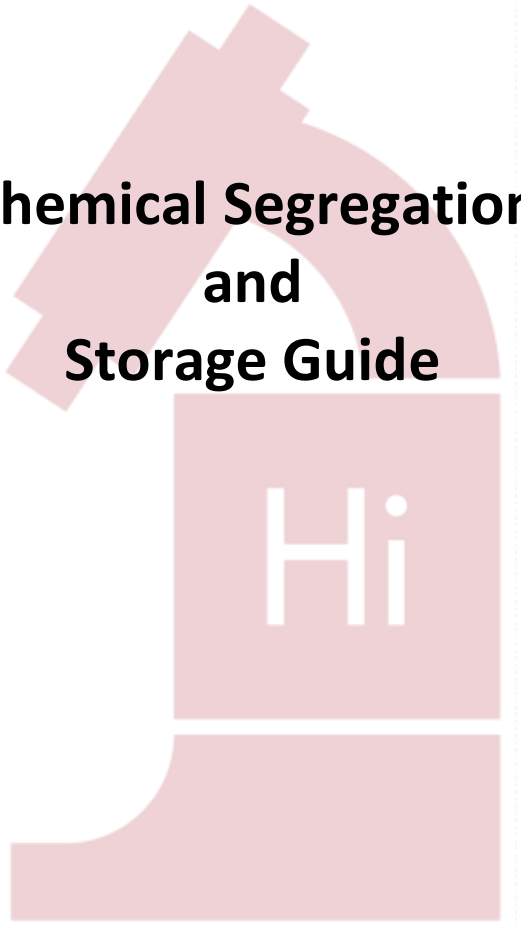
Chemical Segregation and Storage Guide



This resource developed by LabCentral for the Pagliuca Harvard Life Lab

Revision 1, Effective Dec 13, 2016

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1.0 PURPOSE AND SCOPE

The proper segregation and storage of chemicals is a necessity for any laboratory in which hazardous chemicals are used. Accidental mixing of incompatible chemicals may cause fires, explosions or the production of toxic gases. The purpose of this guide document is to provide a standardized plan for chemical segregation and storage to protect Life Lab members and staff against potential hazards from incompatible chemical reactions. This storage guide should be used by Life Lab staff and members when establishing their respective chemical storage areas in the co-working lab as well as private suite, as well as any time new material is ordered. Parts of this Chemical Segregation and Storage Guide have been adapted from Chapman and Boston Universities' chemical storage and segregation guides.

2.0 CLASSES OF CHEMICALS

2.1 Flammable liquids

Flammable liquids are liquids that will ignite easily and burn rapidly. More precisely, they are liquids with flash points that do not exceed 100°F (37.8°C). Less flammable liquids with flash points at 100°F or higher are categorized as combustible liquids. For storage purposes, flammable and combustible liquids are considered to be part of the same category. Flammable and combustible liquids are further subdivided, depending on the liquid's flash point and boiling point.

Table 1: Classes of Flammable and Combustible Liquids

Class	Flash Point	Boiling Point	Exceptions
Class IA Flammable Liquids	< 73°F (22.8°C)	< 100°F (37.8°C)	
Class IB Flammable Liquids	< 73°F (22.8°C)	≥ 100°F (37.8°C)	
Class IC Flammable Liquids	≥ 73°F (22.8°C) and < 100°F (37.8°C)	< 100°F (37.8°C)	
Class II Combustible Liquids	≥ 100°F (37.8°C) and < 140°F (60°C)	< 140°F (60°C)	Any mixture having components with flash points ≥ 200°F (93.3°C) is considered to be Class IIIB
Class IIIA Combustible Liquids	≥ 140°F (60°C) and < 200°F (93.3°C)	N/A	Any mixture having components with flash points ≥ 200°F (93.3°C), the total volume of which make up 99% or more of the total volume of the mixture is considered to be Class IIIB
Class IIIB Combustible Liquids	≥ 200°F (93.3°C)	N/A	

Common chemical examples: ethanol, methanol, acetone, xylene, toluene, TEMED; diethyl ether and tetrahydrofuran are flammable liquids as well as peroxide formers.

