*This document is under review, if you have any input, please email safety@unsw.edu.au.

HS404 – Dangerous Goods Storage Guideline

Introduction:

Since the introduction of the Globally Harmonised System for the classification of Hazardous Chemicals, the term 'Dangerous Goods' is now mostly associated with transport. However, since the physical hazard classes in the GHS closely resemble similar classes in the Dangerous Goods class system the information below is valid for either classification system

1. Scope **1**

2. General principles for storage for dangerous goods **1**

3. Minor Storage **2**

4. General Requirements for the storage of all Dangerous Goods **2**

4.1. Storage on shelves 3
4.2. Storage in Cabinets 3
4.3. Segregation of Chemicals 3
4.4. Class 2 Gases 3

5. Storage of Cryogen Vessels **5**

6. Class 3 Flammables **5**

6.1. Storage of Flammable Liquids in Domestic Refrigerators 7

7. Class 4 Flammable Solids **7**

8. Class 5.1 Oxidising Agents and 5.2 Organic Peroxides **7**

9. Toxic Substances **8**

10. Class 8 Corrosives **9**

11. General Provisions relating to all Dangerous Goods **10**

12. Do you have Placard Quantities? **10**

1. Scope

The information supplied in this document will mostly benefit laboratory or workshop staff and their supervisors.

2. General principles for storage for dangerous goods

Dangerous goods of different classes cannot be stored together. They need to have sufficient distance between them to eliminate the risk of fire, explosion, or accumulation of toxic gases or vapours from a leak or spillage, etc.

The risk obviously increases with the quantity of dangerous goods being stored.

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3. Minor Storage

The underlying concept behind Minor Storage is that quantities below a certain level are so small or scattered that they present little real risk or, if flammable, do not significantly contribute to a building's fire load. Neither would they unduly hinder the activities of the emergency personnel. So, if quantities can be kept below minor storage limits, then the requirements are not as stringent. This could mean that storage can exist scattered (safely) throughout the laboratory without having to purchase an Australian Standard approved cabinet.

The following table is from AS:2243.10 - Safety in Laboratories (Storage of Chemicals).

If you are storing **more** than the quantities listed below for any of the dangerous good's classes, then you are storing more than minor storage quantities for that class.

Class	Max. per 50m2	Max. Container Size	Where to store?
Class 3	10L	5	Labelled laboratory cupboard
Class 4.1, 4.2, 4.3 Class 5.1, 5.2	10L or Kg	10**	Labelled laboratory cupboard
Class 6.1	PG I 10L or Kg Other 50L or Kg	PG I – 10L or Kg Other 20L or Kg	Labelled laboratory cupboard
Class 8	Liquids 20L Solids 50Kg	20L or Kg	Labelled laboratory cupboard

**Note from author: It would be advisable to keep the package size for these classes as low as possible; 10L or Kg of these could pose significant risk for some substances.

From the above table, if you have more than 4 Winchester bottles (2.5L) of any flammable liquid (e.g., Ethanol), then those bottles need to be stored in an Australian Standard approved cabinet.

These maximum limits per area are more conservative than the limits for minor storage allowed in the individual Australian Standard for each dangerous good. For example, in AS1940: Storage and Handling of Flammable Liquids, the minor quantity limit allowed for laboratory situations is 50L per 50 m^2. This limit does not take into account the fact that, in many laboratories, each class (or at least most classes) of dangerous goods could be present. It is possible that a value somewhere between 10 and 50L could be selected depending on an assessment of the risk for the individual situation.

Possible Scenario: Well ventilated laboratory with no sources of ignition (or where sources of ignition fall outside of the hazard zone e.g., greater than 3m away) and the only other type of dangerous goods being stored is 20 Litres of Class 8 corrosives.

A reasonable approach might be to use 25L of flammable liquid as the cut off point for minor storage in this scenario.

4. General Requirements for the storage of all Dangerous Goods

The area where dangerous goods are stored should be:

- Well ventilated and well lit.
- Separated from ignition sources.
- Secured from the public (including unauthorized students).
- Protected from temperature fluctuations and direct sunlight.

Shelving/cupboards should:

- be constructed of chemically resistant materials.
- provide a lip at the front of the shelf.
- have secondary containment (e.g., spill trays). These should be considered for liquid dangerous

goods stored outside of a chemical storage cabinet.
- Dedicated areas should be provided for measuring out chemicals.

See the HS625: Generic Controls for the Storage of Dangerous Goods.

A number of checklists have been provided in section 1.16 to assist in managing storage of chemicals and dangerous goods. These checklists are provided as tools to assist local areas managing their chemicals and provided as examples of tools that can be used (these forms aren't mandatory).

