

CLEANING AND DISINFECTING BUILDINGS AND AREAS PREVIOUSLY OCCUPIED BY CORONAVIRUS 2019 (COVID-19) POSITIVE PERSONNEL

This information is intended to assist military personnel who are assigned to conduct final cleaning and disinfection of buildings that housed COVID-19 patients. The document provides upfront guidance for establishing cleaning teams, followed by a standardized procedure for cleaning and disinfecting buildings, areas, and/or vehicles, and options to obtain professional support or disinfection devices to assist with the process.

SECTION 1 – GUIDANCE FOR COVID-19 CLEANING TEAMS

1. CLEARING A BUILDING/AREA AFTER HOUSING A POSITIVE COVID-19 PERSON(S)

The Centers for Disease Control and Prevention (CDC) recommends vacating a building for 24 hours to allow any droplets and aerosols to dissipate, making it safer for those who enter to clean. Cleaning/disinfection can take place according to the guidelines in this document without a 24-hour wait if rapid turnaround is required, though the 24-hour wait is the recommended approach prior to cleaning/disinfection.

A recent study published by the National Institute of Health (NIH) showed SARS-CoV-2 virus (which causes COVID-19 disease) can survive on cardboard for 24 hours and plastic and metal surfaces for up to 72 hours. In order to conserve limited personal protective equipment (PPE) and disinfectant stocks, the affected housing space and furniture could be allowed to sit for a minimum of 72 hours to allow the virus to die in lieu of conducting cleaning and disinfection tasks.

2. DESIGNATED PERSONNEL

The Installation or Unit Commander will determine whether in-house trained staff or contracted support personnel will conduct building cleaning and disinfection. When using in-house military personnel, The Installation or Unit Commander will designate a COVID-19 Cleaning Team (CCT) leader, an alternate leader, and dedicated CCT members. All designated cleaning personnel (in-house or contracted) require training according to the Occupational Safety and Health Administration (OSHA) worker exposure and PPE standards.

- The CCT responsibilities include cleaning space occupied by positive COVID-19 personnel.
- The CCT leader will be present during the entirety of cleaning and disinfection operations.
- Unit/Installation leadership personnel are responsible for documenting worker exposure details and PPE training in any OSHA-mandated plans.
- The CCT Leader, assisted by the Installation Safety Manager or Public Health personnel, will assess the types of surfaces and items that require cleaning/disinfection and determine what types of cleaning and disinfection products are required.
- Safety and/or Public Health personnel will provide and document a safety briefing to all CCT members, covering PPE and safe use of cleaning products and disinfectants for all applicable surface cleaning/disinfection tasks.
- The CCT Leader will screen CCT members and ensure CCT members do not participate in cleaning tasks if they display symptoms of COVID-19, have been identified as potentially being exposed to a positive patient(s), or are considered high risk (e.g., pregnant, immunocompromised).
- The CCT Leader will document areas cleaned/disinfected and the products used, date and time of completion, and CCT members who participated.

3. TRAINING AND EDUCATION

- Base training for CCT members on Centers for Disease Control and Prevention guidelines and this document.
- Design structured, targeted, mandatory training for CCT members.
- Include participatory, hands-on delivery in the training.
- Develop the training program according to the intended audience, in terms of education and literacy level.
- Develop training content specifically for CCT members who may be responsible for cleaning procedures in high-risk areas.
- Maintain training records, including dates, training content, and names of trainers and trainees.
- Select appropriate qualified trainers (Installation Safety or Public Health personnel)
- Training content should include, at a minimum:
 - General introduction to the principles of environmental infection control and prevention, including transmission of pathogens.
 - How CCT members can protect themselves from pathogens.
 - Detailed review of the specific cleaning tasks for which they are responsible, including review of SOPs, checklists and other job aids.
 - When and how to safely prepare and use different detergents, disinfectants, and cleaning solutions and store supplies and equipment (including PPE).
 - How to dispose of PPE, cleaning supplies, and mop water.
 - Participatory methods, hands-on component with demonstration and practice.
 - Key areas of the mission (e.g., trash removal, surface cleaning, surface disinfection, waste disposal).
 - Other health and safety aspects, as appropriate.

SECTION 2 – STANDARDIZED PROCEDURES

1. PPE PROTOCOLS

In all areas designated for final disinfection, select and use PPE that complies with the CDC guidance for COVID-19 treatment and OSHA worker exposure requirements. Safety and/or Preventive Medicine personnel will train the CCT to understand and mitigate the risks and hazards associated with the process, to ensure that proper PPE is used for selected cleaning and decontamination methods, and provide CCT personnel with functional, hands-on training that includes donning PPE, doffing PPE, and waste collection of used PPE. PPE for cleaning and disinfection is meant to prevent contact with the exposed surfaces and protect the CCT personnel from the disinfectant products used. Additional PPE might be required based on the cleaning/disinfectant products being used and whether there is a risk of splash or inhalation (face shield/mask) especially when mixing or pouring cleaning/disinfectant solutions.

