



## Storage of minor quantities of hazardous substances in laboratories

### 1. Purpose

To assist laboratory users in safe and compliant storage of minor quantities of chemicals (excluding explosives, radioactive and infectious materials) in laboratories of the School of Chemistry

### 2. Scope

This guideline applies to all students and staff from the School of Chemistry who are authorised to purchase, handle and store hazardous substances in the laboratories.

### 3. References

AS1940 (2004): The storage and handling of flammable and combustible liquids

AS/NZS 2243.10 (2004): Safety in laboratories – Storage of Chemicals

AS/NZS 2243.2 (2004): Safety in laboratories – Chemical Aspects

AS 2714 (1993): The storage and handling of hazardous chemical materials - Class 5.2 substances (organic peroxides)

AS2982.1 (1997): Laboratory design and construction - General requirements

PER-OHS-GUI-048.4 UOW Laboratory Safety Guidelines

### 4. Definitions

*Minor quantity* – Minor quantities are the quantities which can be stored outside of a safety storage cabinet (see Section 5.5) plus the maximum quantity stored in a chemical storage cabinet within a laboratory. The capacity of a safety storage cabinet in a laboratory to store classes 4.1, 4.2, 4.3, 5.1 or 5.2 should not exceed 50L. For other chemicals the capacity should not exceed 250L (AS/NZS 2243.10:2004)

### 5. Procedure

#### 5.1. General

Uncontrolled reactions of chemicals in storage can result in the generation of heat, fire, explosion and evolution of a toxic gas. Chemicals in a laboratory must be stored in such a way as to prevent:

- incompatible materials from being accidentally mixed together in the event of the breakage of one or more storage containers
- the formation of reactive vapours from chemicals which require vented storage areas

Do not simply store all laboratory chemicals in alphabetic order! Assess the risks when storing a chemical within your laboratory. Information on the storage requirements of an individual chemical can be found on the material safety data sheet (MSDS). A good MSDS will not only describe the hazardous characteristics of the chemical, it will also list incompatible materials.

When purchasing a chemical, ensure that there is appropriate storage for that chemical BEFORE it arrives on site. On arrival of the chemical:

- label the container with the date
- ensure the chemical will be added to the ChemAlert inventory (each research group should have a mechanism by which chemicals are added to laboratory stock holdings).

#### General storage tips!

- Think about the size of the package when purchasing. Don't buy 1 kg of material, simply because it is cheaper, if you are never going to use that amount. Remember laboratories have limited storage space.
- List all chemicals stored in a laboratory in the ChemAlert stock holding, for that laboratory.
- Control your inventory – only keep minimum amounts – don't squirrel chemicals. Minimising chemicals directly reduces the hazards posed by them.

- Inspect the storage areas regularly, keep clean and tidy and dispose of outdated chemicals.
- Storage Areas should be clearly placarded. Label shelves and cupboards with the segregation scheme so that chemicals can be put away in the right place quickly.
- Use secondary containment at all times for large volumes of liquids.
- Do not store liquids above solids in case of contamination in the event of a breakage.
- Do not store containers on the floor.
- Limit the size of containers on open shelves to less than 5L or kg, otherwise use a storage cabinet.
- Use the compatibility reports produced by ChemAlert to check your storage areas.
- Hazardous Substances must be kept in areas with restricted (ie locked) access only.
- Remove all cardboard and other packing from laboratory.

### 5.2. Segregation of Compatible Chemicals

Storage of chemicals is based upon the Dangerous goods classification, Appendix A. Even chemicals within a DG class may need to be separated, for example strong acids and alkalis are both Class 8, but should never be stored together.

Store the chemical according to the Dangerous Goods class and compatibility.

#### Segregation tips!

- The easiest and most efficient way to separate chemicals by compatibility group is to use secondary containment:
  - Place the chemicals to be stored separately in a heavy gauge plastic tub.
  - Plastic secondary containers must be compatible with the material being stored.
  - Bottle-in-a-can type containers are acceptable as secondary forms containment.
  - Small containers of compatible chemicals may be stored in a dessicator or other secure container. This is especially useful for highly toxic materials and carcinogens.
- Strong acids, especially perchloric, nitric and hydrofluoric are best stored in plastic containers designed to store strong mineral acids. These are available from laboratory equipment suppliers.
- Dry chemicals stored in approved cabinets may be grouped together by compatibility type, on separate shelves or segregated in areas of shelving (tape off sections of shelving to designate where chemicals of one type are stored).
- Ensure incompatible chemicals are physically separated when stored. Physically separated cabinets may be used to provide a barrier.
- Refer to MSDS for specific incompatibilities.

