NJIT New Jersey Institute of Technology

ADVANCED FLAMMABLE & COMBUSTIBLE LIQUIDS

STANDARD OPERATING PROCEDURE

This Standard Operating Procedure (SOP) is for work in which flammable/combustible liquids are used in operations that can generate static electricity which can act as an ignition source. This includes the pumping or pouring of solvents between metal containers. As described below, those operations require grounding and/or bonding of the containers to prevent a fire/explosion.

If your operations would not involve static electricity generation, then a different SOP template in the New Jersey Institute of Technology (NJIT) SOP Library can be used: BASIC FLAMMABLE AND COMBUSTIBLE LIQUIDS

Type of SOP: ☐ Process ☐ Hazardous Chemical ☐ Hazard Class

Department: _____ **Building:** _____ **Room #:**_____

Principal Investigator: _____ **Phone #:**_____

Prepared By: _____ **Email:** _____ **Date:** _____

1. HAZARD OVERVIEW

Flammable and combustible organic solvents are amongst the most dangerous chemicals in the lab. A measure of how ignitable a particular solvent is refers to its **flashpoint;** defined as the lowest temperature at which a material can form an ignitable mixture with air and produce a flame when a source of ignition is present. **The lower the flashpoint, the more easily the liquid can be ignited.** Most common organic solvents in the lab are readily ignited with the exception of chlorinated solvents like dichloromethane, which require more extreme conditions to burn. An organic solvent may have other hazards beyond their flammability. For example, benzene is a recognized carcinogen. Review the Safety Data Sheet for the organic solvent to determine if there are any additional hazards.

Classes of Flammable Liquids
(Flash Point < 100^{O}F)

Class	Flash Point	Boiling Point	Examples
IA	Below 73^{o}F	Below 100^{o}F	Ethyl Ether
IB	Below 73^{o}F	At or above 100^{o}F	Acetone, Benzene, Toluene
IC	At or above 73^{o}F and below 100^{o}F		Isopropanol, Xylene

Classes of Combustible Liquids
(Flash Point > 100^{o}F)

Class	Flash Point	Examples
II	100 – 139^{o}F	Acetic acid, Cyclohexane, Mineral spirits
IIIA	140 – 199^{o}F	Cyclohexanol, Formic acid, Nitrobenzene
IIIB	Above 200^{o}F	Formalin, Vegetable oil

Reference: University of California, Santa Barbara - Environmental Health & Safety

2. PERSONAL PROTECTIVE EQUIPMENT (PPE)

In general, workers who use flammable liquids will be issued a free fire-resistant lab coat. At minimum, safety glasses, lab coats, and gloves are required. Additional or more protective PPE may be required pending the volume, ignitability, explosivity, or unique hazards. Please refer to the NJIT Chemical Hygiene Guide and Hazard Assessment Form to determine the proper PPE for handling corrosive materials.

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3. ENGINEERING/VENTILATION CONTROLS

All chemicals should be transferred and used in an annually certified chemical fume hood with the sash at the certified position or lower. Prior to use, the air flow indicator should be checked to ensure it is operating within specifications. Please review the NJIT Chemical Hygiene Guide and the Safe Chemical Fume Hood Use Guide for information on the proper use of a chemical fume hood and criteria for implementing engineering controls.

☐ Chemical Fume Hood ☐ Glovebox ☐ Biological Safety Cabinet ☐ Other _____

Room Location of Unit(s): _____

Safety Shielding: Shielding is required any time there is a significant 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 and reduce the fire risk. Fume hoods provide the best protection against exposure to flammable liquids in the laboratory and are the preferred ventilation control device. If your research does not permit the handing of large quantities of flammable liquids in your fume hood, contact EHS to review the adequacy of all special ventilation.

