

# **Standard Operating Procedure**

# **Explosives & Potentially Explosives**

Print a copy of this SOP and insert into your Safety Binder.

## - SOP Information

Department:	CSUDH Campus – (Name of your department)	
Date SOP was written:	1/3/2020	
Date SOP was approved by PI/Iab supervisor:	Click or tap to enter a date.	
Principal Investigator:	Click or tap here to enter text.	
Chemical Hygiene Officer/Lab Manager:	Ricardo Magallanes/	
Lab Phone:	(XXX) – XXX – XXXX	
Office Phone:	(XXX) – XXX – XXXX	
Emergency Contact:	EHS (310) 243 – 3000	
	(Name and Phone Number)	
Location(s) covered by	Campus	
this SOP:	(Building/Room Number)	

SOP Type: [D] Specific lab procedure or experiment

[⊠] Generic use of specific chemical or class of chemicals w/ similar hazards [D] Generic use of highrisk equipment

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#### Definitions

**P.I.** – Principal Investigator. Usually a professor in charge of a laboratory or set of laboratories who is actively undertaking research. They are considered the front-line supervisor and are responsible for training and personnel safety in the laboratory.

**SDS** – Safety Data Sheets. An essential component of the GHS and are intended to provide comprehensive information about a substance or mixture for use in workplace chemical management. Also Known as MSDS (Material Safety Data Sheet)

**S.O.P.** – Standard Operating Procedure. A written set of instructions that document how to safely perform work involving hazardous chemicals or hazardous operations. Includes training documentation.

### 1. Purpose

The purpose of this standard operating procedure is to acquaint you with the proper and safe handling, use, storage and disposal of the subject chemicals.

### 2. Subject Chemicals Used in this Laboratory

Refer to the banded laboratory chemical inventory located in the Chemical Inventory Program for a listing of all chemicals in this laboratory that this SOP applies to. In addition, the banded inventory includes chemical-specific notations that supplements the information provided in this SOP (e.g., special hazards, handling, PPE).

### 3. Properties & Hazards

Chemicals in this band can cause a sudden, almost instantaneous release of pressure, gas, or heat when subjected to sudden shock, pressure, or high temperature. Also this band includes chemicals that can become explosive when they come in contact with some other chemical. The band is generally divided into two hazard levels as follows:

Highly Hazardous

• Mass explosion hazard, projection hazard, or blast hazard.

#### Generally Hazardous

• Minor hazard contained to package with no projection of fragments of appreciable size or range.

The GHS and Cal/OSHA definition of the band is described in the table below:

Hazard Level	GHS Category	GHS H-Code	Cal/OSHA Definitions
Highly Hazardous	Explosives (Division 1.1, 1.2, 1.3, 1.5 and "unstable explosive")	H200, H201, H202, H203, H205	Explosive
Generally Hazardous	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 toxic chemicals.

### 4. Administrative Control

In addition to the practices described below, follow procedures as specified in the lab-specific and special handling/use sections of this SOP.

#### General practices:

- 1. Consult with EHS prior to purchasing ATF/DOD explosives and fireworks.
- 2. Be sure to review the Safety Data Sheet (SDS) for all chemicals to be used in the experiment.
- 3. **Never work alone**. At least one other person must be present in the same laboratory when any work involving hazardous chemicals is being done.
- 4. Eliminate or substitute for a less hazardous material when possible.
- 5. Design your experiment to use the least amount of material possible to achieve the desired result.
- 6. Verify your experimental set-up and procedure prior to use. Be familiar with the Safety Data Sheets for all chemicals in use. Assess the hazards to ensure that appropriate controls are in place to minimize risk and address emergency shut-down procedures as appropriate.
- 7. Consult with the PI if the work involves procedure scale-up or other large quantities or there are any questions regarding appropriate safety procedures.

