**Flammable Liquids**

**STANDARD OPERATING PROCEDURE (SOP)**

**Type of SOP:** ☐ Process ☐ Hazardous Chemical ☒ Hazardous Class

**All personnel subject to these SOP requirements must review a completed SOP and sign the associated training record. Completed SOPs must be kept in the laboratory’s safety binder or be otherwise readily accessible to laboratory personnel. Electronic access is acceptable. SOPs must be reviewed, and revised where needed, as described in the** [**SJSU Chemical Hygiene Plan**](https://www.sjsu.edu/fdo/departments/ehs/lab/Chemical_Hygiene_Plan.pdf)**. Note that not all hazardous chemicals are appropriately addressed in a single Hazard Class SOP, and some chemicals are subject to several Hazard Class SOPs.**

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| Date SOP Written:  |  |  | Approval Date: |  |
| SOP Prepared by: | **REQUIRED - Insert Preparer's Name** |
| SOP Reviewed and Approved by (name/signature): | **REQUIRED - Insert Approver's Name & Signature** |
| Department:  | **REQUIRED - Insert Department** |
| Principal Investigator/Laboratory Supervisor:  | **REQUIRED - Insert Name** | Phone:  | **REQUIRED - Insert Phone#** |
| Emergency Contact(s):  | **REQUIRED - Insert Name** | Phone:  | **REQUIRED - Insert Phone#** |
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| Location(s) covered by SOP: | Building: | **REQUIRED - Insert Name** | Lab Phone: | **REQUIRED - Insert Phone#** |
| Room #(s):  | **REQUIRED - Insert Number** |

1. **HAZARD OVERVIEW**

Flammable and combustible liquids are those which can ignite when exposed to an ignition source at or above the flash point of the liquid. For a fire to occur three elements are required: fuel, ignition source, and oxygen. Flammable and combustible liquids serve as fuel for a fire.

1. **HAZARDOUS CHEMICAL(S)/CLASS OF HAZARDOUS CHEMICAL(S)**

Flammable liquids are defined by their flash point (i.e. the minimum temperature at which vapors are formed on the surface of a substance in sufficient quantity to ignite when exposed to an ignition source). OSHA and GHS (hazard codes H224, H225, H226) define flammable liquids as those with a flash point less than 37.8 °C (100 °F), while combustible liquids (hazard code H227) have a flash point greater than 37.8 °C (100 °F). The California Fire Code further classifies flammable liquids by their flash and boiling points. A summary table is provided below:



A few examples of common flammable or combustible liquids in use at SJSU are:

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| **Chemical name** | **Boiling point** | **Flash point** | **Classification** | **GHS Code** |
| Acetone | 56 °C (133 °F) | -20 °C (-4 °F) | IB | H225 |
| 1-Butanol | 118 °C (244 °F) | 37 °C (98 °F) | IC | H226 |
| Diesel fuel | 149 – 371 °C (300 - 700 °F) | >60 °C (140 F) | IIIA | H227 |
| Diethyl ether | 34.6 °C (94.3 °F) | -45 °C (-49°F) | IA | H224 |
| Ethanol | 78.2 °C (173.3 °F) | 14 °C (55.0 °F) | IB | H225 |
| 1-Propanol | 97.2 °C (207 °F) | 59 °C (59 °F) | IB | H225 |
| Vacuum pump oil | 476 °C (889 °F) | 288 °C ( 550°F) | IIIA | H227 |

**REQUIRED:** List (or attach) the applicable Flammable chemical(s) for your inventory, and describe important properties and signs/symptoms of exposure. Note: listing only Flammable Liquids is required, though Combustible Liquids may be added if desired.

1. **ENGINEERING/VENTILATION CONTROLS**

**Chemical Fume Hood**

Flammable liquids should be used in a certified chemical fume hood. Flammable liquids should not be used in reverse-flow laminar flow benches (e.g. clean bench), recirculating biosafety cabinets, poorly-ventilated rooms, or near ignition sources.

**Flammable Liquid Storage Cabinets**

Flammable liquid storage cabinets must meet NFPA 30 specifications, Flammable and Combustible Liquids Code, and the California Fire Code. Cabinets must also be Underwriter Laboratories (UL) 1275 listed. Self-closing doors with a latching mechanism are required on all newly purchased cabinets. Cabinets should be placed so that they do not block or impede egress. Flammable liquid storage cabinets are not required to be vented.

