

Standard Operating Procedure (SOP)

This Standard Operating Procedure (SOP) describes basic chemical safety information for explosives and potentially explosives. Prior to conducting work with explosives and potentially explosives personnel must obtain approval from their Principal Investigator (PI) and/or Supervisor and attend the appropriate laboratory safety training. The PI must complete the Lab-Specific Use Procedures section and provide their personnel with a copy of this SOP and a copy of the SDS from the manufacturer.

Explosives and Potentially Explosives

Date SOP was written:	
Date SOP was approved by PI/lab supervisor:	
Principal Investigator:	
Principal Investigator Signature:	

Type of SOP: Process Hazardous Chemical Hazardous Class

Purpose

The purpose of this standard operating procedure is to acquaint you with the proper and safe handling, use, storage, and disposal of explosives and potentially explosive compounds.

Properties & Hazards

Chemicals in this band can cause a sudden, almost instantaneous release of pressure, gas, or heat when subjected to an initiator such as a sudden shock, pressure, light, or high temperature. This band also includes chemicals that can become explosive when they come in contact with incompatible chemicals.

GHS Pictogram	UCI Hazard Level	Hazards	GHS Category	GHS H-Code	Cal/OSHA Definitions
	Highly Hazardous	Mass explosion hazard, projection hazard, or blast hazard.	Explosives (Division 1.1, 1.2, 1.3, 1.5 and "unstable explosive")	H200, H201, H202, H203, H205	Explosive
	Generally Hazardous	Minor hazard contained to package with no projection of fragments of appreciable size or range.	Explosives (Division 1.4)	H204	Explosive

Explosive compounds can create dangers from lacerations due to shrapnel (metal, glass, ceramic, etc.) and burns due to fires that might accompany or follow the explosion. An explosion might also lead to exposure to hazardous chemicals.

Personal Protective Equipment (PPE)

Skin and Body Protection:

A flame resistant Nomex® lab coat, long pants (or equivalent) completely covering legs, and closed toed shoes.

Hand Protection:

Choose gloves that provide a balance between protection against chemical exposure, lacerations (in case of an explosion), and the dexterity required for working with explosive compounds. Nitrile or neoprene gloves are typically adequate for minor splashes. Consult the SDS and/or your PI to determine whether the material or process requires alternative hand protection. If there is a high risk of fire, fire-resistant hand protection should be worn, including a chemical resistant outer glove (neoprene) over an approved fire-resistant (Nomex®) inner glove/liner.

Eye Protection:

ANSI Z87.1-compliant safety glasses or safety goggles if a splash hazard is present. The use of a face shield over safety glasses and a blast shield are strongly recommended, even when working in front of a fume hood sash due to the potential shattering in the event of an explosion.

Administrative Controls

- Never work alone with explosives and potentially explosives. Inform all other personnel in the laboratory before working with these chemicals.
- Prior to beginning work, determine the initiating mechanism that could lead to an explosion such as friction, impact, catalysts, light, or heat. Refer to the SDS for this information.
- Review the Safety Data Sheets (SDSs) for all chemicals used in the experiment. Online SDSs can be accessed at <https://ehs.uci.edu/sds/index.php>.
- Use equipment that cannot generate static electricity or sparks.
- Explore alternative strategies with your PI before working with explosives and potentially explosives.
- The PI and/or supervisor must communicate and enforce clear limits on the quantity of each explosive and potentially explosive that can be used in a single experiment.
- Reduce the quantity of explosive and potentially explosives that you work with and store.
- Buy Less, Store Less, and Use Less. Dispose of unused or unwanted compounds.
- Review the chemical safety board report on explosives safety: <https://www.depts.ttu.edu/research/integrity/csb-response/downloads/report.pdf>.
- All work with explosives and potentially explosives must:
 - Be pre-approved by the PI and campus fire marshal
 - Develop an energetic material/explosive safety plan
 - Establish a qualification/certification plan for users
 - Have a user with demonstrated proficiency

Federally regulated explosives are strictly controlled. If you want to purchase or synthesize any of the compounds on the Bureau of Alcohol, Tobacco, and Firearms (ATF), <https://www.govinfo.gov/content/pkg/FR-2020-01-02/pdf/2019-28316.pdf>, contact EHS and the Campus Fire Marshal.

Engineering Controls

Fume Hoods:

All reactions involving explosives, potentially explosive reagents, intermediates, or products must be conducted in a fume hood. Keep the fume hood sash closed while the reaction is in progress. Do not linger unnecessarily in front of the fume hood where explosives are in use.

Blast Shields:

The use of a portable blast shield inside the fume hood is highly recommended, in the event of a violent explosion the fume hood safety glass may shatter and blow outward. Place the blast shield between yourself and the reaction so you can reach around.

Special Storage and Handling Requirements

Always follow the manufacturer's recommendations for storage and handling.