#### Band-specific practices:

- 1. Before you work with potentially explosive compounds, discuss alternative strategies with your PI.
- 2. All work involving energetic materials (explosives):
  - a. Must be pre-approved by the PI and EHS.
  - b. Must develop an energetic material / explosives safety plan
  - c. Must establish a qualification /certification plan for users
  - d. Must demonstrate proficiency
  - e. PI must set limits on not to exceed quantity of energetic material
  - f. Must review the Chemical Safety Board report on explosives safety: <u>http://www.depts.ttu.edu/vpr/integrity/csb-response/downloads/report.pdf</u>
- 3. Consult with the PI when scaling up above 50 mmol of potentially explosive compound or reagent.
- 4. Federally regulated explosives are strictly controlled. Please refer to the most recent list from the Bureau of Alcohol, Tobacco, and Firearms to see if the material you are interested in buying or making a compound that is on their list: <a href="http://www.atf.gov/regulations-rulings/rulemakings/general-notices.html">http://www.atf.gov/regulations-rulings/rulemakings/general-notices.html</a>. There are over 200 compounds and compound classes on the ATF list, including some surprisingly common reagents like dinitrophenylhydrazine. If you want to purchase or synthesize any of the explosives on the ATF list you must first contact EH&S.
- 5. Reduce the quantity of potentially explosive compounds that you work with. Buy less; store less; use less. Minimize the quantity of potentially explosive compounds in the lab by tracking them in the laboratory's inventory and disposing of unused compounds.

### 5. Engineering Control

In addition to the practices described below, follow procedures as specified in the lab-specific and special handling/use sections of this SOP.

#### General practices:

- 1. In general, it is preferable to perform all work with hazardous chemicals in a fume hood. Sash height should be kept as low as possible to avoid the escape of vapors, gases and particulates.
- 2. Supplemental equipment such as blast shields should be used when working with chemicals or processes that may result in explosions or pressure releases.
- 3. Consider the use of a glove box, toxic gas cabinet or other local exhaust in order to further contain hazards as appropriate.

#### Band-specific practices:

 All reactions involving potentially explosive reagents, intermediates, or products must be conducted in a fume hood. The use of the portable blast shield inside the hood is also recommended, as in the event of a violent explosion the fume hood safety glass may shatter and blow outward. Don't linger unnecessarily in front of a hood where explosive compounds are in use.

### 6. Personal Protective Equipment

In addition to the practices described below, follow procedures as specified in the lab-specific and special handling/use sections of this SOP.

#### **Respiratory Protection**

Respiratory protection is generally not required for lab research, provided the appropriate engineering controls are employed. Respirators should be used only under any of the following circumstances:

Lab personnel intending to use/wear a respirator mask must be trained and fit-tested by EH&S. This is a regulatory requirement. If you think that your process may require respirator use, contact EH&S for assistance.

#### Hand Protection

Disposable nitrile gloves provide sufficient protection for most routine lab operations involving small quantities. They should be changed if liquid is splashed onto them. They are not appropriate for longer operations or operations using larger quantities.

For longer operations, or operations using larger quantities, use thicker gloves made from a material appropriate for the specific chemical in use (e.g., natural rubber, butyl, neoprene, nitrile, PVA). When working chemicals or processes that increase the risk of exposure to fire, use hand protection appropriate to both the risk of chemical exposure and the risk from fire. Gloves must be inspected prior to use for signs of wear or damage. Such gloves should be disposed of in accordance with appropriate laboratory disposal practices.

Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with any chemical residues on the surface. Wash and dry hands after use.

For additional information on selection of glove material, review the specific chemical Safety Data Sheet. Consult with your preferred glove manufacturer's website to ensure that the gloves you plan on using are compatible with a specific chemical substance. Common manufacturer glove selection guidance can be found at:

http://www.ansellpro.com/download/Ansell\_8thEditionChemicalResistanceGuide.pdf

http://www.allsafetyproducts.biz/page/74172 http://www.showabestglove.com/site/default.aspx http://www.mapa-pro.com/our-gloves/protections/chemical-protection/b/handled\_product.html

#### **Eye Protection**

Use safety glasses with side shields or tightly fitting safety goggles whenever working in the laboratory.

#### **Skin and Body Protection**

Long pants, closed toed-shoes, shirt and a lab coat must be worn whenever working in the laboratory. Flame resistant Nomex® lab coats should be used when working with chemicals or processes that increase the risk of fire. Fully extend sleeves to the wrists and keep buttoned at all times. Avoid wearing synthetic clothing when practicable.

#### **Hygiene Measures**

Wash hands immediately and thoroughly after handling chemicals. Any contaminated clothing should be disposed of or washed before reuse.

#### Band-specific practices:

- 1. The use of a face shield in addition to safety glasses is recommended when working with potentially explosive chemicals. This is true even when working in front of a fume hood sash do to potential shattering in the event of a violent explosion.
- 2. Choose gloves that provide a balance between protection against lacerations (in case of an explosion) and the agility needed to work nimbly with potentially explosive compounds.

