

How Clean is “Clean”?  
Regulations and Standards for Workplace Clothing  
and Personal Protective Equipment

**On-Line Supplemental Guide**

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This Supplement provides a centralized resource for specific requirements and recommendations regarding the cleaning and cleanliness of worker clothing and personal protective equipment. The Supplement is organized into three major sections which are presented in the following order:

1. Government Agencies;
2. Advisory Bodies
3. Equipment Manufacturers

Within each section, agencies, advisory bodies and manufacturers are listed alphabetically.

Some agencies and advisory bodies (e.g., OSHA, ANSI) have multiple relevant Standards. In those cases, specific Standards are listed in numerical order according to the official titles of the Standards. For OSHA, the Standards are first sub-grouped for General Industry (29 CFR 1910), Maritime Industry (29 CFR 1915) and Construction Industry (29 CFR 1926); within those sub-groups individual Standards are presented in numerical order (e.g., 1910.132; 1910.133; etc.).

The Equipment Manufacturers section is intended to be representative, not comprehensive. Manufacturers were selected on the basis of product familiarity and name recognition. Our concern was to evaluate the adequacy of regulatory and advisory recommendations that users rely upon the recommendations of manufacturers; we did not evaluate the correctness of manufacturers' actual recommendations. Inclusion or exclusion of specific manufacturers does not imply endorsements or equipment recommendations.

To facilitate finding specific information, this Supplement contains a large number of bookmarks. To utilize them, be sure that the index of bookmarks in the left hand column of Adobe is open. That index follows the organization of the Supplement. When an agency or advisory body has several Standards relevant to specific types of equipment (e.g., respirators; gloves), the index links have sub-links that correspond to specific pages and sections of interest. To expand the index and see those sub-links, click the "+" sign next to section labels. This will allow you to readily find particular items of most interest to you. In addition,

reference numbers in the text are hyperlinked and will take you directly to that reference within the reference list.

### **1) Government Agencies**

**Centers for Disease Control & Prevention (CDC)**

**Environmental Protection Agency (EPA)**

**Food and Drug Administration (FDA)**

**Federal Emergency Management Agency (FEMA)**

**Mine Safety and Health Administration (MSHA)**

**National Aeronautics and Space Administration (NASA)**

**National Institute for Occupational Safety and Health (NIOSH)**

**Nuclear Regulatory Commission (NRC)**

**Occupational Safety and Health Administration (OSHA)**

**OSHA General Industry**

**OSHA Maritime**

**OSHA Construction**

**United States Coast Guard (USCG)**

**United States Department of Agriculture (USDA)**

**United States Navy (USN)**

### **2) Advisory Bodies**

**American Industrial Hygiene Association (AIHA)**

**American National Standards Institute (ANSI)**

**American Society of Health-System Pharmacists (ASHP)**

**ASTM International**

**Canadian Centre for Occupational Health & Safety (CCOHS)**

**New York Committee for Occupational Safety and Health (NYCOSH)**

**National Fire Protection Association (NFPA)**

**National Safety Council (NSC)**

### **3) Equipment Manufacturers**

## **Government Agencies**

### **Centers for Disease Control & Prevention**

#### **CDC Guidelines for Infection Control in Dental Health-Care Settings — 2003<sup>1</sup>**

##### **Personal Protective Equipment**

Primary PPE used in oral health-care settings includes gloves, surgical masks, protective eyewear, face shields, and protective clothing (e.g., gowns and jackets). ... Reusable PPE (e.g., clinician or patient protective eyewear and face shields) should be cleaned with soap and water, and when visibly soiled, disinfected between patients, according to the manufacturer's directions.

##### **Masks, Protective Eyewear, Face Shields**

If the mask becomes wet, it should be changed between patients or even during patient treatment, when possible.

##### **Protective Clothing**

Dental Health Care Professionals (DHCP) should change protective clothing when it becomes visibly soiled and as soon as feasible if penetrated by blood or other potentially infectious fluids. All protective clothing should be removed before leaving the work area.

##### **Gloves and Gloving**

Medical gloves, both patient examination and surgeon's gloves, are manufactured as single-use disposable items that should be used for only one patient, then discarded. Gloves should be changed between patients and when torn or punctured.

Sterile surgeon's gloves must meet standards for sterility assurance established by FDA and are less likely than patient examination gloves to harbor pathogens that could contaminate an operative wound.

Washing latex gloves with plain soap, chlorhexidine, or alcohol can lead to the formation of glove micropunctures and subsequent hand contamination. Because this condition, known as wicking, can allow penetration of liquids through undetected holes, washing gloves is not recommended. After a hand rub with alcohol, the hands should

be thoroughly dried before gloving, because hands still wet with an alcohol based hand hygiene product can increase the risk of glove perforation.

## **CDC Interim Domestic Guidance on the use of respirators to prevent transmission of SARS<sup>2</sup>**

This interim guidance provides information on the selection and handling of respirators for SARS and includes guidance for when respirators are either not available or in short supply.

1. A NIOSH-certified, disposable N95 respirator is sufficient for routine airborne isolation precautions. Use of a higher level of respiratory protection may be considered for certain aerosol-generating procedures (see [www.cdc.gov/ncidod/sars/aerosolinfectioncontrol.htm](http://www.cdc.gov/ncidod/sars/aerosolinfectioncontrol.htm)).
  - a. Respirators should be used in the context of a complete respiratory protection program in accordance with OSHA regulations. This includes training and fit testing to ensure a proper seal between the respirator's sealing surface and the wearer's face. Detailed information on respirator programs, including fit test procedures can be accessed at [www.osha.gov/SLTC/etools/respiratory](http://www.osha.gov/SLTC/etools/respiratory).
  - b. Once worn in the presence of a SARS patient, the respirator should be considered potentially contaminated with infectious material, and touching the outside of the device should be avoided. Upon leaving the patient's room, the disposable respirator should be removed and discarded, followed by hand hygiene.
2. If a sufficient supply of respirators is not available, healthcare facilities may consider reuse as long as the device has not been obviously soiled or damaged (e.g., creased or torn). Data on reuse of respirators for SARS are not available. Reuse may increase the potential for contamination; however, this risk must be balanced against the need to fully provide respiratory protection for healthcare personnel.
3. When elastomeric (rubber) or powered air purifying respirators (PAPRs) are used, their reusable elements should be cleaned and disinfected after use, in accordance with manufacturer's recommendations. When half- or full-facepiece elastomeric negative pressure respirators are used by more than one individual, filters should be replaced between individual users. When PAPRs are used, the filters should be replaced following manufacturer's recommendations. All used filters must be safely discarded.

## **CDC: Biosafety in Microbiological and Biomedical Laboratories <sup>3</sup>**

### **“Biosafety Level 3**

#### **C. Safety Equipment (Primary Barriers)**

1. Protective laboratory clothing such as solid-front or wraparound gowns, scrub suits, or coveralls are worn by workers when in the laboratory ... Reusable clothing is decontaminated before being laundered. Clothing is changed when overtly contaminated.
3. Frequent changing of gloves accompanied by hand washing is recommended. Disposable gloves are not reused.

### **Biosafety Level 4**

When leaving the laboratory and before proceeding into the shower area, personnel remove their laboratory clothing in the inner change room. Soiled clothing is autoclaved before laundering.”

## **Environmental Protection Agency (EPA)**

### **EPA: Mold Remediation in Schools and Commercial Buildings: *Investigating, Evaluating, and Remediating Moisture and Mold Problems*** 4

“Disposable clothing is recommended during a medium or large remediation project to prevent the transfer and spread of mold to clothing and to eliminate skin contact with mold.

In addition, the use of respirators must follow a complete respiratory protection program as specified by the Occupational Safety and Health Administration (see Resources List for more information).

... All contaminated PPE, except respirators, should be placed in a sealed bag while in this chamber. Respirators should be worn until remediators are outside the decontamination chamber. PPE must be worn throughout the final stages of HEPA vacuuming and damp-wiping of the contained area. PPE must also be worn during HEPA vacuum filter changes or cleanup of the HEPA vacuum.”

### **EPA: Worker Protection Standard <sup>5</sup>**

#### **How to comply with the Worker Protection Standard for Agricultural Pesticides: *What Employers Need to Know***

## **PPE**

“PPE is coveralls, respirators, protective eyewear, and chemical-resistant suits, gloves, footwear, aprons and headgear. “

### **“Cleaning and Maintaining PPE**

Employers must do the following:

1. Keep pesticide-contaminated PPE away from other clothing or laundry, and wash it separately.
2. If PPE will be reused, clean it before each day of reuse according to the instructions from the PPE manufacturer unless the pesticide labeling specifies other requirements. If there are no such instructions or requirements, wash PPE thoroughly in detergent and hot water.
3. Thoroughly dry the clean PPE before it is stored, or put it in a well-ventilated place to dry.
4. Store clean PPE separately from personal clothing and away from pesticide-contaminated areas.”

### **Disposal of PPE**

Employers must:

1. Discard coveralls or other absorbent materials that have been drenched or heavily contaminated with an undiluted pesticide that has the signal word “DANGER” or “WARNING” on the labeling. They must not be reused.
2. Comply with any applicable Federal, State, Tribal, and local regulations when disposing of PPE that cannot be cleaned correctly.

### **Instructions for Persons Who Clean PPE**

Employers must inform people who clean or launder PPE:

- that the PPE may be contaminated with pesticides,
- of the potentially harmful effects of exposure to pesticides,
- how to protect themselves when handling contaminated PPE, and
- how to clean PPE correctly.

For more information about laundering pesticide-contaminated clothing, please visit the Worker Protection Standard topic page on the Ag Center's Web site at: <http://www.epa.gov/agriculture/twor.html>  
For an example of what to tell people who clean PPE, see page 95.  
(Page 95 of the referenced EPA document and not this supplement, page 95 information shown directly below)

## **INFORMATION ABOUT CLEANING PPE**

### **PROTECT YOURSELF FROM PESTICIDES**

4. To avoid harm from the pesticide, you should: Pour the clothes from their container into the washer without touching them. Handle only the inner surfaces, such as the inside of boots, aprons, or coveralls. Do not breathe the steam from the washer and dryer.

5. Pesticides should not be allowed to stay on your hands: When you wash clothing or equipment by hand, use plenty of water and rinse your hands often. Wash your hands before eating, drinking, chewing gum, using tobacco, or using the toilet. Wash your hands as soon as you finish handling the clothing or equipment.

6. You should not allow clothing and equipment with pesticides on them to be washed with regular laundry. The pesticides can rub off on other items.

## **RECOMMENDED METHODS FOR CLEANING PPE**

### **Cleaning Eyewear and Respirators**

Hand-wash reusable respirator facepieces, goggles, face shields, and shielded safety glasses, following manufacturer's instructions. In general, use mild detergent and warm water to wash the items thoroughly. Rinse well. Wipe dry, or hang in a clean area to air dry.

### **Cleaning Other PPE**

1. Follow the manufacturer's cleaning instructions. If the instructions say only to wash the item, or if there are no cleaning instructions, follow the procedure below.

2. Recommended procedure for washing most PPE:

a. Rinse in a washing machine or by hand.

b. Wash in a washing machine, using a heavy-duty detergent and hot water for the wash cycle.

- c. Wash only a few items at a time to allow plenty of agitation and water for dilution. Use the highest water-level setting.
  - d. Rinse twice using two rinse cycles and warm water.
  - e. Use two entire machine cycles to wash items that are moderately to heavily contaminated.
  - f. Run the washer through at least one more entire cycle without clothing, using detergent and hot water, to clean the machine.
3. Some plastic or rubber items that are not flat, such as gloves, footwear, and coveralls, must be washed twice — once to clean the outside and a second time after turning the item inside out.
  4. Some items, such as heavy-duty boots and rigid hats or helmets, should be washed by hand using hot water and heavy-duty detergent.
  5. Hang the items to dry, if possible. Let them hang for at least 24 hours in an area with plenty of fresh air — preferably outdoors. Do not hang items in enclosed living areas.
  6. You may use a clothes dryer for fabric items if it is not possible to hang them to dry. But after repeated use, the dryer may become contaminated with pesticides.”

## **EPA: Respiratory Protection Program for Auto Refinish Shops <sup>6</sup>**

### **Cleaning, Maintenance, Change Schedules, and Storage 4.6.1**

#### **Respirator Cleaning**

“Each employee is issued a respirator for his or her exclusive use. Employees must regularly (at least once a week) clean and disinfect their respirator(s) (excluding dust masks)...

Employees must use the following procedures when cleaning and disinfecting respirators:

- Disassemble respirator, removing any filters, canisters, or cartridges;
- Wash the facepiece and associated parts in a mild detergent with warm water. Do not use organic solvents;
- Rinse completely in clean warm water;

- Wipe the respirator facepiece with ... disinfectant wipes. (Check with the respirator manufacturer to identify an appropriate disinfecting agent that will not damage the respirator facepiece, seals, or valves.)
- Air dry in a clean area;
- Reassemble the respirator and replace any defective parts; and
- Place in a clean, dry plastic bag or other air tight container.

Note: The Program Administrator will ensure that there is an adequate supply of appropriate cleaning and disinfection material at the cleaning station. If supplies are low, employees should contact the Program Administrator.”

**EPA: Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities <sup>7</sup>**

The above referenced document was prepared by four agencies (NIOSH, EPA, USCG, OSHA). For specific information outlined by this guidance manual listed above, please see the NIOSH section of this supplement.

**Food and Drug Administration (FDA)**

**FDA: Center for Devices and Radiological Health <sup>8</sup>**

**About Personal Protective Equipment (PPE)**

**“Avoid Reusing PPE**

Do NOT reuse personal protective equipment. Almost all personal protective equipment used in patient care is disposable and is designed to be used one time for contact with one patient. Dispose of the equipment carefully after each patient use or if the equipment becomes soiled.

The only type of personal protective equipment that can be reused is a surgical gown that is labeled as washable for multiple use.

**Washing and disinfecting PPE**

The only type of personal protective equipment that can be washed is a surgical gown that is labeled as washable for multiple use.

There is no proper way to wash or disinfect **disposable** personal protective equipment. Dispose of the equipment carefully after each patient use or if the equipment becomes soiled.

### **Disposing of contaminated PPE at healthcare and public facilities**

*The FDA does not regulate the disposal of PPE. The following are general recommendations. Please refer to the [EPA's medical waste website](#), [OSHA's bloodborne pathogens and needlestick prevention website](#), and individual State websites for specific requirements regarding the disposal of contaminated PPE.*

PPE that is dripping with blood or body fluids (grossly contaminated) should be placed into a container that is leak-proof and closed.

Lightly soiled PPE, for example PPE with spots of blood or with small amounts of body fluids absorbed into the materials, can be discarded in the regular trash.

Waste containers holding contaminated PPE are considered to be biohazardous medical waste which needs to be disposed of according to individual state regulations.

### **Disposing of contaminated PPE at home**

When disposing of PPE at home,

- always wear medical gloves;
- place used or soiled PPE into a tied plastic bag to prevent dripping;
- carefully clean waste containers with disinfectant or diluted bleach (1 part bleach to 9 parts water); and
- wash hands thoroughly with soap and water or alcohol-based hand rub after handling.”

## **Personal Protective Equipment and Influenza Outbreaks, Including Bird Flu (Avian Influenza) <sup>8</sup>**

### **“Q. Can I reuse personal protective equipment?”**

**A.** Not usually. Almost all personal protective equipment is designed to be used one time for one patient. Dispose of the equipment carefully after each patient use or if the equipment becomes soiled.

The only type of personal protective equipment that can be reused is a surgical gown that is labeled as washable for multiple use.

**Q. Can I wash disposable personal protective equipment?**

**A.** No. You cannot wash disposable personal protective equipment. Washing medical gloves or disposable masks and gowns will destroy their barrier properties so that they will no longer help prevent infection. Dispose of the equipment carefully after each patient use or if the equipment becomes soiled.

The only type of personal protective equipment that can be washed is a surgical gown that is labeled as washable for multiple use.

**Q. Can I disinfect disposable personal protective equipment?**

**A.** No. There is no way to disinfect disposable personal protective equipment. Dispose of the equipment carefully after each patient use or if the equipment becomes soiled.

**Q. Can I share personal protective equipment with other users?**

**A.** No. You should not share personal protective equipment because used equipment will not provide an effective barrier against infection.”

## **Federal Emergency Management Agency (FEMA)**

### **Non-Destructive Testing & Field Evaluation of Chemical Protective Clothing<sup>9</sup>**

This FEMA document outlines a process by which the entities responsible for cleaning and maintaining CPC can evaluate and test the cleaned garments by inserting them in a volatilization chamber and testing them for residual contamination. This process is non-destructive to the CPC and gives results on the actual item prior to its return to service. The FEMA procedures are outlined below.

#### **“Decontamination Procedure**

The decontamination procedure used during this study was designed to simulate a typical field decontamination scenario. While the overall time of this procedure may appear shorter than that typically used in the field, it was assumed that the times were representative of what an isolated area on a garment might encounter during decontamination.

- Rinse swatch for 30 seconds with room temperature tap water from a shower head,
- Wash swatch for 30 seconds using the decon agent. Washing consisted of scrubbing the swatch with a soft bristle brush. The decon agent was a 12 gm/L, solution of liquid Tide and water,
- Rinse swatch for 30 seconds with room temperature tap water,
- Pat swatch dry with a paper towel to remove all visual signs of wetness,
- Remove swatch from tab enclosure and aerate for 21-24 hours by hanging swatch in fume hood.

## **PROTECTIVE CLOTHING REUSE CONSIDERATIONS**

The principal purpose of this study was the development of a procedure for assessing the extent of chemical contamination of protective clothing. Such a procedure would become part of an overall process for using and disposing of the clothing. This process is illustrated in Figure 3, and described below. Many of the decision points in the process are influenced strongly by financial considerations. If money were no object, then it is likely that the decision would always be to use clothing once and discard it.

## **Appendix E**

### **NON-DESTRUCTIVE TESTING AND FIELD EVALUATION OF CHEMICAL PROTECTIVE CLOTHING FINAL REPORT**

#### **TECHNICAL**

#### **Project Objective --**

The objective of this contract is to develop and validate a cost effective means by which the fire department and other hazardous material response team can make decisions on the use/reuse of chemical clothing that has been exposed to hazardous chemicals during a hazardous material incident.

#### **BACKGROUND**

The evaluation for contamination in protective clothing ensembles has been an on going problem since the awareness of health related illness to contaminated clothing was first suggested in the 1960s with Asbestos workers. Since that time, heightened awareness of chemical protective ensembles, rubbers, and compound materials, have increased in respect to their ability to be decontaminated. Although many different methods exist to test for contamination, they are all of a

destructive nature. Until this study, no practical testing technique has been developed that has field use application.

## **DISCUSSION**

The non-destructive testing and field evaluation of chemical protective clothing technique has been achieved. The testing technique used a swatch sampling scheme ... Swatches of CPC are made to face out of a window to allow for contamination and decontamination. Once this Band-Aid™ type tab is attached to the garment by the adhesive action of the tape, it becomes an intimate part of the garment with the same exposure possibilities as any other surface area on the protective ensemble.

Finally, develop a decontamination strategy based on the testing method ... This decontamination strategy could be adopted by the Fire Service so we, as an industry, could finally standardize our method of what is dirty and what is clean.”

## **Mine Safety and Health Administration (MSHA)**

### **Protective Equipment and Clothing for Hazards and Irritants <sup>10</sup>**

#### **56/57.15006 Protective Equipment and Clothing for Hazards and Irritants**

”This standard requires that special protective equipment and special protective clothing shall be provided, maintained in a sanitary and reliable condition, and used whenever hazards of process or environment, chemical hazards, radiological hazards, or mechanical irritants are encountered in a manner capable of causing injury or impairment.

Unusual items for conditions requiring extra protective measures could include aprons, rubber gloves, asbestos blankets, leg shields, protective creams, solvent impermeable coveralls, and other items such as tag lines, safety belts and lines. These must be maintained in a clean and reliable condition, ready for use.

The inspector must exercise considerable judgment in the enforcement of this standard.”

#### **57.15030 Provisions and Maintenance of Self-Rescue Devices**

”This standard requires that a 1-hour self-rescue device approved by MSHA shall be made available by the operator to all personnel underground and that each operator shall maintain self-rescue devices in

good condition.

