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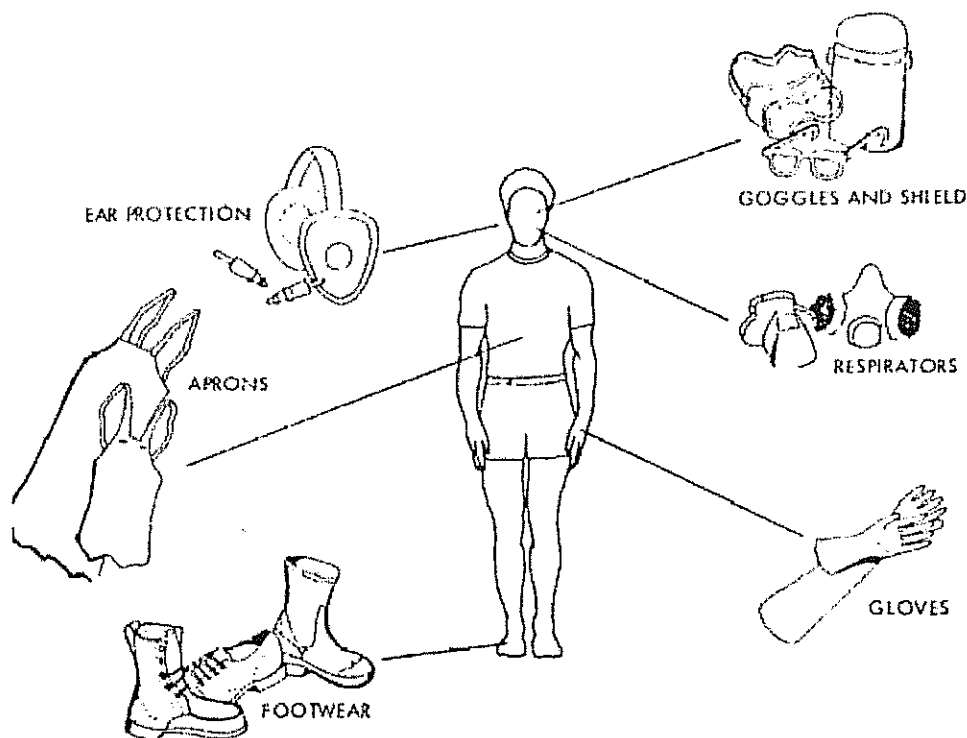
Lab Safety Training Guide

**SECTION 3: Personal Protective Equipment**

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Personal protective equipment (PPE) is special gear used to protect the wearer from specific hazards of a hazardous substance. It is a last resort protection system, to be used when substitution or engineering controls are not feasible. It should be understood that PPE does not reduce or eliminate the hazard. It only protects the wearer and does nothing for anybody else in the area or for any equipment exposed to the chemical.



PPE includes gloves, respiratory protection, eye protection, and protective clothing. The need for PPE is dependent upon the type of operations and the nature and quantity of the materials in use, and must be assessed on a case by case basis. Workers who rely on PPE must understand the functioning, proper use, and limitations of the PPE used.

[Gloves](#)(top)

### **Glove Selection And Use**

Choosing the appropriate hand protection can be a challenge in a laboratory setting. Considering the fact that dermatitis or inflammation of the skin accounts for 40-45% of all work-related diseases, selecting the right glove for the job is important.

Not only can many chemicals cause skin irritation or burns, but absorption through the skin can be a significant route of exposure to certain chemicals. Dimethyl sulfoxide (DMSO), nitrobenzene, and many other organic solvents are examples of chemicals that can be readily absorbed through the skin into the bloodstream, where the chemical may cause harmful effects.

### **When Should Gloves Be Worn**

Protective gloves should be worn when handling hazardous materials, chemicals of unknown toxicity, corrosive materials, rough or sharp-edged objects, and very hot or very cold materials. When handling chemicals in a laboratory, disposable latex, vinyl or nitrile examination gloves are usually appropriate for most circumstances. These gloves will offer protection from incidental splashes or contact.



When working with chemicals with high acute toxicity, working with corrosives in high concentrations, handling chemicals for extended periods of time or immersing all or part of a hand into a chemical, the appropriate glove material should be selected, based on chemical compatibility.

### **Selecting the Appropriate Glove Material**

When selecting the appropriate glove, the following characteristics should be considered:

- degradation rating
- breakthrough time
- permeation rate

*Degradation* is the change in one or more of the physical properties of a glove caused by contact with a chemical. Degradation typically appears as hardening, stiffening, swelling, shrinking or cracking of the glove. Degradation ratings indicate how well a glove will hold up when exposed to a chemical. When looking at a chemical compatibility chart, degradation is usually reported as E (excellent), G (good), F (fair), P (poor), NR (not recommended) or NT (not tested).

*Breakthrough time* is the elapsed time between the initial contact of the test chemical on the surface of the glove and the analytical detection of the chemical on the inside of the glove.

