

**G. PROVISIONS FOR EMPLOYEE PROTECTION WHEN WORKING WITH
PARTICULARLY HAZARDOUS SUBSTANCES
(CARCINOGENS, REPRODUCTIVE TOXINS, SUBSTANCES THAT HAVE A HIGH
DEGREE OF ACUTE TOXICITY, AND CHEMICALS OF UNKNOWN TOXICITY)**

NOTE: The provisions described in this section of the Rutgers Chemical Hygiene Guide are intended to protect laboratory workers from either the acute and/or chronic toxicological properties associated with substances as defined in the Lab Standard at 1910.1450 (e)(3)(viii), while ensuring their continued safe use support the academic and research objectives contained in the university mission statement.

The actual control measures required for laboratory work with particularly hazardous substances depends upon the chemical(s), the quantity and concentration used per lab activity, its physical form, its hazardous properties, and the actual conditions of use. In many instances, established laboratory procedures (i.e., use of lab coats, safety glasses, appropriate chemical resistant gloves, properly operating fume hood, etc.) will be sufficient in controlling the hazard. In these cases, the principal investigator and laboratory worker must supplement the protocols with the following information:

- a. Identify the designated area(s) in the lab for these research activities,
- b. Restrict work activities to a properly operating fume hood, as appropriate,
- c. Identify and make available appropriate personal protective equipment to protect against accidental skin contact, and
- d. Describe how employees should respond to a small chemical spill or accident.

Principal investigators will establish and enforce procedures described in this section when performing laboratory work with any select carcinogen, reproductive toxin, substance that has a high degree of acute toxicity, or a chemical whose toxic properties are unknown. While the primary focus for this section of the Chemical Hygiene Guide is to address the acute and chronic toxicological properties associated with certain chemicals, all users must recognize that these chemicals may also possess other hazardous properties, such as flammability and reactivity. Laboratory workers need to consider and follow the requirements outlined in Section A, Standard Operating Procedures, to address these hazardous properties, as well as these requirements.

The following definitions apply:

- a. Select carcinogen: Any substance defined as such in 29 CFR 1910.1450 and any other substance described as such in the applicable MSDS.
- b. Reproductive toxin: Any substance described as such in the applicable MSDS.
- c. Substances with a high degree of acute toxicity: Any substance for which the LD₅₀ data described in the applicable MSDS cause the substance to be classified as a “highly toxic chemical” as defined by ANSI Z129.1.
- d. Chemical whose toxic properties are unknown: A chemical for which there is no known statistically significant study conducted in accordance with established scientific principles that establish its toxicity.

- e. For the purposes of this CHP, chemicals in the above four categories will be referred to as “particularly hazardous substances”.
- f. Designated area: A hood, glove box, portion of a laboratory, or an entire laboratory room designated as the only area where work with quantities of particularly hazardous substances shall be conducted.

REHS has identified 36 chemicals that meet the definitions of a select carcinogen, reproductive toxin, or substances with a high degree of acute toxicity to facilitate compliance with the Chemical Hygiene Plan requirements; these chemicals are listed in Table 1 at the end of this section. This list does not include all particularly hazardous substances; principal investigators and lab workers need to review the toxicological properties of the chemicals used to conduct their research work to determine if they meet the criteria defined in the section above, and implement appropriate work practices and control measures to ensure adequate worker protection.

Each laboratory that uses particularly hazardous substances is required to establish designated work areas, identify containment devices, properly dispose of wastes and contaminated materials, and develop and implement decontamination procedures for equipment and designated areas. The following summarizes these requirements and recommends methods to achieve compliance.

General Requirements

A. Designated Areas

Laboratory workers must request and receive permission from the principal investigator (faculty member) before working with particularly hazardous substances. In addition, each laboratory must delineate “designated areas” for research activities performed with particularly hazardous substances. The criteria used to identify the designated area will depend upon the chemical form (solid, liquid, gas), its physical properties, and the prevalence of use in the lab. Designated areas can include a specific piece of equipment (fume hood, spill tray, or balance), a work area within the lab, or the entire laboratory itself. All lab workers approved to use particularly hazardous substances must confine their work within these designated areas and decontaminate them when their work is completed. Since work areas and equipment are often shared among several users within a laboratory, it is prudent to confine and/or limit the designated areas established for research activities with particularly hazardous substances.

REHS will provide the following signs to delineate designated areas:

Caution
Designated Area
Substance Name: _____

B. Containment Devices

The actual control measures used to protect employees from exposure to particularly hazardous substances will vary based upon the chemical, its physical state (gas, liquid, powder, or solution), the amount used per specific research activity, and its condition of use. The following general control measures represent practical recommendations that apply to all laboratories using particularly hazardous substances. Substance specific control measures for particular operations shall incorporate and modify as appropriate these recommendations.

Administrative Control Measures

1. Use the smallest amount and concentration of chemical that is necessary and consistent with the work activity to be performed.

