

Australian/New Zealand Standard™

Laboratory design and construction



AS/NZS 2982:2010

This Joint Australian/New Zealand Standard was prepared by Joint Technical Committee BD-046, Laboratory Design and Construction. It was approved on behalf of the Council of Standards Australia on 24 November 2009 and on behalf of the Council of Standards New Zealand on 22 February 2010.
This Standard was published on 12 March 2010.

The following are represented on Committee BD-046:

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Australian Chamber of Commerce and Industry
Australian Institute of Architects
Commonwealth Department of Health and Ageing
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This Standard was issued in draft form for comment as DR 09033.

Australian/New Zealand Standard™

Laboratory design and construction

Originated in Australia as AS 2982—1987.
Previous edition AS/NZS 2982.1:1997.
Jointly revised and redesignated as AS/NZS 2982:2010.

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Jointly published by Standards Australia, GPO Box 476, Sydney, NSW 2001 and Standards New Zealand, Private Bag 2439, Wellington 6140

PREFACE

This Standard was prepared by the members of the Joint Standards Australia/Standards New Zealand Committee BD-046, Laboratory Design and Construction, to supersede AS/NZS 2982.1:1997, *Laboratory design and construction*, Part 1: *General requirements*. This Standard specifies requirements for the design and construction of laboratories based mainly on maximizing the safety of such facilities. Note that this is a single part Standard. The 'Part 1' title reference, included in the superseded standard, has now been dropped.

This Standard supplements the AS/NZS 2243 series, which refers mainly to safe working practices in laboratories. However, the AS/NZS 2243 series also includes some design and construction requirements particularly for specialized components (e.g. fume cupboards) and applications (e.g. physical containment). Reference to both AS/NZS 2982 and the AS/NZS 2243 series is recommended where laboratories are being assessed or planned.

This Standard is designed to help organizations responsible for commissioning and operating laboratories to provide a safe workplace. A laboratory must be designed, constructed, maintained and operated to minimize hazards and reduce risks to personal or public safety to an acceptable level.

While conformity to this Standard will enhance the safety of the workplace, disregard for safe working practices may negate the provisions for safety that are built into a laboratory. It is therefore essential that all personnel, including non-technical staff and visitors, be aware of and follow safe working procedures.

The Committee does not suggest that any of the provisions of this Standard are retrospective. However, users are encouraged to critically reassess their laboratories and adopt and implement those parts of this Standard that are cost effective and practicable and that can improve overall site safety.

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. Notes are also informative and for information and guidance.

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FOREWORD

The Standard is intended to apply to a wide range of laboratories. It is recognized that certain common design principles apply to laboratories with quite different functions. Separate sections refer to the distinctive needs of biological, radiological, and secondary school laboratories.

A number of different types of hazards may be encountered in laboratories, including—

- (a) physical hazards including machinery or equipment in motion, parts under stress, noise, vibration, vacuum or pressurization;
- (b) flammable or explosive materials;
- (c) ignition sources;
- (c) temperature hazards including high temperature materials, cryogenic fluids;
- (d) electrical hazards including high voltages, live equipment, static charge;
- (e) chemical hazards including asphyxiants, oxidizers, carcinogens, toxins, sensitizing agents, corrosives, irritants and genotoxins;
- (f) biological hazards including infectious agents, allergens, irritants, genotoxins, zoonoses;
- (g) radiation including both ionizing and non-ionizing; and
- (h) ergonomic hazards, including repetitive and fixed postures, slips and trips.

Laboratory design and construction plays a fundamental and critical part in ensuring that laboratories are safe places to work. It is therefore necessary to consider in detail the type of hazards that apply to a particular laboratory and clearly define their nature and significance. This information is essential in order to maximize opportunities to eliminate hazards or to reduce risks to an acceptable level at the laboratory design and construction phase.

STANDARDS AUSTRALIA/STANDARDS NEW ZEALAND

Australian/New Zealand Standard

Laboratory design and construction

SECTION 1 SCOPE AND GENERAL

1.1 SCOPE

This Standard specifies requirements for the design and construction of laboratories. Sections 1 to 7 apply to all laboratories. Sections 8, 9 and 10 contain additional requirements applicable to biological, radiological and secondary school laboratories respectively.

NOTES:

- 1 This Standard is primarily intended for those aspects of laboratory building design and construction related to the safety of the occupants. Various design and construction requirements that are intended to minimize the hazards associated with laboratories are detailed.
- 2 This Standard should be used in conjunction with the applicable building regulations and other regulations such as those on occupational health and safety, and the relevant referenced Standards.

1.2 DESIGN

Laboratories shall be designed to address the many and varied requirements for safe operation and usage. The design process should include hazard identification, risk assessment and risk management to achieve safe and functional design.

NOTE: For guidance on the design and planning of laboratories, see Appendix A.

