3.2. Procedures for Proper Labeling, Storage, and Management of Chemicals

Proper chemical labeling and storage is essential for a safe laboratory work environment. Inappropriate storage of incompatible or unknown chemicals can lead to spontaneous fire and explosions with the associated release of toxic gases. To minimize these hazards, chemicals in the laboratory must be segregated properly. The storage procedures listed below are not intended to be all-inclusive but should serve instead to supplement more specific procedures and recommendations obtained from container labels, Safety Data Sheets (SDSs), and other chemical reference material. For more information about chemical storage contact the University Environmental Health and Safety for your respective campus. (see Laboratory Safety Contacts).

3.2.1. Labeling

- Manufacturer chemical labels must never be removed or defaced until the chemical is completely used.
- All secondary chemical and waste containers must be clearly labeled with the full chemical name(s) (no abbreviations or formulas).
- Small containers that are difficult to label such as 1-10 ml vials and test tubes can be numbered, lettered, or coded as long as an associated log is available that identifies the chemical constituents. Groups of small containers can be labeled as a group and stored together.
- Unattended beakers, flasks, and other laboratory equipment containing chemicals used during an experiment must be labeled with the full chemical name(s).
- All chemicals should be labeled with the "date received" and "date opened."
- All laboratory chemical waste containers must be labeled with the name of the chemicals contained.
- All full waste containers must be disposed of promptly. Waste containers must NOT be filled to more than 90% of their capacity).
- Chemical storage areas such as cabinets, shelves and refrigerators may be labeled to help the laboratory personnel identify the hazardous nature of the chemicals stored within the area (e.g., flammables, corrosives, oxidizers, water reactives, toxics, carcinogens, and reproductive toxins).

3.2.2. Safety Data Sheets

Safety Data Sheets (SDS) for all laboratory chemicals are required to be maintained in the laboratory or on-line. Safety Data Sheets are available from manufacturer's web sites and through the MSDSOnline® service at the IUEHS website, https://msdsmanagement.msdsonline.com/6df89148-4e9b-4af6-9ba8-da0d494c926a/ebinder/?nas=Truew

- The SDS for the exact chemical or mixture provided by the manufacturer of the product must be available. The chemical identity and manufacturer found on the label must match the chemical identity and manufacturer found on the SDS.
- All personnel must know how to access the SDS whether they are maintained on paper or electronically.
- All personnel must know how to read and understand an SDS.

Additional guidance on how to read, understand, maintain and (if necessary) prepare a Safety Data Sheet is available from IUEHS for your respective campus.

3.2.3. **Storage**

HAZARD GROUPS

- Flammable/Combustible Liquids
- Flammable Solids
- Inorganic Acids
- Organic Acids
- Oxidizing Acids (Nitric, etc.)
- Caustics (Bases)
- Oxidizers
- Water Reactives
- Air Reactives
- Unstable (shock-sensitive, explosive)
- Carcinogens & Reproductive Toxins
- Toxins, Poisons
- Non-Toxics
- Gases:
  - Toxic Gases
  - Flammable Gases
  - Oxidizing Gases
  - Corrosive Gases
  - Inert Gases

- A defined storage place should be provided for each chemical and the chemical should be returned to that location after each use.
- Chemical containers must be in good condition before they are stored. Containers must be managed to prevent leaks.
- Maximum quantities of chemicals that can be in storage and use in laboratories are found in the Uniform Building Code[1], the Uniform Fire Code[2], the International Building Code[3] and International Fire Code[4]. The tables maximum allowable quantities are found in Appendix B. These codes place specific quantity limits on storage of chemicals in all hazard classes and some are very low, such as those for highly toxic gases and organic peroxides.
- Chemicals (including waste) must be separated and stored according to their hazard group and specific chemical incompatibilities. Chemicals within the same hazard group can be incompatible, therefore, it is important to review the chemical label and Safety Data Sheet (SDS) to determine the specific storage requirements and possible incompatibilities. Appendix B contains a partial list of incompatible chemicals.
- Special attention should be given to the storage of chemicals that can be classified into two or more hazard groups. For example, acetic acid and acetic anhydride are both corrosive and flammable. In addition, nitric and perchloric acids are both corrosive and strong oxidizers. Separate organic acids from oxidizing acids using secondary tubs or trays in the corrosives cabinet. Refer to the Safety Data Sheet (SDS) for proper storage procedures.
- Chemicals should be separated by distance. Physical barriers such as storage cabinets and secondary containers should be used to prohibit contact of incompatible chemicals in the event that they are accidentally released or spilled.
- Secondary containers are highly recommended for the storage of liquid chemicals. Secondary containers must be made of a material that is compatible with the chemical(s) it will hold and must be large enough to contain the contents of the largest container.
- Liquids should not be stored above dry chemicals unless they are stored in secondary containers.
- Storage of chemicals within hoods and on bench tops should be avoided.
- Stored chemicals should not be exposed to heat or direct sunlight.
- Storage shelves and cabinets should be secure to prevent tipping. Shelving should contain a front-edge lip or doors to prevent containers from falling.
- Flammable and corrosive storage cabinets should be used when possible.

