

AS 2243.2:2021



STANDARDS
Australia



Safety in laboratories

Part 2: Chemical aspects and storage



AS 2243.2:2021

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- Association of Biosafety for Australia and New Zealand
- Australian Chamber of Commerce and Industry
- Australian Industry Group
- Australian Institute of Health and Safety
- Australian Institute of Occupational Hygienists
- Bureau of Steel Manufacturers of Australia
- CSIRO
- Institution of Chemical Engineers
- National Measurement Institute
- RMIT University
- Royal Australian Chemical Institute
- Victorian WorkCover Authority (WorkSafe Victoria)

Additional Interests

- Environmental Science and Research New Zealand
- Ministry for Primary Industries (NZ)
- New Zealand Institute of Architects
- New Zealand Microbiological Society
- Responsible Care New Zealand
- WorkSafe New Zealand

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Safety in laboratories

Part 2: Chemical aspects and storage

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Preface

This Standard was prepared by the Australian members of Joint Standards Australia/Standards New Zealand Committee CH-026, Safety in Laboratories, to supersede AS/NZS 2243.2:2006, *Safety in laboratories, Part 2: Chemical aspects*, and AS/NZS 2243.10:2004, *Safety in laboratories, Part 10: Storage of chemicals*.

After consultation with stakeholders in both countries, Standards Australia and Standards New Zealand decided to develop this document as an Australian Standard rather than an Australian/New Zealand Standard.

The objective of this document is to provide information, recommendations and procedures involving the use and storage of chemicals to promote safe work practices in laboratories.

Major changes in this edition are as follows:

- (a) Incorporates chemical storage content from AS/NZS 2243.10, which has been withdrawn.
- (b) Addition of new clauses on nanotechnology.
- (c) Addition of new Appendices on nanomaterials and the Globally Harmonized System of Classification and Labelling of Chemicals (GHS).

The Standard is Part 2 of an 8-part series designed to promote safety in laboratory operations, and is aimed at specific aspects of chemical safety common to laboratories.

The series comprises the following:

AS 2243.1, *Safety in laboratories, Part 1: Planning and operational aspects*

AS 2243.2, *Safety in laboratories, Part 3: Chemical aspects and storage* (this Standard)

AS/NZS 2243.3, *Safety in laboratories, Part 3: Microbiological safety and containment*

AS/NZS 2243.4, *Safety in laboratories, Part 4: Ionizing radiations*

AS/NZS 2243.5, *Safety in laboratories, Part 5: Non-ionizing radiations — Electromagnetic, sound and ultrasound*

AS/NZS 2243.6, *Safety in laboratories, Part 6: Plant and equipment aspects*

AS/NZS 2243.8, *Safety in laboratories, Part 8: Fume cupboards*

AS/NZS 2243.9, *Safety in laboratories, Part 9: Recirculating fume cabinets*

It is recommended that Part 1 be used in conjunction with this Part, and that additional Parts be obtained where applicable to the type of operations carried out in the particular laboratory.

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The terms “normative” and “informative” are used in Standards to define the application of the appendix to which they apply. A “normative” appendix is an integral part of a Standard, whereas an “informative” appendix is only for information and guidance.

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Introduction

AS 2243.1 deals in a general manner with planning and operational safety matters, and AS 2243.2 covers operational safety when using chemicals, including the method of storage and the amounts of chemicals that can be stored in laboratories and stores associated with laboratories.

This document sets out requirements for storage within a laboratory, which is not addressed in other Standards.

AS/NZS 3833, *The storage and handling of mixed classes of dangerous goods, in packages and intermediate bulk containers*, is intended mainly for the storage of large quantities of predetermined dangerous goods, but excluding Packing Group I. It does not allow the storage flexibility often required for research and experimental laboratories. The required segregation distances may not be achievable in laboratories and laboratory stores. It may be more suitable for industrial applications where larger quantities of raw materials or finished products are held “in quarantine” awaiting quality assurance testing.

The relevant Standard for the particular class of dangerous goods or type of chemical may be preferable if only non-flammable dangerous goods or only one or two classes of dangerous goods or types of chemicals are stored, or they are in dominant quantities.

Australian Standard®

Safety in laboratories

Part 2: Chemical aspects and storage

Section 1 Scope and general

1.1 Scope

This document sets out requirements and recommended procedures for safe work with chemicals in the laboratory.

This document applies to —

- (a) substances, mixtures or materials defined as hazardous chemicals, dangerous goods or hazardous substances, except for those that are explosive, infectious and radioactive;
- (b) combustible liquids;
- (c) goods too dangerous to be transported; and
- (d) nanomaterials.

NOTE Refer to National, state and territory legislation for transport of dangerous goods requirements.

This document also applies to chemicals not classed as hazardous or dangerous if compatibility problems could arise during storage.

This document also sets out the requirements for the safe keeping and storage of chemicals and gases —

- (i) inside a laboratory; and
- (ii) in associated storerooms or spaces which are support areas to the laboratory.

The requirements of this document apply only to the keeping, in use or storage, of chemicals in packages and apparatus.

1.2 Application

This Standard is intended to be used in conjunction with AS 2243.1, which provides requirements and recommendations on matters common to all types of laboratory work.

Where the size of packages of chemicals or the aggregate quantities to be stored exceed the limitations of this document, reference should be made to —

- (a) AS 1940, for storage of flammable and combustible liquids;
- (b) AS/NZS 1596, for LP Gas;
- (c) AS 3780, for storage and handling of corrosive substances; or
- (d) other appropriate Australian, Australian/New Zealand or New Zealand Standards.

NOTE Refer to national, state and territory regulations for specific information.

1.3 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document:

NOTE Documents referenced for informative purposes and suggested further reading are listed in the Bibliography.

