# LICENCE

for

**DR AS 2243.1:2018, Safety in laboratories, Part 1: Planning and operational aspects**

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# Draft

## Australian Standard

Public Comment is invited for:

DR AS 2243.1:2018, *Safety in laboratories*, Part 1: *Planning and operational aspects*

Public Comment period:

Start date: 24 October 2018

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At the expiry of the comment period, the committee responsible for the document is obliged to give serious consideration to all comments received. However, normally no acknowledgement of comment is sent.

# 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 2243.1:2005.

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

The objective of this Standard is to provide general information, recommendations and procedures which will promote safe working in laboratories.

Major changes in this edition are as follows:

Update of existing definitions and addition of new definitions and abbreviated terms.

Addition of new clauses on electrical installations, as AS 2243.7, *Safety in laboratories, Part 7: Electrical aspects*, is now obsolete.

Addition of new clauses on nanotechnology and fieldwork.

Update of existing Appendices. and addition of a new Appendix containing a field trip plan.

The Standard is Part 1 of an 8-part series designed to provide basic coverage of all important aspects of the safety function in laboratories. It deals with the general aspects of safety common to all kinds of laboratories and is intended to be used in conjunction with other Parts of the series, which relate to particular aspects of laboratory operations and to particular kinds of hazards. It emphasizes the importance of preventive measures and sets out safe practices, emergency procedures, and first aid.

The other Parts in the series are as follows:

AS/NZS 2243.2, *Safety in laboratories, Part 2: Chemical aspects and storage*

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*

The term “informative” has been used in this Standard to define the application of the appendix to which it applies. An “informative” appendix is only for information and guidance.

# Contents

# Introduction

Safety in laboratories is impacted upon by design and construction. When combined with systems of work that are based on the recognition of hazards and control of risks, and appropriate attitudes and behaviours, we have an integrated approach to achieving a safe workplace.

Everyone has a responsibility to work safely in laboratories. The aim is for every person to be able to make informed decisions based on sound risk management principles.

Top leadership has a duty to provide information, instruction, training and supervision, and to communicate and reinforce safety rules and work practices. Increased alertness is required with personnel who are at greater risk of injury because of their age, inexperience and unfamiliarity with the work surroundings.

It is recommended that a health and safety management system or a quality management system be adopted for the control and review of all laboratory practices and procedures.

NOTES

# Australian Standard®

## Safety in laboratories

## Part 1: Planning and operational aspects



## Section 1 Scope and general

### 1.1 Scope

This Standard sets out requirements, general procedures, precautions, recommendations and information designed to promote safety of persons and property in laboratory operations. The safety aspects described in this Standard apply to laboratory staff, maintenance staff, contractors, visitors and other authorized personnel, including students, cleaners and security staff who use or enter the laboratory facilities.

This Standard deals specifically with safe practices in laboratories and does not cover the design and construction of laboratories, which is covered in building regulations and is the subject of AS/NZS 2982.

### 1.2 Application

This Standard should be used in conjunction with the appropriate part(s) of AS/NZS 2243 that is relevant to the type of work being carried out in the laboratory.

NOTE If the requirements of any part of this Standard conflict with any national, state or territory regulations, the appropriate statutory regulations apply.

While this Standard has been developed for laboratories in buildings, it may be used for guidance for laboratories and laboratory activities in other locations, such as in the field.

### 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 for informative purposes are listed in the Bibliography.

AS 1530.4, *Methods for fire tests on building materials, components and structures, Part 4: Fire-resistance tests of elements of building construction*

AS 1851.1, *Maintenance of fire protection equipment, Part 1: Portable fire extinguishers and fire blankets*

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

AS 2252.1, *Biological safety cabinets, Part 1: Biological safety cabinets, (Class I) for personnel and environment protection*

AS 2252.2, *Controlled environments, Part 2: Biological safety cabinets Class II — Design*

AS 2252.5, *Controlled environments, Part 5: Cytotoxic drug safety cabinets (CDSC) — Design, construction, installation, testing and use*

AS 2444, *Portable fire extinguishers and fire blankets — Selection and location*

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

AS 4775, *Emergency eyewash and shower equipment*

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

AS/NZS 1337.1, *Personal eye protection, Part 1: Eye and face protectors for occupational applications*

AS/NZS 1338, *Filters for eye protectors* (all parts)

AS/NZS 1715, *Selection, use and maintenance of respiratory protective equipment*

AS/NZS 1716, *Respiratory protective devices*

AS/NZS 1800, *Occupational protective helmets — Selection, care and use*

AS/NZS 1801, *Occupational protective helmets*

AS/NZS 2210, *Occupational protective footwear* (all parts)

AS/NZS 2243.2, *Safety in laboratories, Part 2: Chemical aspects*

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 2243.8, *Safety in laboratories, Part 8: Fume cupboards*

AS/NZS 2243.9, *Safety in laboratories — Recirculating fume cabinets*

AS/NZS 2430.3.6, *Classification of hazardous areas, Part 3.6: Examples of area classification - Laboratories, including fume cupboards and flammable medical agents*

AS/NZS 2647, *Biological safety cabinets — Installation and use*

AS/NZS 2982, *Laboratory design and construction*

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

AS/NZS 3105, *Approval and test specification — Electrical portable outlet devices*

AS/NZS 3504, *Fire blankets*

AS/NZS 3760, *In-service safety inspection and testing of electrical equipment*

UN. *Globally Harmonized System of Classification and Labelling of Chemicals (GHS)*

## 1.4 Terms and definitions

For the purpose of this Standard, the definitions below apply.

**1.4.1**
**accident**
any occurrence which results in personal injury, disease or death, or property damage

**1.4.2**
**ADG Code**
Australian code for the transportation of dangerous goods by road or rail

**1.4.3**
**competent person**
person who has acquired through training, qualifications or experience, or a combination of these, the knowledge and skills enabling that person to perform a specified task

**1.4.4**
**corrosive**
having the characteristic of damaging or destroying by direct chemical action; this includes the effect of caustic substances

**1.4.5**
**cryogenic liquid**
liquid having a normal boiling point below −90°C at atmospheric pressure (101.3 kPa).

[SOURCE: AS 1894]

**1.4.6**
**dangerous goods**
substances, mixtures or articles 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: Note 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.*

**1.4.7**
**exposure standard**
airborne concentration of a particular substance in the worker's breathing zone, exposure to which, according to current knowledge, should not cause adverse health effects nor cause undue discomfort to nearly all workers

**1.4.8**
**fieldwork**
**working in the field**
gathering of information either through passive observation, or the conducting of scientific activities in a natural environment, rather than in a place of study such as a research or teaching laboratory in a building. Fieldwork can be further categorized on the basis of the time or significant distance from essential emergency and required services such that the location presents a significant increase in risk

**1.4.9**
**fire-isolated compartment**
portion of a building separated from another portion or portions by fire-resisting construction

**1.4.10**
**fire-resisting (as applied to a structural member or other part of a building)**
having resistance rating, determined in accordance with the fire-resistance test set out in AS 1530.4, required for that structural member or other part

**1.4.11**
**flammable**
capable of being ignited and of burning in air

**1.4.12**
**flammable liquid**
liquids, or mixtures of liquids, or liquids containing solids in solution or suspension (for example, 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

[SOURCE: AS 1940:2017, 1.4.28]

**1.4.13**
**flash point**
the lowest temperature, corrected to a barometric pressure of 101.3 kPA, at which application of a test flame causes the vapiur of the test portion to ignite under the specified conditions of a test

Note 1 to entry: Note to entry: Closed-cup flash point methods are given in the AS/NZS 2106 series.

**1.4.14**
**Globally Harmonized System of Classification and Labelling of Chemicals**
**GHS**
international system of classification and labelling of chemicals, published by the United Nations

**1.4.15**
**harmful processes**
processes in which energy or harmful substances are used or produced and which, upon uncontrolled release, can cause injury or illness to persons or can damage property

**1.4.16**
**hazard**
source or a situation with a potential for harm in terms of human injury or ill-health, damage to property, damage to the environment, or a combination of these

[SOURCE: AS/NZS 4801:2001, 3.5]

**1.4.17**
**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 WHS Regulations

**1.4.18**
**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

**1.4.19**
**incident**
any unplanned event resulting in, or having a potential for injury, ill-health, damage or other loss

[SOURCE: AS/NZS 4801 — 2001, 3.9]

**1.4.20**
**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

Note 1 to entry: 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 2 to entry: AS/NZS 2982 contains definitions of various types of laboratories.

**1.4.21**
**laboratory compartment**
fire-isolated compartment in a laboratory, being either the whole laboratory or a subdivision of the laboratory

Note 1 to entry: Note to entry: A laboratory compartment may be divided into subcompartments such as workrooms, stores or offices, or may be an open-plan area.

**1.4.22**
**laboratory waste**
all liquid, solid or gaseous material that results from laboratory operations and is for disposal

**1.4.23**
**may**
indicates the existence of an option

**1.4.24**

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

[SOURCE: SA TS 80004.1:2016, 2.1 and 2.3]

**1.4.25**
**plant**
any machinery, equipment (including scaffolding), appliance, implement or tool and any component or fitting thereof or accessory thereto

**1.4.26**

**residual current device**
**RCD**
device intended to isolate supply to protected circuits, socket-outlefs or electricalequipment in the event of a current flow to earth that exceeds a predetermined value(SOURCE: AS/NZS 3000:2018, 1.4.102)

**1.4.27**
**risk**
<in relation to any potential injury or harm> likelihood and consequence of that injury or harm occurring

[SOURCE: AS/NZS 4801:2001, 3.18]

**1.4.28**
**risk assessment**
overall process of estimating the magnitude of risk and deciding what actions will be taken.

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

**1.4.29**
**safety**
state in which the risk of harm (to persons) or damage is limited to an acceptable level.

[SOURCE: AS/NZS 4801:2001, 3.19]

**1.4.30**
**safety data sheet**
**SDS**
document which provides information on the identification, hazards, precautions for use and safe handling of a specific chemical product

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

**1.4.31**
**shall**
indicates that a statement is mandatory

**1.4.32**
**should**
indicates a recommendation

**1.4.33**
**toxic substance**
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: Note to entry: Such substances —

Note 2 to entry: (a) are listed in the *ADG Code* or NZS 5433; or

Note 3 to entry: (b) meet the classification criteria set out in the *UN Manual of Tests and Criteria* or NZS 5433; or

Note 4 to entry: (c) in New Zealand, meet the criteria of the *Hazardous Substances (Health and Safety Reform Revocations) Regulations 2017*

**1.4.34**
**working in isolation**
work carried out in an area where normal means of contact (e.g. verbal, sight) with other staff are not available, so that the potential risk of existing hazards is increased to the extent that extra precautions are needed

Note 1 to entry: Note to entry: This includes working in isolated areas on or off-site, either during or outside normal working hours.

