

1. Purpose

OSHA has designated certain categories of chemicals as “Particularly Hazardous Substances” (PHSs). Special precautions may be required when working with such substances. PHSs include select carcinogens, reproductive toxins, and substances with a high degree of acute toxicity. The purpose of this procedure is to provide general safety guidelines for working with substances deemed to be particularly hazardous.

2. Scope

The Program applies to all areas owned, leased or operated by KSU where particularly hazardous materials are stored, handled, and/or used. These areas include, but are not limited to, laboratories, art studios, engineering shops, maintenance shops, and chemical and hazardous wastes storage areas. The program covers all faculty, staff, students, contractors and other personnel at KSU, or under the management or control of KSU.

3. Responsibilities

- Lab Supervisors/Principal investigators (PIs) and Managers are responsible for identifying particularly hazardous substances used in the work area.
- Lab Supervisors/PIs/Managers shall also ensure that a review of the hazards of these materials, their use, and the controls in place has been conducted.
- The EHS department will provide assistance in hazard assessment and guidance for establishing engineering and administrative controls, good work practice and selection of personal protective equipment.

4. Definitions

A. Carcinogens (National Research Council, 2011)

A carcinogen is a substance capable of causing cancer. Carcinogens are generally chronically toxic substances. They cause adverse effects after repeated or long-duration exposure, and their effects may become evident only after a long latency period.

OSHA identifies certain classes of chemicals as Select Carcinogens. These include:



- Any substance regulated by OSHA as a [Carcinogen](#)
- Any substance listed under the category [“Known to be a carcinogen”](#) or [“Reasonably anticipated to be carcinogens”](#) in the latest edition of Annual Report on Carcinogens published by the National Toxicology Program (NTP).
- Substances listed in [Group 1](#), "carcinogenic to humans," or in either [Group 2A](#) or [Group 2B](#) “probably carcinogenic to human” by the International Agency for Research on Cancer (IARC) monograph (latest edition).

B. Reproductive and Developmental Toxins (National Research Council, 2011)

- Reproductive toxins are substances that have adverse effects on various aspects of reproduction, including fertility, gestation, lactation and general reproductive capabilities.
- Reproductive toxins (mutagens) can affect both men and women. Male reproductive toxins can in some cases lead to sterility.
- Developmental toxins (Teratogens) are substances that act during pregnancy to cause adverse effects on the developing embryos or fetus.

C. Highly Toxic Substances (National Research Council, 2011)

- Highly toxic substances include materials that may be fatal or cause damage to target organs because of a single exposure, exposures of short duration, or are capable of causing intense irritation that can result in fluid and swelling in the lungs (pulmonary edema), chemical asphyxia, and systemic (body-wide) poisoning.
- Useful parameters for assessing the acute toxicity of a chemical are its LD₅₀ and LC₅₀ values, which are selected with due regard for the possible routes of exposure. LD₅₀ and LC₅₀ values can be found in the SDS.
 - LD₅₀ (Lethal Dose) is the amount of a material, when given all at once, causes the death of 50% (one half) of a group of test animals.
 - LC₅₀ (Lethal Concentration) is the concentration of a chemical in air that kills 50% of the test animals in each time (usually four hours).



- A chemical is considered highly toxic if it falls within any of the following categories:
 - Has a median lethal dose (LD₅₀) of 50 mg or less per kg of body weight when administered orally to certain test populations.
 - Has a LD₅₀ of 200 mg less per kg of body weight when administered by continuous skin contact for 24 hours to certain test populations.
 - Has a median lethal concentration (LC₅₀) of 200 parts per million by volume or less of gas or vapor, or 2 milligrams per liter or less of mist, fume, or dust, when administered by continuous inhalation for one hour (or less if death occurs within one hour) to certain test populations.

Table 1: Acute Toxicity Hazard Level

Hazard Level	Toxicity Rating	Oral LD ₅₀ (Rats, per kg)	Skin Contact LD ₅₀ (Rabbits, per kg)	Inhalation LC ₅₀ (Rats, ppm for 1 h)	Inhalation LC ₅₀ (Rats, mg/m ³ for 1 h)	
High	Highly toxic	<50 mg	<50 mg	<200 mg	<200	<2,000
Medium	Moderately toxic	50 to 500 mg	50 to 500 mg	200 mg to 1 g	200 - 2,000	2,000 - 20,000
Low	Slightly toxic	500 mg to 5 g	500 mg to 5 g	1 to 5 g	2,000 - 20,000	20,000 - 200,000

5. Procedure

The following controls are required for working with particularly hazardous substances:

A. Health and Safety Review

- A hazard assessment must be conducted for any work activity involving use of particularly hazardous substances to ensure that proper controls are in place.
- The hazard assessment may determine that area monitoring and/or medical surveillance is necessary for ensuring the safety of the employees. Such a determination is likely to be made only when there is reason to believe that exposure levels for the substances planned to be used in an



experiment could exceed OSHA-established regulatory action levels or similar guidelines established by other authoritative organizations.