The operator needs an effective inspection program to ensure that each self-rescue device is maintained in "good condition." An effective inspection program established by the operator must include visual inspection and weighing. Visual inspection serves to identify surface defects such as a crushed case or dented seal. The operator's inspection program should also provide for the weighing of each self-rescuer at least every 90 days and for keeping a record of weighing for each device.

A self-rescuer is weighed by first cleaning the device, i.e., scraping off debris and wiping with a damp cloth, and then placing it on the balance. The balance used for weighing must have a capacity of at least 1100 grams and an accuracy of +1 gram. The current weight is compared with the manufacturer's weight stamped or etched in the self-rescuer case.

Self-rescue devices shall be removed from service if the device has a crushed or deeply dented case, the device has dents or damage around the seal area, or the device has a weight gain of 10 grams or more above the weight imprinted on the self-rescuer case."

## **MSHA 30 CFR PART 62—Occupational Noise Exposure**

"Training

(a) The mine operator must, within 30 days of a miner's enrollment into a hearing conservation program, provide the miner with training ... Training must include:

(4) the various types of hearing protectors offered by the mine operator and the care, fitting, and use of each type;"

## **National Aeronautics and Space Administration (NASA)**

### **NASA Ames Health and Safety Procedural Requirements <sup>11</sup>**

#### **29.6.3 Personal Hearing Protection**

"5. Earplugs. Various styles of foam and formed earplugs are available to employees in hazardous noise areas. Both disposable and non-disposable earplugs are available. Employees must be instructed in the proper method of insertion, storage, and cleaning of the earplugs.

6. Earplugs (custom). If reusable preformed earplugs are used, they will be permanently issued to the employee and fitted to the employee under medical supervision. During fitting, the employee will be instructed in the proper method of insertion, storage, and cleaning of the earplugs.

7. Earmuffs. Earmuffs will be provided for employees when analysis of noise environments shows that the attenuation provided by earplugs is not sufficient to reduce noise exposures below 85 dBA or when muffs are more efficient for the operation. The user shall inspect earmuffs on a regular basis.

8. Special Equipment. Special hearing-protective equipment, such as sound-suppression communication headsets, may be used in hazardous noise areas. These devices should be inspected regularly ... If replacement parts (such as ear cup seals) are available, the headsets may be repaired and reused. If sound-suppression headsets are not permanently issued to employees, such equipment must be cleaned and sanitized before re-issuance.”

#### **NASA: John F. Kennedy Space Center <sup>12</sup>**

##### **“Safety clothing/footwear:**

... Protective equipment, including personal protective equipment for eyes, face, head, and extremities, protective clothing, respiratory devices, and protective shields and barriers, shall be provided, used, and maintained in a sanitary and reliable condition wherever it is necessary by reason of hazards of processes or environment, chemical hazards, radiological hazards, or mechanical irritants encountered in a manner capable of causing injury or impairment in the function of any part of the body through absorption, inhalation or physical contact.”

#### **NASA: Langley Research Center: Personal Protection – Clothing and Equipment <sup>13</sup>**

##### **“1.6 CLEANING OF PROTECTIVE CLOTHING**

Protective clothing, as defined in this Langley Procedural Requirement (LPR), shall be laundered, cleaned, and decontaminated at Government or contracting company expense. An annual purchase requisition is submitted through the Logistics Management Team, Center Operations Directorate, to cover laundry and/or dry cleaning services for civil service organizations.

Laundry and/or dry cleaning services are available for coveralls, towels, lab coats, pants, shirts, night suits, and jackets to all civil service employees. The initiator or designee of the purchase request for laundry or dry cleaning service shall ensure accountability of items cleaned and sign appropriate delivery tickets certifying quantities received.”

#### **5.4.2 Earmuffs**

“Earmuffs shall be kept clean by regularly wiping them with a damp cloth, and the cushions shall be replaced when they become worn, stiff, or torn.”

**NASA: *Glenn Research Center Glenn Safety Manual BMS Document GLM-QSA-1700.1***<sup>14</sup>

“Eye:

#### D. Eye and Face Protection Inspection/Maintenance

Eye protection is a personal item and should be used exclusively by the individual to whom it is issued. All eye and face protection shall be maintained in a clean and reliable condition. Continuous use of dirty or scratched lenses can contribute to eye fatigue and result in accidents. Eye protectors shall be cleaned as needed in a solution of mild soap and water.

Pitted or scratched lenses must be replaced before the safety eyewear may be used again. Supervisors shall ensure compliance.”

**Hard Hats:**

#### “D. Hard Hat Inspection/Maintenance

Employees are responsible for inspecting their hard hat before each use. Hard hats should be cleaned of debris prior to inspections to ensure all fractures and defects can be seen. Hard hats should be cleaned in warm water with a mild detergent. Solvents and other harsh chemicals should not be used to clean a hard hat. Stickers should not be used on hard hats since they can cover a small fracture in the shell.”

**Footwear:**

#### 15.6.4.3 Foot Protection Inspection/Maintenance

“Footwear is a personal item and should be used exclusively by the individual to whom it is issued. Footwear shall be maintained in a clean and reliable condition.”

**Gloves:**

“In some circumstances, it may be more cost effective to regularly dispose of cheaper gloves than to reuse types that are more expensive.

15.6.6.3 Hand Protection Inspection/Maintenance

All arm and hand protection equipment shall be maintained in good, clean condition in accordance with the manufacturer's recommendations. Gloves should be checked for signs of deterioration before every use.”

**National Institute for Occupational Safety and Health (NIOSH)**

**NIOSH: A Guide For Evaluating The Performance of Chemical Protective Clothing<sup>15</sup>**

“Appendix D. Information to Consider in CPC Reuse

If the CPC is to be reused, additional testing must be done to evaluate the following:

1. Is the CPC adversely affected by the decontamination process? The physical or chemical resistance may be affected by heat or chemicals used to clean the CPC. The best way to measure any effect is to subject the CPC to a number of exposure-decontamination cycles and to retest it by repeating the tests suggested in “*Test the Candidates Under Expected Conditions*” step (see page 8).”

Page 8 states: *Test the Candidates Under Expected Conditions*

“Reuse of any CPC after decontamination is not recommended unless chemical resistance testing is conducted after decontamination. The test should evaluate (1) the adverse effect of the decontamination procedure on the CPC material and (2) the effectiveness of the decontamination procedure in removing the chemical from the material. Any chemical and physical resistance tests should be repeated after the CPC has undergone a number of chemical exposure and decontamination cycles.”

2. Is the decontamination process effective? There is some indication that volatile, small molecule chemicals may be successfully removed from the CPC with the use of heat. No standard method is available, however, to determine whether a product is decontaminated. Repeating the permeation test after decontamination may detect low-level-matrix release phenomenon which could expose users.

3. Can the decontamination process cause exposures? Any chemicals used in the process must be evaluated to ensure they do not result in unacceptable exposures—either during the decontamination process or when CPC is reused.

The recommendation to evaluate reused products necessitates performing the tests on virgin samples and repeating them after a number of exposure and decontamination cycles. Occasional testing of a product that has been in the use/reuse process for a time near the expected product life would provide greater confidence in its effectiveness.

## **NIOSH: Eye Protection for Infection Control <sup>16</sup>**

### **“Can another worker reuse my eye protection?”**

The eyewear described above (Goggles, Face Shields, Safety Glasses, Full-faced Respirators) is generally not disposable and must be disinfected before reuse ... A labeled container for used (potentially contaminated) eye protection should be available in the health care worker change-out/locker room. Eye protection deposited here can be collected, disinfected, washed, and then reused.

### **How should eye protection be disinfected?**

Healthcare setting-specific procedures for cleaning and disinfecting used patient care equipment should be followed for reprocessing reusable eye protection devices. Manufacturers may be consulted for their guidance and experience in disinfecting their respective products. Contaminated eye protection devices should be reprocessed in an area where other soiled equipment is handled. Eye protection should be physically cleaned and disinfected with the designated hospital disinfectant, rinsed, and allowed to air dry.”

## **NIOSH: Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities <sup>7</sup>**

### **“Clothing Reuse**

Chemicals that have begun to permeate clothing during use may not be removed during decontamination and may continue to diffuse through the material towards the inside surface ... Where such potential hazards may develop, clothing should be checked inside and out for discoloration or other evidence of contamination. This is particularly important for fully encapsulating suits, which are generally subject to reuse due to their cost. Note, however, that negative (ie, no chemical found) test results do not necessarily preclude the possibility that some absorbed chemical will reach the suit's interior.

At present, little documentation exists regarding clothing reuse. Reuse decisions must consider the known factors of permeation rates as well as the toxicity of the contaminant(s). In fact, unless extreme care is taken to ensure that clothing is properly decontaminated and that decontamination does not degrade the material, the reuse of chemical protective clothing that has been contaminated with toxic chemicals is not advisable.”

## **Decontamination Methods**

“All personnel, clothing, equipment, and samples leaving the contaminated area of a site (generally referred to as the Exclusion Zone) must be decontaminated to remove any harmful chemicals or infectious organisms that may have adhered to them. Decontamination methods either (1) physically remove contaminants, (2) inactivate contaminants by chemical detoxification or disinfection/sterilization, or (3) remove contaminants by a combination of both physical and chemical means.

### **Physical Removal**

In many cases, gross contamination can be removed by physical means involving dislodging/displacement, rinsing, wiping off, and evaporation. Physical methods involving high pressure and/or heat should be used only as necessary and with caution since they can spread contamination and cause burns. Contaminants that can be removed by physical means can be categorized as follows:

Loose contaminants. Dusts and vapors that cling to equipment and workers or become trapped in small openings, such as the weave of the clothing fabrics, can be removed with water or a liquid rinse. Removal of electrostatically attached materials can be enhanced by coating the clothing or equipment with anti-static solutions.

Adhering contaminants. Some contaminants adhere by forces other than electrostatic attraction. Physical removal methods for

gross contaminants include scraping, brushing, and wiping. Removal of adhesive contaminants can be enhanced through certain methods such as solidifying, freezing (e.g., using dry ice or ice water), adsorption or absorption (e.g., with powdered lime or kitty litter), or melting.

Volatile liquids. Volatile liquid contaminants can be removed from protective clothing or equipment by evaporation followed by a water rinse. Evaporation of volatile liquids can be enhanced by using steam jets. With any evaporation or vaporization process, care must be taken to prevent worker inhalation of the vaporized chemicals.

## Chemical Removal

Physical removal of gross contamination should be followed by a wash/rinse process using cleaning solutions. These cleaning solutions normally utilize one or more of the following methods:

Dissolving contaminants. Chemical removal of surface contaminants can be accomplished by dissolving them in a solvent. The solvent must be chemically compatible with the equipment being cleaned. This is particularly important when decontaminating personal protective clothing constructed of organic materials that could be damaged or dissolved by organic solvents.

Halogenated solvents generally are incompatible with personal protective equipment and are toxic. They should only be used for decontamination in extreme cases where other cleaning agents will not remove the contaminant.

Because of the potential hazards, decontamination using chemicals should be done only if recommended by an industrial hygienist or other qualified health professional.

Surfactants. Household detergents are among the most common surfactants. Some detergents can be used with organic solvents to improve the dissolving and dispersal of contaminants into the solvent.

Solidification. Solidifying liquid or gel contaminants can enhance their physical removal.

Rinsing. Rinsing removes contaminants through dilution, physical attraction, and solubilization.

Disinfection/Sterilization. Chemical disinfectants are a practical means of inactivating infectious agents. Unfortunately, standard sterilization techniques are generally impractical for personal protective clothing and equipment. “

## **Testing for the Effectiveness of Decontamination**

“The effectiveness of any decontamination method should be assessed at the beginning of a program and periodically throughout the lifetime of the program ... The following methods may be useful in assessing the effectiveness of decontamination.

### **Visual Observation**

There is no reliable test to immediately determine how effective decontamination is. In some cases, effectiveness can be estimated by visual observation.

- Natural light. Discolorations, stains, corrosive effects, visible dirt, or alterations in clothing fabric may indicate that contaminants have not been removed. However, not all contaminants leave visible traces.
- Ultraviolet light. Certain contaminants, such as polycyclic aromatic hydrocarbons, which are common in many refined oils and solvent wastes, fluoresce and can be visually detected when exposed to ultraviolet light. Ultraviolet light can be used to observe contamination of skin, clothing, and equipment ... therefore, a qualified health professional should assess the benefits and risks associated with ultraviolet light prior to its use at a waste site.

### **Wipe Sampling**

Wipe testing provides after-the-fact information on the effectiveness of decontamination. In this procedure, a dry or wet cloth, glass fiber filter paper, or swab is wiped over the surface of the potentially contaminated object and then analyzed in a laboratory. Both the inner and outer surfaces of protective clothing should be tested. Skin may also be tested using wipe samples.

### **Cleaning Solution Analysis**

Another way to test the effectiveness of decontamination procedures is to analyze for contaminants left in the cleaning

solutions. Elevated levels of contaminants in the final rinse solution may suggest that additional cleaning and rinsing are needed.

### **Testing for Permeation**

Testing for the presence of permeated chemical contaminants requires that pieces of the protective garments be sent to a laboratory for analysis. “

### **NIOSH: Suggested Respirator Cleaning and Sanitation Procedures <sup>17</sup>**

#### **“Decide on the procedures needed based on how respirators are being used**

**Option 1:** Cleaning for Single users: the same person uses the same respirator all the time. **NOTE:** this option should not be used if respirators are not marked with user names.

- Use Procedure 1 for basic cleaning of single user respirators.
- If desired or required, add Procedure 2 to sanitize single user respirators after cleaning.

**Option 2:** Cleaning for Multiple users: different persons will be sharing respirators.

- Use Procedure 3 to clean and sanitize respirators.
- Note that Procedure 3 is equal to combining procedures 1 and 2.

### **Gather Equipment and Supplies**

#### **Procedure 1**

- 2 buckets
- Warm water
- Thermometer
- Alcohol free wipes and or soft brush and sponge
- Neutral detergent - no lanolins or oils - (most dish detergents will work)
- Table or work surface

#### **Procedure 2**

- 2 buckets
- Warm water
- Thermometer

- Metric graduated cylinder for measuring small quantities
- Quaternary ammonia disinfectant OR hypochlorite (household bleach) OR iodine solution OR other commercially available cleansers of disinfectant quality that are recommended by the respirator manufacturer
- Table or work surface

### Procedure 3

- 4 buckets and the materials listed above for procedure 1 and 2.

## Description of Procedures

### Procedure 1

Generic Single User Cleaning Procedure (the same person uses the same respirator all the time). Cleaning can be done as often as required. Atmosphere supplying and emergency use respirators should be cleaned and sanitized after each use. **THE RESPIRATOR MUST BE CLEANED AND SANITIZED BEFORE IT CAN BE TRANSFERRED TO ANOTHER INDIVIDUAL.**

- Prepare 2 buckets (2 gal/7.5 L) of fresh warm water; follow sequence of use as described below.
- Do not use boiling or hot water. Water Temperature should be less than 110 F.
- Disassemble respirator, removing cartridges and/or filters and any external accessories such as communications, hoods, head harness (if possible) and eye lens outserts. Do not remove the valves because they are easy to lose.
- Bucket 1. Clean respirator and associated parts (excluding cartridges and/or filters) with alcohol free wipes, or by immersing in a warm water cleaning solution, scrubbing with a soft brush or sponge. Do not brush eye lenses. Use a neutral detergent cleaning solution that does not contain lanolin or oils.
- Bucket 2. Rinse in fresh, warm water. Running water is better than immersion if available. Thorough rinsing is important to keep detergents or disinfectants from drying on the respirator. [See OSHA 29CFR1910.134, Appendix B-2, running water for rinsing (if available) is preferred over immersion.]
- Replace cleaning solution and rinse water after approximately 20 respirators have been cleaned, or as needed.

- Allow the respirator to air dry in a non-contaminated environment. Do not dry with heaters or in sunlight. Respirators can be reassembled before or after drying.

Prior to re-use, conduct checks as recommended by the manufacturer's manual to assure that the system is ready to be placed in operation. It is very important to check that the inhalation and exhalation valves are in place prior to use.

## **Procedure 2**

IF Sanitization is desired or required:

- Clean respirator as described above. The final air drying step is not necessary.
- Prepare 2 buckets (2 gal/7.5L) of fresh warm water; follow sequence of use as described below.
- Do not use boiling or hot water. Water Temperature should be less than 110 F.
- Bucket 1. Disinfect respirator by immersing in a disinfectant water solution. A quaternary ammonia disinfectant (one packet per 2 gallons or per manufacturer's recommendation), or a hypochlorite (1 oz [30milliliters] household bleach in 2 gal [7.5 L] water) solution, or an aqueous solution of iodine (50ppm of iodine, made by adding 0.8 milliliters of tincture of iodine to one liter of water at 110 F) can be used.
- Bucket 2. Rinse in fresh, warm water. Thorough rinsing is important to keep detergents or disinfectants from drying on the respirator.
- Replace sanitizing solution and rinse water after approximately 20 respirators have been sanitized, or as needed.
- Allow the respirator to air dry in a non-contaminated environment. Do not dry with heaters or in sunlight

Prior to re-use, conduct checks as recommended by the manufacturer's manual to assure that the system is ready to be placed in operation It is very important to check that the inhalation and exhalation valves are in place prior to use.

## **Procedure 3**

## Respirator Cleaning and Sanitization Procedures

Generic Multiple User Cleaning and Sanitizing Procedure (different people use the same respirator). Atmosphere supplying and emergency use respirators should be cleaned and sanitized after each use. **THE RESPIRATOR MUST BE CLEANED AND SANITIZED BEFORE IT CAN BE TRANSFERRED TO ANOTHER INDIVIDUAL.**

- Prepare 4 buckets (2 gal/7.5 L) of fresh warm water; follow sequence of use as described below.
- Do not use boiling or hot water. Water Temperature should be less than 110 F.
- Disassemble respirator, removing cartridges and/or filters and any external accessories such as communications, hoods, head harness (if possible) and eye lens outserts Do not remove the valves because they are easy to lose.
- Bucket 1. Clean respirator (excluding cartridges and/or filters) with alcohol free wipes, or by immersing in a warm water cleaning solution, scrubbing with a soft brush or sponge. Do not brush eye lenses. Use a neutral detergent cleaning solution that does not contain lanolin or oils.
- Bucket 2. Rinse in fresh, warm water. Running water is better than immersion if available. Thorough rinsing is important to keep detergents or disinfectants from drying on the respirator. [See OSHA 29CFR1910.134, Appendix B-2, running water for rinsing (if available) is preferred over immersion.]
- Bucket 3. Disinfect respirator by immersing in a disinfectant water solution. A quaternary ammonia disinfectant (one packet per 2 gallons or per manufacturer's recommendation), a hypochlorite (1 oz [30ml] household bleach in 2 gal [7.5 L] water) solution, or an aqueous solution of iodine (50ppm of iodine, made by adding 0.8 ml of tincture of iodine to one liter of water at 110 F) can be used.
- Other commercially available cleansers of equivalent disinfectant quality when used as directed can be used, if their use is recommended or approved by the respirator manufacturer [See 29 CFR910.134, Appendix B-2, Para I, D.3.]
- Bucket 4. Rinse in fresh, warm water. Running water is better than immersion if available. Thorough rinsing is important to

keep detergents or disinfectants from drying on the respirator. [See OSHA 29CFR1910.134, Appendix B-2, running water for rinsing (if available) is preferred over immersion.]

- Replace cleaning solution, sanitizing solution, and rinse water after approximately 20 respirators have been sanitized, or as needed.
- Allow the respirator to air dry in a non-contaminated environment. Do not dry with heaters or in sunlight. Respirators can be reassembled before or after drying.
- Prior to re-use, conduct checks as recommended by the manufacturer's manual to assure that the system is ready to be placed in operation. It is very important to check that the inhalation and exhalation valves are in place prior to use.

### **General Notes**

- The process should always include these steps:  
Cleaning ► Sanitizing ► Rinsing ► Drying ► Reassembly ►  
Inspection Prior to Use
- Different respirator manufacturers market different cleaning and sanitizing solutions. Contact them for details regarding these products.
- Quaternary ammonia is a disinfectant that contains ammonia (NH<sub>4</sub>) with additional surfactant (detergent) action. It is used as a disinfectant with cattle producers and animal health workers. It has a wide germicidal range, is non-corrosive, and is considered very effective for sanitizing cleaned surfaces.