# Section 2 Planning the laboratory for safety

## 2.1 General

Aspects of laboratory operations pertaining to particular kinds of hazards are covered in other Parts of the AS/NZS 2243 series as follows:

(a) For chemical aspects, see AS/NZS 2243.2.

(b) For microbiological safety and containment, see AS/NZS 2243.3.

(c) For ionizing radiation, see AS 2243.4.

(d) For non-ionizing radiation, see AS/NZS 2243.5.

(e) For plant and equipment aspects, see AS 2243.6.

(g) For fume cupboards, see AS/NZS 2243.8.

(h) For recirculating fume cabinets, see AS/NZS 2243.9.

NOTE 1 For other aspects, including manual handling, electrical aspects, confined spaces and noise, reference should be made to relevant national, state and territory legislation, codes of practice or other standards.

NOTE 2 For any particular operation, hazards are likely to be identified in more than one aspect and each aspect may require a different document to be consulted.

## 2.2 Design and construction

### 2.2.1 General

Laboratory design and construction shall be in accordance with AS/NZS 2982, the requirements of which apply to the design of both new laboratories and existing buildings which have been converted to a laboratory or to a different type of laboratory use. At the planning stage, risk assessment and hazard and operability(HAZOP) studies (refer to AS IEC 61822 ) shall be carried out. Special consideration shall be given to access, egress and security, as well as to the design and construction of laboratories and of their facilities.

### 2.2.2 Laboratory layout

In the process of designing the laboratory, attention shall be given to manual handling and work flow issues, including traffic routes, traffic volumes and the carrying out of repetitive operations.

The minimum spacing for benches shall be as specified in AS/NZS 2982. The minimum spacing for biological safety cabinets shall be as specified in AS/NZS 2647 and the minimum spacing for fume cupboards shall be as specified in AS/NZS 2243.8. Benches and large items of equipment should be arranged so that employees can work without being impeded or subjected to danger by others working in the laboratory. Benches and large items of equipment shall not be moved after the final layout has been established, without a risk assessment of the consequences (see Clause 3.1.2). Bench heights and widths should be designed taking into account the type of work to be performed.

Consideration should be given to appropriate ergonomics and available lighting, particularly where computer and other screen-based equipment is to be used. The height of screen-based equipment should be adjusted to minimize the potential for overuse strain injury (see AS/NZS 4443).

### 2.2.3 Protection against sunlight

Direct sunlight should be prevented from entering the interior of the laboratory where it can affect the work being carried out (see also AS/NZS 2243.2 and AS/NZS 2982).

NOTE 1 An important aspect of laboratory safety is that volatile chemicals and liquids should not be subjected to heat from sunlight.

NOTE 2 Sunlight can also cause formation of unstable by-products in certain chemicals, and degrade certain plastic containers.

### 2.2.4 Eating facilities

Adequate facilities for storage, preparation and consumption of food and drink shall be provided outside the laboratory and readily accessible by laboratory staff (see also AS/NZS 2982).

### 2.2.5 Amenities

Hand washing facilities, sufficient for the number of staff and the tasks being undertaken, should be provided within laboratories (see AS/NZS 2982).

Showering facilities, readily accessible but external to the laboratory, may be required depending upon the tasks being carried out and the quantity of chemicals being used.

Changing facilities, including clothing storage facilities, may also be required.

NOTE Other Parts in the AS/NZS 2243 series may contain more specific requirements for the positioning of amenities.

### 2.2.6 Write-up areas

Precautions shall be taken to ensure that reading and writing materials do not become contaminated or damaged.

Write up areas shall be separated from areas where hazardous materials are used or harmful processes are undertaken.

### 2.2.7 Storage place

Provision should be made for the housing of laboratory records, stores and equipment which are currently not in use.

### 2.2.8 Access for disabled persons

Where a disabled person uses the laboratory, special facilities may be required to ensure a safe system of work. A review of the risk assessment program for the laboratory procedures should be undertaken to confirm that no additional risks are present for the disabled person or their work colleagues.

In designing the laboratory, provision should be made for safe access and egress for disabled persons during any emergency.

NOTE 1 There are statutory requirements that address discrimination against persons on the grounds of disability that include work, education and access to premises.

NOTE 2 Increasingly, laboratories operate in the field and may not be designed to AS/NZS 2982.

## 2.3 Fire detection and explosion protection

Fire protection equipment or automatic fire detection equipment shall be installed in a laboratory where there is a foreseeable risk of fire or explosion.

For a laboratory where substances that can pose a fire or explosion risk are used, hazardous areas shall be classified in accordance with AS/NZS 2430.3.6.

In some situations, more than one type of protection should be provided. For example, flammable liquid stores should have automatic detection, automatic extinguishing and, where necessary, explosion-venting equipment.

NOTE Examples of areas where protection equipment or automatic fire detection equipment may be required are given in Appendix A.

## 2.4 Emergency alarm systems and associated operations

Because of the distinctive nature of the operations being carried out within a laboratory, the need may arise to evacuate the building for emergencies other than fire. Accordingly, consideration should be given to installing an independent intercommunication system which in accordance with AS 1670.4. The following emergency equipment shall be provided for a laboratory occupancy:

(a) An emergency evacuation alarm system which is audible in all parts of the building and is accompanied by a visual alarm where the specific circumstances can prevent the identification of the audible alarm, e.g. background noise levels.

Remote signalling systems connecting the emergency alarm and any automatic detection or protection devices to an attended location.

(b) Where remote signalling systems are impracticable, alternative means of direct communication shall be provided.

(c) Annunciator (indicator) panels for all automatic detection, extinguishing and manual alarm systems, in locations easily accessible to the attending emergency service, to indicate the location of any detection, extinguishing or manual alarm device which has operated. Annunciator panels shall be clearly and conspicuously marked.

NOTE Refer to relevant national, state and territory regulations regarding information to be provided alongside panels.

(d) When actuated, by any automatic or manual fire or gas detection, protection or alarm device, mechanical ventilation systems shall exhaust air so that there is no recirculation.

NOTE The laboratory exhaust system and fume cupboards should continue to operate unless manually shut down by the personnel in charge of the laboratory.

## 2.5 Information on substances

### 2.5.1 Safety data sheets and inventory

An inventory of hazardous chemicals used in the laboratory and safety information in the form of material safety data sheets shall be readily accessible and understandable to all personnel. This information shall also be available external to the laboratory in an accessible place known to the emergency services.

NOTE: Refer to relevant national, state and territory regulations for the preparation of safety data sheets.

### 2.5.2 Storage and use of substances

The storage, handling and use of substances in laboratories shall be in accordance with the requirements of AS/NZS 2243.2, AS 4332 and AS/NZS 2982.

### 2.5.3 Labelling

Substances shall be adequately labelled and personnel using the substances shall be made familiar with the relevant hazardous properties.

NOTE Refer to relevant national, state or territory regulations, in addition to GHS requirements.

### 2.5.4 Warnings

Appropriate warning placards shall be placed in internal locations and on the external wall of the building.

NOTE: Refer to relevant national, state, and territory regulations.

### 2.5.5 Change in laboratory tasks

Before a change is made in the tasks performed within a laboratory compartment that involves the storage or use of substances, that compartment shall be assessed for its suitability for the new task.

### 2.5.6 Liaison with emergency services

A regular liaison should be maintained with emergency services to inform them of the nature of hazards in the laboratory and of the emergency requirements.

## 2.6 Safety equipment

Fixed safety equipment shall be as specified in AS/NZS 2982. Each eyewash and safety shower shall be tested and maintained in accordance with AS 4775.

NOTE Other Parts in the AS/NZS 2243 series, may contain more specific requirements for the positioning of safety equipment.

The following additional safety equipment shall be available and accessible to all staff within the laboratory area:

(a) Fire extinguishers, installed in each laboratory in accordance with AS 2444, which shall be maintained in accordance with AS 1851.1.

(b) Fire blankets, manufactured in accordance with AS/NZS 3504.

(c) Adequate first aid facilities and supplies.

NOTE Refer to relevant national, state and territory regulations.

(d) Suitable spill kits (see AS/NZS 2243.2).

(e) A manual containing safety procedures.

NOTE If there is a risk of damage by grease, chemicals, or humidity, the pages of the manual should have a protective coating or be sealed in suitable transparent envelopes.

Where outside support is not relied upon for self-contained breathing apparatus (SCBA), a minimum of two sets of SCBA should be accessible to personnel competent in its use within the laboratory area. The decision on whether to provide SCBA, for use in operations, spillages of hazardous chemicals, dangerous operations and emergency rescue operations, should be based on a risk assessment of the potential for exposure to hazardous atmospheres if responding to emergency situations. The assessment should take account of the ability of local emergency services to respond. Where provided, self-contained breathing apparatus shall be maintained in accordance with AS/NZS 1715.

In addition to the safety equipment held in the laboratory, an area at the entrance to each main laboratory or laboratory occupancy (complex) should be a safety station containing safety equipment compatible with the work being performed, such as the following:

(i) Safety glasses and face shields.

(ii) Safety helmet.

(iii) Disposable clothing.

(iv) Fire extinguishers (suitable for electrical and chemical fires).

(v) Fire blanket manufactured in accordance with AS/NZS 3504.

(vi) Absorbent materials for chemical spills.

(vii) Protective gloves, e.g. heat-resistant, chemical-resistant.

(viii) Torch of appropriate type, e.g. suitable for hazardous areas.

(ix) Hearing protection.

(x) Properly maintained self-contained breathing apparatus, where appropriate.

## 2.7 Room ventilation

### 2.7.1 General

The capacity of the laboratory ventilation shall be appropriate to the current laboratory operations and for the maintenance of fume cupboards. The ventilation requirements given in AS 1940 should be taken into account. Where unsafe concentrations of airborne contaminants are generated or there is a risk of oxygen depletion in a laboratory, adequate ventilation or fume extraction facilities shall be available to ensure their efficient removal or treatment. Appropriate fail-safe or alarm mechanisms shall be provided.

Refer to AS 1668.1, AS 1668.2 and AS 1668.4 for requirements associated with fire and smoke control, the use of ventilation and air conditioning in buildings and, where applicable, smoke control systems for large single compartments or smoke reservoirs.