### 7. Special Handling & Storage Requirements

In addition to the practices described below, follow procedures as specified in the lab-specific section of this SOP.

Band-specific practices:

- 1. There are a variety of common triggers for chemical explosions:
  - a. Heat facilitates explosive detonations. See your PI before heating any reaction that involves potentially explosive compounds.
  - b. 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.

- c. Many metal ions, including the iron in rust, can catalyze the violent decomposition of peroxides.
- d. Acids, bases, and other substances catalyze the explosive polymerization of acrolein.
- e. Hydrogen and chlorine react explosively in the presence of light.
- f. Concentrating chemicals will increase the risk of explosion
- 2. Running reactions involving potentially explosive compounds (reagents, intermediates, or products):
  - a. Consult with your PI the first time you run a reaction.
  - b. Always follow a published procedure. If the procedure is over 20 years old then find a recent related procedure that more adequately addresses issues of safety.
  - c. If this is your first time using or making a potentially explosive compound, then run the reaction first on a small scale.
  - d. Wear appropriate PPE (see above).
  - e. Conduct all work in a fume hood.
  - f. Place a blast shield in front of the reaction so that you can reach around the sides.
  - g. Allow for gas evolution. Use glassware with septa and attach a gas outlet of sufficient diameter to allow for the non-explosive escape of gases. Never seal explosives in a closed metal vessel.
  - h. Be cautious when adding potential catalysts to significant amounts of explosive reagents. Ideally, you should add potential explosives slowly (e.g., dropwise) to solutions of a catalyst not the other way around.
  - i. Run reactions at the lowest temperature possible. If heat is needed, increase the temperature slowly.
  - j. Keep the hood sash closed while the reaction is in progress. Don't linger unnecessarily in front of the hood.
  - k. If the reaction involves formation of explosive intermediates like peroxides, quench them behind the blast shield.
  - I. Do not work up the reaction in a way that will concentrate potentially explosive compounds. In particular, never put solutions of potentially explosive compounds on the rotary evaporator.
  - m. If a solid precipitates or crystallizes and you suspect it is an explosive compound, then dissolve it in cold methanol or other appropriate solvent (the less flammable the better). Peroxides and other strong oxidizers can be reduced with aqueous bisulfate. Most non-oxidizing explosive compounds are rendered safe by dilution.
- 3. Do not transfer peroxides with metal spatulas or syringe needles; instead use a ceramic or Teflon-coated spatula for solids, or a micropipettor for liquids. Metal ions, like those in rust, can catalyze the violent decomposition of peroxides. Contact Your PI if you are unsure how to measure out a peroxide or other dangerous compound.
- 4. Compounds like diazomethane (H<sub>2</sub>C=N<sub>2</sub>) are so unstable that sharp glass edges, or even ground glass joints, can initiate detonation. If you need to make and use diazomethane, consult with your PI and the SOP before making diazomethane for the first time. There are two types of special apparatus for preparing diazomethane as ethereal solutions—the

diazomethane generator has no ground glass joints; the mini-Diazald apparatus has ClearSeal® fire-polished tapered joints. **Note:** In many cases, (trimethylsily)diazomethane performs the same chemical transformations as diazomethane (eg. Esterification) and provides a far safer and more convenient alternative, as it is commercially available (Aldrich, ACROS, P&B) as a solution in hexane or ether that may be safely transferred and metered by syringe techniques.

- 5. Follow the recommendations on the label when storing potentially explosive reagents. Store them at low temperature in an explosion-proof refrigerator/freezer or in an explosion-proof cabinet that do not contain flammable solvents. For newly synthesized potentially explosive chemicals with no manufacturer label, it is always best to store them in an explosion-proof refrigerator/freezer
- 6. Designated area(s) for use and storage of potentially explosive chemicals must be established. These designated areas must have a sign that at a minimum states "EXPLOSION RISK". Keep and store all potentially explosive chemicals away from all ignition sources such as heat, open flames, spark sources and direct sunlight
- 7. Additional information regarding the safe handling and use of oxidizers can be found at:
  - a. 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. (<u>http://www.nap.edu/catalog.php?record\_id=4911</u>).

### 8. First Aid

In addition to the practices described below, follow procedures as specified in the lab-specific and special handling/use sections of this SOP.