Table 1. Suggestions for Personal Protective Equipment

Suggested PPE	
Gloves (medical or other water proof kitchen type – disposable preferred)	
Gown or Apron (disposable preferred)	Face Shield
Boots or closed toe shoes – capable of being sprayed with disinfectant	
Mask – for inhalation hazards	
Cloth Face Coverings – Worn if not wearing a face shield to prevent asymptomatic cleaners from spreading disease.	

- Cleaning staff should wear disposable gloves and gowns for all tasks in the cleaning process, including handling trash.
- Gloves and gowns should be compatible with the disinfectant products being used.
- Check team for glove allergies to latex and nitrile and adjust accordingly.
- Gloves and gowns should be removed carefully to avoid contamination of the wearer and the surrounding area.
- Clean hands immediately after gloves are removed.
- Remove gloves immediately after cleaning a room or area occupied by ill persons.
- Cleaning staff should immediately report breaches in PPE (e.g., tear in gloves) or any potential exposures to their supervisor.
- When dressed in PPE
 - Avoid touching your face
 - Limit surfaces touched
 - Change gloves when worn, torn, or contaminated

2. DONNING AND DOFFING PPE

- When Donning PPE
 - Gowns/aprons – secure so they cover and prevent exposure
 - Face shields – place on face and secure to fit properly
 - Gloves – extend to cover wrists and overlap cuff on gowns (if applicable)
 - During training – provide demonstration of how to don PPE acquired by the cleaning team
- When Doffing PPE
 - Face shield
 - Assume the outside is contaminated and handle with gloves
 - Lift band from the back of head and remove (avoiding contact with outside of face shield)
 - If item is reusable – place in designated location for cleaning
 - If item is disposable – place in solid waste
 - Gown/apron
 - Assume front and sleeves are contaminated
 - Grab in the front and pull away from your body so the ties break, touching outside of gown only with gloved hands. If break away ties don't exist, untie first.
 - Fold or roll the gown inside out into a bundle
 - Put in the solid waste
 - Gloves
 - Peel off only touching the inside of the gloves with bare hands
 - Place in the solid waste
 - Masks
 - Assume the front is contaminated and avoid touching

- Grasp bottom, then top ties or elastics and remove
- Place in the solid waste
- Immediately wash hands with soap and water for at least 20 seconds
- During training – provide demonstration of how to doff PPE acquired by the cleaning team.

3. CLEANING AND DISINFECTION PRODUCTS

Select cleaning and disinfection products that are appropriate for the types of surfaces and items that require cleaning/disinfection.

A. *Cleaning Products*

- Use the cleaning agents (soap, laundry detergent, toilet bowl cleaner, and so forth) that are normally used in these areas and follow the directions on the label.
- Clean soft surfaces, such as carpets and drapes, with soap and water (or cleaners appropriate for use on these surfaces such as steam cleaning solutions) then disinfect with an U. S. Environmental Protection Agency (EPA)-registered household disinfectant that will not impact/alter fabrics.
- Follow the manufacturer’s directions for cleaning and disinfecting electronics. In the absence of guidance, use alcohol-based wipes or sprays containing at least 70% alcohol.
- Launder sheets, pillow covers, blankets and clothing in warm water with normal laundry detergent.

B. *Disinfectants*

- Refer to the EPA-registered disinfectants on List N: Disinfectants for Use Against SARS-CoV-2, available at: <https://www.epa.gov/pesticide-registration/list-n-disinfectants-use-against-sars-cov-2>
 - Refer to the list of pre-approved EPA-registered products for use against emerging enveloped viral pathogens, available at: <https://www.americanchemistry.com/Novel-Coronavirus-Fighting-Products-List.pdf>.
 - A product approved by the EPA will have an EPA registration number that is on List N. The product label will display the number as “EPA Reg. No.” Disinfection products may be marketed and sold under different brand names but share the same EPA registration number. You can identify a distributor product by its three part EPA Reg. No. The first two parts match the primary product numbers. The third set of numbers represents the distributor identification. If you see a product on List N with two sets of numbers and your product has those plus a third set, it is an EPA-registered product.
 - Available quaternary ammonia products are suitable for use on carpets and laundry pre-soaking.
- Unexpired 5-6% household bleach will be effective against coronaviruses when properly diluted.
 - Prepare chlorine bleach disinfecting solution with a minimum concentration of 1,000 parts per million free available chlorine; wet contact time required to achieve adequate disinfection is 1-minute.
 - Mix: 5 tablespoons (1/3rd cup) bleach (5-6%) per gallon of water, OR
 - Mix: 4 teaspoons (5-6%) bleach per quart of water
 - Note: mixing other chemicals with chlorine bleach may produce hazardous gases.

- A bleach/water solution loses its strength and is weakened by heat and sunlight; therefore, mix a fresh bleach solution each day.
- Also, use of bleach solution may require additional ventilation.
- Alcohol – If undiluted alcohol is used for disinfection, it must have at least 70% alcohol content.
- Consult with your local Public Health office before adding anything to the disinfection solution.