NOTE Exposure standards for atmospheric contaminants are given in Safe Work Ausralia and NZ Worksafe Workplace Exposure Standards.

### 2.7.2 Ventilation requirements

Duct materials, ventilation of storage rooms and cabinets, and access for service to ducts and fans shall be in accordance with AS/NZS 2982.

### 2.7.3 Heating and cooling

A permanent form of heating should be provided in laboratories where the temperature consistently falls below 20°C during working hours. Where flammable or combustible vapours are present, heating shall be by indirect means. Where high temperatures in the laboratory can give rise to identifiable potential hazards, cooling shall be provided.

Any heating and cooling system provided should be designed to maintain a temperature of 22 ± 2°C throughout the laboratory except where another temperature is required.

## 2.8 Local exhaust ventilation (including fume cupboards)

### 2.8.1 General

The purpose of local exhaust ventilation is to minimize contamination of the air in the laboratory by removing contaminants at the point where they are generated. There is a wide variety of local exhaust ventilation systems that can be used within laboratories. Fume cupboards are one of the most common types of local exhaust ventilation used, while biological safety cabinets are commonly used within microbiological and biomedical laboratories. Other types of local exhaust ventilation that can be used include cytotoxic drug safety cabinets, slot ventilation, overhead canopy hoods and flexible trunk hoods.

The risk assessment process conducted for the laboratory, in conjunction with consideration of toxicity and amount of emissions from equipment or instruments, shall determine the need for local exhaust ventilation and, if required, the appropriate type. Some additional hazards that should be considered as part of the risk assessment are as follows:

(a) Presence of flammable substances and sources of ignition.

(b) Corrosion of sensitive instruments and the position of electrical leads.

(c) The possibility of bottles or cylinders exploding from exposure to heat.

NOTE AS 2243.4 should be consulted for ventilation where radioactive substances are used.

### 2.8.2 Installation

If a risk assessment identifies the need for local exhaust ventilation, the local exhaust ventilation installed shall be in accordance with AS/NZS 2982.

### 2.8.3 Fume cupboards

Where fume cupboards are provided, their installation, operation and maintenance shall be in accordance with AS/NZS 2243.8.

### 2.8.4 Biological safety cabinets

There are three classes of biological safety cabinets that can be used to protect the operator from hazardous biological agents. They are as follows:

(a) Class I biological safety cabinets that provide protection for personnel and the environment (see AS 2252.1).

(b) Class II laminar flow biological safety cabinets that provide protection for personnel and the environment and also provide a clean work area for materials in the cabinet (see AS 2252.2).

(c) Class III biological safety cabinets are totally enclosed ventilated cabinets that allow work to be performed through the use of attached gloves (see BS 5726-4).

Where biological safety cabinets are provided, they shall be installed in accordance with AS/NZS 2647.

NOTE Clean workstations, which are often referred to as "laminar flow cabinets" are not biological safety cabinets. Clean workstations do not provide protection for personnel or the environment. They provide a clean work area for materials in the cabinet by drawing air into the cabinet through a HEPA filter and blowing air out of the cabinet towards the operator.

### 2.8.5 Cytotoxic drug safety cabinets

The design, construction, installation and use of cytotoxic drug safety cabinets shall be in accordance with AS 2252.5.

### 2.8.6 Recirculating fume cabinets

The use of recirculating fume cabinets and their testing shall be in accordance with AS/NZS 2243.9.

### 2.8.7 Other types of local exhaust ventilation

There are no specific Australian or New Zealand Standards for the design of other types of local exhaust ventilation such as slot ventilation, flexible ducts or overhead hoods. However, guidance material is available from the American Conference of Governmental Industrial Hygienists and the British Occupational Hygiene Society.

The effectiveness of local exhaust ventilation systems is dependent on the choice of appropriate hood capture velocities, the proximity of the hood to the source and duct transport velocities. Appropriate advice should be obtained in the design phase.

The ACGIH Industrial Ventilation: A Manual of Recommended Practice for Design (Design Manual) recommends a range of minimum duct transport velocities be maintained to prevent settling and clogging.

NOTE 5 m/s to 10 m/s for vapours and gases, 12 m/s to 15 m/s for particles liable to condense and 17 m/s to 22 m/s for dusts.

The selection of appropriate parameters is dependent on a risk assessment of the agents and activities used in the laboratory.

To be effective in protecting workers, it is important that an engineering control is of good design, is fit for purpose, is regularly maintained and the systems performance is monitored. Guidance material is available from the ACGIH Industrial Ventilation: A Manual of recommended Practice for Operation and Maintenance (O and M Manual).

## 2.9 Electrical installations

### 2.9.1 General

Electrical services shall be suitable for the environments in which they are installed. Some laboratories and facilities are required to operate at unusual temperatures and humidities. Extreme operating conditions require attention to issues such as electrical conduction of wet surfaces, improved insulation quality, corrosion resistance of equipment, and improved corrosion resistance of electrical fittings and components.

Some microbiological laboratories and containment facilities require sealing of penetrations to prevent decontaminant gas leakage and to prevent the ingress or escape of vermin. See AS/NZS 2243.3.

For detailed information on electrical aspects of laboratory design and construction refer to AS/NZS 2982.

For relevant referenced standards for electrical safety and hazard management within the laboratory environment refer to AS/NZS 3000.

For work in laboratories where hazardous and explosive atmospheres are possible, refer to the AS/NZS 2430 series and the AS/NZS 60079 series of standards.

Temporary wiring shall be in accordance with AS/NZS 3000.

All electrical installations shall comply with the requirements of the relevant electricity supply authority.

### 2.9.2 Protection and emergency isolation of final subcircuits

#### 2.9.2.1 Protection of final subcircuits

All electrical apparatus that is not permanently wired shall be protected in accordance with the measures described in AS/NZS 3000.

All final subcircuits in a laboratory shall be protected unless special circumstances preclude this (see AS/NZS 2982).

NOTE In research laboratories where medical electrical appliances are connected to persons, and in laboratories involving animals, additional protection may be required. Refer to AS/NZS 2500, AS/NZS 3000 and AS/NZS 3003.

#### 2.9.2.2 Emergency isolation of final subcircuits

Laboratories shall be provided with emergency switches to remove any hazard to persons or property due to an unexpected flow of electrical energy. Switches shall be located in sensible locations, clear of any likely danger and preferably at or near exit paths from the laboratories. Emergency switches should be zoned or arranged to ensure safe isolation without disconnecting essential equipment such as fume cupboard extraction systems or other special purpose equipment where dangerous consequences could arise from sudden power isolation.

NOTE 1 Switches should be of push-button type or similar, with colour selection, size, shape and safety signage to ensure that they can be easily recognized, understood and operated. Shrouding or covering of switches to prevent accidental activation should not impede ease of access in an emergency.

NOTE 2 Lighting circuits would normally be excluded from this requirement.

### 2.9.3 Flexible cords

Flexible cord connections to appliances shall be in accordance with the definition and requirements of "cord, flexible" in AS/NZS 3000. Flexible cords shall not contains joins, shall be in good operating condition and shall be of minimum length for the applicable installation location.

### 2.9.4 Electrical leads and electrical portable outlet devices (EPODs)

Electrical leads and electrical portable outlet devices shall be in accordance with AS/NZS 3105. Electrical leads and electrical portable outlet devices shall not be weakened by pulling or being subjected to impact, and all parts of the equipment shall be in serviceable condition. Where multiple outlet connectors are used on one device, the device shall not be overloaded.

### 2.9.5 Extension cords

The use of extension cords should be eliminated where practicable. Where necessary, an extension cord shall be double-insulated, the rated load shall be clearly identified and its use shall be managed such that its electrical capacity is not exceeded. Extension cords shall not be used in a coiled condition. Operators of equipment such as floor polishers shall take precautions to minimize the likelihood of tripping associated with cords draped across floors. See AS/NZS 3000.

### 2.9.6 Inspection of electrical equipment

New equipment and connections shall be inspected when new, and shall be tested and tagged at regular intervals, in accordance with AS/NZS 3760.

### 2.9.7 Protective devices for special equipment

Special equipment associated with human safety requires individual assessment of risk and appropriate measures to ensure continuity of operation unless there is a fault which could directly result in injury. This includes:

(a) Air supply systems for breathing in high containment microbiological laboratories and facilities. See AS/NZS 2243.3.

(b) Gaseous decontamination systems including door sealing provisions.

(c) Safety shower and eye wash systems.

(d) Ventilation, safety and alarm systems associated with storage and handling of hazardous chemicals. See AS/NZS 2243.2.

(e) Ventilation, safety and alarm systems associated with cryogenic and refrigerated liquid storage and handling. See AS 1894.

NOTE Some equipment can represent a safety hazard or highly significant detriment to long term projects in the event of power loss. Examples of this include freezers, incubators, electronic testing processes, cyclic testing procedures and other time-duration work. Alternatives to the use of RCDs may need to be considered in these situations. The use of dedicated RCD protected circuits can reduce the likelihood of such failures. Monitoring of devices can provide early warning of failures. Alternatives, such as transformer isolation can be considered (AS/NZS 3000).

### 2.9.8 Experimental equipment

The designer and builder of experimental equipment shall ensure that, as far as is practicable, the equipment is safe when used for the intended purpose. Live parts should be enclosed or otherwise protected against inadvertent contact. Where repeated access to these parts is required for monitoring purposes, and where laboratory electrical circuits are not RCD protected, supplementary equipment such as RCDs and isolating transformers shall be used, and warning signs shall be displayed.

A special check of safety features is necessary where experimental apparatus has undergone evolutionary development, as safety may have been overlooked in the search for functional improvements. The following should be observed when designing and building experimental equipment:

(a) Provide protection against electric shock by use of an RCD or isolation transformer.

(b) Ensure that all wiring and components are adequately rated for expected current, voltage, temperature and humidity.

(c) Bond all exposed metal into electrical continuity and connect to a marked earth terminal.

(d) Energize the equipment through a control switch operating in all live conductors to minimize the effect of unconventionally wired plug sockets.

(e) Incorporate a pilot lamp to show when equipment is energized.

(f) Provide a protection device for each piece of equipment. A breakdown in equipment with a normally low-current drain should be sufficient to blow the supply fuse or operate the circuit breaker.

(g) Mark equipment with its rated voltage and wattage.

(h) Always have an up-to-date circuit diagram of the equipment.

(i) When a number of single-phase power supplies are connected to experimental equipment or apparatus, the potential will be raised to 415 V if the supplies are connected to different phases. This should be factored into safe equipment design and insulation requirements.