AS 1894, *The storage and handling of non-flammable cryogenic and refrigerated liquids*

AS 1940, *The storage and handling of flammable and combustible liquids*

AS 2714, *The storage and handling of organic peroxides*

AS 1324.1, *Air filters for use in general ventilation and airconditioning, Part 1: Application, performance and construction*

AS 2243.1, *Safety in laboratories, Part 1: Planning and operational aspects*

AS 3780, *The storage and handling of corrosive substances*

AS 3961, *The storage and handling of liquefied natural gas*

AS 4326, *The storage and handling of oxidizing agents*

AS 4332, *The storage and handling of gases in cylinders*

AS/NZS 1336, *Eye and face protection—Guidelines*

AS/NZS 1337 (all parts), *Personal eye protection*

AS/NZS 1596, *The storage and handling of LP Gas*

AS/NZS 2022, *Anhydrous ammonia—Storage and handling*

AS/NZS 2243.6, *Safety in laboratories, Part 6: Plant and equipment aspects*

AS/NZS 2243.8, *Safety in laboratories, Part 8: Fume cupboards*

AS/NZS 2927, *The storage and handling of liquefied chlorine gas*

AS/NZS 2982, *Laboratory design and construction*

AS/NZS 3000, *Electrical installations (known as the Australian/New Zealand Wiring Rules)*

AS/NZS 3833, *The storage and handling of mixed classes of dangerous goods, in packages and intermediate bulk containers*

AS/NZS 4681, *The storage and handling of Class 9 (miscellaneous) dangerous goods and articles*

AS/NZS 60079.10.1, *Explosive atmospheres, Part 10.1: Classification of areas—Explosive gas atmospheres (IEC 60079-10-1, Ed.1.0 (2008) MOD)*

AS/NZS 60079.10.2, *Explosive atmospheres, Part 10.2: Classification of areas—Combustible dust atmospheres*

EN 14470 (all parts), *Fire safety storage cabinets*

National Transport Commission. *Australian Code for the Transport of Dangerous Goods by Road and Rail (ADG Code)*

1.4 Terms, definitions and abbreviations

For the purpose of this document, the definitions in AS 2243.1 and those below apply.

NOTE Some of the definitions listed below may not apply in New Zealand.

1.4.1

ADG Code

Australian Code for the Transportation of Dangerous Goods by Road and Rail

1.4.2

agglomerate

collection of weakly bound particles or aggregates or mixtures of the two, where the resulting external surface area is similar to the sum of the surface areas of the individual components

[SOURCE: ISO/TS 27687:2008, 3.2]

1.4.3

aggregate

particle comprising strongly bonded or fused particles where the resulting external surface area may be significantly smaller than the sum of calculated surface areas of the individual components

[SOURCE: ISO/TS 27687:2008, 3.3]

1.4.4

attached room

room attached to another room with one or more common walls, or a room within another room

1.4.5

auto-ignition temperature

lowest temperature at which a substance will spontaneously catch fire in air

1.4.6

bulk material

material of the same chemical composition as the NOAA, at a scale greater than the nanoscale

[SOURCE: ISO/TS 12901-2:2014, 3.4]

1.4.7

bund

embankment or wall which may form part or all of the perimeter of the room or specific area

1.4.8

capacity

maximum volume or space within a container or compound

Note 1 to entry: The normal capacity of a container is less than its full capacity, to allow for ullage (headspace) or vapour expansion.

1.4.9

chemical

includes, but is not limited to, a pure element, a compound of a number of elements, or a mixture of two or more such compounds, and any solution, suspension, fume or aerosol thereof

1.4.10

chemical storage cabinet

cabinet for the storage of dangerous goods

Note 1 to entry: Additional information and requirements are set out in [Clause 6.3](#).

1.4.11**class**

<dangerous goods> number assigned to dangerous goods which exhibit a common single or most significant risk, determined from the criteria given in the UN *Manual of Tests and Criteria* and listed in the ADG Code

1.4.12**combustible liquid**

any liquid other than a flammable liquid that has a flash point, and has a fire point that is less than its boiling point

For the purpose of this document, combustible liquids are divided into two classes as follows:

- (a) *Class C1* — A combustible liquid that has a closed cup flash point of greater than 60 °C and no greater than 93 °C.
- (b) *Class C2* — A combustible liquid that —
 - (i) has a flash point of greater than 93 °C; or
 - (ii) has been excluded from being a flammable liquid by any of the criteria for sustaining combustion.

Note 1 to entry: A water miscible solution with a water content of more than 90 % by mass, which has been excluded from being a flammable liquid and which does not have a fire point less than its boiling point is not a combustible liquid.

Note 2 to entry: The boiling point is that point at which it is no longer possible to achieve the rate of temperature rise required by ISO 2592 for the determination of fire point.

Note 3 to entry: ISO 2592, IP 36 and ASTM D92 are technically equivalent test methods for determination of fire point and fire point by Cleveland open cup tester.

[SOURCE: AS 1940:2017, 1.4.9]

1.4.13**combustible materials**

materials deemed to be combustible in accordance with AS 1530.1 and AS 1940

1.4.14**control banding**

process to identify safe work practices with new chemicals where there is little or no toxicity information available

1.4.15**controlled substances**

substances and preparations for therapeutic use which have high potential for abuse and addiction and are classified as S8 substances in the *Standard for the Uniform Scheduling of Medicines and Poisons* (SUSMP)

1.4.16**cryogenic liquid**

liquid having a normal boiling point below –90 °C at atmospheric pressure (101.3 kPa)

1.4.17**dangerous goods**

substances, mixtures or materials that —

- (a) satisfy the UN tests and criteria for determining whether they are dangerous goods;
- (b) are listed in the ADG Code; or

- (c) are determined to be dangerous goods by relevant legislation.