**Refrigerator/Freezers**

If flammable liquids must be stored at reduced temperature, a UL Listed Flammable Material Storage Refrigerator/Freezer must be used (some grandfathered, converted equipment is acceptable, contact ehs@sjsu.edu). These refrigerator/freezers are designed to prevent ignition of flammable vapors inside the storage compartment.

**REQUIRED:** Describe the lab-specific engineering or ventilation controls and equipment safety features (if applicable) that will be used to reduce the risk of chemical exposures to Flammable Liquid and keep vapor concentrations below the Lower Explosive Limits.

1. **ADMINISTRATIVE CONTROLS**

The following elements are required:

1. Complete laboratory safety training prior to working in the laboratory;
2. Complete laboratory-specific safety orientation and training on laboratory-specific safety equipment, procedures, and techniques to be used, including the location of laboratory safety equipment (emergency eyewash, safety shower, fire extinguisher);
3. Demonstrate competency to perform the procedures described in this SOP to the Principal Investigator (PI) or trainer;
4. Be familiar with the location and content of any Safety Data Sheets (SDSs) for the chemicals used (online SDSs are available from [MSDS online](https://msdsmanagement.msdsonline.com/8511b604-100d-449a-9a6b-366eff19da04/ebinder/?nas=True));
5. Inspect all equipment and experimental setups prior to use;
6. Follow best practices for the movement, handling, and storage of hazardous chemicals (see Chapters 5 and 6 of [Prudent Practices in the Laboratory](http://ucanr.edu/sites/ucehs/files/133892.pdf) for more detail). An appropriate spill cleanup kit must be located in the laboratory. Chemical and hazardous waste storage must follow an appropriate segregation scheme and include appropriate labeling. Hazardous chemical waste must be properly labelled, stored in closed containers, in secondary containment, and in a designated location;
7. Do not deviate from the instructions described in this SOP without prior discussion and approval from the PI; and
8. Notify the PI of any accidents, incidents, near-misses, or unexpected outcomes involving the Flammable Liquids described in this SOP.

For Flammable Liquids, the following are also required:

1. A Class A/B/C fire extinguisher is required. Dry sand, Met-L-X, soda ash or dry lime extinguishing agents may be needed.
2. Depending on the operation and volume of flammable liquids used, a safety shower/eyewash within ten seconds of travel may be required.
3. No more than 10 gallons of flammable liquids, including hazardous waste, may be stored outside of an approved Flammable Liquid storage cabinet, at any time in any room;
4. Each Flammable Liquid storage cabinet should have self-closing doors with a latching mechanism (required for all newly purchased cabinets);
5. Flammable Liquids must be separated from incompatible materials (e.g. oxidizers, alkali metals, pyrophorics, and water-reactive materials); and
6. If stored outside of a Flammable Liquid storage cabinet, Flammable Liquids shall not be stored near ignition sources.

**REQUIRED:** Insert the laboratory-specific restrictions on maximum quantities to be used or stored, including any special handling or storage requirements.

**INSERT IF APPLICABLE:** Describe any additional administrative controls (e.g. restrictions on working alone/procedure/work equipment/work locations/unattended operations). Include any chemical-specific administrative controls (e.g. peroxide formers).

1. **PERSONAL PROTECTIVE EQUIPMENT (PPE)**

At a minimum, long pants (covered legs) and closed toe/closed heel shoes (covered feet) are required to enter a laboratory or technical area where hazardous chemicals are used or stored.

In addition to the minimum attire required upon entering a laboratory, the following PPE is required for all work with Flammable Liquids:

1. **Eye Protection** (must be ANSI Z87.1-compliant)**:**
2. At a minimum safety glasses are necessary.
3. Splash goggles may be substituted for safety glasses, and are required for processes where splashes are foreseeable or when generating aerosols.
4. Ordinary prescription glasses are not acceptable eye protection and cannot be used in lieu of proper safety eyewear.
5. **Body Protection**: At a minimum a chemically-compatible laboratory coat that fully extends to the wrist is necessary.
	1. Clothing worn under PPE should not be constructed from synthetic materials
	2. A flame-resistant laboratory coat that is NFPA 2112-compliant that fully extends to the wrist is required if using large quantities (>1 liter) or when using flammable liquids near an open flame or ignition source. The only exception to this requirement is for conducting Flame Sterilization (e.g. of an inoculation loop) using extremely small volumes of ethanol; and
	3. For chemicals that are also corrosive and/or toxic by skin contact/absorption additional protective clothing (e.g. face shield, chemically-resistant layer, disposable sleeves, etc.) are required where splashes or skin contact is foreseeable.
6. **Hand Protection**: Hand protection is needed for the activities described in this SOP. Define the type of glove to be used based on:
7. The chemical(s) being used;
8. The anticipated chemical contact (e.g. incidental, immersion, etc.);
9. The manufacturers’ permeation/compatibility data; and
10. Whether a combination of different gloves is needed for a specific procedural step/task.
11. Flame-resistant gloves (e.g. neoprene) should be considered if using large quantities (>1 liter) or using Flammable Liquids near an open flame or ignition source.