### 2.9.9 Live unattended equipment

If experimental equipment is to be left running unattended for long periods, a notice marked "PLEASE LEAVE ON" shall be displayed. It should give details of any immediate emergency action which could be taken and include at least two emergency telephone numbers and be signed by the person responsible for the experiment. The following additional safety measures should also be taken:

(a) Provide for the isolation of all power to the equipment with one clearly marked switch, or push-button operated shunt-trip circuit-breaker.

(b) Monitor critical parameters such as voltage, pressure, liquid level, temperature. Design the control circuit to disconnect the supply automatically if any one of these goes beyond predetermined limits.

(c) Fit thermostatically controlled equipment with manually resetting over-temperature switches set to operate at slightly above the upper limit of the controlled temperature. Liquid level controllers may also require controls, set to operate just outside the automatically controlled limits, to be reset manually.

(d) Install the experiment in an area monitored by the laboratory fire-protection system. It should be noted that the interiors of fume cupboards are not usually covered by the fire-protection system (see AS 2243.8). A considerable time could elapse before fire in a fume cupboard is detected by the sensors or sprinkler heads in the laboratory.

### 2.9.10 Electrophoresis apparatus

#### 2.9.10.1 General

Electrophoresis techniques use power supplies capable of supplying high voltages of up to 5000 V at currents capable of causing injury and fatality. Using these supplies with aqueous solutions requires care and a thorough knowledge of electrical safety.

#### 2.9.10.2 Power supply units

Power supply units for electrophoresis apparatus shall provide the following:

(a) Automatic shutdown if earth leakage is detected by the supply unit (where laboratory electrical circuits are not RCD protected).

(b) Overload protection to protect the supply unit.

(c) Safety interlocks to shut off power if —

(i) the electrophoresis cell is opened;

(ii) apparatus plugs are removed; or

(iii) the cell cooling system fails.

The following requirements apply to the use of power supply units:

(i) Power points shall be earthed.

(ii) Cooling air inlets and outlets shall not be obstructed.

(iii) Dust filters shall be cleaned or replaced regularly.

(iv) The supply unit shall be used within the manufacturer's specifications of temperature and humidity. Sufficient time shall be allowed for the power supply to equilibrate when the unit is moved from a cold location to a location at a substantially higher temperature.

#### 2.9.10.3 Connecting cables

The cables, connectors and fittings connecting the power supply unit to the electrophoresis cell shall be capable of withstanding the maximum voltage which the power supply unit can provide. Substitutions shall be made only by suitably qualified personnel who have been made aware of the voltage used. The cable connecting the power supply unit to the electrophoresis cell shall be inspected regularly for damaged insulation and faulty connectors.

#### 2.9.10.4 Electrophoresis cell

The design of the electrophoresis cell shall be such that the high-voltage supplies are disconnected when the cell is opened. A warning label denoting "DANGER HIGH VOLTAGE" shall be attached to the cell body or cover.

High-grade insulation is necessary between the cooling system and the cell for the earth-leakage detection system to work. Damaged cells or cell covers shall not be used.

#### 2.9.10.5 Electrolysis effects

During operation, hydrogen and oxygen gases are likely to be produced by electrolysis. Depending on the strength of the electric current, the duration for which the current is applied, and the sealing of the cell, an explosive atmosphere may build up in the cell. Care should be taken to ensure that the power is turned off before the cell is opened, as the gas mixture may be ignited by sparking. The evolved gases may carry the solution from the cell as an aerosol, which may cause a hazard if the solution is toxic.

## Section 3 Laboratory safety and emergency management

### 3.1 Laboratory safety management systems

#### 3.1.1 General

To manage occupational health and safety in a laboratory, laboratory safety systems shall be implemented. A laboratory safety system shall address the assessment and management of all risks and the provision of training, including hazard identification, for personnel. This system shall also address access to, and operations in, the laboratory pertaining to students, maintenance staff, contractors, visitors (including children), cleaners, security staff and animals (experimental and companion).

#### 3.1.2 Risk assessment

Risk assessments of all operations in the laboratory shall be carried out. Risk assessment can be described as a systematic use of the available information to identify hazards and to estimate the risks to staff, property or the environment and to take appropriate steps to avoid or mitigate identified consequences of those risks. For further information on risk identification, control and management see AS/NZS 4801.

When controlling risks, the most effective control measures available should be chosen in order of effectiveness. The hierarchy of controls is as follows:

(a) Elimination of hazards from the laboratory.

(b) Substitution of a substance or process to reduce the risk.

(c) Isolation of the hazard to control the risk.

(d) Application of engineering controls, for example local exhaust ventilation to contain or minimize exposure.

(e) Adoption of safe work practices, including changes to work methods, which minimize exposure.

(f) Where other effective means to control the hazard are not practical, use of suitable personal protective equipment.

NOTE Reducing the scale of the experiment is an important and effective control.

As part of the risk assessment, the information contained in various regulations and accompanying codes of practice and the other Parts of this series shall be considered in areas such as chemical safety, manual handling, and plant and equipment safety. Tasks shall be assessed for performance during normal working hours and outside of normal working hours, as the risk is often increased out of hours when the availability of emergency personnel is reduced. Security requirements for the laboratory's activities shall also be considered with respect to access to the laboratory area.

Within particular industries there may be existing methodology together with control levels that apply to the operation of these assessments.

NOTE: Refer to relevant national, state and territory guidance on risk assessment procedures.

In all cases, documentation of risk assessments should be kept

NOTE Refer to relevant national, state and territory legislation on records management.

### 3.1.3 Management system components

#### 3.1.3.1 General

The key components of a laboratory safety management system listed in Clauses 3.1.3.2 to 3.1.3.6 shall be addressed and the resultant procedures implemented.

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

#### 3.1.3.2 Training and induction

Key components in this area are as follows:

(a) Procedures for the systematic induction of all persons with access to the laboratory shall be implemented and shall ensure they are aware of the provisions and procedures for laboratory safety and that they are trained in the use and maintenance of appropriate personal protective equipment.

NOTE This may include awareness of relevant legislation.

(b) Laboratory staff shall be trained in the safe handling and use of chemicals, electrical apparatus and equipment.

(c) Laboratory staff shall be trained in procedures to be adopted in emergencies, including a procedure to ensure the complete evacuation from the laboratory of all staff and visitors.

(d) The training provided shall be documented and records of such training shall be maintained.

NOTE: Refer to relevant national, state, and territory regulations.

### 3.1.3.3 Safe operation

Key components in this area are as follows:

(a) Procedures for the safe operation of all laboratory activities, including plant and equipment (see AS 2243.6) shall be established and maintained.

(b) A review of the risk assessment shall be carried out when new chemicals or methods are introduced, or when the function of the laboratory compartment is changed and safety procedures shall be updated as required.

(c) Arrangements shall be made for the safe operation of unattended equipment at times of reduced staffing or outside normal working hours.

(d) A procedure shall be established to ensure the safe collection, identification, storage and disposal of laboratory wastes.

(e) Personnel shall be made aware of any special facilities or procedures required for waste disposal.

(f) Laboratory staff shall be made aware of the hazardous nature of the materials and instruments with which they work. (Information on materials can be obtained from sources such as Safety Data Sheets, instruments manufacturers' literature and instruction manuals).

(g) Suggestions for improvements to laboratory safety made by the staff and any actions taken in response to them shall be recorded.

(h) Health surveillance shall be conducted and records maintained.

(i) Appropriate shut down procedures shall be developed.

(j) Appropriate clean-up and decommissioning procedures shall be developed, as required.

### 3.1.3.4 Emergency preparedness

Key components in this area are as follows:

(a) Procedures shall be established for the safe shutdown of all laboratory equipment in the case of an emergency.

NOTE Procedures should be in a "step-by-step" format, and should be displayed prominently alongside the relevant laboratory equipment.

(b) First aid arrangements appropriate to the needs of the laboratory shall be organized.

NOTE Reference should be made to national, state and territory legislation for first aid treatment in the workplace.

(c) A suitable manual outlining emergency and safety procedures, including spill management, exposure to hazardous chemicals, dealing with electric shock and a procedure for evacuating the building shall be made available. The procedures shall ensure the locations and movements of people are readily identified for emergency purposes (see also Clause 3.2). Regular rehearsals of emergency procedures shall be conducted using emergency equipment.

### 3.1.3.5 Safety equipment

Key components in this area are as follows:

(a) All safety equipment shall remain accessible to laboratory personnel at all times. The equipment shall be regularly checked and maintained in working order.

(b) Requirements for clothing, apparel (e.g. jewellery), hairstyles and footwear worn by laboratory personnel compatible with safe working practices shall be prepared and implemented.

(c) Protective clothing and safety equipment shall be provided for laboratory personnel and visitors.

NOTE The requirements for visitors may vary depending on the activities and risk exposure.

#### 3.1.3.6 Information management and review

Key components in this area are as follows:

(a) Subsequent reviews of the risk assessment for all laboratory activities including materials used shall be undertaken.

NOTE A review may be necessary where changes occur in procedures, materials or staff.

(b) Safety information shall be provided by effective means, e.g. noticeboards, websites or pamphlets. The information shall be regularly reviewed and replaced, if necessary, to ensure that it is current.

(c) Records of laboratory accidents and incidents, and the follow-up procedures taken, shall be maintained.

### 3.1.4 Working in isolation

The occupational hazards of working in isolation are the same as those associated with any other work, but the consequences of incidents are likely to be more severe.

All tasks to be carried out while working in isolation shall be subject to a risk assessment. This assessment shall also consider the experience, fitness and training of the individual involved in the planned work and the availability of emergency response. Additional training and instruction may be necessary before a particular individual commences working in isolation.

Where the risk assessment identifies high risk, these tasks shall not be undertaken by personnel working in isolation. This also applies to contractors, visitors or students.

NOTE 1 Examples of activities that may be high risk are given in Appendix B.

NOTE 2 Some tasks, by legislation, are not permitted to be carried out alone at any time. Specifically this includes entry to confined spaces.

Personnel who have any medical condition that can give rise to a dangerous or lifethreatening situation when working in isolation should notify their supervisor of their condition.

Personnel who work in isolation shall be provided with a means of summoning help and such summons for assistance shall be monitored by appropriate means at all times when such work is in progress.

## 3.2 Fire, emergency and rescue procedures

### 3.2.1 General

Fire and other emergencies in a laboratory building call for prompt action. Emergency procedures which are effective for fire evacuation can also be effective in the event of leaks of toxic gases and similar situations. Supervisors should be aware of the movements of staff and visitors in their respective areas.