2.2 Flammable solids

Any material or chemical, which in solid state can readily undergo combustion in the presence of a source of ignition (e.g. large quantities of heat, light, gases) under normal pressure and temperature, is considered to be a flammable solid. Certain flammable solids are also pyrophoric which means that the material, even in small quantities, is able to ignite or self-combust within five (5) minutes after coming in contact with air at or below 55°F.

Common chemical examples: carbon, charcoal, paraformaldehyde

2.3 Corrosives

Corrosive chemicals are highly reactive substances that cause obvious damage to living tissue. Corrosives act either directly by chemically destroying the part (through oxidation), or indirectly by causing inflammation. Corrosives can be either acidic or basic, and are sometimes referred to as caustics. They can also be of organic or inorganic nature and exist in any state of matter: solid, liquid, gas, mist and vapor.

Common chemical examples:

- *Inorganic acids – hydrochloric acid, sulfuric acid, phosphoric acid, chromic acid, nitric acid*
- *Organic acids – acetic acid, trichloroacetic acid, formic acid*
- *Inorganic bases – ammonium hydroxide, potassium hydroxide, sodium hydroxide*
- *Organic bases – ethanolamine, hydroxylamine, tetramethylethylamine, diamine, triethylamine*

2.4 Oxidizers

Oxidizers are chemicals that initiate or promote combustion in other materials, causing fire either of itself or through the release of oxygen or other gases to a substrate. Oxidizers are incompatible with most materials, especially flammables, combustibles and mineral materials.

Common chemical examples: Inorganic nitrates, nitrites, permanganates, chlorates, perchlorates, iodates, periodates, persulfates, chromates, hypochlorites, peroxides, perborates (such as nitric acid, perchloric acid, hydrogen peroxide, ammonium persulfate, sodium hypochlorite (bleach), sodium peroxide)

2.5 Water reactives

Water reactive chemicals are those that react vigorously with water, steam and moisture in the air to produce a flammable gas and heat. The most common water sensitive chemicals include sodium, potassium, lithium metals and aluminum alkyls. Many water reactive chemicals may also be corrosive, toxic or pyrophoric.

Common chemical examples: sodium, lithium, and potassium metals, sodium borohydride

2.6 Peroxide formers

Commonly used organic solvents can undergo auto-oxidation under normal storage conditions to produce peroxides. Peroxides are a class of chemical compounds with unusual stability problems. They are sensitive to a varying degree to shock, heat, light or friction and may cause unexpected explosion of peroxidized organic chemicals. Common classes of compounds that form peroxides include ethers, aldehydes, compounds containing benzylic hydrogens and compounds containing allylic hydrogens.

Common chemical examples: diethyl ether, tetrahydrofuran

2.7 Compressed gases

A compressed gas is a containerized gas or mixture of gases having an absolute pressure exceeding 40 pounds per square inch (PSI) at 70°F; a containerized gas or mixture of gases having an absolute pressure exceeding 104 PSI at 130°F regardless of the pressure at 70°F; or a liquid having a vapor pressure exceeding 40 PSI at 100°F as determined by ASTM D-323-72. In addition to the chemical properties of the gas itself, compressed gas cylinders are physically dangerous because the contents are stored under high pressure. Punctures, heat, faulty valves, and increases in pressure may result in a rapid release of the contents.

3.0 STORAGE GROUPS

Storage groups are groups of chemicals that, if stored together, will not react violently if mixed. The storage group determination of any material can be determined by referring to the “Hazards Identification” and “Toxicological Information” sections of the material’s Safety Data Sheet (SDS). Chemicals with multiple hazards are typically stored according to their primary hazard.

3.1 Incompatibility

The following table describes the different chemical classes and their general incompatibilities. Always consult the manufacturer's SDS for specific chemical incompatibility information.

