Chapter 53: Chemical Safety

Personal Protective Equipment Requirements

1 Purpose

The purpose of these requirements is to ensure the proper selection and use of personal protective equipment (PPE) to minimize or eliminate exposure to chemical hazards. They cover selecting, using, inspecting, and maintaining chemical safety PPE. They apply to workers (as chemical workers), supervisors, and area and building managers.

2 Requirements

In addition to specific requirements below, follow these general precautions in the work area:

- Do not use or wear torn or excessively loose clothing.
- Wear shoes at all times.
- Do not wear perforated shoes, sandals, or cloth sneakers. Steel-toed shoes are recommended for use with compressed gas cylinders (CGCs).

2.1 General PPE

General policies and procedures pertaining to PPE are described in Chapter 19, “Personal Protective Equipment”. In addition to requirements listed in Chapter 19, the guidelines listed below ensure maximum protection:

- Select PPE based upon the greatest hazard: ensure the PPE provides both the kind and degree of protection needed for the potential hazard as well as the task.
- Understand PPE limitations: for instance, splash-proof goggles must be used when handling corrosive liquids because regular safety glasses are insufficient.
- Ensure the PPE fits properly.
- Maintain PPE according to the manufacturer’s instructions.

2.2 Chemical PPE

Chemical-specific PPE must be chosen with careful attention to the physical and health hazards of the substance(s) and work processes involved, as well as the chemical compatibility of the PPE material itself. PPE selection guidance can be found in the resources below:

- Safety data sheets (SDSs) for all chemicals and chemical mixtures.
Warning Solutions or mixtures may differ in hazard or solubility than starting reagents. Ensure the PPE selected is compatible with all substances that will be used.

2.3 Protective Apparel

Protective apparel includes coats, aprons, jump suits, special types of boots, shoe covers, and gauntlets. Appropriate protective apparel is recommended for most chemical work; for some tasks it is required. Protective apparel should protect against physical hazards yet enable easy execution of physical tasks.

2.3.1 Lab Coats

Lab coats protect the body and clothing from dirt, grime, incidental splashes, incidental chemical contamination and chemical attack. Lab coats should be used for all work in chemical and biological laboratories, and are recommended for use where chemical use is routine. The composition of lab coats must be compatible with the types of hazards in use. A review of common lab coat materials and recommended uses is listed below:

- Flame resistant (FR) rated materials are typically NFPA 70E and NFPA 2112 certified, and have arc ratings and CAT ratings based on performance standards in testing. FR-rated fabrics are either treated with an FR coating or are made from fabrics that have inherent FR properties, such as aramid (Nomex). FR fabrics must be used for work with any volume of pyrophoric chemicals outside a glove box. FR-rated fabrics should be used with work that involves an open flame, the combination of flammable chemicals and heat, or large volumes of flammables (>4 L).
- Chemical protection (CP) fabrics offer splash protection against corrosives, polar solvents, and other chemicals.
- Polyester and poly-cotton blends will readily ignite and melt onto skin, exacerbating injury in a flash fire event. Polyester and poly-cotton blends are acceptable for work with nonflammable chemicals, and for general work that involves limited volumes of hazardous materials.
- Cotton is not FR, but ignites more slowly than poly-blends, and will not readily melt onto skin in a flash fire. 100 percent cotton is often used in laboratories where flammable chemicals are handled. 100 percent cotton fabrics may be permissible when working with small volumes of flammable chemicals and contained heat sources (such as hot plates). Cotton is sensitive to degradation from acids.
- FR/CP materials, such as Shieldtec, are both flame resistant and chemical protection and are compatible with the widest variety of hazardous materials in the laboratory.

2.3.2 Chemical Aprons

Chemical aprons should be used when working with strong corrosives, reactive mixtures, or where other potential for splashes to the body exist.
2.4 Eye and Face Protection

Eye and face protection is required in areas where chemicals used could cause injury to the eyes or face upon contact from splashing or pouring. PPE for eye and face protection must be selected in accordance with 8 CCR 3382 and must meet the requirements specified in ANSI Z87.1.

Laboratory managers or supervisors should contact the equipment manufacturers and the ESH coordinator for proper equipment selection.

- Safety glasses with permanently attached side shields are required whenever there is a potential for projectile objects in the work area.
- Safety goggles are required to protect the eyes when handling any chemical or process that can create fine dust, fumes, mists, and sprays.
- Face shields are typically paired with safety goggles. Face shields are required to protect the face when splash potential exists or when performing strongly exothermic reactions or working with reactive mixtures.
- Do not use face shields as a substitute for eye protection. When both face and eye protection is needed, both types of protective equipment must be used.
- Eye and face protection is required when radiant energy sources are present in the work area.