1.3 REFERENCED DOCUMENTS

The following documents are referred to in this Standard:

AS

1216	Class labels for dangerous goods
1319	Safety signs for the occupational environment
1345	Identification of the contents of pipes, conduits and ducts
1482	Electrical equipment for explosive atmospheres—Protection by ventilation—Type of protection v
1668	The use of ventilation and airconditioning in buildings
1668.2	Part 2: Ventilation design for indoor air contaminant control
1735	Lifts, escalators and moving walks (series)
1894	The storage and handling of non-flammable cryogenic and refrigerated liquids
1940	The storage and handling of flammable and combustible liquids
2243	Safety in laboratories
2243.4	Part 4: Ionizing radiations
2243.6	Part 6: Mechanical aspects
2243.7	Part 7: Electrical aspects

AS	
2252	Controlled environments
2252.2	Part 2: Biological safety cabinets Class II—Design
2507	The storage and handling of agriculture and veterinary chemicals
2567	Laminar flow cytotoxic drug safety cabinets
2639	Laminar flow cytotoxic drug safety cabinets—Installation and use
2676	Guide to the installation, maintenance, testing and replacement of secondary batteries in buildings
2714	The storage and handling of organic peroxides
3780	The storage and handling of corrosive substances
4260	High efficiency particulate air (HEPA) filters—Classification, construction and performance
4775	Emergency eyewash and shower equipment
5601	Gas installations
AS/NZS	
1596	Storage and handling of LP Gas
1680	Interior and workplace lighting
1680.1	Part 1: General principles and recommendations
2022	Anhydrous ammonia—Storage and handling
2106	Methods for the determination of the flashpoint of flammable liquids (closed cup)
2243	Safety in laboratories
2243.1	Part 1: Planning and operational aspects
2243.2	Part 2: Chemical aspects
2243.3	Part 3: Microbiological aspects and containment facilities
2243.5	Part 5: Non-ionizing radiations—Electromagnetic, sound and ultrasound
2243.8	Part 8: Fume cupboards
2243.9	Part 9: Recirculating fume cabinets
2243.10	Part 10: Storage of chemicals
2430	Classification of hazardous areas
2430.3.6	Part 3.6: Examples of area classification—Laboratories, including fume cupboards and flammable medical agents
2647	Biological safety cabinets—Installation and use
2927	The storage and handling of liquefied chlorine gas
3000	Electrical installations (known as the Australian/New Zealand Wiring Rules)
3500	Plumbing and drainage (series)
3816	Management of clinical and related wastes
4586	Slip resistance classification of new pedestrian surfaces materials
4663	Slip resistance measurement of existing pedestrian surfaces
4801	Occupational health and safety management systems—Specification with guidance for use
60079	Explosive atmospheres
60079.10	Part 10: Classification of areas—Explosive gas atmospheres

NHMRC Australian code of practice for the care and use of animals for scientific purposes

Gene Technology Act 2000

National Health Security Act 2007

NZS

4304 Management of Healthcare Waste

5433 Transport of dangerous goods on land

ACTDG

ADG Code Australian Code for the Transport of Dangerous Goods by Road and Rail (Advisory Committee on the Transport of Dangerous Goods)

NHMRC

No. 19 Radiation Health Series 19, Code of Practice for the Safe Use of Ionizing Radiations in Secondary Schools (1986) (National Health and Medical Research Council)

Australian Safety and Compensation Council, Worksafe Australia

NOHSC:1003 Exposure Standards for Atmospheric Contaminants in the Occupational Environment

NOHSC:1008 Approved criteria for classifying hazardous substances

NOHSC:1015 Storage and Handling of Workplace Dangerous Goods

NOHSC:2005 National code of practice for manual handling

NOHSC:3009 Guidance Note for Placarding Stores for Dangerous Goods and Specified Hazardous Substances (1990)

NOHSC:10005 List of designated hazardous substances

NHMRC Australian code of practice for the care and use of animals for scientific purposes

New Zealand

Animal Welfare Act 1999

Chemical Weapons Prohibition Act 1996

Hazardous Substances and New Organisms (HSNO) Act 1996

Hazardous Substances (Minimum Degrees of Hazard) Regulations 2001

Code of Practice for School Exempt Laboratories

OSH NZ Department of Labour, Occupational Safety and Health Service

Approved Code of Practice for Manual Handling

HSNO

Approved Code of Practice for Signage for Premises Storing Hazardous Substances and Dangerous Goods

United Nations

Manual of Tests and Criteria and the UN Recommendations on the Transport of Dangerous Goods—Model Regulations

1.4 DEFINITIONS

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

1.4.1 Air-handling system

A system for the purpose of force ventilating specific enclosures by means of fan powered plant, ducts, plenums, air-distribution devices and automatic controls.

NOTE: See AS 1668.2 for further definitions of types of air-flow and air-handling systems.

1.4.2 Approved, approval

With the approval of, acceptable to, and meeting the prescribed standards of the authority having jurisdiction.

1.4.3 AQIS (Australian Quarantine and Inspection Service)

Inspects and assesses imports for exotic pests and diseases, and provides certification for a range of exports.