4.1. Storage on shelves

In general, hazardous chemicals should be stored in chemical storage cabinets or laboratory cupboards. Where chemicals are kept on shelves or racks, they are subject to the following restrictions:

- Shelving must be compatible with the goods stored.
- Shelving systems must be designed to hold the maximum holding capacity of the chemical containers.
- Incompatible chemicals should not be stored together on shelves. Keep a distance of 3m between them. The space between can be used to store non-hazardous substances.
- To assist housekeeping, chemical packages should not be kept on the floor.
- Solid chemicals should preferably be stored on upper shelves above liquid chemicals;
- Secondary containment* is essential for large containers (e.g., the 20 litre waste cubes). It also makes sense to bund any container of 2.5L and above capacity. As a priority all dangerous goods of this size should be bunded.
- Shelves should have raised edges to reduce the likelihood of dislodging.
- The most dangerous chemicals should be stored at easily accessible heights (e.g., 1.5m from the floor).
- Chemicals should not be stored in direct sunlight.

4.2. Storage in Cabinets

Each chemical storage cabinet must have a designated person responsible for its management. Their duties would include ensuring that:

- appropriate emergency spill measures are in place;
- emergency first aid is accessible and in a working state;
- the storage location appears on the building manifest and on the annual notification to SafeWork NSW (if applicable in terms of quantity);
- risks have been assessed for the storage of dangerous goods in the storage location;
- disposal of old and unwanted chemicals occurs regularly. Refer to the HS321 Laboratory Hazardous Waste Disposal Guideline.

4.3. Segregation of Chemicals

The matrix in Appendix 1 details the compatibility of dangerous goods by class. In general, each class of dangerous goods should be segregated.

For further information about the segregation of particular substances, refer to the substance SDS and the list of commonly incompatible chemicals in Appendix 2.

Bringing incompatible chemicals into contact with each other, whether during storage or transport, or during use where the risks have not been properly assessed, can have serious consequences.

This can result in:

- uncontrolled release of heat;
- Emission of noxious fumes;
- Precipitation of unstable solids leading to an explosion.

Let's go through each dangerous goods class for specific storage recommendations. Since Class 1 Explosives are rarely used, we will go straight to Class 2 Gases.

The Information Sheet for Explosives and Security Sensitive Ammonium Nitrate (SSAN) should be consulted if you are considering using Class 1 substances.

4.4. Class 2 Gases

Where possible gas cylinders and cryogen tanks should be located outdoors and piped back into the

laboratory. If an indoor location is the only practicable location, then ventilation is critical. The need for gas monitoring and alarm systems needs to be determined in the assessment of the risks for the storage location. Two possible alarms systems to consider could be:

1) to warn of unsafe atmospheres or
2) to warn of the failure of a ventilation system.

Table 1: Minor storage limits for Class 2 Gases are:

Class	Volume in Litres	Volume of Cylinder based on Size	
		Cylinder Type	Volume in Litres
2.1	500 (=10 G size) cylinders	C	2.8
2.2	2000 (=40 G size)	D	10
2.2 (5.1)	1000 (=20 G size)	E	23
2.3	50 (= 1 G size)	G	50

Ref: AS4332: The Storage and Handling of Gases

Basic Precautions for Storage of Class 2 Gases

- Keep away from any artificial sources of heat, e.g., radiators, boilers or steam pipes.
- Kept clear of combustible matter and rubbish for a distance of at least 3m.
- Keep all cylinder stores well ventilated at all times.
- Keep gas cylinders restrained at all times.
- Keep valves closed when not in use.
- Have Safe Work Procedures (SWPs) available for moving cylinders, changing over cylinders when empty, decanting liquid nitrogen etc. Ensure such SWPs are communicated, and competency is assessed before personnel are allowed to work unsupervised.

Outdoor Storage of Class 2 Gases

Keep outdoor minor stores of Class 2 gas cylinders separated from other dangerous goods stores by a minimum distance of 3m. Keep them at least 1m from any door, window, air vent or duct.

Indoor Storage of Class 2 Gases

Avoid indoor storage of gas cylinders wherever possible. Where it is impractical to provide an outdoor cylinder and reticulation system, the following restrictions apply to indoor storage:

- The total capacity of gas in cylinders allowed for any particular indoor location includes cylinders in use, spare cylinders not in use, and used cylinders awaiting removal.
- The total capacity of the gases kept shall not exceed one minor storage quantity (i.e., as per table 1) per 200m ^{2} of floor area. Where the floor area exceeds 200m ^{2} any arrangement which results in an undue concentration of cylinders shall be avoided.
- Indoor minor stores of gas cylinders shall be separated from other dangerous goods stores by a minimum distance of 5 m.
- Except for Class 2.2 gases having no subsidiary risks, there shall be no minor storage in basements of buildings.
- Where cylinders are kept inside a building or a confined area, then that building, or area shall be adequately ventilated by natural air movement or equivalent.
- Cylinders may be kept connected for use inside a compartment only if an outdoor location is not practicable.

- Keep volumes to a minimum.
- Gas monitoring may be required for toxic and flammable gases (determined by assessment of risks).
- Similarly, Oxygen monitoring may be necessary for Asphyxiant gases particularly cryogens.

