

Standard Operating Procedure

Developing a Chemical SOP in Laboratories

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Hazardous chemicals or procedures involving those materials that present extreme hazards to personnel and environment requires the development and implementation of a laboratory specific Standard Operating Procedure (SOP) even for a single event where they are used. These substances include OSHA defined particularly hazardous substances (select carcinogen, reproductive toxins, and chemicals with high acute toxicity) as well other “high risk” chemicals considered to be extremely hazardous. Refer to Appendix A for the Particularly Hazardous Substances (PHS) and” High-Risk” Chemical’s criteria.

NOTE: Complete the SOP for all particularly hazardous substances, typically the stock material. Keep in mind that many substances do not meet the PHS criteria once they are diluted or mixed. Consult with PI, Laboratory Supervisor, or Instructor if you are unsure or require further guidance.

All laboratories should conduct a hazard assessment prior to working with any hazardous chemical and the development of any SOP. Hazard assessments are important and must be performed on procedures that are new to the laboratory or have not been studied previously. The level of formality and what you need to document will depend on the chemical or process being reviewed or examined.

PROCEDURES

1. Consult with workers, vendors, or other experts.

They may point out hazards you haven’t considered or known about. For example, compressed gas vendors can explain appropriate handling. Include warning or trouble signs and what to do to prevent a laboratory accident. Submit the SOP for review by the Principal Investigator, Laboratory Supervisor, Instructor, and other laboratory personnel.

CAUTION: Consult with the Department, Facilities Management (Fire Marshal, Operations,

PDG, etc.) and EHRS for information on any department, regulatory or building requirements.

2. Review literature and other guidance materials.

- Consult the Safety Data Sheet (SDS) for specific chemicals to be used.
- Consult applicable code, standards, and references (Consult EHRS for assistance in obtaining)
- Review the literature for lessons learned.
- Review the experiment for what could go wrong/likely failures.
- What failures, even if unlikely, could lead to a catastrophic event?

3. Ensure that all the required elements are included in the SOP:

The SOP template developed by EHRS serves as a tool to coordinate into succinct procedures and facilitates review with and by laboratory personnel. The laboratory can also develop alternative procedures to the SOP template, if the document includes the elements listed below:

✓ **Name of Principal Investigator (PI) and location of laboratory where procedure/experiment will be conducted.**

✓ **Description:** Include a brief description of how the chemical will be used.

✓ **Chemical Risk Identification/Information:**

- Include all potential safety hazards.
- Include the name or class, CAS number, primary hazard classification, physical state, concentration, the amount on hand, the estimated rate of use, and reactivity/incompatibility for the substance.
- Review the SDS, container label or other technical documents for this information. Recommended optional information include the manufacturer name and product number.

✓ **Significant Route(s) of Exposure:** Anticipate and check all potential route(s) of exposure based on the work that is done with the substance.

✓ **Additional materials to be reviewed before using this chemical:** List the documents

that a user must review prior to using this substance to ensure safe handling. Include the name and their location.

✓ **Exposure Controls:** Identify engineering controls and personal protective equipment; giving priority to engineering controls to mitigate or eliminate exposure.

- **Chemical Fume Hood:** Should be used for chemicals that generate gases or vapors and for processes that can produce mists, fumes, or aerosols.
- **Glove Box/Atoms Bag:** Should be used if protection from atmospheric moisture or oxygen is needed; or when a chemical fume hood does not provide adequate protection from exposure to the substance.
- **Personal Protective Equipment (PPE):** Identify PPE that must be worn in addition to standard laboratory PPE.
 - **Disposable Lab Coats:** select a disposable lab coat if there is potential for contamination with a substance that should not go to laundry, or that could readily penetrate the lab coat.
 - **Face Shield:** Worn over chemical splash goggles, a face shield provides full face protection when working with large volumes or severely corrosive chemicals.
 - **Chemical splash goggles:** Should be worn when there is a possibility of a significant chemical splash. Many chemical manipulations, particularly where pressure is involved, warrant chemical splash goggles.
 - **Safety glasses:** Protect from flying particles and minor chemical splash, e.g., opening a centrifuge tube or a cryogen vial.
 - **Gloves:** Since no single glove material offers complete protection from all chemicals, it is important to select the glove that offers the best resistance for each application. Refer to the SDS or glove manufacturer compatibility charts for more information.
 - **Respirators:** Offer protection from inhalation when engineering controls are not sufficient. The use of a respirator must be approved by EHRS. Contact EHRS at 215-707-2520 if a respirator is needed.