Safety information and emergency procedures shall be made available. Procedures for dealing with foreseeable emergencies shall be prepared and distributed

NOTE 1 For Australia, see AS 3745 and for New Zealand see the fire safety and evacuation requirements in the Buildings Regulations 1992 and Responsible Care New Zealand Emergency Preparedness.

NOTE 2 The information and procedures should be prominently displayed at all times. Emergency procedures should be posted in each laboratory and should provide telephone numbers of —

(a) fire brigade;

(b) ambulance;

(c) safety officer;

(d) hospital; and

(e) police.

NOTE 3 A list containing current names, addresses and telephone numbers of local medical practitioners, hospitals, the poison information centre and other emergency services should be kept readily accessible. National Poisons Information Centres exist in both Australia and New Zealand.

### 3.2.2 Primary emergency procedure

To prevent injury and limit the spread of the hazard, the emergency procedure shall include the following instructions:

(a) Alert emergency services and personnel in the immediate vicinity.

(b) Confine the fire or other source of danger, if practicable without endangering personnel, to gain time for evacuation and to limit the extent of the damage.

(c) Summon other aid as required.

(d) Evacuate the building if necessary, making provision for injured personnel.

### 3.2.3 Evacuation of the building

Civil disturbances, power failure to essential equipment, large spills of chemicals, fires and leaking cylinders of toxic or corrosive gases are examples of emergencies which can require rapid evacuation of the building. The procedures shall ensure that all visitors and occupants of the laboratory are safely evacuated. On evacuation of the building, personnel should be moved to a designated assembly area away from the building.

## 3.3 Safety inspections

Safety inspections to identify hazards and review practices shall be carried out at regular intervals and whenever any significant change is made to the work procedures or equipment in the laboratory to improve and maintain a safe environment. The inspection team should incorporate independent personnel.

Findings and recommendations arising from safety inspections shall be reported to the appropriate personnel. If the safety inspection uncovers a situation that places an employee at significant risk, immediate action shall be taken to remedy the situation.

# Section 4 General safety procedures

## 4.1 Requirements for safe conduct

Safety in the laboratory depends upon personnel achieving a recognized standard of behaviour. Personnel who have medical conditions that can affect their ability to work safely within the laboratory's procedures, or that can contribute to increasing the hazardous nature of the situation should report this to the appropriate person. The following requirements shall apply to all personnel who use or enter the laboratory:

(a) Always adopt an alert attitude and be conscious of potential hazards.

(b) Always report hazards, faults, incidents and injuries to the appropriate person.

(c) Ensure that personal clothing is suitable to laboratory conditions, e.g. non-slip, closed-in footwear. Do not wear open-toed shoes in the laboratory.

(d) Use protective clothing and devices appropriate to the type of operation being carried out.

(e) Secure long hair to keep it out of moving equipment. Do not apply cosmetics or handle contact lenses in the laboratory and only wear jewellery that either cannot be caught in equipment or contaminated by infectious substances or chemicals, or is protected from these hazards.

(f) Do not run in the laboratory or in corridors.

(g) Do not indulge in reckless behaviour in the laboratory.

(h) Always exercise care when opening and closing doors and entering or leaving the laboratory.

(i) Do not handle, prepare, store or consume food or drink for personal consumption in the laboratory.

NOTE Refrigerators, freezers, ovens and microwave ovens used in the laboratory should be labelled to prohibit their use for food or drink for personal consumption.

(j) Do not store food or drink for personal consumption in a refrigerator, freezer or cupboard which is used to store laboratory materials.

(k) Do not smoke within the laboratory or associated storage areas.

(l) Regard all substances as hazardous unless there is definite information to the contrary.

(m) Do not undertake any work unless the potential hazards of the operation are known as accurately as possible, and the appropriate safety precautions, including containment, are adopted.

(n) Only carry out work in isolation in a laboratory in accordance with Clause 3.1.4.

(o) Always use safety carriers for transporting chemicals in glass or plastic containers with a capacity of 2 L or greater. Do not carry containers of mutually reactive substances at the same time. Use measures such as enclosed containers or secondary containment when carrying materials.

(p) Keep only the minimum required quantities of chemicals in the laboratory work area.

(q) Wash skin areas which come in contact with chemicals, irrespective of concentration. Wash hands upon leaving the laboratory.

(r) Practise good housekeeping, e.g. immediately cleaning up spills and disposing of wastes including packaging.

(s) Keep all fire-escape routes completely clear at all times.

(t) Label all safety equipment and maintain it in good operating condition. Check and inspect safety equipment for correct operation in accordance with the manufacturer's instructions and report, in writing, any requirement for maintenance.

(u) Dispose of specialized wastes (e.g. broken glassware, syringe needles, biological and radioactive substances) in containers designated for the particular type of waste.

## 4.2 Use of personal protective equipment (PPE)

### 4.2.1 General

A risk assessment in conjunction with information from relevant SDSs and other Parts in the AS/NZS 2243 series shall determine what PPE is required. Typical PPE worn in a laboratory may include clothing (see Clause 4.2.2), protective eyewear (see Clause 4.2.3) and closed shoes (see Clause 4.2.6).

PPE should not be a substitute for implementing a safe system of work or for using higher level risk controls.

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.

NOTE Specific PPE and equipment is required by New Zealand *Hazardous Substances and New Organisms Act 1996* and regulations.

### 4.2.2 Clothing

Laboratory personnel shall use the protective clothing appropriate to the task being undertaken. To reduce the risk of contamination of non-laboratory areas, safety clothing and equipment should be removed on leaving the laboratory.

The use of long-sleeved cotton or cotton/polyester laboratory coats, wrap-around, back-opening gowns or boiler suits is recommended for general laboratory work. The use of quick release textile fastenings is recommended for wrap-around laboratory gowns. Care should be exercised in the choice of the garment material. Nylon is not recommended because it is easily destroyed by heat or acid. Many synthetic fibres offer poor protection against liquids which can pass through the fibres with little or no absorption. In a fire, synthetic textiles tend to melt and cause burns to the body. Consideration should also be given to any static electricity hazard produced by synthetic clothing. Impervious materials offer better protection when using cytotoxic substances.

NOTE Protective clothing should not be laundered domestically.

### 4.2.3 Eye and face protection

Eye protection shall be used in laboratories where there is a risk of damage to the eyes or contamination to the body through the eyes. When considering sources of damage, include mechanisms such as impact, splashing of liquids, foreign particle entry and radiation. Eye protection shall be selected and used in accordance with AS/NZS 1336, AS/NZS 1337.1 and the AS/NZS 1338 series. Specialized eye protection (e.g. wrap-around safety glasses or goggles) shall be worn when a risk of splashing exists and there is a risk of damage to the eyes or contamination to the body through the eyes.

The wearing of contact lenses or prescription spectacles cannot be considered under any circumstances to be a substitute for normal eye safety protection. Contact lenses can increase the risk of eye damage when dust or harmful liquid or vapours enter the eye. Prescription spectacles (as distinct from prescription eye protectors) are generally inadequate against flying objects or particles and could even be hazardous.

For persons requiring eye protection in addition to sight correction, prescription eye protectors can provide low impact protection, overglasses, goggles or face shields (as appropriate) can be worn over normal prescription spectacles or the appropriate eye protectors can be worn over contact lenses.

Face protection, i.e. a face shield, should be used —

(a) where glass apparatus is evacuated, recharged with gas or pressurized;

(b) when pouring corrosive liquids;

(c) when using cryogenic fluids;

(d) when combustion processes are being carried out;

(e) where there is a risk of explosion or implosion;

(f) when using chemicals that can cause direct damage to the skin; and

(g) when using chemicals and biological agents that can be rapidly absorbed into the body via any path, e.g. through the skin, eyes or nose.

For some tasks, a face shield with a brow guard, chin guard or both, incorporated should be used. The level of protection chosen shall take into account any eye and face hazards from other work being carried out in the vicinity that could affect the worker at the distance by which the operators are separated.

### 4.2.4 Hearing protection

Hearing protection shall be worn when noise can damage or impair hearing. Further information on hearing protection is provided in AS/NZS 1270. An example of a noise source in a laboratory is ultrasonic cleaning apparatus. For further examples, see AS/NZS 2243.6.

### 4.2.5 Gloves

Gloves of suitable material, length and weight are essential for some laboratory operations, e.g. handling of cryogenic substances. In pathology, microbiology and biochemistry laboratories, gloves are the primary barrier to possible infection when handling biological materials. Gloves can also act as a temporary barrier to dermatitis sensitizers, and can be an effective barrier against dust and fibres. Barrier creams can provide adequate protection in certain circumstances; however, they should not be used as a substitute for glove protection. For information on the selection of gloves for particular hazards, see the relevant SDS and manufacturers' permeation breakthrough charts, in conjunction with the AS/NZS 2161 series.

NOTE Allergic reactions such as dermatitis and immediate hypersensitivity have been reported in laboratories where other workers are wearing latex gloves, particularly those with powder. Alternatives such as powder-free latex, nitrile or vinyl gloves should be used if problems occur.

### 4.2.6 Safety footwear

Where specific safety footwear is required for a particular hazard, it shall be selected in accordance with the AS/NZS 2210 series.

### 4.2.7 Respiratory protection

Where hazardous dusts, mists, fumes and vapours are present in the laboratory, respiratory protective devices shall be selected and used in accordance with AS/NZS 1715 and AS/NZS 1716. Where a process requires the continued (day-to-day) use of respirators, the process should be modified to minimize or eliminate the respiratory hazard.

### 4.2.8 Safety helmets

Wherever there is a danger of falling objects or impacts to the head, safety helmets in accordance with AS/NZS 1801 shall be selected, used and maintained in accordance with AS/NZS 1800.

NOTE Safety helmets have a limited working life.

### 4.2.9 Other personal protection

If additional personal protection, e.g. boots, leggings, aprons, jackets, spats or elbow-length gloves, is required for certain hazardous processes (e.g. when sampling from tanks or handling hazardous materials) it shall be made available.

## 4.3 Containers for substances

### 4.3.1 General

The material of construction and the labelling and volume of containers for substances have a significant bearing on the prevention of laboratory incidents. Where substances are poorly or incorrectly labelled, they shall be relabelled. Labelling requirements are set out in national, state and territory regulations and the GHS. Provision should be made for the systematic review of stocks of substances. Where the stocks are old or unstable, e.g. peroxide forming chemicals, disposal may be necessary.