C. Supplies

Examples of cleaning and disinfection supplies include:

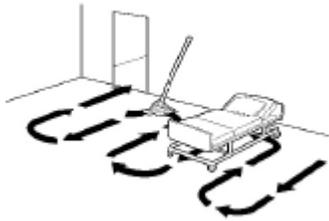
TABLE 2. SUPPLIES

Suggested Supplies	
Disposable wipes/cloths or micro-fiber cloths	Measuring cups
Mop heads and handles	Mop buckets
Buckets	Garbage bags
Spray bottles	Paper towels
Toilet brushes	Trash cans
Soap/selected cleaning products	Disinfectants (bleach, alcohol wipes, EPA-registered disinfectant)

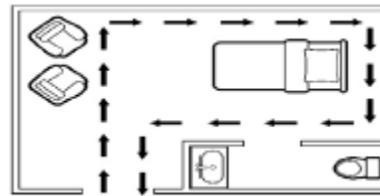
4. CLEANING TECHNIQUES

These cleaning techniques will be utilized when conducting the enhanced cleaning and disinfection process discussed in paragraph 5 below.

- Proceed from High To Low (Top To Bottom) to prevent dirt and microorganisms from dripping/falling down and contaminating already cleaned areas. Practical examples of this strategy include:
 - Cleaning bed rails before bed legs
 - Cleaning environmental surfaces prior to cleaning floors
 - Cleaning floors last to allow collection of dirt and microorganisms that may have fallen
- Proceed in a methodical, systematic manner to avoid missing areas—for example, left to right or clockwise.
 - In a multi-bed area, clean each bed zone in the same manner—for example, starting at the foot of the bed and moving clockwise.
 - Mop in a systematic manner, proceeding from area farthest from the exit and working towards the exit.
 - Pictured below is an example of a cleaning strategy for environmental surfaces, moving in a systematic manner around the area and an example of a mopping strategy moving from the farthest point towards the exit.



Mopping strategy



Surface wiping strategy

Images copied from CDC Document: CDC, *Best Practices for Environmental Cleaning in Healthcare Facilities in Resource-Limited Settings, Version 1*.

- Change mop heads and buckets of cleaning and buckets disinfectant solutions as often as needed (e.g., when visibly soiled, after every room, or every 1-2 hours) and at the end of each cleaning session.
- Allow reusable mop heads to dry after laundering/cleaning by hanging the mops by the handles with the mop heads down.
- **MOPPING** – general mopping process:
 1. Immerse the mop or floor cloth in the bucket with environmental cleaning solution and wring out.
 2. Mop with a figure eight, overlapping stroke, turning the mop head regularly (e.g., every 5-6 strokes).
 3. After cleaning a small area (e.g., 3m x 3m), immerse the mop or floor cloth in the bucket with rinse water and wring out.
 4. Repeat process from step 1.
- **SURFACE WIPING** – general surface cleaning wipe process:
 1. Thoroughly wet (soak) a fresh cleaning cloth in the environmental cleaning solution.
 2. Wipe surfaces using the general strategies (e.g., high to low, systematic manner).
 3. Thoroughly wet the surfaces to allow required contact time (for disinfection steps).
 4. Regularly rotate and unfold the cleaning cloth to use all of the sides.
 5. When all of the sides of the cloth have been used or when it is no longer saturated with solution, dispose of the cleaning cloth.
 6. Repeat process from step 1.
- Never double-dip cleaning cloths into containers buckets used for storing unused/stock environmental cleaning products (or solutions).
- Never shake mop heads and cleaning cloths—it disperses dust or droplets that could contain microorganisms.
- Never leave soiled mop heads and cleaning cloths soaking in buckets.

5. CONDUCTING ENHANCED CLEANING AND DISINFECTION PRACTICES

Conducting enhanced cleaning and disinfection practices during a viral pandemic event are important control measures that can reduce the risk of disease transmission. It is a two-part process of cleaning and then disinfecting high-contact, frequently touched surfaces and potentially contaminated surfaces in the living and restroom areas. Several technologies exist to reduce time and alleviate the manual effort involved in disinfecting surfaces. However, a cleaning process must be conducted prior to use of these technologies. For this reason, the cleaning procedure is provided in full below, utilizing the cleaning techniques discussed above

in paragraph 4. The procedure must be conducted by the CCT or by a contracted service provider prior to disinfection procedures.

A. Initial Site Assessment

Identification of high-touch surfaces and unique items in areas designated for cleaning/disinfection (carpet, fabrics, electronics, furniture) is a necessary prerequisite to refine/adjust cleaning procedures, as these will often differ by building type (room, office, gym, etc.) or vehicle (bus, car). Select cleaning and disinfection products appropriate for the specific surface areas identified during the site assessment.

- Determine Surfaces to be Disinfected
 - Common touch non-porous surfaces that will be wiped with disinfectant include: doorknobs, faucets, toilet seats, tiles (floor/wall) vinyl/leather furniture/arm rests, mirrors, remote control key pads.
 - Surfaces that will be sprayed with disinfectant: fabric furniture, bedding, pillow, curtains, carpeting, common traffic areas, shower stalls/bathtubs.
- Identify Surfaces not to be Disinfected
 - Area behind or underneath furniture.
 - Heavily soiled surfaces that need to be cleaned first.
 - Out-of-reach surfaces such as ceilings.