✓ **Use and Storage:** Review the Safety Data Sheet (SDS) to determine if specific handling or storage conditions exist for the product.

NOTE: The information below must be documented for all work involving Particularly Hazardous Substances (PHS and or High-Risk chemicals).

- **Authorized personnel:** Select the type of personnel authorized to work with the

chemical and/or PHS. Only personnel who are fully trained on the handling procedures and are aware of the hazard(s) associated with a chemical and/or a PHS are allowed to handle it. List the documents that a user must review prior to using this substance to ensure safe handling. Include the name and their location.

- Personnel handling or conducting procedures with PHSs should never work alone.
- Laboratory Protocol/Procedure: Provide a brief description of the part of the experiment that requires handling the substance, including the various concentrations.
- Vacuum Systems (if used): Describe what will be done to ensure that the substance is not accidentally drawn into the vacuum system (e.g., cold traps, filters, etc.).
- Use Location: Designate and post the location(s) where the substance will be used. The clear posting of designated use areas will increase control, facilitate decontamination, and minimize contamination.

NOTE: A designated area may be the entire laboratory, a smaller section of a laboratory (e.g., section of benchtop), or a piece of equipment (e.g., chemical fume hood).

- Storage Location: Designate and post the location(s) where the substance will be stored. The clear posting of designated storage areas will increase control, facilitate decontamination, and minimize contamination.
- Hazard Communication and Signage: Signage should be posted, and information should be communicated to lab personnel.
 - Containers: A container label must be applied to all chemicals and/or PHSs. Ensure that the contents name and hazard warning are on the label.
 - Storage Areas: Post a PHS Storage Area sign in each area where the PHS is used. The sign must include a hazard warning (e.g., acutely toxic, water reactive, etc.) and all laboratory personnel must understand and be trained on the meaning of the designated storage sign.
 - Designated Areas: Post a PHS Designated Use sign in each area where the PHS is used. The sign must include a hazard warning (e.g., acutely toxic, water reactive, etc.) and all laboratory personnel must understand and be trained on the meaning of the designated storage sign.

CAUTION: Consult with the ULAR, IACUC and EHRS if a PHS will be administered to animals.

✓ **Medical Attention and First Aid:** Some chemicals and/or PHSs may require specific first-aid or emergency procedures, such as the administration of an antitoxin in the event

of an exposure. The SOP must include information on first-aid procedures, supplies and emergency contacts beyond basic first aid, as well as requirements for follow-up medical consultations or examinations. Consult with the PI, Laboratory Supervisor, or Instructor if you are unsure what emergency/first-aid procedures are required for the material used.

✓ **Decontamination:**

- Include special decontamination procedures beyond basic laboratory housekeeping and cleaning. Good housekeeping is essential to the health and well-being of laboratory personnel. All equipment and work surfaces used with a PHS must be decontaminated after each use. The decontamination method used must effectively remove/deactivate any residual of the substance.
- When leaving a designated area, remove any PPE to avoid cross contamination.
- Ensure a hand washing facility is available when working with PHSs.

✓ **Emergency Procedures and Spill Response:**

- Include specialized spill clean-up or neutralization procedures needed for the chemicals and/or PHSs in case of a spill or emergency. Verify that the laboratory is equipped with the proper emergency supplies for the chemical and/or PHS. Ensure that all laboratory personnel know how to respond to chemical spills or emergencies involving a chemical.
- Basic emergency equipment such as eyewash station, safety shower and fire extinguisher must be present in the work area.
- Contact Campus Police at 1-1234 (215-204-1234) for any emergency requiring immediate assistance.

✓ **Waste Management and Disposal:** Identify and select which waste disposal procedure(s) apply to HHS:

- Chemical/Hazardous waste collected by EHRS.
- Neutralization or deactivation prior to disposal which requires EHRS pre-approval.
- Other disposal method(s) which require EHRS pre-approval.