Ref: AS4332: The Storage and Handling of Gases

5. Storage of Cryogen Vessels

Excerpt from AS:1894:

Internal siting shall only be considered after exhaustive investigation has shown that there is no suitable outdoor location. If this is the case, the vessel shall be placed on a level floor, preferably above ground level, as far away from normal work locations as is practicable.

Areas where cryogenic or refrigerated liquids are stored/used shall be ventilated to prevent the accumulation of gas or vapour which could evaporate from the liquid. The vessel's location shall be adequately ventilated so as to disperse the gas or vapour evaporating from any liquid spill without reducing the oxygen content of the surrounding air below 18%. This shall be provided by **one** of the following:

1. Siting the vessel against an external wall and incorporating into that wall a wire mesh, lattice or louvred opening equivalent in size to the width of the vessel being installed, and of a height from floor level to the vessel fill point. The opening shall not incorporate any means of being sealed, nor allow discharge to areas of public congregation or into any basements, pits or trenches.
2. Providing natural cross-ventilation by means of permanent openings of not less than $10m^2$ inlet and $10m^2$ outlet per $1000m^3$ of vessel full gas volume, in close proximity to the vessel.
3. Providing continuous forced exhaust ventilation of a capacity not less than $10m^3$/min per $1000m^3$ of vessel full gas volume [See *AS 1668.2 for requirements for mechanical ventilation]*
4. The total free space of the building shall be sufficient to ensure that the oxygen content in the atmosphere will not be reduced below 18% in the event of total evaporation of entire vessel contents. Based on the assumptions that—
    a. the initial oxygen content is 20%; and
    b. the inert gas will displace an equivalent volume of air from the building (making no allowance for ventilation);

The total free space air volume in the building shall be at least 10 times the total full gas volume of the contents of the vessel.

The concentration of Oxygen should be calculated for the storage location in the event of total release of the contents of a cryogen vessel.

See section 12 for details on quantities of dangerous goods requiring the storage area to be **placarded** and the storage location included on the **annual notification to SafeWork NSW**. If your storage location (e.g., Laboratory) has 'placard' quantities, then this location will also need to appear on the dangerous goods manifest for your building.

Note: The Dangerous Goods Classes for the purposes of placard and notification are now described using the Physical Hazard classes within the Global Harmonised System (GHS). Full detail is available in HS333 Placard, Manifest and Notification Procedure for Schedule 11 Chemicals.

You need to keep your chemical register up to date in order to compare your storage quantities with the limits in section 12.

6. Class 3 Flammables

Minor Storage Quantities for Class 3 Flammable Liquids (excerpt see table 2.1 in AS:1940)

Location	PGI & PGII	PGIII
Laboratories	50L per $50m^2$	100L per $50m^2$

However, since most chemical laboratories are keeping dangerous goods of more than 1 class then the minor storage quantities in AS: 2243.10, which are more conservative, should be adopted. This would reduce

the minor storage quantity for flammable liquids to 10 Litres per 50m^2.

Basic Precautions for Storage of Class 3 Flammable Liquids

- Keep the storage away from heating or ignition source, e.g., a hotplate, other heating appliances, pumps, stirrer motors, light switches, welders, or similar ignition sources.
- Keep containers closed when not in use. Decant in a well-ventilated area, and away from any potential source of ignition. Decanting and pouring of small quantities of flammable liquids can generate a static spark of sufficient energy to ignite a flammable vapour-air mixture. Earthing (bonding) may be required when decanting 20L or more.
- Keep the storage in such a way that it does not impede emergency egress.
- Keep the area where flammable liquids are stored or decanted free from combustible matter.
- Keep flammable liquids separate from other dangerous goods classes particularly Oxidisers (i.e. Class 5).
- Where refrigerated storage for flammable liquids is required, do not use domestic refrigerators. [Options include intrinsically safe refrigerators or domestic refrigerators that have been made electrically safe by a licensed electrician].

Outdoor Storage of Class 3 Flammable Liquids

Spill containment systems are required to prevent the spill from contaminating surrounding soil or from entering any drainage system other than one intended specifically for its drainage and collection.

Flammable Liquid Cabinets

See AS: 1940: Section 4.9.

Storage of flammable liquids above Minor Quantities requires the installation of a dangerous goods cabinet. The requirements for the cabinet include:

