FLINN SCIENTIFIC CANADA

Safety Notes

Discussion and Notes

Keep a copy of these safety training notes and a signed attendance sheet to verify regular safety training. Regulatory inspectors will usually request proof of safety training.

Flammable Liquid Safety

Understanding the properties and hazards of flammable liquids is important for the safe purchase, storage and use of these materials in academic labs.

General Safety Precautions

Always keep flammable liquids away from flames, sparks, heat, and other sources of ignition. Use the smallest amounts possible in experiments and demonstrations, and always cap solvent bottles when not in use. Most flammable liquids are volatile organic compounds that are also slightly toxic by inhalation and are body tissue irritants. Mild headaches or dizziness may be a symptom of overexposure to organic vapours. Always work with flammable organic liquids in a hood or well-ventilated lab. Wear chemical splash goggles, chemical-resistant gloves, and a chemical-resistant apron.

The Fire Triangle

Fires need three components to start and continue to burn—fuel, oxygen, and heat. Removing or disrupting one of the points of the so-called "fire triangle" will prevent or extinguish a fire. Reducing the amount of fuel available to support a fire and using only the amount of flammable liquid you need to perform any experiment are important safety precautions. In most flammable liquid fires, it is not the liquid that is burning, but rather vapour that mixes with air and burns. Consequently, limiting the amount of flammable liquid used will result in fewer vapours.

Flammable and Combustible Liquids

OSHA classifies the flammability of materials based on how readily a material will begin to burn. The following table shows the classes of flammable and combustible liquids and common examples. The flash point is the minimum temperature at which a liquid forms a vapour above its surface in sufficient concentration that it may be ignited with a spark or flame.

Class	Boiling Point*	Flash Point*	Example(s)
Flammable IA	< 37.8 (100)	< 22.8 (73)	Ethyl Ether, Acetaldehyde
Flammable IB	>_37.8 (100)	< 22.8 (73)	Methyl, Ethyl, or Isopropyl Alcohol
Flammable IC	—	between 22.8 and 37.8 (100)	Butyl Alcohol
Combustible II	—	between 37.8 and 60 (140)	Acetone, Acetic Acid
Combustible IIIA	—	between 60 and 93.3 (200)	Cyclohexanol
Combustible IIIB	—	>93.3 (200)	Ethylene Glycol

*All temperatures are in °C and (°F)

The major difference between a flammable and combustible liquid is the flash point. Flammable liquids are classified as having flash points below 100 °F, which means a spark can ignite them at or near room temperature. Combustible liquids are still dangerous but require more than a spark to ignite them at room temperature. Holding a flame above a combustible liquid will quickly heat the vapours up above the flash point and may start a fire.

The Safety Data Sheet (SDS) of a substance lists the flammability class and flash point, the lower and upper flammable limits, the autoignition temperature, and the NFPA code. The lower and upper flammable limits are the minimum and maximum concentrations, by volume percent in air, in which a fire can be started or maintained. The autoignition temperature is the temperature at which the material will initiate a self-sustained fire even without an ignition source.

The NFPA code was developed by the National Fire Protection Association to rate chemicals under fire conditions in four categories: health, flammability, reactivity, and unusual reactivity. Within each category, a system has been established with five numerical ratings (0–4). Number 4 is a severe hazard and number 0 is no special hazard.

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Discussion and Notes

Purchase and Storage

- Organic compounds are not easy to dispose of and may require costly professional disposal. Purchase smaller-sized bottles of flammable liquids whenever possible, and only what is required for 1–2 years usage. Smaller bottles are easier to handle and also contain less liquid that is likely to spill during an accident or add fuel to a potential fire. Always purchase flammable liquids in plastic or PVC-coated glass bottles.
- Store flammable liquids and solids in a dedicated flammables cabinet. The best flammables cabinets are built of high-density plywood. Metal is a heat conductor while wood is an insulator. Applying intense heat to a metal flammables cabinet may cause the door to warp and release flammable liquids and vapours into the fire. A wooden flammables cabinet insulates the chemicals inside the cabinet and will withstand a fire better than a metal cabinet. Flinn/SciMatCo wooden flammable cabinets have been reviewed and approved by the major standard-setting organizations such as OSHA and NFPA.
- Flammables storage cabinets should be located in a locked chemical storeroom to prevent theft. The cabinets should also be secured with a lock. A chemical storeroom that contains flammable materials should be equipped with an ABC fire extinguisher, fire blanket, and smoke detector.
- The chemical storeroom should also be equipped with an exhaust system. Flinn Scientific Canada recommends a fan that will provide six air changes per hour. The fan should be placed near the ceiling of the storeroom. Since organic vapours are heavier than air, the exhaust system must draw vapours from the floor. Use galvanized sheet metal ductwork to draw air from the floor to the exhaust fan near the ceiling.
- Within the flammables cabinet, all the materials should be stored in chemical compatible families using the Flinn Scientific Chemical Storage Pattern. Never store flammable or combustible materials near strong oxidizing agents.
- Do not store flammable liquids in a household refrigerator or freezer. Vapours can build up inside the refrigerator and a spark from the compressor, thermostat, lightbulb or electrical switch can ignite the vapours.
- Diethyl ether forms explosive peroxides. Buy and store only small quantities of this solvent. Some alcohols also form peroxides over time. These peroxides can be explosive if they are allowed to accumulate or are concentrated. Consult the Flinn Scientific Canada Catalogue/Reference Manual or SDS for specific storage recommendations.