✓ **Training:** Identify and select all applicable training prior to working with a chemical and/or PHS:

- University and EHRS required Trainings.
- Reading the Safety Data Sheet (SDS), the SOP, and other identified materials to be reviewed prior to working with a chemical and/or PHS.
- Hands-on training with the PI, Laboratory Supervisor, Instructor, or other experienced senior staff familiar with the safe handling of the PHS and/or working under the close supervision of an experienced senior staff until deemed competent

to work unsupervised.

- List other training requirements specific to each PHS work.

4. Prepare for the experiment. Perform a dry run.

- *Remove any combustible or unnecessary materials from the area around the experiment.*
- *Make sure there is a clear emergency egress and have appropriate attire and PPE.*
- *Have a plan to monitor the experiment.*
- *Review the hazards and make sure measures have been taken to reduce risk.*
- *Address other laboratory or facility operations that might affect the experiment or be affected by it.*
- *Practice using nonhazardous materials or using a scaled down process.*

5. Identify unsafe conditions. Revise SOP, incorporate new information.

- *Do not perform an experiment in low humidity, with inadequate space or lighting, or in a cluttered or cramped area.*
- *Do not perform while working alone or without emergency response personnel, if needed.*
- *Do not perform the experiment if rushed, fatigued or ill.*
- *Do not proceed if there is evidence of a gas or a tubing or equipment failure.*
- *Report any near misses, incidents, or concerns to a supervisor.*

6. Train all laboratory personnel on the SOPs and document the training.

APPENDIX A: Criteria for Particularly Hazardous Substances (PHS) & High-Risk Chemicals

The Occupational Safety and Health Administration (OSHA's) Hazardous Chemicals in Laboratories Standard (29 CFR 1910.145) defines particularly hazardous substances as including select carcinogens, reproductive toxins, and chemical with high acute toxicity. Temple also considers some reactive materials to be particularly hazardous and has identified some extremely hazardous chemicals as "high-risk".

These materials present extreme hazards to personnel and environment and requires the development and implementation of a laboratory-specific SOP even for a single event where they are used. The use of a PHS and/or a high-risk" chemical requires PI approval. In some cases, departmental approval may be required.

PHS OR HIGH-RISK CHEMICAL DETERMINATION

Laboratories at Temple University should evaluate GHS-complaint Safety Data Sheets (SDS) and other chemical information and should treat chemicals as a particularly hazardous is they have one or more hazard classifications indicated below. **If the chemical has a hazard classification shown in red, it is also considered "high-risk".**

Criteria for Particularly Hazardous Chemicals Based on GHS* Labeling-found in Section 2 of the SDS	
Select Carcinogens	<ul style="list-style-type: none"> • GHS*-Carcinogenicity Category 1A of 1B • IARC** Group 1 • NTP's*** "Known to be Human Carcinogens" • OSHA-listed carcinogens • GHS Category 2 and IARC Group 2 (A or B), And NTP "Reasonably Anticipated to be Human Carcinogens"
Reproductive Toxins	<ul style="list-style-type: none"> • GHS Category 1A or 1B for reproductive toxicity
Chemicals Having High Acute Toxicity	<ul style="list-style-type: none"> • Acute toxicity by inhalation or dermal exposure GHS-Category 1 or 2 • Acute toxicity by oral exposure GHS category 1 • Specific Target Organ Toxicity-Single Exposure GHS category 1 • Skin or Respiratory Sensitizer-Category 1A • Strong Hydrogen Fluoride releaser • Corrosive to the respiratory tract

**Reactive &
Explosive
Chemical
Considered
Particularly
Hazardous (and
High-Risk)**

- In contact with water liberates toxic gas
- Reacts violently with water
- Pyrophoric liquid or solid-Category 1, or Pyrophoric Gas
- Explosives-Unstable or Divisions 1.1.-1.3
- Explosives when dry, or Explosives with or without air contact
- Self-reactive or Organic Peroxides-Type A
- Self-heating Category 1
- Oxidizing liquid or solid GHS category 1
- In contact with water releases flammable gas GHS category 1 or 2
- In contact with acids liberates toxic gas
- Pyrophoric liquid or solid GHS category 1
- Self-reactive or organic peroxides-Type B

*GHS=Global Harmonized System

**IARC=International Agency for Research on Cancer

***National Toxicology Program