- Maximum capacity. No cabinet shall exceed a capacity of 850 litres. Any cabinet greater than 250 litre capacity can only be located on a floor having direct access to the street. The aggregate capacity of cabinets shall not exceed 850 litres per 250m^2 on ground level or 250 litres per 250m^2 on other floors.
- Cabinet separation. Each aggregate quantity shall be separated by at least 10m.
- Cabinet construction. The cabinet must be fire resistant.
- Cabinet marking. Each individual cabinet shall be marked with the maximum capacity to be kept in the cabinet, a Class 3 dangerous goods label of at least 100mm nominal size, and a NO SMOKING, NO IGNITION SOURCES warning sign in lettering of at least 50mm height.
- Ventilation. Some cabinets may require venting. Seek expert advice.
- Free escape. A cabinet shall be located in relation to exits and stairways such that in the event of fire the escape of persons will not be jeopardised.
- Ignition sources. A cabinet (which is not vented) shall be kept at least 3m away measured laterally from any ignition source, such as a power point, electrical equipment or light switch. Ignition sources should be excluded within 1m above any opening or vent from the cabinet (including the door).
    - Variation on the proximity to ignition sources of cabinets may be made after a documented hazard zone assessment is made by a dangerous goods consultant or via UNSW Health, Safety and Environment Coordinators. HSE Coordinators shall use the process in Appendix 4.
    - If there is a hazard zone assessment allowing a variation in proximity to ignition sources, then you must document how you will manage the risk of ignition of vapours within the hazard zone before opening the cabinet. For example, before each time you open the cabinet you must turn off switches, unplug items, extinguish flames, or allow equipment to cool if they are within the 3m lateral hazard zone.

Under Bench Flammable Liquid Cabinets (FLC)

Where an under bench FLC contains only flammable liquids which produce heavier than air vapours then the hazard zone shall not extend above the bench or 900mm above fixed floor level. The hazard zone shall extend 3m laterally from the cabinet and any opening of the cabinet. Ignition sources shall be excluded from this zone or be managed with documented procedures as stated above.

Minor storage and Flammable Liquids Cabinets

Where a laboratory space has been assessed to contain less than minor storage quantities of flammable liquids, in accordance with AS1940 and/or this Guideline, and a FLC is being used to store flammable liquids, then the hazard zone can be assumed to be negligible around the cabinet and therefore the 3m rule does not apply.

- The above is true provided any quantity of flammable liquid in the laboratory space is not a PG1 Dangerous Good and/or does not exceed:
    - 100L in total in closed containers
    - 25L for decanting purposes
    - 5L in open containers for occasional use
    - 1L in open containers for continuous use

See section 12 for details on quantities of flammable liquids requiring the storage area to be **placarded.**

6.1. Storage of Flammable Liquids in Domestic Refrigerators

Storage of flammable chemicals within domestic refrigerators is not permitted since these fridges have the potential to create a spark when the contact switch opens and closes.

However, Australian Standard AS2243.2:2006 Safety in Laboratories Part 2: Chemical Aspects, permits storage of flammable liquids in fridges *provided* that the fridge has been modified by a competent person to eliminate ignition sources. Such modification could include the removal of the wiring for the internal light, removal of the switching part of the thermostat from inside the compartment and possibly modification of any automatic defrosting system and internal fans. [It is the responsibility of the competent person to identify and eliminate all ignition sources].

If flammable liquids are diluted (with water) to a concentration below the cut-off concentration for flammables, then a risk assessment may deem it acceptable to store small quantities of flammables in the fridge provided this percentage is clearly listed on the label. For most flammable liquids a concentration of below 10% (90% balance water) renders them non-flammable.

Cool rooms are not intrinsically safe. The risks of storing flammables in cool rooms and freezers should be identified on a case-by case basis prior to allowing such storage.

7. Class 4 Flammable Solids

Since there are no Australian Standards for the handling and storage of flammable solids the SDS is the resource to be used to establish best practice for these substances. In addition, refer to Australian Standard AS:2243.10: Storage of Chemicals.

There are three sub classes of flammable solids:

- Class 4.1 Flammable solids (the most stable)
- Class 4.2 Spontaneously Combustible (mostly unstable and highly reactive and are required to be stored separate from everything else)
- Class 4.3 Dangerous when wet [must not be stored in a fridge due to potential for condensation]

The capacity of any chemical storage cabinet used in a laboratory to store chemicals of Classes 4.1, 4.2 or 4.3 shall not exceed 50L (ref: AS:2243.10).

See also section 1.14 for details on quantities of flammable solids requiring the storage area to be placarded.

8. Class 5.1 Oxidising Agents and 5.2 Organic Peroxides

Maximum quantities of oxidising substances to qualify for minor storage are listed here.

PGI	PGII	PGIII
50	250	1 000

However, since most chemical laboratories are keeping dangerous goods of more than 1 class then the minor storage quantities in AS: 2243.10, which are more conservative, should be adopted. This would reduce the minor storage quantity for all oxidising agents to 10 Litres per 50m^2.

Many substances belonging to Class 5.1 and 5.2 are highly reactive, unstable and unpredictable. For this reason, keep Class 5 substances away from combustible material or any other incompatible substance where there is any risk of interaction, e.g., ammonium nitrate shall not be kept next to petrol or diesel oil; hydrogen peroxide shall not be kept next to sodium hydroxide.

Storage in Cabinets for Oxidising Agents

Class 5.1 and 5.2 dangerous goods shall be kept in a chemical storage cabinet, suitable refrigerated storage or a laboratory cupboard dedicated to their storage. Where these goods are stored on open shelves, they shall be segregated from Classes 3, 4.1, 4.2, 4.3, 5.2, 6.1 and 8 dangerous goods.

