Flammable Liquids Overview

To control the potential hazards posed by handling flammable and combustible liquids, several properties of these materials should be understood.

Information on the properties of a specific liquid can be found in that liquid's Safety Data Sheet (SDS), or other reference material.

It is the liquid's vapor rather than the liquid itself that ignites when mixed in certain proportions with air in the presence of an ignition source. Flammable and combustible liquids vaporize and form flammable mixtures with air when in open containers, when leaks occur, or when heated. Volatility is the tendency or ability of a liquid to vaporize. Vapor pressure is a measure of a liquid's volatility. A high vapor pressure usually is an indication of a volatile liquid, or one that readily vaporizes. The boiling point is 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. The liquid is forming a gas. In general, a low boiling point indicates a high vapor pressure and, possibly, an increased fire hazard.

An important characteristic of any flammable or combustible liquid is its flashpoint. Flashpoint is the minimum temperature at which the vapor concentration near the surface of the liquid is high enough to form an ignitable mixture. According to the NFPA, any liquid with a flashpoint less than 100°F is considered to be a flammable liquid. According to the NFPA, a liquid with a flashpoint between 100°F and 200°F is combustible. In general, the relative hazard of a flammable liquid increase as the flashpoint decreases.

The proportion of vapor to air mixture that is ignitable is referred to as the flammable range (or flammable limits), 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 LFL is the minimum concentration of 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. The UFL is the maximum concentration of vapor in air that will support the propagation of flame. It is important to note that vapor-air mixtures below the LFL may burn at the ignition source without propagating away from the point of ignition.

The auto ignition temperature is the minimum temperature at which a vapor- air mixture will spontaneously ignite, without the necessity of a spark or flame.

Vapor density is a measure of a vapor's weight when compared to air. Air is assigned a value of 1. Heavier, or denser, vapors (with values greater than 1) tend to sink to floor level while lighter, less dense vapors (with values less than 1) tend to rise to ceiling level. This property must be

taken into account when working with flammable or combustible liquids outside of fume hoods. Most flammable liquid vapors are heavier than air. These vapors can travel some distance and encounter ignition sources remote from the workstation.

If you have questions concerning the applicability of any item listed in this procedure contact Risk Management and Safety at 334-740-9711, or the Principal Investigator of your laboratory. Specific written procedures are the responsibility of the Principal Investigator.

Hazard Assessment

Not all risks can be eliminated from work with hazardous chemicals, but through informed risk assessment and careful risk management, laboratory safety is greatly enhanced. Do not begin work with a flammable liquid unless you have been adequately trained in the proper handling and emergency procedures.

Protective Apparel

Lab coats, closed toed shoes, and long sleeved clothing made of non- synthetic materials should be worn when handling flammable liquids. When handling large amounts of flammable liquids, flame resistant lab coats should be used. Additional protective clothing should be worn if the possibility of skin contact is likely.

- Gloves should be worn when handling flammable liquids. Disposable nitrile gloves provide adequate protection against accidental hand contact with small quantities of most laboratory chemicals. Lab workers should contact RMS for advice on chemical resistant glove selection when direct or prolonged contact with hazardous chemicals is anticipated. Lab workers should consult the glove chart that can be found on the RMS website and consult the glove manufacturer for suitability of a particular glove.
- Researchers should assess the risks associated with an experiment and use the appropriate level of eye protection. Safety glasses with side shields provide the minimum protection acceptable for regular use. Chemical splash goggles or face shields should be worn when there is a risk of splashing hazardous materials.

Decontamination Procedures

Personnel: Wash hands and arms with soap and water immediately following any skin contact with flammable liquids.