- Flammable liquids in quantities exceeding a total of 10 gallons in each laboratory must be stored in an approved flammable storage cabinet.
- Only explosion-proof or laboratory-safe refrigerators may be used to store flammable liquids.
- Liquid chemicals should be stored below eye level to avoid accidental spills.
- Chemicals must not be stored in areas where they can be accidentally broken and spilled such as on the floor or on the edge of a bench top.
- Chemicals must not be stored in areas where they obstruct aisles, exits, and emergency equipment.

3.2.4. Chemical Inventory Management

All reportable chemicals must be inventoried. A list of reportable chemicals can be found in the appendices of the Chemical Hygiene Plan located at IUEHS. In addition to reportable chemicals, all chemicals should be inventoried. Inventories provide a method for tracking chemicals for ordering and re-ordering, waste disposal, complying with the maximum allowable quantity limits in accordance with the International Building and Fire Codes (found in Appendix B), hazard communication, community right-to-know requirements, and tracking dangerous or time-sensitive chemicals for safety and security reasons.

Inventories should contain all pertinent information including the following data:

- Chemical name (synonym or trade name found on the Safety Data Sheet), if mixture list composition and percent of components.
- Chemical Abstract Service (CAS) number.
- Manufacturer.
- Product number.
- Physical state.
- Hazard class.
- Container size.
- Units of measure.
- Quantity or number of containers.
- Principal Investigator, Lab Manager, Lab Supervisor, or Chemical Hygiene Officer.
- Owner or researcher.
- Location (e.g., building, room number, cabinet).
- Receiving date.
- Opened container date.
- Expiration date.

Other information such as cost can be recorded as necessary for accounting purposes. Expiration dates are of particular importance for time-sensitive chemicals that can become dangerous with age. Several noteworthy time-sensitive laboratory chemicals include:

- Chemicals that form peroxides.
- Picric acid and other multi-nitro aromatics.
- Chloroform.
- Anhydrous hydrogen fluoride and hydrogen bromide.
- Liquid hydrogen cyanide.
- Formic acid.
- Alkali metals (such as potassium, sodium, and lithium).

See Standard Operating Procedure (SOP 3.17), Peroxide-Forming Chemicals and Other Time-Sensitive Materials, Procedures for Safe Handling and Management.

Use the following guidelines to manage laboratory chemicals including time-sensitive materials:

3.2.4.1. Acquisition control

- Do not hoard chemicals
- Do not over-purchase quantities
- Use just-in-time purchasing whenever possible
- Dispose of unused portions

3.2.4.2. Research the literature and Safety Data Sheet (SDS) information

- Define storage conditions
- Consider refrigeration requirements or other storage options
- Consider chemical incompatibilities

3.2.4.3. Define "unsafe" conditions such as:

- Temperature or humidity extremes
- Peroxide concentrations greater than 100 ppm
- Dry picric acid
- Expiration dates

3.2.4.4. Track Laboratory Chemicals

- Maintain a chemical inventory and check expiration dates regularly
- Define inspection interval for each chemical
- Log the date of inspection and re-inspect without fail

3.2.4.5. Manage Expired or "Unsafe" Chemicals

- Never place chemicals where they will become lost or forgotten.
- Do NOT touch lost time-sensitive chemicals. Call IUEHS for your respective campus immediately (see Laboratory Safety Contacts).

References:

1. Uniform Building Code, 1997, Section 307, Requirements for Group H Occupancies.
2. Uniform Fire Code, 1997, Article 80, Hazardous Materials.
3. International Building Code, 2000, Section 307, High-Hazard Group H
4. International Fire Code, 2000, Chapter 27, Hazardous Materials-General Provisions
5. Journal of Chemical Health and Safety, Management of Time-Sensitive Chemicals, p. 14-17, Vol. 11, No. 5, September/October 2004.