### 4.3.2 Materials of construction

The materials of construction of containers shall be compatible with the substance contained. Because of its inertness, glass is the generally accepted material for containing most substances. However, metal or plastic containers may provide greater protection from breakage or mishandling. Over time containers can become brittle and the contents may need repacking. Where substances require repacking, care shall be taken to ensure that the new container is compatible. Special safety cans are available for flammable solvents.

### 4.3.3 Labelling

Safety labels and signs shall be used for the clear identification of substances.

NOTE Refer to national, state or territory regulations and GHS requirements.

### 4.3.4 Volume, quantity and storage

The volume of individual containers, the total volume of substances retained and their segregation in the laboratory, shall be in accordance with AS/NZS 2243.2.

## 4.4 Use of local exhaust ventilation (including fume cupboards)

### 4.4.1 General

There are many types of local exhaust ventilation systems (see Clause 2.7).

Personnel shall be aware of and adopt the proper procedures for the use of local exhaust ventilation and the hazards associated with their work.

### 4.4.2 The use of fume cupboards

The use of fume cupboards shall be in accordance with AS/NZS 2243.8. The following recommendations should be observed:

(a) Excess materials and containers should not remain in the fume cupboard during experimental work. If it is essential that materials be retained, they should not present a source of danger.

(b) When a shared facility is being used, a reservation notice and, if necessary, a warning notice of any danger should be displayed.

(c) When an experiment is complete, the equipment should be cleaned and the cupboard left clear for the next experiment.

Fume cupboards shall not be used as storage facilities for hazardous materials. Laboratories should install a separate ventilated storage cabinet where volatile corrosive substances can be stored separate from flammable substances. Oxidative corrosive chemicals and organic materials shall not be stored together; it is dangerous to allow fumes from these classes of materials to mix.

All fume cupboards shall be maintained in good working order and their condition and operation shall be checked periodically in accordance with AS/NZS 2243.8. In New Zealand, operational fume cupboards require a compliance certificate in accordance with the Building Act 2004. Prior to turning off the fume cupboard fan, a thorough check should be carried out on the type of work being performed in the fume cupboard and the essential services (i.e. water, electricity) that the work requires.

#### 4.4.3 The use of biological safety cabinets

The use of laminar-flow cabinets and biological-safety cabinets shall be in accordance with AS 2252.1, AS 2252.2 and AS/NZS 2647.

#### 4.4.4 The use of cytotoxic drug safety cabinets

Cytotoxic drug safety cabinets shall be installed and used in accordance with AS 2252.5.

#### 4.4.5 The use of recirculating fume cabinets

The use of recirculating fume cabinets and their testing shall be in accordance with AS/NZS 2243.9.

### 4.5 General laboratory practices

#### 4.5.1 Handling of glass

Manipulation of glass is the cause of many injuries in laboratories. Glass should only be used where safer materials or work practices are not practical. In addition to the wearing of appropriate PPE, the following procedures should be observed:

(a) Dispose of broken glassware in a container reserved and labelled specifically for the purpose, ensuring any contamination hazard is taken into account.

(b) When inserting pipettes into pipette holders, hold the pipette close to the insertion end.

(c) Care should be taken when cleaning or drying glassware.

(d) If it is necessary to remove sharp edges of glass that often protrude from freshly broken surfaces, heat the broken surface in a flame until the surface is rounded. Ensure there is no residual volatile chemical on or in the glassware.

(e) Avoid carrying long lengths of glass tubing.

(f) To break glass tubing, a rod or a vial, hold it in a cloth with thumbs on both sides of a score mark made by a sharp file or glass-cutter and break it by snapping it away from the body. Large diameter tubing can be cracked by placing a red-hot rod or wire on a score mark that rings the tube.

(g) If glass tubing or rod is to be passed through a bung, lubricate the glass before insertion. The bung should never be held in the palm of the hand while inserting the tube. If any significant force is required to push the tube through the bung, the hole should be enlarged.

#### 4.5.2 Stirring

Wherever possible, a magnetic stirrer should be used in preference to manual or fixed shaft stirring. When using a magnetic stirrer, the speed control should be set at the low-speed position before switching on the stirrer.

Magnetic coupling devices are available for operating a stirrer shaft in a closed vessel. Turbine stirrers driven by compressed air or vacuum are recommended for use where a spark-free environment is required.

### 4.5.3 Use of flexible tubing

Flexible tubing shall only be selected where it is appropriate to the function. Rubber and plastic tubing shall be checked periodically for cracks, hardening and other damage. Reinforced tubing should always be used where the tubing is to be exposed to vacuum or pressure. Tubing to any supply service should be secured by appropriate hose clips. Flexible tubing should only be removed from glassware by cutting. When assembling apparatus, lengths of tubing should be kept to a realistic minimum.

NOTE The use of plastic tubing is preferred over rubber for the attachment of laboratory services, as it is less liable to perish.

### 4.5.4 Pipetting

Pipetting by mouth shall be prohibited. A suction device, automatic pipette or other safe means of pipetting shall be used.

Consideration shall be given to the repetitive nature of some pipetting work and controls shall be implemented.

NOTE See also Clause 4.5.1(b).

### 4.5.5 Solvent extraction

Extractions that may release quantities of flammable vapours shall be performed in well ventilated areas where the electrical installations conform to AS/NZS 2430.3.6.

Extractions using organic solvents, which are carried out in separating funnels, often lead to an increase in pressure when the solvents are shaken together. Any pressure should be released at frequent intervals by inverting the funnel with the stopper securely held, and opening the tap cautiously, with the funnel stem pointing in a safe direction.

### 4.5.6 Operations involving compressed and liquefied gases

Commercially-supplied cylinders of compressed and liquefied gases connected to equipment being used within the laboratory shall be secured in the upright position unless contrary advice has been received from the supplier. When not connected for use, gas cylinders shall be stored outside the laboratory building in a ventilated housing in an upright position, unless contrary advice has been received from the supplier. Adequate precautions shall be taken to protect cylinders, valves and reticulation lines from mechanical damage and external sources of heat. Oxygen depletion through displacement of air by released gas can cause asphyxiation, even if the gas is not very toxic. Detailed information on the storage and handling of gas cylinders is given in AS/NZS 2243.2, AS 2243.6 and AS 4332.

Where filling and maintenance of cylinders is conducted in the laboratory, the AS 2030 series should be consulted.

### 4.5.7 Operations involving cryogenic liquids

Oxygen depletion through displacement of air by released gas can cause asphyxiation, even if the gas is not toxic. Liquid or low temperature gas from any cryogenic substance can produce an effect on the skin similar to a burn.

The handling of cryogenic liquids shall be carried out in accordance with AS/NZS 2243.2 or AS 1894, as appropriate. For biological applications, AS/NZS 2243.3 should be consulted. Large cryogenic vessels should be transported on a stable trolley designed to hold them securely in position during transit, and to permit easy and safe loading and unloading.

### 4.5.8 Use of fail-safe devices

The fitting of fail-safe devices designed to cut off gas, water or electricity services, decreases the risk of fire, explosion and property damage. In addition to the fail-safe devices fitted for reticulated

services and residual current devices for electrical services, examination of apparatus and procedures to be used shall be undertaken to determine if other situations require fail-safe devices. Examples of situations when additional fail-safe devices may be required are as follows:

(a) A thermal relay should be fitted to switch off the power in the event of a temperature control failure.

(b) A thermal relay or a pressure or flow switch should be available to cut the power supply to a distillation in the event of condenser cooling-water flow failure.

(c) A means of cutting off the supply of a reactant should be fitted where there is a possibility of the reaction getting out of control.

(d) An external safety thermostat should be fitted to laboratory ovens to minimize the consequences of failure of the internal thermostat.

(e) A bursting disc or vent with appropriate discharge should be installed on apparatus which is operated under positive pressure.

### 4.5.9 Use of ultraviolet lamps, arcs, and high-intensity sources

Ultraviolet lamps and other high-intensity light sources, such as lasers and welding, may cause eye damage. Infrared heat lamps can also cause burns. Preference shall be given to suitable enclosure of the source. Suitable eye protection (see AS/NZS 1337.1 and AS/NZS IEC 60825.1) and skin protection shall be worn by any person exposed to such radiation. Care should also be taken to avoid reflected rays. Appropriate warning signs shall be displayed at the entrance to the laboratory indicating the type of radiation hazard present. In addition, a warning light (preferably wired to the on-switch circuit of the instrument) should be installed at the entrance to the laboratory. See also AS/NZS 2243.5.

### 4.5.10 Handling of human biological material

Human body fluids and tissues (e.g. urine, blood, skin samples) can be infected with pathogenic microorganisms, and the risk of infection should be recognized and appropriate precautions followed. It is essential therefore to institute adequate preventative, handling decontamination, disposal and medical management procedures (see AS/NZS 2243.3).

### 4.5.11 Handling of cytotoxic drugs

Some cytotoxic drugs have been demonstrated to be mutagenic and carcinogenic. Particular care is required in the handling, preparation and use of these substances. Before these substances are introduced into the laboratory or working environment, procedures shall be established to ensure the safety of all personnel. In Australia, consult local authorities before handling cytotoxic substances. In New Zealand, consult the guidelines for the safe handling of cytotoxic drugs and related waste.

### 4.5.12 Temperature measurement

Other temperature measurement methods should be considered in place of the use of mercury thermometers. Electronic thermometers, sometimes referred to as dial thermometers, should be used in place of mercury thermometers in laboratory ovens and incubators.

## 4.6 Operation of instruments

Recommended procedures for the safe operation of laboratory instrumentation are described in the following relevant Standards:

(a) For flame atomic absorption spectrometry, see AS 2134.1.

(b) For graphite furnace atomic absorption spectrometry, see AS 2134.2.

(c) For vapour generation atomic absorption spectrometry, see AS 2134.3.

(d) For arc/spark atomic emission spectrometry, see AS 3641.1.

(e) For inductively coupled plasma spectrometry, see AS 3641.2.

(f) For glow discharge mass spectrometry (GD-MS), see AS 3685.

(g) For ion chromatography, see ASTM E1151-93.

(h) For UV-visible spectrophotometry, see AS 3753.

(i) For packed column chromatography, see ASTM E260-96.

(j) For infrared spectrophotometry, see ASTM E168-16.

(k) For X-ray analysis equipment, see AS 2243.4, ARPANSA RHS No. 9 and NZ Ministry of Health, CSP17.

(l) For robotic equipment, see AS 2939 and AS 4024.3301.

