**FLAMMABLE LIQUIDS**

**STANDARD OPERATING PROCEDURE**

**Type of SOP:**  ProcessHazardous Chemical Hazard Class

# HAZARD OVERVIEW

The **flashpoint** of a flammable liquid is the lowest temperature at which it can form an ignitable mixture with air and produce a flame when a source of ignition is present.

# HAZARDOUS CHEMICAL(S) OR CLASS OF HAZARDOUS CHEMICAL(S)

Flammable liquids are chemicals that have a flash point below 100º F (38.7º C) and a vapor pressure that does not exceed 40 psig at 100º F.

Flammable liquids are commonly divided into three classes

Class Flash Point Boiling Point Example

IA Below 73°F Below 100 °F Ethyl Ether

IB Below 73 °F At or above 100 °F Acetone, Benzene, Toluene

IC At or above 73°F and Methanol, Isopropanol, Xylene

below 100°F

Combustible liquids are divided into three classes

|  |  |  |
| --- | --- | --- |
| Class | Flash Point | Example |
| II | 100-139 °F | Acetic acid, cyclohexane, and mineral spirits |
| IIIA | 140-199 °F | Cyclohexanol, formic acid and nitrobenzene |
| IIIB | 200 °F or above | Formalin and vegetable oil |
|  |  |  |

# PERSONAL PROTECTIVE EQUIPMENT (PPE)

## Eye Protection

ANSI compliant safety glasses with side shields should be worn. Chemical splash goggles should be worn when working with larger quantities. If chemical has a skin hazard or is a caustic liquid, a face shield should be worn when splashing onto the face is a possibility.

## Skin and Body Protection

Wear chemical resistant cleanroom smock, long pants or equivalent, and closed-toe shoes. These smocks must be appropriately sized for the individual and be zipped to their full length. Cleanroom smock sleeves must be of a sufficient length to prevent skin exposure while wearing gloves.

A chemical resistant apron should be used when transferring or using large quantities and splashing is a possibility.

## Hand Protection

At a minimum, wear a nitrile chemical-resistant glove (supplied by cleanroom). Consult with your preferred glove manufacturer to ensure that the gloves you plan on using are compatible with the chemical and usage.

<http://www.ansellpro.com/download/Ansell_8thEditionChemicalResistanceGuide.pdf> or <http://www.showabestglove.com/site/default.aspx>

Additional PPE may be required if procedures or processes present additional risk. It is the responsibility of the PI to ensure that any additional PPE requirements are identified and communicated to research staff. Contact EH&S for consultation.

# ENGINEERING/VENTILATION CONTROLS

All chemicals should be transferred and used in the stainless steel solvent bench or spin coating bench. The bench flow magnahelic pressure gauge should be checked to be operating correctly prior to using the hood.

* Safety Shielding: Shielding is required any time there is a risk of explosion, splash hazard or a highly exothermic reaction. All manipulations of flammable liquids which pose this risk should occur in a fume hood with the sash in the lowest feasible position. Portable shields, which provide protection to all laboratory occupants, are acceptable.
* Special Ventilation: Manipulation of flammable liquids outside of a fume hood may require special ventilation controls in order to minimize exposure to the material. Fume hoods provide the best protection against exposure to flammable liquids in the laboratory and are the preferred ventilation control device. Always attempt to handle quantities of flammable liquids greater than 500 mL in a fume hood. If your research does not permit the handing of large quantities of flammable liquids in your fume hood, contact the EHS to review the adequacy of all special ventilation.
* Vacuum Protection: Evacuated glassware can implode and eject flying glass, and chemicals. Vacuum work involving flammable liquids must be conducted in a fume hood, glove box or isolated in an acceptable manner. Mechanical vacuum pumps must be protected using cold traps and, where appropriate, filtered to prevent particulate release. The exhaust for the pumps must be vented into an exhaust hood. Vacuum pumps should be rated for use with flammable liquids.

# SPECIAL HANDLING PROCEDURES AND STORAGE REQUIREMENTS

Use in an area that is properly equipped with a certified eye wash/safety shower and is available within ten seconds of travel.

Wash thoroughly after handling. Do not ingest or inhale nor get in eyes, skin or clothing. Remove contaminated clothing and wash before reuse.

Store in a tightly closed, labeled container and in a cool, dry well-ventilated area. Segregate from incompatible materials. Secondary containers must be labeled clearly. Follow any substance-specific storage guidance provided in Safety Data Sheet documentation.

