



PERSONAL PROTECTIVE EQUIPMENT FOR CHEMICAL EXPOSURES

Overview

Use of an appropriate ensemble of personal protective equipment (PPE) may be necessary to protect against potential chemical exposures. In all cases, PPE is a supplement to and not a substitute for feasible engineering and administrative controls. Components selected for an adequate ensemble of PPE vary with the nature of the contaminant, route(s) of exposure, and contaminant concentration. General classes of PPE, with specific examples, are discussed below. Recommendations specific to laboratory operations are provided at the end of this document. EHS is available to provide guidance on selection of specific PPE.

Ensemble Components

- **Respirators** - When engineering controls are not sufficient to reduce the concentration of air contaminants below an acceptable level, respirators may be required. Many types of respirators are available, ranging from filtering face pieces (dust masks) to full face respirators. The appropriate type of respirator depends on the concentration of contaminants, as well as the form of contaminants (e.g., dusts, mists, fumes, etc.). Persons who intend to use a respirator must contact EHS to enroll in UNL's Respiratory Protection Program (RPP) prior to using a respirator.
- **Eye and Face Protection** - Protective eyewear or eyewear/faceshield combination may be needed to protect against projectiles, airborne particles, thermal burns, chemical splashes, vapors, or mists, dusts, or radiant energy. See the EHS SOP, ***Personal Protective Equipment - Eyes and Face***.
- **Hand Protection** – Gloves provide protection for the hands from many types of hazards, including chemical absorption. Like other classes of PPE, many types of gloves are available, varying in materials of construction and thickness. All glove manufacturers provide glove permeability and degradation data that will assist in selecting the proper glove based on specific chemical and conditions of use. In general:
 - Butyl rubber gloves protect against a wide variety of chemicals such as peroxides, acids, bases, alcohols, aldehydes, ketones, esters, and nitro compounds. They resist oxidation, ozone corrosion and abrasion, and remain flexible at low

temperatures. However, butyl rubber does not perform well with aliphatic and aromatic hydrocarbons and halogenated solvents.

- Natural (latex) rubber gloves are usually fairly thin and provide a low barrier protection against incidental contact with water solutions of acids, alkalis, salts and ketones. They are very elastic and are resistant to abrasion. Some people are prone to development of latex allergies.
- Neoprene gloves are usually of similar texture and appearance to latex gloves. Like latex, thin neoprene gloves offer comfort, dexterity, and resistance to tears and abrasions. Thin neoprene gloves, while generally more resistant than latex, provide a low barrier protection against incidental contact with hydraulic fluids, gasoline, alcohols, organic acids, and alkalis.
- Nitrile gloves are usually of similar texture and appearance to latex or neoprene gloves. Like latex and neoprene, thin nitrile gloves offer comfort, dexterity, and resistance to tears and abrasions. They are made of a copolymer and provide protection from chlorinated solvents such as trichloroethylene and perchloroethylene, as well as oils, greases, acids, caustics, and alcohols, but are generally not recommended for use with strong oxidizing agents, aromatic solvents, ketones, and acetates.

For additional information see EHS SOP, ***Personal Protective Equipment – Hand Protection***.

- **Body Protection** – Protective body apparel may be required when there is potential for accidental contact through spills or splashes. To be effective in high-risk splash hazard situations, body apparel should fully cover the torso, arms and legs. Material of construction varies with type of garment selected. Cotton, flame-retardant laboratory smocks or coats provide protection in low hazard situations. More sophisticated apparel, such as Tyvek coveralls, may be necessary when working with large quantities or highly dangerous chemicals.

For additional information see EHS SOP, ***Personal Protective Equipment –Body Protection***.

- **Foot Protection** – Protective footwear should be selected based on the degree of hazard. Street shoes are generally sufficient to provide protection in low-hazard operations. Bare feet, sandals, and open-toed shoes are ***not permitted*** when there is risk of chemical exposure. Shoe covers provide protection in medium-hazard operations (e.g., contact with chemicals is likely but risk of splash is low). Selection of the material of construction for shoe covers is very important. Like gloves, the material of construction and thickness determines the level of protection of the shoe cover.

Formed boots provide the highest level of protection and are designed for operations with significant potential for contact with chemicals. Formed boots may also be necessary for medium-hazard activities that are not compatible with shoe covers because of the likelihood of damage to the shoe cover (e.g., outdoors, abrasive floor coverings, etc.) and for activities that require good traction (e.g., slippery surfaces).

For additional information see EHS SOP, ***Personal Protective Equipment –Foot Protection Evaluation and Checklist***.

- **Hearing Protection** – Persons using chemicals that could explode or noisy equipment should use hearing protectors. Consult EHS for hearing protector evaluation/hazard assessment.

Other Considerations

- All types of PPE have limitations and are only effective when in good condition and are of suitable fit to the user. Ensure that selected PPE:
 - Is clean and ready to use.
 - Is appropriate for the task at hand.
 - Has sufficient resistance rating for the chemical(s) used.
 - Is routinely inspected for damage and is repaired or replaced as necessary.
 - Is stored in a clean area that is protected from excessive light, cold, and heat when not in use.
- Minimize potential exposures through administrative or engineering controls. For example, avoid the need for respiratory protection by working in a chemical fume hood or other appropriate local exhaust ventilation; avoid the need for immersing hands in chemical baths by using retrieval tongs or removable baskets, etc.
- Use of disposable PPE is preferred if it is difficult to predict the remaining resistivity of PPE, such as gloves.

