Administrative Information

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| --- | --- | --- | --- |
| School |  | Department |  |
| PI name |  | PI email |  |
| Lab manager name (if applicable) |  | Lab manager email (if applicable) |  |
| Locations covered by this SOP (buildings/rooms) |  |
| SOP version number |  | SOP approval date |  |
| Reviewed and approved by (name) |  | Reviewed and approved by (initials) |  |
| **Emergency contact name** |  | **Emergency contact phone\*** |  |
| Secondary emergency contact name |  | Secondary emergency contact phone\* |  |
| \* Provide emergency contact phone numbers that will be active both during normal work hours and after hours, e.g., personal mobile phone. Alternatively, give separate daytime and after-hours numbers for both contacts. |

SOP Requirements

Instructions document You are responsible for reading the [SOP Instructions](https://tiny.cc/usc-sop-instructions) outlining roles, responsibilities, and other important safety information. In addition, you must include that document as part of your records.

Recordkeeping Acknowledgement forms for this SOP and any associated training are included at the end of this document. Additional copies of the forms are available online ([SOP Acknowledgement](https://tiny.cc/usc-sop-acknowledgement), [Internal Training Record](https://tiny.cc/usc-sop-training)).

Customization It is intended that personnel add lab-specific information to the SOP template to produce a finished and functional SOP. Suggested places to add customization are highlighted in yellow throughout the document.

Standard (Safe) Operating Procedure: Explosive and Potentially Explosive Materials

Scope and importance This SOP is intended for labs which may be synthesizing or using explosive compounds or mixtures. Due to the serious nature of explosive hazards, personnel must make every effort to customize this SOP with lab and experiment specific information.

 This SOP is not aimed at labs which use explosive compounds under conditions of dilution, where explosion is impossible (e.g. picric acid solution used for staining).

 **Due to the grave nature of the hazards associated with potentially explosive materials, especially when synthesizing or using explosive compounds or mixtures, rigorous training and thorough understanding of all experimental procedures is essential. It is incumbent on personnel intending to work with potentially explosive materials to research and understand the chemistry and hazards of the materials they will be using. Training may be done by the PI’s designee; however, as supervisor, the PI is ultimately responsible for the quality and appropriateness of lab- and experiment-specific safety training.**

Planning for safe work Personnel must be aware of the serious nature of the potentially explosive materials that they intend to use and must be fully trained to work with these materials to the satisfaction of the PI. In addition, ensure all other laboratory personnel are aware of the hazardous nature of the work taking place around them.

 It is the responsibility of personnel to use every available engineering and administrative control available to them, to utilize appropriate PPE and to employ strict minimization of quantities when possible. Personnel should keep the hierarchy of safety controls in mind and utilize substitution when available.

 Two fundamental rules must be kept in mind when planning safe work with potentially explosive materials: **A potentially explosive material cannot be assumed as safe simply on the basis that it has been worked with one or more times previously without exploding** and **it is unsafe to significantly scale-up any work with potentially explosive materials.**

 It is essential for personnel working with potentially explosive materials to read, understand and follow the safe working practices outlined in Section 8, Subsection Potentially Explosive Substances, of the [CHP](http://tiny.cc/chem-hygiene-plan). **All personnel who agree to abide by this SOP are required to familiarize themselves with the contents of Section 8 of the CHP.**

Nature of hazard Explosives are substances capable of undergoing extremely rapid combustion/decomposition, which may propagate thermally below the speed of sound (“deflagration”), or via a supersonic shock wave (“detonation"). Many explosives produce large volumes of gas and high temperatures on explosion. Explosion may cause severe physical damage directly from the shock wave or extreme peak pressures, and indirectly from projectiles. Explosive materials also exhibit fire and burn hazards.

Hazard identification Classification and identification of explosives is covered in detail in Section 6 of the [CHP](http://tiny.cc/chem-hygiene-plan). **All personnel who agree to abide by this SOP are required to familiarize themselves with the contents of Section 6 of the CHP.**

 For chemicals being purchased, identification as an explosive material is made according to information found in the SDS. The OSHA/GHS hazard classification system is covered in detail in Section 6 of the [CHP](http://tiny.cc/chem-hygiene-plan).

