



Australia's National
Science Agency

Chemical Storage Areas Technical Guide

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Chemical Storage Areas Guide – Overview and navigating this guide

All chemical related installations/modifications/maintenance must be undertaken by a qualified and experienced trades person.

General Storage Requirements

(pg. 4)

You must:

1. Follow **general chemical storage requirements**. (pg. 6)
2. Follow specific technical guidance safety advice for storing chemicals:
 - **Dangerous Goods (DG) cabinet** (pg. 8)
 - **General laboratory cabinet or cupboard** (pg. 10)
 - **Shelf, rack, bench, or pallet** (pg. 10)
 - **Refrigerator or freezer** (pg. 11)

Requirements in an area where packages are opened (e.g. laboratories, workshops)

(pg. 13)

Covered by AS 2243.2

You must:

- Follow **general storage requirements** in **s2.3** (pg. 6)
- Follow **additional requirements** in **s3.1** for:
 - Storing chemicals within DG cabinets, including minimizing cabinets and meeting volume limits (pg. 13)
 - Storing chemicals outside of DG cabinets, including not exceeding container size and net quantity limits (pg. 14)
- Segregate **incompatible chemicals**. (pg.16)
- Ensure suitable **ventilation**. (pg.16)
- **Assess the risk** of a **hazardous atmosphere** forming where gases or cryogenes are present in an area. (pg.16)
- NOT store **gas cylinders** in labs unless connected for use and reticulation into the lab is not practical. (pg. 16)

Requirements for separate stores containing mixed classes of DGs

(pg. 18)

You must:

- Use Table 3 to select the most appropriate requirements, to be applied in full, for the area. (pg. 18)
 - **s4.2** – stores containing a **range of hazardous chemicals** (pg. 19) where quantity thresholds (pg. 20) are not exceeded
 - **s4.3** – stores containing moderate amounts of **lower to moderate risk substances** (e.g., paints, solvents) (pg. 23)
 - **s5** – stores containing only **one class of DGs**, see below (pg. 25)
- Additionally, follow **general storage requirements** in **s2.3** (pg. 6)

For stores containing **smaller quantities**, it may be more practical to work according to **requirements** of **s4.2** or **s4.3** (see above).

Requirements for areas containing only one class of DGs

(pg. 25)

- **s5.2** – Class 2 DGs (**gases and cryogenes**) (pg. 25)
- **s5.3** – Class 3 DGs (**flammable liquids**) (pg. 25)
- **s5.4** – Class 4.1, 4.2 & 4.3 DGs (**flammable solids, spontaneously combustible solids, dangerous when wet**) (pg. 27)
- **s5.5** – Class 5.1 and 5.2 DGs (**oxidisers and organic peroxides**) (pg. 28)
- **s5.6** – Class 6.1 DGs (**toxics**) (pg. 29)
- **s5.7** – Class 8 DGs (**corrosives**) (pg. 30)
- **s5.8** – Class 9 DGs (**miscellaneous or environmentally hazardous**) (pg. 31)

1 Introduction

This document provides information on the necessary aspects of, and establishes mandatory minimum requirements for, new chemical storage areas across CSIRO sites to comply with Commonwealth Work Health and Safety (WHS) Act and Regulations, Australian Standards and other model codes of practice. This is necessary to ensure all hazardous chemicals are stored and handled safely. Aspects of chemical storage and safety covered in this guide include:

- General requirements applicable to all chemical storage areas.
- Criteria for determining which type of chemical storage area is most appropriate depending on the flexibility required for the range and quantities of chemicals required to be stored.
- Specific requirements based on the size and scope of the chemical storage area required, either:
 - Chemical storage within laboratories, including dangerous goods cabinets.
 - Chemical stores separated from a laboratory, either attached to the laboratory or a freestanding building for the purpose of storing chemicals.

This guide primarily focuses on chemical storage areas that will be encountered in CSIRO such as laboratories and smaller single or mixed DG dedicated chemical stores, and does not cover all types of chemical storage as per the Australian Standards. Specifically, this document does not cover the storage of:

- Compressed gases or cryogenics (DG Class 2 items). These are only briefly mentioned in this guide. Please consult the Reticulated Gas Installation and Maintenance Guide.
- Radioactive substances (DG Class 7 items). Please refer to CSIRO's Radiation Safety guidance material.
- Infectious substances, biologically hazardous materials or other materials requiring physical containment (PC) controls. Please refer to AS 2243.3 Safety in laboratories Part 3: Microbiological safety and containment.
- Transit storage i.e., areas where chemicals are only temporarily stored for <5 working days.
- Chemicals at port facilities or on ship-board installations. Please refer to the IMDG code for requirements, though this document may provide additional guidance for ship-board laboratories, where this guide does not contradict the IMDG code.
- Chemicals in bulk containers or quantities that exceed "minor storage", as defined by the relevant Australian Standard for each section. For storage areas containing bulk containers quantities above minor storage, external professional advice must be sought.
- If there is any uncertainty regarding an installation, professional advice should be sought. All chemical installations/modifications/maintenance must be undertaken by a qualified and experienced tradesperson.

2 General requirements for the storage of chemicals

2.1 Introduction

Hazardous chemicals are substances, mixtures or articles that can pose a health or physical hazard to humans and the environment. They may be solids, liquids or gases.

The basic principles of chemical storage aim to ensure:

- The health and safety of persons by eliminating the risk of exposure to hazardous chemicals.
- The environment is protected by preventing, containing, and cleaning any chemical spills.
- Chemicals are prevented from degrading over time, such as through exposure to heat or sunlight, to form potentially more hazardous by-products.
- Chemicals are prevented from reacting with other incompatible chemicals and subsequently undergoing uncontrolled reaction.
- Chemicals are protected from the effects of and/or contributing to the development of a fire.

2.2 Terms used in this document

- **Hazardous Chemical** means that one or more hazard categories under the Globally Harmonised System of Classification and Labelling of Chemicals (GHS) applies to the chemical.¹
- **Dangerous Good (DG)** means that the chemical is assigned to a Dangerous Goods (DG) class under the Australian Dangerous Goods code. A chemical's DG class is listed in section 14 of the SDS.
- **Packing Group (PG)** means the assigned measure of Dangerous Goods' hazard rating. See Appendix B for more information.
- **Laboratory** means any building or part of a building used or intended to be used for scientific and related work, including research, quality control, testing, teaching or analysis. This may include workshops, process bays, sheds or other areas where chemical containers are opened or handled.²























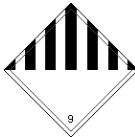
Other definitions for this guide, including abbreviations, are provided in Appendix B.

Table 1 provides an overview of the Dangerous Goods classes, the class labels, and the equivalent GHS pictograms. A chemical may be hazardous under the GHS, but not classed as a Dangerous Good. Chemicals with more than one Dangerous Goods class generally should be stored based on their primary Class, though secondary or tertiary Classes should be considered for incompatibilities with other substances in the storage areas.

¹ See the definition of the Work, Health and Safety Regulations for chemicals which are classified under the GHS but are not considered hazardous in Australia (e.g. acute toxic category 5).

² This definition of laboratory is sourced from Australian Standard 2982.

Table 1. Dangerous Goods Classes, Class labels and equivalent GHS pictograms (where relevant).

DG Class	Class label	Equivalent GHS Pictograms	DG Class	Class label	Equivalent GHS Pictograms	DG Class	Class label	Equivalent GHS Pictograms
CLASS 1 Explosives	 Some classes of explosive may not include the image.		CLASS 2 2.1 Flammable gas 2.2 Non-flammable non-toxic gas 2.2 (5.1) Oxidising gas 2.3 Toxic gas	   		CLASS 3 Flammable liquid		
CLASS 4 4.1 Flammable solid 4.2 Spontaneously combustible solid 4.3 Dangerous when wet	  		CLASS 5 5.1 Oxidising substances 5.2 Organic peroxides	 		CLASS 6 6.1 Toxic substance 6.2 Infectious substance	 	 Infectious substances are not covered by the GHS
CLASS 7 Radioactive material		Radioactive materials are not covered by the GHS	CLASS 8 Corrosive substance			CLASS 9 Miscellaneous Goods		Miscellaneous goods are not covered by the GHS

2.3 General chemical storage requirements

2.3.1 General

All chemical storage areas (including laboratories and workshops) must incorporate the following:

- All chemicals must be stored in a cool, dry area away from direct sunlight, heat or ignition sources. Liquids should be stored below solids, and as low as possible to the ground to minimize the spread of spills or breakages.
- Appropriate chemical spill clean-up materials (e.g. spill kits) available and accompanied by established processes (e.g. SWI) for managing chemical spills.
- Where possible, bunding (such as trays resistant to the chemical being stored) of at least 25% of the maximum possible spill volume should be utilised.
- Access to First Aid facilities and supplies.
- Hand washing facilities for personal hygiene must be available in, or immediately nearby where the chemicals are stored.
- Ventilation must be suitable to ensure any flammable vapours do not exceed 5% of the applicable lower explosive limit (LEL) and any toxic vapours must not exceed the relevant exposure standard.
- Areas must be secured against unauthorised entry and kept clear of combustible matter or refuse.
- Chemicals and chemical storage cabinets must not block escape routes or emergency access points.
- Any staff who will access the area must have received training in identifying chemical hazards, assessing risks associated with chemicals and be familiar with appropriate risk control measures.