Use small quantities whenever possible. Monitor your inventory closely to assure that you have tight control over your material.

* **Flammable Liquid Storage Cabinets**
* One or more Flammable Liquid Storage Cabinets (FLSC) are required for laboratories which store, use or handle more than 5 gallons of flammable or combustible liquids.
* Containers one gallon and larger of flammable liquids must be stored in a flammable-liquids storage cabinet.
* The storage of flammable and combustible liquids in a laboratory, shop, or building area must be kept to the minimum needed for research and/or operations. FLSC are not intended for the storage of highly toxic materials, acids, bases, compressed gases or pyrophoric chemicals.
* In most university laboratories flammable liquids storage is provided under the chemical fume hood. These cabinets are clearly marked “Flammable Storage”. Flammable liquids storage cabinets are constructed to limit the internal temperature when exposed to fire. When additional storage is needed, NFPA 30-4.3.3 approved flammable liquids storage cabinet (FLSC) may be purchased. All containers of flammable liquids must be stored in a FLSC when not in use. The following requirements apply:

General Requirements

* Cabinets shall be no larger than 45 gallon capacity
* Cabinets should be located near fume hood alcoves
* Cabinets shall be marked “Flammable-Keep Fire Away”
* Cabinets should be kept in good condition. Doors that do not close and latch must be repaired or the cabinet must be replaced.
* Flammable liquids storage cabinets are equipped with a grounding system that can be connected to a building ground. If you are pouring from a container in the storage cabinet and if the container being poured into is conductive then a bonding strap must be attached between them as explained in PROCEDURES TO AVOID STATIC ELECTRICITY.
* **Transferring/Dispensing**

STATIC ELECTRICITY HAZARDS IN THE LABORATORY

The flow of flammable and combustible liquids can cause the buildup of static electricity. When enough of a charge is built up a spark can result and potentially cause a fire or explosion. The likelihood of this happening is dependent upon how well the liquid conducts electricity, the flash point and the capacity to generate static electricity.

Static electricity can be generated when liquid is transferred from one metal container to another. No metal containers with flammable liquids are allowed inside the cleanroom. Liquids have the ability to generate static electricity when they move in contact with other materials during pouring, pumping or agitating. The buildup of this static electricity can cause a spark to form where the solvent exits the container. This could result in a fire or explosion.

PROCEDURES TO AVOID STATIC ELECTRICITY

Static hazards may also exist in non-metallic plastic or glass containers that cannot be grounded. Static may be generated by the free fall and turbulence of the liquid being poured. To minimize this hazard, pour as slowly as possible and use a grounded nozzle extension that allows filling the container from the bottom.

* **Labeling**
* All flammable liquids must be clearly labeled with the correct chemical name.
* Handwritten labels are acceptable; chemical formulas and structural formulas are not acceptable.
* The label on any containers of flammable liquids should say “Flammable” and include any other hazard information, such as “Corrosive” or “Toxic”, as applicable.
* **Heating/Open flame**
* Do not store flammable liquids in chemical fume hoods or allow containers of flammable liquids in proximity to heating mantles, hot plates, or torches.
* With the exception of vacuum drying ovens, laboratory ovens rarely have any means of preventing the discharge of material volatilized within them. Thus it should be assumed that these substances will escape into the laboratory atmosphere, but may also be present in sufficient concentration to form explosive mixtures within the oven itself. Venting the oven to an exhausted system will reduce this hazard.
* Drying ovens should not be used to dry glassware that has been rinsed with organic solvents until the majority of the solvent has had the opportunity to drain or evaporate at room temperature.
* Do not use mercury thermometers to monitor oven temperatures. Accidental breakage of the thermometer will cause a serious hazard since uncontained mercury will volatilize very rapidly.

# SPILL AND INCIDENT PROCEDURES

**Chemical Spill** - Dial 911 and EH&S: (951) 827-5528

Assess the extent of danger. Help contaminated or injured persons. 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* – If you have training, use appropriate personal protective equipment and clean-up materials for chemical spilled. Double bag spill waste in clear, plastic bag, then label and arrange for chemical waste pick-up.
* *Large*– Dial 911 and EH&S at (951) 827-5528 for assistance. Notify others in area of spill. Turn off ignition sources in area. Evacuate area and post doors to spill area. Remain on the scene, but at a safe distance, to receive and direct safety personnel when they arrive.

