CHEMICAL STORAGE FACT SHEET

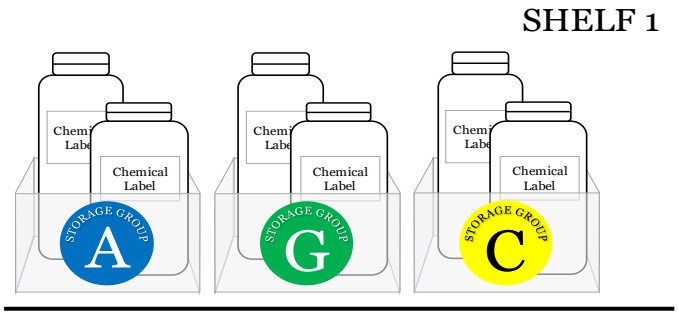
Chemicals should be separated by hazard class and stored in separate cabinets. When that is not possible, the following guidelines can be used.

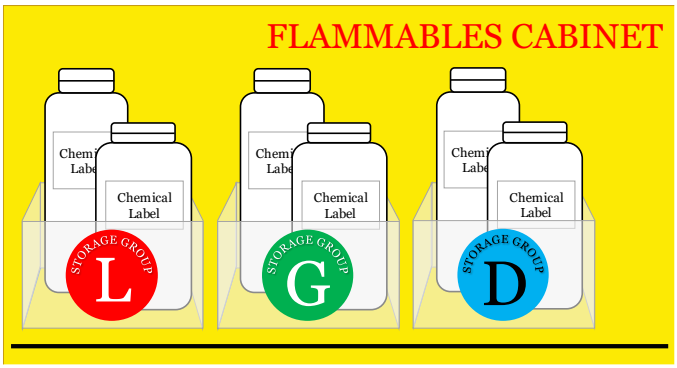
Storage Classifications

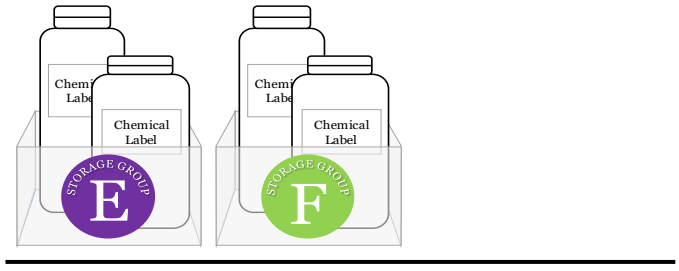
A – Organic bases
B – Pyrophoric and water reactive
C – Inorganic bases
D – Organic acids
E – Oxidizers
F – Inorganic acids
G – Compatible with anything
K – Explosives or other highly unstable materials
L – Non-reactive flammables and other combustibles
OA – Oxidizing acids
X – Organic peroxide

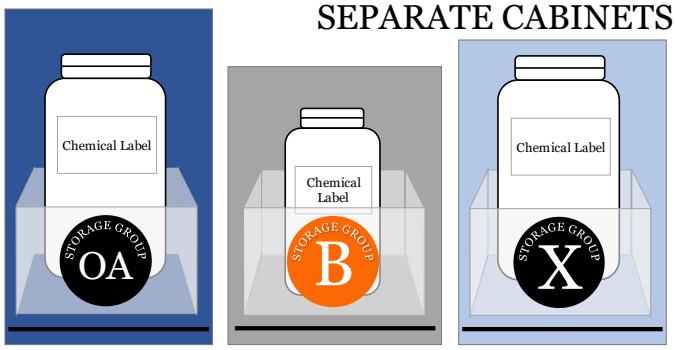
Chemical Storage Shelving Requirements

The images below show the storage shelving requirements.