2.3.2 Chemical containers

All hazardous chemicals must be:

- Labelled in compliance with the GHS³. Labels must be in English.
- The minimum practical volume necessary for usage.
- Treated as full, unless the container has been emptied, cleaned and the label removed or completely defaced.
- Kept closed when not in use.

³ If purchased prior to 2017, chemicals are permitted to be labelled in accordance with the National Occupational Health and Safety Commission (NOHSC) or the European Dangerous Substances Directive 67/548/EEC annex II, provided the chemical hazards have not substantively changed. These chemicals must be used before newer stock.

Very small chemical containers and in-house prepared products, including working mixtures, synthesis products and waste chemicals have reduced labelling requirements under the GHS.

- Segregated from incompatible materials or other substances with which they may react dangerously, to prevent them from mixing, generally by a physical barrier (e.g. separate storage tubs) or intervening space. Segregation distances will vary depending on the types and quantities of chemicals.
- Where required, stored under specific conditions based on Section 7 of the Safety Data Sheet (e.g. low temperature, under inert atmosphere).
- Inspected at least annually to ensure they are undamaged, and the labelling remains legible.
- Disposed of, where they are no longer required, have exceeded their shelf life, where the container is damaged, or the label is illegible.

2.3.3 Signage

- Chemical storage areas must include clear signage on entry doors to identify chemical classes contained within the area. Where quantities of chemicals stored in the work area do not exceed the Placard Quantity for any category of chemicals listed in Schedule 11 of the WHS Regulations, this can be a simple poster (see Appendix C for an example Area Hazard Poster). Full placard signage must **not** be displayed for areas which do not, or no longer contain Placard Quantities of the Class of chemical described on the placard.
- Where the quantities of chemicals in the area do exceed the Placard Quantity for any hazard class listed in Schedule 11 of the WHS Regulations, placards which meet Schedule 13 of the WHS Regulations must be displayed on workplace entrance(s), the building entrance(s) and the storage area entrance(s).
- If chemical holdings are reduced below the Placard Quantities in future, the placarding signage must be updated or removed to reflect the quantities held.

2.3.4 Documentation

- For any chemical storage area, an inventory of the chemicals held in that area must be maintained. Additionally, staff working in or with access to an area where chemicals are used or stored must also have access to the Safety Data Sheets.
 - In CSIRO, we use ChemAlert to maintain our electronic inventory and provide access to SDS.
- Some chemical storage areas may require an ARA to document specific hazards, risks, and control measures relating to the store. These include areas where:
 - high-risk chemicals are kept, where any breakage, spill or leak presents a serious health, physical or environmental hazard (e.g. fatal if inhaled chemicals).
 - there is a potential risk of a hazardous area from flammable gases, vapours, mists or dusts. See the Managing Hazardous Areas guide for more information.
 - Any condition of this guide is not completely complied with (e.g. maximum container size in a laboratory exceeded due to specific work need but the risk has been assessed as acceptable for that activity).

Note: any chemical storage area that exceeds the volume or quantity limits in this guide **must** have a documented risk assessment, as well as meeting other requirements of the relevant Australian Standard(s). Professional DG consultation should be sought for these areas.

2.4 Types of chemical storage

2.4.1 Dangerous Goods Cabinets

Dangerous Goods cabinets are commonly used to store hazardous chemicals, as they provide greater protection from the chemicals stored within them in an emergency. They also provide protection of the chemicals stored from fire so that time is available for escape or fire fighting.

To be considered a Dangerous Goods cabinet, the cabinet must have:

- Signage indicating the Class(es) of Dangerous Goods stored within the cabinet. See below for more information on storing mixed Classes of Dangerous Goods in a single cabinet.
- Walls, floor, door and roof made of double-walled sheet steel construction with a space of at least 40 mm between the walls (can be air space or filled with non-combustible insulation).
- Any gaps sealed as far as necessary to prevent the spread of flame or heat.
- An inner base of the cabinet that forms a liquid-tight bunded compound at least 150 mm deep, designed in a way to prevent the compound from being used as a storage space, with all leakage directed into this lower compound.
- Shelves that are perforated to permit free air movement and which are capable of carrying the maximum load of chemicals to be stored on each shelf.
- Doors which are self-closing, close-fitting and held shut automatically by catches at two or more points. Where doors have a mechanism to hold them open, the mechanism will automatically release above 80°C.
- Be constructed of materials of any components critical to the cabinet's structural integrity that must not melt at a temperature <850°C (seals or gaskets are acceptable, but their use should be avoided if their failure could affect the protective function of the cabinet).
- For Dangerous Goods cabinets of >250 L capacity⁴
 - the top of the cabinet must be no more than 2 m tall, and all external surfaces of the cabinet must be constructed from sheet steel at least 1 mm thick.
 - The cabinet's lower compound must be capable of holding at least 25% of the design capacity of the cabinet or the volume of the largest package able to be stored in the cabinet, whichever is larger.

When using a Dangerous Goods Cabinet to store chemicals:

- In general, only a single Class of chemicals should be stored in a Dangerous Goods cabinet. Where more than one Class of chemicals is stored within a Dangerous Goods cabinet, a risk assessment (ARA) must be undertaken which details the controls to prevent incompatible chemicals must be prevented from mixing.

⁴ The maximum size of a Dangerous Goods cabinet allowed in a laboratory is 250 L. For chemicals of Class 4.1, 4.2, 4.3, 5.1 or 5.2; the maximum cabinet size is 50 L. Cabinets of up to 850 L capacity may be used outdoors or in a dedicated fire rated flammable liquids store but only on floors that have direct access from street or ground level and meet the other requirements listed in AS 1940.

For example, a Dangerous Goods Cabinet containing Class 8 corrosives, including one container each of nitric acid (which has a secondary Class of 5.1) and formic acid (which has a secondary Class of 3). It may not be practical to require separate cabinets for these two chemicals, but if stored in the one cabinet, they should be kept in separate secondary containment trays which are compatible with the acid in question to prevent them from mixing in the event of a leak.

- Cabinets must not be stacked one on top of another or prevent access to emergency equipment or escape routes.
- Chemicals must not be opened or used on top of a Dangerous Goods cabinet.
- Dangerous Goods cabinets containing chemicals with a primary or subsidiary risk of Class 3, or other chemicals able to generate a flammable gas, mist or vapour must be assessed to determine ignition source exclusion zones (as documented in an ARA), or whether a full hazardous area assessment is necessary.

See the Managing Hazardous Areas Technical Guide for more information and a worked example of completing an assessment of a flammable liquid cabinet in a laboratory in the Appendices of that Guide.

- Cabinets containing Class 5.2 Dangerous Goods must have doors with a self-closing mechanism with catches that will release in the event of a pressure build-up within the cabinet.⁵
- Cabinets used to store Class 8 Dangerous Goods must either be constructed of corrosion-resistant materials or be protected by a corrosion-resistant lining or coating. Cabinets should be checked regularly and cleaned and re-sealed where corrosion is present.
- Where a Dangerous Goods cabinet is used to store volatile chemicals that present an inhalation risk (i.e. have an exposure standard or health effect by inhalation), ventilation must be considered (but is not mandatory if an assessment of the risk of exposure deems ventilation unnecessary).

For example, consider a cabinet containing a 2.5 L bottle of methanol, a volatile Class 3 and 6.1 liquid with an exposure standard. It is identified that the closed bottle and small quantity present a low risk of exceeding unsafe levels of methanol and therefore ventilation of the cabinet is not necessary. If a more toxic volatile liquid, or a substantially larger quantity were stored, then ventilation for the cabinet may be necessary.

- If an individual cabinet is vented, the ventilation must be to an external atmosphere (i.e. outside the building) in a manner that allows safe dispersal of vapours, fumes or dust. Each cabinet ventilation system must be completely independent unless an assessment has been conducted to ensure the vapours or evolved gases are compatible. Cabinets must not be ducted to a fume cupboard exhaust. Note that the fire resistance of the cabinet must not be compromised by ventilation ductwork connections⁶ and the fire resistance of building elements (e.g. walls) at exhaust ductwork penetrations must be maintained.

⁵ See AS 4362 section 4.8.3 (Class 5.1) or AS 2714 Section 4.6.1 (Class 5.2) for more information.

⁶ Flame arrestors and fire-collars should be installed.

2.4.2 Other cabinets or cupboards

Other cabinets or cupboards which do not meet the specifications of Dangerous Goods cabinets may be used to store chemicals, provided:

- Cabinets used to store chemicals should not be used for the storage of other laboratory equipment, especially equipment which has the potential to cause a hazard (e.g. heating equipment which may be put away while still warm).
- The cabinet is made of a material which is resistant to moisture deterioration or spills, leaks or vapours from the chemicals enclosed.

