Best Practices for the Safe Storage and Handling of Laboratory Combustible and Flammable Liquids

Scope

The scope of this best practice consists of guidelines that a facility could use to develop their own detailed and specific procedures for the safe storage and handling of laboratory combustible and flammable liquids. There are a number of codes and standards that one needs to be familiar with. These include the National Fire Protection Association's (NFPA's) *Code for Flammable and Combustible Liquids*, NFPA 30 and *Fire Protection for Laboratories Using Chemicals*, NFPA 45. Also, there is reference to laboratory flammable and combustible liquid safety in 29 CFR 1910.1450, Occupational Exposure to Hazardous Chemicals in Laboratories (a.k.a. the Laboratory Standard) and 29 CFR 1910.106, Flammable Liquids. Finally, check the local fire codes, building codes, and with the local Fire Marshal.

Key Points

- Manage risk by limiting storage volumes and types of containers. Store materials inside flammable cabinets to the extent practical.
- Ensure the laboratory is properly equipped to handle combustibles/flammables. Proper ventilation, fire protection and absence of ignition sources are typical engineering controls.
- Ensure proper grounding or bonding is used when transferring containers 2.5 gallons or greater of combustibles/flammables to prevent static electricity discharge.
- Have an EHS inspection and procurement review process to prevent the excess accumulation of combustibles/flammables in the laboratories.
- Best practice is to have a Chemical Hygiene Plan or equivalent (template found in Appendix A of §1910.1450) that includes the hazards and procedures applicable to flammable liquids.

Classification of Combustibles and Flammables

The National Fire Protection Association's (NFPA's) *Code for Flammable and Combustible Liquids*, NFPA 30, is an excellent resource and introduction to the hazards of these materials. NFPA 30 classifies flammables as Class I and divides them into Class IA, IB, and IC, while combustible materials are classified as Class II, Class IIIA, and Class IIIB, based on flash points and boiling points. Make these determinations for the flammables and combustibles involved so that storage quantities can be determined in the next step as described below. In addition, OSHA classifies flammables as Class 1-4 as indicated on the safety data sheet. OSHA does not address combustible liquids.

Storage and Use Quantity Limitations

To manage risk, controlling the volume of flammables and combustibles in each laboratory is necessary. NFPA 45, *Fire Protection for Laboratories Using Chemicals*, provides universal

guidelines for safe storage, addressing the maximum quantity of flammable and combustible materials stored in labs. Chapter 4 of NFPA 45 classifies laboratories into four fire hazard categories based on the amount of flammable and combustible material in the lab.

Storage Container Types and Maximum Volume per Container

NFPA 45 Tables 9.1.1(a) and (b) recommend maximum capacities for different storage container types. Table 9.2 specifies maximum container sizes, ranging from highest risk container type/smallest volume to lowest risk container type/highest volume. In addition, 29 CFR 1910.106(d)(2) indicates maximum storage volumes for each container type.

Safe Laboratory Facilities

A properly outfitted laboratory for flammables and combustibles will have an automated fire protection system (typically a sprinkler system), fire extinguisher(s), a laboratory exhaust system (e.g., fume hood), flammable storage cabinets, and a means to ground equipment. NFPA 45 Chapter 7 has good detail on laboratory exhaust systems. Safety cabinets shall be those specified by NFPA and OSHA. Typically, there is no need to vent these cabinets and the vent openings are closed unless specified otherwise by the fire marshal. Electrical equipment will be classified for the flammable vapor that may be, or is, present. Combustible materials (e.g. papers, overly-upholstered furniture, excess trash) will not be present or will be kept to an absolute minimum. There will be no open flames or spark producing equipment in these laboratories.

Handling of Flammables and Combustibles

- Use the appropriate level of PPE when handling flammable/combustible liquids. Perform a hazard review if necessary.
- Do not leave a transfer operation unattended.
- When working with open containers, use a laboratory fume hood to control the accumulation of flammable vapor. Ensure any electrical devices under the fume hood that aren't appropriately electrically classified are removed or unplugged. Vapors from flammable liquids are typically denser than air and tend to sink to the floor level where they can spread over a large area if not properly ventilated.
- Pouring flammable liquids can generate static electricity. The development of static electricity is related to the humidity levels in the area. Bonding or using ground straps for metallic or non-metallic containers can prevent static generation. For containers 2.5 gallons or greater, 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. When grounding non-metallic containers, contact must be made directly to the liquid, rather than to the container. In the rare circumstance that static electricity cannot be avoided, proceed slowly to give the charge time to disperse or conduct the procedure in an inert atmosphere.
- Store flammable liquids in grounded flammable storage cabinets.
- Whenever possible, use plastic or metal containers or safety cans.

- Use bottle carriers for transporting glass containers.
- Use equipment with spark-free, intrinsically safe electrical equipment to avoid producing sparks. Electrical equipment must meet National Electric Safety Code requirements. Many stirrers, variable speed transformers, outlet strips, ovens, heat tape, hot plates and heat guns do not conform to these code requirements.
- Do not heat flammable liquids with an open flame unless there is a robust safety review/approval process in place to ensure special precautions. Steam baths, salt and sand baths, oil and wax baths, heating mantles and hot air or nitrogen baths are preferable.

Other Administrative Controls

Best practice is to periodically audit laboratories to ensure that specified inventory levels have not been exceeded and that administrative and engineering controls remain in place. Another best practice is to have EHS personnel approve purchases of chemicals not previously purchased. This process can be simplified by triggering an EHS review only if certain volumes and hazard levels are exceeded. This review process makes EHS personnel aware of incoming risks and gives them the opportunity to encourage procuring only volumes that are necessary.