General Chemical Storage Requirements

- Chemical solids should never be alphabetized until they are segregated by hazard class first. Flammable solids and oxidizing solids should be segregated onto separate shelves. Water reactive or pyrophoric materials should be placed in their own cabinets.
- Gloveboxes should be cleaned out regularly and incompatible chemicals should not be stored together in the same glovebox.
- Secondary contaminant should be Nalgene trays or equivalent.
- Do not store chemicals in fume hoods. Excessive materials in fume hoods can impact fume hood performance by creating eddy currents and turbulence.
- Do not store old or outdates chemicals. Remove all chemicals past their expiration date. If no expiry date is listed, then a date should be put on the bottle when received for reference. Chemicals that have been used for 6 months to a year should be discarded.
- All chemical bottles should be wiped clean prior to being placed in storage.
- Funnels should be used when pouring chemicals.
- Liquid chemicals should not be stored above eye level.
- All bottles must be tightly closed and clearly labelled.
- Chemicals should be inspected immediately upon arrival and should not be stored in their shipping cans and boxes.

Labeling

- Do not store chemicals until they have been clearly labelled. Labels should be stickers. Do not write directly on bottle.
- If manufacturer labels are not available or illegible, chemicals should be relabelled. Labels should include at a minimum: product identifier, safe handling instructions, and that the SDS is available.

Organic Bases

Hazard Description

Organic bases contain either nitrogen or an amino group. Two main hazards of bases are their corrosivity (a pH of >10) and toxicity.

When handling corrosive chemicals, the eyes and skin are most commonly at risk, however failure to use proper protective equipment and handling procedures can result in exposures to the respiratory and digestive tract through inhalation and ingestion.

Examples

- Methylamine
- Phenylamine
- Amines

Storage

- Organic bases can be kept on the same shelf and in the same cabinet as inorganic bases.
- Organic bases should be separated from inorganic acids, ideally in a different cabinet in at a minimum on a different shelf in secondary containment.
- Organic bases should **not** be stored with organic acids.
- Take note if an organic base has a flammable/combustible hazard associated with it. If it does, it should be stored with flammables (ideally in its own secondary containment).

Hazardous Waste

- Must be disposed of as per the University's Hazardous Waste Standard.

Pyrophoric and Water Reactive

Hazard Description

When these liquids or solids come into contact with air or water they either spontaneously ignite or react violently. Any handling of pyrophore/water reactive material is high risk and must be controlled with adequate system design, direct supervision, and training. Note that when working with metal dust, the smaller the particle size, the greater the hazard. Many metals are also toxic.

Examples

- Lithium
- Potassium metals
- Sodium borohydride
- Zinc dust
- Alkyl lithium solutions

Handling

- Always wear a fire-retardant lab coat, face shield and safety glasses at a minimum when working with explosive materials. Read SDS for additional PPE requirements.
- Do not return unused material to the original container as it may contain impurities that can cause fire or explosion.
- Chemicals of this nature should be used in an inert environment (glovebox/bag) to prevent air/moisture exposure.

Storage

- Only minimal amounts of reactive chemicals should be stored.
- Must be stored in their own cabinet.
- Store in cool, dry place, away from flammables.
- Rigorously avoid exposure to water and air.

Hazardous Waste

- Must be disposed of as per the University's Hazardous Waste Standard.
- Water or air reactive materials should not be mixed. They should be packaged individually in inerting or stabilizing substance.
- Solid alkali metals should be immersed in mineral oil prior to bringing it to the ESF for disposal. Contact esf@uwaterloo.ca.

Inorganic Bases

Hazard Description

Inorganic bases normally contain a hydroxide group and accept hydrogen ions from other substances. Their general action is the corrosion of metals and destruction of living tissue.

When handling corrosive chemicals, the eyes and skin are most commonly at risk, however failure to use proper protective equipment and handling procedures can result in exposures to the respiratory and digestive tract through inhalation and ingestion.

Examples

- Sodium hydroxide
- Potassium hydroxide
- Ammonium hydroxide

Storage

- Inorganic bases can be kept on the same shelf and in the same cabinet as organic bases.
- Inorganic bases should be separated from inorganic acids, ideally in a different cabinet in at a minimum on a different shelf in secondary containment.
- Inorganic bases should **not** be stored with organic acids.

Hazardous Waste

- Must be disposed of as per the University's Hazardous Waste Standard.

Organic Acids

Hazard Description

Organic acids are acids that contain a carbon-hydrogen backbone. Are often the weaker of acids.

When handling corrosive chemicals, the eyes and skin are most commonly at risk, however failure to use proper protective equipment and handling procedures can result in exposures to the respiratory and digestive tract through inhalation and ingestion as well.

