

Queen's University Environmental Health & Safety



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Revision: 2.0 September 5, 2023	Subject: Chemical Storage Procedures	

1.0 Introduction

The Chemical Storage Procedures have been developed in order to minimize the risk of accidental chemical reactions and exposure resulting from the improper storage of hazardous chemicals. The chemical storage procedures have been developed by the Department of Environmental Health & Safety in accordance with the University's Policy Statement on Health and Safety and to ensure compliance with all relevant legislation.

2.0 Applicable Legislation and Guidelines

Ontario Occupational Health & Safety Act - R.S.O. 1990
Workplace Hazardous Materials Information System (WHMIS) – Regulation 860
Hazardous Products Act (Federal)
The Ontario Fire Code (O. Reg. 388/97) as amended by (O. Reg. 398/98 and 428/98)
Environmental Protection Act, R.S.O. 1990, c. E.19

3.0 Responsibilities

3.1 Departments are responsible for;

- Ensuring staff that handle chemicals are made familiar with these procedures and segregate and store chemicals according to the procedure.
- Conducting periodic self-compliance chemical storage audits for submission, at the request of EH&S.

3.2 The Department of Environmental Health and Safety is responsible for;

- Providing advice on chemical compatibility and storage.
- Conducting periodic laboratory inspection ensuring compliance with the procedure and reviewing self-compliance audits.
- Reviewing and updating this procedure as necessary.

4.0 Primary storage

The first step in preventing possible adverse reactions is to ensure chemicals are stored in appropriate containers. Original containers shipped by the manufacturer are ideal for

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storage. If you are mixing new chemicals, know the properties of the new mixture/solution to determine the appropriate storage container and label the container with all relevant information.

A Material Safety Data Sheet (MSDS) must be consulted to obtain any necessary information pertaining to the chemicals you are using. Know the properties and safety protocols before beginning any work with chemicals. MSDS sheets can be obtained by following a link on the Health and Safety website at <https://www.queensu.ca/risk/safety/chemical>.

All chemical containers must be properly labeled to comply with WHMIS requirements. The HECHMET Inventory System keeps track of chemicals in your laboratory. This includes the date the chemical was purchased or created enabling safety inspections to identify expired chemicals or chemicals that pose a hazard due to prolonged storage.

Ensure all containers are properly sealed minimizing odour, personnel exposure and reactions.

4.1 Container Size

Containers larger than 5L containing flammable or combustible liquids cannot be stored with the exception of 20L liquid waste containers and specialized containers permitted by the Ontario Fire Code. Refer to **SOP-Chem-02, Laboratory Flammable & Combustible Liquids handling Procedures** and **SOP-Chem-03 General Flammable & Combustible Liquid Handling Procedures**. Dispensing flammable liquids from larger than a 5 L container is not permitted. Only approved and trained staff at a specially designated intrinsically safe, grounded, explosion proof room can decant containers greater than 5 L.

Keep volumes of other chemicals purchased to a minimum. Minimizing amounts reduces the purchase cost, reactivity hazards, storage space, loss due to expired chemicals, disposal cost of leftovers and minimizes any negative impacts on the environment.

5.0 Secondary Storage and Hazard Segregation

Accidental mixing of incompatible chemicals can result in fire, explosion or release of corrosive or toxic fumes into the laboratory. It is therefore essential that incompatible materials be stored as to minimize the potential for mixing in case of accidental release.

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Chemicals must be segregated and stored according to chemical compatibility. **Never** store chemicals alphabetically, except within a compatible group.

Table 1 identifies 9 groups into which chemicals should be segregated. Identify the primary or most hazardous class. Often chemicals have multiple hazards and an informed decision must be made as to which storage location would be most appropriate.

