

## Flammable Liquids

### Introduction

The Occupational Safety and Health Administration (OSHA) defines a flammable liquid as having a flash point of not more than 93° C (199.4° F). In most cases, the relative hazard of a flammable liquid increases as the flash point and boiling point decreases. 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 (73°F) and an initial boiling point ≤ 35°C (95°F) | Extremely flammable liquid and vapor |
| 2        | Flash point < 23°C (73°F) and an initial boiling point > 35°C (95°F) | Highly flammable liquid and vapor    |
| 3        | Flash point ≥ 23°C (73°F) and ≤ 60°C (140°F)                         | Flammable liquid and vapor           |
| 4        | Flash point ≥ 60°C (140°F) and ≤ 93°C (199.4°F)                      | Combustible liquid                   |

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.

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 the air) must be present.
- (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.

### **Key Terminology**

*Boiling point* - the temperature at which the vapor pressure equals atmospheric pressure, such that the pressure of the atmosphere can no longer hold the liquid in a liquid state and bubbles begin to form.

*Flashpoint* - 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.

*Lower Flammable Limit (LFL)* - the minimum concentration of a flammable liquid vapor in air that will support the propagation 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.

*Upper Flammable Limit (UFL)* - 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.

*Vapor Pressure* - 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* - measure of a vapor’s weight when compared to air. 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., a vapor density less than 1) tend to rise in air. When working with flammable liquids, especially outside of fume hood, efforts should be made to remove or control ignition sources in areas where vapors would migrate given their vapor densities.

## Standard Operating Procedures

- Read the safety data sheet (SDS) for each flammable liquid prior to use.
- Eliminate, substitute with less flammable chemicals, or reduce the quantities of flammable liquids being used, if possible.
- Develop a **standard operating procedure** to communicate the hazards and safe work practices.
- Wear personal protective equipment indicated in the safety data sheet or the workplace hazard assessment form (WHA). Lab coats are recommended to minimize dermal contact.
- Work with flammable liquids in a chemical fume hood.
- Keep the flammable liquid containers closed when not in use.
- Limit the quantity of flammable liquids needed for the work in progress. Do not stockpile.
- 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.
- Identify the locations of fire alarms, eyewash stations, 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.
- Flammable storage cabinets must be labeled with the words “Flammable – Keep Fire Away” or the words “Flammable.”
- Never store paper, cardboard, or other combustible material in flammable storage cabinets.
- Flammable liquid storage areas should be free from ignition sources (e.g., electrical outlets, open flames, hot surfaces, static electricity, etc.)
- No more than 10 gallons of flammable liquids can be stored outside of a rated flammable storage cabinet in the laboratory.
- Storage of flammable liquids on floors should be limited to the greatest extent possible. When storage on the floor is unavoidable, secondary containment bins that contain at least 110% of the volume of the largest container being stored are required.

- Ensure safety cans are approved by a nationally recognized testing laboratory, have a flash-arresting screen, spring-closing lid, spout cover, and are designed to safely relieve internal pressure when subjected to fire exposure.
- Flammable liquids stored in rated flammable storage cabinets in laboratories shall not exceed 60 gallons (unless approved by EHS and the UConn Fire Department).
- Any refrigerator used to store flammable liquids must be designed for flammable or explosive storage (i.e., contain no ignition sources such as exposed electrical contacts).
- Flammable liquids must be stored separately from strong oxidizers, corrosives, and other incompatible materials.
- Flammable liquid storage cabinets and other flammable liquids must not block any route of egress.

## Resources

- [Occupational Safety and Health Standards \(29 CFR 1910.106\) - Flammable Liquids](#)
- [Occupational Safety and Health Standards- Hazard Communication](#)