*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 (951) 827-5528 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 (951) 827-5528 immediately.

**Medical Emergency** - Dial 911 and EH&S (951) 827-5528

Refer to “Injuries and Medical Treatment” Flipchart posted in the laboratory.

# DECONTAMINATION

Wear proper PPE, decontaminate equipment and bench tops using [soap and water]. Dispose of all used contaminated disposables as hazardous waste following the Waste Disposal Section.

# WASTE DISPOSAL

All waste must be disposed through the EH&S Hazardous Waste Program. Staff dealing with hazardous waste disposal should have completed UCR Hazardous Waste Management training - <http://ehs.ucr.edu/training/online/hwm/indexlms.html>

General hazardous waste disposal guidelines:

* Affix an on-online hazardous waste tag using the Online Tag Program (OTP - <https://otp.ucop.edu/>) on all waste containers as soon as the first drop of waste is added to the container.
* Store hazardous waste in closed containers, in secondary containment, and in a designated location. Do not let product enter drains. Discharge into the environment must be avoided.
* Double-bag dry waste using transparent bags.
* Waste must be under the control of the person generating and disposing of it.
* Dispose of routinely generated chemical waste within 90 days.
* Request a waste pick-up on-line: <http://ehs.ucr.edu/services/waste.html>

# PRIOR APPROVAL/REVIEW REQUIRED

All work with Flammable Liquids must be pre-approved by the Principal Investigator prior to use and all training must be well documented. In addition, the following shall be completed:

* Documented specific training and specific training on the techniques and processes to be used.
* Read and understand the relevant Safety Data Sheet.
* Demonstrate competence to perform work.

A review of this SOP and re-approval is required when there are any changes to procedures, personnel, equipment, or when an incident or near miss occurs.

# DESIGNATED AREA

Work should be completed in a laboratory fume hood designated for Flammable Liquids.

# SAFETY DATA SHEETS

Online SDS can be found at <http://www.ehs.ucr.edu/services/msds.html>.

# DETAILED PROTOCOL

All lab workers who will be using Flammable Liquids must review this SOP and sign the associated training sheet. Lab workers must have specific training on the proper handling of Flammable Liquids and understand the hazards.

Lab workers using Flammable Liquids must demonstrate competence to the Cleanroom Staff by being able to 1) identify the hazards and list any particularly hazardous handling techniques (extremes of pressure or temperature, etc.), 2) list the foreseeable emergency situations, 3) describe the proper response to the emergency situations, and 4) know the control measures to minimize the risks.

The research laboratory requires variation in reaction conditions to develop and optimize new chemical or biological transformations. The researcher must seek literature precedent for reaction conditions that have reasonable similarities to new chemistry that is planned with Flammable Liquids described in this SOP. The researcher must also consult the Cleanroom staff for approval to proceed with chemical or biological transformations that have little literature or local research group precedent. Cleanroom staff approval must also be obtained for significant scale-up of new chemistry or biological transformations.

When working in the lab, a laboratory worker must:

* + 1. not work alone;
    2. be cognizant of all of the SDS and safety information presented in this document;
    3. follow all related SOPs in the laboratory SOP bank (PPE, syringe techniques, waste disposal, etc. as appropriately modified by any specific information in the SDS information presented in this document);
    4. employ less (< 200 mL) of this Flammable Liquids in any given reaction (larger quantities REQUIRE the approval of Cleanroom Staff), and
    5. discuss ALL issues or concerns regarding this Flammable Liquids with the staff prior to its use.

If there is an unusual or unexpected occurrence when using this material(s), the occurrence must be documented and discussed with the Principal Investigator and Cleanroom Supervisor and others who might be using Flammable Liquids.  Unusual or unexpected occurrences might include a fire, explosion, sudden rise or drop in temperature, increased rate of gas evolution, color change, phase change, or separation into layers.

**SOP Reviewed and Approved by:**

**Print name:** Dr. Robert C. Haddon **Signature:** \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Approval Date:** \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Acknowledgement

**Standard Operating Procedure**

**Title: ­ Flammable Liquids**

By my signature I acknowledge the contents, requirements, and responsibilities outlined in this Standard Operating Procedure (SOP):

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| **Name** | **Identification\*** | **Signature** | **Date** |
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***\*Identification:*** *Enter your Student ID, Employee ID, UCR NetID, UCR Email*