

# Standard Operating Procedure



## FLAMMABLE LIQUIDS

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*This standard operating procedure (SOP) is intended to provide general guidance on how to safely work with flammable liquids. This SOP is generic in nature and only addresses safety issues specific to flammable liquids. In some instances, several general use SOPs may be applicable for a specific chemical.*

The National Fire Protection Agency (NFPA) considers any chemical to be flammable if it has a flashpoint below 37.8°C (100°F). There are three classes of flammable liquids per the NFPA:

- Class IA. Liquids having a flash point below 73F (23°C) and having a boiling point below 100F (38°C).
- Class IB. Liquids having a flash point below 73F (23°C) and having a boiling point above 100F (38°C).
- Class IC. Liquids having a flash point at or above 73F (23°C) and below 100F (38°C)

OSHA defines a flammable liquid as any liquid having a flashpoint at or below 199.4 °F (93 °C). Flammable liquids are divided into four categories as follows:

- Category 1 shall include liquids having flashpoints below 73.4 °F (23 °C) and having a boiling point at or below 95 °F (35 °C).
- Category 2 shall include liquids having flashpoints below 73.4 °F (23 °C) and having a boiling point above 95 °F (35 °C).
- Category 3 shall include liquids having flashpoints at or above 73.4 °F (23 °C) and at or below 140 °F (60 °C). When a Category 3 liquid with a flashpoint at or above 100 °F (37.8 °C) is heated for use to within 30 °F (16.7 °C) of its flashpoint, it shall be handled in accordance with the requirements for a Category 3 liquid with a flashpoint below 100 °F (37.8 °C).
- Category 4 shall include liquids having flashpoints above 140 °F (60 °C) and at or below 199.4 °F (93 °C). When a Category 4 flammable liquid is heated for use to within 30 °F (16.7 °C) of its flashpoint, it shall be handled in accordance with the requirements for a Category 3 liquid with a flashpoint at or above 100 °F (37.8 °C).

### Examples of flammable liquids include:

- Acetone
- Alcohols
- Benzene
- Ether
- Hexane
- Hydrazine
- Toluene
- Xylene

### Potential Hazards/Toxicity

## Physical Hazards

Flammable liquids usually have high vapor pressures at room temperature and their vapors, mixed with air at the appropriate ratio, can ignite and burn. As with all solvents, their vapor pressure increases with temperature and therefore as temperatures increase, they become more hazardous.

The concentrated vapors of flammable liquids may be heavier than air and can cause vapor trails which can travel to reach an ignition source, resulting in a flashback fire. Fire can also result from reactions between flammables or combustibles and oxidizers.

## Health Hazards

In addition to the fire hazard, many flammable liquids pose health hazards as well. Effects from acute inhalation exposures range from irritation to CNS depression, nausea and dizziness. In extreme situations, coma can result. Chronic exposures may lead to liver or kidney damage. Skin absorption can lead to similar long term effects as inhalation exposures. Skin contact with solvents may result in defatting and drying of the skin. Some flammable liquids also have additional health hazards, i.e., benzene is also a known human carcinogen.

As the hazards may vary by compound, users must familiarize themselves with the specific hazards of the compounds they are working with, which can be found on the chemical's Safety Data Sheet (SDS). SDSs are available through the Safety Data Sheet link on Yale's EHS webpage ([ehs.yale.edu](http://ehs.yale.edu)).

## Personal Protective Equipment (PPE)

*The University's Personal Protective Equipment Policy can be found on the EHS website ([ehs.yale.edu](http://ehs.yale.edu))*

### Eye Protection

Safety glasses must be worn whenever handling flammable liquids. When there is the potential for splashes, goggles and/or a faceshield must be worn.

### Hand Protection

Gloves must be worn when handling flammable liquids. Exam style nitrile gloves (minimum 4mil thickness) are generally adequate for handling these compounds in laboratory settings when skin contact is unlikely. However, if skin contact is likely or larger amounts are being used, then a utility grade glove should be worn over the exam style nitrile. To ensure that the appropriate utility grade glove is selected, refer to the chemical's SDS, use a glove manufacturer's selection guide or contact EHS.