Each group of chemicals must be stored away from the other groups by one or more of the following methods:

1. Chemically resistant physical barrier (Cabinet dividers, shelves with spill containment, etc.)
2. Secondary containment (Separate bins, trays, buckets etc, large enough to contain the material should a spill occur)
3. Distance (store incompatible chemicals far enough away to ensure no mixing could occur)

The type of barrier will depend on the chemical properties of the chemicals being segregated, therefore consult your MSDS. **Sections 7 and 10 of the MSDS list storage requirements, incompatible chemicals and conditions to avoid!**

Designate a storage location in your laboratory/shop/storage area for each group and clearly identify the location with an appropriate label. A closable cabinet under the bench is the best place for storage of chemicals. Open shelving can also be used, however shelves should have a raised lip to prevent bottles from sliding off. Avoid storage of chemicals on bench tops. Such storage is more vulnerable to accidental breakage by laboratory, housekeeping or other personnel. Store larger bottles of liquids as close to the ground as possible. Ensure all personnel are aware of the designated storage locations.

Do not :

- overcrowd shelving with chemicals or store other materials with chemicals.
- store chemicals on the ground, with the exception of approved waste containers and empty containers in designated areas out of the flow of traffic.
- store chemicals in laboratory fume hoods as they may impede the airflow.
- store chemicals near exits, heaters, ovens, under sinks or in direct sunlight
- store chemicals in hard to reach areas

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6.0 Specialized Storage

Certain categories of chemicals must follow further requirements to ensure safe storage.

6.1 Flammable and Combustible Liquids

Refer to ***SOP-Chem-02, Laboratory Flammable & Combustible Liquids handling Procedures*** and ***SOP-Chem-03 General Flammable & Combustible Liquid Handling Procedures***. These procedure outline strict limits which are set on the total amount of liquid that can be stored in a “fire compartment” while defining cabinet and bench-top storage requirements as well as allowable container sizes.

6.2 Refrigerated Chemicals

All refrigerators and freezers containing chemicals must contain a “Caution no food” sticker which can be obtained from EH&S. Non-explosion proof refrigerators/freezers used to store non-flammable or non-combustible chemicals must contain a sticker stating “Not Explosion proof”

6.3 Refrigerated Flammable and Combustible Liquids

Approved and labeled “Laboratory Safe” or “Explosion/ Intrinsically Safe” refrigerators/freezers **MUST** be used for the storage of $\leq 20\%$ solutions of flammable and combustible liquids. Refer to ***SOP-Chem-02, Laboratory Flammable & Combustible Liquids handling Procedures***.

6.4 Controlled substances or extremely toxic or reactive materials

These materials shall be stored in separate locations preferably within a locked cabinet. Laboratory doors must remain closed and locked when not in immediate use.

6.5 Gas Cylinders

Storage of gas cylinders must comply with section 5.6 *Compressed Gas Cylinders* of the Ontario Fire Code. Due to the extensive requirements of the section, please consult the Ontario Fire code directly or please contact EH&S for assistance.
<https://www.ontario.ca/laws/regulation/r01315>.

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In general, cylinders must be securely mounted to a wall in an upright position by a chain or strap. Handcarts can be used for transporting cylinders, but are not to be used for storage. When mounting cylinders ensure the valve is easily accessible and hazard labels and markings are visible. Compressed gas cylinders are to be stored in areas with ambient temperatures not exceeding 52 Celsius. Flammable gasses or gasses heavier than air are not to be stored in basement areas. Ensure valves are protected from damage.

6.6 Malodorous chemicals

Smelly chemicals such as mercaptans should be stored in a vented cabinet when possible. Ensure the bottle is well sealed, when possible store in a secondary tight sealing container.

6.6 Potential Explosive Chemicals

Explosive chemicals must be stored separately from all other chemicals in a safe location. Ensure laboratory personnel are aware of the location of the chemicals and proper handling procedures. Some chemicals not generally thought of as explosive can form explosive peroxides when stored for prolonged periods and allowed to dry. These chemicals such as Picric acid, ether and other compounds can then pose an explosion hazard. Mark chemicals with date of purchase and do not store longer than the recommended storage period. If old or dry looking chemicals with residue from this category of chemicals are noticed, contact EHS for assistance. Do not attempt to open or move the chemicals.