Storage:

- Explosives and potentially explosives must be used and stored in designated area(s). All containers and storage locations must be clearly labeled with a sign that, at a minimum, states "EXPLOSION RISK".
- Keep and store away from all ignition sources such as heat, sparks, light, incompatible materials, and any potential initiators.
- Store in secondary containment in an explosion-proof refrigerator/freezer or an explosion-proof cabinet that does not contain flammables or incompatible materials.
 - It is best to store newly synthesized explosives and potentially explosives in an explosion-proof refrigerator or freezer.
- Limit the amount stored to only the amount needed for planned experiments.
- Always use compatible materials for storage, transfer, etc.

Handling:

- Consult with your PI the first time you run a reaction or anytime you make a change.
- Always follow a published procedure, if the procedure is over 20 years old, find a more recent related procedure that more adequately addresses safety issues.
- Always run the first reaction on a small scale.
- Allow for gas evolution. Never seal explosives in a closed metal vessel.
- Add potential explosives to solutions of catalysts (not the reverse). Be cautious when mixing explosive reagents or potentially explosive reagents and potential catalysts.
- Run reactions at the lowest temperature possible. If a reaction requires heat, slowly increase the temperature.
- Handle explosives, explosive intermediates, and potential explosives behind a blast shield.
- Do not work up the reaction in a manner that will concentrate explosives and potentially explosives.
 - Never put solutions of explosives and potentially explosives on a rotary evaporator.

Common triggers for chemical explosions:

Keep explosives and potentially explosives away from all triggers and incompatible materials

- **Heat:** consult your PI before conducting any reaction that involves heating explosives and potentially explosives.
- **Shock:** shock-sensitive materials include metal acetylides, azides, nitrogen triiodide, nitrate esters, nitro compounds, metal perchlorates, many organic peroxides, and compounds containing diazo, halamine, nitroso, and ozonide functional groups.
- **Metal ions:** many metal ions, including the iron in rust, can catalyze the violent decomposition of peroxides. Do not transfer peroxides with metal spatulas or syringes.
- **Incompatible Chemicals:** acids, bases, and other substances catalyze the explosive polymerization of acrolein.
- **Light:** hydrogen and chloride react explosively in the presence of light.
- **Concentration:** concentrating chemicals will increase the risk of explosion.

Spill, Accident, and First Aid Procedures

Spills:

Refer to the spill response flowchart. Notify others in the area of the spill. Evacuate and prevent access to the location where the spill occurred. Notify your supervisor and EHSEHS at x4-6200 immediately.

Skin or Eye Contact:

Remove contaminated clothing or contact lenses and flush the affected area with water for at least 15 minutes. Obtain medical attention immediately.

Inhalation:

Move to fresh air. Obtain medical attention immediately.

Ingestion:

Obtain medical attention immediately. (The poison control center, (800) 222-1222, is available 24 hours every day).

Waste Disposal Procedure

Stabilization of explosives and potentially explosives (dilution):

Any formulation of explosive molecules farther apart will reduce the potential for an explosion. The more unstable the molecule, the more dilution is required to render it safe.

Decontamination:

Decontamination methods will vary based on the materials being handled and the equipment being used. Please review the SDS for guidance on decontamination.

Disposal:

- Hazardous waste must be transferred to EHSEHS for disposal within 6 months of being generated.
- Hazardous Waste Disposal
 - [Text a pick up](mailto:hwp@uci.edu) to hwp@uci.edu, EHS will pick up your waste within 1-3 days
 - Or visit <https://ehs.uci.edu/enviro/haz-waste/EHS>

Additional Information

For additional information about handling explosives and potentially explosives refer to

- Prudent Practices in the Laboratory: Handling and Management of Chemical Hazards (section 4.D.3.1 “Explosive Hazards” and also section 6.G., “Working with highly reactive or explosive chemicals.”) The National Academies Press: Washington, DC, 2011. (<https://nap.nationalacademies.org/catalog/12654/prudent-practices-in-the-laboratory-handling-and-management-of-chemical>)
- The chemical safety board report on explosives safety: <https://www.depts.ttu.edu/research/integrity/csb-response/downloads/report.pdf>.
- The Bureau of Alcohol, Tobacco, and Firearms (ATF) list of federally regulated explosives: <https://www.govinfo.gov/content/pkg/FR-2020-01-02/pdf/2019-28316.pdf>.

APPENDIX A: **Lab-Specific Use Procedures**

The following procedures describe how the subject chemicals are used in this laboratory beyond the practices described above.

Please see the General Information for ***Hazardous Materials Standard Operating Procedure*** for specific instructions on writing lab-specific use produces.

This section must describe lab-specific procedures to address the safe use of all highly hazardous chemicals from this band in use in the laboratory. These procedures may be organized around specific chemicals, specific tasks or the band as a whole.