B. Cleaning Procedures

Conduct a cleaning process prior to the disinfection process to remove dirt, debris, body fluids, and so forth, from surfaces because solid matter will prevent the disinfectant from contacting the surface area and killing the virus.

1. Ventilation of the area/building is recommended. Air exchanges through the HVAC system will help to remove particles in the air. If possible, ventilate the building during the 24-hour waiting period. Opening windows and doors will also help provide fresh air.
2. Don appropriate PPE for manual surface cleaning tasks.
3. Remove all trash, debris, and so forth, and dispose as general solid waste. All exposed perishable items on the surface to be cleaned will be disposed as solid waste. Place in a trash bag, and seal with a knot or tie to limit contact.
4. Place all items designated for laundering in a trash bag, and seal with a knot or tie to limit contact. Hold it there for 24-72 hours to limit the exposure hazard and let the virus die.
5. Clean soiled areas that would impact the effectiveness of disinfection using soap and water.
6. Clean soiled surface areas, such as carpet, with an approved cleaning product to remove dirt, food wastes, stains, body fluids, and so forth.
7. Remove all paper products from the area where disinfectant will be sprayed.
8. Use separate wiping cloths/devices for cleaning and disinfection tasks.
9. Mop floors and clean horizontal surfaces, such as window sills, with soap (detergent) and water to remove visible dirt and debris.
10. Mop the floor starting at the far side and finishing at the door; disposable mop heads are preferred.
11. Starting at the far side of the room, wipe down all common touch surfaces working back towards the teams egress point from the room.

12. Open cabinets and drawers, and clean the inside and outside surfaces.
13. Starting at the far side of the room, spray or mist fabric furniture, bedding, and flooring with cleaning products in common traffic areas working back towards the teams egress point from the room.

C. Disinfection Process

Conduct the disinfection process after the cleaning process to kill any remaining virus in the environment. Conduct the disinfection process manually or with disinfection devices or contract support discussed in **SECTION 3**. Leadership will make the determination based on time required, cost, and available resources.

Disinfection Procedures – complete all cleaning procedures first

1. Don appropriate PPE for disinfectant application (possibly increased respiratory protection).
2. Apply the disinfectant to all surfaces in the area. Follow the manufacturer's operating guidance for the disinfectant and adequately wet the surfaces for required contact time. When the CDC guidance and this document recommends a greater bleach concentration than the manufacturer recommends, follow the CDC guidance.
3. Starting at the far side of the room, wipe down all common touch surfaces working back towards the teams egress point from the room.
 - Wipe high-touch surfaces such as doorknobs, handles, tabletops, chairs, rails, sink faucets, light switches, locker doors, soap dispensing levers, vending machines, ATMs, washing machines/dryers, gym equipment, and other surfaces (e.g., showers, toilets, bathtubs, sinks) with a disposable wipe/cloth and disinfectant.
 - Wipe all high-touch surfaces even if they were wiped during the cleaning process.
4. Again starting at the far side of the room, spray or mist fabric furniture, bedding, and flooring in common traffic areas working back towards the teams egress point from the room.
5. Mop the floor with disinfectant starting at the far side and finishing at the door.
6. Once the bleach/disinfectant solution is applied to surfaces, allow the solution to air dry, affording sufficient contact time (specified on product label—usually 1–10 minutes).
7. If the product recommends wiping or doesn't provide any recommendation about wiping, wait until the recommended contact time elapses and then wipe all high-contact, food, and/or hygiene surfaces (latrine counter tops) using clean water to remove any residual disinfectant. Use clean wipes for this process.
8. Once the process is complete, spray or wipe the bottom of your shoes with a suitable disinfectant and allow to air dry.
9. After disinfecting, place disposable items in the general trash and doff PPE items into the trash.
10. Wash your hands with soap and water for at least 20 seconds.

D. Disposal of PPE and Cleaning Supplies

- All PPE derived trash will be disposed of as solid waste, except for any empty aerosol cans. These will be turned into garrison as hazardous waste and/or for recycling.
- Dispose of wipes, mop heads, and cloths/paper towels as solid waste.
- Place solid waste items in a trash bag, and seal with a knot or tie to limit contact.
- Pour dirty mop water and wash water down a drain (preferably a floor drain) to the sanitary sewer. Pour an equivalent amount of water down the drain after the mop/wash water.

E. Mattress Cleaning and Disinfection

- Mattresses with impermeable covers:
 - Remove the sheets, and clean soiled areas that would impact the effectiveness of disinfection using a disposable wipe, soap, and water, allow to dry.
 - Spray or wipe the entire mattress cover surface with an EPA-approved disinfectant from List N that is compatible with the mattress cover and allow to dry.
- Mattresses without impermeable covers:
 - If a mattress cover is not used, clean soiled or stained areas with an appropriate fabric cleaner and allow to dry.
 - Disinfect uncovered mattress with a suitable spray fabric disinfectant, sufficiently wetting to allow for required contact time (be careful not to oversaturate).