For example, cabinets made from particle board may fail when subjected to moisture over time; cabinets made of metal or using metal supports or shelving should not be used to store chemicals which give off corrosive vapours as the metal will corrode over time.

- Secondary containment in the form of bunded trays is used.
- Cabinets do not enable the build-up of hazardous atmospheres such as toxic vapours.
- Cabinets have signage indicating the Class(es) of Dangerous Goods stored within them, such as the relevant DG or GHS pictograms.
- If a cabinet is used to store volatile chemicals which present an inhalation risk, ventilation must be considered. If an individual cabinet is vented, the ventilation must be to an external atmosphere (i.e. outside the building) in a manner that allows safe dispersal of vapours, fumes or dust. Each cabinet ventilation system must be completely independent (i.e. two cabinets cannot share ducting; a cabinet cannot be ducted to a fume cupboard exhaust).

2.4.3 Shelves, racks, benches, or pallets

- Chemicals should preferentially be stored in Dangerous Goods cabinets or laboratory cabinets or cupboards, wherever practical.
- Where chemicals are stored on a shelf, rack or bench, secondary containment should be used to prevent spills from spreading or incompatible chemicals from mixing.
- Bench, shelf, rack or pallet materials must be made of a material which is as resistant as practicable to the chemicals. The use of particle or similar boards is not recommended as they may fail when subjected to moisture or chemicals.
- Shelves must not exceed their maximum holding capacity and must be restrained against lateral movement.
- Pallets of hazardous chemicals must not be stacked on top of one another.
- Chemical containers should not be stored directly on the floor (i.e. if stored on the floor, bunding such as a tray must be used).



Figure 1. Examples of using shelves to store chemicals.

2.4.4 Refrigerators or freezers

- Refrigerators or freezers intended for the storage of chemicals must not be used to store food or beverages.
- Refrigerators or freezers used to store Dangerous Goods must have the relevant DG Class Labels displayed on the door or lid.
- Flammable chemicals must not be stored in a refrigerator unless it is intrinsically safe (i.e. does not have spark or ignition sources which could interact with a flammable vapour. This may include internal motors, lights or thermostats which are not specifically designed to be spark-proof). It is permitted to use a domestic refrigerator for chemical storage, provided the refrigerator has been modified by a qualified electrician to remove all ignition sources.
- If a refrigerator is not intrinsically safe, it must be marked as unsuitable for the storage of flammable materials.
- If flammable chemicals are stored in a freezer an assessment of the risk must be made, taking into consideration any possible ignition sources, the temperature of the freezer and the physical properties (e.g. flash point and boiling point) of the chemicals being stored.
- Some temperature-sensitive chemicals (e.g. some Class 4 and 5.2 substances) may require the provision of temperature monitoring indicators and alarms for the refrigerator or freezer in which they are stored, to provide a warning if the maximum safe storage temperature is exceeded.



2.4.5 Fume Cupboards (fume hoods)

- In general, chemicals should not be stored inside a fume cupboard on an ongoing basis.
- Where it is necessary to store chemicals in a fume hood (e.g. a strong smelling waste solution that can't be kept elsewhere), identify and document in an ARA any risks associated with this (e.g, harmful fumes contaminating fume hood ventilation pipework; compatibility with other work being undertaken)

Figure 2. Examples of using a refrigerator to store chemicals.

2.5 Types of chemical storage areas

There are several types of chemical storage areas, each of which have specific requirements covered by one or more Australian Standards, including:

- Within a laboratory, workshop or other place where packages are opened.
- Separate store (internal or external) containing mixed classes of Dangerous Goods.
- Separate store containing only one class of Dangerous Goods.
- Storage of chemicals in a bulk tank.

Note: this guide does **not** include the storage requirements for bulk containers.

3 Chemical storage requirements for laboratories, workshops and other areas where chemical containers are opened.

3.1 General requirements

The storage of chemicals in a laboratory or other area where chemical containers are opened and used is covered by Australian Standard 2243.2.

In addition to the general requirements for all chemical storage areas listed in Section 2.3, the following general requirements for chemical storage in a laboratory apply:

3.1.1 Storage of chemicals within DG Cabinets

- Where possible, chemicals classed as Dangerous Goods should be stored in an DG cabinet.
- Dangerous Goods cabinets in laboratories must have a capacity of 250 L or less.
- Dangerous Goods cabinets used to store Class 4.1, 4.2, 4.3, 5.1 or 5.2 chemicals must have a capacity of 50 L or less.
- Under-bench Dangerous Goods cabinets used to store Class 3 liquids must have a capacity of 30 L or less.
- Within a horizontal radius of 10 m, measured from any one cabinet, the aggregate storage capacity (i.e. the volume written on the front of the cabinet) for all cabinets in that radius must not exceed 250 L or kg, including through intervening non-fire rated walls. Within this radius, any PG I dangerous goods from Classes 4.1, 4.2, 4.3, 5.1, 5.2 must not exceed 10 kg or L for each class. An example layout is provided in Figure 3 at the end of this section.
- It is recommended to limit a laboratory to no more than 3 Dangerous Goods cabinets in any 250 m² area, where possible. It is also recommended to separate DG cabinets by 3 m, where possible. If more than 3 DG cabinets in an area are necessary to provide safer segregation in storage, or if cabinets will sit <3 m apart this must be briefly documented in an ARA.
- Incompatible chemicals must not be stored together unless segregated to prevent mixing. Where mixed classes of Dangerous Goods are stored within one DG cabinet, the risks of, and controls used to prevent dangerous mixing must be documented in an ARA.

For example, acids and bases are incompatible, but may be stored in a DG Class 8 cabinet together by storing the chemicals in separate bunded trays with sufficient capacity to prevent a leak or spill from mixing.

The ARA for this laboratory notes the risk of a thermal reaction occurring from the mixing of acids and bases and highlights the separate bunding and limited volumes as the control measures used. This ensures staff in the area understand why it is important to store these chemicals in their separate tubs.

For reference, a list of incompatible Class 8 substances is provided in Section 5.7 of this guide.

3.1.2 Storage of chemicals outside of DG Cabinets

- Total quantities and maximum container sizes of Dangerous Goods stored **outside** of Dangerous Goods cabinets (e.g. on benches, shelves or in general laboratory cupboards) must not exceed those listed in Table 2 below. For quantities greater than those in Table 2, dedicated Dangerous Goods cabinets must be used or a separate chemical storage area must be utilised.
 - Note: If a laboratory is only being used for the use and storage of flammable liquids, AS 1940 may be more appropriate for threshold quantities. See Section 5.3 for more information.
- Incompatible chemicals must not be stored together unless segregated to prevent mixing.
- Any individual chemical container must be ≤ 25 L unless a manual handling facility is provided in the work area. This includes chemical waste containers.
- Hazardous chemicals stored on shelves above benches must not be stored higher than 1.5 m from the ground.

For example, storage shelves above a bench in a laboratory where there are flammable liquids, oxidisers, toxics and assorted other non-DG hazardous and non-hazardous chemicals.

The chemicals in volumes and container sizes less than Table 2 are kept on the shelf in separate banded trays with sufficient capacity to prevent a leak or spill from mixing.

The hazardous chemicals are kept on the lower shelf which is < 1.5 m from floor height. The upper shelf over the bench is > 1.5 m from floor height, so only non-hazardous chemicals or laboratory consumables are stored there.

- Hazardous chemicals (including Class 2.1 and 2.2 aerosols) used in quantities and for purposes consistent with household use (e.g. lubricants, fly spray, spray paint, super glue, detergent etc.), may be stored in laboratories or work areas without restriction and are not required to be listed on the chemical inventory or to have SDS present.⁷
- Where flammable liquids or other chemicals that can produce a flammable gas or vapour are stored, consider whether an ARA or a hazardous area assessment is necessary to document ignition source exclusion zones or other controls for managing the risk of ignition. For example:
 - Flammable liquids, where the aggregate volume in a specific location (e.g. on one bench) is ≥ 5 L, or where containers in any volume are stored open and uncapped.
 - Open flame or high heat ignition sources present in the laboratory (e.g. gas or spirit burners, hotplates).
 - Substances that may produce a flammable gas or vapour in circumstances which may occur during storage (e.g. some DG 4.3 substances which produce a flammable gas, or ignite when exposed to water).

⁷ This exemption **does not** apply where quantities of chemicals greater than household use volumes are stored (e.g. bulk detergent concentrate), or where they are used in a manner not consistent with household use (e.g. where they are used as a reagent in a chemical process).

Table 2. Quantities of chemicals allowed to be stored outside of Dangerous Goods cabinets in a laboratory (reproduced from AS 2243.2).