### 5.3. Specific Dangerous Goods Classes



#### 5.3.1. Class 3 Flammable Liquids

- Flammable solvents must be stored in an Australian standard approved flammable solvents cabinet.
- Flammable organic materials (organic acids, organic reagents) are stored separately.
- When the procedure/experiment requiring the use of flammable liquids has been completed, immediately return these chemicals to the flammable storage cabinet.
- Don't leave bottles of Class 3 materials larger than 500mL out on the bench. The day-to-day total recommended working allowance being used on laboratory benches, or in fume cupboards for laboratories is 50 litre per 50 square metre of laboratory floor space materials.
- Class 3 substances must NOT be stored in a "domestic refrigerator". Any refrigerator/freezer used to store Class 3 good must be modified to ensure the temperature switch is externally located (i.e. spark proof).
- Flammable liquid storage cabinets or cupboards must not be used for storage of any other Class of dangerous goods. Do not keep dichloromethane or chloroform in a flammables liquid cabinet (they are Class 6, toxic).
- Flammable solvent cabinets should be greater than 5m apart and at least 3m from power points ignition sources.



### 5.3.2. Class 4 Flammable Solids

#### Class 4.1

e.g. metal powders

Storage cabinets or cupboards used to store Class 4.1 dangerous goods must not be used for storage of any other Class.

#### Class 4.2 Spontaneously Combustible Substances

e.g. white phosphorus

Cabinets or cupboards used to store Class 4.2 dangerous goods must not be used for storage of any other Class. Significant incompatibility exists with flammable liquids and oxidizing agents.

#### Class 4.3 Substances that emit Flammable gases on contact with water

e.g. calcium carbide, sodium metal

Cabinets or cupboards used to store Class 4.3 dangerous goods must not be used for storage of any other Class. Significant incompatibility exists with flammable liquids, oxidizing agents and water.

### 5.3.3. Class 5 Oxidising substances and Organic peroxides



e.g. ammonium nitrate, hydrogen peroxide, ammonium perchlorate

- Oxidising agents intensify fires, may ignite spontaneously if damp or explode if heated.
- If stored on open shelves, keep containers on a totally separate vertical shelf unit and horizontal shelf away from all Class 3, Class 4, Class 6.1 and Class 8 dangerous goods.
- Segregate flammables from oxidizing acids and oxidizers.
- Incompatibilities exist within Class 5.1 refer to MSDS for more information.
- Make sure an eye wash unit is located nearby

### 5.3.4. Class 6: Toxic

e.g. cyanides, phenol, chloroform, dichloromethane

- Complete a risk assessment before you purchase (you may need an authority to purchase certain scheduled poisons or may need to notify WorkCover of use of certain Class 6 material).
- Have appropriate antidotes on hand if required.
- Certain toxic materials should have restricted access. Use a lockable, dedicated Class 6 cabinet for high risk goods – e.g. cyanides
- Incompatibilities exist between inorganic cyanides and acids.



### 5.3.5. Class 8 Corrosives

e.g. acids and alkalis- nitric acid, sodium hydroxide.

- Large volumes of corrosive materials, such as 2.5L Winchesters of concentrated acids should be stored in a corrosives cabinet.
- Always store corrosives on spill trays (kitty litter trays are inexpensive and ideal).
- Make sure an eye wash unit is located nearby.
- Separate acids from alkalis, hypochlorites, cyanides and Class 4.3 dangerous goods.
- Separate incompatible acids e.g. Perchloric acid and Hydrofluoric acid are separated from all other materials.
- Solutions of inorganic hydroxides are stored in polyethylene containers.
- If stored on open shelves, keep containers below 1.5m on separate shelf unit away from all other dangerous goods classes.
- Store on suitable trays that will contain 110% of the volume of the largest container.



**Summary**

The following should be stored separately:-

1. Flammable solvents
2. Highly toxic materials (LD<sub>50</sub> of 50 mg/kg or less)
3. Carcinogenic chemicals
4. Inorganic acids (except for 1, 2, 3 above)
5. Bases
6. Strong oxidizing agents
7. Strong reducing agents
8. Water reactive, pyrophoric and explosive materials

But always consult MSDS and risk assess the storage of chemicals.

**5.4. Chemical Storage Areas**

1. Storage shelves should be level and secure.
2. Shelving material and its fixtures should be compatible with the goods stored or protected from the chemicals (Particle or similar boards are not recommended as they may disintegrate when subjected to moisture or chemicals).
3. Do not overload the shelf. The maximum holding capacity of the shelf must not be exceeded.
4. Labelled containers of chemicals must be stored below eye level (not higher than 1.5m from the floor)
5. Containers must not protrude over the edge of the shelf.
6. Chemicals should not be kept on the floor.
7. Liquids of any kind should not be stored above solids to reduce the risk of contamination.
8. Liquids should be stored as low as possible to reduce the risk of breakage and spillage.
9. Materials that react with water are not stored in areas where they may encounter water (e.g., under a sink or on a shelf with aqueous solutions).