## 4.7 Operations under vacuum

### 4.7.1 Vacuum distillation and evaporation

The vacuum distillation and evaporation of organic liquids is often carried out using a water pump or rotary oil pump. In either case, a trap and a non-return valve should be placed between the pump and the apparatus to avoid the danger of sucking water or oil back into the apparatus. A safety screen should be installed to protect the operator. While the apparatus is in use, it should not be left unattended.

The use of a slow nitrogen purge during the distillation process can be beneficial to remove solvent and control bumping of the flask's contents.

### 4.7.2 Use of vacuum pumps

Electric motors, and heating elements of mercury diffusion or oil pumps, can act as ignition sources for flammable vapours, both inside and outside a vacuum system. Effluents from the pumps shall be appropriately vented to the outside air.

### 4.7.3 Use of traps

In vacuum systems, traps are used —

(a) to prevent foreign substances entering the pump; and

(b) to prevent water and oil (from the pump) entering the apparatus.

The following coolants are commonly used in traps:

(i) Cold water.

(ii) Brine.

(iii) Solid carbon dioxide.

(iv) Solid carbon dioxide in acetone.

(v) Liquid nitrogen.

A hazard can arise where the coolant becomes depleted and the condensed gas is warmed by the atmosphere. The volume of gas produced by the volatilization of the trapped substances is often far greater than the available volume within the trap; the gas will escape through any manometer, by blowing out the key of a tap or by bursting the vessel.

The level of coolant surrounding the trap should be carefully monitored, as a general purpose dewar flask seldom holds its charge of coolant for more than 24 h.

During operation, the contents of the trap should be monitored regularly, to ensure that dangerous substances do not accumulate to such an extent that some leakage to the pump or laboratory can occur. The pump should be cleaned and emptied after use. Where this involves handling of cryogenic fluids, see Clause 4.5.8.

### 4.7.4 Closing down vacuum experiments

A procedure should be established for safely returning the pumping system and vacuum apparatus to atmospheric pressure. A vacuum apparatus can be returned to atmospheric pressure by increasing the nitrogen purge rate to the system, where a nitrogen purge is fitted.

### 4.7.5 Filtration

Filtration of flammable liquids under vacuum will release vapours which can ignite if a source of ignition is present. Therefore, vacuum filtrations of flammable liquids shall not be carried out in the vicinity of any source of ignition.

### 4.7.6 Vacuum glassware

#### 4.7.6.1 Safety aspects

Operations which are carried out under vacuum should be shielded to minimize injury to the operator and those in the vicinity of the apparatus. If the apparatus is unshielded or shields need to be removed at times, additional PPE shall be worn. Use of specialized vacuum equipment, e.g. electron microscopes or vacuum coating equipment, shall be in accordance with the manufacturer's instructions.

#### 4.7.6.2 Assembly of apparatus

Only glassware designed for vacuum operations shall be used. All glassware shall be checked to be free of damage prior to use and general purpose glassware, e.g. flat-bottomed flasks, shall not be used. Standard glass joints should be used in the assembly of a temporary system. Dry cone-and-socket joints tend to stick and seal poorly. Ball-and-socket joints can be used where some flexibility or ease of adjustment is required. If grease is incompatible with the process, the use of polytetrafluoroethylene (PTFE) sleeves in the joints is recommended.

#### 4.7.6.3 Repair

Repairs to glassware for use under vacuum shall only be carried out by a competent glassblower. All vapours and traces of materials used in the apparatus shall be removed prior to it being sent for repair. Sections of the apparatus in which radioactive materials have been used should be replaced, not repaired.

#### 4.7.6.4 Implosion protection during use

Vacuums achieved by a water pump or a rotary oil pump can cause implosion of glassware. Glass round-bottom flasks, vacuum desiccators and dewar flasks should be taped, netted or boxed to guard against damage on implosion during use.

#### 4.7.6.5 Mercury-filled manometers

Quickly flowing mercury in a vacuum apparatus strikes bends or top surfaces with considerable force, which may break glassware. The rate of movement of mercury within apparatus should be controlled by careful use of the taps or by inclusion of restricting capillaries. Mercury-filled manometers should be rotated slowly, to minimize dispersion of the liquid in the apparatus.

## 4.8 Operations under internal pressure

Where installed, containers and glass apparatus that either operate under positive pressure or may be subject to a rise in pressure (e.g. from a chemical reaction), should be fitted with a means of pressure relief. An assessment of the need to install a safety valve, bursting disc or vent should be made in each individual case. Glass vessels that are heated to produce high pressure reactions should be enclosed in steel tubes, and carefully cooled before opening. Gases under pressure store a great quantity of energy compared with liquids. Failure of apparatus under gas pressure is therefore much more dangerous than failure under liquid pressure. Advice should be obtained before applying any internal pressure to an apparatus.

Where the apparatus is capable of being held under a pressure greater than atmospheric, the apparatus, including its safety devices, shall be designed and tested by a competent person in accordance with relevant Standards and regulations. Information on the installation of the apparatus and the provision of protective barriers should be obtained from a competent person.

## 4.9 Operations using microwave equipment

The equipment manufacturer's instructions shall be followed. See also AS/NZS 2243.5.

When using microwave equipment, the need for local exhaust ventilation should be assessed. The procedures for carrying out any heating or digestion tasks in a microwave oven should be carefully planned to ensure samples are not overheated (microwaves tend to heat materials more quickly than conventional heating methods) and any pressure build-up in the sample container or digestion vessel is dissipated safely.

Any potential for leakage of radiation due to damage, modification or ineffective sealing of microwave equipment should be investigated.

## 4.10 Handling, labelling and disposal of laboratory wastes

### 4.10.1 General

Training shall be provided to all personnel involved in the handling of laboratory wastes. This training shall include the use of appropriate safety equipment, the use of firefighting equipment and procedures for cleaning up spills of waste material.

NOTE Refer to national, state and territory legislation for the collection, labelling, storage and disposal of laboratory wastes.

### 4.10.2 Collection

Collection of laboratory wastes is an essential part of good housekeeping and should be carried out with minimal risk to laboratory personnel, waste collection staff or to the environment. When the laboratory waste is being transported through the laboratory area, consideration should be given to the need for particular safety equipment, e.g. a spill kit or an accessible fire extinguisher for flammable wastes. Following collection, chemical wastes shall be clearly identified, segregated and stored in labelled containers reserved and suitable for the purpose. See AS/NZS 2243.2.

### 4.10.3 Segregation

Laboratory wastes should be at least segregated into the following categories:

(a) Paper and plastics (see AS/NZS 2243.3).

(b) Broken glass (see Clause 4.5.1).

(c) Sharps, e.g. scalpel blades, syringe needles (see AS/NZS 2243.3).

(d) Chemical (see AS/NZS 2243.2).

(e) Biological (see AS/NZS 2243.3).

(f) Cytotoxic (see Clause 4.5.12).

(g) Animal carcasses (see AS/NZS 2243.3 and AS 2243.4).

(h) Radioactive (see AS 2243.4).

(i) Drugs of addiction.

Biological wastes should be handled in accordance with AS/NZS 2243.3. Each waste category should be clearly labelled with the identity and source (department or laboratory) of the waste.

Some mixed waste streams, e.g. biological and radioactive, infectious material and animal carcasses or cytotoxic material and animal carcasses, may not require segregation. However, an assessment of each situation shall be conducted before combining wastes prior to storage or disposal.

### 4.10.4 Transfer and storage

A collection depot should be set aside for the storage of laboratory wastes prior to their disposal. A responsible person shall be appointed to oversee the security of wastes at the depot and for the supervision of collection procedures carried out by the waste disposal contractor. Where flammable materials are stored, precautions shall be taken to eliminate sources of ignition in the area.

Where a risk of static electricity discharge exists during flammable liquids transfer, electrical earthing shall be provided. Ensure that there is good ventilation and that all sources of ignition have been removed from the area (refer also to AS 1940).

The collection depot should display the hazard warning signs appropriate to the type of material being stored. Safety equipment and spill kits (to be used in cases of waste spillage) should be maintained at the collection depot.

### 4.10.5 Disposal

Laboratory wastes shall be disposed of in accordance with AS/NZS 2243.2, AS/NZS 2243.3 and AS/NZS 2243.4.

Information and advice may also be provided by product suppliers, environmental service companies or waste disposal companies. Damaged gas cylinders shall be returned to the supplier.

NOTE 1 The disposal requirements of the waste authority, the environment protection authority and the health department need to be met. In Australia, imported biosecurity materials are required to be disposed of in accordance with the Department of Agriculture and Water Resources (DAWR). In New Zealand, the Hazardous Substances (Health and Safety Reform Revocations) Regulations 2017 need to be consulted.

NOTE 2 Users of imported biosecurity material should be familiar with the content of current guidelines available from the relevant regulatory authority websites.

## 4.11 Nanotechnology

All nanomaterials and nanotechnology processes shall be considered potentially hazardous unless evidence is obtained to the contrary. While the bulk form of a material may be non-hazardous, the nano form of the same material may have altered physical properties or toxicological profile, which could lead to it being hazardous. Work practices shall in accordance with AS/NZS 2243.2.

The health, safety and environmental hazards associated with each nanomaterial or nanotechnology process shall be identified and documented, and the risks shall be assessed and controlled.

## 4.12 Fieldwork

### 4.12.1 Scope

Fieldwork is an integral part of many teaching and research activities. It is important that all fieldwork activities are properly planned and managed in order to protect the health and safety of workers, and prevent harm to the environment. See BS 8848.

Fieldwork can be carried out in the following areas:

(a) *Metropolitan/Urban* Where standard public emergency services are available.

(b) *Rural/Regional* Where it may take more than half an hour to get medical aid to an injured or ill person.

(c) *Remote* Includes off road areas, rivers, inland waterways, estuarine and oceanic locations where there is very little traffic and telecommunications rely on very high frequency or satellite phones, where topographic features would make it difficult to summon assistance in an emergency or receive help.

(d) *Overseas* In or to a foreign country.

### 4.12.2 HSE risk management

All fieldwork hazards shall be identified, the risks assessed and the control measures documented, and shall include:

(a) list of hazardous chemicals and gases, radioactive sources, radiation equipment and biological agents;

(b) list of plant and equipment, including electrical devices;

(c) permits and approvals;

(d) work instructions;

(e) communication equipment and contact protocols;

(f) emergency plans including evacuation;

(g) first-aid and medical requirements;

(h) training and competence requirements;

(i) site decontamination and remediation requirements;

(j) working in isolation requirements; and

(k) records management.