Type or Class of chemicals	Maximum quantity per 50 m ² floorspace	Maximum container size	Other comments on storage outside of DG cabinets
DG Class 3 (flammable liquids)	10 L	5 L	In labelled laboratory cupboards; or small quantities may be distributed through the lab on benches or shelves.
Combustible liquids	50 L	20 L	
DG Class 4.1 (flammable solids), 4.2 (spontaneously combustible liquids) or 4.3 (ignites in contact with water)	20 kg or L, but no more than 10 kg or L of any one Class.	10 kg or L	In labelled laboratory cupboards; or small quantities of DG 4.1 or 4.3 may be distributed through the lab on benches or shelves.
DG Class 5.1 (oxidisers)* or 5.2 (organic peroxides)	20 kg or L, but no more than 10 kg or L of any one Class.	10 kg or L	In labelled laboratory cupboards; or small quantities of DG 5.1 may be distributed through the lab on benches or shelves.
DG Class 6.1 (toxic substances)	10 kg or L (packing group I) 50 kg or L (packing group II or III)	10 kg or L (packing group I) 20 kg or L (packing group II or III)	In labelled laboratory cupboards; or small quantities may be distributed through the lab on benches or shelves.
DG Class 8 (corrosive substances)	20 L (liquids) 50 kg (solids)	20 kg or L	
DG Class 9 (miscellaneous dangerous goods) and mixed aerosols	50 L (liquids) 100 kg (solids)	5 L (liquids) 20 kg (solids)	
Other hazardous chemicals which are not classed as Dangerous Goods	No maximum limit, but the minimum practical quantity	5 L (liquids) 20 kg (solids)	
Aggregate total quantity of dangerous goods (all classes)	200 kg or L	-	-
<p>Note: These quantities are intended to represent the day-to-day working stock and waste containers for chemicals on shelves, benches, and pallets in a laboratory or other working area. Chemicals being analysed, used, mixed, blended or reacted upon on are not subject to these quantity limits while in active use. For an area less than 50 m² floor space, up to the maximum quantity of Dangerous Goods may be stored, where the total quantity of chemicals outside of Dangerous Goods cabinets within the laboratory does not exceed 200 L total.</p> <p>* For Class 5.1s, this represents the total active ingredient. For example, a much larger volume of 6% hydrogen peroxide is permitted than 30% hydrogen peroxide.</p>			

3.1.3 Gases and Cryogens in laboratories

- Gas cylinders must not be stored in a laboratory unless an outdoor store with reticulation into the laboratory is not practical. Cylinders kept in a laboratory must be secured and connected for use (i.e. spare cylinders are not to be kept in a laboratory). Individual cylinders must have a water capacity of ≤ 70 L (for reference, a G-size cylinder has a water capacity of ~ 50 L).
- Cryogenic liquid containers in a laboratory must be ≤ 250 L. For cryogenic liquids which are toxic or flammable, this maximum container size is reduced to ≤ 5 L and they must be kept in a specially ventilated enclosure (i.e. they may not be stored in the laboratory when not in active use).
- It is recommended that Dewars > 5 L capacity are not kept in laboratories but returned to central, well-ventilated storage areas when not in use. Where a larger Dewar remains present in a laboratory, ensure the risks and any necessary controls are documented in an ARA.
- Where gas cylinders or cryogens are present in a laboratory or workshop, an assessment of the risk must be made to identify the potential for a hazardous atmosphere to form. See the Reticulated Gas Installations and Maintenance Guide and the Managing Hazardous Areas Technical Guide (where flammable gases are present) for more information.
- There are other requirements for installation and maintenance of gas or cryogen related infrastructure (e.g. reticulation, regulators, gas detection and alarm systems) detailed in the Reticulated Gas Installations and Maintenance Guide.

3.1.4 Other requirements for a laboratory or workshop

- If any substances classed as too dangerous to be transported (e.g. explosives, nitrocellulose) are kept in a lab, an ARA must be documented to identify any storage risks and necessary controls.
- The ventilation within a laboratory must be suitable to ensure any flammable vapours do not exceed 5% of the applicable lower explosive limit (LEL) and any toxic vapours must not exceed the relevant workplace exposure standard. This includes when chemical containers are opened for decanting or other use. Depending on the volatile nature of the chemicals in use, this may be achieved *via* either natural or mechanical ventilation, see Section 5 of AS/NZS 2982 for further specifications. Each laboratory must have a dedicated ventilation system not shared by other storage areas, and exhaust air must discharge outside the building away from protected places.⁸
- For a workshop, the ventilation must be adequate to prevent the build-up of a hazardous atmosphere, based on the chemicals and processes undertaken.
- The laboratory must have at least one fixed eyewash facility and safety shower positioned in accessible locations that are no more than 10 seconds away for any user's reach. These must be capable of hands-free operation once activated and meet the specifications of AS 4775.

⁸ See Appendix B for the definition of a protected place.

3.1.5 Example laboratory that combines all requirements

Consider an open plan laboratory which contains multiple Dangerous Goods cabinets holding Class 3 liquids, Class 4.3 solids, Class 6.1 liquids and solids and Class 8 liquids as well as small quantities of other hazardous and non-hazardous chemicals on benches and shelves throughout the laboratory.

Each individual DG cabinet must have a maximum storage capacity of 250 L, while the DG cabinet for Class 4.3s is further limited to 50 L capacity. The DG cabinets must be separated in a way that there is no more than 250 L total storage capacity in any 10 m radius. Storage capacity is based on the number of L written on the front of the cabinet, not the volume of chemicals actually held inside it (though the volume of chemicals inside must be no more than the volume written on the front).

Best practice additionally limits any given area of 250m² to a maximum of three Dangerous Goods cabinets. Where a risk assessment determines that safer storage of chemicals will occur with more than 3 cabinets per floorspace area, this must be documented in an ARA (e.g. 4-5 smaller cabinets to separate 4 incompatible classes may be better than 3 larger cabinets). This arrangement of three cabinets per 250 m² floorspace could be repeated throughout a larger lab, provided these separation and area thresholds are maintained.

The small quantities of mixed hazardous and non-hazardous chemicals stored in laboratory cupboards, on shelves or on benches listed in Table 2 are allowed **in addition** to what is stored in DG cabinets.

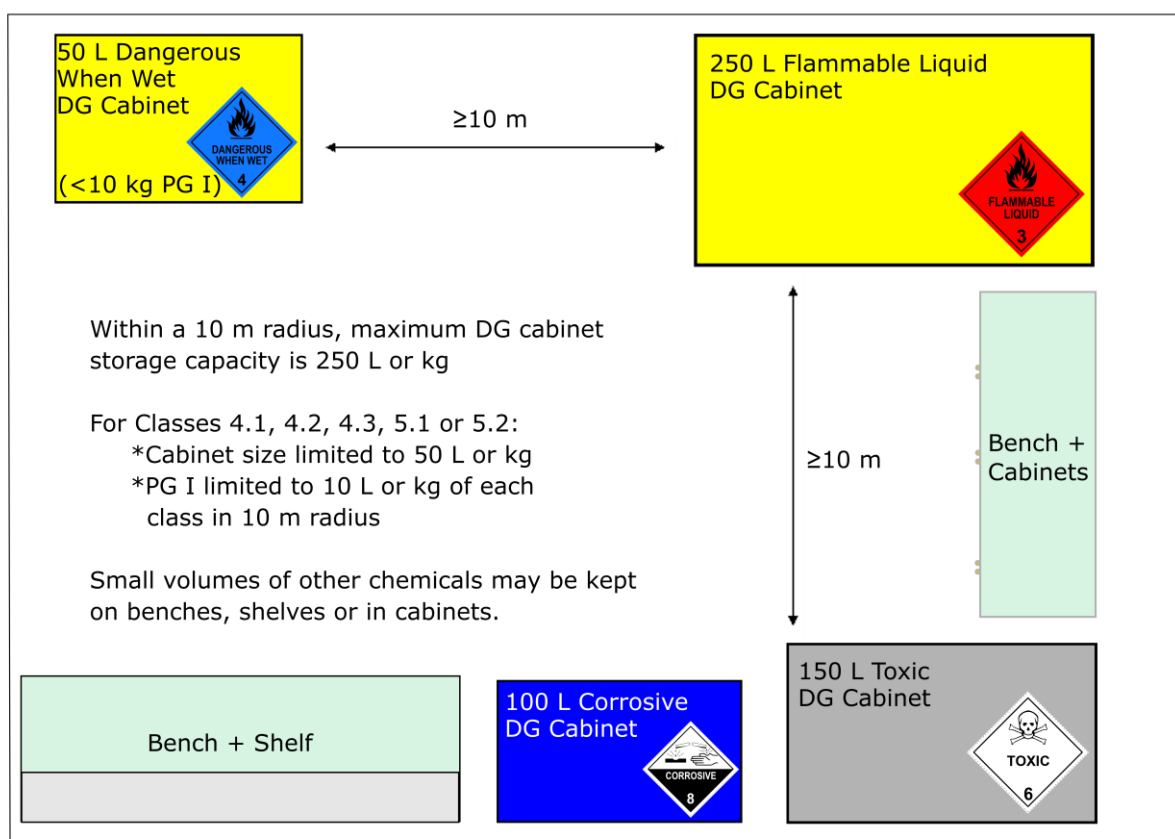


Figure 3. Example layout of laboratory Dangerous Goods cabinets which meets the minimum separation distances. Note, the best practice recommendations to limit the 250m² area to 3 cabinets and the 3 m separation between DG cabinets are not met here, though the cabinets have been minimized to four. An ARA documenting the potential risks of keeping the corrosives and toxic DG cabinets < 3 m apart, and how the fourth DG cabinet improves segregation and safety outcomes.