Examples

- Oxalic acids
- Trichloroacetic Acid
- Malic Acid

Storage

- May not be stored with inorganic acids, oxidizing acids, or all bases. Organic acids are ideally stored in a flammable cabinet.
- If stored in the same cabinet as inorganic acids, they should at a minimum be on a different shelf with both types of acids in their own secondary containment.
- Organic acids should not be stored near cyanide or sulfide containing chemicals to prevent formation of hydrogen cyanide or hydrogen sulfide gas.
- Organic acids should not be stored near metal piping that supplies natural gas or water.
- Take note if an organic acid has a flammable/combustible hazard associated with it, the acid should be stored with flammables (ideally in its own secondary containment)

Hazardous Waste

- Must be disposed of as per the University's Hazardous Waste Standard.
- Label as organic acid.

Oxidisers and Inorganic Peroxides

Hazard Description

Oxidizers are substances that readily release oxygen or another oxidizing substance (chlorine, bromine, or fluorine). Solid oxidizing agents such as metallic chlorates, perchlorates, nitrates, chromates and permanganates may form explosive mixtures with oxidizable dusts and other suspended particles (e.g., flour, coal dust, magnesium powder, zinc dust, carbon powder). Inorganic peroxides are generally stable but can react with organic compounds to generate peroxides and the reaction can at times be very violent. Additional training must be completed prior to use of any type of peroxides.

When handling corrosive chemicals, the eyes and skin are most commonly at risk, however failure to use proper protective equipment and handling procedures can result in exposures to the respiratory and digestive tract through inhalation and ingestion.

Examples (Oxidizers)

- Nitrates
- Nitrites
- Permanganates
- Chlorates

Examples (Inorganic Peroxides)

- Hydrogen Peroxide
- Manganese Peroxide
- Sodium Peroxide

Storage

- Solid oxidizers can be stored with other solid chemicals.
- Peroxides should be stored according to the manufacturer's guidelines.

Hazardous Waste

- Must be disposed of as per the University's Hazardous Waste Standard.
- Should be labelled as an oxidizer if an oxidizer, or a peroxide if an inorganic peroxide.
- Be aware of what acids can be mixed. Piranha solutions (sulfuric acid/peroxide mix) as well as aqua regia (nitric acid/hydrochloric acid mix) are highly aggressive, off-gassing solutions. These cannot be brought to the ESF and need to be neutralized in-house. They should be diluted (usually 20x) before being neutralized and then sent to drain with lots of water. If there are other contaminants remaining (e.g., heavy metals) then the neutralized solution needs to be brought to the waste facility.

Inorganic Acids (Not including: Oxidzers or Combustibles)

Hazard Description

An inorganic acid is a compound of hydrogen and one or more other element (with the exception of carbon) that dissociates or breaks down to produce hydrogen ions when dissolved in water or other solvents. Often the "stronger" acids.

When handling corrosive chemicals, the eyes and skin are most commonly at risk, however failure to use proper protective equipment and handling procedures can result in exposures to the respiratory and digestive tract through inhalation and ingestion as well.

Examples

- Hydrochloric acid
- Boric acid
- Hydrofluoric acid (requires additional SOP prior to use)

Storage

- May be stored with oxidizing acids or organic acids (non-flammable) when in their own secondary containment.
- Acids should not be stored near cyanide or sulfide containing chemicals to prevent formation of hydrogen cyanide or hydrogen sulfide gas.
- Acids should not be stored near metal piping that supplies natural gas or water.

Hazardous Waste

- Must be disposed of as per the University's Hazardous Waste Standard.
- Be aware of what acids can be mixed. Piranha solutions (sulfuric acid/peroxide mix) as well as aqua regia (nitric acid/hydrochloric acid mix) are highly aggressive, off-gassing solutions. They require an SOP to be developed prior to use. The SOP must include neutralization. If there are other contaminants remaining (e.g., heavy metals) then the neutralized solution needs to be brought to the waste facility.
- Inorganic acids should not be mixed prior to be sent to the waste facility. Individually segregate.
- Should use plastic bottles for waste in case of off-gassing which will be visible by expansion of container (if off-gassing is too rapid for venting cap to allow release).

Compatible With Anything

Hazard Description

Materials used with no special hazards.