Note 1 to entry: UN tests and criteria are specified in the UN *Manual of Tests and Criteria* and the UN *Recommendations on the Transport of Dangerous Goods — Model Regulations*.

1.4.18

flammable liquids

liquids, or mixtures of liquids, or liquids containing solids in solution or suspension (e.g. paints, varnishes, lacquers, etc., but not including substances otherwise classified on account of their dangerous characteristics) which give off a flammable vapour at temperatures of not more than 60 °C, closed cup test, normally referred to as the flash point

Flammable liquids include —

- (a) liquids stored or handled at temperatures at or above their flash point; and
- (b) substances that are stored or handled at elevated temperatures in a liquid state and which give off a flammable vapour at a temperature at or below the maximum storage or handling temperature.

Flammable liquids do not include liquids meeting the above definition with a flash point of more than 35 °C which do not sustain combustion if —

- (i) they have passed a suitable combustibility test (refer to Sustained Combustibility Test prescribed in the UN *Manual of Tests and Criteria*, Part III, sub-section 32.5.2); or
- (ii) their fire point according to ISO 2592:2000 is greater than 100 °C; or
- (iii) they are water miscible solutions with a water content of more than 90 % by mass.

Note 1 to entry: The above definition is consistent with the definition of flammable liquids in ADG except for the omission of open-cup testing for flash point. This has been omitted to conform to GHS classification which is based solely on closed cup testing. This omission is consistent with a provision in the UN Model regulations.

GHS does provide for exemption based on the UN Sustained Combustibility Test, but does not provide for —

- (a) inclusion of heated liquids (as GHS has no consideration of temperature); and
- (b) exclusions based on fire point or water miscibility.

Note 2 to entry: Liquids excluded as not sustaining combustion are included within the definition of combustible liquids in this document.

Note 3 to entry: Packing group provides further information on flammable liquid classification.

Note 4 to entry: Liquids with a flash point less than 60 °C that are excluded by not sustaining combustion, may present a risk of fire and explosion if there is a hazardous area in the head space of a tank or package. An assessment of the risk needs to be undertaken based on AS/NZS 60079.10.1.

[SOURCE: AS 1940:2017, 1.4.28]

1.4.19

Globally Harmonized System of Classification and Labelling of Chemicals

GHS

international system of classification and labelling of chemicals, published by the United Nations

1.4.20**hazardous area**

area (three-dimensional space) in which an explosive atmosphere, due to flammable gas or flammable vapour, is or may be expected to be present, in quantities such as to require special precautions for the construction, installation and use of equipment

Note 1 to entry: The classification of hazardous areas in relation to flammable liquids is given in AS/NZS 60079.10.1.

(SOURCE: AS 1940:2017, 1.4.35)

1.4.21**hazardous chemical**

(Australia) any substance, mixture or material that satisfies the criteria of one or more Globally Harmonized System of Classification and Labelling of Chemicals (GHS) hazard classes, including a classification in Schedule 6 of the Work Health and Safety Regulations

1.4.22**hazardous substance**

(New Zealand) any substance that triggers any one of the threshold levels defined in the *Hazardous Substances (Minimum Degrees of Hazard) Regulations 2017*

Note 1 to entry: (Australia) The term “hazardous substance” is used in the *Occupational Health and Safety Act 2004* (Victoria) but maintains the same definition as “hazardous chemical”.

1.4.23**HEPA**

acronym for “High Efficiency Particulate Air”

1.4.24**in use**

applicable to chemicals that are kept in a laboratory for frequent use, e.g. on a daily or weekly basis; and to gas cylinders, kept inside or outside a laboratory, that are connected to a system for use

Note 1 to entry: This term is only relevant to a laboratory. Chemicals, including gases and cryogenic liquids, are not considered to be “in use” when kept in a storeroom.

1.4.25**incompatible**

<dangerous goods or other goods> goods that are —

- (a) likely to interact with the dangerous goods so as to increase the hazard when mixed or otherwise brought into contact with the liquids;
- (b) listed in the ADG Code as being incompatible; or
- (c) declared by the regulatory authority to be incompatible.

<packaging or transfer equipment> container or item of equipment that is constructed of a material likely to interact with the liquids such that it is weakened or damaged to the extent that risk increases

1.4.26**ignition source**

source of energy sufficient to ignite a flammable or explosive atmosphere

Note 1 to entry: It may include catalysts, 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.

1.4.27**laboratory**

any building or part of a building used, or intended to be used, for scientific or technical work, including research, quality control, testing, teaching or analysis. Such work may involve the use of chemicals and gases, pathogens and radiation, or processes including electrical or mechanical work. The laboratory includes such support areas as instrument and preparation areas, laboratory stores and any offices attached or adjacent to the laboratory

Note 1 to entry: AS/NZS 2982 contains definitions of various types of laboratories.

1.4.28**may**

indicates the existence of an option

1.4.29**nanomaterial****nanoparticle**

substance with a nominal diameter (such as geometric, aerodynamic, mobility, projected-area or otherwise) smaller than 100 nm

[SOURCE: ISO/TR 27628:2007, 2.12 (modified)]

1.4.30**nanotechnology**

application of scientific knowledge to manipulate and control matter predominantly in the nanoscale (length range approximately from 1 nm to 100 nm) to make use of size- and structure-dependent properties and phenomena distinct from those associated with individual atoms or molecules, or extrapolation from large sizes of the same material

Note 1 to entry: Manipulation and control includes material synthesis.