Cabinets for the storage of Oxidizing agents must not be used for the storage of other classes of substances. Where more than one Oxidizing agent is kept in a cabinet, check that the Oxidizing agents are compatible. The capacity of any chemical storage cabinet used in a laboratory to store chemicals of Classes 5.1 or 5.2 shall not exceed 50L (ref: AS:2243.10). Section 1.14 contains more information on placarding requirements.

9. Toxic Substances

The minor storage quantities given in AS4452: The Storage and Handling of Toxic Substances are as follows:

Maximum Quantity, Kg or L		
PG I	**PG II**	**PG III**
10	100	1 000

However, this is considered excessive for laboratories having other types of dangerous goods present and so the more conservative quantities given in AS:2243.10 [Safety in Laboratories Chemical Storage] should be used i.e.

Maximum Quantity, Kg or L	
PG I	**Other**
10	50

Once these quantities are exceeded then an Australian Standard approved cabinet is required. Cabinets designated for the storage of containers of toxic substances shall not be used for the storage of goods that are incompatible, or that react dangerously.

Note from AS: 4452

- The maximum quantity of toxic substances kept in a single cabinet shall not exceed 250Kg/L,
- Not more than 50Kg/L shall be of Packing Group II and
- Not more than 25Kg/L shall be of Packing Group I.

Where mechanical ventilation of the cabinet is required, the following specifications apply:

- The design of any vent opening in the cabinet wall shall not compromise the structural strength of the cabinet.
- The extraction system shall be sufficient to ensure that the ambient concentration of any toxic substance within the breathing zone of any person using the cabinet is maintained as low as practicable.
- Where a cabinet incorporates provisions for connection to an external venting system—
    - the vent opening shall be provided with a means for permanent closure when venting is not required; and
    - the information supplied with the cabinet shall include instructions on the installation and operation of the vent system; and

- the cabinet vent design shall be such as to ensure that surrounding work areas are not contaminated by emissions.

NOTE: Ventilation provisions should be designed by an appropriately qualified engineer.

Approximately 30 percent of toxic substances also have a subsidiary risk of another class. Toxic substances can have subsidiary risks of Class 3, 4, 5 or 8, and dangerous goods of Classes 1, 3, 4, 5, and 8 can have a subsidiary risk of Class 6.1. A limited number have multiple subsidiary risks. When storing goods having subsidiary risks the hazards of these other classes should also be taken into account.

Note: If dangerous goods have both primary and subsidiary risks then store in accordance with primary risk and take into account the subsidiary risk. For example, Acetic acid (glacial) has a primary risk as corrosive and a subsidiary risk as flammable. It should be stored in with corrosives. However, in this case you also need to ensure that ignition sources are far enough away not to present a risk.

For the substances in this class that are scheduled poisons, generally the same controls for toxics work for poisons. However, refer to the Research Ethics & Compliance Support (RECS) procedures for Schedule 4 and 8 drugs if you are using substances from this schedule. You will need a permit from the Department of Health and be required to keep a log of every use of the substance (in the same way as the pharmacists have to for prescription drugs).

See section 11 for details on quantities of toxic substances requiring the storage area to be placarded.

You need to keep your chemical register up to date in order to compare your storage quantities with the limits in section 1.14.

10. Class 8 Corrosives

Maximum Storage Quantity for Minor Storage for Class 8 Corrosives

Maximum Quantity, Kg or L		
PG I	PG II	PG III
50	250	1 000

As with for Toxic substances, this is considered excessive for laboratories having other types of dangerous goods present and so the more conservative quantities given in AS:2243.10 [Safety in Laboratories Chemical Storage] should be used i.e.

Maximum Quantity,	Kg or L
Liquids	**20 L**
Solids	**50 Kg**

Maximum quantities of Class 8 Corrosives to be kept

The maximum quantity of corrosive substances kept in a single cabinet shall not exceed 1000kg or L, of which not more than 250kg or L shall be of Packaging Group II and not more than 50kg or L shall be of Packaging Group I.

Class 8 dangerous goods shall be stored, in a laboratory cupboard or a chemical storage cabinet, in a manner that will prevent reactions between—

- acids and alkalis;
- acids and hypochlorites;
- acids and cyanides;
- acids and Class 4.3 dangerous goods; and
- oxidizing acids and combustible materials.

See section 1.14 for details on quantities of corrosive chemicals requiring the storage area to be placarded.

Less stringent requirements can apply if the corrosive liquid is diluted to reduce the hazard. In such cases pH

testing must be conducted. Corrosion risks are greatly reduced if the pH is in a more neutral range (e.g. between 5 and 9). As a general guideline a ph reading of less than 2 and greater than 11.5 requires the full precautions.

11. General Provisions relating to all Dangerous Goods

a. What to consider during the Design Phase:

A dangerous goods consultant should be employed for: any planned extensive laboratory refurbishment; prior to any construction; and for the storage of dangerous goods exceeding minor quantities.