B. Planning

- Careful planning needs to precede any work involving use of particularly hazardous substances. This includes whenever the substance is to be used for the first time or whenever an experienced user carries out a new protocol that increases substantially the risk of exposure.
- Planning should include consultations with EHS, or colleagues who have experience in handling the substance safely and in protocols being used.
- Effective planning should consider substitutions of the particularly hazardous substance with a less hazardous alternative whenever appropriate. Also, the smallest amount of material that is practicable for the purpose of the experiment/process should be considered for use.
- Consult the EHS department for guidance regarding chemicals that are regulated by federal, state, and local agencies, or by institutional policy.

C. Standard Operating Procedures

Standard Operating Procedures (SOP) that describe the experiment/process and identify the hazards and safeguards that will be used in all phases of the experiment/process (from acquisition of the chemical to disposal) should be in place before the work begins. The adequacy of the SOPs will be reviewed by the EHS.

D. Designated Areas

- Activities involving particularly hazardous substances, including their transfer from storage containers to reaction vessels, should be confined to a designated work area in the laboratory or other process area.
- A designated area may be a room, a section of a room, a bench top or a containment device (such as a lab hood) where special precautions, prudent laboratory skills, and safety discipline are required.
- Conspicuous signs, as shown below, should be posted clearly indicating which areas are designated.

**DANGER
DESIGNATED AREA**



**for select carcinogens, reproductive toxins and high acute toxicity chemicals
AUTHORIZED PERSONNEL ONLY**

- All employees working in designated areas must be informed of the hazards and controls required for the materials being used.
- EHS, in consultation with lab supervisor/PI, will determine which procedures need to be confined to designated areas.
- When handling substances (in non-laboratory settings) that are regulated by OSHA substance specific standards (such as MDA, Formaldehyde), "regulated areas" will be established in accordance with the applicable OSHA standard.

E. Access Control

Administrative procedures or physical barriers may be required to prevent unauthorized personnel from entering areas where particularly hazardous substances are being handled. Use of locks and barricades may be appropriate to limit access to unattended areas where such materials are being handled routinely or stored. However, such access controls should not prevent emergency exit from the area or hinder entrance for emergency response.

F. Working Safely with Particularly Hazardous Substances

The increased hazard risk associated with PHS calls for more strict operating procedures in the laboratory/process areas.

1) Work Practices and Laboratory Hygiene

Good laboratory hygiene and work practices should never be compromised where particularly hazardous substances are handled. The following guidelines should be followed.

- Do not eat, drink, smoke, chew gum, instill contact lenses, apply cosmetics, or store food, beverages and tobacco products in work areas where particularly hazardous substances are being used or stored.
- Avoid practical jokes or other behavior that might confuse, startle or distract another worker.
- Each procedure should be conducted using the minimum amount of the substance, consistent with the requirements of the work.



- Mixtures that contain toxic chemicals or substances of unknown toxicity must never be smelled or tasted.
- Open bottles or containers slowly and carefully and wear protective equipment to protect hands, face, and body from splashes and vapors/gases.
- Wipe drips/residues from containers and work surfaces. To facilitate decontamination, use absorbent paper with a moisture-proof lining, or other impervious material.
- Store containers in secondary containment such as stainless steel or plastic trays.
- Upon completion of the operation, decontaminate or discard the protective covering material as hazardous waste.
- Disposable PPE such as gloves or disposable aprons should be removed in the designated area and discarded as hazardous waste.
- Equipment (including reusable personal protective equipment such as face shields or goggles) that might be contaminated must never be removed from the environment reserved for handling PHS materials without complete decontamination.
- Wash hands before leaving the work area and prior to consuming food/beverages.
- It is always preferable to avoid working alone in laboratories.
- When highly toxic materials such as hydrogen fluoride (HF) or DMS are being handled, it is essential that more than one person is present and that all people working in the area are familiar with the hazards of the experiments being conducted and with the appropriate emergency response procedures.
- Activities conducted with highly toxic chemicals should be carried out in work areas designed to contain accidental releases. Hood trays and other types of secondary containers should be used to contain inadvertent spills. Careful techniques must be employed to minimize the potential for inadvertent spills and releases.



2) Personal Protective Equipment

Working with PHSs may require more stringent use of personal protective equipment. Check the SDS or consult EHS for information on proper gloves, lab clothing and respiratory protection.

- At a minimum, safety glasses with side shields, laboratory coats (or appropriate coveralls in shop settings) and closed-toed shoes should be worn when handling particularly hazardous substances.
- Use additional PPE such as face shields, chemical aprons, disposable coveralls, chemically resistant gloves and respiratory protection as needed. The use of respiratory protection requires training and medical evaluation, followed by a fit-test by EHS department.
- Since many particularly hazardous substances can be readily absorbed through the skin, gloves must be carefully selected to ensure that they are impervious to the chemicals being used and are of appropriate thickness to allow reasonable dexterity while also ensuring adequate barrier protection. Contact the EHS department for assistance in selecting appropriate gloves and respiratory protection.
- Gloves that might be contaminated with toxic materials should not be removed from the immediate area in which the materials are located. In general, gloves should never be worn when handling common items such as doorknobs, computer keyboards, elevator buttons, handles, or switches on common equipment.