[SOURCE: SA TS 80004.1:2015, 2.1 and 2.3]

1.4.31**NOAA**

nano-objects, and their aggregates and agglomerates greater than 100 nm

[SOURCE: ISO/TR 12885:2018, 4]

1.4.32**on-site protected place**

building where people are employed within the property boundary, including offices, warehouses, manufacturing or processing areas, amenities and other dangerous goods stores where quantities exceed minor storage

1.4.33**packing group****PG**

one of three hazard groups to which dangerous goods (of Classes other than 1, 2, 6.2 and 7) are assigned in the ADG Code, in decreasing order of hazard, by the Roman numerals "I" (high danger), "II" (medium danger) and "III" (low danger)

1.4.34**protected place**

place of domicile or assembly, dwelling, residential building, place of worship, public building, school or college, hospital, theatre, and any building or open area in which persons are accustomed to assemble whether it is within or outside the property boundary of the installation

Note 1 to entry: Depending on the context, a protected place can be one or more of the following:

- (a) *Place of work* — factory, workshop, office, store, warehouse, shop, or building where persons are employed, that is outside the property boundary of the installation.
- (b) *Marine* — ship lying at permanent berthing facilities.
- (c) *Storage* — any storage facility for dangerous goods outside the property boundary of the installation, except for those defined as minor storages in AS 1940 or other relevant Standards.

Note 2 to entry: Refer to other relevant Standards.

1.4.35

public place

any place other than private property, open to the public, which the public has a right to use and which includes a public road

Note 1 to entry: Parking areas for commercial buildings are not considered to be public places.

1.4.36

risk

<potential injury or harm> combination of the likelihood of occurrence of a work-related hazardous event(s) or exposure(s) and the severity of injury and ill health that can be caused by the event(s) or exposure(s)

[SOURCE: AS/NZS ISO 45001:2018, 3.21]

1.4.37

risk assessment

overall process of estimating the magnitude of risk and deciding what actions will be taken

[SOURCE: AS/NZS 4801:2001, 3.7]

1.4.38

safety data sheet

SDS

document (previously known as a material data safety sheet) that provides information on the identification, hazards, precautions for use and safe handling of a specific chemical product

Note 1 to entry: Refer also to Safe Work Australia, *Model Code of Practice: Preparation of Safety Data Sheets for Hazardous Chemicals*.

1.4.39

sampling

taking a sample for analysis or quality control

1.4.40

scheduled poison

substance that has been classified under the *Standard for the Uniform Scheduling of Medicines and Poisons* (SUSMP), signifying the degree of control recommended to be exercised over their availability to the public

Note 1 to entry: For example, an S2, S3, S5, S6, S7 or S9 substance.

1.4.41

segregation

keeping incompatible goods apart from one another, using a barrier or an intervening space

1.4.42

shall

indicates that a statement is mandatory

1.4.43**should**

indicates a recommendation

1.4.44**signal word(s)**

word(s) conveying danger or warning message used on a label to indicate to a label reader the relative degree of severity of the hazard, and to alert the reader to a potential hazard, under the GHS

1.4.45**storage**

keeping of chemicals and gases in a laboratory or an associated store

1.4.46**toxic substance**

<chemical> substances liable either to cause death or serious injury, or to harm human health, if swallowed or inhaled, or following eye or skin contact

Note 1 to entry: Such substances —

- (a) are listed in the ADG Code or NZS 5433;
- (b) meet the classification criteria set out in the UN *Manual of Tests and Criteria* or NZS 5433; or
- (c) in New Zealand, meet the criteria of the *Hazardous Substances (Health and Safety Reform Revocations) Regulations 2017*.

Section 2 Planning for chemical safety

The best basis for planning safety into a laboratory function or design is to consider in advance the consequences of every action (refer to AS 2243.1).

When designing a laboratory in which chemicals are to be used, risk assessment and hazard and operability (HAZOP) studies (refer to AS IEC 61882) should be carried out to provide information to be used when addressing the following aspects of specific relevance to chemical laboratories:

- (a) Exposure control.
- (b) Ventilation.
- (c) Storage requirements.
- (d) Movement of chemicals.
- (e) Waste treatment.
- (f) Emergency management, including the provision of specialized first aid items for chemicals e.g. treatment of hydrofluoric acid exposure.
- (g) Provision of safety equipment.

For detailed information on the design of laboratories and storage facilities, the AS/NZS 2982 series and other relevant Standards should be consulted.

Subsequent reviews of the risk assessment and HAZOP study findings should be undertaken regularly for existing operations and whenever new chemicals are introduced.

Safety provisions shall be incorporated when installing instruments which emit hazardous substances (refer to AS 2243.1). Safety provisions shall include the following:

- (i) A well-ventilated area of the laboratory shall be provided for the installation of spectrophotometers which can emit ozone (refer to AS/NZS 2982).
- (ii) Shielding shall be provided from gas chromatographic detectors which contain radioactive sources, e.g. helium ionization and electron capture detectors, and from the effluent from splitters or detectors.
- (iii) Exhaust to outside atmosphere shall be provided for atomic absorption and emission spectrophotometers.
- (iv) Emissions from ovens, microwaves and furnaces shall be taken into account.
- (v) Scrubbers in fume cupboards that use highly corrosive chemicals shall be taken into account.

NOTE Further information on the selection, installation and maintenance of electrical apparatus in hazardous environments can be found in the relevant parts of the AS/NZS 2381 series (refer to AS/NZS 2982 as well).

Section 3 Chemical safety management

3.1 General

In addition to the laboratory safety and emergency procedures specified in AS 2243.1, procedures shall be implemented to ensure the following:

- (a) Laboratory personnel are not exposed to concentrations of hazardous substances greater than the lowest practically achievable level and in any case less than the exposure standard.
- (b) Health monitoring is established according to a risk assessment.
- (c) Risk assessments of all operations are carried out and reviewed periodically.
- (d) Risk assessments are updated when new chemicals or methods are introduced into the laboratory, or where changes in volumes, degree of exposure of chemicals or safety procedures are modified.
- (e) An inventory of all hazardous chemicals used in the laboratory is maintained, together with the manufacturer's Safety Data Sheet (SDS), which provide information on safe storage and handling procedures, management of spills and waste disposal.
- (f) The collection, storage and disposal of chemical wastes from the laboratory.