7.0 Self Compliance Audits

EH&S will periodically send out a self-compliance audit check-sheet. Items listed are to be checked by laboratory personnel to ensure compliance with the policy and applicable legislation. Self-compliance audits must be returned to EH&S for review and follow up when necessary.

Chemical Storage Guide

1. **Know the hazards!** Consult your MSDS to obtain the physical and chemical properties of your chemical. Identify the primary and if applicable secondary hazard class and determine the appropriate storage group listed in Table 1.
2. Ensure the chemical is stored in an appropriate primary container
3. Ensure the container is labeled and tightly sealed.
4. Use the appropriate secondary containment such as trays, separators or distance.
5. Place the container in the appropriate and labeled storage location ensuring that bottles are not crowded or close to the edge of a shelf where they can be knocked or pushed off.

Table 1. Chemical storage groups

The following table should only be used as a guideline. The ultimate responsibility for segregation and compatibility is the MSDS provided by the supplier of the product. It is your responsibility to ensure it is consulted and understood prior to making decisions about the storage and handling of hazardous chemicals. The chemicals listed in the “Examples” and “Storage Requirements” section represent only a small portion of the chemicals that must be properly segregated. Consult your MSDS in all cases to ensure incompatible materials are not stored together.

Hazard Description	Storage Group	Examples	Storage Requirements
Acids Oxidizing, inorganic	A1	Sulfuric Acid, Nitric Acid, Chromic Acid, Perchloric Acid	Store in a dedicated cabinet of non-combustible, ideally non-metallic material, separate cabinet from A2. (Store organic acids, and mineral spirits with Group D, or provide adequate segregation)
Acids Non-Oxidizing, inorganic	A2	Hydrochloric Acid, Benzoic Acid, Phosphoric Acid, Hydrofluoric Acid	Store in a dedicated cabinet of non-combustible, ideally non-metallic material, separate cabinet from A1 (Store organic acids, and mineral spirits with Group D, or provide adequate segregation)
Bases	B	Ammonium Hydroxide, pyridine, Ammonium Chloride	Store in cabinet or shelving
Organic Solids	C	Paraformaldehyde, cellulose, acrylamide, enzymes,	Store in cabinet or shelving Segregate organic oxidizers (Group E)

Flammable & Combustible Liquids	D	Ethanol, methanol, hexane, diethyl ether, xylene, toluene, formalin Dimethylsulfoxide	See Section 6.1 for storage requirements, total volumes, bottle sizes permitted and other restrictions. See section 6.3 for storage in refrigerators Flammables Can be Stored in: 1. Flammable storage cabinet 2. Open bench top, shelving 3. OFC Approved containers. I.e. 20L Flammable storage container with flame arrestor.
Organic Acids		Acetic Acid, Formic Acid, Butyric Acid	Store away from heat, open flames and sparks.
Non-Flammable Solvents		Carbon Tetrachloride, Ethylene Glycol	Keep segregated from Group E
Oxidizers	E	Sodium hypochlorite, benzoyl peroxide, potassium permanganate, potassium chlorate, potassium dichromate.,	Store in cabinet or shelving, separate from combustible and flammable materials and other reducing agents .
Gas Cylinders/Compressed Gases	F		Store in cool, dry area, away from gasses of other incompatible groups as outlined in the MSDS and this table. Securely strap or chain large cylinders to a wall or bench top. See section 6.5
Specials (Water reactive, air reactive, highly toxic etc.)	G	Sodium Metal, potassium metal. Lithium metal, lithium aluminum hydride, thiocyanates ferrocyanates, cyanide, mercury etc	Store in cabinet, separate from all other chemicals, especially oxidizers, aqueous solutions and any sources of water or moisture. See MSDS for storage requirements. Ensure bottles are well sealed.
Explosives	H	Picric Acid (less than <10%), Ammonium Nitrate, Nitro Urea, , Trinitrobenzene and derivatives, Trinitrophenol,, Trinitrotoluene, etc.	Store separately in a locked cabinet segregated from each other.
Controlled Substances	I	Barbiturates, ketamine, benzodiazepines	Store separately in a locked cabinet. Special Health Canada approval and registration required.