 For individuals preparing potentially explosive chemicals or mixtures in the lab, it is imperative that they understand the guidelines for identification outlined in Section 8, Subsection *Potentially Explosive Substances* of the [CHP](http://tiny.cc/chem-hygiene-plan). This section contains information on identifying structural features in molecules that may cause them to be explosive. It also contains information on the types of mixtures which may have explosive or pyrotechnic properties. **All personnel who agree to abide by this SOP are required to familiarize themselves with the contents of Section 8 of the CHP.**

 Further information on identifying explosive hazards should be sought from [Bretherick’s Handbook of Reactive Chemical Hazards](https://app.knovel.com/web/toc.v/cid%3AkpBHRCHVE2/viewerType%3Atoc/root_slug%3Abrethericks-handbook-of) (available online at USC Libraries). Safety information given in synthetic procedures in academic journals should also be consulted.

Specific substances [Add details of specific substances you will be using in the lab under this SOP.]

Designated work area/signage Work with potentially explosive materials should be confined to areas of the lab which are appropriate for the hazards present. Areas used for work with potentially explosive materials should be signed to warn of the hazard. If highly hazardous work is being performed, additional signage giving the name of the responsible individual and contact number is also recommended.

[Add lab-specific work area and signage information here, if needed.]

Unattended experiments Unattended hazardous experiments should be signed according to the requirements of the [Unattended Experiments Fact Sheet](https://tiny.cc/usc-unattended-operations).

Storage Requirements Potentially explosive materials must be stored separately from flammables. They should be stored away from conditions that may sensitize them to explosion, including light or excessive heat, heavy metal compounds, oxidants and acids. Potentially explosive materials should be stored in non-shattering plastic containers when possible. Glass vessels of potentially explosive materials are recommended to be stored in tough plastic secondary containment. Storage in a labeled dedicated cabinet (NOT glass-fronted) is preferable.

 Storing potentially explosive materials as a solid wetted with water or as a dilute solution is a safer option whenever possible. It is very important to regularly monitor these materials in storage to ensure they are not drying out and becoming more hazardous.

 Keep track of storage time and dispose before the expiration date, or when no longer required. Many potentially explosive materials are rendered more sensitive by impurities — take care not to introduce contamination.

 Section 7 of the [CHP](http://tiny.cc/chem-hygiene-plan) gives additional information about appropriate storage of potentially explosive materials.

Labelling Potentially explosive materials not in active use shall be labelled to indicate the hazard. Storage areas should be labelled “Explosive.” Please refer to Section 5 of the [CHP](http://tiny.cc/chem-hygiene-plan) for further information about hazardous materials labelling.

PPE: General Appropriate personal protective equipment shall be worn for all work with hazardous materials, in accordance with the USC [Minimum Standard](https://tiny.cc/usc-ppe-standard), CHP, and [fact sheets](https://tiny.cc/usc-ehs-fact-sheets). Most commonly, research lab PPE consists of a lab coat, eye protection (safety glasses; goggles required if there is a splash hazard) and chemical protective gloves. A face shield may be needed in addition to goggles for severe splash hazards. Note that for reasons of safety and regulatory compliance, respirator usage is NOT permitted outside of the [USC Respiratory Protection Program](https://tiny.cc/usc-ehs-RPP-fs). Please refer to the CHP (Section 8) and [EH&S Fact Sheets](https://tiny.cc/usc-ehs-fact-sheets) for additional information about PPE requirements.

PPE: Specific Additional PPE may be required by personnel working with potentially explosive materials. Heavy leather gauntlets and apron together with a face shield (safety glasses or goggles worn underneath) may be needed for protection against flying fragments in the event of an explosion. Hearing protection is also advisable as an unexpected explosion may result in permanent hearing loss. Hearing protection designed for use with firearms should be satisfactory, including active hearing protection which allows speech to be understood but will block concussive sound.

 Note: Lab personnel in the vicinity of the work taking place must be protected to the same degree as those working with the potentially explosive material and must be trained on emergency procedures. If there is a significant potential for detonation, all lab personnel within the room, regardless of vicinity to the work taking place, must be sufficiently protected with adequate eye and hearing protection.

