



Flammable Liquids and Solids

H224 H225 H226 H227 H228



Prior to SOP approval, lab-specific information must be entered in the fields marked by blue boxes.

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:	
Date SOP was approved by PI/lab supervisor:	
Principal investigator/lab supervisor:	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).

4. Engineering Controls

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.



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, and 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 are not 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, or 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 (1 gal) 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 a 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 fume 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 (e.g., because of odor) 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 510-642-3073 if you need assistance.

11. Safety Data Sheet (SDS) Location

SDS can be accessed online at <http://ucds.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
	Remember to obtain PI approval if higher scale is necessary.			
Notes	Any deviation from this SOP requires approval from PI.			



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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 distinguishes 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 Combustible</i> 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)