Table 2: Chemical Incompatibilities

Chemical Class	Common Incompatibles
Flammable Liquids	Oxidizers, water reactives, acids, bases
Flammable Solids	Acids, bases, oxidizers
Corrosive Acids - Inorganic	Flammable liquids, flammable solids, bases, oxidizers, organic acids, cyanides, sulfides
Corrosive Acids - Organic	Flammable liquids, flammable solids, bases, oxidizers, inorganic acids, cyanides, sulfides
Corrosive Bases - Inorganic	Flammable liquids, acids, oxidizers, organic bases
Corrosive Bases - Organic	Acids, oxidizers, hypochlorites, inorganic bases
Oxidizers	Flammables, combustibles, organic materials
Water Reactives	Aqueous solutions, oxidizers, water sources
Explosives	Please consult SDS

4.0 STORAGE AND SEGREGATION METHODS

4.1 General guidelines

4.1.1 Due to the uniqueness of the shared facilities here at the Life Lab, all chemical containers should be labeled with the owner's name and venture, date received and date opened.

4.1.2 The following are general guidelines to keep in mind when storing chemicals:

- Chemicals from different storage groups should never be stored in the same secondary container or cabinet.
- Chemical containers should be turned with the labels facing out so they can be easily read.
- Avoid storing chemicals on the floor or under sinks.
- Chemical storage on benches should be minimized in order to reduce the amounts of chemicals unprotected from a potential fire and to prevent them from being easily knocked over.
- Chemical storage in hoods should be minimized to avoid interfering with proper airflow into the hood.
- Routinely inspect material. Indications for disposal includes:
    - Cloudiness in liquids

- Material changing color
- Evidence of liquids in solids, or solids in liquids
- Sign of container leakage
- Indication of pressure buildup within the container
- Obvious container deterioration
- Peroxide formation or oxidation

- Always date peroxide-forming chemicals upon receipt as well as when the bottle is first opened for use. Peroxide-formers should be discarded within one year of receipt if unopened, and 6 months from first day of use. The Life Lab provides peroxide-forming chemical labels for this use. It is the responsibility of each scientist who owns peroxide-forming chemicals in their inventory to test, date and initial the labels for timely disposal.

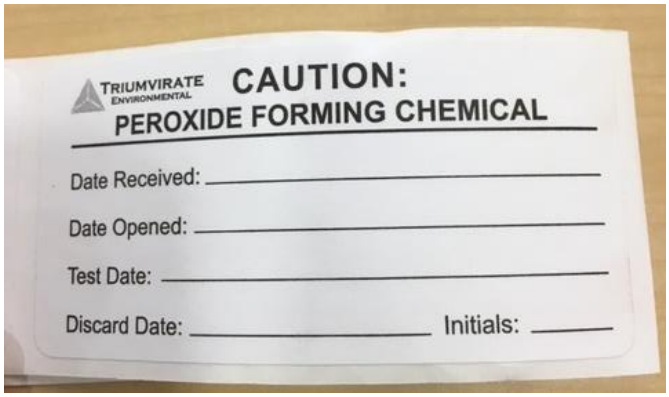

Figure 1: Label for Peroxide Formers

4.2 Flammable liquids/solids and peroxide-forming chemicals

Any flammable or combustible materials including peroxide-forming chemicals must be stored in approved flammable cabinets. Keep the cabinet away from all ignition sources, such as open flames, hot surfaces, direct sunlight and sparks. Explosion-proof or flammable-proof refrigerators must be used when flammable liquids must be refrigerated. The use of standard refrigerators is prohibited for this type of storage.

4.3 Corrosive acids and bases

Corrosives must be stored in ventilated cabinets rated for corrosives or on protected shelving in secondary containment, below eye level. If acid cabinets are available, store acids in dedicated cabinets. All products should be stored in secondary containers if cabinet shelves are metallic. Acids and bases should be stored in separate cabinets to avoid salt formations. Organic acids are considered combustible and corrosive and

can be stored in flammable storage cabinets in separate secondary containers if organic and inorganic acids cannot be segregated to different shelves in the cabinets. Acids should not be stored near any cyanide or sulfide containing chemicals to prevent the generation of highly toxic hydrogen cyanide or sulfide gases. Acids should also not be stored near household bleach to avoid generating highly toxic chlorine gas.

4.4 Water-reactives and Pyrophorics

Water reactive and pyrophoric materials should be stored in closed, watertight containers in cool, dry places. Avoid under-sink and open-shelving storage to prevent any direct contact with water, or fire sprinkler systems. These materials should be segregated from any corrosives and aqueous liquids. The storage area for water-reactives should be labeled “Water-Reactive Chemical Storage”. Pyrophoric materials should be prevented from contacting air. For additional protection, consider keeping the chemicals in the manufacturer’s original shipping packaging surrounded by vermiculite.