 [Add details of any lab- or procedure-specific PPE rules/requirements.]

Exposure control Secondary containment (e.g. polypropylene trays) should be used for experiments wherever there is potential for spillage of hazardous materials.

To prevent exposure of personnel, appropriate engineering safety controls (normally a fume hood) shall be used for all work which has potential to release health-hazardous vapor or particulates (dust, powder, spray, or liquid/solid aerosol). Please consult the [CHP](http://tiny.cc/chem-hygiene-plan) for detailed information on engineering safety controls outline in Section 8.16.

Some potentially explosive materials may also be health hazardous (e.g. acutely toxic). **Significantly health-hazardous materials which are volatile or powdery shall NOT be weighed in the open lab.** Use a balance in a fume hood if possible. Health-hazardous volatile or powdery substances may only be weighed outside of a fume hood if placed inside a tared glass vial sealed with a tight-fitting cap and free of external contamination.

Decontamination All work areas and equipment is to be cleaned and decontaminated after use.

Potentially contaminated PPE shall be removed before entering clean areas. Hands shall be washed before entering clean areas and after completion of work.

[If specific decontamination/cleaning procedures are required please enter details here.]

Blast Shield Consideration should be given to use of a heavy polycarbonate blast shield to protect personnel from blast and flying fragments. A blast shield should be commercial units designed for the purpose. Improvised blast shields may not perform adequately, especially if they are constructed from incorrect polymer (e.g. acrylic polymers which tend to shatter).

 **A regular fume hood sash is NOT a blast shield and shall NOT be used in lieu of one.**

Work practice It is essential for personnel working with potentially explosive materials to read, understand and follow the safe working practices outlined in Section 8, Subsection Potentially Explosive Substances, of the [CHP](http://tiny.cc/chem-hygiene-plan). **All personnel who agree to abide by this SOP are required to familiarize themselves with the contents of Section 8 of the CHP.**

 It is incumbent on personnel intending to work with potentially explosive materials to research and understand the chemistry and hazards of the materials they will be using. Personnel should add customized information to this section based on the specific materials and processes they will be employing. For example, if working with azides it is essential to avoid adventitious formation of heavy metal azides (e.g. from metal spatulas) as these are highly sensitive explosives. Personnel should consider chemical incompatibilities, appropriate scale of working, necessary engineering controls, and all other safety factors. Based on this, personnel should formulate appropriate written safety rules and work practices which should be documented in this SOP.

Experimental procedures [Add details of specific experimental procedures/protocols you will be using in the lab under this SOP]

Waste disposal Contaminated materials shall be disposed as hazardous chemical waste. Please follow all EH&S directions ([hazmat webpages](https://ehs.usc.edu/hazmat/), [fact sheets](https://tiny.cc/usc-ehs-fact-sheets), [CHP](http://tiny.cc/chem-hygiene-plan)). Please email hazmat@usc.edu if you have questions that are not answered by EH&S online resources.

[Add details of any lab-specific waste disposal rules.]

Spill response Chemical spill clean-up shall not be attempted if lab personnel do not have proper training and experience, necessary spill kit supplies, and/or appropriate personal protective equipment. **Before starting work, review the** [**Spill Response and Clean-Up**](https://ehs.usc.edu/hazmat/spill-cleanup/) **web page and Section 10 of the** [**CHP**](http://tiny.cc/chem-hygiene-plan)**. All personnel operating under this SOP shall familiarize themselves with this information and shall re-review these references at least annually.**

Please refer to the EH&S [Chemical Spill Kit Guide Sheet](https://tiny.cc/usc-ehs-chmSplkit-gs) for guidance on appropriate spill kit materials.

 **Call DPS for all spills, even if they get cleaned up by lab personnel.** DPS will pass information to the EH&S and Hazmat on-call system. If needed, trained staff will be sent to the lab to clean and decontaminate the spill. If lab personnel clean the spill themselves, notification should still be made as lab safety specialists may wish to follow up with a routine safety investigation.