4 Chemical storage requirements for separate stores containing mixed classes of Dangerous Goods

4.1 General requirements

The storage of mixed classes of Dangerous Goods in a separate store includes areas such as:

- A separate storeroom attached to a laboratory area
- A chemical storage room inside a building, where laboratory work is not undertaken in the room
- A chemical storage room, shed, or similar, which is outside the building

There are several Australian Standards which may be applicable to the storage of chemicals in a dedicated store as reflected in this Section and in Section 5 of this guide. Each standard has different threshold quantities for minor storage and may include additional specific requirements for the storage area.

The most appropriate set of requirements should be selected for the storage area, using Table 3 below. Once chosen, the minimum requirements for that standard (provided in the relevant section of this guide) must be applied in full.

Table 3. Overview of standards which may be applied to a separate chemical storage area.

Australian Standard	Overview of requirements	Section of this Guide
AS 2243.2	This Standard is most appropriate for stores containing a wide range of hazardous chemicals, such as those attached to, or intended to support a laboratory, with total quantities of chemicals limited to those given in Table 4 below.	4.2
AS/NZS 3833 – minor storage	This standard may offer larger allowable volumes for individual containers or for a given storage area than AS2243.2, and may be more appropriate for stores supporting large, or multiple laboratories or research areas. Where minor storage quantities are not exceeded, this standard has very few additional requirements pertaining to the store (e.g., ventilation, fire suppression systems). This may be more appropriate for stores containing moderate quantities of lower-risk (PG II-III) chemicals such as paints, solvents or hazardous chemicals with agricultural applications.	4.3
AS/NZS 3833 – greater than minor storage	This guide does not provide specific guidance on mixed DG stores exceeding minor storage quantities. Professional Dangerous Goods consultation should be sought.	N/A
Individual DG class – minor storage	Where only one Dangerous Goods class will be stored, the standard for that class may be used. See Section 5 of this guide for the minor storage requirements for each class. For small quantities it may still be preferable to use AS 2243.2.	5

4.2 Separate Chemical stores meeting AS 2243.2 requirements





In addition to the general requirements for chemical storage listed in Section 2.3:





- The store must not contain gas cylinders or cryogenic liquids.
- Where possible, the store should not contain other laboratory items such as glassware or apparatus, though the storage of other non-hazardous chemicals is permitted.
- An ARA and SWI must be documented for any activities involving opening chemical containers within a store area (e.g. decanting), capturing spill management, emergency response, and manual handling.
- Secondary containment should be used to prevent spills or leaks. Incompatible chemicals must be prevented from mixing (e.g. separate secondary containment, maximum practical distance).
- Quantities of classes/packing groups must not exceed those listed in Table 4. This includes any additional requirements listed for storage of that Class, Packing Group, or container type.
- The store may hold at most 4500 kg or L of aggregate hazardous chemicals/Dangerous Goods. This comprises of up to 500 kg or L of PG I Goods, up to 2000 kg or L of combined PG II or III Goods, and up to 2000 additional kg or L of other hazardous chemicals (e.g. eye/skin irritant) or non-PG Goods (e.g. dry ice).
- Any individual chemical container holding liquids must be no larger than 250 L. This includes chemical waste containers. In general, large or heavy containers (>20 L/kg) should only be used if suitable manual handling provisions are available (e.g. decanting stations, pumps, lifting tools, scoops). These must be documented in and ARA and SWI.
- Where possible, DG cabinets should be used to store chemicals in a dedicated store.
Requirements for DG cabinets in a chemical store:
 - The maximum quantity of chemicals in any one chemical storage cabinet must be ≤250 L or kg.
 - Incompatible goods must be segregated within the cabinet (e.g. acids and bases stored in separate secondary containment tubs).
 - Where mixed classes of Dangerous Goods are kept in one cabinet, consider whether a risk assessment is necessary to document incompatibilities and controls necessary to safely store the chemicals together. If unsure, keep different classes in separate DG cabinets.
 - If PG I goods are stored in a DG cabinet, the volume of the whole cabinet must be considered to be PG I, for purposes such as quantity thresholds. Consider keeping PG I chemicals in a separate smaller cabinet.
 - Dangerous Goods cabinets containing chemicals must be separated by a minimum distance of 300 mm of clear air space.

For example, an internal store with a 250 L flammable liquids cabinet containing a 2.5 L bottle of diethyl ether (DG Class 3 PG I) along with other Class 3 PG II and PG III totalling 110 L would not be permitted. The presence of the PG I container in this cabinet means that the aggregate 110 L must all be considered PG I and this volume exceeds the allowed quantity for PG I in Table 4, of 100 L in any one cabinet.

If the diethyl ether was stored in a separate smaller flammable liquids cabinet, then these quantities would be allowed as long as the cabinets had 300 mm airspace between them.

Table 4. Quantities allowed to be kept in a dedicated chemical store (reproduced from AS 2243.2). This includes chemicals inside and outside DG cabinets within the store.

Type of chemicals	Class label(s) / pictograms	PG I	PG II and PG III	Other requirements
Goods too dangerous to be transported (e.g. explosives)		N/A		Risk assessment required for any storage of these goods.
DG Class 2 Aerosols (UN 1950)		N/A	100 L	N/A
DG Class 3 (flammable liquids) – primary or subsidiary risk		200 L; no more than 100 L in any one cabinet.	1000 L	No UN 3256 elevated temperature liquids.
Combustible liquids		N/A		1000 L total allowed.
DG Class 4.1 (flammable solids) DG Class 4.2 (spontaneously combustible) DG Class 4.3 (ignites in contact with water) DG Class 5.1 (oxidisers)* DG Class 5.2 (organic peroxides)		200 kg or L aggregate across Classes 4 & 5. UN 3221 - UN 3240 (self-reactive liquids and solids), UN 3101 & 3102 (organic peroxide type B), and UN 3111 - UN 3120 (temperature controlled organic peroxides) to be included in this limit also – see note.	1000 kg or L aggregate across DG Classes 4 & 5. No more than 50 kg or L of DG Class 5.2 in any one cabinet.	N/A
DG Class 6.1 (toxic substances) DG Class 8 (corrosive substances) DG Class 9 (misc. dangerous goods) - excluding UN 3257-3258 elevated temperature goods, UN 3480 lithium ion batteries, and UN 1845 dry ice.		500 kg or L aggregate across Classes 6.1, 8 & 9. No more than 100 kg or L of Class 6.1 or 8 in any one cabinet.	1000 kg or L aggregate across DG Classes 6.1, 8 & 9.	Class 6.1 or 8 substances stored outside of DG cabinets must be: <ul style="list-style-type: none"> • In containers ≤1L (breakable container); or • In containers ≤5 L (non-breakable container); or • In containers ≤10 kg (solids); or • Non-combustible articles (e.g. lead acid batteries)

DG Class 9 UN 1845 Dry Ice		N/A		Risk assessment required, considering room size, temperature, ventilation and quantity of dry ice to be stored.
DG Class 9 UN 3256-3258 Elevated Temperature Goods		N/A	Risk assessment required for any storage of these goods to determine whether storage suitable, and if so, quantities.	N/A
DG Class 9 UN 3090-3091 Lithium Metal Batteries and UN 3480-3481 Lithium Ion Batteries		N/A		Lithium/Lithium-Ion Batteries may be both an ignition source and fire hazard and should be stored in a fire rated store.
Other hazardous chemicals which are not classed as Dangerous Goods		N/A		2000 kg or L aggregate total for hazardous chemicals which are not classed as Dangerous Goods.
Aggregate total of hazardous chemicals and Dangerous Goods		500 kg or L	2000 kg or L	4500 kg or L (500 PG I, 2000 PG II+III, 2000 non-DG other hazardous)

Note: for the purpose of risk management, some dangerous goods of Class 4.1 and 5.2 have been added to Packing Group I, varying from the groupings used for ADG Code and SDS purposes.