Examples

- Agars
- Sodium chloride
- Amino acids

Storage

- If solid chemical, it can be stored with other solid chemical salts.

Hazardous Waste

- May need to be disposed of as per the University's Hazardous Waste Standard. Contact the Environmental Safety Facility if you have any questions.
- Should not be mixed just to save space.

Explosives and Other Highly Reactive

Hazard Description

An explosive is any chemical compound or mechanical mixture that, when subjected to heat, impact, friction, detonation, or other suitable initiation, undergoes rapid chemical change, evolving large volumes of highly heated gases that exert pressure on the surrounding medium. This term applies to materials that either detonate or deflagrate.

Examples

- Trinitrophenol
- Picric acid dry (<10% water)
- Diazolsobutyinitrile
- Tetrazole
- Urea nitrate

Storage

- Explosives are regulated by the Canadian Explosives Act and Ontario Fire Code regulations, and any use, handling or storage must conform to these regulations.
- Only small quantities should be ordered.

Hazardous Waste

- Must be disposed of as per the University's Hazardous Waste Standard, but contact the ESF technician prior to purchase and prior to bringing down to the waste facility.

Non-Reactive Flammables and other Combustibles

Hazard Description

Flammable liquids can be easily ignited, even at concentrations less than their lower flammable limits, and at temperatures below their flash point. Vapours may be heavier than air, allowing them to travel long distances along the ground to reach an ignition source.

Description	Class	Boiling Point (°C)	Flash Point (°C)
Flammable	IA	<37.8	<22.8
Flammable	IB	>37.8	<22.8
Flammable	IC	---	>22.8 and <37.8
Flammable	II	---	>37.8 and <60
Combustible	IIIA	---	<60 and <93.3
Combustible	IIIC	---	>93.3

Examples

- Ethanol
- Methanol
- Hexane
- Acetonitrile
- Carbon
- Charcoal

Handling

All work, research, investigations, etc. involving flammable or combustible liquids must be carried out in an approved chemical (fume) hood when:

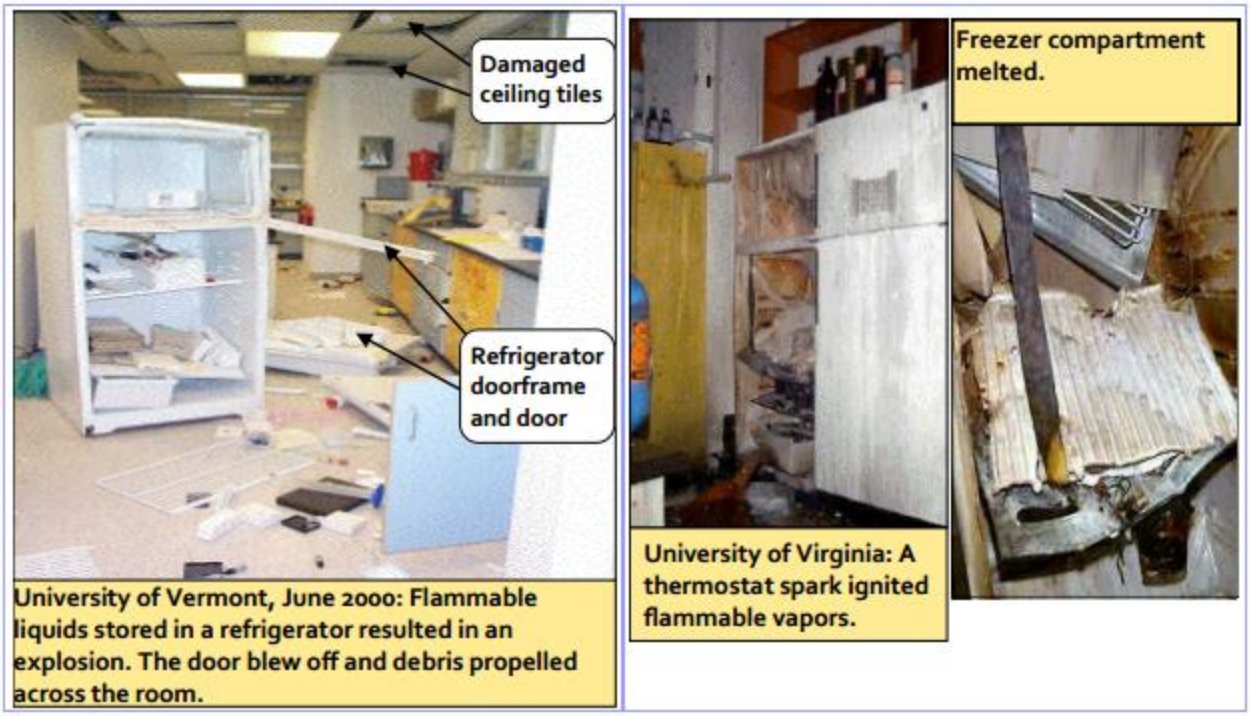
1. Their use releases flammable vapours which could be potentially explosive
2. Liquids are heated to a temperature greater than their flash point
3. Unstable liquids are used