**Spills posing a respiratory hazard SHALL NOT be cleaned by lab personnel. Evacuate the area, restrict access, call DPS.**

Emergency response **Before starting work, review the** [**Non-Life-Threatening Workplace Injury or Illness webpage**](https://ehs.usc.edu/occhealth/non-life-threatening-workplace-injury-or-illness/)**,** [**EH&S emergency webpage**](https://tiny.cc/usc-injury)**,** **and the** [**1-2-3 poster**](https://tiny.cc/usc-123)**. Ensure that the 1-2-3 poster is posted in the lab.** **All personnel operating under this SOP shall familiarize themselves with these documents and webpage.**

**All personnel operating under this SOP shall have downloaded and read Section 10 of the** [**CHP**](http://tiny.cc/chem-hygiene-plan) (“*Emergency Response / Injury and Illness Reporting*”). This section provides information on chemical exposure response, spill response, and injury reporting.

**The non-life threatening workplace Injury or Illness web page, 1-2-3 poster, CHP Section 10, and the EH&S emergency webpage are hereby incorporated into this SOP by reference.**

**All personnel operating under this SOP shall have the DPS emergency number programed into their phone** (UPC 213-740-4321; HSC 323-442-1000).

**Phone the DPS emergency line in an emergency!!** DPS have 24 h/day immediate communication access to primary and backup personnel on the EH&S and Hazmat on-call rota. **Do NOT call the EH&S general phone line or individual EH&S personnel in an emergency as access is not guaranteed.**

SOP Acknowledgement

The undersigned acknowledge by their signature that they:

1. Have read, understood, have access to, and agree to abide by this SOP, AND;
2. Have read and understood the emergency response resources incorporated into this SOP by reference (“[**1-2-3 poster**](https://tiny.cc/usc-123)”, [**Non-Life-Threatening Workplace Injury or Illness webpage**](https://ehs.usc.edu/occhealth/non-life-threatening-workplace-injury-or-illness/), [**CHP Chapter 10**](http://tiny.cc/chem-hygiene-plan), and [**EH&S emergency webpage**](https://tiny.cc/usc-injury)), AND;
3. Will download, store, read, and thoroughly familiarize themselves with safety data sheets (SDSs) for all the hazardous materials they intend to use within the scope of this SOP.

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| **Name** | **USC ID** | **Email** | **Signature** | **Date** |
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Internal Training Record

If hazards are high or complex, or personnel have limited prior experience or training, then hands-on training should be provided on the contents of this SOP. For convenience, the training may be documented using this form, although PIs are free to keep internal training records in other formats if desired. Training may be conducted by the PI, or the PI may delegate a suitably experienced and knowledgeable lab member (e.g. lab manager or senior postdoc) as the trainer. If delegated, the PI still retains management responsibility for the quality and adequacy of the safety training.

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| --- | --- | --- | --- |
| Trainer name |  | Trainer position |  |
| Trainer USC ID |  | Trainer email |  |
| Trainee #1 name  |  | Trainee #1 USC ID |  |
| Trainee #1 email |  | Trainee #1 signature |  |
| Trainee #2 name |  | Trainee #2 USC ID |  |
| Trainee #2 email |  | Trainee #2 signature |  |
| Trainee #3 name |  | Trainee #3 USC ID |  |
| Trainee #3 email |  | Trainee #3 signature |  |
| Trainee #4 name\* |  | Trainee #4 signature |  |
| Trainee #4 email |  | Trainee #4 USC ID |  |
| Date training started |  | Date training completed |  |
| Type of training (delete as appropriate) | **Initial training****Refresher training** | Type of training (delete as appropriate) | **Classroom training****Hands-on laboratory training** |
| If refresher training, provide date of initial training |  | If refresher training, was the initial training hands-on in the lab? | **YES 🞏 NO 🞏** |
| Signature of trainer confirming the above named trainees have successfully completed safety training on the contents of this SOP (and any additional subjects listed below) |  |
| Date of signing by trainer |  |
| Additional subjects covered by safety training |  |
| \* If there are more than four trainees, please append an additional sign-in sheet. |