NOTE National, state or territory legislation may also apply.

3.2 Management system components

3.2.1 General

In addition to the requirements in AS 2243.1, the procedures in [Clauses 3.2.2](#) to [3.2.8](#) shall be implemented.

NOTE For any particular laboratory, there may be additional procedures necessary to cover specific functions of that laboratory.

3.2.2 Safety information

There is a wide range of safety information available in reference books, Safety Data Sheets (SDSs) and other sources. Care needs to be taken to ensure that information is from reliable and authoritative sources. The information shall relate to the way the chemical is used. Where chemicals are to be mixed, information other than the SDS will be required, e.g. specific reactivities.

NOTE SDS provide information about the general hazards and use of a product. This information needs to be interpreted for use in the laboratory as products are mixed, reacted, form intermediates or end products and may be used at a scale that may impact risk control measures.

The outcome of the risk assessment conducted for the work shall be readily accessible, reviewed and taken into account before chemicals are used. See [Clause 3.3.1](#).

Safety information shall be readily accessible in the work area. This information could include the type of hazard, treatment required for spills, burns and other injuries, proper storage procedures, safe handling and correct labelling. Information should be accessible and understandable to personnel involved in activities using chemicals.

3.2.3 Security

Security requirements for the laboratory access, materials and activities shall also be taken into account.

Chemicals such as scheduled poisons and controlled substances, and chemicals of security concern shall be used and stored so that they do not present a risk to persons in the vicinity and are secure against theft or unauthorized tampering.

3.2.4 Storage and handling of chemicals

3.2.4.1 General

National, state or territory legislation may apply to the storage of chemicals in the laboratory.

Provision shall be made for safe movement of chemicals and samples, e.g. using trolleys and sample racks.

When transferring flammable liquid from one vessel to another, earthing should be provided to eliminate static electricity discharges. Ventilation shall be provided in the transfer area. All sources of ignition should first be removed.

3.2.4.2 Storage and handling of chemical waste

National, state or territory legislation may apply to the storage and handling of chemical waste.

Chemical wastes shall be collected and separated to keep incompatible materials apart, and disposal shall occur in consultation with waste disposal contractors.. Particular care should be taken with substances which are prone to decompose, become unstable, or pressurize containers, and to ensure waste containers and closures are compatible with wastes to be collected in them. Sufficient ullage (headspace) shall be provided to allow for safety in thermal expansion of wastes.

NOTE See [Clause 3.2.8.2](#) for labelling of laboratory chemical waste.

3.2.5 Maintenance of laboratory services and cleaning of laboratories

Special instructions for the cleaning of chemical facilities shall be provided.

Cleaning shall be carried out by trained personnel engaged for this purpose. Only laboratory or facility staff or authorized contractors shall handle chemically contaminated material.

3.2.6 Health monitoring

3.2.6.1 General

Health monitoring appropriate for any hazardous substances in use shall be conducted and records maintained.

An assessment shall be conducted to determine if ongoing health monitoring is required.

Workplace environmental and health monitoring for some toxic chemicals is covered by national, state or territory legislation, e.g. lead, mercury and carcinogens. Additional cases for monitoring and surveillance shall be identified by risk assessment. Some chemicals present or increase risk to people of reproductive age and developing foetuses. The chemicals shall be identified from sources of safety information and controlled separately.

NOTE Exposure to toxic chemicals should be limited.

3.2.6.2 Workers using NOAAs

Health monitoring shall be implemented for all workers where there is risk of exposure to NOAAs, and where it has been demonstrated that there is a relationship between exposure to the substance and a measurable biological indicator.

Where national, state or territory legislation specifies a health monitoring program be undertaken for NOAAs containing certain chemicals or components, the health monitoring program shall include at a minimum —

- (a) identifying workers exposed to manufactured NOAAs, which have unknown health effects;
- (b) conducting workplace characterization and worker exposure assessments; and
- (c) providing NOAA workers with “baseline” medical evaluations and including them in a nonspecific routine health monitoring program.

Periodic medical evaluations may include routine tests such as pulmonary, renal, liver, and haematopoietic function testing.

3.2.7 Safety equipment

Safety equipment shall be provided in accordance with AS 2243.1.

The risk assessment process conducted for the laboratory, in conjunction with information from relevant SDSs and other parts of the AS/NZS 2243 series, shall determine what, if any, additional or more specialized personal protective equipment is to be used. The issue and use of personal protective equipment should not be a substitute for implementing a safe system of work.

Where personal protective equipment is issued, adequate training shall be provided to all users. The equipment shall be maintained in an effective working condition in accordance with the relevant Standard or the manufacturer’s instructions. Refer to AS 2243.1.

3.2.8 Laboratory chemical wastes

3.2.8.1 General

[Clauses 3.2.8.2](#) to [3.2.8.4](#) consider aspects of handling laboratory chemical wastes. For the disposal of other types of laboratory waste, refer to AS 2243.1.

3.2.8.2 Collection, handling and storage

All laboratory wastes shall be collected, labelled, stored and disposed in accordance with safe procedures.

National, state or territory legislation may apply to the clear identification and labelling of chemical waste (i.e. GHS labelling requirements). Recycled containers shall be decontaminated prior to use. Waste chemicals shall be checked for storage compatibility and, if necessary, separate storage containers shall be provided (e.g. chloroform and acetone are incompatible especially in the presence of a base). Waste can contain chemicals that degrade on storage and can become more hazardous, e.g. build up pressure or become explosive. Such wastes shall be identified and managed appropriately.