2. Ensure all particularly hazardous substance stock and process containers are properly labeled, stored in ventilated locations (as appropriate), and maintained within secondary containment. All stock and process containers shall be closed and/or covered, except during material transfers.
3. Store and segregate all particularly hazardous substances stock containers by appropriate hazard class. These substances should be secured when not in use, and REHS recommends maintaining a log to record use and remaining quantities of chemical remaining.
4. Establish, maintain, and enforce written standard operating procedures that identify the following:
 - a. Material handling locations (i.e., designated areas)
 - b. Material storage locations
 - c. Segregation, collection, and disposal of waste generated by the lab processes according to current REHS requirements for satellite accumulation areas
 - d. Emergency response actions (spills and personal exposures) for the chemical used and work activity performed
 - e. Personal protective equipment required for the work activity
5. Enforce prohibitions on food consumption and cosmetic application in all labs containing designated areas.
6. Do not wear jewelry when working in designated areas, and ensure good hygiene practices (washing hands) are followed after completing work activities, removing personal protective equipment, or when leaving the designated area.
7. Immediately notify the principal investigator and/or lab supervisor of all spills, and seek medical evaluation for all incidents that result in personal exposure.
8. Maintain supplies near the designated area in the lab to clean small spills of these substances.

Engineering Control Measures

General Engineering Controls

1. For research activities with powders, use wet cleaning methods or a HEPA equipped vacuum to clean up spills. As appropriate, conduct material transfer and weighing activities within enclosures to contain powder dispersal within the designated area.
2. Protect vacuum lines and other mechanical equipment to prevent contamination or dispersal of the particularly hazardous substance outside the regulated area.
3. Protect equipment and work areas from contamination by these substances, and decontaminate designated areas before returning them to “general use”. Use spill trays, absorbent paper, and other appropriate methods to contain spills and facilitate decontamination work in designated areas.

Fume Hoods

1. Confine all laboratory research activities that may generate gases, vapors, mists, or fumes of a particularly hazardous substance within a laboratory fume hood or other appropriately ventilated area.
2. Fume hoods shall be equipped with a properly functioning flow-indicating device, and must be surveyed by REHS annually.
3. Maintain the fume hood free of clutter; and do not block the rear slot openings with equipment or materials. Items not currently in use shall not be stored in the fume hood, and large items required to support the research activities should be raised on blocks to allow air to flow under the equipment.

Personal Protective Equipment (PPE)

Although not a containment strategy, personal protective equipment supplements lab worker protection to prevent against personal exposure to particularly hazardous substances. Personal protective equipment must be worn when performing manipulations with particularly hazardous substances, when decontaminating designated areas after completion of research activities, or when cleaning up spills. The personal protective equipment selected must be appropriate to prevent or minimize lab worker exposure with the particularly hazardous substance used while not limiting or adversely affecting the work activities performed in the lab. The following are generic guidelines for the use of personal protective equipment; contact REHS to review the personal protective equipment selected for your work activities.

1. Prohibit lab workers from wearing of open toe shoes and sandals in laboratories that use particularly hazardous substances.
2. At a minimum, all lab workers must wear safety glasses when working in designated areas. Lab workers shall wear chemical splash goggles when handling liquids, as well as face shields when transferring large volumes (> 1 liter) of liquids from one container to another.
3. Laboratory coats must be available and worn in the laboratory, and removed before leaving the laboratory.
4. Wear chemical resistant gloves when performing research activities with particularly hazardous substances. Gloves selection shall be based upon the chemicals used, the anticipated chemical contact (intermittent splash or immersion) for the activity performed, and the nature of the task performed.
5. Lab workers shall not wear respirators in the lab when handling particularly hazardous substances unless their use has been properly evaluated by REHS. All employees wearing respirators must be medically cleared, fit-tested, trained, and included in the University Respiratory Protection Program.

C. Disposal of Wastes and Contaminated Materials

1. Waste Disposal

All waste solutions and contaminated materials containing particularly hazardous substances shall be disposed in accordance with the "Policy for the Disposal of Chemicals" contained in appendix 6 of this Chemical Hygiene Guide. Section II, Generator/Lab Personnel Responsibilities reviews in detail the requirements for managing waste in Satellite Accumulation Areas (SAA's).

2. Acutely Hazardous Waste Disposal

Of the 36 chemicals currently on the particularly hazardous substance list, the following 8 are listed as acutely hazardous wastes in 40 CFR 261.33(e):

Cyanide (soluble) salts	Fluorine [7782-41-4]
Hydrogen Cyanide [74-90-8]	Phosgene [75-44-5]
Phosphine [7803-51-2]	Ethylenimine [151-56-4]
N-Nitrosodimethylamine [62-75-9]	

Specific Organic Mercury Compounds:

Mercury Fulminate [628-86-4]	(aceto-o)phenyl-mercury [62-38-4]
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The maximum quantity of acutely hazardous waste that can be stored in each satellite accumulation area is 1 quart. Once this limit is reached, lab personnel must contact REHS immediately to enable us to remove the waste within 3 days. Lab personnel generating waste from the use of these chemicals must ensure these materials are properly managed and REHS is contacted when accumulation limits are reached.