2.5 Hand Protection

Skin contact is a potential source of exposure to toxic materials. For substances that can create a significant exposure to individuals through skin contact, see 8 CCR 5155 Table AC-1, “Permissible Exposure Limits for Chemical Contaminants” (see those marked with “skin designation”). Appropriate gloves can be selected from safety supply catalogs.

- Gloves are required whenever there is potential for contact with corrosive or toxic materials, or materials of unknown toxicity or other unknown properties or hazards.
- Gloves should be worn as a standard precaution for all work in laboratories and other work areas where chemicals are routinely handled, used, or stored.
- Select glove material based on chemical resistance, as not all gloves are equally effective in preventing skin exposure to certain chemicals.
- Know the time-exposure limitations of glove use. Check degradation, breakthrough and permeation rates for the chemicals planned for use.
- Disposable gloves are designed for short-term applications; change frequently throughout the day and never re-use.
- If heavy-duty gloves are reused, wash gloves after you complete a procedure but before removing them from your hands. Let dry completely before storing.
- Inspect heavy-duty gloves for damage before and after each use. Replace heavy-duty gloves periodically, depending on frequency of use and permeability of the substances.
- Ensure gloves are air-tight: fill the gloves with air, roll the cuff, and check for leaks.

A good summary reference is Stanford University’s Lab Gloves.
Informative glove chemical-compatibility and resistance resources are listed below:

- **Ansell Chemical Hand Protection Tool** (for use with single chemicals or mixtures)
- **Cole Parmer Glove Chemical Compatibility Database**
- **North Chemical Resistance Guide**

### 2.6 Respiratory Protection

Respiratory protection prevents the inhalation of hazardous vapors or fumes into the lungs. Chemical fume hoods or other hazard control ventilation systems will prevent most exposures. However, when procedures cannot be performed in a fume hood or ventilation is not adequate to provide protection against inhalation hazards, respiratory protection equipment is required. (See Chemical Safety: Hazard Control Ventilation Requirements.)

Respirators may be used at SLAC only after medical evaluation, training, fit-testing, and specific approval of the operation by an ESH industrial hygienist. Respirators are the last resort for control of exposures and are only to be used when engineering controls, process modification, and other measures are not practical or have proved inadequate. (See Chapter 29, “Respiratory Protection”.)

### 2.7 Training

Workers who are required to use PPE must receive training specific to both the required PPE and the conditions under which it will be used. The supervisor or principle investigator must determine if the general training meets the level of training required for the work area. If it does not, they must ensure on-the-job training is completed for any specialized PPE. Training requirements for hazard-specific PPE are listed in each appropriate ESH Manual chapter.

ESH provides the following general PPE training:

- ESH Course 255, Personal Protective Equipment (ESH Course 255)

Laboratory-specific PPE training is provided in either of the training courses below:

- Course 204, Sample Preparation Laboratory Training (Course 204). This course is geared toward users who work in sample preparation laboratories.
- ESH Course 128, Laboratory Safety Orientation (ESH Course 128). This course is geared towards staff research laboratories.

### 3 Forms

The following forms and systems are required by these requirements:

- **Chemical Management System**, System used for ordering and tracking chemicals and storing safety data sheets
4 Recordkeeping

The following recordkeeping requirements apply for these requirements:

- None

5 References

SLAC Environment, Safety, and Health Manual (SLAC-I-720-0A29Z-001)
- Chapter 53, “Chemical Safety”
  - Chemical Safety: Hazard Control Ventilation Requirements (SLAC-I-730-0A09S-021)
  - Chemical Safety: Safe Handling Guidelines
  - Chemical Safety Program Site (SharePoint)
- Chapter 19, “Personal Protective Equipment”
- Chapter 29, “Respiratory Protection”

Other SLAC Documents

- Chemical Management Services (CMS)

Other Documents

- Title 8, California Code of Regulations, “Industrial Relations”, Division 1, “Department of Industrial Relations”, Chapter 4, “Division of Industrial Safety”, Subchapter 7, “General Industry Safety Orders”
  - Group 2, “Safe Practices and Personal Protection”, Article 10 (8 CCR 3382–3384)
- American National Standards Institute (ANSI) Z87.1, “Occupational and Educational Personal Eye and Face Protection Devices” (ANSI Z87.1)
- Stanford University, Department of Environmental Health and Safety. Lab Safety. Personal Protective Equipment. Lab Gloves
- Stanford University, Department of Environmental Health and Safety. Lab Safety. Lab Safety Fact Sheets
- Stanford University, Department of Environmental Health and Safety. Lab Safety. Standard Operating Procedures
- Stanford University, Department of Environmental Health and Safety. Lab Safety. Personal Protective Equipment. Laboratory PPE Assessment Tool
- Ansell Chemical Hand Protection Tool (for use with single chemicals or mixtures)
- Cole Parmer Glove Chemical Compatibility Database
- North Chemical Resistance Guide