Any changes in storage locations that are listed on the annual notification to SafeWork NSW (and thus included in the dangerous goods manifest for the building) must be notified to UNSW Health & Safety, who perform this notification.

b. Summary of storage requirements for all dangerous goods

Consider the variety of substances you are storing. Chemicals should be assigned to one or more of the following categories:

- Unstable chemicals—unstable at or below ambient temperature requiring storage in a cold store;
- Spontaneously combustible or pyrophoric chemicals—such as metal alkyls and sodium dithionite, including Class 4.2 dangerous goods.
- Chemicals that react with water—such as Class 4.3 dangerous goods.
- Organic peroxides —including dangerous goods of Class 5.2.
- Other oxidizing chemicals—including dangerous goods of Class 5.1.
- Toxic and special poisons—including dangerous goods of Class 6.1.
- Corrosive chemicals—including Class 8 dangerous goods.
- Flammable and combustible solids and liquids—Class 3 and Class 4.1 dangerous goods may fall into this category.

*Also known as bunding, secondary containment is where a secondary container is used to receive the contents of the first if the first one breaks. (e.g., Placing a bottle in a tray made from materials resistant to the chemicals being handled and large enough to receive the contents).

c. Overall

- Keep stocks to a minimum
- Make sure the area is well ventilated. Install gas monitoring in accordance with risk.
- Keep package sizes small and bund the larger containers.
- Maintain segregation as far as possible (in accordance with compatibility).
- Ensure emergency facilities are adequate and communicated.
- Use Australian standard approved cabinets where possible unless quantities are very small.
- Keep a record of the dangerous goods quantities up to date and include on the building manifest if required.

12. Do you have Placard Quantities?

Some examples from Schedule 11 of the WHS Regulation

Hazard Class	Hazard Category	Quantity
Flammable Gas	n/a	4 ‘G’ size cylinders (200L)
Non-flammable non-toxic Gas	n/a	20 ‘G’ size cylinders (1000L)
Toxic Gas	n/a	1 ‘G’ size cylinder (50L)
Any of the below three classes: • Flammable Liquids • Substances with Acute Toxicity • Oxidising Liquids/Solids	Hazard Category 1 Hazard Category 2 Hazard Category 3	50 250 1000

Hazard Class	Hazard Category	Quantity
Skin Corrosion	Hazard Category 1A Hazard Category 1B Hazard Category 1C	50 250 1000
Mixed hazard categories in any of the above classes where the hazard category limit is not exceeded		1000L/ Kg

For full list and more information, refer to HS333 Placard, Manifest and Notification Procedure for Schedule 11 Chemicals

APPENDIX 1 – INDICATION OF COMPATIBILITY BASED ON CLASS

This Appendix may be used for guidance as to compatibility between the different classes of dangerous goods (DGs), in the absence of more detailed compatibility information about specific products, which is available from SDSs.

Ref: *WorkCover Code of Practice: The Storage and Handling of Dangerous Goods.*

CLASS	2.1	2.2	2.3	3	4.1	4.2	4.3	5.1	5.2	6.1	8	9
2.1 Flammable Gas	A	E	C	B	B	D	B	D	D	C	B	B
2.2 Non-flammable Non-toxic Gas	E	A	B	E	E	E	E	B	E	B	B	B
2.3 Toxic Gas	C	B	A	C	C	C	C	C	C	B	B	B
3 Flammable Liquid	B	E	C	A	B	D	B	D	D	C	B	B
4.1 Flammable Solid	B	E	C	B	A	D	B	D	D	C	B	B
4.2 Spontaneously Combustible	D	E	C	D	D	A	B	D	D	C	B	B
4.3 Dangerous When Wet	B	E	C	B	B	B	A	D	D	C	D	B
5.1 Oxidizing Agent	D	B	C	D	D	D	D	A	D	F	D	F
5.2 Organic Peroxide	D	E	C	D	D	D	D	D	G	F	D	F
6.1 Toxic	C	B	B	C	C	C	C	F	F	A	B	B
8 Corrosive	B	B	B	B	B	B	D	D	D	B	G	B
9 Miscellaneous DG's	B	B	B	B	B	B	B	F	F	B	B	A

In this table, combustible liquids should be included with Class 3.

Letters A–G have the following meaning:

A. **Most** dangerous goods of the same Class have similar primary hazards and are usually considered to be compatible.

B. **With** a few exceptions which should be indicated on SDS, goods of these two classes are usually non-reactive with each other. However, in an emergency such as a spill, leak or fire, the presence of the second Class may lead to different hazards or increased risk such that additional control measures are required.

C. **While** goods of these two classes are usually non-reactive with each other, a fire involving the fire risk goods may lead to the release of large clouds of toxic gases or vapours.

D. **Goods** of these two classes are likely to interact with each other in such a way as to significantly increased risk. In some cases, interaction may result in fire or evolution of toxic vapours. For those that do not interact, a fire involving one may be violently accelerated by the presence of the other. These classes should not be kept in the same area unless it can be demonstrated that the risks are fully controlled.