F. Laundering Process

- Fabrics cannot be disinfected – instead, they are sanitized to remove/neutralize some (not all microbes) to a level that is considered safe for public health.
- Standard laundry processes are effective for removing and neutralizing microbes on fabrics. Microbes are removed from fabrics by the detergent.
- Launder all clothing, sheets, blankets and pillow cases at 160°F or the warmest water possible. Using a hot water wash also helps to destroy microbes.
- Heated (mechanical) drying further destroys microbes; drying temperature and time for effectiveness will vary; however, a drying temperature of 140°F applied for at least 45-minutes and until the laundry is completely dry will effectively destroy viruses and bacteria remaining on fabrics. This is fully discussed in chapter 10 of TB MED 531, Facility Sanitation Controls and Inspections.
- Dry items in the dryer on normal settings; the heat of the dryer aids with sanitizing.
- Do not shake dirty laundry.
- Launder items soiled by an infected person separately, and only handle with PPE (gloves/apron or gown).
- Disinfect laundry hampers or launder dirty laundry bags.
- For COVID-19 there is no need to add chemical sanitizers to the laundry outside of a medical facility. Laundry from medical facilities are always required to use bleach or other laundry sanitizers as an added infection control measure not specific to coronavirus.
- If sanitizing is preferred, pre-soak laundry in a quaternary ammonium product that is safe for laundry, prior to washing with laundry detergent.
- The CCT can place clothing and linens soiled with body fluids from an infected person in a trash bag, and seal with a knot or tie to limit contact and leave for the individuals to clean when they return.
- If leaving for other to clean, keep it sealed in the bag for 24 hours to 3 days to limit the exposure hazard and let the virus die.

G. Carpet and Upholstery Cleaning and Sanitizing

- The best method to clean and sanitize carpet and fabric covered items/upholstery is with a steam cleaning machine and its recommended cleaning product.
- Fabrics such as drapes can be laundered according to Paragraph G above.
- Carpet/fabric cleaning products can be hand applied, scrubbed into the material/carpet, and absorbed with clean cloths, if steam cleaning is not available or laundering is not possible.

- To sanitize, select a product from the EPA List N with a porous surface application (quaternary ammonium is one example). If possible, select a product marketed as carpet/fabric safe.
- Apply the sanitizing product as stated on the label to ensure the treated area is sufficiently wetted. Be careful not to over saturate the carpet or upholstered surface.
- Bulk liquid sanitizers can be applied with a fogger, low-volume sprayer, or squeeze bottle.

6. MANAGEMENT OF PERSONAL BELONGINGS AND ROOM FURNISHINGS

If the room/area occupant is diagnosed with COVID-19, soiled personal property and room furnishings must be either cleaned/disinfected and returned to use or disposed of properly. The Unit Chain of Command, Garrison Staff, and supporting MTF Infection Control Team will coordinate to decide what items to disinfect and return to service and what items to dispose, taking note to adhere to personal property and accountability regulations. Most personal property items such as money, passports, identifications, wedding rings, cell phones, computers, and eyeglasses warrant disinfection. Disinfection is also warranted for room furnishings such as sinks, toilets, countertops, glassware, and nonporous furniture. Mattresses (covered with liners and without liners) may also be disinfected. Clothing and linens may be bagged and laundered.

SECTION 3 – USE OF DISINFECTION DEVICES AND PROFESSIONAL SUPPORT

1. DISINFECTION DEVICES

A. Enhanced Disinfection Using Portable Electrostatic Sprayers (Foggers) or Low Volume Foggers

Portable electrostatic sprayers (foggers) and low-volume foggers can safely, effectively, and quickly apply EPA-approved disinfectants to surfaces of all types in large and small areas including those in hard-to-reach places.

The electrostatic sprayer positively charges the disinfectant as it passes through the sprayer nozzle. This generates positively charged disinfectant droplets that seek out negatively charged surfaces. The positively charged disinfectant droplets stick to the surfaces in a uniform coating that fully covers the targeted surfaces. Over-application is reduced because the charged particles will seek out an exposed surface area instead of adhering to each other. The droplets are applied wet and left to dry, affording the required disinfectant contact time. The recommended disinfection ingredient for this process is a product that uses quaternary ammonium chloride because it is naturally positively charged and more chemically stable for the process. However, hydrogen-peroxide, hypochlorous acid, and bleach-based products can be used in the devices.

Low-volume fogging devices are also available on the market. These devices do not charge the particles to provide uniform application to the target surface. Instead, the device operator must display technical expertise and knowledge to sufficiently wet the surfaces without over saturation. The devices work with all types of disinfection solutions and could be an alternative for qualified technicians since they are readily available on the market.