3. Contaminated Material Disposal

Contaminated materials generated during research activities with particularly hazardous substances, such as used gloves, absorbent bench paper, and glassware, must also be collected and disposed in accordance with the "Policy for the Disposal of Chemicals". Contact REHS for assistance with the proper segregation and management of these wastes.

D. Decontamination Procedures

Lab workers must decontaminate designated areas in response to a spill or when the designated area (including equipment) is returned to general use. Lab workers performing these decontamination activities must wear appropriate personal protective equipment to avoid exposure through skin contact, inhalation, or

injection, and must dispose of all wastes generated by this activity in accordance with section C above. The following outlines recommended guidelines for the decontamination of liquids and powders.

Liquids

1. Select an appropriate solvent that will remove the liquid from the surfaces to be cleaned. Typically, a damp paper towel with a surfactant solution is adequate for this purpose.
2. Begin cleaning the designated area from the outer edges in toward the center. For equipment, begin cleaning the surfaces from the least contaminated area toward the higher contaminated area. Repeat cleaning in this manner for a total of three times.
3. Gloves selected for this purpose shall be resistant to both the particularly hazardous substance as well as the solvent used, provide protection from immersion to both chemicals, and resist tearing or damage from the cleaning activity.
4. Collect and manage the wastes generated by all decontamination work activities.

Powders

1. Use wet cleaning methods or a HEPA equipped vacuum. Typically, a damp paper towel with a surfactant solution is adequate for this purpose.
2. Begin cleaning the designated area from the outer edges in toward the center. For equipment, begin cleaning the surfaces from the least contaminated area toward the higher contaminated area. Repeat cleaning in this manner for a total of three times.
3. Gloves selected for this purpose shall be resistant to both the particularly hazardous substance as well as the solvent used, provide protection from immersion to both chemicals, and resist tearing or damage from the cleaning activity.
4. Collect and manage the wastes generated by all decontamination work activities.

Table 1: Current Particularly Hazardous Substance List

Chemicals with Acute Toxicity*

Aniline [62-53-3]	Dimethylmercury [593-74-8]
Cyanide salts [592-01-8]	Hydrofluoric acid [7664-39-3]

Compressed Gases with Acute Toxicity

Arsine [7784-42-1]	Hydrogen cyanide [74-90-8]
Boron trifluoride [7637-07-2]	Hydrogen fluoride [7664-39-3]
Bromine [7726-95-6]	Hydrogen peroxide [7722-84-1]
Chlorine [7782-50-5]	Methylamine [74-89-5]
Fluorine [7782-41-4]	Ozone [10028-15-6]
Hydrogen bromide [10035-10-6]	Phosgene [75-44-5]
Hydrogen chloride [7647-01-0]	Phosphine [7803-51-2]

OSHA Carcinogens

4-Nitrodiphenyl [92-93-3]	Ethylenimine [151-56-4]
alpha-Naphthylamine [134-32-7]	beta-Propiolactone [57-57-8]
Chloromethyl methyl ether [107-30-2]	2-Acetylaminofluorene [53-96-3]
3,3'-Dichlorobenzidine [91-94-1]	4-Dimethylamino-azobenzene [60-11-7]
Bis(chloromethyl)ether [542-88-1]	N-Nitrosodimethylamine [62-75-9]
beta-Naphthylamine [91-59-8]	Benzene [71-43-2]
Benzidine [92-87-5]	Formaldehyde [50-00-0]
4-Aminodiphenyl [92-67-1]	

Reproductive Toxins

Formamide [75-12-7]	Organic mercury compounds
Lead compounds	

* The ANSI Z129.1 classification as a “highly toxic chemical” includes chemicals in any of the following categories:

- 1) A chemical that has a median lethal dose (LD₅₀) of 50 milligrams or less per kilogram of body weight when administered orally into albino rats weighing between 200 and 300 grams each, or
- 2) A chemical that has a median lethal dose (LD₅₀) of 200 milligrams or less per kilogram of body weight when administered by continuous contact for 24 hours (or less, if death occurs within 24 hours) with the bare skin of albino rabbits weighing between two and three kilograms each, or
- 3) A chemical that has a median lethal concentration (LC₅₀) in air of 200 parts per million by volume or less of a gas or vapor, or 2 milligrams per liter of mist, fume, or dust, when administered by continuous inhalation for one hour (or less, if death occurs within one hour) to albino rats weighing between 200 and 300 grams each, provided such concentrations and/or conditions are likely to be encountered in a reasonably foreseeable manner.