E. – D, if the Class 2.2 has a Subsidiary Risk 5.1. –B, otherwise.

F. – D, if the Class 6.1 or 9 is a fire risk substance. –B, otherwise.

G. – D, if one material is a concentrated, strong acid and the other is a concentrated, strong alkali. –A, otherwise.

APPENDIX 2 - DANGEROUS GOODS INCOMPATIBILITY TABLE

This table is reproduced from the CCH Laboratory Safety Manual courtesy of CCH Australia Ltd.

The following substances may react violently when mixed with other chemicals and must be kept apart. The list is not exhaustive. Refer to the SDS for specific incompatibilities.

Chemical	Not compatible with
Acetic acid	Chromium (VI) oxide, nitric acid, alcohols, ethylene glycol, perchloric acid, peroxides, permanganates.
Acetylene	Chlorine, bromine, fluorine, copper, silver, mercury.
Activated charcoal	Calcium hypochlorite, oxidising agents.
Alkali metals	Water, carbon tetrachloride and other halogenated alkanes, carbon dioxide halogens.
Aluminium alkyls	Water.
Ammonia, laboratory gas	Mercury (e.g. in pressure gauges), chlorine, calcium hypochlorite, iodine, bromine, hydrogen fluoride.
Ammonium nitrate	Acids, powdered metals, flammable liquids, chlorate, nitrates, sulphur, fine particulate organic or combustible material.
Aniline	Nitric acid, hydrogen peroxide.
Bromine	See chlorine.

Chlorates	Ammonium salts, acids, powdered metals, sulphur, fine particulate organic or combustible substances.
Chlorine	Ammonia, acetylene, butadiene, butane, methane, propane, hydrogen, petroleum benzine, benzene, powdered metals.
Chomium (VI) oxide	Acetic acid, naphthalene, camphor, glycerol, petroleum spirit, alcohols, flammable liquids.
Copper	Acetylene, hydrogen peroxide.
Cumene hydro-peroxide	Acids, both organic and inorganic.
Cyanides	Acids.
Flammable liquids	Ammonium nitrate, chromium (VI) oxide, hydrogen peroxide, nitric acid, sodium peroxide.
Fluorine	Store separately.
Hydro-carbons	Fluorine, chlorine, bromine, chromium (VI) oxide, sodium peroxide.
Hydrogen Fluoride	Ammonia, laboratory gas or liquid.
Hydrogen peroxide	Copper, chromium, iron, metals and metal salts, alcohols, acetone, organic substances, aniline, nitromethane, combustible substances.
Hydrogen sulphide	Fuming nitric acid, oxidising gases.
Iodine	Acetylene, ammonia (laboratory gas or solution).
Mercury	Acetylene, ammonia.
Nitric acid, conc	Acetic acid, aniline, chromium (VI) oxide, prussic acid, hydrogen sulphide, flammable liquids and gases.
Oxalic acid	Silver, mercury.
Perchloric acid	Acetic anhydride, bismuth and its alloys, alcohols, paper and wood.
Phosphorus	Sulphur, oxygen containing compounds such as chlorates.
Potassium	See alkali metals.
Potassium chlorate	See chlorates.

Potassium Permanganate	Glycerol, ethylene glycol, benzaldehyde, sulphuric acid.
Silver	Acetylene, oxalic acid, tartaric acid, ammonium compounds.
Sodium	See alkali metals.
Sodium peroxide	Methanol, ethanol, glacial acetic acid, anhydride, benzaldehyde, carbon disulphide, glycerol, ethylene glycol, ethyl and methyl acetate, furfurol.
Sulphuric acid	Potassium chlorate, potassium perchlorate, potassium permanganate.