Other non-alkaline biodegradable disinfectants have been tested and are recommended by leading respirator manufacturers that are effective against HIV-1 (AIDS virus).”

### **NIOSH: Current Issues and Advances in Personal Protective Equipment**

18

“NIOSH has been studying the effects of decontaminating respirators and filters by utilizing various methods including autoclaving them at elevated temperatures.

Effect of Decontamination on Filtration

- Experimental Design

- 1 N95 and 1 P100 Filtering Facepiece Respirator (FFR) model
- Automated systems: autoclave, VHP, EtO
- Chemical: IPA, Bleach, LHP, Soap & Water
- Physical: UV, microwave, heat
- Controls: water, no decon

- Preliminary Findings

- Autoclave, 160° C heat, 70% IPA, and soap & water caused significant filter degradation
- Bleach, EtO, and a microwave degraded filter performance, but particle penetration levels were still less than the NIOSH certification criteria.
- Hydrogen Peroxide (vaporized and liquid forms) and UV radiation caused no significant change
- Future research should consider low-temperature decontamination methods such as VHP/LHP, EtO, microwave radiation (< 2 min), UV, and diluted bleach.

Viscusi, D., King, W., Shaffer, RE [2007], Effect of Decontamination on the Filtration Efficiency of Filtering Facepiece Respirators (in review).”

**NIOSH: Criteria for a Recommended Standard: *Occupational Noise Exposure NIOSH Publication No. 98-126:*** <sup>19</sup>

“Chapter 5. Hearing Loss Prevention Programs (HLPPs)

*Training in the use of hearing protectors.* This training should include (a) the purpose of hearing protectors, (b) the types of protectors available and the advantages and disadvantages of each, (c) selection, fitting, use, and care of hearing protectors...”

**NIOSH: Choose the Hearing Protection That’s Right For You** <sup>20</sup>

**Pre-molded, reusable plugs**

“Advantages of pre-molded plugs are that they are relatively inexpensive, reusable, washable, convenient to carry, and come in a variety of sizes.

Because many people like the comfort of foam plugs, but don't want to roll them in dirty environments, a plug is now available that is essentially a foam tip on a stem.”

## **Nuclear Regulatory Commission (NRC)**

### **NRC: Regulatory Guide 8.15- Acceptable Programs for Respiratory Protection <sup>21</sup>**

#### **“4.15 Decontamination and Disinfection of Facepieces; Contamination Control**

Licensees should decontaminate and disinfect respirators and associated equipment in accordance with the manufacturer's instructions, paying particular attention to the cleaning or sanitizing agents used and to the maximum temperature of the water used for cleaning, to avoid degradation of the respirator. Chemical residues should not be hazardous or irritating to the user. Radiological limits for reuse of respirators after they have been cleaned and sanitized should be established by the licensee.”

## **Occupational Safety and Health Administration (OSHA)**

### **OSHA General Industry**

#### **OSHA: 29 CFR 1910 (Occupational Safety and Health Standards for General Industry) <sup>24</sup>**

##### **“1910.95 (Occupational Noise Exposure)**

###### **1910.95(i)(4)**

The employer shall provide training in the use and care of all hearing protectors provided to employees.”

##### **1910.120 (Hazardous Waste Operations and Emergency Response)**

###### **“1910.120(k)**

###### ***Decontamination --***

###### **1910.120(k)(1)**

*General.* Procedures for all phases of decontamination shall be developed and implemented in accordance with this paragraph.

###### **1910.120(k)(2)**

***Decontamination procedures.***

**1910.120(k)(2)(iii)**

All employees leaving a contaminated area shall be appropriately decontaminated; all contaminated clothing and equipment leaving a contaminated area shall be appropriately disposed of or decontaminated.

**1910.120(k)(2)(iv)**

Decontamination procedures shall be monitored by the site safety and health supervisor to determine their effectiveness. When such procedures are found to be ineffective, appropriate steps shall be taken to correct any deficiencies.

**1910.120(k)(3)**

Location. Decontamination shall be performed in geographical areas that will minimize the exposure of uncontaminated employees or equipment to contaminated employees or equipment.

**1910.120(k)(4)**

*Equipment and solvents.* All equipment and solvents used for decontamination shall be decontaminated or disposed of properly.

**1910.120(K)(5)**

***Personal protective clothing and equipment.***

**1910.120(k)(5)(i)**

Protective clothing and equipment shall be decontaminated, cleaned, laundered, maintained or replaced as needed to maintain their effectiveness.

**1910.120(k)(5)(ii)**

Employees whose non-impermeable clothing becomes wetted with hazardous substances shall immediately remove that clothing and proceed to shower. The clothing

shall be disposed of or decontaminated before it is removed from the work zone.”

### **1910.120 Hazardous Materials Appendix C. Compliance guidelines**

“3. Decontamination. Decontamination procedures should be tailored to the specific hazards of the site and will vary in complexity and number of steps, depending on the level of hazard and the employee's exposure to the hazard. Decontamination procedures and PPE decontamination methods will vary depending upon the specific substance, since one procedure or method will not work for all substances. Evaluation of decontamination methods and procedures should be performed, as necessary, to assure that employees are not exposed to hazards by reusing PPE. References in Appendix D may be used for guidance in establishing an effective decontamination program. In addition, the U.S. Coast Guard's Manual, "Policy Guidance for Response to Hazardous Chemical Releases," U.S. Department of Transportation, Washington, DC (COMDTINST M16465.30) is a good reference for establishing an effective decontamination program.

5. Personal protective equipment programs. The purpose of personal protective clothing and equipment (PPE) is to shield or isolate individuals from the chemical, physical, and biologic hazards that may be encountered at a hazardous substance site.

The use of PPE can itself create significant worker hazards, such as heat stress, physical and psychological stress, and impaired vision, mobility and communication. For any given situation, equipment and clothing should be selected that provide an adequate level of protection. However, over-protection, as well as under-protection, can be hazardous and should be avoided where possible. Two basic objectives of any PPE program should be to protect the wearer from safety and health hazards, and to prevent injury to the wearer from incorrect use and/or malfunction of the PPE. To accomplish these goals, a comprehensive PPE program should include hazard identification, medical monitoring, environmental surveillance, selection, use, maintenance, and decontamination of PPE and its associated training.

The written PPE program should include policy statements, procedures, and guidelines. Copies should be made available to all employees, and a reference copy should be made available at the worksite. Technical data on equipment, maintenance manuals, relevant regulations, and other essential information should also be collected and maintained.”

## **1910.132 (Personal Protective Equipment)**

### **1910.132 (a)**

“Application. Protective equipment, including personal protective equipment for eyes, face, head, and extremities, protective clothing, respiratory devices, and protective shields and barriers, shall be provided, used, and maintained in a sanitary and reliable condition wherever it is necessary by reason of hazards of processes or environment, chemical hazards, radiological hazards, or mechanical irritants encountered in a manner capable of causing injury or impairment in the function of any part of the body through absorption, inhalation or physical contact.”

### **1910.132(f) (1)**

“The employer shall provide training to each employee who is required by this section to use PPE. Each such employee shall be trained to know at least the following:”

#### **1910.132 (f) (1) (v)**

“The proper care, maintenance, useful life and disposal of the PPE.”

## **1910.133 (Eye and Face Protection)**

### **1910.133(b)(1)**

“Protective eye and face devices purchased after July 5, 1994 shall comply with ANSI Z87.1-1989, "American National Standard Practice for Occupational and Educational Eye and Face Protection," which is incorporated by reference as specified in Sec. 1910.6.”

## **OSHA –Etool regarding eye and face protection <sup>22</sup>**

“Employees must be trained in the proper care, maintenance, useful life, and disposal of PPE. 1910.132(f)(1)(v)“

“Maintenance:

- PPE must be used and maintained in a sanitary and reliable condition.

- Pitted lenses, like dirty lenses, can be a source of reduced vision. They should be replaced. Deeply scratched or excessively potted lenses are apt to break.

Cleaning:

- Atmospheric conditions and the restricted ventilation of the protector can cause lenses to fog. Frequent cleansing may be necessary.
- Eye and face protection equipment that has been previously used should be disinfected before being issued to another employee.
- When employees are assigned protective equipment for extended periods, the equipment should be cleaned and disinfected regularly.
- Several methods for disinfecting eye-protective equipment are acceptable. The most effective method is to disassemble the goggles or spectacles and thoroughly clean all parts with soap and warm water.
- Carefully rinse all traces of soap and replace defective parts with new ones.
- Swab thoroughly or completely and immerse all parts for 10 minutes in a solution of germicidal deodorant fungicide.
- Remove parts from solution and suspend in a clean place for air drying at room temperature or with heated air.
- Do not rinse after removing parts from the solution because this will remove the germicidal residue that retains its effectiveness after drying.

Storage:

- Items should be placed in a clean, dust-proof container, such as a box, bag, or plastic envelope, to protect them until reissue.”

Etool Web Address:

<http://www.osha.gov/SLTC/etools/eyeandface/employer/requirements.html>

**1910.134 (Respiratory Protection)**

**1910.134(h)**

“Maintenance and care of respirators. This paragraph requires the employer to provide for the cleaning and disinfecting, storage, inspection, and repair of respirators used by employees.”

**1910.134(h)(1)**

“Cleaning and disinfecting. The employer shall provide each respirator user with a respirator that is clean, sanitary, and in good working order. The employer shall ensure that respirators are cleaned and disinfected using the procedures in Appendix B-2 of this section, or procedures recommended by the respirator manufacturer, provided that such procedures are of equivalent effectiveness. The respirators shall be cleaned and disinfected at the following intervals:

**1910.134(h)(1)(i)**

Respirators issued for the exclusive use of an employee shall be cleaned and disinfected as often as necessary to be maintained in a sanitary condition;

**1910.134(h)(1)(ii)**

Respirators issued to more than one employee shall be cleaned and disinfected before being worn by different individuals;

**1910.134(h)(1)(iii)**

Respirators maintained for emergency use shall be cleaned and disinfected after each use; and

**1910.134(h)(1)(iv)**

Respirators used in fit testing and training shall be cleaned and disinfected after each use.”

**Appendix B-2 to § 1910.134: Respirator Cleaning Procedures (Mandatory)**

“These procedures are provided for employer use when cleaning respirators. They are general in nature, and the employer as an alternative may use the cleaning recommendations provided by the manufacturer of the respirators used by their employees, provided such procedures are as effective as those listed here in Appendix B- 2. Equivalent effectiveness simply means that the procedures used must accomplish the objectives

set forth in Appendix B-2, i.e., must ensure that the respirator is properly cleaned and disinfected in a manner that prevents damage to the respirator and does not cause harm to the user.

#### I. Procedures for Cleaning Respirators

A. Remove filters, cartridges, or canisters. Disassemble facepieces by removing speaking diaphragms, demand and pressure- demand valve assemblies, hoses, or any components recommended by the manufacturer. Discard or repair any defective parts.

B. Wash components in warm (43 deg. C [110 deg. F] maximum) water with a mild detergent or with a cleaner recommended by the manufacturer. A stiff bristle (not wire) brush may be used to facilitate the removal of dirt.

C. Rinse components thoroughly in clean, warm (43 °C [110 °F] maximum), preferably running water. Drain.

D. When the cleaner used does not contain a disinfecting agent, respirator components should be immersed for two minutes in one of the following:

1. Hypochlorite solution (50 ppm of chlorine) made by adding approximately one milliliter of laundry bleach to one liter of water at 43 deg. C (110 deg. F); or,
2. Aqueous solution of iodine (50 ppm iodine) made by adding approximately 0.8 milliliters of tincture of iodine (6-8 grams ammonium and/or potassium iodide/100 cc of 45% alcohol) to one liter of water at 43 deg. C (110 deg. F); or,
3. Other commercially available cleansers of equivalent disinfectant quality when used as directed, if their use is recommended or approved by the respirator manufacturer.

E. Rinse components thoroughly in clean, warm (43 deg. C [110 deg. F] maximum), preferably running water. Drain. The importance of thorough rinsing cannot be overemphasized. Detergents or disinfectants that dry on facepieces may result in dermatitis. In addition, some disinfectants may cause deterioration of rubber or corrosion of metal parts if not completely removed.

F. Components should be hand-dried with a clean lint-free cloth or air-dried.

G. Reassemble facepiece, replacing filters, cartridges, and canisters where necessary.

H. Test the respirator to ensure that all components work properly.”

## **OSHA Etool regarding Respiratory Protection <sup>23</sup>**

### **Maintenance and Care of Respirators**

”The proper functioning of respirators and ensuring that the devices themselves do not pose a hazard to the user require a regular maintenance and cleaning schedule. In general, respirators should be inspected for basic function prior to each use and cleaned as often as necessary to prevent the occurrence of unsanitary conditions.”

#### **Etool web address:**

<http://www.osha.gov/SLTC/etools/respiratory/index.html>

### **1910.135 (Head Protection)**

#### **1910.135(b)**

“Criteria for protective helmets.

##### **1910.135(b)(1)**

Protective helmets purchased after July 5, 1994 shall comply with ANSI Z89.1-1986, "American National Standard for Personnel Protection-Protective Headwear for Industrial Workers- Requirements," which is incorporated by reference as specified in Sec. 1910.6, or shall be demonstrated to be equally effective.

##### **1910.135(b)(2)**

Protective helmets purchased before July 5, 1994 shall comply with the ANSI standard "American National Standard Safety Requirements for Industrial Head Protection," ANSI Z89.1-1969, which is incorporated by reference as specified in Sec. 1910.6, or shall be demonstrated by the employer to be equally effective.”

### **1910.137 (Electrical Protective Devices)**

**1910.137(b)**

"In-service care and use.

**1910.137(b)(1)**

Electrical protective equipment shall be maintained in a safe, reliable condition.

**1910.137(b)(2)**

The following specific requirements apply to insulating blankets, covers, line hose, gloves, and sleeves made of rubber:

**1910.137(b)(2)(v)**

Insulating equipment shall be cleaned as needed to remove foreign substances.

**1910.1030 (Bloodborne Pathogens Standard)**

**1910.1030(d)(3)(iv)**

"Cleaning, Laundering, and Disposal. The employer shall clean, launder, and dispose of personal protective equipment required by paragraphs (d) and (e) of this standard, at no cost to the employee.

**1910.1030(d)(3)(v)**

Repair and Replacement. The employer shall repair or replace personal protective equipment as needed to maintain its effectiveness, at no cost to the employee.

**1910.1030(d)(3)(vi)**

If a garment(s) is penetrated by blood or other potentially infectious materials, the garment(s) shall be removed immediately or as soon as feasible.

**1910.1030(d)(3)(vii)**

All personal protective equipment shall be removed prior to leaving the work area.

**1910.1030(d)(3)(viii)**

When personal protective equipment is removed it shall be placed in an appropriately designated area or container for storage, washing, decontamination or disposal.

**1910.1030(d)(3)(ix)(A)**

Disposable (single use) gloves such as surgical or examination gloves, shall be replaced as soon as practical when contaminated or as soon as feasible if they are torn, punctured, or when their ability to function as a barrier is compromised.

**1910.1030(d)(3)(ix)(B)**

Disposable (single use) gloves shall not be washed or decontaminated for re-use.

**1910.1030(d)(3)(ix)(C)**

Utility gloves may be decontaminated for re-use if the integrity of the glove is not compromised. However, they must be discarded if they are cracked, peeling, torn, punctured, or exhibit other signs of deterioration or when their ability to function as a barrier is compromised.

**1910.1030(d)(4)**

Housekeeping --

**1910.1030(d)(4)(i)**

General. Employers shall ensure that the worksite is maintained in a clean and sanitary condition. The employer shall determine and implement an appropriate written schedule for cleaning and method of decontamination based upon the location within the facility, type of surface to be cleaned, type of soil present, and tasks or procedures being performed in the area.

**1910.1030(d)(4)(iv)**

Laundry.

**1910.1030(d)(4)(iv)(A)**

Contaminated laundry shall be handled as little as possible with a minimum of agitation.

**1910.1030(d)(4)(iv)(A)(1)**

Contaminated laundry shall be bagged or containerized at the location where it was used and shall not be sorted or rinsed in the location of use.

**1910.1030(d)(4)(iv)(A)(2)**

Contaminated laundry shall be placed and transported in bags or containers labeled or color-coded in accordance with paragraph (g)(1)(i) of this standard. When a facility utilizes Universal Precautions in the handling of all soiled laundry, alternative labeling or color-coding is sufficient if it permits all employees to recognize the containers as requiring compliance with Universal Precautions.

**1910.1030(d)(4)(iv)(A)(3)**

Whenever contaminated laundry is wet and presents a reasonable likelihood of soak-through or leakage from the bag or container, the laundry shall be placed and transported in bags or containers which prevent soak-through and/or leakage of fluids to the exterior.

**1910.1030(d)(4)(iv)(B)**

The employer shall ensure that employees who have contact with contaminated laundry wear protective gloves and other appropriate personal protective equipment.

**1910.1030(d)(4)(iv)(C)**

When a facility ships contaminated laundry off-site to a second facility which does not utilize Universal Precautions in the handling of all laundry, the facility generating the contaminated laundry must place such laundry in bags or containers which are labeled or color-coded in accordance with paragraph (g)(1)(i).”

**1910.1030(e)**

“HIV and HBV Research Laboratories and Production Facilities.

## **1910.1030(e)(2)**

Research laboratories and production facilities shall meet the following criteria:

### **1910.1030(e)(2)(i)**

#### **1910.1030(e)(2)(ii)(F)**

Laboratory coats, gowns, smocks, uniforms, or other appropriate protective clothing shall be used in the work area and animal rooms. Protective clothing shall not be worn outside of the work area and shall be decontaminated before being laundered.”

## **1910.6 Occupational Safety and Health Standards: Subpart A – Incorporation by Reference (IBR)**

### **“1910.6(e)(65)**

ANSI Z87.1-68 Practice of Occupational and Educational Eye and Face Protection, IBR approved for §§1910.133(b)(2); 1910.252(b)(2)(ii)(I); and 1910.261(a)(3)(xxv), (d)(1)(ii), (f)(5), (g)(10), (g)(15)(v), (g)(18)(ii), and (i)(4).

### **1910.6(e)(66)**

ANSI Z87.1-89, Practice for Occupational and Educational Eye and Face Protection, IBR approved for §1910.133(b)(1).

### **1910.6(e)(67)**

ANSI Z88.2-69 Practices for Respiratory Protection, IBR approved for §§1910.94(c)(6)(iii)(a); 1910.134(c); and 1910.261(a)(3)(xxvi), (b)(2), (f)(5), (g)(15)(v), (h)(2)(iii) and (iv), and (i)(4).

### **1910.6(e)(68)**

ANSI Z89.1-69 Safety Requirements for Industrial Head Protection, IBR approved for §§1910.135(b)(2); and 1910.261(a)(3)(xxvii), (b)(2), (g)(15)(v), and (i)(4).

### **1910.6(e)(69)**

ANSI Z89.1-86, Protective Headwear for Industrial Workers Requirements, IBR approved for §1910.135(b)(1).”

### **OSHA: Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities <sup>7</sup>**

The above referenced document was prepared by four agencies (NIOSH, EPA, USCG, OSHA). For specific information outlined by this guidance manual listed above, please see the NIOSH section of this supplement.

## **OSHA Maritime**

### **OSHA: 29 CFR 1915 (Occupational Safety and Health Standards for Shipyard Employment)**

#### **1915.152 (Shipyard Employment - Personal Protective Equipment)**

##### **1915.152(d)**

“Reissued equipment. The employer shall ensure that all unsanitary PPE, including that which has been used by employees, be cleaned and disinfected before it is reissued.”

##### **1915.152(e)(1)**

“The employer shall provide training to each employee who is required, by this section, to use PPE ... Each employee shall be trained to understand at least the following:

##### **1915.152(e)(1)(v)**

The proper care, maintenance, useful life and disposal of the PPE.”

#### **1915 Subpart I App A, (12): (Non-Mandatory)**

“(a) It is important that all PPE be kept clean and be properly maintained. Cleaning is particularly important for eye and face protection where dirty or fogged lenses could impair vision.

(b) For the purposes of compliance, PPE should be inspected, cleaned, and maintained at regular intervals so that the PPE provides the requisite protection.

