



Flammable Liquids and Solids

H224 H225 H226 H227 H228



Areas with blue text indicate that information must be provided or modified by researcher prior to the SOP approval.

This SOP is not a substitute for hands-on training.

Print a copy and insert into your laboratory SOP binder.

Department:	
Date SOP was written:	Monday, August 21, 2017
Date SOP was approved by PI/lab supervisor:	
Principal Investigator:	Name: Signature: _____
Internal Lab Safety Coordinator or Lab Manager:	Name: Lab Phone: Office Phone:
Emergency Contact:	Name: Phone Number:
Location(s) covered by this SOP:	

1. Purpose

This SOP covers the precautions and safe handling procedures for the use of Flammable Liquids and Solids.

For a list of Flammable Liquids and Solids covered by this SOP and their use(s), see “List of Chemicals”. Procedures described in Section 12 apply to all materials covered in this SOP.

If you have questions concerning the applicability of any recommendation or requirement listed in this procedure, contact the Principal Investigator/Laboratory Supervisor or the campus Chemical Hygiene Officer at ucbcho@berkeley.edu.



2. Physical & Chemical Properties/Definition of Chemical Group

Flammable liquid means a liquid having a flash point¹ of not more than 199.4 °F (93 °C).

Combustible liquid means a liquid having a flash point higher than 199.4 °F (93 °C).

Flammable solid means a solid which is readily combustible² or may cause or contribute to fire through friction.

3. Potential Hazards/Toxicity

Flammable and combustible liquids are defined by their flash point.

Flammable liquids are divided into 4 categories:

- **Category 1** includes liquids having flashpoints below 73.4 °F (23 °C) and having a boiling point at or below 95 °F (35 °C)
- **Category 2** includes liquids having flashpoints below 73.4 °F (23 °C) and having a boiling point above 95 °F (35 °C)
- **Category 3** includes liquids having flashpoints at or above 73.4 °F (23 °C) and at or below 140 °F (60 °C).
- **Category 4** includes liquids having flashpoints above 140 °F (60 °C) and at or below 199.4 °F (93 °C)

Flammable solids are divided into 2 categories based on their burning rate and resistance to being extinguished:

- **Category 1** – rapidly burning materials very resistant to being extinguished by water
- **Category 2** – slower burning materials that may be extinguished by water

The Globally Harmonized System of Classification and Labeling of Chemicals (GHS) designates flammable liquids and solids by one or more of the following H codes:

- H224** Extremely flammable liquid and vapor
- H225** Highly flammable liquid and vapor
- H226** Flammable liquid and vapor
- H227** Combustible liquid
- H228** Flammable solid

Flammable liquids and solids may also have other hazardous properties in addition to toxicity. Safe use requires assessing all potential hazards.

It is the Principal Investigator's responsibility to ensure activity-specific laboratory procedures and/or processes are taken into account when using this Chemical Class SOP.

Please, review the SDS of any chemical before use (see Section 11 – SDS Location).

¹ Flash point: lowest temperature at which the application of an ignition source causes vapors of a liquid to ignite under specified conditions.

² Readily combustible solids are powdered, granular or pasty substances which are dangerous if they can be easily ignited by brief contact with an ignition source and if the flames spread rapidly.



4. Engineering Controls

Use the engineering controls listed below unless other lab-specific information is included in the Protocol/Procedure section.

- Work with Flammable Liquids and Solids – the work must be conducted in a fume hood unless other controls are designated in the lab-specific Protocol/Procedure section. Sash height must be kept as low as possible to avoid escaping fumes and provide a physical barrier.
- Laboratories and rooms where Flammable Liquids and Solids are used must have general room ventilation that is negative pressure with respect to the corridors and external environment. The laboratory/room door must be kept closed at all times.

5. Personal Protective Equipment

At a minimum, the following PPE must be worn at all times.