3) Engineering Controls

- Procedures involving particularly hazardous substances that can generate dust, vapors, or aerosols must be conducted in a chemical fume hood, glove box, or other suitable containment device.
- Chemical fume hoods in which such substances are handled should have an adequate face velocity (between 80 and 120 lfm). Hoods should be checked for adequate functionality prior to conducting experiments with toxic chemicals.
- The CHF should be equipped with either visual or audible flow-indicating devices that can show whether the hood is performing adequately. If the operating condition of the engineering control is not acceptable, please contact the EHS or maintenance department.



- If experimental set-up involving hazardous substances is ongoing over a significant time, the hood should be rechecked at least quarterly to ensure adequate face velocity.
- Highly toxic gases must be used and stored in vented gas cabinets that are connected to a laboratory exhaust system.

4) Process and Laboratory Equipment

- Equipment used for the handling of PHSs should be separated and clearly identifiable from general laboratory environment.
- Laboratory vacuum pumps used with these substances should be protected by high-efficiency scrubbers or HEPA filters and vented into an exhaust hood.
- Motor-driven vacuum pumps are recommended because they are easy to decontaminate.
- Decontamination should be conducted in a designated hood.

5) Transportation

- Transportation of very toxic chemicals from one location to another should be planned carefully, and handling of these materials outside the designated laboratory area should be minimized.
- When these materials are to be transported, the full complement of personal protective equipment appropriate to the chemicals in question must be worn, and the samples must be carried in unbreakable secondary containers.
- These materials must not be transported in personal vehicles, on university shuttles, or other public transportation.

6) Storage

- Separate incompatible chemicals from one another.
- Store particularly hazardous substances in a cool, dry environment, away from light and free from extreme temperature and humidity.
- Highly toxic chemicals should be stored in unbreakable secondary containers.



- Use secondary containment for all liquids.
- All particularly hazardous substances should be stored in sealed, air-impermeable containers. Containers with loose fitting lids or glass stoppers should not be used.
- All containers should be labeled clearly with chemical name/composition, known hazards, and warnings for handling.
- Access to areas where PHS are stored should be restricted to workers who are properly trained in the handling and use of these materials and are familiar with the associated risks.
- Ordinary domestic refrigerators must not be used for the storage of PHS that are flammable because they contain built-in ignition sources (such as electrical contacts). These ignition sources can ignite flammable vapors that are present, causing a fire or explosion. Approved flammable storage refrigerators must be used when cold storage is needed.

7) Decontamination

- Contaminated materials should either be decontaminated or be removed for subsequent disposal.
- All work surfaces must be decontaminated at the end of the procedure or workday, whichever is sooner.

8) Waste Management

- Procedures for disposal of particularly hazardous materials, in accordance with the University procedure on Management of Hazardous Waste, should be established before experiments begin.
- The procedures should also address methods for decontamination of all laboratory equipment that contacts (or could contact) PHS.
- It is the responsibility of the operator and the supervisor to ensure that waste is handled in accordance with the sites policy on management of Hazardous Waste.
- Waste should be accumulated in clearly labeled, impervious containers that are stored in unbreakable secondary containers. All waste containers, including volatile or reactive waste,



should always be covered to minimize release to the environment in which it is being handled.

G. Emergency Procedures

- An emergency eyewash and safety shower must be located in all areas where particularly hazardous materials are used. In the event of skin or eye contact, flush the affected area for at least 15 minutes.
 - Report the incident to your supervisor or EHS.
 - Chemical Spills involving any amount of a particularly hazardous substance must be immediately reported using KSU's emergency phone number **(470-578-6666)**. These spills will be cleaned up under EHS coordination.

H. Training and Information

- Employees who either handle or who may be exposed to particularly hazardous substances must complete Hazard Communication or Laboratory Safety training.
- All employees working with particularly hazardous materials must be trained on the procedure, the specific hazards and controls of the materials being handled.
- Employees working in designated areas must be informed of the specific hazards and controls of the materials used.
- Area specific training is the lab supervisor/PI's responsibility. EHS department is available to provide assistance.
- Designated and regulated areas must be posted with a warning placard stating the hazard and that the area is restricted to authorized personnel only.
- The area entrance must be posted with a caution placard depicting the hazards.
- Primary and secondary containers must be labeled with the identity of the substance and its hazards.



I. Medical Surveillance

Medical supervision or surveillance may be warranted when using some toxic substances, particularly when large quantities of chemicals are involved or experiments are conducted with smaller quantities over an extended period of time.