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Emergency Procedure

Emergency procedures which address response actions to fires, explosions, spills, injury to staff, or the development of sign and symptom of overexposure should be developed. The complete Emergency and Spill Response Procedures can be found here, however the laboratory procedures should address the following at a minimum:

- Who to Contact - (911, RMS, and the Principal investigator of the laboratory including evening phone number)
- The location of all safety equipment (Emergency showers, Emergency eye wash, fire extinguishers, etc.)
    - For more information on Emergency safety showers and Emergency eye washes, click here.
- The method used to alert personnel in nearby areas of potential hazards
- Special spill control materials required by the type of flammable liquids handled in the laboratory

Handling Precautions

- Control all ignition sources in areas where flammable liquids are used. Smoking, open flames and spark producing equipment should not be used. Use intrinsically safe equipment around flammable liquids.
- Whenever possible use approved safety cans, plastic or metal containers.
- When working with open containers, use a laboratory fume hood to control the accumulation of flammable vapor.
- Use bottle carriers for transporting glass containers.
- Electrically bond metal containers when transferring flammable liquids from one to another. Bonding can be direct, as a wire attached to both containers, or indirect, as through a common ground system.
    - For more information regarding bonding and grounding click here.
- Flammable liquids are often used with HPLC machines. Make sure to seal around tubing going in to flammable liquid containers to prevent vapors from escaping into the laboratory.
- Do not evaporate flammable liquids off as a means of disposal. Chemical waste should be properly disposed of using the Chematix system found on the RMS website.

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Flammable Liquids Overview

Vacuum Protection

Evacuated glassware can implode and eject flying glass and splattered chemicals. Vacuum work involving flammable liquids must be conducted in a fume hood, glove box, or isolated in an acceptable manner.

Mechanical vacuum pumps must be protected using cold traps and, where appropriate, filtered to prevent particulate release. The exhaust for the pumps must be vented into an exhaust hood. Vacuum pumps should be rated for use with flammable liquids.

Fume Hood

Flammable materials should be handled in a chemical fume hood. Fume hood baffling captures fumes from chemicals based on their vapor density. Fume hood baffling should only be adjusted by qualified personnel.

Manipulation of flammable liquids outside of a fume hood may require special ventilation controls in order to minimize exposure to the material. Fume hoods provide the best protection against exposures to flammable liquids in the laboratory and are the preferred ventilation control device.

Always attempt to handle large quantities of flammable liquids in a fume hood. If your research does not permit the handling of large quantities of flammable liquids in your fume hood, contact RMS to review the adequacy of all special ventilation.

Safety Shielding

Safety shielding is required any time there is a 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.

Labels

Containers: All flammable liquids must be clearly labeled with the correct chemical name. Handwritten labels are acceptable; chemical formulas and structural formulas are not acceptable. Labels can be found here: https://cws.auburn.edu/rms/pm/chemguidestools

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Special Storage

Flammable and combustible liquids should be stored in only certain types of approved containers. Approval for containers is based on specifications developed by organizations such as OSHA, National Fire and Protection Association (NFPA), or American National Standards Institute (ANSI). Containers used by the manufacturers of flammable and combustible liquids generally meet these specifications.

Different types of containers are required depending on the quantities and classes of flammable or combustible liquids. A safety can is an approved container of not more than 5 gallons capacity that has a spring closing lid and spout cover. Safety cans are designed to safely relieve internal pressure when exposed to fire conditions. A closed container is one sealed by a lid or other device so that liquid and vapor cannot escape at ordinary temperatures.

A flammable liquid storage cabinet is an approved cabinet that has been designed and constructed to protect the contents from external fires. Storage cabinets are usually equipped with vents, which are plugged by the cabinet manufacturer. Venting is not required by any code or the local municipalities and may actually prevent the cabinet from protecting its contents. Therefore, vents should remain plugged at all times. Storage cabinets must also be conspicuously labeled “FLAMMABLE-KEEP FIRE AWAY”.

Use only those refrigerators that have been designed and manufactured for flammable liquid storage. Standard household refrigerators must not be used for flammable storage. Refrigerators must be prominently labeled as to whether or not they are suitable for flammable liquid storage.

Storage Considerations:

- Quantities should be limited to the amount necessary for the work in progress.
- No more than 10 gallons of flammable and combustible liquids, combined, should be stored outside of a flammable storage cabinet unless safety cans are used. When safety cans are used up to 25 gallons may be stored without using a flammable storage cabinet.
- Storage of flammable liquids must not obstruct any exit.
- Flammable liquids should be stored separately from oxidizers, shielded from direct sunlight, and away from heat sources.

Where feasible (if the quality of the solvent will not be adversely affected), transfer flammable liquids from glass bottles into metal safety cans.

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