Eye and Face Protection

- A. ANSI Z87.1-compliant safety glasses with side shields, or chemical splash goggles.
 - Ordinary prescription glasses will NOT provide adequate protection unless they also meet ANSI standard and have compliant side shields.
- B. If the potential for explosion/splashing exists, and adequate coverage is not provided by the hood sash, a face shield must be worn.

Skin and Body Protection

- A. Gloves are required when handling hazardous chemicals.
 - Refer to specific chemical SDS for information on glove selection.
 - For additional information on glove selection, go to:
<http://ehs.berkeley.edu/hs/63-laboratory-safety/94-glove-selection-and-usage.html>
- B. Lab coats are required when handling hazardous chemicals in the lab. Select the type of lab coat according to the hazards at the specific workplace.
 - Flame-resistant lab coat (Nomex IIIA, NFPA 2112) must be worn if handling large quantities (>1 liter) or when working near an open flame or ignition source.
 - *Exception to this requirement is for conducting **Flame Sterilization** following the campus approved SOP.*
 - Long pants, closed-toe/closed-heel shoes, covered legs, and ankles.

Respiratory Protection

Respiratory protection is normally not required for UC Berkeley laboratory activities. Any lab personnel considering the use of a respirator (e.g. N-95 respirator, dust mask) must contact EH&S for a workplace assessment.

6. First Aid Procedures and Medical Emergencies

In the event of an injury, notify your supervisor immediately and EH&S within 8 hours.



Go to the Occupational Health Facility (Tang Health Center, on campus); if after hours, go to the nearest emergency room (Alta Bates, 2450 Ashby Ave in Berkeley); or



Call 911 (from a cell phone: 510-642-3333) if:



- *it is a life threatening emergency; or*
- *you not are confident in your ability to fully assess the conditions of the environment and/or the condition of the contaminated/injured person, or you cannot be assured of your own safety; or*
- *the contaminated/injured person is not breathing or is unconscious.*

Please remember to provide a copy of the appropriate manufacturer SDS (if available) to the emergency responders or physician. At a minimum, be ready to provide the identity/name of any hazardous materials involved.

In case of skin contact

If skin contact occurs, and/or skin or clothing are on fire, immediately drench in the safety shower with copious amounts of water for no less than 15 minutes to remove any remaining contaminants. If possible to do so without further injury, remove any remaining jewelry or clothing.

In case of eye contact

Rinse thoroughly with plenty of water using an eyewash station for at least 15 minutes, occasionally lifting the upper and lower eyelids. Remove contact lenses if possible.

If swallowed

Do NOT induce vomiting unless directed otherwise by the SDS. Never give anything by mouth to an unconscious person. Rinse mouth with water.

If inhaled

Move into fresh air.

Needle stick/puncture exposure

Wash the affected area with antiseptic soap and warm water for 15 minutes.

7. Special Handling, Storage, and Disposal Requirements

Lab-specific information on handling and storage may be included in Section 12-Protocol/Procedure.

Bonding and grounding

- All containers of 4L (1 gal) or more of Category 1, 2 and 3 Flammable Liquids must be bonded and grounded during dispensing. For guidance on bonding and grounding, please contact EH&S.
- **Transfers of flammable liquids without bonding and grounding are allowed when dispensing between containers of 4L (1gal) or less.**

Precautions for Safe Handling

- Eliminate or substitute for a less hazardous material when possible.
- Design your experiment to use the least amount of material possible to achieve the desired result.
- Do not exceed the scale of procedures specified in Protocol/Procedure section without approval of the PI.
- Verify your experimental set-up and procedure prior to use.
- Know the location of the nearest eyewash, safety shower and fire extinguisher before beginning work.
- Upon leaving the work area, remove any personal protective equipment worn and wash hands.
- At the end of each project, thoroughly decontaminate the work area according to the material being handled.