When transferring flammable liquid wastes from one vessel to another, earthing should be provided to eliminate static electricity discharges. Ventilation shall be provided in the transfer area and all sources of ignition should first be removed.

Chemical wastes should be divided into aqueous solutions, solutions containing heavy metals, water-insoluble waste, chlorinated solvents and peroxides. Further division into particular types of compounds, e.g. cyanides and non-chlorinated solvents may be necessary. Mutually reactive wastes shall not be stored together. Materials for disposal that are likely to have formed peroxides shall be assessed and handled appropriately before they leave the laboratory.

Chemical wastes shall be stored in a well-ventilated area. A storage area for large volumes of collected waste should provide fume protection, fire protection and bunding.

Categories of waste from the laboratory shall be properly segregated for temporary accumulation and storage as well as for transportation and disposal.

3.2.8.3 Labelling of laboratory chemical waste

All waste shall be properly labelled.

Wording for the labelling of waste is available from the relevant national, state and territory regulator (e.g. code of practice) and Safe Work Australia.

Where mixed waste products are packaged together, the information on the label should be based on the major component or the component which constitutes the main risk.

The label shall be firmly secured to the container and remain in place until the container is cleaned and free of the substance, or until it reaches its final disposal point. The label should be resistant to degradation and positioned away from container openings. The lettering of the label shall be durable and of a size and style which is legible.

NOTE [Appendix A](#) provides an example of a suitable label for waste containers.

3.2.8.4 Disposal

Waste minimization, especially recycling of solvents, should be practised where practical. This includes the return of unwanted chemicals and containers to the supplier or agent.

Waste containing heavy metals shall not be disposed into the environment.

The disposal of certain wastes is subject to local regulations or national, state and territory regulations.

NOTE 1 Relevant authorities should be consulted on the correct methods for placing this material into storage or for its disposal.

NOTE 2 Disposal may need to be carried out by a licensed waste collector.

NOTE 3 With the approval by the appropriate water authority a variety of water soluble wastes can be disposed via the sewer, provided that limits of volume, pH and biological and chemical content are properly observed.

3.3 Chemical safety practices

3.3.1 Principles of protection

3.3.1.1 General

Work shall be planned to eliminate or minimize the production of vapours, fumes, mists, dusts and fibres in the work area. The aim is to minimize exposure and the potential for incidents, e.g. fire or explosion.

3.3.1.2 Hazard identification, risk assessment and control process

This process shall be based on at least the following:

- (a) Identification of the hazards associated with the chemicals and the proposed handling methods, as well as identification of the chemical's effects on people and its physicochemical properties. Appropriate sources of safety information, such as SDSs, shall be consulted.
- (b) Assessment of the nature of the risks associated with the toxicological and physicochemical hazards. Risk will be associated with both —
 - (i) the potential for exposure that can cause adverse health effects; and

NOTE The routes by which the chemical can enter or interact with the body need to be considered.

- (ii) the potential for dangerous occurrences, e.g. fire, due to physicochemical properties.
- (c) Evaluation of the severity or degree of risk.
- (d) Selection and application of control measures to either eliminate or minimize risks.
- (e) Assessment of the level of training suitable for personnel who handle or may be exposed to the chemicals.

3.3.1.3 Control measures

No situation shall be allowed to continue where exposure is expected to be greater than the exposure standard or where exposures are likely to cause adverse health effects, injuries or illness. At all times, operations should be conducted in such a way that exposure or the risk of an incident (e.g. fire or explosion) is as low as reasonably achievable.

There are numerous effective measures available to control the risks associated with the use of chemicals. The controls chosen shall be suitable for, and compatible with, the chemicals and handling methods used.

General safeguards include the following:

- (a) Elimination or substitution of the hazard, e.g. use of a different process or use of a different chemical.
- (b) Engineering controls such as isolation (e.g. handle the chemical within a closed system) or ventilation (e.g. use volatile chemicals within a fume cupboard or under local exhaust ventilation).
- (c) Administrative controls such as minimizing the time spent using chemicals or documenting and implementing handling procedures (e.g. standard operating procedures and standard test methods).
- (d) Personal protective equipment (PPE). As PPE is the least effective control measure, however, it shall be used in conjunction with other control measures.
- (e) Emergency response preparedness and mechanisms.

When applying these controls, appropriate protocols should be developed, documented, implemented and reviewed to ensure their effectiveness.

3.3.2 Environmental considerations

The following requirements shall be observed to minimize hazards in a laboratory:

- (a) Work shall be planned and executed to eliminate or minimize vapours, fume, dust, mist or fibres in the work area.
- (b) Sources of safety information shall be consulted before commencing work involving the use of or production of toxic volatile substances.

NOTE 1 The sense of smell should not be used as a substitute for safe working procedures or as a method of monitoring chemical vapours.

- (c) The use of chemicals in an area with restricted or low ventilation shall be monitored where it cannot be avoided, as it can result in oxygen depletion, a hazardous area or unnecessary exposure of personnel.
- (d) Self-contained breathing apparatus shall only be used by personnel trained in its use.

NOTE 2 Cartridge and canister respirators are limited in performance as their effectiveness depends on time and the type and concentration of substances to which they are exposed. Cartridge and canister-type respirators provide no protection in oxygen-deficient atmospheres (refer to AS/NZS 1715 and AS/NZS 1716).

NOTE 3 Air supplied and sealed masks should be considered in a risk assessment.

Where a process requires the continued (day-to-day) use of respirators, the process shall be modified to minimize, or possibly eliminate the respiratory hazard.

- (e) As the discharge of materials to ducts and drains can cause corrosion and a build-up of potentially dangerous products in the piping system, such discharges shall be minimized. If permissible contamination limits are likely to be exceeded, preventive measures such as dilution of contaminants or rendering the toxic substances harmless, shall be taken.