(c) It is important to ensure that contaminated PPE which cannot be

decontaminated is disposed of in a manner that protects employees from exposure to hazards.”

#### **1915.153 Maritime (Eye and Face Protection)**

“Ensure that eye protection is cleaned frequently and replaced when necessary.”

#### **1915.154 Maritime (Respiratory Protection):**

“Respiratory protection for shipyard employment is covered by 29 CFR 1910.134.”

#### **1915.155 Maritime (Head Protection)**

##### **1915.155(b)**

“Criteria for protective helmets.

##### **1915.155(b)(1)**

Protective helmets purchased after August 22, 1996 shall comply with ANSI Z89.1-1986, "Personnel Protection -- Protective Headwear for Industrial Workers-Requirements," which is incorporated by reference, as specified in Sec. 1915.5, or shall be demonstrated by the employer to be equally effective.

##### **1915.155(b)(2)**

Protective helmets purchased before August 22, 1996 shall comply with the "American National Standard Safety Requirements for Industrial Head Protection, Z89.1-1969," which is incorporated by reference as specified in 1915.5, or shall be demonstrated by the employer to be equally effective.”

#### **1915.157 Maritime (Hand and Body Protection)**

##### **1915.157(b)**

“Hot work operations. The employer shall ensure that no employee wears clothing impregnated or covered in full or in part with flammable or combustible materials (such as grease or oil) while engaged in hot work operations or working near an ignition source.”

## **OSHA Construction**

## **OSHA: 29 CFR 1926 (Safety and Health Regulations for Construction)**

### **1926 Subpart E: Personal Protective and Life Saving Equipment**

#### **1926.95 Criteria for Personal Protective Equipment**

##### **1926.95 (a)**

"Application. Protective equipment, including personal protective equipment for eyes, face, head, and extremities, protective clothing, respiratory devices, and protective shields and barriers, shall be provided, used, and maintained in a sanitary and reliable condition wherever it is necessary by reason of hazards of processes or environment, chemical hazards, radiological hazards, or mechanical irritants encountered in a manner capable of causing injury or impairment in the function of any part of the body through absorption, inhalation or physical contact."

##### **1926.95(b)**

"Employee-owned equipment." Where employees provide their own protective equipment, the employer shall be responsible to assure its adequacy, including proper maintenance, and sanitation of such equipment.

#### **1926.100 (Head Protection)**

##### **1926.100(b)**

Helmets for the protection of employees against impact and penetration of falling and flying objects shall meet the specifications contained in American National Standards Institute, Z89.1-1969, Safety Requirements for Industrial Head Protection.

#### **1926.102 (Eye and Face Protection):**

##### **1926.102(a)(2)**

"Eye and face protection equipment required by this Part shall meet the requirements specified in American National Standards Institute, Z87.1-1968, Practice for Occupational and Educational Eye and Face Protection."

##### **1926.102(a)(4)**

“Face and eye protection equipment shall be kept clean and in good repair. The use of this type equipment with structural or optical defects shall be prohibited.

**1926.102(a)(6)(v)**

They shall be capable of being disinfected.

**1926.102(a)(6)(vi)**

They shall be easily cleanable.”

**1926.103 (Respiratory Protection)**

“Note: The requirements applicable to construction work under this section are identical to those set forth at 29 CFR 1910.134 of this chapter.”

**United States Coast Guard (USCG)**

**U.S. Coast Guard: TECHNICAL GUIDE: PRACTICES FOR RESPIRATORY PROTECTION <sup>56</sup>**

**CHAPTER 6 RESPIRATOR CLEANING, INSPECTION, MAINTENANCE, AND STORAGE**

“A. Introduction. Cleaning and maintenance of respirators are integral parts of the overall respiratory protection program. Wearing a dirty, poorly maintained or malfunctioning respirator can be more dangerous than not wearing a respirator at all. Workers wearing defective devices think they are protected when, in reality, they are not.

Emergency escape and rescue devices are particularly vulnerable to poor maintenance since they generally are used infrequently. Serious injury or death can result from wearing a defective device during emergency escape or rescue.

B. Disposable Respirators. If only disposable respirators are used at a unit, a cleaning and maintenance program is not required. Disposable respirators shall be discarded when dirty, when breathing becomes difficult, when odors or tastes are detected when wearing the respirator, or as directed by the Safety and Environmental Health Officer (SEHO) or unit Respiratory Protection Program Coordinator (RPC). In some circumstances, the disposed respirator may be considered a hazardous waste.

C. Cleaning. Cleaning is required after each use if multiple personnel use the same respirator(s). If a respirator is issued for the exclusive use of an individual, cleaning must be conducted as often as necessary to keep the respirator in a clean and sanitary condition. The following procedure must be used for cleaning respirators:

1. Remove filters and/or cartridges. Disassemble facepieces by removing speaking diaphragms and pressure-demand valve assemblies, hoses, or any components recommended by the manufacturer. Discard or repair any defective parts.
2. Wash components in warm (43 °C [110 °F] maximum) water with a mild detergent or with a cleaner recommended by the manufacturer. A stiff bristle (not wire) brush may be used to facilitate the removal of dirt.
3. Rinse components thoroughly in clean, warm (43 °C [110 °F] maximum), preferably running water. Drain.
4. When the cleaner used does not contain a disinfecting agent, respirator components should be immersed for two minutes in one of the following:
  - a. Hypochlorite solution (50 ppm of chlorine) made by adding approximately one milliliter (approximately 20 drops) of laundry bleach to one liter of water at 43 °C (110 °F); or,
  - b. Aqueous solution of iodine (50 ppm iodine) made by adding approximately 0.8 milliliters of tincture of iodine (6-8 grams ammonium and/or potassium iodide/100 cc of 45% alcohol) to one liter of water at 43 °C (110 °F); or,
  - c. Commercially available cleansers of equivalent disinfectant quality when recommended by the respirator manufacturer.
5. Rinse components thoroughly in clean, warm (43 °C [110 °F] maximum), preferably running water. Drain. The importance of thorough rinsing cannot be overemphasized. Detergents or disinfectants that dry on facepieces may result in dermatitis. In addition, some disinfectants may cause deterioration of rubber or corrosion of metal parts if not completely removed.
6. Components should be hand-dried with a clean lint-free cloth or air-dried in a clean environment on a clean surface.
7. Reassemble facepiece.

8. Test the respirator to ensure that all components work properly.”

**USCG: Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities <sup>7</sup>**

The above referenced document was prepared by four agencies (NIOSH, EPA, USCG, OSHA). For specific information outlined by this guidance manual listed above, please see the NIOSH section of this supplement.

**United States Department of Agriculture (USDA)**

USDA recommends that employers comply with OSHA’s personal protective equipment standards including 1910.132 – 1910.138. In addition, the following guidelines have been recommended:

**USDA: Midwest Area Personal Protective Equipment and Clothing Policy MWA PPE**

**Hand Protection — 29 CFR 1910.138 <sup>24</sup>**

“Hand protection must meet the following minimum requirements:

- be capable of being cleaned and/or disinfected and/or disposed of upon completion of intended use; and,
- be kept clean and in good repair.”

**United States Navy (USN)**

**Industrial Hygiene Field Operations Manual <sup>25</sup>**

The US Navy follows OSHA 1910.134 Appendix B-2 Mandatory respirator cleaning instructions and also includes the following:

Chapter 9: Respiratory Protection

“7. CLEANING.

a. Requirements. Clean and disinfect respirators regularly using the following schedules:

- (1) Respirators issued for the exclusive use of one worker will be cleaned and disinfected as often as necessary to be maintained in a sanitary condition.
- (2) Respirators used by more than one worker will be thoroughly cleaned and disinfected before use by another worker.
- (3) Respirators for emergency use will be cleaned and sanitized after each use.
- (4) Respirators used in fit testing and training will be cleaned and disinfected after each use.

b. Methods ... Although the methods listed below will properly clean and sanitize respirators, the respirator manufacturer's instructions take precedence.

(1) Manual cleaning.

- (a) Remove canisters, filters, valves, straps, and speaking diaphragm from the facepiece.
- (b) Wash facepiece and accessories in warm soapy water. Gently scrub with a soft brush. Cleaner temperatures should not exceed 110° F (43° C).
- (c) Rinse parts thoroughly in clean water no hotter than 110 °F (43 °C) to remove all traces of detergent. This is very important to prevent dermatitis.
- (d) Air dry in a clean place or wipe dry with a lintless cloth.
- (e) Reassemble.

(2) Machine cleaning. Machines may be used to expedite the cleaning, sanitizing, rinsing, and drying of large numbers of respirators.

(a) Extreme care must be taken to ensure against excessive tumbling and agitation, or exposure to temperatures above those recommended by the manufacturer, as these conditions are likely to result in damage to the respirators.

(b) Ultrasonic cleaners, clothes-washing machines, dishwashers, and clothes dryers have been specially adapted and successfully used for cleaning and drying respirators.

(3) Disinfection. Disinfection procedures include:

(a) Immerse the respirator body in a bleach solution (made from mixing either 2 ml 5.25 percent bleach per liter of tap water or 2 teaspoons 5.25 percent bleach per gallon of tap water) for two minutes. Rinse thoroughly in clean water no hotter than 110° F (43° C) to remove all traces of disinfectant and dry.

(b) Immerse the respirator body for two minutes in a quaternary ammonium solution (200 ppm of quaternary ammonium compounds in water with less than 500 ppm total hardness). Depending on water hardness, different concentrations of quaternary ammonium salts are required to achieve sanitizing strength. Rinse thoroughly in clean water no hotter than 110° F (43° C) to remove all traces of disinfectant and dry.

(c) Immerse the respirator body for two minutes in a ~ 50 ppm iodine solution made by mixing one tablespoon or 15 ml of (1.75 percent aqueous iodine solution) in 1.5 gallons of tap water. Rinse thoroughly in clean water no hotter than 110° F (43° C) to remove all traces of disinfectant and dry.

(d) Immersion times shall be limited to minimize damage to the respirator. These solutions can age rubber and rust metal parts. Caution must be taken to thoroughly rinse the respirator after cleaning and disinfection to prevent dermatitis. “

## CHAPTER 10: PERSONAL PROTECTIVE EQUIPMENT AND CHEMICAL PROTECTIVE CLOTHING

“6. CPC CLASSIFICATION. CPC can be classified by:

c. Service life - This is an end user decision depending on the cost and risks associated with clothing decontamination and reuse. CPC may be labeled as reusable (multiple wearings) or disposable (one-time use). Disposable clothing is generally lightweight and inexpensive. Reusable clothing is often more rugged, but also more costly.

(1) Extensive contamination of any garment may render it disposable. The basis of this classification really depends on the cost involved in purchasing, maintaining, and reusing CPC versus the alternative of disposal following exposure.

(2) The key assumption in this determination is that the garment will provide an effective barrier during and after exposure and can be effectively decontaminated.

### 13. DECONTAMINATION.

a. Decontamination removes or neutralizes contaminants that have accumulated on CPC, personnel and equipment. Proper decontamination does the following:

(1) Protects end users from hazardous substances that may contaminate and eventually permeate the CPC, respiratory equipment, tools, vehicles or other equipment used at or near the hazard area.

(2) Protects the community and site personnel by minimizing the transfer of contaminants into clean areas.

b. Things to consider during decontamination procedures:

(1) Is the CPC adversely affected by the decontamination? The physical or chemical resistance may be affected by heat or chemicals used to clean the CPC.

(2) Is the decontamination process effective? There is some indication that volatile, small molecule chemicals may be successfully removed from the CPC with the use of heat. No standard method is available to determine whether a product is decontaminated.

(3) Can the decontamination process cause exposure? Any chemicals used in the process must be evaluated to ensure they do not result in unacceptable exposures, either during the decontamination process or when the CPC is reused.

#### 14. PPE/CPC INSPECTION.

a. The PPE user must take all necessary steps to ensure that the protective ensemble will perform as expected. Emergencies are not the right time to discover problems! Following a standard program for inspecting protective equipment and realizing its limitations are the best ways to avoid exposure during PPE use. Additional inspection information may be available from the PPE manufacturer.

b. An effective CPC inspection program features:

(1) Inspection and operational testing of equipment as received from the factory or distributor;

(2) Inspection of equipment as it is selected for a particular chemical operation;

(3) Inspection of equipment after use or training and prior to maintenance;

(4) Periodic inspection of stored equipment; and

(5) Periodic inspection when questions arise about the appropriateness of the selected equipment, or when problems with similar equipment are discovered.

15. STORAGE. All PPE must be stored properly to prevent damage or malfunction from exposure to dust, moisture, sunlight, damaging chemicals, extreme temperatures, and impact. Some guidelines for storage include:

a. Potentially contaminated clothing or equipment should be stored separately from street clothing and unused PPE.

b. Potentially contaminated PPE should be stored in a well-ventilated area, with good air flow around each item.”

## **Advisory Bodies**

### **American Industrial Hygiene Association (AIHA)**

#### **AIHA: Guideline for the Decontamination of Chemical Protective Clothing and Equipment <sup>26</sup>**

##### “8. The Decontamination Planning Process

###### 8.2 Decontamination Methodology

The various methods for decontaminating CPC and equipment fall into two basic categories: Physical methods and chemical methods.

###### 8.2.1 Physical Methods

Physical methods remove contaminants from CPC or equipment using mechanical and/or thermal energy, such as wiping, dislodging, wringing, heating, or through evaporating (airing).

###### 8.2.1.1 Gross Decontamination

Gross decontamination means removing as much contaminant as possible using simple means, such as kicking mud from boots before showering inside a decontamination facility.

###### 8.2.1.2 Wiping

If dust contaminants are involved, remove the contaminants from the surfaces or interface areas of CPC or equipment using a dry mechanical method such as a soft bristle brush, or a wet method using water with or without a surfactant. Sometimes vacuuming the surfaces with HEPA filters prior to the wiping may be needed if a bristle brush is unable to reach the contaminants directly ... A booth equipped with a blow-down inside can be used to remove the particulate prior to washing the suits in a shower.

#### 8.2.1.3 Water Rinsing

If contaminants are inorganic compounds, salts, organic acids or other water-soluble compounds, water rinsing of contaminated CPC is generally an effective method to remove the contaminants from the barrier materials.

When using water rinsing, detergents with surfactants that lower surface tension of water are able to lower pesticide residues in agricultural workers' clothing more completely than water alone. The water-rinsing process can be sped up using hot water (~80°C or 176°F) or spraying water at high pressures (= 3,000 PSI). If cold water is used, the CPC should be dried in a temperature up to 45°C (113°F). However, hot water with high pressure should not be applied to ensembles with a person inside.

#### 8.2.1.4 Evaporation and Heated Air Drying

Volatile chemical contaminants such as organic solvents may be removed simply by evaporation. This usually takes a long time for an effective decontamination down to a "Zero" residual level. Application of heated air drying between 50°C and 70°C (122°F and 158°F) will shorten the time and improve the decontamination effectiveness. For example, research has shown that several solvents can be removed from butyl rubber by drying at 50°C (122°F) for 24 hours ... Theoretically, time needed to remove any level of contamination is less than or equal to the time needed to decontaminate a saturated CPC. This can be determined in the laboratory prior to the actual decontamination.

#### 8.2.1.5 Dry Decontamination

Dry decontamination ... It can be done using brushing, blotting vacuuming techniques, or with dry powders (such as earth or flour). Dry decontamination alone may be sufficient to effectively remove

certain contaminants, or can be used as an interim step followed by additional removal methods.

#### 8.2.1.6 Additional Techniques

Other contaminants such as glues, cements resins, or mud that adheres to CPC may require additional techniques such as scraping solidification, freezing, absorption or adsorption. Caution should be used to avoid introducing new hazards by tearing or scraping the CPC or by causing the user to inhale powdered adsorbent spill cleanup products.

### 8.2.2 Chemical Methods

Chemical removal usually involves the use of organic solvents that are compatible with the contaminated CPC or equipment.

#### 8.2.2.1 Solvent Washing

Solvent washing simply applies the principle of “like dissolve like”, i.e., polar compounds dissolve in polar compounds and nonpolar dissolve in nonpolar ... Chemical agents can be removed from the surface by washing the molecules away using alcohol, diesel fuel, ethers, Freon TF, ketones, perchloroethylene, Stoddard solvent or others. The solvents can be recycled for further use in additional cycles before being discarded and detoxified.

Halogenated solvents can be used for decontaminating equipment when other cleaning agents do not work effectively. However, halogenated solvents are generally incompatible with CPC materials and more toxic than some organic solvents, and thus should not be used for CPC decontamination.

#### 8.2.2.2 Solvent Extraction

Organic solvents such as methanol, acetone, or toluene can be used to remove matrix contaminants by extraction, especially for low volatility or viscous chemicals that are difficult to remove by other methods. The selected solvents should be compatible with the barrier materials. The decontamination personnel should consult the manufacturers or literature for such information. The method is particularly useful for decontaminating small CPC articles, such as chemical protective gloves since only a relatively small amount of the solvent is required. The process is conducted at room temperature (no more than 40°C or 104°F) to avoid material degradation. Use of a water bath shaker or an ultrasonic

bath may increase extraction effectiveness. Multiple extractions may be needed to completely remove the contaminants. Following the extraction, residue solvents should be removed from the CPC by evaporation or heated air drying, as described in Section 8.2.1.4.

#### 8.2.2.3 Neutralization

Neutralization may be needed when water rinsing is unable to completely remove the acidic or basic compounds. Commercially available buffers can be used for the neutralization of basic (caustic) compounds, such as amines, hydrazines, or acidic compounds including phenols, thiols, and some nitro and sulfonic compounds. Complexing with Borax and hydrofluoric acid can be used to convert some hazardous agents to a non-hazardous form.

#### 8.2.2.4 Solidification Agents

Solidification agents completely solidify or gel contaminants, making the physical removal process easier ... Solidification agents are more suited for equipment and surfaces than for CPC.

#### 8.2.2.5 Oxidizing Agents

Oxidizing agents are used when contaminants cannot be removed by the methods describe earlier. This usually applies to biological agents and some chemical warfare agents.

### 8.3. Selection of Appropriate Methods

The decontamination method should be selected based on the contaminant (extent, physical state, toxicity, flammability, persistence, decontamination site, etc.), vulnerability of the item being contaminated, cost of the items vs. cost of decontamination process, and most importantly, the threat posed to the decontamination personnel, the public, or the environment.

### 8.4. Hazard and Risk Assessment

If decontamination is not cost-effective, the protective clothing should be disposed of properly. Despite all of the efforts complete (100%) decontamination cannot be achieved. Typically, a small amount of the toxic substances will remain in the matrix of the material, no matter which decontamination method is used.

## 9. Decontamination Facility

### 9.1. Management and Personnel Consideration

The establishment of a protective equipment decontamination program requires planning, preparation, and training.

Considerations for the EH&S professional charged with creating and management of the program must consider the following aspects:

- The number and layout of decontamination stations
- Decontamination equipment needed
- Appropriate decontamination methods
- Procedures to prevent contamination of clean areas
- Methods and procedures to minimize worker contact with contaminants during the removal of PPE
- Methods for disposal of clothing and equipment that cannot be completely decontaminated
- Selection and training of personnel
- The event that an entrant is experiencing problems and needs to be decontaminated more expeditiously than the planned methodology.

### 9.3 Contamination Control Measures

The particular decontamination process and the risk of secondary contamination are dependent upon the nature of the agent, the route of exposure, and the degree of contamination. A key consideration for a successful decontamination strategy includes contamination control measures. This aspect can impact the selected method of decontamination (e.g. wipe down, spray down, immersion) as well as the materials used to decontaminate CPC and equipment. In large scale emergency response operations for example significant amounts of water may be used in the process of decontaminating PPE of first responders, their equipment, as well as victims. Dependent upon the contaminant, that water may need to be treated or disposed of in a particular way.

As a practical matter, when the material is unknown or information is lacking on the nature of the chemical, then one must proceed to establish a conservative decontamination and contaminant control procedure.

### 9.4 Training

All personnel involved in decontaminating CPC and equipment should receive training in these fundamental areas commensurate with the level of risk they might encounter:

- The hazards of the material they could encounter;

- The PPE and practices to protect themselves during decontamination procedures;
- The proper methods of decontamination;
- Evaluation of the effectiveness of the decontamination steps;
  - Visual inspection of the PPE (discoloration, tearing, alterations, visible tracers),
  - Wipe sampling when available, and
- Disposal and contaminant control methods

Within the realm of OSHA 1910.120(q)(6)(v), a person charged with decontamination during an emergency response operation is considered a HAZMAT specialist. This standard outlines specific training requirements and qualification procedures for those personnel.