- Don appropriate PPE for disinfectant fogging.
- Apply the disinfectant fog to all surfaces in the area. Follow the manufacturer's operating guidance for the sprayer to ensure the fog has time to adequately wet the surfaces.
- Depart the area and allow the manufacturer recommended dwell/contact time for the surfaces to dry (Most fall between 1–10 minutes).
- Remove PPE used for disinfection, discard in the trash, and wash hands.
- If the product recommends wiping or doesn't provide any recommendation about wiping –
 - Don PPE (gloves).
 - Enter the area, and wipe all high-contact, food, and/or hygiene surfaces (latrine counter tops) to remove any residual disinfectant.
 - Use clean wipes and clean water for this process.
- Open up the area doors/windows and/or activate the heating, ventilation, and air-conditioning (HVAC) system to provide ventilation to clear any remaining disinfectant odor.

Do not re-purpose any equipment previously used for pesticide/herbicide applications.

Electrostatic Foggers are available from the GSA Advantage® Website:

<https://www.gsaadvantage.gov/advantage/s/search.do?q=0:2Portable+electrostatic+sprayers+&db=0&searchType=0>

The APHC published the following technical information paper (TIP) that provides more information about electrostatic sprayer disinfection: *Use of Electrostatic Sprayers (Foggers) with EPA-registered Disinfectants in Response to COVID-19* (TIP No. 98-107-0420).

B. Ultraviolet Germicidal Irradiation (UVGI)

Mercury or xenon gas lamps generate ultraviolet C (UV-C) light, which deactivates bacteria, viruses, and spores. This treatment option is relatively quick, repetitious, and leaves no residue.

- Use manufacturer's instruction to ensure a sufficient number of UV lamps are used or sufficient treatment cycles are conducted in order to treat all exposed surfaces.
- Treat areas with a higher likelihood of contamination for a longer period to increase disinfectant exposure.
- Place treatment monitors under the equipment and at the darkest, furthest locations to ensure that the treatment reaches all areas.
- Assess the treatment area size to determine the appropriate amount of time to allow the by-products of the treatment process (ozone) to clear the area prior to re-entry.
- Activate the HVAC system to remove any treatment bi-products.

UVGI Room Disinfection Units are available from GSA Advantage Website at:

<https://www.gsaadvantage.gov/advantage/s/search.do?q=0:2Ultraviolet+room+disinfection&db=0&searchType=0>

The APHC published the following TIP that provides more information about UVGI disinfection: *Effectiveness and Safety of Ultraviolet Germicidal Irradiation Lamps Used for Air and Surface Disinfection* (TIP No. 24-103-0320).

C. Ozone Generators

With caution, ozone generators can be used to disinfect areas such as rooms, vehicles, and buildings for coronaviruses. Ozone poses a significant health exposure risk to humans and animals and can damage materials such as rubber, electrical wire coating, fabrics, and artwork.

Surface cleaning must still be done prior to the disinfection process to allow the gas to make contact with surfaces. Additionally, chemical disinfection of high touch surfaces such as door knobs, light switches, handles, tabletops, chairs, rails, sink faucets, light switches, soap dispensing levers, etc. should be conducted in conjunction with the surface cleaning. The ozone generators will significantly reduce the amount of manual effort required to disinfect all surfaces.

- **Considerations.** The areas treated with an ozone generator (including adjoining spaces that share ventilation) must be vacated during the treatment and for a recovery period after the ozone treatment ends to allow oxygen to re-enter the space. Using 2.5 parts of ozone per million parts of air per million (ppm) to 5 ppm will effectively disinfect and limit damage. The Occupational, Safety, and Health Administration (OSHA) regulates permissible exposure limits to ozone. Use an ozone meter to monitor the room and prevent reentry until the ozone level dissipates below an acceptable level. The OSHA permissible exposure limit (PEL) for ozone is listed as an 8-hour, time-weighted average value of 0.1 ppm. Therefore, a conservative level to reach before re-entry into a room after ozone disinfection is 0.08 ppm. An average of 2 hours wait time after disinfection will allow the ozone to dissipate to safe levels, however, checking with a meter is advised.

The HVAC system must be shut off and air exchange spaces/vents must be sealed prior to activating the ozone generator. The ozone generator, or multiple smaller generators, must achieve a target concentration of at least 2.5 ppm in the entire area of concern. Application time is 30 minutes to 2 hours depending on the size of the area. Ventilation of a treated area is recommended to bring in fresh air prior to reoccupying the space.