APPENDIX 3 GENERIC CONTROLS FOR THE STORAGE OF DANGEROUS GOODS

Category	Specific Requirement
Ventilation	• Adequate ventilation shall be provided for package storage and handling areas. • Adequate ventilation depends on the nature of the substance and the circumstances of its use.
First Aid	• The occupier shall provide an adequate first aid kit and appropriate personal protection equipment. Reference should be made to the safety data sheet (SDS) for the substance being kept.
Security & Access	• Each laboratory must be secured against unauthorized access. • The means of entry into and exit from the areas, rooms or buildings where dangerous goods are kept or handled shall be kept clear at all times. • At all times, access shall also be available to— ↦ firefighting equipment; ↦ personal protective equipment; ↦ clean-up materials and equipment; and ↦ the place where the dangerous goods manifest is kept.
Communications	• Each laboratory must have a phone and contact details for emergency response.
Lighting	• There must be adequate lighting in any area where dangerous goods are stored or handled.
Emergency Requirements	• An adequate supply of water for emergency use shall be available at a nearby location. • A fire extinguisher of suitable type shall be installed in each minor store. It shall be located so that it is immediately accessible in an emergency, along an exit route. • Dangerous goods can present the following hazards in a fire: ↦ They may give off vapours, fumes or smoke, which may be flammable, toxic or corrosive, or may form flammable mixtures in the air. ↦ Flammable or oxidising dangerous goods may intensify or spread the fire. ↦ Spilled substances and contaminated debris may be toxic to the environment. ↦ Containers may rupture violently, or become projectiles, when heated. ↦ Some substances may react violently with water or other chemicals, causing the substances to be sprayed over a wide area. ↦ The mixing of spilt or fire-affected substances may have unknown properties and consequences. ↦ Contaminated water run-off from fires may present a hazard to persons and the environment.
Containers & Decanting	• The contents of a container shall not be transferred to any other container for storage unless the latter is suitable for the storage of this particular dangerous good and is clearly marked with the appropriate hazard diamond to indicate the identity and hazard potential of that substance. • Containers shall: ↦ be kept on non-combustible surfaces which are not liable to attack or damage by the contents if spilt; ↦ be kept at least 3m away from sources of heat; ↦ be opened only in appropriately ventilated areas; ↦ be kept securely closed when not in use; and ↦ not be kept next to reactive material. • Containers shall be kept closed when not in use. Containers should only be opened in a well-ventilated area, and, if their contents are flammable, away from any potential ignition sources. • Appropriate spillage-retention measures shall be provided where

	containers are opened for the transfer of their contents. • The transfer of dangerous goods from the store to the point of use shall be carried out in a manner that minimises the possibility of spillage. • Suitable containers may be available from the Sciences store.
Storage & Segregation	• Any materials that are incompatible, or might react dangerously if mixed, shall be segregated so that the possibility of reaction is minimised.
Spills	• All spills and leaks from containers shall be attended to promptly. Spilled or leaked material shall not be returned to its original container. • Every endeavour shall be made to prevent leaks or spills, and to control them if they do occur; clean-up action shall be initiated immediately. Leaked or spilled materials shall be kept segregated from other waste and disposed of properly. • NOTE: Entry into the affected area should always be under supervision. For dealing with spills, the following are essential: ↦ Clean-up materials and equipment ↦ An adequate supply of water (if the dangerous goods are compatible with water). ↦ Appropriate personal protective clothing equipment shall be used.
All Dangerous Goods Cabinets	• Cabinets shall be located not less than 3 m from any source of heat that could affect the cabinet or its contents. • Where cabinets are installed in a building — ↦ irrespective of the occupancy of the building, not more than one cabinet shall be installed in each 100m^2 of building area, and the separation distance between any two cabinets shall be not less than 3m; ↦ the cabinets shall be so located in relation to exits and stairways that they will not impede the escape of persons in the event of fire; and ↦ cabinets shall be located near a provision for the washing of hands. • Cabinets kept out-of-doors shall be protected from the weather. • Dangerous goods requiring special storage conditions (e.g. temperature control) shall not be kept in a minor store. • When calculating the floor area, use only the area of the current floor of a multiple floor building.
Personal Protective Equipment	The head of the work unit where dangerous goods are stored will: • ensure that all persons on the premises are provided with appropriate personal protective equipment; • keep personal protective equipment in designated, well-identified locations and ready for use; and • maintain, in a fit state of repair, all personal protective equipment.

Reference AS 3833:2007 “The Storage and handling of mixed classes of dangerous goods.”

Appendix A: Version control

Version	Authorised by	Approval Date	Effective Date	Sections modified
0.1	Director, Human Resources	1 November 2006	1 November 2006	Created 2 guidelines from one original document. This guideline focuses on the storage aspects of dangerous goods. The second guideline is an introduction to the 9 classes of dangerous goods. Released for consultation purposes.
1.0	Director, Human Resources	1 January 2007	1 January 2007	No changes from consultation
1.1	Director, Human Resources	16 December 2010	16 December 2010	Updated Guideline to the standard University template.
1.2	Director, Human Resources	1 March 2013	1 March 2013	Updated legislation references Reference to the GHS Updated Branding Logo in accordance with UNSW Branding Guidelines. Modified the document identifier from OHS to HS in accordance with WHS legislation review
1.3	Director, UNSW Safety and Sustainability	30 April 2014	30 April 2014	Reviewed for administrative updates
2.0	Director, UNSW Safety and Sustainability	23 March 2016	23 March 2016	Added new section 1.8.1 re storage of flammable liquids in fridges In 1.9 added that 'dangerous when wet chemicals' are not to be stored in fridges In 1.12 clarification: less stringent requirements if corrosives are diluted Added another link to a compatibility table (Appendix 2)
2.1	Director, UNSW Safety and Sustainability	3 August 2016	3 August 2016	Transferred into new template with administrative updates. Updated section 1.8 in relation to FLC proximity to ignition sources. Added Appendix 4.
3.0	Director, Risk & Safety Management	8 August 2022	8 August 2022	Updated template, removed from Governance.

Updates to this document

Any suggestions, recommendations or updates to this document should be emailed to safety@unsw.edu.au with the email header stating *GUIDELINES UPDATE HS404.*