## 10. Waste Management and Reuse Issues

### 10.2 Laundering

Sometimes with certain CPC, for instance, the cost of laundering may be greater than the cost of a new pair of gloves, depending on the particular polymer used to make the CPC or gloves. Laundries will not accept overtly contaminated hazardous materials. If the launderer does not consider the related issues addressed in this section, a different launderer should be found for the purpose.

### 10.3 Reuse of CPC

CPC is manufactured as reusable or single-use (some single-use CPC is reusable as stated earlier). Either type requires some level of decontamination prior to reuse or disposal.

10.3.1 Reusable CPC must be decontaminated adequately to ensure that CPC still functions correctly and the materials do not fail after decontamination.

10.3.2 Single-use CPC may also be considered for limited reuse under very specific conditions. If the CPC was not subject to a contaminant during its use or if it is minimally contaminated and has been effectively decontaminated following use, it may be reused if it passes stringent visual inspection and is approved for reuse by the incident commander (operation manager) and the Health and Safety Officer.

If the CPC is a level A suit, it must also pass a pressure test

### 10.4 Off-site Transport for Disposal or Decontamination

#### 10.4.1 Transportation of CPC or Equipment for Decontamination

The contaminated CPC or equipment needs to be sealed in a container before transport off-site for decontamination, together with a detailed log that includes the following information:

- Place and date of exposure
- Location and extent of exposure on the product
- Exposure types, such as liquid splash, liquid deluge, mist, spray, gas, vapor, or solid
- The task being performed when the exposure occurred
- The generic chemical name of the contaminant
- Manufacturer's trade name; chemical formula, and
- Whether or not the contaminant is flammable, toxic, corrosive, or a suspected carcinogen. Such information can be found in the Material Safety Data Sheet (MSDS)

10.4.2 After decontamination, a complete Certificate of Decontamination is needed for return shipment, which should include the following information:

- Date of decontamination,
- Person performing the decontamination,
- Decontamination methods used, and
- The methods used to evaluate decontamination efficacy.

If the article can not be reused and should be disposed as hazardous waste, relevant Federal regulations must be followed. If necessary, the item should be stored in a closed container in an adequate aisle space. It should be labeled with the words "Hazardous Waste" and a clear description of the waste. Related EPA regulations should be followed.

#### 10.5 Quality Assurance and Control

Manufacturers may recommend laundering CPC and provide specific instructions. These must be followed and temperature recommendations must not be exceeded. The type of detergent or cleaning agent must also follow the manufacturer's recommendations. If a manufacturer recommends certain laundering instructions, they may still guarantee CPC as long as the washing instructions are followed up to a certain number of washings.

If a manufacturer does not provide laundering instructions, the guarantees and limited warranties may not extend past the workmanship at the time of manufacture."

## **American National Standards Institute (ANSI)**

### **ANSI Z87.1-1968 Practice of Occupational and Educational Eye and Face Protection <sup>27</sup>**

#### “4. General Requirements

4.4 (5) They shall be capable of being disinfected

4.4 (6) They shall be easily cleanable.

#### 6.2 Materials and Methods of Test of Protectors

6.2.2 Disinfection. All materials shall be such as to withstand, without deterioration or discoloration, the cleansing and disinfection procedure specified in 6.4.3

#### 6.4 Maintenance and Disinfection of Eye Protectors

##### 6.4.1 Maintenance

###### 6.4.1.1

It is essential that the lenses of eye protectors be kept clean. Continuous vision through dirty lenses can cause eye fatigue and become a contributory factor to accidents. Daily cleaning of eye protectors is recommended.

###### 6.4.1.2

Pitted or scratched lenses reduce vision and seriously reduce protection. They shall be replaced immediately.

##### 6.4.2 Issue and Use

Protectors are a personal item and should be for the individual and exclusive use of the person to whom they are issued. If circumstances require reissue, the protectors shall be thoroughly cleaned and disinfected as hereinafter described.

##### 6.4.3 Disinfection

6.4.3.1 General. When a person is assigned protective equipment, it is recommended that this equipment be cleaned

and disinfected regularly, without sharing by another person unless disinfected as herein specified.

6.4.3.2 Procedure. Thoroughly clean all surfaces with soap or suitable detergent, and warm water. Carefully rinse all traces of soap or detergent. Completely immerse the protector for 10 minutes in a solution of modified phenol, hypochlorite, or quaternary ammonium compounds, in a strength specified by the manufacturer, at a room temperature of 68 °F. Remove protector from solution and suspend in a clean place for air drying at room temperature, or with heated air. Do not rinse because this will remove the residual effect.

Ultraviolet disinfecting equipment may be utilized in conjunction with the washing procedure above, when such equipment can be demonstrated to provide comparable disinfection.

Protectors showing need for extensive cleansing should be disassembled to the extent possible without tools, prior to the washing and disinfection procedure. Replace defective parts with new ones.

#### 6.4.3.3 Storage

The dry parts or items should be placed in clean, dust-proof containers to protect them.”

*Material taken from ANSI/ASSE Z87.1 standard, permission granted by the ASSE.  
www.ASSE.org*

### **ANSI Z87.1-1979 Practice for Occupational and Educational Eye and Face Protection<sup>28</sup>**

#### “4. General Requirements

4.4 Protectors shall meet the following minimum requirements:

(5) They shall be capable of being disinfected.

(6) They shall be easily cleanable

4.5 Protectors should be kept clean and in good repair”

#### “5. Welding Helmets, Head Shields, and Face Shields

##### 5.2 Face Shields

## 5.2.4 Materials

Materials used in the manufacture of face shields shall meet the requirements of 6.2. ... and shall be capable of withstanding frequent disinfection.

### 5.2.8.5 Disinfection.

All face shield materials shall be such as to withstand, without discoloration or deterioration, the cleaning and disinfection procedure specified in 6.4.3.”

## “6. Eye Protection

### 6.2 Protectors – Materials and Methods of Test

6.2.1 Materials used in the manufacture of face shields shall meet the requirements of 6.2. ... and shall withstand frequent disinfection by the methods hereinafter prescribed.

6.2.2 Disinfection. All face shield materials shall be such as to withstand, without discoloration or deterioration, the cleaning and disinfection procedure specified in 6.4.3.

### 6.4 Maintenance and Disinfection of Eye Protectors

#### 6.4.1 Maintenance

6.4.1.1 It is essential that the lenses of eye protectors be kept clean. Restricted vision due to dirty lenses can cause eye fatigue and become a contributory factor to accidents. Daily cleaning of eye protectors is recommended.

6.4.1.2 Pitted or scratched lenses may reduce vision and seriously reduce protection. Lenses that are pitted or scratched should be replaced when, in the judgment of the safety supervisor or other qualified person, the eye protector no longer complies with the requirements of 6.3.3.4.

6.4.2 Issue and Use. Protectors are a personal item and should be for the individual and exclusive use of the person to whom they are issued. If circumstances require reissue, the protectors shall be thoroughly cleaned and disinfected as described in 6.4.3.

#### 6.4.3 Disinfection

6.4.3.1 General. When a person is assigned protective equipment, it is recommended that this equipment be cleaned and disinfected regularly, as herein specified. Equipment to be shared shall be cleaned and disinfected before use by another individual.

6.4.3.2 Procedure. Thoroughly clean all surfaces with soap or suitable detergent and warm water. Carefully rinse all traces of soap or detergent. Completely immerse the protector for 10 minutes in a solution of modified phenol, hypochlorite, quaternary ammonium compound, or other disinfection reagent, in a strength specified by the manufacturer of the safety equipment, at a room temperature of 20°C (68°F). Remove protector from solution and suspend in a clean place for air drying at room temperature, or with heated air. Do not rinse because this will remove the residual effect.

Ultraviolet disinfecting equipment may be utilized in conjunction with the preceding washing procedure, when such equipment can be demonstrated to provide comparable disinfection.

Spray-type disinfecting solution and bactericides may be utilized when such pressure spray solutions can be demonstrated to provide comparable disinfection with the immersion procedure outlined above.

Protectors showing need for extensive cleaning should be disassembled to the extent possible without tools, prior to the washing and disinfection procedure. Replace defective parts with new ones.

6.4.3.3 Storage. The dry parts or items should be placed in clean, dustproof containers to protect them.”

*Material taken from ANSI/ASSE Z87.1 standard, permission granted by the ASSE.  
www.ASSE.org*

## **ANSI Z87.1-1989 Practice for Occupational and Educational Eye and Face Protection<sup>29</sup>**

### “8. Spectacles

#### 8.7 Cleanability

Spectacles shall be cleaned in accordance with Section 15.7. The function of the spectacles shall not be impaired.

## 9. Faceshields

### 9.7 Cleanability

Faceshields shall be cleaned in accordance with Section 15.7. The function of the faceshield shall not be impaired.

## 10. Goggles

### 10.7 Cleanability

Goggles shall be cleaned in accordance with Section 15.7. The function of the goggles shall not be impaired.

## 11. Welding Helmets

### 11.7 Cleanability

Welding Helmets shall be cleaned in accordance with Section 15.7. The function of the welding helmet shall not be impaired.

## 14. Instructions, Use, and Maintenance

14.4 Maintenance. Protectors should be cleaned at appropriate intervals. Protectors shall be maintained in a useable condition.

14.6 Training. Employers and educational authorities shall train employees and students in the proper use, application, inspection, maintenance, storage, and limitations of protective devices.

## 15. Test Methods

15.7 Cleanability. Products shall be cleaned according to the manufacturer's instructions. If none are available, clean with mild soap and warm water solution by soaking the device in the soap solution maintained at 120°F for ten minutes. Rinse thoroughly and allow to air dry."

*Material taken from ANSI/ASSE Z87.1 standard, permission granted by the ASSE.  
www.ASSE.org*

## **ANSI Z87.1-2003 American National Standard Occupational and Educational Personal Eye and Face Protection Devices**<sup>30</sup>

### 13.4 Maintenance

Protectors shall be maintained in a usable condition in accordance with the manufacturers instructions. When one protector is being used by more than one person, it is recommended that it be cleaned and disinfected prior to use by another person.

## 14.8 Cleanability

### 14.8.1 Puropose

This test is intended to determine the capability of a protector to withstand cleaning.

### 14.8.2

Products shall be cleaned in accordance with the manufacturer's instructions. If none are available, clean with mild soap and warm water solution by soaking the device in the soap solution maintained at 43°C-49°C (110-120°F) for ten minutes. Rinse thoroughly and allow to air dry."

*Material taken from ANSI/ASSE Z87.1 standard, permission granted by the ASSE.  
www.ASSE.org*

## **ANSI Z88.2-69 Practices for Respiratory Protection** <sup>31</sup>

### "3. Recommended Requirements for Codes

#### 3.5 Minimal Acceptable Program

##### 3.5.5

Respirators shall be regularly cleaned and disinfected. Those issued for the exclusive use of one worker should be cleaned after each day's use, or more often if necessary. Those used by more than one worker shall be thoroughly cleaned and disinfected after each use. See 8.3

##### 3.5.6

Respirators shall be stored in a convenient, clean, and sanitary location. See 8.5

##### 3.5.7

Respirators used routinely shall be inspected during cleaning.

## 8. Maintenance and Care of Respirators

8.1 General. A program for maintenance and care of respirators shall be adjusted to the type of plant, working conditions, and hazards involved, and shall include the following basic services:

- (1) inspection for defects (including a leak check)
- (2) cleaning and disinfecting
- (3) repair
- (4) storage

Equipment shall be properly maintained to retain its original effectiveness.

8.3 Cleaning and Disinfection. Routinely used respirators shall be collected, cleaned, and disinfected as frequently as necessary to insure that proper protection is provided for the wearer. Each worker should be briefed on the cleaning procedure and be assured that he will always receive a clean and disinfected respirator. Such assurances are of greatest significance when respirators are not individually assigned to workers. Respirators maintained for emergency use shall be cleaned and disinfected after each use.

The following procedure is recommended for cleaning and disinfecting respirators:

- (1) Remove any filters, cartridges, or canisters.
- (2) Wash facepiece and breathing tube in cleaner-disinfectant or detergent solution (see following paragraphs). Use a hand brush to facilitate removal of dirt.
- (3) Rinse completely in clean, warm water.
- (4) Air dry in a clean area.
- (5) Clean other respirator parts as recommended by manufacturer.
- (6) Inspect valves, headstraps, and other parts; replace with new parts if defective.
- (7) Insert new filters, cartridges, or canisters; make sure seal is tight.
- (8) Place in plastic bag or container for storage.

Cleaner-disinfectant solutions are available that effectively clean the respirator and contain a bactericidal agent. The bactericidal agent is generally a quaternary ammonium compound. The respirator may be immersed in the solution, rinsed in clean, warm water, and air dried.

Alternatively, respirators may be washed in a liquid detergent solution, then immersed in: 1) a hypochlorite solution (50 parts per million of

chlorine) for 2 minutes; 2) an aqueous iodine solution (50 parts per million of iodine) for 2 minutes; or 3) a quaternary ammonium solution (200 parts per million of quaternary ammonium solution (200 parts per million of quaternary ammonium compounds in water with less than 500 parts per million total hardness).

Different concentrations of quaternary ammonium salts are required to achieve a disinfecting solution with waters of varying hardness. Also, dermatitis may occur in the quaternary ammonium compounds are not completely rinsed from the respirator. The hypochlorite and iodine solutions are not stable; they age rubber parts, and are corrosive to metallic parts. Therefore, immersion times should not be extended and the disinfectants shall be thoroughly rinsed from the respirator parts.

Strong cleaning and disinfecting agents can damage respirator parts. Temperature above 185 degrees Fahrenheit and vigorous mechanical agitation should not be used. Solvents which affect elastomer or rubber parts should be used with caution.

Respirators may be contaminated with toxic materials (that is, organic phosphate pesticides and radionuclides). If the contamination is light, normal cleaning procedures should provide satisfactory decontamination; if heavy, a separate decontamination step may be required before cleaning.

For complete decontamination against phosphate pesticides, the respirator should be washed with alkaline soap and rinsed with 50 percent alcohol (ethyl or isopropyl).

Respirators used to protect against radioactive contaminants should be decontaminated to levels not exceeding 100 disintegrations per minute per 100 square centimeters fixed alpha and 0.2 millirad per hour of beta-gamma above background at contact. There should be no detectable removable activity using standard swipe techniques.”

### **ANSI Z89.1-1969 Safety Requirements for Industrial Head Protection <sup>32</sup>**

“Appendix (This Appendixes are not part of American National Standard Requirements...but are included for information purposes only.)

#### **A1. Recommendations Concerning Equipment**

##### **A1.2 Painting and Cleaning.**

Caution should be exercised if shells are to be painted, since some paints and thinners may attack and damage the shell and reduce protection. The manufacturer should be consulted with regard to paints or cleaning materials for their particular products. A common method of cleaning and sterilization of shells, is dipping them in hot water (approximately 140°F) containing a good detergent for at least a minute. Shells should then be scrubbed and rinsed in clear water (approximately 140°F). After rinsing, the shell should be carefully inspected for any signs of damage.”

### **ANSI Z89.1-1986 Protective Headwear for Industrial Workers – Requirements<sup>33</sup>**

“(These Appendixes are not part of American National Standard Requirements ... but are included for information purposes only.)”

“Appendix B: Recommendations and Precautions Helmet Use, Maintenance, and Testing

#### B2. Cleaning

Shells should be scrubbed with a mild detergent and rinsed in clear water approximately 60°C (140°F). After rinsing, the shell should be carefully inspected for any signs of damage.

Removal of tars, paints, oils, and other materials may require the use of a solvent. Since many solvents may attack and damage the shell, the manufacturer should be consulted with regard to an acceptable solvent.”

ANSI/ISEA Z89.1-1986 published by the International Safety Equipment Association, Arlington, VA [www.safetysiteequipment.org](http://www.safetysiteequipment.org). Used by permission.

### **ANSI Z89.1-2003 American National Standard for Industrial Head Protection<sup>34</sup>**

“(These Appendixes are not part of American National Standard Requirements ... but are included for information purposes only.)”

#### Appendix A – Recommendations, Cautions, Use, and Care

#### A3. Cleaning

Shells should be cleaned following the manufacturer’s instructions. The helmet should be carefully inspected for any signs of damage.”

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## **ANSI/ISEA Z89.1-2009, American National Standard for Industrial Head Protection**<sup>35</sup>

Excerpted from Appendix A, Recommendations, Cautions, Use and Care

### A3. Cleaning

Shells should be cleaned following the manufacturer's instructions. The helmet should be carefully inspected for any signs of damage.

### A4. Painting

Caution should be exercised if shells are to be painted, since some paints and thinners may attack and damage the shell and reduce protection. The helmet manufacturer should be consulted with regard to paints or cleaning materials.

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## **American Society of Health-System Pharmacists (ASHP)**

### **Drug Distribution and Control: Preparation and Handling—Guidelines on Handling Hazardous Drugs**<sup>36</sup>

#### **Appendix C—Recommendations for Use of Gloves**

4. Sanitize gloves with 70% alcohol or other appropriate disinfectant before performing any aseptic compounding activity.
5. Change gloves every 30 minutes during compounding or immediately when damaged or contaminated.
12. Wash hands before donning and after removing gloves.
13. Remove gloves with care to avoid contamination. Specific procedures for removal must be established and followed.

#### **Appendix D—Recommendations for Use of Gowns**

3. Coated gowns must be worn no longer than three hours during compounding and changed immediately when damaged or contaminated.

## **ASTM International**

### **Standard Practice for Chemical Protective Clothing: Wearing, Care and Maintenance**<sup>37</sup>

#### **“3. Terminology**

3.3 Decontamination, n-removal or neutralization of a contaminant(s) from the protective clothing to the extent necessary to safely permit the protective clothing to be doffed (taken off), or reused, or disposed of.

#### **6. Information Related to Care Instructions**

##### *6.1 Information Related to Cleaning:*

6.1.1 *Cleaning Instructions*—The seller shall provide specific instructions for the end user to properly clean, launder, or refurbish the protective clothing. This information shall include instructions for washing (for example, specific washing method, type of washing machine, machine cycle or formulation, detergents or cleaning agent, wash temperature, and pretreatment options) and drying (for example, the drying method, drying temperature, and length of time required). Warnings for limitations on the cleaning of protective clothing such as loss of physical integrity or other forms of degradation shall be included in this section. Additionally, the seller shall describe methods to inspect or test for damages to the protective clothing caused by cleaning or other maintenance, as applicable.

##### *6.2 Decontamination and Disinfection:*

6.2.1 The seller shall provide specific instructions for removing various forms of contamination, if decontamination is recommended. These instructions shall include descriptions of acceptable processes, the types of contaminants that can be safely removed, the means of handling contaminated or non-sterile garments, the limitations of the processes, and all other information of importance to decontamination. This shall also include information necessary for decontamination while the protective clothing is being worn by the end user, as appropriate, to allow for safe doffing without the hazard of contamination. If known, the seller shall recommend practices or test methods to assist in determining if the decontamination has been effective.

NOTE 3—In the absence of information for determining effective decontamination of protective clothing, a warning that all contamination may not have been removed is appropriate.

6.2.2 The seller shall provide specific instructions for disinfection of protective clothing, as appropriate, for personal hygiene or other such needs.”

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### **Performance of Protective Clothing; Volume 5 (ASTM STP 1237) <sup>38</sup>**

#### **Evaluating the Effectiveness of Different Laundering Approaches for Decontaminating Structural Fire Fighting Protective Clothing <sup>39</sup>**

“In structural fire fighting, both cleaning and decontamination of protective clothing and equipment are needed on a frequent basis.”

“Some common cleaning agents, such as sodium hypochlorite bleach, can actually rapidly destroy clothing through deterioration of materials and thread. Detergents and specialized cleaning products may also cause degradation ... these effects become more pronounced as the number of cleanings on a single item increases.”

“Only simulated dry cleaning was consistently effective in removing the majority of chemical contaminants as compared to the other cleaning techniques ... In addition, aeration proved to be a more effective way for removing chemical contamination ... overall, the results of this study point towards the use of dry cleaning as the most effective process for removing chemical contaminants.”