- **Training.** Emergency personnel such as firefighters are trained to operate these devices and are equipped with sensors to detect ozone and/or oxygen levels during and after treating a room. If this technology is incorporated in areas outside of Emergency Service personnel oversight, safety procedures, training, and monitoring should be incorporated to prevent harmful health effects.
- **Testing.** Previous test results indicate the room/area to be treated must be completely sealed off to ensure contact with all surfaces in the room; even then, some porous surfaces such as wood floors with cracks may not receive the full disinfectant efficacy. A test on the SARS virus is documented at:
https://scholar.google.com/scholar?q=ozone+disinfection+of+SARs+contaminated+area&hl=en&as_sdt=0&as_vis=1&oi=scholar

A second test on multiple viruses is documented at:

<https://www.tandfonline.com/doi/full/10.1080/01919510902747969?src=recsys&>

- **EPA Requirements.** The EPA does not post a list of disinfection devices, but does register companies who produce them and provides a company device registration number. This can be verified on the EPA website:
<https://www.epa.gov/sites/production/files/2016-02/activeestablishmentlist.csv>
No claims of treatment efficacy are required for registering the devices but misrepresentation is regulated by FIFRA.
- **Background information.** OSHA provides the ozone permissible exposure limits (PELs) and guidance at:
<https://www.osha.gov/laws-regs/standardinterpretations/1994-09-29-0>
<https://www.cdc.gov/niosh/pel88/10028-15.html>

The EPA discusses use of ozone generators for indoor air treatment at:
<https://www.epa.gov/indoor-air-quality-iaq/ozone-generators-are-sold-air-cleaners>

An extract from the EPA website:

Can Ozone be Used in Unoccupied Spaces?

Ozone has been extensively used for water purification, but ozone chemistry in water is not the same as ozone chemistry in air. High concentrations of ozone in air, when people are not present, are sometimes used to help decontaminate an unoccupied space from certain chemical or biological contaminants or odors (e.g., fire restoration). However, little is known about the chemical by-products left behind by these processes (Dunston and Spivak, 1997). While high concentrations of ozone in air may sometimes be appropriate in these circumstances, conditions should be sufficiently controlled to insure that no person or pet becomes exposed. Ozone can adversely affect indoor plants, and damage materials such as rubber, electrical wire coatings and fabrics and art work containing susceptible dyes and pigments (U.S. EPA, 1996a).

How is Ozone Harmful?

The same chemical properties that allow high concentrations of ozone to react with organic material outside the body give it the ability to react with similar organic material that makes up the body, and potentially cause harmful health consequences. When inhaled, ozone can damage the lungs. Relatively low amounts can cause chest pain, coughing, shortness of breath and throat irritation. Ozone may also worsen chronic respiratory diseases such as asthma and compromise the ability of the body to fight respiratory infections. People vary widely in their susceptibility to ozone. Healthy people, as well as those with respiratory difficulty, can experience breathing problems when exposed to ozone. Exercise during exposure to ozone causes a greater amount of ozone to be inhaled, and increases the risk of harmful respiratory effects. Recovery from the harmful effects can occur following short-term exposure to low levels of ozone, but health effects may become more damaging and recovery less certain at higher levels or from longer exposures (US EPA, 1996a, 1996b).

What EPA says about why ozone generators are not on List N (Disinfectants for Use Against SARS-CoV-2):

It doesn't list devices that kill viruses, including ozone generators and UV lights because they are registered pesticide devices, not surface disinfectants. These devices must be registered and the company must receive an EPA Registrant Number for the device.

<https://www.epa.gov/coronavirus/why-arent-ozone-generators-uv-lights-or-air-purifiers-list-n-can-i-use-them-kill-covid>

2. USE OF CONTRACTED PROFESSIONAL SERVICES

Numerous commercial cleaning and restoration companies specialize in cleaning and disinfecting buildings/areas. These companies offer disinfection products and equipment and/or onsite cleaning and disinfection support. Secure contract services in advance of need on a contingency basis.

Guidance for Commercial Cleaning Contracts. Contracts for COVID-19 cleaning and disinfection should include the following information/requirements.

- A Site Safety and Health Plan will be developed detailing what PPE will be used, procedures for cleaning and disinfection of porous and non-porous surfaces, and how and where waste will be disposed.
- Contractor will be authorized to conduct official personal effects and property inventories (utilizing PPE to handle personal effects) and prepare required documentation.
- For disinfectant selection, select products appropriate for the surface or area selected for disinfection detailed in **SECTION 2, Paragraph 3, Cleaning and Disinfection Products** above.
- The contractor will clean and disinfect all accessible items/surfaces in the area/building, especially high-contact surfaces such as doorknobs, handles, tabletops, chairs, rails, sink faucets, light switches, locker doors, soap dispensing levers, vending machines, ATMs, washing machines/dryers, gym equipment, and other surfaces (e.g., showers, toilets, bathtubs, sinks). Items and surfaces that do not appear to be soiled will be disinfected.

3. PROFESSIONAL SUPPORT

Industrial cleaning and restoration contractors and/or companies specializing in hospital disinfection offer services using electrostatic systems, low-volume fogging systems, and UVGI systems. The table below presents certifying companies, disinfection companies, and organizations with experience using certain technologies. State public health agencies may also regulate or recommend cleaning companies. Additional information obtained from medical treatment facilities (MTFs) and research organizations with experience in this subject or that used the devices/contract support are provided for reference. Entries in this table do not indicate an endorsement of a product or service by the U.S. Army.