Conditions for Safe Storage



- No more than 10 gallons of flammable materials, including hazardous waste, can be stored outside of a flammable storage cabinet.
- It is best practice to store flammable liquids in flammable storage cabinets with self-closing doors and latching mechanism.
- Chemicals that require refrigeration must be stored appropriately in a U.L. Listed flammable refrigerator/freezer. They are designed to prevent ignition of flammable vapors inside the storage compartment. Explosion proof refrigerators/freezers require special wiring rather than the simple plug-in type power cord. Consult with UC Berkeley Fire Prevention Office before purchasing an explosion proof refrigerator/freezer.
- Flammable storage cabinets must be clearly marked (e.g. “Flammable Storage” or “Flammable”).
- If stored outside a flammable storage cabinet, flammable liquids and solids must be stored away from ignition sources.

Disposal

- Waste materials generated must be treated as a hazardous waste.
- The empty container must be rinsed three times with a COMPATIBLE solvent; leave it open in the back of the hood overnight. Solvent rinses and water rinse must be disposed of as hazardous waste.
- As an alternative, unrinsed empty containers can be disposed of through EH&S as hazardous waste. The unrinsed empty containers must be capped.
- Do not mix with incompatible waste streams.

8. Chemical Spill

Spill – Assess the extent of danger; if necessary request help by calling **911** (from a cell phone: **510-642-3333**) for emergency assistance or 510-642-3073 for non-life threatening situations. If you cannot assess the conditions of the environment well enough to be sure of your own safety, do not enter the area. If possible help contaminated or injured persons. Evacuate the spill area. Avoid breathing vapors from spill. 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.).

- **Minor Spill** – In the event of a minor spill, if there is no potential for hazardous chemical exposure, report the spill to 510-642-3073 and if you are trained, proceed to clean it. Use appropriate personal protective equipment and clean-up material for chemical spilled. Double bag spill waste in clear plastic bags, label and request pick-up.
- **Major Spill** – Any hazardous chemical spill that involves chemical exposure, any chemical spill that due to size and/or hazard requires capabilities beyond your training, or any chemical spill that gives the perception (because of odor, for example) that there has been a hazardous release. Call **911** or 510-642-3073 for assistance.

9. Cleaning and Decontamination

Lab-specific information on decontamination may be included in Section 12 - Protocol/Procedure.

- Wearing proper PPE, laboratory work surfaces must be cleaned at the conclusion of each procedure and at the end of each work day.
- Decontaminate all equipment before removing from a designated area.



10. Hazardous Waste Disposal

Label Waste

- Label all waste containers. See the EH&S Fact Sheet, “Hazardous Waste Management” for general instructions on procedures for disposing of hazardous waste.

Dispose of Waste

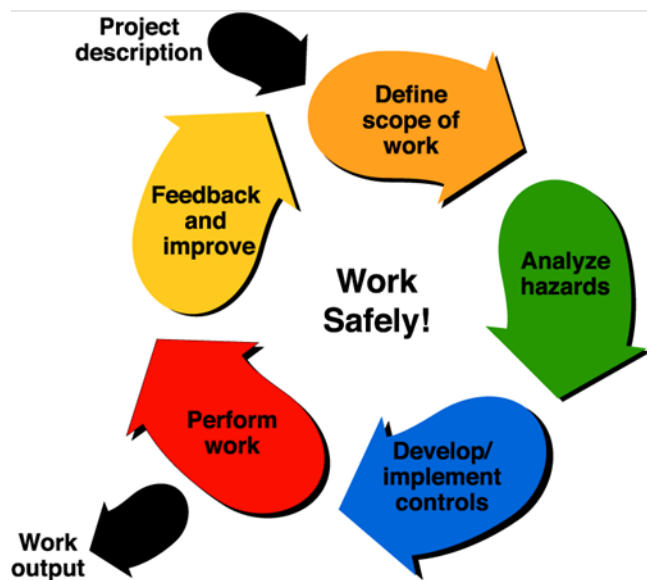
- Dispose of regularly generated chemical waste within 6 months.
- Contact EH&S at 642-3073 if you need assistance.