“While dry cleaning removed the majority of chemical contaminants ... the process destroys retroreflective trim and removes certain water repellent finishes on the outer shell and other clothing materials.”

“Frequent cleaning is likely to help in removing the majority of contamination, such as blood and other biological agents, but this study also shows how repeated cleaning can impact the clothing’s long term performance.”

### **Performance of Protective Clothing; Second Symposium (ASTM STP 989) <sup>40</sup>**

#### ***Development of a Comprehensive Approach to Chemical Protective Clothing Use <sup>41</sup>***

“Multiple-use CPC items will normally require some form of decontamination. Therefore, both the inside and outside surfaces may need to be routinely checked for residual contamination before use.

Decontamination techniques will vary depending on the reactivity and solubility of the chemical agent to be removed as well as the base material of construction of the CPC to be decontaminated. Water soluble chemicals may be removed with a detergent and water wash while some chemicals may require complexing or another method of inactivation before removal. Volatile chemicals may be removed by simply drying the CPC at elevated temperatures in some cases.”

## **Standard Guide for Industrial Laundering of Flame, Thermal, and Arc Resistant Clothing**<sup>42</sup>

### 1. Scope

1.3 It is important that potentially flammable contaminants are removed from garments during the wash process. If flammable contaminants are not removed, the flame resistance of the garment will be compromised.

1.5 It is the responsibility of the end user to determine if their laundering method is the appropriate care and maintenance procedure for their application.

### 6. Procedure

6.1 Garment manufacturers, in consultation with fiber and fabric suppliers, are responsible for providing information on the performance characteristics and maintenance needs of their garments.

6.2 The processor should sort flame, thermal, and arc resistant clothing by fiber, fabric, finish, and soil level in consultation with the chemical supplier, and wash separately from all other clothing.

6.3 The processor, in consultation with the chemical supplier, should develop loading plans and wash formulas to remove soils, while maintaining the flame and thermal protective characteristics of the garments.

6.3.1 Laundry wash formulas should be developed by the processor and wash chemical supplier in collaboration with the clothing and fabric manufacturers based on the following criteria:

- (1) *Washing Machine Type and Volume*
  - Machine Loading Factor
  - Mechanical Action
  - Extraction
  - Cycle Times
- (2) *Product Classifications and Material Construction*
- (3) *Soil types and soil level*
- (4) *Sorting*
- (5) *Wash Room Chemistry*
  - Water Temperature
  - Water Hardness
  - Detergent Make-up
  - Additives
- (6) *Finishing Process*
  - Type Finishing-Drying, Pressing, Tunneling
  - Moisture Retention
  - Finishing Temperature
  - Finishing Time
- (7) *Special Instructions prohibiting laundering (for example, “Dry Clean Only” or “Do Not Wash”).*

6.3.2 Based on the preceding criteria, some or all of the following processes may be included in the wash formula:

6.3.2.1 *Flush*—A high-level bath for a short period of time prior to the break. Flushes generally are used for conditioning textiles before subsequent baths and for removing loose soils.

6.3.2.2 *Break (Break Suds)*—The first wash chemical bath. In light and medium-soil formulas, all of the surfactant/detergent and alkali to be used in the entire formula is generally added to the washer in the break bath.

6.3.2.3 *Suds*—A bath occurring between the break and ensuing steps. Suds baths are carried out at low water levels, usually with hot or warm water. If alkali or detergent isn't added on these additional suds baths, they are referred to as carryover.

6.3.2.4 *Carryover (Carryover Suds)*—A cleaning step in a laundry formula in which no supplies are added, but supplies previously added are retained for use.

6.3.2.5 *Rinse*—High water-level bath or baths following the carryover and preceding the sour or finishing bath. During rinsing the final portions of loosened soils are removed along with the bulk of the washing compounds used in laundering.

Rinses are used to cool down the wash load. Except for antichlors, chemicals are usually not added to rinse.

6.3.2.6 *Sour Bath*—Normally the final bath in the laundering process. The purpose for the sour (or acid) bath is to neutralize the alkalinity of the water in the textiles before removing them from the machine for finishing.

6.4 *Load Size*—Since proper loading of the washer is essential to effective processing of flame, thermal, and arc resistant clothing, appropriate consideration of load size should be made by the processor in coordination with the machine manufacturer and the processor's chemical supplier.

6.5 *Removal from Service*—For most practical purposes, garments may be temporarily or permanently removed from service for reasons as determined by inspection based on subjective evaluation and advice by the processor. Ultimately, determination of when flame, thermal and arc resistant clothing should be removed from service is the responsibility of the end user.

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## **Canadian Centre for Occupational Health & Safety (CCOHS)**

### **Prevention and Control of Hazards: Personal Protective Equipment <sup>43</sup>**

“How do I clean my equipment?”

Basic care prolongs the life of the unit and contributes to its performance.

- Wipe off all surface dirt with a sponge dampened in plain water. Rinse the sponge and squeeze it dry. Dip the sponge in a mild solution of water and commercial soap or detergent. Work up a thick lather with a vigorous back and forth motion.
- Rinse the webbing in clean water.
- Wipe the belt dry with a clean cloth. Hang freely to dry.
- Dry the belt and other equipment away from direct heat, and out of long periods of sunlight.
- Store in a clean, dry area, free of fumes, sunlight or corrosive materials and in such a way that it does not warp or distort the belt.”

## CCOHS (Respirator)

“Repair, cleaning and storage

- Do not clean with solvents.
- Follow the manufacturer's instructions.
- Wash with a mild dish detergent or a combination of detergent and disinfectant. Use a brush and warm water (49-60°C or 120-140°F).
- Rinse with clean water, or rinse once with a disinfectant and once with clean water. The clean water rinse removes excess detergent or disinfectant that can cause skin irritation or dermatitis.
- Dry on a rack or clean surface or hang from a clothes line. Position the respirator so that the facepiece rubber will not "set" crookedly as it dries.
- Store the respirator at the end of each shift to protect it from dust, sunlight, heat, extreme cold, excessive moisture, and chemicals.
- Clean and disinfect shared respirators after each use.
- Permit only trained and qualified personnel to repair respirators.
- Do not mix parts from different manufacturers.
- Record all repairs and inspections.
- Remove dirt.
- Check for distortion caused by improper storage.

What is an example of a checklist for caring for my self-contained breathing apparatus (SCBA)?

Checklist for self-contained breathing apparatus (SCBA)

- Inspect the SCBA unit before each use. Test and clean after each use.
- Follow the manufacturer's instructions and CSA Standard Z94.4-02 for care and maintenance.

Facepiece

- Disconnect the facepiece from the breathing apparatus. Wash alone in warm (49-60°C or 120-140°F) soapy water using a mild dish detergent.
- Rinse the water through the facepiece by placing the palm of the hand over the breathing tube connector on the exhalation-valve body.
- Remove excess water with a paper towel or lint-free cloth.
- Allow to air dry.
- Sanitize according to the manufacturer's instructions.
- Check for tears in the rubber.
- Check head strap for deterioration.
- Examine lenses for cracks, excessive scratching or other deformities.

- Check rings and clamps securing the lens for bends or bulges in the metal.

#### Breathing tube

- Stretch the breathing tube and check for cracks, tears and punctures.
- Wash the breathing tube separately and allow to air dry. If it is permanently attached to the facepiece, allow the breathing tube to dry for several days before using.

#### Audible alarm

- Clean bells or whistles.

#### Cleaning the rest of the unit

- Remove backpack, cylinder and regulator assembly.
- Clean with water, or soapy water.
- Wipe the regulator, high-pressure hose, audible alarm, air cylinder, backpack and harness with a damp cloth.
- Dry with a cloth.”

#### **Headware (Hardhats) – CCOHS <sup>44</sup>**

“The care and maintenance of headwear are needed if the headwear is to protect as designed. Its lifespan is affected by normal use and by heat, cold, chemicals and ultraviolet rays.

- Clean the suspension and shell regularly according to the manufacturers' instructions.”

#### **Hearing Protectors**

“How should I care for my hearing protection device?

Follow the manufacturer's instructions.

Disassemble ear muffs to clean.

Wash ear muffs with a mild liquid detergent in warm water, and then rinse in clear warm water. Ensure that sound-attenuating material inside the ear cushions does not get wet.

Use a soft brush to remove skin oil and dirt that can harden ear cushions.

Squeeze excess moisture from the plugs or cushions and then place them on a clean surface to air dry. (Check the manufacturer's recommendations first to find out if the ear plugs are washable.)”

## **Gloves**

Decontamination procedures. Consider whether the gloves should be disposed of or cleaned after use. If they are cleaned, consider the cleaning method, how often they can be cleaned, and any special procedures required for disposing of the "decontamination wash waste"?

And,

Clean gloves as instructed by the supplier.

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<http://www.ccohs.ca/oshanswers/prevention/ppel/>

## **New York Committee for Occupational Safety and Health (NYCOSH)**

### **Personal Protective Equipment (PPE) <sup>45</sup>**

**“6. Make sure employers provide proper decontamination areas or other appropriate procedures following use of PPE.**

Contaminated protective clothing and other PPE should be removed prior to entering the clean side of any locker room or changing facility where street clothes are stored. Often, contaminated PPE must be disposed of as hazardous waste; therefore, proper disposal facilities must be on hand for contaminated PPE that cannot be cleaned.

**7. Make sure adequate cleaning and storage facilities are available for all PPE that is issued.**

Workers must have the training, supplies, and time to properly clean and store protective equipment that is issued to them.”

[http://www.nycosh.org/workplace\\_hazards/PPE-1999.html](http://www.nycosh.org/workplace_hazards/PPE-1999.html) "New York Committee for Occupational Safety and Health <http://www.nycosh.org>".

## **National Fire Protection Association (NFPA)**

### **NFPA 1851 <sup>46</sup> Standard on Selection, Care, and Maintenance of Protective**

#### **Ensembles for Structural Fire Fighting and Proximity Fire Fighting.**

"NOTICE: An asterisk (\*) following the number or letter designating a paragraph indicates that explanatory material on the paragraph can be found in Annex A. (Contained at the end of the NFPA 1851 section)"

## “Chapter 7 Cleaning and Decontamination

### 7.1 General.

7.1.1\* Organizations shall provide a means for having ensemble elements cleaned and decontaminated.

7.1.2 Ensembles and ensemble elements shall be evaluated by the wearer for application of appropriate cleaning level after each use.

7.1.3 Ensembles and ensemble elements contaminated by CBRN terrorism agents shall be immediately retired after confirmed exposure and shall not be subjected to cleaning or decontamination.

7.1.4\* Ensembles and ensemble elements that are known or suspected to be contaminated with hazardous materials shall be evaluated on the incident scene by members of the organization authorized by the organization to conduct a preliminary assessment of the extent of contamination and the need for ensemble or ensemble

7.1.4.1 Contaminated ensembles and ensemble elements shall be isolated during the incident personnel decontamination process and removed from service until the contaminant or suspected contaminant is identified and the elements can receive specialized cleaning as necessary to remove the specific contaminant(s).

7.1.4.2\* Where possible and where the contaminant and its source have been identified, the organization shall consult the supplier of the contaminant and the manufacturer of the ensemble and ensemble elements for an appropriate decontamination agent and process.

7.1.4.3 A member(s) of the organization who has received training in the cleaning of ensembles and ensemble elements shall be responsible for performing or managing specialized cleaning of elements contaminated with hazardous materials.

7.1.5 Ensembles and ensemble elements that are known or suspected to be contaminated with body fluids shall be evaluated on the incident scene by members of the organization authorized to conduct a preliminary assessment of the extent of contamination and need for the ensemble or ensemble elements to be isolated, tagged, and bagged at the incident scene.

7.1.6\* Organizations shall have written procedures detailing the decontamination and cleaning processes for ensembles and ensemble elements contaminated with body fluids. Universal precautions shall be observed at all times by members handling elements known or suspected to be contaminated with body fluids.

7.1.7 Soiled or contaminated elements shall not be brought into the home, washed in home laundries, or washed in public laundries unless the public laundry has a dedicated business to handle protective ensembles and ensemble elements.

7.1.8\* Commercial dry cleaning shall not be used as a means of cleaning or decontaminating ensembles and ensemble elements unless approved by the ensemble or ensemble element manufacturer.

7.1.9\* When contract cleaning or decontamination is used, the Independent Service Provider (ISP) shall demonstrate, to the organization's satisfaction, that the procedures for cleaning and decontamination do not compromise the performance of ensembles and ensemble elements.

## 7.2 Routine Cleaning.

7.2.1\* The end users shall be responsible for the routine cleaning of their issued ensemble and ensemble elements.

7.2.2 Organizations shall examine the manufacturer's label and user information for instructions on cleaning and drying that the manufacturer provided with the ensemble or ensemble element. In the absence of manufacturer's instructions or manufacturer's approval of alternative procedures for the ensemble or ensemble element, the routine cleaning and drying procedures provided in this section shall be used.

### 7.2.3 Routine Cleaning Process.

7.2.3.1\* Where possible, the contamination levels shall be evaluated and cleaning shall be initiated at the emergency scene.

7.2.3.2 Ensembles and element layers shall be isolated whenever possible to avoid cross contamination.

7.2.3.3 Any dry debris shall be brushed off.

7.2.3.4 Other debris shall be gently rinsed off with water. Heavy scrubbing or spraying with high-velocity water jets such as a power washer shall not be used.

7.2.3.5 Where necessary, a soft bristle brush shall be used to gently scrub, and the ensemble or element shall be rinsed off again.

7.2.3.6 Where necessary, elements for routine cleaning shall be cleaned in a utility sink designated for personal protective equipment (PPE) cleaning and decontamination using the following procedures:

(1)\*Heavily soiled or spotted areas shall be pre treated. Chlorine bleach, chlorinated solvents, active-ingredient cleaning agents, or solvents shall not be used without the ensemble or element manufacturer's approval.

(2)\*Water temperature shall not exceed 40°C (105°F).

(3) Mild detergents with a pH range of not less than 6.0 pH and not greater than 10.5 pH as indicated on the product MSDS or original product container shall be used.

(4)\*Protective gloves and eye/face splash protection shall be worn.

(5) Element(s) shall be gently scrubbed using a soft bristle brush.

(6) Element(s) shall be thoroughly rinsed.

(7) Element(s) shall be inspected and, where necessary, shall be rewashed or submitted for advanced cleaning procedures. The manufacturer shall be consulted if stronger cleaning agents are required.

(8) Elements shall be dried in accordance with Section 7.4.

(9) Following the routine cleaning procedure, the utility sink shall be rinsed.

#### 7.2.4 Additional Requirements for Routine Cleaning of Garment Elements.

7.2.4.1 Routine cleaning procedures for cleaning garment elements shall be used only for spot cleaning of the element and shall be performed in a utility sink.

7.2.4.2 To avoid cross contamination, garment element layers shall be isolated whenever possible.

7.2.4.3 Cleaning of the entire garment element shall be accomplished using advanced cleaning procedures.

#### 7.2.5 Additional Requirements for Routine Cleaning of Helmet Elements.

7.2.5.1 If it is necessary to totally immerse the helmet, the impact cap shall be separated from the helmet shell. Each element component shall be washed and dried separately before reassembly.

7.2.5.2 Solvents shall not be used to clean or decontaminate helmets or helmet components. The manufacturer shall be consulted if stronger cleaning agents are required.

7.2.5.3 Helmets shall not be machine dried using equipment that produces mechanical action from tumbling or agitation.

#### 7.2.6 Additional Requirements for Routine Cleaning of Glove Elements. Glove elements shall not be machine dried using equipment that produces mechanical action from tumbling or agitation.

#### 7.2.7 Additional Requirements for Routine Cleaning of Footwear Elements. Footwear elements shall not be machine dried using equipment that produces mechanical action from tumbling or agitation.

#### 7.2.8 Additional Requirements for Routine Cleaning of Proximity Fire Fighting Ensembles and Ensemble Elements. Outer shell and other radiant reflective components of proximity fire fighting protective ensembles and ensemble elements shall not be cleaned with a brush or any other abrasive cleaning devices.

7.2.9 Where routine cleaning fails to render the ensemble or ensemble element(s) sufficiently clean for service, the ensemble or ensemble element(s) shall receive advanced cleaning.

### 7.3 Advanced Cleaning and Decontamination.

7.3.1 Advanced cleaning shall be performed by a verified ISP or the organization's trained personnel.

7.3.1.1 The advanced cleaning shall be managed by a member of the organization or conducted by members of the organization who have received training in the advanced cleaning of protective ensembles and ensemble elements. The ensemble or ensemble element manufacturer and the organization shall determine the level of training required to perform advanced cleaning. The ensemble or ensemble element manufacturer shall provide written verification of training.

7.3.2\* Ensemble and ensemble elements that are soiled shall receive advanced cleaning prior to reuse.

7.3.3 Ensemble and ensemble elements that are issued and used shall receive advanced cleaning at the time of advanced inspection if not subjected to advanced cleaning in the preceding 12 months.

7.3.4 The training of the organization's personnel shall be performed by the element manufacturer or a verified ISP, who will provide written documentation of training.

7.3.5 Organizations shall examine the manufacturer's label and user information for instructions on cleaning and drying that the manufacturer provided with the element. In the absence of manufacturer's instructions or manufacturer's approval of alternative procedures for the ensemble or ensemble element, the advanced cleaning and drying procedures provided in this section shall be used.

7.3.6\* Advanced cleaning of ensembles and ensemble elements shall be conducted by machine unless specifically prohibited.

7.3.7 The following procedures shall be used for machine washing:

(1)\*The machine shall not be overloaded.

(2)\*Heavily soiled or spotted areas shall be pretreated. Chlorine bleach, chlorinated solvents, active-ingredient cleaning agents, or solvents shall not be used without the ensemble or ensemble element manufacturer's approval.

(3) All closures, including pocket closures, hooks and loops, snaps, zippers, and hooks and dees shall be fastened.

(4)\*Water temperature shall not exceed 40°C (105° F).

(5) A mild detergent with a pH range of not less than 6.0 pH and not greater than 10.5 pH as indicated on the product MSDS or original product container shall be used.

(6)\*Washing machines with the capability of drum RPM adjustment shall be adjusted so the g-force does not exceed 100 g for all elements.

(7)\*Machine manufacturer's instructions shall be followed for proper setting or program selection for the specific element being washed.

(8) The element shall be inspected and rewashed if necessary.

(9)\*Where the machine is also used to wash items other than protective ensemble elements, it shall be rinsed out by running the machine without a laundry load through a complete cycle with detergent and filled to the maximum level with water at a temperature of 49°C to 52°C (120°F to 125°F).

7.3.8 Ensembles and ensemble elements shall be dried in accordance with Section 7.4.

7.3.9 Additional Requirements for Advanced Cleaning of Garment Elements.

7.3.9.1 If the coat element has a drag rescue device (DRD) and the DRD is removable, the DRD shall be removed prior to the coat being laundered. If the DRD also requires cleaning, it shall be placed in a separate mesh bag for washing and drying.

7.3.9.2\* Where the shells and liners of protective garment elements are separable, those items shall be cleaned and decontaminated only with like items, other than as provided for in 7.3.13.

7.3.9.3 Separable liner systems shall be turned inside out so the moisture barrier is on the inside for both machine washing and machine drying.

7.3.10 Additional Requirements for Advanced Cleaning of Helmet Elements.

7.3.10.1\* Detachable items shall be removed from the helmet and shall be washed and dried separately.

7.3.10.2 Helmets shall not be machine cleaned or dried using equipment that produces mechanical action by tumbling or agitation.

7.3.11\* Additional Requirements for Advanced Cleaning of Glove Elements. Gloves shall not be machine dried using equipment that produces mechanical action by tumbling or agitation.

7.3.12\* Additional Requirements for Advanced Cleaning of Footwear Elements. Footwear shall not be machine cleaned or dried using equipment that produces mechanical action by tumbling or agitation.

7.3.13 Additional Requirements for Advanced Cleaning of Hood Elements. Hoods shall be permitted to be machine washed and machine dried with garment liners.

7.3.14 Additional Requirements for Advanced Cleaning of Proximity Fire Fighting Ensembles and Ensemble Elements.

7.3.14.1 Outer shell and other radiant reflective components of proximity fire fighting protective ensembles and ensemble elements shall not be cleaned with a brush or other abrasive cleaning devices.