Name	Geographic Area and/or Treatment Method	Contact Information
Institute of Inspection, Cleaning, and Restoration Certification (IICRC)	The IICRC is a certification and standard-setting non-profit organization for the inspection, cleaning and restoration industries. IICRC is developing an ANSI	http://www.iicrc.org/

Name	Geographic Area and/or Treatment Method	Contact Information
Locate a Certified Professional listing	standard, BSR-IICRC S540 Crime Scene Cleanup.	
American BioRecovery Association listing	Nationwide, certification organization	888-979-2272, http://americanbiorecovery.org/ , or https://www.americanbiorecovery.org/search/custom.asp?id=4705
Clean Harbors emergency response and decontamination contractor	Clean Harbors is a decontamination and emergency response contractor that offers Infectious Materials Response Agreements (IMRA) and on-call emergency response disinfection services	https://www.cleanharbors.com/coronavirus
Clorox Electrostatic Sprayer system	Clorox offers a system called the Clorox® Total 360® System.	https://www.cloroxpro.com/products/clorox/total-360/
Delta Airlines	Delta Airlines is using the Protec 4 battery sprayer as part of the evaclean™ Protexus Disinfection System to perform full disinfection of airline interiors.	https://evaclean.com/products/protexus-cordless-electrostatic-sprayers https://news.delta.com/coronavirus-update-deltas-cleaning-measures-protect-public-health-and-safety-check-arrival
Madigan Army Medical Center (MAMC)	MAMC acquired a Xenex Pulsed Xenon UV Disinfection System.	https://www.xenex.com/
ServPro® Restoration Services contractor	ServPro is an industrial restoration and cleanup contractor that offers onsite disinfection services.	https://www.servpro.com/coronavirus
University of Nebraska Medical Center Biocontainment Unit	The University of Nebraska Biocontainment Unit utilized UV germicidal irradiation (UVGI) generators from ClorDiSys Solutions, Inc. of Lebanon, New Jersey during their Ebola treatment.	http://www.clordisys.com/healthcareapp.php
Victory Innovations Company	Victory innovations electrostatic sprayer system	https://victorycomplete.com/
Warrior Restoration	Warrior Restoration and Environmental is an industrial restoration and cleanup contractor that offers onsite disinfection services.	https://www.atlwaterdamage.com/coronavirus

POINT OF CONTACT. The POC for this information is the APHC Environmental Health Sciences Division, Waste Management Branch, 410-436-3651 or DSN 584-3651.

REFERENCES.

Centers for Disease Control and Prevention (CDC), Coronavirus Disease 2019 (COVID-19), Healthcare Infection Prevention and Control FAQs for COVID-19. Page last reviewed March 24,

2020: <https://www.cdc.gov/coronavirus/2019-ncov/infection-control/infection-prevention-control-faq.html>

CDC, Coronavirus Disease 2019 (COVID-19), Interim Infection Prevention and Control Recommendations for Patients with Suspected or Confirmed Coronavirus Disease 2019 (COVID-19) in Healthcare Settings. Page last reviewed April 1, 2020: <https://www.cdc.gov/coronavirus/2019-ncov/infection-control/control-recommendations.html>

CDC, COVID-19, Cleaning and Disinfecting Your Facility, Page last reviewed March 27, 2020: <https://www.cdc.gov/coronavirus/2019-ncov/prepare/disinfecting-building-facility.html>

CDC, COVID-19, Cleaning and Disinfecting Your Home, Page last reviewed March 28, 2020: (<https://www.cdc.gov/coronavirus/2019-ncov/prevent-getting-sick/disinfecting-your-home.html>)

CDC, National Center for Emerging and Zoonotic Infectious Diseases, Division of Healthcare Quality Promotion, 2019, November. *Best Practices for Environmental Cleaning in Healthcare Facilities in Resource-Limited Settings, Version 1.*

Department of the Army. 2019. Technical Bulletin Medical (TB MED) 531, Facility Sanitation Controls and Inspections, available at: https://armypubs.army.mil/ProductMaps/PubForm/TB_Cal.aspx.

EPA, Office of Pesticide Programs. 2020. *List N: Disinfectants for Use Against SARS-CoV-2*, <https://www.epa.gov/pesticide-registration/list-n-disinfectants-use-against-sars-cov-2>

Multi-Clean® Electrostatic. 2020. Electrostatic Spraying White Paper. Accessed April 1, 2020. <https://multi-clean.com/wp-content/uploads/2018/02/ElectrostaticSprayingWhitePaper3-1-18.pdf>

National Institutes of Health (NIH), News Release, March 17, 2020, *New coronavirus stable for hours on surfaces*. <https://www.nih.gov/news-events/news-releases/new-coronavirus-stable-hours-surfaces>

Occupational Safety and Health Administration (OSHA), COVID-19, Control and Prevention. March 25, 2020. <https://www.osha.gov/SLTC/covid-19/controlprevention.html>

“Q&A: Electrostatic Spray Technology, Advances in surface disinfection technology help to prevent the spread of illness-causing pathogens” by Katherine Velez, PhD. December 11, 2019. Accessed April 2, 2020: <https://www.cmmonline.com/articles/q-a-electrostatic-spray-technology>