4.5 Oxidizers

Oxidizers are highly reactive to many other chemical categories. They should be stored in secondary containment away from organic and flammable materials. Oxidizing acids specifically may be stored with other mineral acids if storage is limited.

4.6 Compressed gases

Limit the quantity of compressed gas cylinders on site that will be used within a reasonable period. Only the same type of gas can be stored together. Cylinders should be stored upright and secured to the wall with a chain, strap or wall mount to prevent from tipping and falling. Double-strapping cylinders is not permitted at this facility unless specifically approved by the Life Lab Safety Officer. Cylinders should be stored away from flames, sparks and any source or heat or ignition. They should be placed in a manner that the label and markings are visible, in locations where they will not be subject to mechanical or physical damage. All cylinder storage areas should be marked with proper precautionary signs. Caps used for valve protection should be kept on the cylinders at all times, except when the cylinder is actually being used or charged; the valve should always remain closed.

4.7 Explosives

Any chemical that has the potential to explode should be stored in a secured location, away from other chemicals and in areas away from shock or friction, elevated temperatures, and rapid temperature changes. Please consult the chemical Safety Data Sheet for any specific storage requirement.

4.8 Segregation pictograms

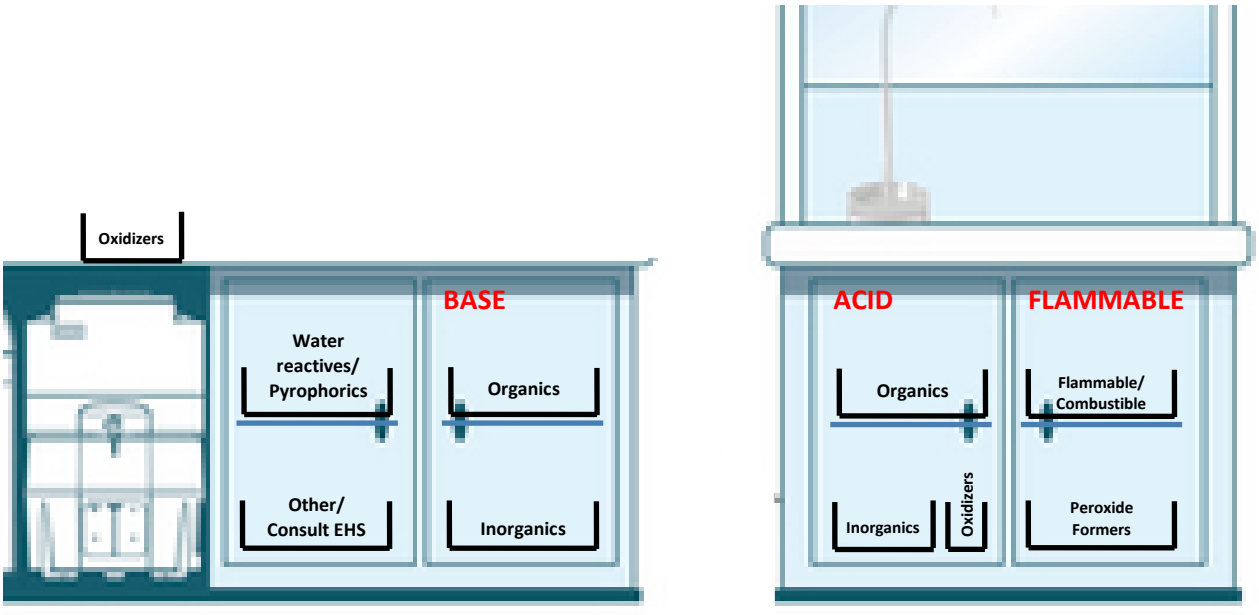

Figure 2: Chemical Segregation

5.0 REVISION HISTORY

Change	Reason	Effective Date
New Document	to provide a standardized plan for chemical segregation and storage to protect Life Lab members and staff against potential hazards from incompatible chemical reactions	Dec 13, 2016