- Wherever possible, internal chemical stores should be located on a floor directly accessible from street level. For stores located on any other floor of a building, a risk assessment must be conducted and documented to identify any risks posed to other floors or evacuation routes.
- An external store must be separated from neighbouring buildings, site boundaries or other protected places by:
 - 3 m, if the aggregate hazardous chemicals kept in the store is ≤ 1000 kg or L,
 - 5 m, if the aggregate hazardous chemicals kept in the store is between 1000 kg or L and 4500 kg or L.
 - Separation distance can be achieved using fire walls or vapour screens complying with Australian Standard 1940.
- The store floor must be made of non-absorbent, non-combustible materials which are as resistant as practicable to the chemicals stored.
- The store must contain a spill catchment mechanism (e.g. bunding of containers or a floor pit) which is sufficiently impervious to retain the spillage until clean-up measures can be taken. Where bunding under the chemical containers is used, the capacity must be at least equal to the volume of the largest container stored in the bunded area.
- Where incompatible chemicals are stored in the same area, the spill catchment system must prevent these substances from coming into contact with one another in the event of a spill (e.g. separate bunding containers or pits for each incompatible class).
- Similar to laboratory ventilation requirements, the store's ventilation must be suitable to ensure any flammable vapours do not exceed 5% of the applicable lower explosive limit (LEL) and any toxic or harmful vapours must not exceed the relevant exposure standard. The needs of the ventilation system may differ depending on the volatile nature and quantity of chemicals stored, but the store must be designed with the principles of Section 4.5 of AS/NZS 1940, including:
 - A preference for mechanical ventilation over natural ventilation.
 - Where stores are mechanically ventilated, the ventilation system must be exclusive to the room. There must be no recirculation of exhaust air, except for a cool room where a risk assessment has been conducted and control measures put in place to prevent the build-up of a hazardous atmosphere. The ventilation system must either: operate continuously; or operate whenever a person is occupying the store *and* be fitted with an airflow failure warning device.
 - Further specifications, such as the location of vents/ducting and exhaust velocities is provided in AS 1940.
- Where flammable liquids or other chemicals that can produce a flammable gas or vapour are stored, consider whether an ARA or a hazardous area assessment is necessary to document ignition source exclusion zones or other controls for managing the risk of ignition.

- If the store has been designated a hazardous area it must not contain any ignition sources. See the Managing Hazardous Areas Technical Guide for more information and other requirements.
- The store should either:
 - Have an automatic fire extinguishing system which is compatible with the chemicals being stored, or;
 - Be equipped with an alarm which will activate when the concentration of flammable or toxic vapour exceeds set limits, when there is smoke, or when heat is generated.

Where a sprinkler-based fire suppression system (water or foam) is installed, there must be a mechanism to contain the effluent of 20 minutes of operation within the building (but not necessarily within the store itself).

- The store must have at least one fire extinguisher compatible with the chemicals being stored immediately outside the door to the store, with a minimum size equivalent to a 2A 60B(E) for powder-type extinguishers or a 2A 20B for foam extinguishers. Additional fire extinguishers should be considered for larger stores.
- Have PPE appropriate for the chemicals stored available at or just inside the door of the storage area (e.g., gloves, safety glasses, lab coats).
- The store must have at least one permanently fixed safety shower and aerated eyewash facility capable of operation in hands-free mode once activated.

4.3 Chemical stores meeting AS 3833 minor storage requirements

In addition to the general requirements for chemical storage listed in Section 2.3:

- The store must be separated from other minor stores by at least 10 m and must be clear of heating or ignition sources.
- The aggregate maximum quantities of chemicals held in the store must not exceed those listed in Table 5 per 500 m² floor or ground space.
 - Where an area exceeds 500m², the intent is to keep stores of chemicals >10 m apart and to avoid an undue concentration of minor stores within an area.
- Incompatible chemicals within the store are segregated to prevent incompatible chemicals from mixing or otherwise reacting. This includes storage in separate containers or cabinets.
- The transfer of dangerous goods from the store to the point of use must be carried out in a manner that minimizes the possibility of spillage or fire.
- A fire extinguisher of suitable type must be installed in each minor store, located so that it is immediately accessible in an emergency along an exit route.
- PPE such as gloves, safety glasses and lab coats must be available at or just inside the door of the storage area.

Table 5. Maximum quantities (L or kg) of chemicals to be stored in a location to meet the requirements of minor storage AS3833 (per 500 m²)

Type of Goods	Packing Group I (kg or L)	Packing Group II (kg or L)	Packing Group III (kg or L)	Combustible Liquids (kg or L)
Class 5.2	10 total			N/A
Total quantity of all Dangerous Goods	25	250	1000	1500

The maximum allowance of each of the groups can be stored concurrently (i.e. a store could contain 25 L of PG I plus 250 L of PG II). For chemicals which are consistent with the definition of 'Manufactured Product' in Australian Standard 3833, the maximum storage allowance is doubled. Chemicals meeting this definition include most solvent-based paints, lacquers, and polishes.

Additionally, for an outdoor store:

- The ground around the store must be kept clear of combustible vegetation or refuse to a distance ≥ 3 m.
- The store must be separated by at least 3 m from:
 - Any building that is not another minor chemical store, laboratory or workshop (e.g., offices, cafeterias)
 - Any place accessible to the general public where people are likely to congregate (e.g., public lawn areas, emergency evacuation points)
 - Any environmentally sensitive areas
 - A ship at permanent berthing facilities
 - The property boundary
- The effluent or flow of a chemical spill or leak must be prevented from reaching any adjacent buildings or facilities, the property boundary or any watercourse. This may be achieved using a natural ground slope or through a diversion channel, kerb, or bund.

5 Chemical storage requirements for a minor storage area containing only one class of Dangerous Goods

5.1 Introduction

Where a storage area will contain only one class of Dangerous Goods, the requirements for that class may be used. For stores containing smaller quantities of chemicals, it may be more practical to work to the requirements of AS 2243.2 or AS 3833 (see sections 4.2 or 4.3, respectively).

Note this guide only covers minor storage quantities of chemicals. If the quantities in these sections are to be exceeded, a professional Dangerous Goods consultant should be engaged to ensure compliance with the full relevant standard.

5.2 Class 2 Dangerous Goods (Gases and cryogenics)

See the Reticulated Gas Installations and Maintenance Guide for more information.

5.3 Class 3 Dangerous Goods (Flammable Liquids)

In addition to the general requirements for chemical storage listed in Section 2.3:

- The maximum quantities and container sizes of chemicals held in the store must not exceed those listed in Table 6.

Table 6. Minor storage thresholds for a store containing only DG Class 3 substances.

Storage location type	PG I or II	PG III	Combustible liquids
Laboratory *, **	50 L per 50m ² floor space; or 50 L in a room ≤50m ² floor space PG I containers ≤2.5 L ***	100 L per 50m ²	200 L
Workshop (indoors)	1 L per 2m ² of floor space	1 L per 1 m ² of floor space	4 L per 1m ² of floor space
Outdoor shed or detached out-building which is: 1 m from building 3 m from building, or separated by a wall with a FRL of 180/180/180	100 L 250 L	250 L 250 L	500 L 500 L

* These limits do not apply to a laboratory constructed and equipped as a flammable liquid storage room and only flammable liquids are being handled there.

** These limits do not apply to materials being analysed, used, mixed, blended or reacted upon, where stored on a laboratory bench or in a fume cupboard.

*** This container size may be exceeded if the chemical is essential for daily operations and the person(s) using it are trained to understand the risks and appropriate risk controls.

- A chemical storage cabinet or cupboard which is used to store flammable liquids must not be used to store any other classes of Dangerous Goods. Where flammable liquids have subsidiary risks, these substances must be segregated either by separate storage locations or by providing secondary containment to prevent the incompatible liquids from mixing.

For example, acetic anhydride (DG 8(3)) and methanol (DG 3 (6.1)) react aggressively when mixed and must be stored in a way that prevents the two chemicals from mixing.

- Flammable liquids should be stored as far away from oxidising agents and organic peroxides as is practical. For example, if these chemicals are stored on an open shelf or bench, they should be placed on separate benches, or at opposite ends of the shelf.
- There must be no uncontrolled ignition sources in any space where a flammable mixture of vapour and air could be present.
- Class 3 liquids must be stored away from heat sources.
- If any of the following are exceeded, or a process is occurring that is likely to emit significant flammable vapours, a hazardous area classification must be made (see the Managing Hazardous Areas Technical Guide for more information):
 - 100 L in closed containers
 - 25 L for decanting purposes
 - 5 L in open containers for occasional use
 - 1 L in open containers for continuous use
- If the store is located above another floor, it must not jeopardize the safety of any lower areas of the building, including mechanisms to prevent flammable vapours and spilled liquids escaping to other areas of the building.
- Where there is more than one minor store on the same premises, stores must be separated by at least 20 m (indoor stores) or 15 m (outdoor stores).
 - If two buildings are separated by at least 5 m of open space or by a fire rated wall, each building may have their own indoor minor store quantity.
- Spills or leaks must be cleaned up immediately and prevented from reaching ignition sources, stores of other chemicals, combustible materials or from flowing into drains or onto neighbouring property.
- When decanting Class 3 liquids, dispensing pumps or self-closing metal taps should be used in order to reduce the hazards of splashing, spillage and vapour escape while filling the container.
- Where >100 L of flammable liquids or >1000L of combustible liquids are stored or decanted, there must be at least one portable fire extinguisher suitable for the chemicals stored.
 - Note, this requirement does not apply on farms.
- Decanting of flammable liquids shall only occur in a fume cupboard or location with a dedicated exhaust system that is able to locally capture flammable vapours.
- In areas where flammable liquids are decanted, a sign complying with AS 1319 must be displayed, with the following wording:
DANGER—FLAMMABLE LIQUIDS—NO SMOKING—KEEP FIRE AWAY

5.4 Class 4.1, 4.2 and 4.3 Dangerous Goods (Flammable solids, Spontaneously combustible solids, and Dangerous when wet)

In addition to the general requirements for chemical storage listed in Section 2.3:

- The maximum quantities and container sizes of chemicals held in the store must not exceed those listed in Table 7.