Dispensing flammable or combustible liquids from containers of 5L capacity or less is permissible if performed in an approved chemical (fume) hood. ChemStores is the only location on campus which may dispense flammable or combustible liquids from containers with greater than 5L capacity.

Some flammable liquids are peroxide formers, and the user should be aware of which ones are. Purchase date should be written on the container, expiry dates should be observed and testing for peroxide formation should be done as per guidelines. For more information, visit the chemistry departments resource on peroxide forming compounds.

Storage

- Store away from oxidizers, oxidizing acids, and sources of ignition.
- No more than 50 L of flammable liquids may be kept in a laboratory outside of a flammable cabinet.
- Non-flammable solvents may also be stored in flammables cabinets.
- Flammable cabinets must be installed as per building code with proper venting.
- **Refrigerators used for storage of flammable compounds shall be certified for such use and designated as explosion proof. Vapours from stored chemicals can accumulate over time and come in contact with an electrical spark which creates a powerful explosion.**



(Image from [Emory Research Administration News - Flammable Chemicals and Refrigerator Storages])

Hazardous Waste

- Must be disposed of as per the [University's Hazardous Waste Standard].
- Label as liquids as either a Halogenated Solvent or a Flammable Solvent.
- Plan ahead and request a specialized container from the ESF if large (weekly) volumes will be generated.

Oxidizing Acids

Hazard Description

Highly reactive acids that give off oxygen and other oxidizing substances. They can intensify combustion during a fire.

Examples

- Nitric acid
- Perchloric acid (requires SOP prior to use)
- Sulfuric acid

Storage

- Oxidizing acids should be stored in their own designated cabinets with each chemical having their own secondary containment.
- May not be stored with inorganic acids, organic acids, or flammables.
- Acids should not be stored near cyanide or sulfide containing chemicals to prevent formation of hydrogen cyanide or hydrogen sulfide gas.
- Acids should not be stored near metal piping that supplies natural gas or water.

Hazardous Waste

- Must be disposed of as per the University's Hazardous Waste Standard.

Organic Peroxides and Incompatible with All Other Storage Groups

Hazard Description

Highly reactive and possibly explosive. Very sensitive to shock, sparks, light, strong oxidizers, reducing agents, frictions, and high temperatures. Organic Peroxides are more dangerous than inorganic peroxides and require additional training prior to use.

Note that some chemicals, while not peroxides, have the potential to form peroxides due to being exposed to air. These chemicals are stored based on the chemicals original hazard class (e.g., acid or flammable) but have additional controls that must be in place. For more information, visit the chemistry departments resource on peroxide forming compounds.

Examples

- Benzoyl peroxide
- Methyl ethyl ketone peroxide
- Tert butyl hydroperoxide
- Acetyl peroxide

Handling

- Only use plastic or ceramic spatulas – no metal ones
- Dispose of quantities not needed. Do not return unused material to stock container.

Storage

- Label and date **all suspected peroxides**.
- Peroxide-forming solvents should be purchased in limited quantities with older material being used first.
- Store in original container as per manufacturer's recommendations (usually in cool place not with flammables)
- Store out of direct light.
- Should not be placed on the same shelf as flammables.

Hazardous Waste

- Must be disposed of as per the University's Hazardous Waste Standard
- Do not mix with other chemicals. Package individually.