7.3.14.2 Outer shell and other radiant reflective components of proximity fire fighting protective ensembles and ensemble elements shall not be machine washed.

7.3.14.3 Outer shell and other radiant reflective components of proximity fire fighting protective ensembles and ensemble elements shall not be machine dried.

7.3.15 Additional Requirements for Advanced Cleaning of Ensembles Certified to the Optional CBRN Requirements of NFPA 1971. The manufacturer shall be consulted to determine if any special handling procedures or the removal of interface components or other components must be undertaken prior to advanced cleaning.

#### 7.4 Drying Procedures.

7.4.1\* Organizations shall examine the manufacturer's label and user information for instructions on drying procedures that the manufacturer provided with the ensemble or ensemble element. In the absence of manufacturer's instructions or manufacturer's approval of alternative procedures, the drying procedures provided in this section shall be used.

7.4.2\* The following procedures shall be used for air drying:

(1)\*Place elements in an area with good ventilation.

(2)\*Do not dry in direct sunlight.

7.4.3\* The following procedures shall be used for machine drying:

(1) The recommended capacity of the machine shall not be exceeded.

(2) All closures, including pocket closures, hooks and loops, snaps, zippers, and hooks and dees shall be fastened.

(3)\*A “no heat” or “air dry” option shall be used, if available.

(4)\*In the absence of a “no heat” or “air dry” option, the basket temperature shall not exceed 40°C (105°F).

(5)\*The use of a heat cycle shall be discontinued prior to the removal of all moisture from the ensemble or ensemble elements.

(6)\*The remainder of the drying process shall be accomplished by a “no-heat” machine setting or removal of the ensemble or ensemble elements from the machine dryer to air dry.”

## **Annex A:**

### **Annex A Explanatory Material**

*“Annex A is not a part of the requirements of this NFPA document but is included for informational purposes only. This annex contains explanatory material, numbered to correspond with the applicable text paragraphs.*

**A.3.3.13.1 Advanced Cleaning.** Advanced cleaning usually requires that ensemble elements be temporarily taken out of service. Examples include hand washing, machine washing, and contract cleaning.

**A.3.3.13.3 Routine Cleaning.** Examples include brushing off dry debris, rinsing off debris with a water hose, and spot cleaning.

**A.3.3.13.4 Specialized Cleaning.** This level of cleaning involves specific procedures and specialized cleaning agents and processes.

**A.7.1.4** Organizations should consult the local hazardous materials team or health department and seek their assistance in determining what the contaminant(s) is and if the contamination is a true hazardous materials situation. Should it be determined that the contamination is not a hazardous material, advanced cleaning should be performed.

**A.7.1.4.2** Organizations should be aware that decontamination of protective equipment is a complicated process and that there is no guarantee that the protective elements will be free from contamination. While the purpose of decontamination is to remove all contaminant(s) from an ensemble element, decontamination procedures or cleaning processes are not always 100 percent effective in removing all contamination. The actual success of a decontamination process can be determined only by measuring the concentration of the contaminant(s) in the element before and after the selected decontamination or cleaning process. The majority of tests that can be applied for measuring the concentration of contaminant(s) in the element require destructive sampling of the element that may render the element unusable or nonrepairable. The sole evaluation of contamination levels in rinse water is not an appropriate measure of decontamination effectiveness. Claims for protective elements being contaminant free based on statements from ISPs or from the use of specific cleaning products should be viewed with caution.

Procedures used for measuring contamination levels should be specific for the contaminant(s), if known.

The decontamination effectiveness will vary with each contaminant because some contaminants can be removed more easily than other contaminants, given differences in the properties of the contaminant and the properties of the contaminated element materials. For example, chemicals such as hexane and benzene that evaporate easily usually will be removed relatively easily compared with nonvolatile (nonevaporating) chemicals found in tars and oily chemicals. The remaining level of contaminant in a protective element can be used to determine the potential risk to the wearer. However, there are no established safe levels of surface concentration for most contaminants. The decision to reuse a protective element based on known, measured levels of contamination should be undertaken by a trained professional familiar with the properties and hazards of the contaminant ... The procedures for measuring contamination levels in protective elements are usually destructive in that they require that a specimen be taken from the protective element and subjected to extraction or

digestion with a solvent. This requirement, in addition to the expense of the analytical testing, can make the decision to investigate contamination levels in protective elements cost prohibitive ... Concerns over protective element contamination can arise from a single incident involving a contamination event or can be an ongoing consideration as contaminants from routine situations accumulate in the ensemble element(s) ...

Further details about this information are provided in the report for the U.S. Fire Administration, "Research, Testing, and Analysis on the Decontamination of Fire Fighting Protective Clothing and Equipment." A synopsis of that report is provided in ASTM STP 1237, *Performance of Protective Clothing*.

**A.7.1.6** Members should follow universal precautions when handling cleaning and decontamination of any ensemble or ensemble element contaminated by body fluids. Universal precautions include member self-protection with the use of gloves, aprons, full torso covers, arm covers, and eye/face protection.

In addition, cleaning of contaminated ensembles and ensemble elements should take place in a designated area with sinks and counters made of materials, such as stainless steel, that can be adequately decontaminated following an element-cleaning procedure. Organizations should ensure that appropriate decontamination agents are available for member use as well as applicable procedures for each type of ensemble and ensemble element.

**A.7.1.8** Some dry cleaning solvents that are used in lieu of water can damage components of the ensembles and ensemble elements ... The manufacturer should be consulted prior to dry cleaning to confirm that ensembles and ensemble elements will not be damaged.

**A.7.1.9** For ensembles and ensemble elements that are to be cleaned or decontaminated by contract cleaning, the following questions should be asked to determine if the ISP is knowledgeable enough to provide adequate service and not cause damage to the ensembles and ensemble elements:

(1) Can the ensembles or ensemble elements be effectively cleaned or decontaminated? (*See information following this list.*)

(2) Does the ISP have references for cleaning and/or decontamination of ensembles and ensemble elements?

(3) Does the ISP have liability insurance to clean protective clothing (i.e., for the repair or replacement of ensembles and ensemble elements damaged in laundry, from wash water contamination, etc.)?

(4) Does the ISP take reasonable precautions to protect its personnel from contaminant exposures while handling ensembles and ensemble elements?

(5) Is the ISP familiar with the requirements of NFPA 1971, *Standard on Protective Ensembles for Structural Fire Fighting and Proximity Fire Fighting*, and NFPA 1581, *Standard on Fire Department Infection Control Program*, as well as federal, state, and local regulations?

(6) Does the ISP have a quality assurance program?

(7) What type of process does the ISP use? Are Material Safety Data Sheets (MSDS) available? If the process is proprietary, is it approved by the manufacturer of the ensemble or the ensemble element?

(8) Does the ISP take appropriate steps to prevent cross contamination between any and all products laundered in the facility?

(9) How does the ISP demonstrate the effectiveness of the cleaning process?

(10) What testing or evaluation method(s) are used to ensure that decontaminated ensembles or ensemble elements are truly decontaminated and safe to wear?

(11) Does the ISP comply with applicable federal, state, and local wastewater discharge regulations and standards?

(12) Does the ISP provide delivery and pick-up services for soiled and/or contaminated ensembles and ensemble elements?

(13) Does the ISP have the capability to restore water-repellent properties of ensembles and ensemble elements?

(14) What is the turnaround time?

It is important that the organization request information from the ISP or the cleaning agent supplier about the effectiveness of cleaning agents

and cleaning procedures and about the effects of the cleaning agents and cleaning procedures on ensembles and ensemble elements ... there are few established procedures for making these determinations.

Actual cleaning effectiveness should be demonstrated by washing ensembles or ensemble elements that either have become soiled from use or have been intentionally soiled. Cleaning effectiveness is typically confirmed by a visual comparison of the before and after cleaned samples. It is important to note that ensembles and ensemble elements that appear clean might not be fully clean and can contain chemical contaminants.

The effects of the cleaning agent or cleaning process should be judged on the basis of tests performed on representative material samples following several cleaning cycles (washing and drying). The samples should be subjected to at least 10 cleaning cycles; however, organizations might want suppliers or the ISP to demonstrate effects after as many as 25 cleaning cycles.

**A.7.2.1** Routine cleaning is a light cleaning of ensembles and ensemble elements performed by the end user without the elements being taken out of service. Routine cleaning can be accomplished by brushing off dry debris, rinsing off debris with a water hose, and spot cleaning.

**A.7.2.3.1** Routine cleaning immediately after the termination of an incident can remove substantial amounts of surface contaminants before they have a chance to set in and can help limit the transfer of contaminants to apparatus and stations. Many of the contaminants that can cause damage to visibility markings also can be removed if routine cleaning is done as soon as possible after an exposure to those contaminants.

**A.7.2.3.6(1)** Care must be exercised in the use of aggressive cleaning agents that contain active ingredients such as sodium percarbonate, found in oxy-type additives, and d-limonene, found in citrus-type additives and degreasers, as well as other solvents. Chlorine will damage the fibers of the protective fabrics used in ensemble elements. Use of aggressive cleaning agents must be accomplished in strict accordance with manufacturer's instructions for such chemicals, or serious damage to the elements can result. Elements that contain leather, such as footwear, helmets, and gloves, are extremely susceptible to damage from such chemicals. In addition, use of those chemicals with more absorbent element materials without extreme care taken to fully rinse out the chemical can create an

extremely hazardous condition for the member by impregnating protective elements with a flammable substance.

**A.7.2.3.6(2)** Water above 40°C (105°F) can cause scalding of the hands when washing is performed in a utility sink. Water above 40°C (105°F) can also cause damage to some components on protective ensemble element(s).

**A.7.2.3.6(4)** Appropriate precautions should be taken to provide protection from possible exposure to contaminants during the cleaning process.

**A.7.3.2** Advanced cleaning is a thorough cleaning of ensembles and ensemble elements accomplished by washing them with cleaning agents. Advanced cleaning usually requires elements to be temporarily taken out of service. Advanced cleaning can be accomplished by hand washing in a utility sink, by machine washing, or by an ISP ... Periodic cleaning is required to avoid use of ensemble elements that could be contaminated without visible evidence of soiling.

**A.7.3.6** Machine cleaning is the most effective method for cleaning ensemble elements such as coats, trousers, coveralls, and hoods. It is the most effective means of loosening and removing dirt, soot, and other debris. Two basic types of automatic washing machines are commonly available for use by end users: top-loading agitator style machines and front-loading washer/extractors ... It is generally accepted that frontloading machines are more appropriate for protective ensembles and ensemble elements, where allowed by the element manufacturer. It is very important for machine operators to ensure correct water temperatures and proper detergent and additive selection and to carefully monitor and adjust the g forces of the spinning/extraction cycle for each element type being laundered. Careful adherence to manufacturers' recommendations of cleaning processes has a significant impact on cleaning thoroughness and maintenance of protection factors inherent in each element, as well as extending the life expectancy of elements.

... it is generally accepted that front-loading machines are more appropriate for protective clothing.

**A.7.3.7(1)** For example, no more than one set of garments should be placed in a top-loading machine, and machine manufacturer's instructions should be followed for frontloading machines. Proper load size is essential for effective cleaning.

**A.7.3.7(2)** The garments should be soaked according to the detergent manufacturer's instructions. The garment should be removed and the soak water should be drained. If necessary, a soft bristle brush should be used to gently scrub the garment. Extra care should be taken with liner assemblies.

**A.7.3.7(4)** It is important to check with the manufacturer as to the appropriate wash temperature for machine washing of protective garments, because different materials and components in the garment can have different susceptibilities to wash temperatures and other washing conditions. For example, leather, rubber-coated materials, and some fluorescent film-based materials can be affected by relatively high wash temperatures and can degrade prematurely when repeatedly washed under those conditions.

**A.7.3.7(6)** Preliminary research suggests excessive *g* forces created by washing machine drums that spin at high RPMs can damage protective garments.

**A.7.3.7(7)** If the machine does not automatically have a second rinse, an additional complete cycle without detergent should be run.

**A.7.3.7(9)** When possible, organizations should provide a washing machine(s) for the sole purpose of cleaning protective ensemble elements.

**A.7.3.9.2** Ensembles and ensemble elements should be cleaned and decontaminated only with like elements, including but not limited to outer shells with outer shells, liners with liners, hoods with hoods, gloves with gloves, and boots with boots. It is highly recommended that garment liner systems be removed if possible and cleaned separately to avoid contamination with the debris found in the shell.

**A.7.3.10.1** Advanced cleaning includes washing both the inside and outside surfaces of the helmet carefully, using a soft brush to reach between components and into difficult-to access spaces, and washing the eye/face protection ... The helmet should be thoroughly washed prior to disassembly to prevent the migration of dirt and contamination.

**A.7.3.11** The thermal protective capability of leather gloves is seriously degraded when gloves are washed in any machine that develops excessive *g* forces to extract water from the materials ... Alternative commercial machine technologies are available that are suitable for

gloves but should be used only with approval of the glove manufacturer.

**A.7.3.12** Unless specifically approved by the manufacturer, footwear should not be machine laundered.

**A.7.4.2** Air drying is the most appropriate method for drying ensembles and ensemble elements. It causes no mechanical damage and little or no shrinkage. The most efficient method of air drying involves forced air ventilation. This method of drying can be achieved by simply using fans to recirculate air in the room with the ensembles and ensemble elements. The basic drying room should include floor drains, a method to exchange the air to the outside environment, and drying racks for hanging ensembles and ensemble elements to provide maximum air exposure. Overall drying time will depend on the efficiency of the drying room and the ambient conditions.

Heating the room or the inlet air up to 38°C (100°F) can further improve the efficiency of the drying process. Drying ensembles and ensemble elements in ambient air, as opposed to drying rooms, takes a considerable length of time, depending on the ambient environmental conditions.

**A.7.4.2(1)** The use of racks to provide maximum air exposure of the ensembles and ensemble elements will decrease the overall drying time.

**A.7.4.2(2)** Exposure to direct sunlight will cause degradation of fibers in protective garments, resulting in loss of fabric strength.

**A.7.4.3** Machine drying of ensembles and ensemble elements is generally not recommended.

**A.9.1.6** Soiled ensembles and ensemble elements can present a health risk to individuals who come into contact with them and need to be segregated. To prevent the spread of disease or infections through cross contamination, soiled elements should not be cleaned with other items of clothing or laundry.

**A.9.1.7** Storage in contact with hydraulic fluids, solvents, hydrocarbons, hydrocarbon vapors, or other contaminants can cause material degradation, transfer toxins to individuals, and reduce self-extinguishing properties of ensembles and ensemble elements.

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material is not the complete and official position of the NFPA on the referenced subject, which is represented only by the standard in its entirety.

## **NFPA 1852 Standard on Selection, Care, and Maintenance of Open-Circuit Self-Contained Breathing Apparatus (SCBA) <sup>47</sup>**

### **Chapter 4 “Program Component”**

#### **“4.3 SCBA Selection, Care and Maintenance Program Component.**

**4.3.3.1** The organization shall define what criteria determines when an SCBA is contaminated beyond the ability to remedy by cleaning and disinfecting in accordance with Section 6.1 of this standard.

#### **4.7 Retirement and Disposal.**

**4.7.2** Where SCBA or SCBA components are contaminated beyond the ability to be decontaminated so the SCBA or components can be returned to service, such SCBA or component shall be disposed of.

**4.7.2.1** Contaminated SCBA or components as identified according to 4.7.2 shall be segregated from other equipment and personnel and disposed of in a manner consistent with the type of contamination and any governmental regulations governing contaminated items.

### **Chapter 6 “Care”**

#### **6.1 Cleaning and Disinfecting.**

**6.1.1** The external surfaces of the SCBA shall be cleaned and disinfected according to the manufacturer’s instructions using only those agents indicated by the manufacturer.

**6.1.2** The facepiece shall be thoroughly cleaned after each use and disinfected as needed. Facepiece cleaning and disinfecting shall be performed according to the manufacturer’s instructions using only those agents indicated by the manufacturer.

**6.1.2.1** The exhalation valve shall be cleaned and flushed.

**6.1.2.2** The facepiece shall be dried, and drying shall not be done in direct sunlight or in high heat.

**6.1.3** Where the internal components have been exposed to bodily fluids, exhaled breath, dirt, or debris, the second stage regulator shall be thoroughly cleaned and disinfected. The cleaning and disinfecting

shall be performed according to the manufacturer's instructions using only those agents indicated by the manufacturer.

**6.1.4** SCBA straps and harness assemblies shall be cleaned and disinfected when required according to manufacturer's instructions. Straps and harness assembly cleaning and disinfecting shall be performed according to the manufacturer's instructions using only those agents indicated by the manufacturer.

**6.1.4.1** Under no circumstances shall a chlorine bleach ever be used to clean straps and harness assemblies.

**6.1.4.2** The straps and harness assemblies shall be dried, and drying shall not be done in direct sunlight or in high heat.

**6.1.5** SCBA cylinder valve assemblies shall be cleaned and disinfected according to the manufacturer's instructions using only those agents indicated by the manufacturer.

**6.1.7** Pneumatic component cleaning and disinfecting shall be performed according to the manufacturer's instructions using only those agents indicated by the manufacturer.

**6.1.7.1** All pneumatic components shall be thoroughly dried after cleaning.

**6.1.7.2** Drying of pneumatic components shall not be done in direct sunlight or in high heat.

**6.1.8** All other SCBA components shall be thoroughly air dried prior to storage in a compartment that does not allow for air circulation.

**6.1.9** Appropriate inspections according to 7.1.2 shall be performed after cleaning.

## **6.2 Contamination and Decontamination.**

**6.2.1** Where SCBA is suspected of being contaminated, it shall be tagged out-of-service and segregated from other equipment and personnel.

**6.2.4** In all cases, decontamination shall be conducted in accordance with the SCBA manufacturer's instructions.

**6.2.5** Where it is determined, in accordance with 4.3.3.1, that the SCBA is contaminated beyond the ability to decontaminate it and

return it to service, the SCBA shall be disposed of in accordance with 4.7.2.”

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## **NFPA 1581 Standard on Fire Department Infection Control Program** <sup>48</sup>

**8.3.7.1** Only disinfectants that are chemically compatible with the equipment to be disinfected and that meet the requirements specified in 8.2.1 shall be used.

**8.2.1** All disinfectants shall be approved by and registered as tuberculocidal with the U.S. Environmental Protection Agency (EPA).

**8.3.8** Reusable emergency medical equipment that comes in contact with mucous membranes shall require cleaning and a high-level disinfection or sterilization in accordance with the medical equipment manufacturer's instructions after each use (*see Annex C*).

### **8.4 Clothing and Personal Protective Equipment.**

**8.4.2** If a garment(s) is penetrated by blood or other potentially infectious materials, the garment(s) shall be removed immediately or as soon as feasible.

**8.4.4** Clothing that is contaminated with body fluids shall be placed in leakproof bags, sealed, and transported for cleaning or disposal.

**8.4.5.2** The cleaning of contaminated PPE, station/work uniforms, or other clothing shall not be done at home.

### **8.4.6 Structural Fire-Fighting Protective Clothing.**

**8.4.6.1\*** Structural fire-fighting protective clothing, gloves, station/work uniforms, and protective footwear shall be cleaned and dried according to the manufacturer's instructions as needed and at least every 6 months.

**8.4.6.2** Chlorine bleach or cleaning agents containing chlorine bleach shall not be used. (*See Annex C, and NFPA 1851.*)

**8.4.7** When a garment is contaminated, it shall be cleaned as soon as possible.

*Annex A is not a part of the requirements of this NFPA document but is included for informational purposes only. This annex contains explanatory material, numbered to correspond with the applicable text paragraphs.*

**A.8.4.1.1** Clean protective clothing reduces health and safety risks. Clothing should be cleaned frequently to reduce the level of, and bodily contact with, contaminants. User agencies should establish guidelines for frequency and conditions for garment cleaning. For gross contamination with products of combustion, fire debris, or body fluids, removal of contaminants by flushing with water as soon as practical is necessary, followed by appropriate cleaning.

Decontamination is sometimes impossible where personal protective clothing is contaminated with chemical, radiological, or biological agents. Where decontamination is not possible, garments should be discarded in accordance with local, state, provincial, and federal regulations.