Table 7. Minor storage thresholds for a store containing only DG Class 4 substances.

DG Class 4 sub-group	Maximum quantity per 100 m ² floor space (kg or L)	Maximum container size (kg or L)
Division 4.1 self-reactive and related substances or desensitized explosives Division 4.2 pyrophoric substances	2.5	1
Other DG 4 PG I substances	5	1
Other DG 4 PG II substances	10	1
Other DG 4 PG III substances	20	5

Note: The aggregate quantity of Class 4 dangerous goods of all categories held in a storage area should not exceed the maximum quantity specified for the least dangerous category being kept, i.e. if a mix of PG II and PG III substances are held, the total quantity of Class 4 substances must not exceed 20 kg or L per 100 m².

Note: There may be additional limitations for desensitised explosive substances, based on state or territory legislation.

- A chemical storage cabinet or cupboard which is used to store any of the DG 4 classes must not be used to store any other classes of Dangerous Goods. This includes storing DG Class 4.1 from DG Class 4.2 and DG Class 4.3 substances in different cabinets.
- Flammable solids should be stored as far away from oxidising agents and organic peroxides as is practical. For example, if these chemicals are stored on an open shelf or bench, they should be placed on separate benches, or at opposite ends of the shelf.
- Substances in DG Class 4.3 (dangerous when wet) spontaneously react with water to emit flammable gases and must be stored in a way to prevent mixing or interaction with water or mixtures containing water. In particular, avoid cupboards or benches near or under sinks, water baths and equipment using a water condenser.
- Special consideration shall be given to the provision of fire extinguishing media when used to protect Class 4.3 storage areas (e.g. class D type portable fire extinguishers should be provided; foam or water portable fire extinguishers are not suitable).
- Due to the varied hazards and incompatibilities of Class 4 substances, a risk assessment must be completed for the storage area.
- Where there is more than one minor store on the same premises, stores must be separated by at least 20 m (indoor stores) or 15 m (outdoor stores). If two buildings are separated by at least 5 m of open space or by a fire rated wall, each building may have their own indoor minor store quantity.

5.5 Class 5.1 and 5.2 Dangerous Goods (Oxidisers and Organic peroxides)

In addition to the general requirements for chemical storage listed in Section 2.3:

- The maximum quantities and container sizes of chemicals held in the store must not exceed those listed in Table 8.

Table 8. Minor storage thresholds for a store containing only DG Class 5 substances.

DG class	Maximum container size (kg or L)	Maximum quantity (kg or L)		
		PG I	PG II	PG III
Class 5.1	-	50	250	1000
Class 5.2	5	20 total		

This table does not apply to ammonium nitrate. See AS 4326 Section 9 for the specific additional storage requirements related to ammonium nitrate.

There are additional allowances for DG 5.1 PG IIIs on a farm. See AS 4326 Table 2.1.

- A chemical storage cabinet, cupboard or refrigerator which is used to store any DG Class 5.1 or DG Class 5.2 substances must not be used to store any other classes of Dangerous Goods. This includes separating Class 5.1 substances from Class 5.2 substances.
- Any incompatible Class 5.1 or 5.2 substances will be further segregated (e.g. using separate banded containers) to prevent the substances from mixing in the event of a spill or leak.
- Class 5.1 and 5.2 substances must be stored on non-combustible surfaces which are not liable to attack or damage from the chemicals being stored.
- Class 5.1 and 5.2 substances must be kept at least 3 m away from heat sources.
- Class 5.2 substances must be stored at or below the recommended storage temperature in the product's Safety Data Sheet.
- Where Class 5.2 substances are stored outside of a Dangerous Goods cabinet, they should be kept in a dedicated fire-resistant metal cupboard or lidded bin designed to retain any spillages. The cupboard or bin must be able to withstand temperatures >750°C and prevent or retard the passage of flame and hot gases.
- The exhaust from any mechanical ventilation system in a Class 5.1 or 5.2 store must be directed away from sources of ignition and areas where people are likely to congregate.

5.6 Class 6.1 Dangerous Goods (Toxics)

In addition to the general requirements for chemical storage listed in Section 2.3:

- The maximum quantities of chemicals held in the store must not exceed those listed in Table 9.
 - There may be additional storage restrictions for highly toxic substances (e.g. Schedule 7 poisons⁹) which may vary based on state or territory legislation.
- Packages containing inorganic cyanides must not be stored with acids or in any other way that will allow reactions with incompatible chemicals.

Table 9. Minor storage thresholds for a store containing only DG Class 6.1 substances.

Storage location type	Maximum quantity (kg or L)		
	PG I	PG II	PG III
Laboratories, workshops and other storage areas	10	100	1000
Farms > 2 hectares	10	100	3500

For DG Class 6.1 substances stored on farms, the following additional storage requirements apply:

- Substances must be for agricultural, horticultural, floricultural or pastoral purposes.
- The area around storage area must be kept clear of combustible materials, vegetation or refuse to a distance of ≥ 3 m.
- The store must be separated from other buildings where chemicals are not used, or by any area which is publicly accessible by ≥ 10 m, and separated from the property boundary by ≥ 15 m.
- Where there are two or more minor stores on the same property, each may be treated as a separate minor store if separated by ≥ 100 m.

⁹ Refer to the Commonwealth Standard for the Uniform Scheduling of Medicines and Poisons (SUSMP).

5.7 Class 8 Dangerous Goods (Corrosives)

In addition to the general requirements for chemical storage listed in Section 2.3:

- The maximum quantities of chemicals held in the store must not exceed those listed in Table 10.
 - The aggregate quantity of must not exceed the maximum quantity for the least dangerous PG being kept (e.g. if only PG I and PG II are kept, aggregate quantity must be limited to 250 L or kg).

Table 10. Minor storage thresholds for a store containing only DG Class 8 substances.

Maximum quantity (kg or L)		
PG I	PG II	PG III
50	250	1000

- The store must be at least 10 m from any other chemical storage area.
- Class 8 substances must be stored in a manner that will prevent reactions between:
 - acids and alkalis
 - acids and hypochlorites
 - acids and cyanides
 - acids and Class 4.3 dangerous goods
 - oxidizing acids and combustible materials
 - other incompatible acids

This can include using secondary containment or bunding to ensure these substances will not mix if spilled or the containers leak.

5.8 Class 9 Dangerous Goods (Miscellaneous or Environmentally hazardous)

In addition to the general requirements for chemical storage listed in Section 2.3:

- The maximum quantities of chemicals held in the store must not exceed those listed in Table 11 per 500 m² floor or ground space.
- Where there are two or more minor stores present, they must be separated by ≥10 m (≥20 m if both stores are Group 3 – Elevated temperature substance (as per Table 11)).
- Class 9 Dangerous Goods of Groups 1, 2 and 5 (as per Table 11) may be stored together, however only a cumulative 1000 kg or L (100 kg or L for PG I) may be stored.

Table 11. Minor storage thresholds for a store containing only DG Class 9 substances.

Type of DG 9		Maximum quantity (kg or L)	
		PG I	Total
Group 1	<i>Environmentally hazardous substances</i> (UN 3077 or UN 3082)	100	1000
	Agricultural chemicals	1000*	10000
Group 2	<i>Equipment containing small quantities of dangerous goods</i> Life-saving appliances (UN 2990 and UN 3072) Lithium batteries or equipment (UN 3091) Air bag inflators (UN 3268) Chemical or first aid kit (UN 3316)	No limit for minor storage	
Group 3	<i>Elevated temperature substances</i> Liquids (UN 3257)	N/A	100
	Solids (UN 3258)	N/A	1000
Group 4	<i>Specially controlled substances</i> Asbestos (UN 2212 or UN 2590)	N/A	Not permitted for minor storage
	Polychlorinated biphenyls (PCBs; UN 2315)	N/A	Only small items permitted (e.g. capacitors)
Group 5	<i>Other Class 9 dangerous goods</i> Solid carbon dioxide (dry ice; UN 1845) Ammonium nitrate fertilizer (UN 2071) Polymeric beads (UN 2211) Plastics moulding compound (UN 3314)	100	1000

* Only one store of PG I materials exceeding 1000 kg or L is permitted on any one site

Additional criteria to meet minor storage requirements for specific sub-categories:

Agricultural chemicals

- Agricultural chemicals must be kept in packages or IBCs not exceeding 1500 L each.

