Table 1. National Stock Numbers for Some EPA-Approved Disinfectants

NSN	Trade Name	Nomenclature
6840-01-389-6088	Dispatch [®]	Disinfectant-Detergent, General Purpose
6840-01-491-4889	Dispatch	Disinfectant-Detergent, General Purpose
7930-01-084-3103	Spray Nine [®]	Cleaner, Industrial, Multi-Purpose
7930-01-177-0795	Spray Nine	Cleaner, Industrial, Multi-Purpose
7930-01-346-5280	Spray Nine	Cleaner, Industrial, Multi-Purpose
7930-01-346-5281	Spray Nine	Cleaner, Industrial, Multi-Purpose
7930-01-346-5284	Spray Nine	Cleaner, Industrial, Multi-Purpose
7930-01-393-6747	Spray Nine	Cleaning Compound Solvent Detergent Liquid Disinfectant 25oz 12s

Notes:

Dispatch[®] is a registered of The Clorox Company. SprayNine[®] is a registered trademark of the U.S. EPA.

b. Bleach. Diluted bleach is highly effective at decontaminating surfaces and items contaminated with the Ebola virus. Non-porous surfaces that are relatively free of debris and caked or pooled material can be decontaminated with a solution of 1 percent bleach [1:100 (~8 teaspoons of bleach added to 1 gallon of water or 10 milliliters (mL) of bleach to 990 mL of water)]. For unclean, soiled, dirty, and porous surfaces, or when decontaminating an item via immersion; a solution of 10 percent bleach solution should be used [1:10 (1 cup of bleach added to 9 cups of water or 100 mL of bleach added to 900 mL of water)].³ Even at the higher concentration of bleach solution, disinfection will be more successful if gross debris is removed prior to disinfection. Organic matter will neutralize bleach solution. Bleach solution should remain in contact with surfaces/items for at least 10 minutes.

(1) Full strength bleach emits toxic vapors and should never be used in small or enclosed spaces. Ideally, mix your solution outside. If that is not an option, go to a large, well-ventilated room and open the windows.

(2) Carefully pour the bleach into the container first, and then add cold water. Mixing the solution in this order will prevent the bleach from splashing up on you. If you do get any bleach on your skin, wipe it off immediately with a damp cloth.

(3) Place the lid on the container and gently invert the container back and forth a few times to mix. The solution is now ready to use. Never add any other ingredients to the bleach solution because many substances, including vinegar, create harmful fumes when mixed with chlorine bleach.

(4) Chlorine bleach solution begins to lose its disinfectant power quickly when exposed to heat, sunlight, and evaporation. To ensure the solution is still strong enough to kill germs, mix a fresh batch every 2 hours using cold water and discard any remaining solution.

(5) Use of Super Tropical Bleach (STB), as specified in FM 3-11.5, can be used where applicable if it will not degrade/damage the contaminated item.

c. MicroChem Plus™ solution. MicroChem Plus solution is highly effective at decontaminating surfaces and items contaminated with the Ebola virus. Approximately 190 mL of MicroChem Plus solution can be added to 1 gallon of water to achieve the correct dilution for decontaminating surfaces. The MicroChem Plus solution should remain in contact with the surfaces/items for at least 15 minutes. An advantage of MicroChem Plus is that it is not believed to be degraded by organic matter to the degree that bleach is. (MicroChem Plus™ is a trademark of National Chemical Laboratories, Inc.)⁴

12. Encapsulated Treatment. This method requires encapsulating an item, or area to be decontaminated, within a sealed enclosure whereupon all items within the enclosure are subjected to treatment. Treatment may be in the form of heating, vaporized chemical oxidizers (e.g., hydrogen peroxide vapor, chlorine dioxide), or disinfectant bombs/fogs (fumigation). The amount of time required to effectively decontaminate the area depends on the concentration used, the contact time, environmental controls (maintaining the temperature and/or concentrations), the size of the space (this will be a factor for reaching the desired concentration), and the integrity of the encapsulation (maintained positive pressure, sealed, and so forth). Failure of any one of these may compromise the decontamination process. Additionally, it will be necessary to validate the treatment process to demonstrate all locations within the enclosed area were adequately subjected to the particular treatment used. Validate according to the chemical manufacturer directions.

The drawback to encapsulation is the potential for the treatment itself to adversely impact sensitive items contained within the enclosure (i.e., corrosion of electronics,

melting of plastics, chemical residues). This form of treatment should only be used in those instances where surface decontamination or disposal of the contaminated item is not feasible due to the total area requiring treatment, when contamination is not limited to the surface, and/or when the cost to replace the item is excessive. Specialized equipment for dispersing reagents, PPE, and controlling the environment will be required.

This option may not be available in theater.