**5.5. Amounts of chemicals that can be stored outside of a storage cabinet<sup>1</sup>**

<sup>1</sup>AS/NZS 2242.10 (2004)

Substance type or DG Class	Maximum per 50m <sup>2</sup> (Kg or L)	Maximum container size
DG Class 3	10	5
Combustible liquids	50	20
DG Classes 4.1, 4.2, 4.3, 5.1, or 5.2 (see note 1)	20 but less than 10 of any one class	10
DG Class 6.1 Packing Group 1 (See note 2)	10	10
DG Class 6.1 Other	50	20
DG Class 8	20	20
DG Class 9 and aerosols	Liquids 50, solids 100	Liquids 5, solids 20
Hazardous substances	-	Liquids 5, solids 20
Combined maximum	200	-

Notes:

1. The quantities of Class 5.1 are the total amount of active ingredient present, to allow for solutions of different concentrations.
2. Check the MSDS or label for Packing Group.

**6. Reference Personnel**

All changes to this document shall be referred to the School Safety Committee prior to implementation.

**7. Documentation**

CHEMFS Dangerous Goods Compatibility.doc-

Storage Compatibility of Dangerous Goods in laboratories and Chemical Stores

<http://www.uow.edu.au/content/groups/public/@web/@sci/@chem/documents/doc/uow019936.pdf>

## Appendix A: Storage Compatibility of Dangerous Goods in laboratories and Chemical Stores

A common practice is to store all chemical materials alphabetically. However, in order to prevent unwanted reactions from occurring in a storage area, chemicals should be stored in compatible groups. The following tables give possible combinations of dangerous goods classes which may be stored together. Note that **class 1** may not be stored with anything else. Sometimes further advice can be obtained from the MSDS or the supplier.

For operations at the School of Chemistry, UOW, no dangerous goods may be stored together that have a classification of I or R.

**Reference:** Appendix G, Australian/New Zealand Standard AS/NZS 3833 The Storage and Handling of Mixed Classes of Dangerous Goods in Packages and Intermediate Bulk Containers.

Class	2	3	4.1	4.2	4.3	5.1	6.1	8
2	C	I	I	R	I	R	C	C
3	I	C	I	R	I	R	C	I
4.1	I	I	C	R	R	R	C	I
4.2	R	R	R	C	R	R	I	R
4.3	I	I	R	R	C	R	C	R
5.1	R	R	R	R	R	R†	R	R
6.1	C	C	C	I	C	R	C	R
8	C	I	I	R	R	R	R	C‡

Key:

**C = are likely to be compatible with each other**

*I = are likely to be incompatible with each other*

**R = are likely to react dangerously with each other**

† All dangerous goods of this Class may be regarded as reacting dangerously with other dangerous goods of the same class but with different UN Numbers.

‡ Liquids may be regarded as incompatible with other liquids or solids of the same class but with different UN Numbers.

The table below indicates more specific chemicals may be safely stored together. Within a group, chemicals may be stored alphabetically.

Storage of minor quantities of hazardous substances

Chemical Group	Reactivity	Do Not Store With
	Group #	Group #
INORGANIC ACIDS	1	2-8,10,11,12,13,15-18,20,21
ORGANIC ACIDS	2	1,3,4,7,13,15-18
CAUSTICS	3	1,2,6-8,12-17,19,21
AMINES AND ALKANOLAMINES	4	1,2,5,7,8,12-17,21
HALOGENATED COMPOUNDS	5	1,3,4,11,13,16
ALCOHOLS, GLYCOLS, GLYCOL Ethers	6	1,7,13,15,19,21
ALDEHYDES	7	1-4,6,8,14-16,18,19,21
KETONES	8	1,3,4,7,18,19
PETROLEUM OILS,SATURATED HYDROCARBONS	9	19
AROMATIC HYDROCARBONS	10	1,19
OLEFINS	11	1,5,19
ESTERS	12	1,3,4,18,19
MONOMERS, POLYMERIZABLE Esters	13	1-6,14,15,18,19,20,21
PHENOLS	14	3,4,7,13,15,18,19
ALKYLENE OXIDES	15	1-4,6,7,13,14,16-18,21
CYANOHYDRINS	16	1-5,7,15,18,21
NITRILES	17	1-4,15,21
AMMONIA	18	1,2,7,8,12-16,19,21
HALOGENS	19	3,6-14,18,20
ETHERS	20	1,13,19
ACID ANHYDRIDES	21	1,3,4,6,7,13,15-18