Consult the Safety Data Sheet for the subject chemical for specific first aid procedures. General first aid procedures for hazardous chemicals are provided below.

#### If inhaled

Move to fresh air. Have victim rest in half-upright position. Artificial respiration victim is not breathing. Seek medical attention immediately.

#### In case of skin contact

In case of contact, immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention immediately

#### In case of eye contact

Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water from emergency eyewash station for at least 15 minutes. Get medical attention immediately.

#### If swallowed

If swallowed, do not induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. Loosen tight clothing such as a collar, tie, belt or waistband. Get medical attention immediately.

### 9. Medical Emergency

Be familiar with information in the CSUDH Emergency poster.

a. Life Threatening Emergency (all times: Business Hours, After Hours, Weekends and Holidays)--CALL 911 if the condition is LIFE THREATENING or REQUIRES IMMEDIATE MEDICAL ATTENTION. <u>Note</u>: All serious injuries <u>must</u> be reported to EH&S at ext. 3000 within 8 hours. Complete online incident report at <u>https://www.csudh.edu/Assets/csudh-sites/rm-ehos/docs/risk-management-ehos/accident-report-form-std-268.pdf</u>

**b.** Non-Life Threatening Emergency – Notify your supervisor or faculty staff if condition is not life threatening or does not require immediate medical attention.

ALL WORK RELATED INJURIES MUST BE REPORTED via the On-line Incident Form <a href="https://www.csudh.edu/hr/workers-compensation/">https://www.csudh.edu/hr/workers-compensation/</a> or call Human Resources, Workers Compensation (310) 243-3771.

### 10. Spill & Accident Procedures

In addition to the practices described below, follow procedures as specified in the lab-specific and special handling/use sections of this SOP.

Evacuate the spill area. Post someone or mark-off the hazardous area with tape and warning signs to keep other people from entering the area. Keep the appropriate fire extinguisher nearby. Avoid incompatible extinguishing agents. Use Class A-B-C or B-C for flammable liquids. **Fire extinguishers containing water are not suitable for flammable liquid fires.** 

**Spill** – Assess the extent of danger. Help contaminated or injured persons if safe to do so. Evacuate the spill area. Avoid breathing vapors. If possible, confine the spill to a small area using a spill kit or absorbent material. Keep others from entering contaminated area (e.g., use caution tape, barriers, etc.).

**Small (<1 L, <100 g)** – If you have training, you may assist in the clean-up effort. Use appropriate personal protective equipment and clean-up material for chemical spilled. Double bag spill waste in clear plastic bags, label and take to the next chemical waste pick-up.

Large (>1 L, >100 g) – Dial 911 and EH&S at ext. 3000 for assistance.

**Chemical Spill on Body or Clothes** – Remove clothing and rinse body thoroughly in emergency shower for at least 15 minutes. Seek medical attention. *Notify supervisor and EH&S at* **ext. 3000** *immediately.* 

**Chemical Splash Into Eyes** – Immediately rinse eyeball and inner surface of eyelid with water from the emergency eyewash station for 15 minutes by forcibly holding the eye open. Seek medical attention. *Notify supervisor and EH&S at* **ext. 3000** *immediately.* 

### 11. Decontamination & Waste Disposal Procedure

In addition to the practices described below, follow procedures as specified in the lab-specific and special handling/use sections of this SOP.

All of the subject chemicals must be disposed as a hazardous waste.

#### Label Waste

 Hazardous waste labels must be placed on the hazardous waste container upon the start of accumulation.

#### **Store Waste**

- Hazardous waste containers must be kept closed, except when adding waste.
- Hazardous waste containers must be stored in secondary containment to adequately contain all of the contents of the container.
- Hazardous waste containers must be inspected weekly for signs of leaks, corrosion, or deterioration.

#### **Dispose of Waste**

- Hazardous waste must be transferred to EH&S for disposal within 6 months of being generated.
- Empty Containers: At no time should full or partially full containers be placed in the trash.
- Hazardous Waste Disposal:
  - o Visit: https://www.csudh.edu/ehs/environmental/hazardous-waste
  - Fill out the "CSUDH Hazardous Waste Label"
  - EH&S will pick up your waste within 1-3 days.
- **Do not** dispose of chemicals by pouring them down the drain or placing them in the trash.
- **Do not** use fume hoods to evaporate chemicals.