Care, Use, & Maintenance

- Users must be trained in proper procedures for putting on, removing, and caring for the PPE that they are assigned to wear. They must also be trained in the limitations of specific PPE, and the process for obtaining replacement PPE. General PPE training is available on the EHS web site (Web Based Training Section). Supervisors must ensure that specific PPE training is provided.
- PPE must be used and maintained in a sanitary and reliable condition.



- Protective clothing should be inspected before each use to ensure the absence of tears, punctures, loose seams, deterioration/ de-lamination, stiffening, or other conditions that may impact performance.
- Store PPE in a clean, dry, and climate-controlled environment, away from sunlight and potential contaminants (chemical vapors, dusts, etc.). Observe all additional recommendations provided by the manufacturer. The effectiveness of PPE is dependent on proper fit and donning procedures. In the case of respirators, users must be fit-tested by EHS on an annual basis. Users should use the proper size of outer garments, gloves, and footwear.

Cleaning/Disposal

- Disposable PPE that is contaminated with chemicals may be regulated under hazardous waste regulations. Consult EHS to determine whether it is necessary to bag and tag PPE for collection by EHS, based on specific chemical contaminants.
- Reusable PPE should be laundered separately from general laundry and not taken home for laundering.

Recommendations Specific to Laboratory Operations

The following recommendations apply to laboratories where open containers of hazardous chemicals, radioactive materials, or risk group 2 biological agents are manipulated.

Standard Lab Attire

Standard lab attire shall consist of the following:

- Pants or skirts that cover the entire leg to the ankle (no cropped pants, shorts, etc.) unless an additional protective garment (e.g., coveralls, lab coat) fully covers exposed skin (e.g., coveralls)
- Closed-toed shoes that cover the top of the feet (e.g., not of a slipper type that exposes the top of the foot) and are resistant to rapid penetration by spilled liquids or sharps.
 - Footwear topped with mesh or incorporating slits or holes (e.g., CROCs) is not recommended.
 - Leather or synthetic leather construction is preferred.
- Work shirt that covers the upper torso.

If the laboratory work involves use of flammable solvents or other conditions that could result in fire, clothing worn in the lab should be constructed of natural fibers (wool, cotton, jut, flax, hemp, cashmere, silk, mohair, etc.). Clothing constructed of synthetic fibers (nylon, polyester, polypropylene, acrylic, etc.) is often highly flammable and will melt to the skin.

Laboratory PPE

Standard minimal laboratory PPE consists of the following:

- Protective long-sleeved outer garment, typically a laboratory coat. Gowns and coveralls are acceptable alternatives. The lab coat/outer garment should be constructed of flame-retardant material if there is risk of fire.
 - Ribbed cuffs are preferred
- Safety spectacles with side shields, unless handling a chemical that can cause irreversible eye damage, in which case goggles are required.
 - Must conform to ANSI Z-87
- Protective gloves
 - Examination gloves are appropriate for lab activities where only incidental contact with minute amounts of chemical is expected and the chemical is not highly toxic.
 - In situations other than that described above, selected glove material and construction based on hazard and chemical resistance, as applicable.
- Other PPE may be appropriate based on specific laboratory task hazards. Examples include: face shields, chemically resistant aprons and sleeves, hearing protectors, respirators, etc.
 - A face shield is supplemental to goggles and is required under the following conditions:
 - Risk of burns from contact with hot liquids, steam, or cryogenes.
 - Risk of cuts and abrasions from flying projectiles.
 - Risk of injury from failure of a pressurized system.
 - Risk of injury from splash of chemicals that cause serious skin damage or are toxic by skin absorption.
 - Chemically-resistant apron and sleeves are appropriate when there is significant splash hazard while handling corrosives and chemicals that are toxic by skin absorption.
 - Consult EHS for a noise exposure evaluation if you suspect that the noise level in your work area is a hazard to your hearing. A useful rule of thumb is whether you can easily communicate with another person at a three-foot distance. If not, then the noise level may exceed a safe level. Hearing protection is also recommended when there is a risk of chemical explosion.
 - Consult EHS with any questions regarding PPE or appropriate clothing in the lab.

Lab Coats – Proper Use and Care

- Coats must be of the appropriate size to the wearer.
- Coats must be fastened closed with buttons or snaps while being worn. Sleeves must extend to the wrist. Sleeves are not to be rolled up to expose the arm.
- If a hazardous material is splashed on a lab coat, immediately remove the coat, bag it in a heavy plastic bag, and exchange it for a clean coat. If street clothes are contaminated with corrosives or materials toxic by skin absorption, remove the street clothes and immediately wash the affected area(s). Report the incident to your supervisor.
- Laboratory coats used in the laboratory are to be stored in the laboratory when not in use, and are not to be stored in “clean” areas (e.g., offices, break rooms, hallways, etc.)

Gloves – Proper Use and Care

- Disposable gloves are not to be reused.



- Reusable gloves are to be reused only if thoroughly washed immediately after each use and inspected for integrity prior to each use.
- Reusable gloves should be changed when suspected or known to be contaminated with chemical residues.
- For disposable gloves, nitrile is preferred over latex since latex can cause allergic responses in some people.
- Gloves must be of the appropriate size to the wearer.
- Hands should be thoroughly washed immediately after removing chemical-protective gloves.
- Gloves should be removed before entering clean areas and touching clean items.