13. Positive Control of Reusable Equipment. Establish a system for tracking items selected for disinfection and reuse. Establish a means for identifying and tracking all items that have and have not been disinfected. Whether through the use of colored tape, flags, tags, spray paints, or designated holding areas; this is absolutely necessary to ensure all reusable items are decontaminated prior to being released for reuse. Identify one person (or team) as the central controller for tracking and documenting all items subject to disinfection. By utilizing a centralized point of contact (POC) or team, this allows for greater control, monitoring, tracking, and review of potentially contaminated items.

14. Decontamination of Non-Porous Surfaces (e.g., Glass, Metal, Painted Surfaces, Plastics). Coat the surface with disinfectant and let stand for 30 minutes. If using hand sprayers, ensure PPE designed for splash protection is worn. During this time, a disinfectant saturated media (i.e., sponge, rag, wipe) can be used to gently spread the disinfectant across and around the surface. Allow to dry.

15. Decontamination of Porous Surfaces. For porous surfaces (e.g., removed clothing, bedding, mattresses, seat cushions); decontamination will require a decision as to whether the item will be reused.

a. Porous items that have been in direct contact with bodily fluids from infected patients will be disposed as infectious waste (see paragraph 17).

b. There may be times when a porous item must be placed back into use. In these limited situations disinfect the item according to FM 3-11.5/MCWP 3-37.3/NTTP 3-11.26/AFTTP(I)3-2.60, *CBRN Decontamination: Multiservice Tactics, Techniques, and Procedures for Chemical Biological Radiological and Nuclear Decontamination*, April 2006. For additional protection after disinfection, cover items with plastic or other fluid-impermeable covering prior to next use.

NOTE: Infection control will determine how to accomplish disinfection and collect wastewater for items that cannot be immersed due to size or inability to detach from a mount.

16. Decontamination of Electronic Equipment. Moisture, dust, and corrosive decontamination chemicals can damage unsealed electronic equipment circuitry. Most field electronic equipment is watertight to protect it from environmental damage. This also provides good protection against biological contamination. Contamination will probably not penetrate gasket-equipped protective covers and sealed components on electronic equipment; but if exposed, the contaminants may be present on the outside of cases containing the electronic equipment. Wipe down the outside of the equipment case with an approved decontaminant and stand for the contact time required for that decontaminant. After decontaminating the outside, wipe down the equipment with water or an approved solvent to remove traces of decontaminant solution. If equipment seals appear damaged or penetration of the Ebola virus into the equipment is suspected, treat the item as if it were unsealed. Under no circumstances should electronic equipment be immersed in a decontaminant solution or subjected to high-pressure application of decontaminant solutions.⁵ Segregate contaminated electronic equipment in a dirty or until technical experts can determine the best decontamination method. Electronic equipment that cannot be decontaminated must be disposed as infectious waste.

17. Disposal of Solid Waste and Wastewater Generated During Decontamination.

a. Solid waste. Solid waste generated during transport (bedding, clothing, pillows), or as part of the decontamination process (including PPE) will be disposed as infectious waste.

(1) Place items in a leak-proof biohazard bag. Use a rigid waste receptacle designed to support the bag to help minimize contamination of the bag's exterior. Care must be taken to prevent splashes and/or spread of fluids beyond the area of contamination.

(2) Do not compact bags.

(3) Tie the bag to prevent the release of material from the bag when inverted.

(4) Treat the exterior of the primary bag with bleach or approved disinfectant. Use an absorbent pad to capture drips from the sprayed bag.

(5) Place primary bag into a secondary bag. Spray the exterior of the secondary bag.

(6) If red biohazard bags are not available, affix signs or labels to the secondary bags to indicate the contents of the bag are infectious waste.

(7) Place the bags in a designated clean rigid waste receptacle for transport to the infectious waste storage area.

b. Storage area. To store the infectious waste prior to treatment and disposal, select a secure location that provides maximum protection from vectors, is enclosed, and protected from the weather. A Military Van (MILVAN) or Container Express (CONEX) may be used for this purpose. Keep this waste separate from all other types of waste.

c. Wastewater. Although decontamination is intended to destroy or inactivate Ebola virus, it is possible that wastewater from decontamination of vehicles could still contain some active virus. Disposing of the wastewater through sanitary sewers is only a good option if additional disinfection occurs as part of the wastewater treatment process. However, in the areas of Africa where EVD has been found recently, functioning modern sewers with disinfection prior to discharge are not routinely available.

d. Using a soakage pit is an option if the site selected is completely isolated from any surface water or any subsurface source of drinking water. If soakage pits are used, after the rinse water enters, add enough lime to achieve a pH of 12 or above and maintain it at that level for 2 hours without adding more lime. Each time the pH slips below 12, add more lime and wait a full 2 hours from the time the additional lime was added.⁶ After the pH has successfully been maintained for 2 hours as described above, cover the area with earth and secure the area so that it is not used for farming, irrigation, digging of wells, and so forth.

e. Lime is usually available at farm supply stores in the United States as a soil pH adjustment and may be available in less developed areas of the world. The lime addition rate to the pit should be approximately a 50 pound (23 kilograms) bag per 1,000 gallons (3,785 liters) of rinse water. The lime will react with water to produce heat. It is best to add the lime as a slurry to the pit by premixing it with other water (NOT the rinse water), rather than pouring powdered lime directly into the rinse water.

