

Flammable Liquids- Safe Work Practices

The Occupational Safety & Health Administration (OSHA) defines a flammable liquid as having a flash point of not more than 93°C (199.4°F). The **flash point** is the minimum temperature at which a liquid gives off vapor in sufficient concentration to form an ignitable mixture with air near the surface of the liquid. In most cases, the relative hazard of a flammable liquid increases as the flashpoint decreases. Many common solvents (e.g., acetone, ether, toluene, etc.) present in laboratories have flash points well below room temperature, making proper use, storage and disposal even more critical. Flammable liquids and mixtures containing flammable liquids are assigned to one of four hazard categories, as indicated in safety data sheets (SDSs), based on their flash points and boiling points (See table below).

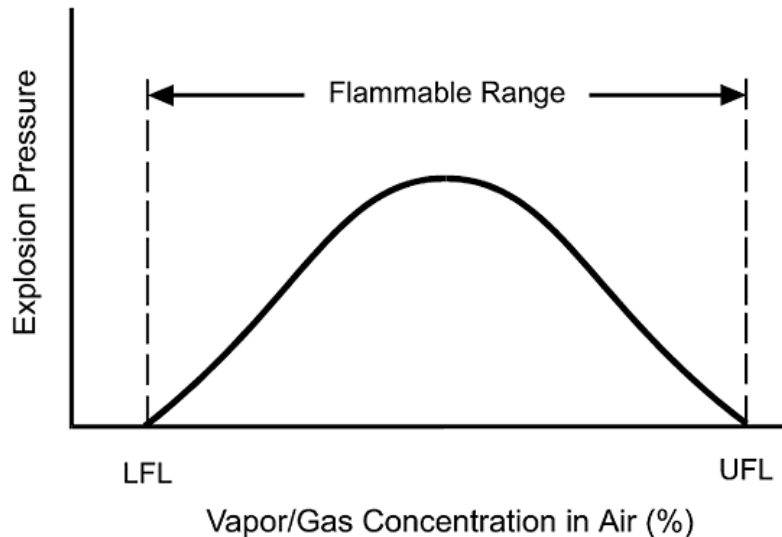
Category	Criteria	Hazard Statement
1	Flash point < 23°C and initial boiling point ≤ 35°C (95°F)	Extremely flammable liquid and vapor
2	Flash point < 23°C and initial boiling point > 35°C (95°F)	Highly flammable liquid and vapor
3	Flash point ≥ 23°C and ≤ 60°C (140°F)	Flammable liquid and vapor
4	Flash point ≥ 60°C (140°F) and ≤ 93°C (200°F)	Combustible liquid

For a flammable liquid to ignite, three conditions must exist simultaneously: (1) the concentration of the vapor must be between the upper and lower flammable limits of the substance; (2) an oxidizer (usually the oxygen in air) must be present; and (3) a source of ignition must be present. Taking measures to remove any of these conditions will prevent the start of a fire. In addition to flashpoint and boiling point, the hazardous potential of flammable liquids can be intensified by other conditions.

Vapor pressure is a measure of a liquid's propensity to evaporate. Flammable liquids with higher vapor pressures are usually more volatile than those with lower vapor pressures since they form vapors more readily. As with all solvents, vapor pressure increases with temperature and, therefore, as temperatures increase they become more hazardous.

Vapor density, a measure of a vapor’s weight when compared to air, also plays a role in the hazards associated with flammable liquids. The vapor density of air is assigned a value of 1. Heavier vapors (i.e. a vapor density greater than 1) from flammable liquids tend to sink in air while lighter vapors (i.e. vapor density less than 1) tend to rise in air. When working with flammable liquids, especially outside of fume hoods, efforts should be made to remove or control ignition sources in areas where vapors would most likely migrate given their vapor densities.

The proportion of vapor to air mixture that is ignitable is referred to as the **flammable range**, and is expressed in terms of percentage of vapor in air by volume. The flammable range is bounded by the **Lower Flammable Limit (LFL)** and the **Upper Flammable Limit (UFL)**. The range can expand as temperature, pressure and container diameter increase. The graph below shows the flammable range, LFL and UFL of a flammable liquid.



The **lower flammable limit (LFL)** is the minimum concentration of a flammable liquid vapor in air that will support the propagation of flame, or spread of flame through the entire volume of vapor-air mixture, upon contact with an ignition source. Below this level, the mixture is too “lean” to burn. Keep in mind that vapor-air mixtures below the **LFL** may still burn at the ignition source, but will not propagate away from the point of ignition.

The **upper flammable limit (UFL)** is the highest concentration (expressed in percent vapor or gas in the air by volume) of a substance that will burn or explode when an ignition source is present. Above this level, the mixture is too “rich” to burn.

Safe Work Practices

- Read the safety data sheet (SDS) for each flammable liquid prior to use.
- Eliminate, substitute less flammable chemicals or reduce the quantities of flammable liquids being used if possible.
- Wear personal protective equipment as indicated in safety data sheets or the lab's [workplace hazard assessment form](#).
- Work with flammable liquids in a chemical fume hood.
- Keep the flammable liquid containers closed when not in use.
- Quantities of flammable liquids should be limited to the amount necessary for the work in progress.
- Control all ignition sources in areas where flammable liquids are used.
- Never heat flammable substances using an open flame. Use oil baths, steam baths, water baths, heating mantles or hot air baths.
- Do not distill flammable substances under reduced pressure.
- Make sure that metal surfaces or containers where flammable substances are being used are properly grounded, discharging static electricity.
- Know the locations of fire alarms, pull stations, fire extinguishers, safety showers, and other emergency equipment.

Storage

- Flammable liquids should be stored in rated flammable storage or explosion-proof cabinets when not in use.
- Flammable storage cabinets should not be vented if possible.
- Storage cabinets of flammable material must be labeled with either the words "**Flammable- Keep Fire Away**" or a red flammable diamond sticker.
- Flammable liquid storage areas should be free of ignition sources (e.g., electrical outlets,

open flames, hot surfaces, static electricity, etc.)

- No more than 10 gallons of flammable liquids should be stored outside of a rated flammable storage cabinet in the laboratory.
- Storage of flammable liquids or other hazardous chemicals on floors should be extremely limited. When storage on floors is unavoidable, secondary containment bins that can contain at least 110% of the volume of the largest container being stored are required.
- Flammable liquids stored in rated flammable storage cabinets in laboratories shall not exceed 55 gallons (unless approved by EH&S and the UCONN Fire Department).
- Any refrigerator that is used for flammable liquids must be designed for flammable or explosive storage (i.e. contain no ignition sources such as exposed electrical contacts).
- Flammable liquids should be stored separately from strong oxidizers, corrosives and other incompatible materials.
- Storage of flammable liquids must not block any route of egress.

Additional Resources

Occupational Safety and Health Standards (29 CFR 1910.106) - Flammable Liquids

http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_id=9752&p_table=STANDARDS

Occupational Safety and Health Standards- Hazard Communication

http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=10099

Prudent Practices in the Laboratory: Handling and Management of Chemical Hazards

<http://www.ehs.uconn.edu/Chemical/Prudent%20Practices%20in%20the%20Laboratory.pdf>