**A.8.4.6.1** See NFPA 1851 and NFPA 1852. (*See also Annex C.*)

Some components of such garments are inherently flame resistant but lose their physical integrity on exposure to chlorine bleach. Other components actually lose their flame resistant properties and thermal insulation on exposure to chlorine bleach. In either case, the protection provided by the garment is compromised.

There are industrial cleaning products and facilities available for protective clothing that merit investigation. The manufacturer of protective clothing should be contacted for additional information. Where not explicitly outlined by the manufacturer, the following procedures are recommended for cleaning and disinfecting protective clothing:

(1) Spot cleaning — Precleaners should be used to clean light spots and stains on protective clothing. Precleaner should be squirted once or twice onto the soiled areas. The fabric should be rubbed together gently until a light foam appears on the surface and carefully rinsed off with cool water.

(2) Pretreating — Liquid detergent should be applied directly from the bottle onto the soiled areas. The fabric should be rubbed together gently until a light foam appears on the surface. The garments should be placed into the washing machine as specified in A.8.4.6.1(3), and the remaining amount of the recommended detergent should be added. To clean garments that are heavily soiled, a liquid detergent or precleaner solution should be used in the following manner prior to laundering:

(a) The garment should be air-dried before applying product.

(b) The liquid detergent or precleaner should be squirted directly onto the stain and the surrounding areas (three to four squirts). It should be made certain that the soiled area is soaked with the product.

(c) A soft-bristle brush (toothbrush or fingernail-type brush dipped in water) should be used to scrub the soiled area gently for about 1 minute.

(d) The liquid detergent or precleaner should be reapplied to the soiled areas again (one or two squirts).

(e) The garment should be placed into the washing machine as described in A.8.4.6.1(3).

(3) Washing instructions — Protective clothing should be washed separately from other garments. All hooks and eyes should be fastened, and the garment should be turned inside out or placed in a large laundry bag that is tied shut to avoid damage to the washtub. A stainless steel tub should be utilized if available.

The following instructions should be used for cleaning any of the following wash loads in a large capacity [60 L (16 gal)] top-loading or front-loading washing machine:

- (a) One protective coat and one protective trouser
- (b) Two protective coats
- (c) Two protective trousers

Prior to washing, heavily soiled garments should be pretreated using the procedures outlined in A.8.4.6.1(2). Detailed washing instructions are as follows:

(a) While the washing machine is filling with hot water [49°C to 55°C (120°F to 130°F)], one-half cup [120 mL (4 oz)] of liquid oxygenated bleach (chlorine bleach should not be used) and one cup [240 mL (8 oz)] of liquid detergent should be added. These products are readily available in supermarkets.

(b) The washing machine should be filled to the highest water level.

(c) The garments to be washed should be added.

(d) The washing machine should be set for normal cycle, cotton/white, or similar setting.

(e) The machine should be programmed for double rinse. If the machine does not automatically double rinse, a complete second cycle should be run without adding detergent or oxygenated bleach. Double rinsing helps remove any residual dirt and ensures detergent removal.

(f) The garments should be removed from the washing machine and dried by hanging in a shaded area that receives good cross-ventilation, or they should be hung on a line and a fan should be used to circulate the air. A water extractor can be used.

(4) Laundering and cleaning products — Some examples of products that are permitted to be utilized for cleaning, spot cleaning, and pretreating include the following:

(a) Spot cleaning and pretreating: Liquid Spray and Wash®, Liquid Tide®,  
Liquid Shout®

(b) Cleaning: Liquid Wisk®, Liquid Cheer®, Liquid Tide®, Liquid Fab®

(c) Oxygenated bleaching: Liquid Clorox 2®, Liquid Vivid®

**WARNING: DO NOT USE CHLORINE BLEACH ON FIRE FIGHTER PROTECTIVE CLOTHING**

## **Annex C Disinfection and Sterilization Methods**

*This annex is not a part of the requirements of this NFPA document but is included for informational purposes only.*

### **C.7 Housekeeping.**

Employers should ensure that the worksite is maintained in a neat condition, free of any contamination. The employer should determine and implement an appropriate written schedule for cleaning and decontamination. The method of decontamination should be based on location within the facility, type of surface to be cleaned, type of contamination, and tasks or procedures to be performed, such as the following:

(1) PPE and other clothing should be cleaned or laundered, or both.

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**NFPA: National Fire Codes, Volume 13 (NFPA 1994: Protective Ensembles for Chemical/Biological Terrorism Incidents-2007) <sup>49</sup>**

“8.2.5.9 Decontamination and Doffing.

8.2.5.9.1 ... all exposed ensemble surfaces, including such items as the respirator, boots, gloves, and helmets, shall be washed with a strong soap solution. If the garment is designed for wet decontamination, it shall be washed with the soap solution as well.”

**National Safety Council (NSC)**

**Fundamentals of Industrial Hygiene, Chapter 18: Methods of Control <sup>50</sup>**

“The difficulty involved in decontaminating protective clothing and the endurance of the material may dictate whether disposable or reusable clothing is selected. The relative cost of replacement and decontamination depend on the garment and the hazard. Limited-use/disposable chemical-protective clothing can be provided to minimize employee exposure to hazardous chemicals and at a reasonable cost.”

“Workers should be informed of the necessity of good housekeeping and maintenance.”

**Equipment Manufacturers**

**Dupont: Nomex Aramid Fiber Laundering Guide <sup>51</sup>**

Dupont provides a guide for the laundering of their products manufactured with NOMEX aramid fiber fire protective equipment. This guide outlines how the end user can have their gear laundered commercially, home laundered, or dry cleaned with the proper steps specifically outlined including wash temperatures and tumble drying. Appendices are also included which details a list of available laundering products such as detergents, spot removers, oil repellants, use of chlorine bleach, fabric softeners, and anti-static sprays.

Dupont also suggests separate wash procedures for both “Lightly Soiled Garments” and “Heavily Soiled Garments”.

**Globe <sup>52</sup>**

## “Basic Care & Cleaning

Recently there has been a greater awareness among emergency responders for the need to have protective clothing laundered regularly. Simply put, clean protective clothing reduces the potential for health and safety risks. Although the Globe label on every garment provides basic information for laundering, the following is a much more comprehensive set of instructions for cleaning gear.

### Guidelines

- Detachable liners should be removed from the shell and laundered separately.
- All closures should be fastened: Velcro® hook tape covering Velcro® loop tape, hooks and dees fastened, zippers zipped and snap's closed. It is imperative that you cover the hook portion of all hook and loop to prevent snagging during laundering.
- We recommend a front loading washing machine, which does not have an agitator, and preferably one that is designated specifically for cleaning turnouts. A stainless steel tub should be utilized if available.
- We suggest using a laundry bag to protect the inside of the washing machine from the hardware (and to protect the hardware from the agitator of a washing machine when using a top load model).

**Machine Washing:** The special fabrics that make up your Globe Fr protective clothing contain inherent flame and heat resistance properties, which cannot be washed off or worn out. However, given the nature of the contaminants to which fire fighters are exposed, we recommend that you never, never, use the same machine that you do your home laundry in. When machine washing, always prepare the clothing as directed, by fastening all closure systems. Use warm water, a normal cycle, and a machine setting of 100 rpm's or less. Following each complete wash cycle, thoroughly rinse your garments; we recommend a double rinse with clear water.

Protective clothing should always be washed separately in a laundry bag; do not overload the washing machine, do not use softeners, and NEVER use chlorine bleach. it is important that the water temperature not exceed 105°F. We do not suggest machine drying; our recommendation is to hang in a shaded area that receives good cross ventilation or hang on a line and use a fan to circulate the air.

**Cleaning Agents:** Cleansers generally fall into two categories, detergents and soaps. Of the two, detergents make the best cleansers because they are formulated to contain special agents that help prevent redeposition of soil. Soil redeposition is soil which is first removed from a laundered

article, but later in the same wash cycle is redeposited as a thin soil film on the entire surface of the article. All cleaning agents are clearly labeled as being either detergents or soaps; and we recommend using liquid detergents, since they are less likely to leave any residue on the clothing. One example of a well known liquid detergent would be Tide®. Finally, it is important that the cleaning solution have a pH range of not less than 6.0 pH and not greater than 10.5 pH.

**Spot Cleaning and Pretreating:** Precleaners can be used to clean light spots and stains on protective clothing. Squirt the precleaner onto the soiled area and gently rub fabric together until a light foam appears on the surface; this foam should be completely rinsed off with cool water prior to washing. A soft bristle brush, such as a toothbrush, may be used to gently scrub the soiled area for approximately one to one and a half minutes. An alternative method would be to pretreat the garment by applying liquid detergent directly from the bottle onto the soiled area and proceed as with precleaners. Any spot cleaning or pretreating should be followed by machine washing prior to field use.

**Special Cleaning Compounds:** Since Globe is in the business of producing protective clothing and not cleaning agents, we are not able to "endorse" any of the special compounds that are being advertised for the fire service...

**Dry Cleaning:** the protective qualities of your Globe turnout clothing will not be adversely affected by dry cleaning. However, some dry cleaning methods can cause deterioration to the trim and is therefore not recommended.

**Bleach:** One of the most often asked questions concerns the decontamination of a turnout system, especially with chlorine bleach. UNDER NO CIRCUMSTANCES should chlorine bleach be used on fire fighters' clothing; most systems contain KEVLAR® fiber, which is completely destroyed by exposure to bleach. if it is absolutely essential that a bleach be used, we recommend 1/2 cup of liquid oxygenated bleach to one cup of detergent.

**Decontamination:** For extreme contamination with products of combustion, fire debris or body fluids, removal of the contaminants by flushing with water as soon as possible is necessary, followed by appropriate cleaning. in the case of blood born pathogens, recommended decontamination procedures include using a .5 to 1% concentration of IYSOL®, or a 3-6% concentration of stabilized hydrogen peroxide. liquid glutaraldehyde, available through commercial sources, will also provide high to intermediate levels of disinfectant activity. Decontamination may not be possible when protective clothing is contaminated with chemical or

biological agents. When decontamination is not possible, the garments should be discarded in accordance with local, state and federal regulations. Garments that are discarded should be destroyed.

**Hand Washing:** Hand washing was once thought to be the least abrasive method of laundering, and allowed the user to pay special attention to those areas that required it. The industry now recognizes that hand washing is generally not able to remove the ground-in soil embedded in the material fibers and usually only serves to remove surface dirt. However, in the event that you do not have access to a washing machine and must hand wash your garment, remove your liner system and lay the outer shell on a nonabrasive hard surface. Using a soft bristle scrub brush and a detergent (not soap), clean your garment by making circular motions with the brush, forming progressively larger circles until the entire surface has been washed. You must then rinse the shell, using clear water, to insure that all of the detergent has been removed. We recommend that you rinse the entire garment several times to avoid any possibility of soil detergent residue.

**Outside Cleaning Assistance:** ... We are aware of several outside agencies who specialize in the cleaning of turnout clothing ... we obviously cannot endorse or authorize any one of these services ... and we encourage our customers to contact any of these outside cleaning facilities to determine if they are able to meet the fire department needs. “

## **Fire and Emergency Manufacturers and Services Association (FEMSA)**

### **Protective Helmets for Structural Fire Fighting. Official User Information Guide <sup>53</sup>**

#### Decontamination

“Warning: If your protective ensemble is contaminated, you must follow procedures mandated by federal, state, and local law for handling and/or decontaminating your protective elements. Failure to do so may increase your risk of death, injuries, illnesses and diseases!”

## **Lab Safety Supply (Industrial and Safety Equipment Supplier)**

“Q. Can I decontaminate and reuse gloves?”

A. Decontaminating gloves is possible, but generally not practical. The decontamination procedures would probably cost more than replacing the gloves, so glove manufacturers do not recommend it. Gloves are a limited-use item that need replacement after time and chemical exposures.”

## **MSA (Mine Safety Appliance Company)**

### **MSA (Advantage 420 Half-Mask Respirator)**

#### “CLEANING AND DISINFECTING

Remove and discard cartridges before cleaning the facepiece. Clean and disinfect after every use with MSA non-sudsing Confidence Plus® Cleaner (P/N 10009971). Rinse thoroughly in plain warm water (never exceed 110°F to avoid overheating and distortion of parts) and then air dry. ANSI suggests that users should be trained in the cleaning procedure.”

### **MSA (Advantage 4000 Full Facepiece Respirator)**

“DO NOT use alcohol as a germicide because it may deteriorate rubber parts.

Depending on the cleaning policy adopted, either a designated person or the user should clean the respirator after each use. Non-sudsing Confidence Plus® Cleaning Solution (P/N 10009971) from MSA is recommended ... A solution as effective as Confidence Plus Cleaning Solution and compatible with MSA respirator components may be substituted. ANSI suggests that users be trained in the cleaning procedure.

Be careful not to inhale or touch the contaminant in handling the respirator or its parts. If necessary, use equipment disposal to protect you from the specific contaminant. Failure to follow this warning can result in serious personal injury or death.

#### 1. Preparing Solution

b. If the Confidence Plus Cleaning Solution is not used, wash in a mild cleaning solution, rinse thoroughly, and submerge in a germicide solution for the manufacturer's recommended time.

#### 2. Clean and Disinfect the Facepiece

a. Remove the canister/cartridge(s) from the facepiece.

b. Thoroughly wash the facepiece (and nose cup) in the cleaning solution. A soft brush or sponge can be used to clean the soiled facepiece. Be sure to include cleaning the exhalation valve and seat.

c. Rinse the facepiece and components in clean, warm (110°F), water (preferably running and drained). If not rinsed thoroughly, cleaning agent residue may irritate the wearer's skin.

d. Allow the facepiece to air dry, face up. Do not dry the parts by placing them near a heater or in direct sunlight. The rubber will deteriorate.

e. Operate the exhalation valve by hand to be sure it works properly.

f. Harness (straps and buckles)

g. The facepiece and components should be air-dried or hand-dried with a clean lint-free cloth.

DO NOT force-dry the parts by placing them in a heater or in direct sunlight. The rubber will deteriorate. “

### **MSA (Confidence Plus Germicidal Cleaner)**

“MSA’s Confidence Plus Germicidal Cleaner ... Just mix 1 oz. of the cleaner with 1 gallon of warm water (110\_ F maximum) for a clear, stable solution for cleaning, sanitizing, and disinfecting hard nonporous surfaces of personal safety equipment.

- Makes 32 gallons of disinfectant
- Includes built-in measuring cup for easy mixing
- Use on hard hats, faceshields, goggles, spectacles, protective headgear, hearing protectors, gas masks, SCBA

Note: Follow the use instructions provided with the safety equipment to avoid damaging the equipment. Surfaces should be rinsed in clean water and air-dried prior to reuse. Cleanup is fast. Just remove the cap from the measuring cup and squeeze the container until the measuring cup is filled with cleaner. Mix with warm water. Immerse the soiled item in the solution and scrub gently with a soft brush until clean. Rinse thoroughly in clean water and allow to dry. Contact time necessary for use as a disinfectant is 10 minutes.”

### **MSA: Fire Helmet Owner’s Guide (CairnsHELMETS) <sup>54</sup>**

#### **“Cleaning**

- Clean the helmet after each use, but before inspection using procedures described.
- NEVER use a helmet that is wet from use or cleaning. Allow all parts to dry before use.
- Remove from service any helmet that has been exposed to chemical or biological contaminants. Consult MSA for decontamination or disposal procedures.

**Clean helmet before inspection following the specified procedures. Failure to follow these cleaning procedures may reduce helmet performance and result in serious personal injury, disease, or death.**

### **Faceshield, Goggles, or Defender Lens**

To clean the faceshield, goggles, or Defender Lens use mild cleaning agents such as ethyl alcohol or a mild detergent and water, and a soft sponge or cloth. NEVER use abrasives, solvents paint removers, acetone, paint or lacquer thinner, or any chlorinated organic solvents. Removal of light scratching and smoke stains to faceshields can be achieved through the use of MSA CairnsHELMETS Scratch Remover & Polish (# R1).

### **Bourkes [Models 880, 1000, 1010, 1044, N5A, N6A]:**

To clean BOURKES, use a mild detergent and water, and a soft sponge or cloth. NEVER use abrasives, solvents paint removers, acetone, paint thinner, lacquer thinner, or any chlorinated organic solvents. Removal of light scratching and smoke stains to Bourkes can be achieved through the use of MSA CairnsHELMETS Scratch Remover & Polish (# R1).

### **Defender Lens**

#### 1. Removing the Defender Lens from the helmet:

- a. Turn the helmet upside down.
- b. Move the lens to the full down position (as worn).
- c. Squeeze the quick-connect locking arms together and pull up.

#### 2. Cleaning the Defender Lens

- a. Use a mild detergent diluted in water and a soft sponge or cloth.
- b. Never use abrasives, solvents, paint removers, acetone, paint thinner, lacquer thinner, or any chlorinated organic solvents.

Removal of light scratching and smoke stains can be achieved through the use of MSA CairnsHELMETS Scratch Remover and Polish (#R1).

### 3. Reinstalling the Defender Lens

- a. Slide each quick-connect down into each slot from where it was removed. The quick-connects will “click” into place when fully engaged.

## **Helmet Shell – Remove Faceshield/Goggles/Bourkes/Defender Lens before cleaning**

### 1. Thermoplastic Shell [Models 360R, 360R-13, 360S, 660 Phoenix, and 880]:

- a. To clean, use mild cleaning agents such as ethyl alcohol or a mild detergent and water, and a soft sponge or cloth. NEVER use abrasives, solvents paint removers, acetone, paint or lacquer thinner, or any chlorinated organic solvents. Removal of light scratching and smoke stains to thermo-plastic helmets can be achieved through the use of MSA CairnsHELMETS Scratch Remover & Polish (# R1).

### 2. Fiberglass/Kevlar Composite Shell [Models 660C Metro, 660CE, 664, 990, 990E, 1000, 1010, 1044, HP3, 515, 515E]:

- a. To clean, use only mild solvents, such as ethyl alcohol, mild detergents and water, mild abrasives, industrial cleaners (such as DuPont® Tar Remover), acetone, or paint remover.

### 3. Leather Shell [Models N5A and N6A]:

- a. To clean, use only mild detergents and lukewarm water. To remove dripping of tar, industrial cleaners (such as DuPont® Tar Remover) can be used. Use only on tar spots, not the entire surface. Other spots can be cleaned with alcohol if an organic solvent is required. Markings or touch-ups can be done with a good quality enamel.

### 4. Flannel Headband Liners and Defender Lens heatshield [All Models except N5A and N6A]:

- a. To clean flannel headband liners, machine wash and dry on low settings.”

### **North (Safety Glasses & Faceshields FAQs)**

“Users should also clean their glasses regularly with cleaning wipes or cleaning solution intended for that purpose. North offers several options for lens cleaning.

Never clean lenses dry. This can cause plastic polycarbonate lenses to scratch. If lens cleaning wipes or lens cleaning solution is not readily available, the lenses should be cleaned with mild soap and water and patted dry with a soft lint free cloth. Do not use window cleaning solutions. Such cleaners contain harsh chemicals that can severely damage polycarbonate lenses.

### **North (Hard Hats)**

... we suggest that the hat and suspension are cleaned at the end of each working day and that the dust, dirt and moisture are removed. The washing and cleaning should be done with light soap and water only.

Q. How do I clean my North/Fibre Metal hard hat?

A. Clean with warm soapy water and a soft cloth. Do not clean with solvents or any cleaner not approved by the manufacturer.

### **North (Gloves) SilverShield/4H specific glove**

Q. Why should I use these gloves when I can wash out the gloves that I use now?

A. Chemicals that permeate gloves cannot be washed out. Silver Shield/4H® gloves are disposable and once contaminated, they can be discarded after use.

### **North (Gloves)**

Q: Where can I get gloves sterilized for clean room environments?

A: ... Gloves can be sterilized using one of three different methods. These methods are steam exposure, ethylene oxide exposure or irradiation. Companies are available that can provide this service.

### **North (Hearing Protectors)**

Q. We work in a dusty, dirty place. Should I worry that our ears will get infected by using earplugs?

A. Using earplugs will not cause an infection. But use common sense. Have clean hands when using earplugs that need to be rolled or formed with your fingers in order for you to insert them. If this is inconvenient, there are plenty of earplugs that are pre-molded or that have stems so that you can insert them without having to touch the part that goes into the ear canal.”

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