Equipment containing explosive and pyrotechnic devices (UN 2990, 3072 3268)

- Equipment containing explosive devices must be kept locked in a secure store, e.g. distress flares.
- Explosive or pyrotechnic devices must not be removed from equipment and stored separately.
- There may be additional State or Territory requirements for the storage and handling of devices.

Elevated temperature liquids and solids (UN 3257, 3258)

- Consider whether heat shielding and/or heat protection should be used to protect people, equipment and other materials from the effects of radiant heat.
- If heat shielding is not used, ensure elevated temperature liquids or solids have a separation distance of at least 3 m from people, equipment or materials (distances of up to 15 m should be considered). Ensure spill prevention measures such as bunding are resistant to the elevated temperature of the material.

Asbestos (UN 2212 or UN 2590)

- In most States and Territories, special legislative and regulatory requirements apply to the storage and handling of these substances. External expert advice must be sought for the design of storage areas which will hold asbestos.

Polychlorinated biphenyls (PCBs) (UN 2315)

- In most States and Territories, special legislative and regulatory requirements apply to the storage and handling of these substances. External expert advice must be sought, except for small items containing PCBs which are in good condition (e.g. capacitors from fluorescent lights that show no signs of leakage or damage).

Solid carbon dioxide (dry ice – UN 1845)

- Any storage area where dry ice is kept must have adequate ventilation to prevent the development of an asphyxiant or toxic atmosphere (see the Reticulated Gas Installations and Maintenance Guide for some threshold quantities).
- Storage areas must be equipped with PPE suitable for handling dry ice, such as cryogenic gloves or tongs.

Ammonium nitrate fertilizer that does not meet the criteria for DG Class 5.1 (UN 2071)

- Must not be kept next to combustible materials, or any other incompatible substances. This includes petrol, diesel, oil, wooden pallets, hay, sulfur, charcoal, chlorates, or dry pool chlorine.

Polymeric beads and plastics moulding material (UN 2211 and UN 3314)

- Unless packaged in closed bags or drums, these items must be kept in well ventilated areas at least 3 m from ignition sources.

6 Appendices

6.1 Appendix A – Codes, Standards and other Information Sources

The following Australian Standards and Codes of Practice are referenced in this document:

- AS 1940 - The storage and handling of flammable and combustible liquids
- AS 2243.1 - Safety in Laboratories – Planning and Operational Aspects
- AS 2243.2 - Safety in Laboratories – Part 2: Chemical Aspects and Storage
- AS 2714 - The storage and handling of organic peroxides
- AS 2982 - Laboratory Design and Construction
- AS 3780 - The storage and handling of corrosive substances
- AS 3833 - The storage and handling of mixed classes of dangerous goods, in packages and intermediate bulk containers
- AS 4326 - The storage and handling of oxidizing agents
- AS 4452 - The storage and handling of toxic substances
- AS 4681 - The storage and handling of Class 9 (miscellaneous) dangerous goods and articles
- AS 4775 - Emergency eyewash and shower equipment
- AS 5026 - The storage and handling of Class 4 dangerous goods
- Australian Dangerous Goods Code – Edition 7.7

6.2 Appendix B – Definitions

ARA

Activity Risk Assessment. CSIRO document for assessing the risk for an activity. This could include work activities where chemicals are used, or the storage or transport of the chemical may be the activity. An ARA may be accompanied by one or more PRAs and/or SWIs.

Article

A manufactured item, other than a fluid or particle, that:

- (a) Is formed into a particular shape or design during manufacture; and
- (b) Has hazard properties and a function that are wholly or partly dependant on the design.

Articles can include equipment which contain hazardous chemicals inside them such as a mercury thermometer.

Bulk or bulk container

A DG Class 2 container > 500 L;

or a container in any other DG class > 450 L or with a net mass > 400 kg.

Bunding

The use of a barrier, pit or secondary containment to prevent the spread of a chemical spill or leak. For small chemical containers, this can be as simple as a chemically resistant plastic tub.

Combustible Liquid

Any liquid, other than a flammable liquid, that:

- (a) has a flash point; and
- (b) has a fire point that is less than its boiling point.

See AS 1940 Section 1.4.9 for more details.

Dangerous Goods (DG)

A chemical assigned to a Dangerous Goods (DG) class under the Australian Dangerous Goods code. Note: A chemical's DG class is listed in section 14 of the SDS. Some hazardous chemicals are not Dangerous Goods, and vice versa.

GHS

Globally Harmonized System for the Classification and Labelling of Chemicals. As of Jan 1 2023, Australia has adopted Revision 7 of the GHS.

Hazardous Chemical

A chemical where one or more hazard categories under the Globally Harmonised System of Classification and Labelling of Chemicals (GHS) applies to the chemical. Note, see the definition of hazardous chemical in the WHS Regulations 2011 Cth for cases where GHS classified chemicals may not be considered hazardous in Australia (e.g. acute toxicity category 5).

IBC

Intermediate bulk container; a rigid or flexible portable packaging with a capacity of up to 3000 L that is a single container used to hold a bulk volume of liquid, solid or semi-solid material.

Incompatible

Substances which, when brought in contact with one another, may react or combine in a manner that could increase the hazard of an individual substance, for example, by causing a fire, explosion, violent reaction, liberating flammable or poisonous gases; could cause the deterioration of the container or substance; could otherwise cause injury to people or endanger property.

This definition also includes substances which are declared by a relevant regulatory authority (e.g. by state, territory or federal legislation) to be incompatible.

Chemicals of different DG Classes are often incompatible, though incompatibilities may exist within a single DG Class, or between chemicals that have more than one DG Class (e.g. acids that are also flammable are incompatible with acids that are oxidising agents).

Ignition source

A source of energy sufficient to ignite a flammable or explosive atmosphere.

It may include naked flames, hot surfaces, exposed incandescent material, electrical arcs, hot particles, electrical discharge including from static electricity, chemical reactions, high intensity electromagnetic radiation including visible light or ultraviolet radiation, mechanical sparks, fixed and portable electrical equipment, portable tools or vehicles such as forklifts.

Minor Storage

Many Standards relating to the storage of chemicals have designated “minor storage” quantities, above which there are additional more stringent requirements for store construction, ventilation and segregation distances. The specific numbers associated with minor storage vary between standards, and for different Dangerous Goods Classes.

This guide focuses on storage areas holding minor storage quantities. If a store is required to hold more than minor storage quantities, a qualified Dangerous Goods consultant must be engaged.

Packing Group (PG)

An assigned measure of Dangerous Goods’ hazard rating.
For Dangerous Goods in Classes 3, 4, 5, 6.1, 8, or 9:

Packing Group I	High danger items
Packing Group II	Medium danger items
Packing Group III	Minor danger items

Class 1, 2 and 6.2 chemicals do not use Packing Group assignments. For Class 7 chemicals, the Packing Group order is reversed (i.e. Packing Group I is the lowest danger rating for Class 7 items).

PRA

Plant Risk Assessment – CSIRO Risk Assessment for items of plant or equipment. A PRA may be accompanied by one or more ARAs and/or SWIs.

Protected Place

Any of the following:

- A dwelling, residential building, place of worship, public building, school or college, hospital, theatre and any building or open area where people are accustomed to assemble (e.g. an emergency evacuation point or large meeting space).
- A factory, workshop, office, store, warehouse, shop or building where people are employed, which sits outside the designated area of the Dangerous Goods store/laboratory in question.
- Any storage facility for Dangerous Goods that exceeds minor storage quantities which sits outside the designated area of the Dangerous Goods store/laboratory in question.
- A ship lying at permanent berthing facilities.
- An environmentally sensitive area, such as a water catchment area or national park

See AS 2243.2 – Section 1.4.34 or AS 3833 – Section 1.4.46 for more information.

SDS

Safety Data Sheet. Formerly called Material Safety Data Sheet (or MSDS).

Segregation

Keeping incompatible goods apart from one another in one room, using a physical barrier or an intervening space.

SWI

Safe Work Instruction – CSIRO document which outlines the steps to undertake a work process safely. These are generally prepared in conjunction with one or more ARA and/or PRA.


UN Number


United Nations number – a four-digit number which is used globally to identify specific classes of Dangerous Goods. See the Australian Dangerous Goods Code section 2.0.2 for more information.

WHS Regulations


Specifically, the Workplace Health and Safety Regulations 2011 (Commonwealth Jurisdiction).

6.3 Appendix C – Example Area Hazard Poster for areas where placarding quantities are not kept





HAZARDS in this Work Area




Precautionary Measures Required



Building 004 – Ex Building Room 103 – Working lab	Name	Out of Hours Contact Number
Area Custodian	A. Custodian	(00) 4272 7476
Other	B. Custodian	(00) 6253 7233

Last updated: 17 August 2021