11. Safety Data Sheet (SDS) Location

SDS can be accessed online at <http://ucsdgs.com>



-Take Ownership of Your Safety-



Before starting any work, ask yourself:

- 1- **What will I be doing?**
- 2- **Do I know what the hazards are?**
- 3- **Do I have everything I need to do the job safely?**
- 4- **Am I doing the job safely?**
- 5- **What can we do better?**



12. Protocol/Procedure for – Flammable Liquids and Solids

Section 12 must be customized to your specific needs. Delete any procedure that does not apply to your laboratory.

Procedure/Use	Scale	Engineering Controls/Equipment	PPE (eye, face, gloves, clothing)	Procedure Steps and Special Precautions for this Procedure
1. Using Flammable Liquids and Solids as reagents.	Up to 100 mL or 2 g as supplied in the reagent bottle. Remember to obtain PI approval if higher scale is necessary.	All reactions using these materials must be performed in a properly operating fume hood with the sash as low as possible.	Eye protection: Wear ANSI Approved tight-fitting safety goggles or safety glasses with side shields. Face Protection: Face shields are to be used when there is no protection from the hood sash. Hand Protection: Confirm compatibility of glove material with chemical being used. General guidance (unless otherwise specified in the specific SDS): Nitrile gloves must be used to prevent incidental contact. For spill handling or for potential contact with larger quantities, use double nitrile or heavier gauge nitrile or neoprene gloves. Gloves must be inspected prior to use. Wash and dry hands after use. Clothing: Wear lab coat; full length pants or equivalent; and close-toed, close-heeled shoes.	Avoid the formation of dusts with solids. Carefully weigh reagent in an enclosed or vented area. If this is not possible use the tared vessel method and cap the vessel during transport to and from the balance. Use a secondary container for transport of the tared vessel. Immediately move all operations to the fume hood when weighing is complete. In a properly functioning fume hood, add reagent to the reaction vessel. If the reagent is a liquid, dispense and transfer to the reaction vessel using the appropriate technique (syringe, pipettor, or cannula method).
Notes	Any deviation from this SOP requires approval from PI.			



Procedure/Use	Scale	Engineering Controls/Equipment	PPE (eye, face, gloves, clothing)	Procedure Steps and Special Precautions for this Procedure
<p>2. Using Flammable Liquids as solvents in reactions, for extractions.]</p>	<p>Up to 500 mL as supplied in the reagent bottle.</p> <p style="color: red;">Remember to obtain PI approval if higher scale is necessary.</p>	<p>All reactions using these materials must be performed in a properly operating fume hood with the sash as low as possible.</p>	<p>Eye protection: Wear ANSI Approved tight-fitting safety goggles or safety glasses with side shields.</p> <p>Face Protection: Face shields are to be used when there is no protection from the hood sash.</p> <p>Hand Protection: Confirm compatibility of glove material with chemical being used. General guidance (unless otherwise specified in the specific SDS): Nitrile gloves must be used to prevent incidental contact. For spill handling or for potential contact with larger quantities, use double nitrile or heavier gauge nitrile or neoprene gloves. Gloves must be inspected prior to use. Wash and dry hands after use.</p> <p>Clothing: Wear lab coat; full length pants or equivalent; and close-toed, close-heeled shoes.</p>	<p>Avoid inhalation of these materials.</p> <p>If a rotary evaporator is used, use an open cold trap system to condense the solvent.</p> <p>Pressure can be built up when these solvents are used in closed reaction vessels. Adequate ventilation (e.g. pressure bubbler on Schlenk manifold, or an equilibrating balloon) must be used to prevent dangerous over pressurization.</p> <p>Pressure may be built up when performing extractions. Adequate ventilation (open the valve frequently during the extraction) has to be used to prevent dangerous over pressurization. The vapor in such a process must be released in a fume hood.</p> <p>If heated, the reaction apparatus has to be fitted with an adequately sized condenser and an adequate flow of cooling water has to be provided to prevent evaporation. Cooling hoses have to be secured with hose clamps to the condenser and the outlet. </p>
Notes	Any deviation from this SOP requires approval from PI.			