*Permeation rate* is the rate at which the test chemical passes through the glove material once breakthrough has occurred and equilibrium is reached. Permeation involves absorption of the chemical on the surface of the glove, diffusion through the glove, and desorption of the chemical on the inside of the glove. Permeation rate is usually reported as E (excellent), G (good), F (fair), P (poor) or NR (not recommended). If chemical breakthrough does not occur, then permeation rate is not measured and is reported ND (none detected).

Manufacturers stress that permeation and degradation tests are done under laboratory test conditions, which can vary significantly from actual end-use conditions. Users may opt to conduct their own tests, particularly when working with highly toxic materials.

For mixtures, it is recommended that the glove material be selected based on the shortest breakthrough time.

*The following table includes major glove types and their general uses. This list is not exhaustive.*

Glove Material	General Uses
Butyl	Offers the highest resistance to permeation by most gases and water vapor. Especially suitable for use with esters and ketones. Poor for aliphatic, aromatic hydrocarbons, halogenated hydrocarbons, and gasoline.
Neoprene	Good for acids and bases, peroxides, fuels, hydrocarbons, alcohols, phenols. Poor for halogenated and aromatic hydrocarbons
Nitrile	Excellent general duty glove. Provides protection from a wide variety of solvents, oils, petroleum products, and some corrosives. Excellent resistance to cuts, snags, punctures, and abrasions
PVC	Provides excellent abrasion resistance and protection from most fats, acids, and petroleum hydrocarbons. Poor for most organics.
PVA	Highly impermeable to gases. Excellent protection from aromatic and chlorinated solvents. Cannot be used in water or water-based solutions.
Viton	Exceptional resistance to chlorinated and aromatic solvents. Good resistance to cuts and abrasions.
Silver Shield	Resists a wide variety of toxic and hazardous chemicals. Provides the highest level of overall chemical resistance.
4H	Same as Silver Shield, but offers better dexterity.

Natural (Latex) rubber	Good for very dilute acids and bases. Poor for organics.
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### Where to Find Compatibility Information

Most glove manufacturers have chemical compatibility charts available for their gloves. These charts may be found in laboratory supply catalogs such as [Fisher Scientific](#) and [Lab Safety Supply](#). [Best Gloves](#) offers copies of their glove compatibility charts upon request. To obtain a copy, call them directly at 800-241-0323. Best Gloves also offers an excellent on-line database for glove selection at [www.bestglove.com](http://www.bestglove.com).

Most material safety data sheets (MSDS) recommend the most protective glove material in their Protective Equipment section. There are MSDSs for many laboratory chemicals available on the web through the [EHS home page](#).

EHS also has a computer program with glove compatibility information for hundreds of chemicals. Contact EHS at 258-5294 for more information.

### Other Considerations

There are several factors besides glove material to consider when selecting the appropriate glove. The amount of *dexterity* needed to perform a particular manipulation must be weighed against the glove material recommended for maximum chemical resistance. In some cases, particularly when working with delicate objects where fine dexterity is crucial, a bulky glove may actually be more of a hazard.

Where fine dexterity is needed, consider double gloving with a less compatible material, immediately removing and replacing the outer glove if there are any signs of contamination. . In some cases, such as when wearing Silver Shield gloves, it may be possible to wear a tight-fitting glove over the loose glove to increase the overall dexterity.

Glove thickness, usually measured in mils or gauge, is another consideration. A 10-gauge glove is equivalent to 10 mils or 0.01 inches. Thinner, lighter gloves offer better touch sensitivity and flexibility, but may provide shorter breakthrough times. Generally, doubling the thickness of the glove quadruples the breakthrough time.

Glove *length* should be chosen based on the depth to which the arm will be immersed or where chemical splash is likely. Gloves longer than 14 inches provide extra protection against splash or immersion.

Glove *size* may also be important. One size does not fit all. Gloves which are too tight tend to cause fatigue, while gloves which are too loose will have loose finger ends which make work more difficult. The circumference of the hand, measured in inches, is roughly equivalent to the reported glove size. Glove color, cuff design, and lining should also be considered for some tasks.

### Glove Inspection, Use and Care

All gloves should be inspected for signs of degradation or puncture before use. Test for pinholes by blowing or trapping air inside and rolling them out. Do not fill them with water, as this makes the gloves uncomfortable and may make it more difficult to detect a leak when wearing the glove.

Disposable gloves should be changed when there is any sign of contamination. Reusable gloves should be washed frequently if used for an extended period of time.

While wearing gloves, be careful not to handle anything but the materials involved in the procedure. Touching equipment, phones, wastebaskets or other surfaces may cause contamination. Be aware of touching the face, hair, and clothing as well.

Before removing them, wash the outside of the glove. To avoid accidental skin exposure, remove the first glove by grasping the cuff and peeling the glove off the hand so that the glove is inside out. Repeat this process with the second hand, touching the inside of the glove cuff, rather than the outside. Wash hands immediately with soap and water.

Follow the manufacturer's instructions for washing and caring for reusable gloves.