4. SPECIAL HANDLING PROCEDURES AND STORAGE REQUIREMENTS

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

Store in a tightly closed, labeled container and in a cool, dry, well-ventilated area. Segregate from incompatible materials. Repackaged chemicals must be labeled clearly. For example, squirt bottles and acid/base cleaning baths. Follow any substance-specific storage guidance provided in Safety Data Sheet.

a. Flammable Liquid Storage Cabinets

- One or more Flammable Liquid Storage Cabinets (FLSC) are required for laboratories which store, use or handle more than 10 gallons of flammable or combustible liquids.
- Containers of flammable liquids that are one gallon and larger 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

Reference: University of California, Santa Barbara - Environmental Health & Safety

intended for the storage of highly toxic materials, acids, bases, compressed gases, or pyrophoric chemicals.

- In most NJIT laboratories, flammable liquids storage is provided under the chemical fume hood. These cabinets are clearly marked “Flammable Storage” and are often ventilated via a stainless steel hose into the fume hood exhaust duct. Flammable liquids storage cabinets are constructed to limit the internal temperature when exposed to fire. When additional storage is needed, NFPA-approved FLSC may be purchased. All containers of flammable liquids must be stored in a FLSC when not in use. The following general requirements apply:
  - 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.

b. Transferring / Dispensing

i. 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. 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.

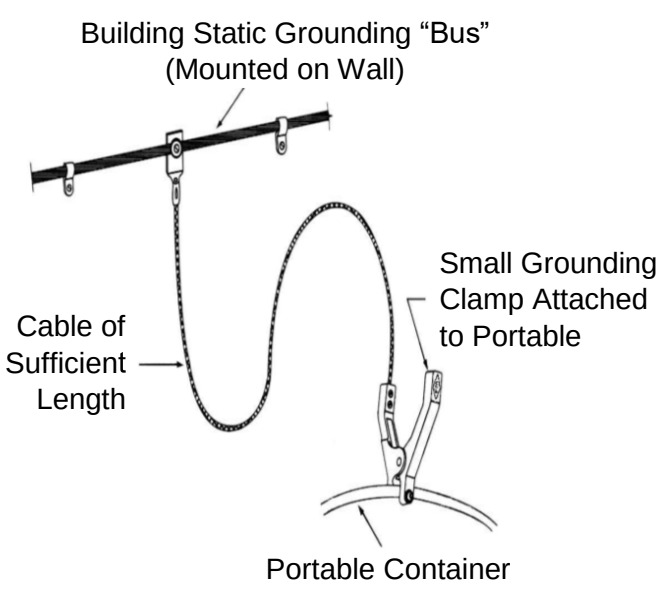
ii. PROCEDURES TO AVOID STATIC ELECTRICITY

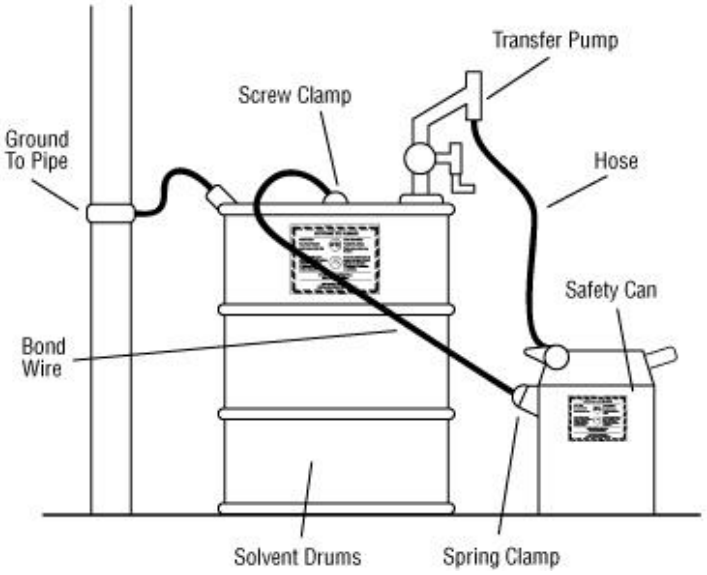
To avoid the buildup of static electricity that may cause a spark, it is important to bond and ground metal containers, particularly for larger quantities, e.g. 55 gallon drum or 5 gallon container. Bonding eliminates the electrical potential between two containers, therefore eliminating the likelihood of sparks. A bonding wire is connected to two conductive objects as shown in the diagrams below.