3.3.3 Housekeeping

The following provisions shall form the basis of good housekeeping practices in the laboratory:

- (a) Do not handle, store or consume food or drink for personal consumption in the laboratory.
Refrigerators, freezers, ovens and microwave ovens used in the laboratory shall be labelled to prohibit their use for food or drink for personal consumption.
- (b) Food or drink for personal consumption shall not be stored in a refrigerator, freezer or cupboard that is used to store chemicals. Any human foodstuffs to be used in the laboratory setting for experimental or animal consumption shall be clearly marked: "Not for human consumption".
- (c) Only use suitable storage containers for chemicals. Containers such as soft drink, juice and water bottles shall not be used for chemical storage.

NOTE 1 Some containers have a limited shelf-life.

NOTE 2 This clause may not apply for incoming samples to be analysed in the laboratory and not classified as hazardous.

- (d) Keep benches, shelves and cupboards clean and tidy.
- (e) Clean up after each stage of an operation, e.g. return all reagents, equipment and glassware not in use to their proper place in a clean condition.
- (f) Clean up spilled material immediately, using a procedure suitable for the particular substance (see [Clause 3.4](#)).
- (g) Clearly and permanently label all chemical containers to reflect the contents.
- (h) Used chemical shall not be returned to the reagent containers.
- (i) Do not store in the laboratory work area quantities of chemicals greater than those required for the efficient operation of the laboratory.
- (j) Do not store chemicals above 1.5 m from the floor.
- (k) Do not allow wastes to accumulate so that they become a hazard. Collect chemical wastes and remove them from the work area. Store them in a safe area in accordance with [Clause 3.2.8](#).
- (l) Dispose of broken glassware by using a container reserved and labelled for the purpose.

3.4 Spill management

3.4.1 General

Every endeavour shall be made to prevent leaks or spills, and to control them if they occur (e.g. through use of secondary containment). Where a spill occurs, clean up shall be initiated immediately.

The response for a spill in the laboratory shall be based on the information provided either in the manufacturer's SDS and/or a risk assessment. Possible consequences of the spill, such as environmental pollution and cross-contamination, shall be included in the assessment of the hazard from the spill. A spill of low hazard, low volatility material may potentially be cleaned up with a paper towel.

3.4.2 Planning

Planning for the control of a spill within the laboratory involves teaching staff the correct response to accidents, the provision of written instructions and suitable equipment for clean-up, and having available those sources of information that will help laboratory staff and facilities personnel to select the correct approach for the particular circumstances. Review of the outcome of the spill assessment needs to occur and take account of relevant information in SDSs, legislation and other reference materials.

An emergency plan shall communicate conditions under which emergency services and relevant authorities need to be notified.

Consideration should be given to segregating collections of broken glass.

Clean-up materials and equipment should be kept at an accessible location (e.g. a safety station) and should include the following:

- (a) "Do not enter" signs or barricade tape.
- (b) Relevant hazard signs.
- (c) Suitable types and quantities of absorbent materials or spill kits.

NOTE [Appendix B](#) provides information on the use of absorbent materials and spill kits.
- (d) Personal protective clothing appropriate to the hazards.
- (e) Appropriate containers for used absorbent materials and contaminated PPE.

3.4.3 Spills inside fume cupboards

Small spills may be treated easily by wiping or absorbing with an appropriate absorbent. If a larger spill, leakage or breakage occurs, more extensive treatment may be needed.

NOTE 1 Refer to SDS and risk assessment to determine appropriate response.

Spills inside a fume cupboard are generally not as hazardous as those outside cupboards, as they are generally contained and fumes, dusts or mists are swept away by the cupboard air stream. The suggested clean-up procedure is as follows:

- (a) Ensure that the fume cupboard remains operating.
- (b) Place absorbent or neutralizing materials over the spill. Proprietary absorbent or neutralizing materials may be used.

NOTE 2 [Appendix B](#) lists general absorbent or neutralizing materials.

- (c) Decontaminate any contaminated materials or equipment adjacent to the spill and fume cupboard surfaces.
- (d) Remove PPE, if contaminated, and wash hands and arms.

- (e) Dispose of any waste, contaminated PPE and used absorbent materials.

NOTE 3 Depending upon the type of the hazardous chemical spilled, cleaning of the exhaust duct may be required.

3.4.4 Spills outside fume cupboards

Spills outside fume cupboards can be complex events. They can occur in laboratories where a limited number of persons work or they in corridors used by a considerable number of persons. For this reason, all work shall be planned to minimize the chance of a spill. Chemicals being moved in or between laboratories or service areas shall be contained.

Spills can involve amounts of material ranging from 1 mL or less to many litres. The amount spilled, the physical characteristics of the material and how the spill occurred are important factors in determining the area of involvement.

When liquid is spilled, it is generally dispersed as the following three spill fractions:

- (a) The bulk of the liquid that remains in an irregular puddle.
- (b) The portion that separates as splashes and rivulets.
- (c) The portion that becomes airborne (e.g. volatilizes or generates airborne dusts).

NOTE Where airborne dust is produced, larger particles settle rapidly whereas the smaller particles can remain suspended in air for a considerable time and can be transported from the spill site by a ventilation system. In the event of a spill of liquid in the laboratory, the potential for airborne material needs to be considered.

Spills in confined areas, especially cold-rooms and basement laboratories, require special consideration.

The response to an accidental spill of chemicals in the laboratory will depend upon the hazards of the material, including the physicochemical properties, and the volume of the spill. The SDS for the chemical should be consulted for spill procedures because the procedures vary with the reactivity, concentration, physical properties, form and hazards of the chemical. Commercial spill kits are available for both small and large spills of many chemicals. However, very large spills can require attendance by an emergency service provider, such as the fire brigade.