Using and Dispensing Flammable Liquids

- Secondary containment is critical in preventing major spills or accidents when transporting flammable liquids. If a cart is used to transport hazardous chemicals, place compatible chemicals inside an unbreakable container, such as a plastic tote or bucket. The cart should be equipped with guardrails to prevent bottles from sliding off the cart.
- If volatile organic solvents are going to be used, the lab must be well-ventilated and/or have a working purge fan to ventilate the lab. The lab should also be equipped with an ABC fire extinguisher, fire blanket, safety eyewash, and safety shower.
- Organic vapours are heavier than air and will quickly travel great distances along a lab bench or floor to an ignition source. Never use flammable liquids around an ignition source. Extreme care must be taken when using flammable liquids around any heat source, flames, or electrical equipment. Laboratory equipment (stirrers, meters, etc.) are designed to be sparkproof, but limiting vapours is always a good safety precaution.
- Flammable liquids are very volatile—dispense them in an operating fume hood and use lab mats or plastic trays to contain spills and drips.
- Dispense flammable liquids from smaller bottles to limit spills and fumes. Set up a central location for dispensing and have students bring a graduated cylinder or test tube to the dispensing area. This will reduce accidents and minimize spills.
- Have spill cleanup materials readily available whenever flammable liquids are used. If a spill occurs, immediately restrict unprotected personnel from the area. Remove all ignition sources and ventilate the area. If the spill is too large to contain, the vapours are overpowering, or ignition sources cannot be completely removed, immediately evacuate the building and call the fire department. If the spill is small, contain the spill with sand or an absorbent material.

Methyl alcohol presents a serious safety hazard in science labs. For a special safety publication describing the precautions for working with methyl alcohol, check out our free publication on our website titled "Methyl Alcohol Safety," Publication No. DC10497.

Personal Protective Equipment and First Aid

- Nitrile or neoprene rubber gloves are recommended for use when handling most organic solvents. Plastic or vinyl gloves will provide some protection against the occasional splash, small spill, or splatter that may occur when using or dispensing solvents. Check the chemical resistance of glove materials for specific solvents.
- Operating eyewashes must be available in any classroom or laboratory where chemicals are used.
- Chemical splash goggles must be worn anytime flammable liquids are used. Safety glasses without complete splash protection are not adequate protection.
- During demos, it is very important that students wear chemical splash goggles anytime flammable liquids are used. The possibility of an explosion or fire always exists and both students and instructors must be protected. A safety shield should also be used when doing demonstrations with flammable liquids.
- If an organic liquid is splashed in the eyes, immediately use an eyewash to irrigate the eyes with fresh, potable water for at least 15 minutes. Make sure the eyelids are held open to properly irrigate the eyes. Ask the victim to look up, down, and sideways to better reach all parts of the eye. Always seek professional medical attention after exposure to any hazardous chemical.
- If a flammable liquid is splashed onto bare skin, rinse the area with water for at least 15 minutes. Many organic solvents will "dry out" the skin and cause minor dermatitis. If the liquid causes burns or other skin irritations, seek medical help immediately.
- If flammable liquid splashes onto your skin and clothing, remove clothing and then begin rinsing the affected areas with water (a safety shower is ideal).

New Free Online Safety Videos

Instructors have a duty to instruct and warn students about the hazards in the laboratory.To view an effective demonstration of flammable vapour hazards, please visit:

https://www.flinnsci.ca/how-to-conduct-a-safe-lab-activity---flinn-scientific/vsc0564/

You will be directed to the video How to Conduct a Safe Lab Activity, which shows several demonstrations useful for teaching students essential safety rules. The discussion pertaining to flammable liquids begins at about the seven-minute mark.

Flinn Scientific Canada Values Your Support

Please continue to support our efforts to improve safety in academic labs by ordering your science supplies and laboratory chemicals from Flinn Scientific Canada.

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