Grounding eliminates the difference in static potential charge between the conductive object and ground. Grounding is accomplished by connecting the conductive object directly to the earth, usually using cold water copper pipes, building steel, or a grounding bus/bar. Bonding and grounding require good electrical connections. Remove any dirt, paint or rust, ensuring metal to metal contact. Bonding and Grounding wires and clamps come in a variety of styles and lengths.

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.

Reference: University of California, Santa Barbara - Environmental Health & Safety

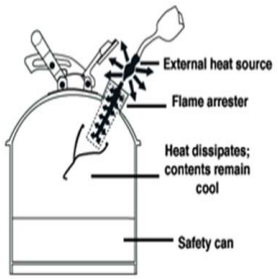




iii. DISPENSING FLAMMABLE LIQUIDS FROM 5 GALLON PAILS

Manual dispensing pumps for 5-gallon pails/cans are available. These pumps are specifically designed to dispense liquids into small laboratory-size bottles without spilling. If you are pouring into a conductive container, a bonding wire should be attached from the 5-gallon pail to the container being filled. The 5-gallon pail should be grounded.

iv. DISPENSING FLAMMABLES FROM SAFETY CANS



Safety cans have self-closing air tight lids and a flame arrestor that protects the contents from an external ignition source. Bonding and grounding is still required on safety cans since static electricity generation is possible. The nozzle provides a bonding path to a receiving metallic vessel. If either of the containers is non-metallic (non-conductive), it is still important to follow the limited velocity and grounded nozzle extension information given previously. Safety cans **do not** offer protection from heat when exposed to fire and should be stored in a flammable liquids storage cabinet when not in use.

c. 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 should include any other hazard information, such as "Corrosive" or "Toxic", as applicable. *e.g. lab squirt bottles, acid/base baths*

d. Heating/Open flame

- Do not permanently store flammable liquids in chemical fume hoods or allow containers of flammable liquids in proximity to heating mantles, hot plates, or torches.

Reference: University of California, Santa Barbara - Environmental Health & Safety

- 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 all of the solvent has had the opportunity to drain or evaporate at room temperature.

5. INCIDENTS AND ACCIDENTS

Laboratory personnel are to report all occupational injuries or illnesses to Faculty/PI as soon as practical. The Faculty/PI and laboratory personnel must submit the required paperwork to NJIT EHS Department. See the the Emergency Response Guidelines posted in the laboratory or Emergency Procedures section of the NJIT CHG for proper procedures involving an injury, exposure, fire, or release/spill of a hazardous material.

In the event of an emergency, DIAL 9-1-1 to activate emergency response personnel.

6. SPILL AND DECONTAMINATION

Wear proper PPE. Decontaminate equipment and work surfaces using soap and water or other appropriate decontamination/cleaning solution. Dispose of all used contaminated disposables in the appropriate waste stream following the Waste Disposal Section of the NJIT CHG.

Decontamination Solution(s): _____

Additional Spill / Decontamination Requirements:

7. WASTE DISPOSAL

Follow the practices and procedures in accordance with the NJIT Laboratory Waste Management Program to properly dispose of waste.

Additional Waste Disposal Requirements:

8. PRIOR APPROVAL/REVIEW

9. DESIGNATED USE AREA

Work should be conducted in a laboratory fume hood given the volatility and flammability of most solvents.

Designated Use Area Location(s): _____

Reference: University of California, Santa Barbara - Environmental Health & Safety

10. SAFETY DATA SHEETS

Location of SDS: _____

11. LAB-SPECIFIC INFORMATION **(required)** ***(Examples of appropriate content)***

Reference: University of California, Santa Barbara - Environmental Health & Safety