### Skin and Body Protection

Long pants or clothing that covers the body to the ankles and closed-toe solid top shoes must be worn when handling flammable liquids. Lab coats must be worn. When working with large amounts of flammable liquids, a 100% cotton or flame resistant lab coat is preferred. For flammable liquids that pose health hazards through dermal absorption, additional protective clothing (i.e., apron, oversleeves) may be appropriate where chemical contact with the skin is likely.

## Engineering Controls

### Fume Hood

Fume hoods, or other locally exhausted ventilation, should be used whenever handling flammable liquids. Local exhaust ventilation is particularly important when using larger quantities (>500ml) or when flammables are heated or at increased pressure.

## Storage/Handling

- Minimize the storage of flammable liquids outside flammable rated storage cabinets. The volume stored outside of rated cabinets and safety cans must be <10 gallons per laboratory.

- 5-gallon cans of flammable liquids must be stored inside flammable rated cabinets.
- Refrigerators used for the storage of flammable liquids must be designed/rated for this purpose.
- Keep flammables segregated from incompatible materials, including oxidizers.
- Store at/below eye level (~5 feet).
- Metal surfaces or containers through which flammable liquids flow must be properly grounded, to discharge static electricity.
- Large quantities ( $\geq 5$  gallons) of flammable liquids must be handled using spark-free tools in areas free of ignition sources, including spark emitting motors and equipment.
- Never heat flammable liquids by using an open flame. Use steam baths, water baths, oils baths, heating mantles or hot air baths.
- If flammable liquids must be heated in an oven, make sure the oven is appropriately designed for flammable liquids (no internal ignition sources and/or vented mechanically).
- When heating flammable liquids, ensure that the autoignition temperature of the solvent is above the oven temperature or its internal elements.
- Do not distill flammable liquids under reduced pressure.

## **Waste Disposal**

Most flammable liquids must be collected as hazardous waste. Some dilute aqueous solutions (<5%) of low molecular weight biodegradable organic chemicals may be appropriate for sanitary sewer discharge, i.e., alcohols, ethylene glycol, and glycerol. Check the "Management of Hazardous Waste" manual for a more comprehensive list. In addition, all items contaminated with a flammable liquid which is also acutely toxic (P-Listed) must be collected as hazardous waste, ex: carbon disulfide. This includes reagent bottles, weigh boats, pipette tips, kimwipes, and other similar items that have come into contact with these compounds.

## **Emergency Procedures**

### **Fire Extinguishers**

Both ABC dry powder and carbon dioxide extinguishers are appropriate for most fires involving acutely toxic compounds.

### **Eyewash/Safety Showers**

An ANSI approved eyewash station that can provide quick drenching or flushing of the eyes must be immediately available within 10 seconds travel time for emergency use. An ANSI approved safety drench shower must also be available within 10 seconds travel time from where these compounds are used. Ensure the locations of the eyewashes and safety showers, and how to activate them, are known prior to an emergency.

## **First Aid Procedures**

### **If inhaled**

Remove to fresh air. Follow up with Acute Care or Employee Health as appropriate (203-432-0123).

### **In case of skin contact**

Go to the nearest emergency shower if contaminated. Yell for assistance and rinse for 15 minutes, removing all articles of clothing to ensure contaminate is completely removed. Follow up at Acute Care/Employee Health as appropriate (203-432-0123).

### **In case of eye contact**

Go to the nearest emergency eyewash. Yell for assistance and rinse for 15 minutes. Follow up at Acute Care/Employee Health (203-432-0123).

## **Spills**

**Small Spill**

If a small spill of a low toxicity flammable liquid occurs, lab personnel should be able to safely clean it up by following standard spill clean up procedures:

- Alert people in immediate area of spill
- Increase ventilation in area of spill (open fume hood sashes)
- Wear personal protective equipment, including utility grade gloves
- Confine/adsorb spill with spill clean up pads or absorbent
- Collect residue, place in container, label container, and dispose of as hazardous waste
- Clean spill area with soap and water

**Larger Spill/Any spill outside a fume hood**

- Call EHS for emergency assistance (203-785-3555)
- Evacuate the spill area
- Post someone or mark-off the hazardous area with tape and warning signs to keep other people from entering
- Stay nearby until emergency personnel arrive and provide them with information on the chemicals involved