18. In-Theater Treatment and Disposal. Personnel handling the EVD waste containers in the treatment and disposal process will don and doff the same level of PPE used by personnel who generate the infectious waste.

a. Incineration is the preferred and most effective disposal method for infectious waste; however, incineration options may be limited. Options include:

(1) Collaborating with local hospitals which may have incineration capabilities.

(2) Determining whether DOD Mediburn incinerators are in the AO and coordinating for their use.

(3) Constructing an inclined plane incinerator as described in Chapter 3 of Technical Manual (TM) 3-34.56/MCIP 4-11.01, *Waste Management for Deployed Forces*, July 2013. The inclined-plane incinerator is a field-expedient means to treat and destroy infectious waste, including sharps (syringes, and so forth). Depending on the size constructed, it can accommodate the waste generated by a combat support hospital or similar-size unit. The waste feed to the inclined-plane incinerator should be mixed at approximately 10 percent, by weight, infectious waste (to include sharps) to 90 percent, by weight, of regular trash. This mixture will help ensure the hottest and cleanest burn possible. General specifications for the inclined plane incinerator are:

(a) Insert a sheet of metal through 2 telescoped 55-gallon drums that have had both ends removed.

(b) The sheet of metal should extend 2 feet beyond the upper end of the telescoped barrels to serve as a loading or stoking platform.

(c) Position the drums, with the plane in place on an inclined surface (hill).

(d) Position a grate at the lower end of the drums. The fire (wood or fuel oil) will be built under the grate.

(e) After the incinerator becomes hot, place the infectious waste on the loading platform (metal sheet). As the waste starts to burn, push it down the incline in small amounts.

(f) Final combustion takes place on the grate.

(4) Burning should be avoided when the wind may blow the resulting smoke toward the base camp or other inhabited areas. Depending on the guidance established for the theater of operations, if the ash does not contain sharps and has been evaluated for hazardous characteristics, it can be buried with other solid waste. If it is determined to be hazardous, manage as hazardous waste. If it is nonhazardous but contains sharps, it must be placed in 55-gallon drums that will be retrograded to an approved landfill. A retrograde shipment of drums containing this ash is not considered a hazmat shipment. If retrograding sharps is not an option, they should be buried below scavenger depth (approximately 8 feet).⁷

(5) Soldiers involved in the actual burning of medical waste must wear PPE that is both protective from exposure to infectious waste as well as inhalation hazards. An

air-purifying respirator (cartridge or canister) with a high-efficiency particulate air filter is recommended. Paper surgical masks do not protect from hazards inherent in the burning of waste and should not be substituted for an air-purifying respirator. Wearing a Soldier's personal protective mask is also not recommended. Though a Soldier's personal protective mask is equipped with a high-efficiency particulate air filter, it is best used to protect the Soldier against chemical and biological threats.⁹

b. Department of Defense Instruction (DoDI) 4715.19, *Use of Open-Air Burn Pits in Contingency Operations*, prohibits the disposal of waste in open-air burn pits during contingency operations except in circumstances in which no alternative disposal method is feasible as determined according to the procedures in this document. Refer to DoDI 4715.19 for details.

c. The World Health Organization provides the option of burying waste in a designated pit of appropriate depth (2 meters or about 7 feet) and filled to a depth of 1–1.5 meters (about 3–5 feet). After each waste load, the waste should be covered with a layer of soil 10–15 centimeters (4–6 inches) deep.⁸

19. Point of Contact. The point of contact for this document is the Army Institute of Public Health Waste Management Program at 410-436-3651 or DSN 584-3651.

Endnotes:

¹<http://www.cdc.gov/vhf/ebola/hcp/environmental-infection-control-in-hospitals.html>

²http://www.epa.gov/oppad001/list_g_norovirus.pdf

³<http://www.phac-aspc.gc.ca/lab-bio/res/psds-ftss/ebola-eng.php>

⁴http://www.nclonline.com/products/view/MICRO_CHEM_PLUS_

⁵FM 3-11.5/MCWP 3-37.3/NTTP 3-11.26/AFTTP(I)3-2.60, *CBRN Decontamination: Multiservice Tactics, Techniques, and Procedures for Chemical Biological Radiological and Nuclear Decontamination*, April 2006, page E-2

⁶40 CFR 503, Rules on lime stabilization of biosolids

⁷TM 3-34.56/MCIP 4-11.01, *Waste Management for Deployed Forces*, July 2013, Chapters 3 and 6

⁸<http://www.who.int/csr/resources/who-ipc-guidance-ebolafinal-09082014.pdf>, page 9

Appendix A

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