3.5 Fire, emergency and rescue procedures

Refer to AS 2243.1 for requirements and recommendations concerning fire, emergency and rescue procedures for laboratories.

Firefighting equipment and services suitable for the types of fires likely to be encountered shall be readily available in all laboratory areas.

NOTE The HAZCHEM Code provides the correct firefighting medium for all substances listed under the ADG Code and is set out in that document. In New Zealand, refer to NZCIC HSNO Approved Code of Practice, *Signage for Premises Storing Hazardous Substances and Dangerous Goods*.

Section 4 Safe use of chemical substances

4.1 General

Laboratories are unique in that they have a diverse range of chemicals, often in smaller quantities than in industrial environments. The methods and systems used within the laboratory can be complex. Hazardous situations can arise in day-to-day operations if personnel are not appropriately trained and aware of the hazards.

This section provides guidance on the range of common chemical hazards that can be encountered in laboratory operations and the precautions to be adopted to address the hazards.

NOTE [Appendix K](#) lists the ADG categories versus the GHS categories.

4.2 Chemical hazards

Chemicals can be hazardous due to their physical properties, chemical nature or interaction with living organisms.

The storage conditions of the chemical substance can also present a hazard if the storage containers used are incompatible with the substance (e.g. storage of peroxides in metal containers) or if the substance is stored under poor environmental conditions (e.g. hot conditions, or those which can lead to the deterioration of the storage container).

Consideration should be given to substituting a less hazardous material for use, where possible.

Chemical safety is subject to national, state and territory legislation. Some specific chemicals, due to their public health impact, are legislated under drugs, poisons and controlled substances legislation and related legislation for agricultural and veterinary chemicals.

NOTE 1 For an explanation of dangerous goods classes, consult the ADG Code.

NOTE 2 In New Zealand, consult NZS 5433 and hazardous substances regulations.

4.3 Gases

4.3.1 General

All compressed and liquefied gases should be regarded as hazardous. Hazards arise from one or more of the following factors:

- (a) *Compressed state* — Rapid expansion takes place suddenly and with considerable force on release of the gases from their container, e.g. compressed nitrogen.
- (b) *Low temperature* — Many gases, when released rapidly, become cold as a result of adiabatic expansion. Also, gases stored as cryogenic fluids are at exceptionally low temperatures upon release (refer to AS 1894 for further information).
- (c) *Reactivity* — Gases (e.g. chlorine, oxygen, nitrous oxide) that are normally highly reactive with certain substances tend to be even more so when released from a compressed state by virtue of their high concentration.
- (d) *Flammability* — Many compressed gases are flammable and should be treated as such. A high concentration combined with pressure increases the risk of a potential hazard.
- (e) *Toxicity* — The toxic properties of gases, such as ammonia and chlorine, increase with higher concentrations.

- (f) *Oxygen depletion* — Gas released may displace air, which can cause asphyxiation even though the gas may not be very toxic. Examples of these gases include carbon dioxide, helium and nitrogen.
- (g) *Density effects* — Gases that are heavier than air, such as LP Gas and carbon dioxide, can travel large distances without dilution (or dissipation).

Depending on their nature, gases used in laboratories are usually contained in one of three ways, each presenting its own specific hazards, as follows:

- (i) High pressure cylinders at approximately 13.7 MPa or at 30.0 MPa. Examples are oxygen, nitrogen, hydrogen, and methane.
- (ii) Liquefied or dissolved gases in cylinders under pressure. Examples are LP Gas, propane, ethylene, acetylene, chlorine, ammonia, and sulfur dioxide.
- (iii) Refrigerated liquid gases in vacuum jacketed containers at pressures between 100 kPa (approximately one atmosphere) and 20 MPa. Examples are refrigerated argon, helium, liquid air, carbon dioxide, oxygen, nitrogen, hydrogen, and neon.

Cylinders shall be handled and stored in accordance with AS 4332 and AS/NZS 2243.6.

4.3.2 Handling of gases, compressed or liquefied (other than cryogenic liquids)

In addition to the mechanical aspects covered in AS 4332 and AS/NZS 2243.6, the following chemical precautions shall be taken when handling compressed or liquefied gases other than cryogenic liquids:

- (a) Materials that a gas comes in contact with prior to its use shall be chemically compatible with that gas.
- (b) Cylinders or gas lines used for flammable gas shall be earthed.
- (c) When leak-testing or cleaning an oxygen system only solutions that are compatible with oxygen shall be used.
- (d) If the gas is corrosive or toxic, adequate precautions shall be taken before it is used, and emergency equipment shall be readily available, e.g. respirator, breathing apparatus, resuscitator and antidote.
- (e) The venting of gases or lines shall be carried out. For Class 2.1 flammable gases in cylinders, the cylinder shall be held vertically in a well-ventilated area. LP Gas shall not be released where a potential ignition hazard exists or where a hydrocarbon cloud can be formed in low-lying areas (refer to AS/NZS 1596). Where flammable gases that are lighter than air are used or stored in cylinders, high level ventilation shall be provided to prevent accumulation of a flammable concentration of gas.

NOTE 1 Particular care should be taken with regard to suspended ceilings to adequately ventilate the ceiling space.

- (f) When decanting liquefied gases, protective clothing, insulated gloves, and eye and face protection shall be worn. Sampling personnel shall use methanol to remove ice which can build up on valves and connections during sampling.
- (g) Acetylene shall not be allowed to come in contact with copper or any alloy containing more than 65 % copper for gas lines.
- (h) Empty cylinders shall be marked “empty” and removed from the work area to appropriately segregated storage. Empty cylinders should be left containing a slight positive pressure in order to avoid possible contamination with moisture or air

NOTE 2 Refer to AS 3383 for further guidance on storage and handling of “empty” cylinders.