**REQUIRED:** Insert lab-specific descriptions of PPE and hygiene practices used with Flammable Liquids, including any specialized PPE needed for a specific procedural step or task.

1. **SPILL AND EMERGENCY PROCEDURES**

Do not attempt to clean up a chemical spill unless you have been trained and feel comfortable doing so. Contact the College Safety Team or Environmental Health & Safety (EH&S), for help with cleaning up a small chemical spill. For a large spill of Flammable Liquids, confine the spill within the fume hood or room, evacuate everyone from the lab, and call 911 (or 408-924-2222 from a non-campus phone).

**REQUIRED:** Insert description of who to call in case of Flammable Liquid spill in the lab.

1. **WASTE MANAGEMENT AND DECONTAMINATION**

**Waste Management:**

Hazardous waste must be managed as outlined in [SJSU’s Chemical Hygiene Plan](https://www.sjsu.edu/fdo/departments/ehs/lab/Chemical_Hygiene_Plan.pdf), and must be [properly labeled](http://www.science.sjsu.edu/safety/HazWasteForm.pdf). In general, hazardous waste must be removed from your laboratory within nine

**REQUIRED:** Insert description(s) of laboratory-specific information on the waste streams generated, storage location, and any special handling/storage requirements.

Upon completion of work with Flammable Liquids and/or decontamination of equipment, remove gloves and/or PPE to wash hands and arms with soap and water. Additionally, upon leaving a designated Flammable Liquids work area remove all PPE worn and wash hands and forearms as needed. Contaminated clothing or PPE should not be worn outside the lab. Soiled lab coats should be sent for professional laundering. Grossly contaminated clothing/PPE and disposable gloves must disposed of as hazardous waste.

1. **DESIGNATED AREA**

Designated area(s) for the use and storage of Flammable Liquids shall be established where limited access, special procedures, knowledge, and work skills are required. Signage indicating the corresponding [Globally Harmonized System (GHS) pictogram(s)](https://www.osha.gov/Publications/HazComm_QuickCard_Pictogram.html) should be visible at the entrance of the designated area (e.g. postings on the exterior of the laboratory door).

**REQUIRED:** Insert description(s) of the designated area(s) for Flammable Liquids in your laboratory. The entire laboratory, a portion of the laboratory, a fume hood, etc. can be designated.

1. **DETAILED PROTOCOL**

**REQUIRED:** Insert or attach the lab-specific protocol for the process, hazardous chemical(s), or hazard class described in this SOP. Include any relevant resources such as journal articles, patents, etc. as desired.

**TEMPLATE REVISION HISTORY**

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| --- | --- | --- | --- |
| **Version** | **Date Approved** | **Author** | **Revision Notes:** |
| **1.0** | **16/24/2021** | **Alexi Ball-Jones** | **New template** |
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**LAB-SPECIFIC REVISION HISTORY**

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| **Version** | **Date Approved** | **Author** | **Revision Notes:** |
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**Documentation of Standard Operating Procedure Training**

*(Signature of all users is required)*

* Prior to using **Flammable Liquids**, laboratory personnel must be trained on the hazards involved in working with this SOP, how to protect themselves from the hazards, and emergency procedures.
* Ready access to this SOP and to a Safety Data Sheet for each hazardous material described in the SOP must be made available.
* The Principal Investigator (PI), or the Laboratory Supervisor if the activity does not involve a PI, must ensure that their laboratory personnel have attended appropriate laboratory safety training or refresher training within the last three years.
* Training must be repeated following **any** revision to the content of this SOP. Training must be documented. This training sheet is provided as one option; other forms of training documentation (including electronic) are acceptable but records must be accessible and immediately available upon request.

**Designated Trainer:** *(signature is required)*

I have read and acknowledge the contents, requirements, and responsibilities outlined in this SOP:

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| --- | --- | --- | --- |
| **Name** | **Signature** | **Trainer Initials** | **Date** |
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