Procedure/Use	Scale	Engineering Controls/Equipment	PPE (eye, face, gloves, clothing)	Procedure Steps and Special Precautions for this Procedure
<p>3. Using Flammable Liquids as solvents in column chromatography (CC) or thin layer chromatography (TLC).</p>	<p>Up to 2 L as supplied in the reagent bottle.</p> <p style="color: red;">Remember to obtain PI approval if higher scale is necessary.</p>	<p>All reactions using these materials must be performed in a properly operating fume hood with the sash as low as possible.</p>	<p>Eye protection: Wear ANSI Approved tight-fitting safety goggles or safety glasses with side shields.</p> <p>Face Protection: Face shields are to be used when there is no protection from the hood sash.</p> <p>Hand Protection: Confirm compatibility of glove material with chemical being used. General guidance (unless otherwise specified in the specific SDS): Nitrile gloves must be used to prevent incidental contact. For spill handling or for potential contact with larger quantities, use double nitrile or heavier gauge nitrile or neoprene gloves. Gloves must be inspected prior to use. Wash and dry hands after use.</p> <p>Clothing: Wear lab coat; full length pants or equivalent; and close-toed, close-heeled shoes.</p>	<p>Avoid inhalation of these materials.</p> <p>Thin Layer Chromatography: allow the plate to dry in the fume hood after removal from the development bath.</p> <p>Column Chromatography: collect fractions of interest and concentrate as needed.</p> <p>If a rotary evaporator is used, use an open cold trap system to condense the solvent.</p> <p>After use in the column, allow the solvent to evaporate from the packing material prior to proper disposal of the packing material.</p>
Notes	Any deviation from this SOP requires approval from PI.			



13. Documentation of Training (signature of all users is required)

- Prior to conducting any work with Flammable Liquids and Solids, designated personnel must provide training to his/her laboratory personnel specific to the hazards involved in working with this substance, work area decontamination, and emergency procedures.
- The Principal Investigator must provide his/her laboratory personnel with a copy of this SOP and a copy of the relevant SDSs provided by the manufacturer(s).

I have read and understand the content of this SOP:

Name	Signature	Identifier	Date



Appendix – Table Comparing GHS and NFPA 30 Nomenclatures

NFPA 30 has not changed their nomenclature of the “classes” of flammable liquids to “categories” and also still distinguished between flammable liquids and combustible liquids. For clarity, the equivalency chart is included as a convenience.

Flash Point (FP)	Flammable Liquid <i>Category</i> (GHS)	Flammable <i>And</i> Combustible Liquid <i>Class</i> (NFPA 30)
FP Below 73.4°F (23°C)/ AND Boiling Point (BP) at or below 95°F (35°C)	Category 1	Class IA
FP Below 73.4°F (23°C)/ AND BP above 95°F (35°C)	Category 2	Class IB
At or above 73.4°F (23°C) but below 100°F (37.8°C)	Category 3	Class IC
At or above 100°F (37.8°C) and at or below 140°F (60°C)		Class II (“Combustible Liquid”)
Above 140°F (60°C) and at or below 199.4°F (93°C)	Category 4	Class III (“Combustible Liquid”)
Above 199.4°F (93°C)	Not regulated by 1910.106, UNLESS a liquid with a FP greater than 199.4°F is heated within 30°F of its FP, it then must be handled as a Category 4 flammable liquid.	Class IIIB (was not regulated by 1910.106)



List of Chemicals

Chemical(s)	Chemical(s)	Chemical(s)
Acetone	Ethanol	Formaldehyde
Formalin		