### 4.12.3 Field trip plan

A field trip plan shall be developed for each field trip prior to the visit. The plan shall list:

(a) names of people on the field trip and their contact details;

(b) dates, location and intended route of travel;

(c) travel and transport details;

(d) call-in schedule;

(e) types of communication equipment taken on the trip;

(f) emergency and medical plans;

(g) plant and equipment details;

(h) permits and approvals, as required;

(i) personal safety and security arrangements; and

(j) site assessment.

NOTE See Appendix C for an example of a field trip plan.

Copies of the field trip plan shall be —

(i) taken with the field party;

(ii) provided to the base contact;

(iii) made readily available to involved managers; and

(iv) placed on record.

NOTE A base contact is a person or service provider appointed to answer the scheduled calls from the field team and to take initial action in the event of lost contact or an emergency.

### 4.12.4 Hazardous work

Appendix B lists high risk hazards which may be encountered by persons working in laboratories or in the field.

NOTE Refer to national, state and territory legislation for the transport of hazardous chemicals and waste on a field trip..

### 4.12.5 Communication

The method and frequency of communication with the field team shall be determined and implemented in response to the hazards associated with the field trip. The requirements are —

(a) an assessment of communication needs;

(b) a suitable and effective communication method or methods, between the field team and base contact that have a high level of reliability;

(c) a documented record of the communication equipment carried by the field team;

(d) an agreed regular contact schedule and emergency plans on what to do in the event of a missed call, or other emergency situation; and

(e) communication and emergency equipment such as satellite phones, mobile phones, radios, and distress beacons (for example Personal Locating Beacons (PLB)) shall be provided and maintained, as required.

### 4.12.6 Emergency plan

Organizations shall establish emergency plans detailing emergency response actions on what to do in the event of a missed call or other emergency situation and appoint appropriate people to support those conducting fieldwork.

Emergency plans shall include response processes for rescue, medical assistance, weather events, natural disasters and civil unrest.

First-aid kits shall be taken on field trips and shall be appropriately stocked and maintained.

### 4.12.7 Site environment

Fieldwork shall be carried out in a way which minimizes the impact on the site environment. This shall be achieved by —

(a) undertaking an environmental assessment as part of the trip risk assessment;

(b) ensuring permits and approvals are in place before the trip, as required; and

(c) removing, storing or handling rubbish and process and laboratory waste to minimize damage to the environment.

### 4.12.8 Training and induction

Key components of training and induction should include —

(a) competence of individual, in particular, to operate plant and equipment and conduct hazardous work;

(b) experience and training of individuals;

(c) requirement for specialist training, for example, fieldwork first-aid, diving certification; and

(d) fitness for work that may include specialist medical examination such as working at altitude.

### 4.12.9 Plant and equipment

(a) Equipment used for field work shall be fit for purpose and in good working order such that it shall remain operable for the duration required.

(b) Prior to the fieldwork, inspection of serviceability shall be conducted.

(c) Operating and repair instructions, spare parts and certificates shall be provided for equipment where required.

(d) Spare equipment, spare parts, alternative power and batteries, as required, shall be provided and maintained.

### 4.12.10 Transport and travel

Fieldwork transport and travel may involve vehicles, truck, motor bikes, caravans, boats and All Terrain Vehicles (ATVs).

The method and mode of transport and travel shall be risk assessed and include:

(a) vehicle suitability and safety;

(b) operator qualification and training;

(c) formal inspection and preventive maintenance schedule; and

(d) manufacturer's service schedule.

# Appendix A
(informative)

# Automatic fire detection or protection devices for hazardous areas

## A.1 Scope

This Appendix lists some hazardous areas which may require automatic fire detection or protection devices.

## A.2 Areas

The following hazardous areas are relevant:

(a) Flammable liquid storage, repackaging or dispensing rooms.

(b) Chemical storage rooms.

(c) Compressed gas of Classes 2.1 or 2.3 in cylinder storage or manifold rooms.

(d) General storage, equipment storage and cleaning supplies storage areas.

(e) Radioactive isotope storage or production areas.

(f) Mechanical equipment rooms, service areas and facilities, boiler rooms, electrical rooms, air-handling equipment, generator rooms and battery rooms.

(g) Vertical chutes, ducts, and pipe chases which pierce more than one floor.

(h) Horizontal concealed spaces that pass through fire walls.

(i) Laboratories in which pathogenic agents are handled.

(j) Laboratories below ground level, or without windows.

(k) Laboratories used for special hazard experimentation, such as hydrogenation, and for the use of explosive substances.

(l) Laboratories containing radiation-generating equipment, such as X-ray tubes.

(m) Others as required by local regulatory authorities.

# Appendix B
(informative)

# High risk hazards

## B.1 Scope

This Appendix lists high risk hazards which may be encountered by persons working in laboratories or in the field.

## B.2 High risk hazards

High risk hazards which may be encountered include the following:

(a) Operating equipment or machinery, including workshop machinery, capable of inflicting serious injury, such as chainsaws, firearms, lathes and power saws.

(b) Handling venomous reptiles, insects, arthropods or fish.

(c) Working with large animals other than for the purpose of feeding or observation.

(d) Working with, or near, toxic, corrosive substances or nanomaterials where there is a significant risk of exposure to the substance, taking into account the volume used.

(e) Using apparatus that could result in explosion, implosion, or the release of high energy fragments or significant amounts of toxic or environmentally damaging hazardous material including pressure vessels ( AS 1210).

(f) Climbing towers or high ladders.

(g) Working with exposed energized electrical or electronic systems with nominal voltages exceeding 50 V a.c. or 120 V ripple-free d.c.

NOTE These limits are for dry, indoor conditions and a more conservative approach should be taken in other conditions.

(h) Working with radionuclides requiring a high level laboratory in accordance with AS/NZS 2243.4.

(i) Working with microorganisms of Risk Group 3 and higher, or which require the use of a Containment Level 3 facility or higher containment level in accordance with AS/NZS 2243.3.

(j) Operating lasers of Class 3B and above.

(k) Working in environments not at atmospheric pressure.

(l) Working in the field or remote locations, including working in zones prone to volcanic, seismic/earthquake and storm events.

# Appendix C
(informative)

# Field trip plan

| | | | |
|---|---|---|---|
| **Program/Group/Team Leader** | | **Site/Location** | |
| **Organization** | | **Contact No** | |

**People undertaking fieldwork (add additional rows as required)**

| Name | Organization | Contact No | Personal information recorded | Training | | |
|---|---|---|---|---|---|---|
| | | | | First Aid | 4WD | ATV/Other |
| | | | Yes/No | | | |
| | | | Yes/No | | | |
| | | | Yes/No | | | |
| | | | Yes/No | | | |

| | | |
|---|---|---|
| **Trip Date** | | |
| Departure | Date: | Time: |
| Expected Return | Date: | Time: |

**Locations (for extended trips and multiple locations a more detailed itinerary is required)**

| Field Site | Date/s | Maps/including travel route |
|---|---|---|
| | | |
| | | |
| | | |
| | | |

**Base Contacts**

| Name | Work Phone | Home Phone | Mobile | Access to field trip plan |
|---|---|---|---|---|
| | | | | |
| | | | | |
| | | | | |

| | | | |
|---|---|---|---|
| **Approvals** | | | |
| Fieldwork Team leader | Name: | Signature: | Date: |
| Senior Manager / Delegate / OIC | Name: | Signature: | Date: |
| | Email approval (if required) | Signature: | Date: |
| Working Alone | Name: | Signature: | Date: |

| | | |
|---|---|---|
| **Communication Equipment/Distress Beacons** | | |
| Vehicle 2-way radio phone | PLB | Mobile Phone |
| Hand 2-Way radio phone | EPIRB | Satellite Phone |

| | |
|---|---|
| **2-Way Radios/Phones (Type/Phone number/call Sign/ Channel** | **Planned operating times and call in schedule** |

| | |
|---|---|
| | |
| | |
| | |
| | |
| | |
| **Distress Beacons (type and Unit Number** | **Local Site 24/7 and PLB Contacts notified** |
| PLB | Yes/No |
| EPIRB | Yes/No |
| **Note: Rescue Coordination Centre Phone:** | |

**Vehicles, Boats, Trailers and ATVs (add others)**

| Type | Appropriately equipped | Maintenance current | Details on file |
|---|---|---|---|
| | Yes/No | Yes/No | Yes/No |
| | Yes/No | Yes/No | Yes/No |
| | Yes/No | Yes/No | Yes/No |
| | Yes/No | Yes/No | Yes/No |

Comments:

**Risk Management**

Have the hazards, risks and controls for Fieldwork been recorded in the Risk Management Plan? YesNo

If No – complete sections below adding hazards and controls to be applied

| Activity | Additional Hazards | Controls | Responsible Person |
|---|---|---|---|
| List the tasks/ activities | List the hazards that may cause injury or environmental harm | List the control measures to mitigate the risk | Who is responsible to implement |
| | | | |
| | | | |
| | | | |
| | | | |

**Approvals**

| | | | |
|---|---|---|---|
| Fieldwork Team leader | Name: | Signature: | Date: |
| Senior Manager / Delegate/OIC | Name: | Signature: | Date: |
| | Email approval (if required) | Signature: | Date: |
| Working Alone | Name: | Signature: | Date: |

NOTE 1: Base Contact Staff and Team Leader shall have access to Field Trip Plans for the duration of the fieldwork.

NOTE 2: All fieldwork documentation to be kept for the duration of the field trip (and archived as required).

PLB = personal location beacon

EPIRB = Emergency Position Indicating Radio Beacon

# Bibliography

**Informative references**

The following Standards are referenced in this Standard in an informative manner:


[1] AS 1210, *Pressure vessels*

[2] AS 1668-1, *The use of ventilation and air conditioning in buildings, Part 1: Fire and smoke control in buildings*

[3] AS 1668-2, *The use of ventilation and airconditioning in buildings, Part 2: Mechanical ventilation in buildings*

[4] AS 1668-4, *The use of ventilation and airconditioning in buildings, Part 4: Natural ventilation of buildings*

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[16] AS 4024-3301, *Safety of machinery, Part 3301: Robots for industrial environments — Safety requirements*

[17] AS/NZS 1270, *Acoustics — Hearing protectors*

[18] AS/NZS 2106, *Methods for the determination of the flash point of flammable liquids (closed cup)* (all parts)

[19] AS/NZS 2161, *Occupational protective gloves* (all parts)

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**Further Reading**

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[69] Australia Safe Work Model Code of Practice: Labelling of workplace hazardous chemicals, September 2015

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[72] Australia Safe Work Guide to Managing Risks of Exposure to Carcinogens in the Workplace, September 2016

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