### Latex Gloves and Related Allergies

Allergic reactions to natural rubber latex have been increasing since 1987, when the [Center for Disease Control](#) recommended the use of universal precautions to protect against potentially infectious materials, bloodborne pathogens and HIV. Increased glove demand also resulted in higher levels of allergens due to changes in the manufacturing process. In addition to skin contact with the latex allergens, inhalation is another potential route of exposure. Latex proteins may be released into the air along with the powders used to lubricate the interior of the glove.

In June 1997, the National Institute of Occupational Safety and Health (NIOSH) issued an alert [Preventing Allergic Reactions to Latex in the Workplace](#) (publication number DHHS (NIOSH) 97-135).

NIOSH studies indicate that 8-12% of healthcare workers regularly exposed to latex are sensitized, compared to 1-6% of the general population. Latex exposure symptoms include skin rash and inflammation, respiratory irritation, asthma and shock. The amount of exposure needed to sensitize an individual to natural rubber latex is not known, but when exposures are reduced, sensitization decreases.

NIOSH recommends the following actions to reduce exposure to latex:

- If latex gloves must be used, choose reduced-protein, powder-free latex gloves.
- Whenever possible, substitute another glove material.
- Wash hands with mild soap and water after removing latex gloves.

Although latex gloves remain a popular glove in some laboratories, they do not offer good protection from many chemicals, including ethidium bromide. Consider nitrile or chloroprene gloves as an alternative.

### Respiratory Protection [\(top\)](#)

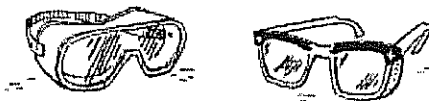
A respirator may only be used when engineering controls, such as general ventilation or a fume hood, are not feasible or do not reduce the exposure of a chemical to acceptable levels. The use of a respirator is subject to prior review by EHS, according to University policy, since their use is regulated by the [OSHA Respiratory Protection Standard](#).



Any worker who believes that respiratory protection is needed must notify EHS for evaluation of the hazard and enrollment in the Respiratory Protection Program. This program involves procedures for respirator selection, medical assessment of employee health, employee training, proper fitting, respirator inspection and maintenance, and record keeping. For more information, see [Section C4](#), Respiratory Protection, in the Princeton University Health and Safety Guide.

### Eye Protection [\(top\)](#)

**Safety glasses** look very much like normal glasses but are designed to protect against flying particles. Safety glasses have lenses that are impact resistant and frames that are far stronger than standard street wear glasses. Safety glasses must have side shields and should be worn whenever there is the possibility of flying particles, glass, powders, etc. entering the eye. Standard street wear eyeglasses



fitted with side shields are not sufficient. Workers who are interested in obtaining prescription safety glasses should contact EHS at 8-5294.

**Chemical Splash Goggles** should be worn when there is potential for splash from a hazardous material. Like safety glasses, goggles are impact resistant. Chemical splash goggles should have indirect ventilation so hazardous substances cannot drain into the eye area. They may be worn over prescription glasses.

**Face shields** are in order when working with large volumes of hazardous materials, either for protection from splash to the face or flying particles. Face shields must be used in conjunction with safety glasses or goggles.

**Contact lenses** may be worn in the laboratory, but do not offer any protection from chemical contact. If a contact lens becomes contaminated with a hazardous chemical, the lens should be removed immediately and discarded.

#### Protective Clothing & Footwear [\(top\)](#)

When the possibility of chemical contamination exists, protective clothing that resists physical and chemical hazards should be worn over street clothes. **Lab coats** are appropriate for minor chemical splashes and spills, while **plastic or rubber aprons** are best for protection from corrosive or irritating liquids. Disposable outer garments (i.e., Tyvek suits) may be useful when cleaning and decontamination of reusable clothing is difficult.

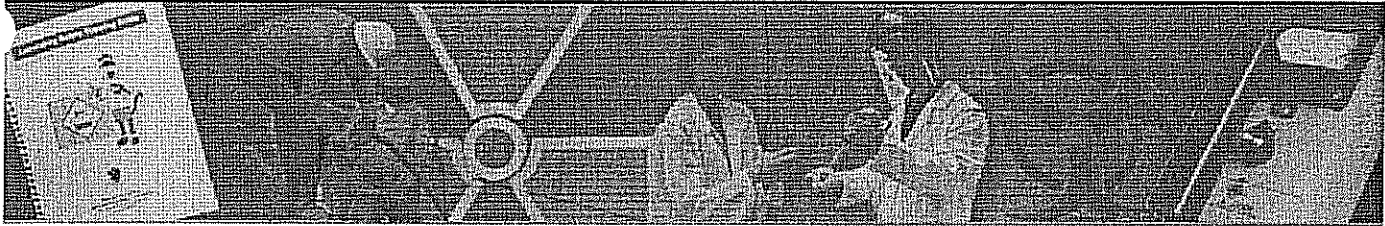
Loose clothing (such as overlarge lab coats or ties), skimpy clothing (such as shorts), torn clothing and unrestrained hair may pose a hazard in the laboratory. Open-toed shoes or cloth sneakers should not be worn in laboratories or where mechanical work is performed



## ◀ Section 2g ▶ Section 4

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