### 12. Safety Data Sheet (SDS) Location

Online SDSs can be accessed at http://hq.msdsonline.com/csuedusl

### 13. Required Travel/Approvals

In addition to the practices described below, follow procedures as specified in the lab-specific and special handling/use sections of this SOP.

All work with the subject chemicals requires the following prior to beginning work:

- 1. Must be pre-approved by the Principal Investigator prior to use and all training must be well documented.
- 2. Must be familiar with the CSUDH Chemical Hygiene Plan. https://www.csudh.edu/ehs/health-safety-programs-policies/
- 3. Must have documented Laboratory Safety training.
- 4. Must read the relevant Safety Data Sheet (formerly referenced as Material Safety Data Sheets).
- Any additional laboratory specific training that is needed is referenced in the 'Laboratory Specific Use Procedures' section. Signed and dated training documents must be uploaded into each assigned researchers training records.

#### Band-specific practices:

1. All persons performing work involving energetic materials (explosives) must follow the training and authorization steps described in the Administrative Controls section above.

### 14. Additional Notes

Any deviation from this SOP requires approval from P.I.

### 15. Documentation of Training

- Prior to conducting any work with the subject chemicals, designated personnel must provide training to his/her laboratory personnel specific to the hazards and procedures involved in working with these substances.
- The Principal Investigator must provide his/her laboratory personnel with a copy of this SOP and a copy of the SDS provided by the manufacturer.
- The Principal Investigator must ensure that his/her laboratory personnel have attended appropriate laboratory safety training or refresher training within the last one year.

#### I have read and understand the content of this SOP:

Name	Signature	CSUDH ID #	Date

### 16. Lab Specific Procedures

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

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. The following minimum requirements must be met:

- Identify designated use areas within the laboratory for highly hazardous chemicals in the following hazard bands:
  - o Carcinogens
  - Reproductive Toxins
  - Toxic Chemicals
- Identify maximum use quantities for which the procedures in this band apply.
- If it is determined that this hazard band SOP is sufficient to address the safe use of all subject chemicals in this lab, then include the following statement in this section: *"Procedures described"*

in this hazard band SOP are sufficient for addressing the safe use of subject chemicals in this laboratory within the listed quantity limitations."

- If it is determined that this hazard band SOP is not sufficient to address the safe use of all chemicals from that band in the lab, then write lab-specific procedures for to address these high hazard operations. Such operations are generally indicated by:
  - o tasks requiring the use of specialized PPE,
  - o tasks using highly hazardous chemicals outside of the fume hood,
  - o tasks using larger quantities of hazardous chemicals,
  - tasks involving the use of particular chemicals considered by CSUDH EHS to be extremely hazardous, and
  - o tasks considered to present high risk by lab personnel.

A few examples of what lab-specific tasks may look like are provided below:

#### Task #1: Title of the specific procedure being done.

- 1) Provide step-by-step instructions in a numbered/lettered format.
- 2) Include in the procedure any relevant:
  - a) Locations of "designated areas" as called for in the special handling section of the SOP, or as otherwise required by regulations. The entire laboratory, fume hood, or a portion of the laboratory may be considered as a designated area.
  - b) Use of specific administrative, engineering and PPE controls.
  - c) Specific quantity use limits/restrictions.
  - d) Specific storage requirements.
  - e) Specific first aid and spill procedures (including what should be handled by whom).
  - f) Specific disposal procedures.
  - g) Process-specific PI approvals required.

#### Task #2: Making dilutions of the acids and bases.

- 1) Consult with PI and obtain approval if quantities greater than 4 L are needed.
- In a fume hood, add the appropriate amount of concentrated acid or base to the calculated amount of water.
- 3) Return the concentrated acids/bases to the proper secondary containment or cabinet.

#### Task #3: Using the pH meter.

- 1) Calibrate on the day of pH testing using at least 2 standards.
- 2) Before use, rinse the electrode with deionized water and blot dry with a kim-wipe.
- 3) Transfer the electrode to the test solution.
- 4) If using a stir plate, make sure the electrode does not touch the stir bar.
- 5) Record the pH when the reading is stable (5–20 seconds after insertion of the electrode into the solution)
- 6) Add dilute acid or dilute base drop-wise until the correct pH is reached.
- 7) Rinse the electrode with deionized water and store according to the manufacturer's instructions.
- 8) Make sure the acid and base caps are on tightly.

Add as many tasks as necessary.