1.4.4 Contaminated

Containing harmful or hazardous concentrations of toxic, noxious, pathogenic, flammable, radioactive, explosive, oxidative, corrosive, irritating or other potentially injurious matter, including dusts.

1.4.5 Corrosive

Having the quality of damaging or destroying by direct chemical action. This also includes the effect of caustic substances.

1.4.6 Cryogenic liquid

Dangerous goods of Class 2, with a boiling point at atmospheric pressure of below minus 90°C, stored in liquid form at or near atmospheric pressure.

1.4.7 Dangerous goods

(Australia) Substances and 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 the competent authority.

(New Zealand) Substances and articles that have properties described in table A of NZS 5433, including packaging and empty containers that have not been cleared after containing dangerous goods.

NOTES:

- 1 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.
- 2 Dangerous goods also include empty receptacles or packages that have contained dangerous goods, unless such receptacles or packages have been decontaminated.

1.4.8 Designated radiation area (DRA)

An area where the occupational exposure of personnel to radiation or radioactive substances is under the supervision of a radiation protection adviser (RPA).

NOTE: This includes the 'controlled' and 'supervised' areas referred to in publications of the International Commission on Radiological Protection, the International Atomic Energy Agency and the NHMRC.

1.4.9 Environmental Risk Management Authority (ERMA)

The New Zealand Government statutory body responsible for regulating new organisms (including genetically modified organisms), under the *Hazardous Substances and New Organisms (HSNO) Act 1996*. The term includes ERMA New Zealand, the Agency that is the support organization for the Authority.

1.4.10 Flammable

Capable of being readily ignited and burning.

1.4.11 Flammable liquid

A liquid that is defined in the Australian Dangerous Goods Code (NZS 5433 for New Zealand) as a Class 3 liquid (also see AS 1940).

1.4.12 Flammable liquid storage cabinet

A cabinet for the indoor storage of flammable liquids complying with Clause 7.2. The liquid capacity of these cabinets relates to flammable liquid contained in separate containers.

1.4.13 Flashpoint

The temperature at which the liquid, when tested according to the method set out in AS/NZS 2106 or other equivalent specifications, evolves vapour in a sufficient quantity to be ignited by the test flame specified in the method.

1.4.14 Fume cabinet (also known as 'recirculating fume cabinet')

A partially enclosed workstation that contains the fume to protect operators and other personnel, is ventilated by an induced flow through a working aperture and, by means of a filtration or absorption system, provides for the safe return of the exhaust air to the laboratory.

1.4.15 Fume (as used in the term 'fume cupboard' or 'fume cabinet')

Airborne contaminants in the form of gases, vapours, aerosols or particulate matter.

1.4.16 Fume cupboard

A partially enclosed workplace that—

- (a) is designed to prevent the spread of fume to operators and other personnel in the laboratory;
- (b) is ventilated by an induced flow of air through a sash opening or working aperture that may be adjusted;
- (c) dilutes the fume; and
- (d) by means of an exhaust system, provides for the safe and remote discharge of the fume outside the building.

NOTES:

- 1 A fume hood is a device mounted over a workplace to receive or capture fumes. It may provide little or no enclosure for the workplace and is therefore unable to attain containment as high as a fume cupboard.
- 2 In American usage, a 'fume hood' means a laboratory fume cupboard.

1.4.17 Gas container

A closed cylinder or vessel used to contain a gas under pressure.

1.4.18 OGTR (Office of the Gene Technology Regulator)

The Australian regulatory agency administering the *Gene Technology Act 2000*, which regulates genetically modified organisms in Australia.

1.4.19 Hazard

A source or 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 (see AS/NZS 4801).

1.4.20 Hazardous substance

(Australia) A substance that has been classified as hazardous in accordance with NOHSC 1008 or listed in NOHSC 10005.

(New Zealand) Any substance that triggers any one of the threshold levels defined in the Hazardous Substances (Minimum Degrees of Hazard) Regulations 2001 for any of the hazard properties listed in the *Hazardous Substances and New Organisms Act 1996*.

1.4.21 HEPA filter

‘High-efficiency particulate air’ filter complying with AS 4260 with a minimum arrestance efficiency of 99.99% for particles of 0.3 µm diameter.

1.4.22 HSNO

Hazardous Substances and New Organisms.

1.4.23 Ignition source

A source of energy sufficient to ignite a flammable atmosphere or material. An ignition source may include naked flames, exposed incandescent material, spontaneously combusting material, electrical arcs, mechanical or static sparks and electrical or mechanical equipment not approved for use in locations where flammable hazards exist.

1.4.24 International Commission on Radiological Protection (ICRP)

International advisory body providing expert recommendations and guidelines on all aspects of protection against ionizing radiation.

1.4.25 Laboratory

Any building or part of a building used or intended to be used for scientific and related work that may be hazardous, including research, quality control, testing, teaching or analysis. Such work may involve the use of chemicals, (including dangerous goods, and hazardous substances), pathogens and harmful radiation, or processes including electrical or mechanical research and testing work.

The laboratory may include areas such as instrument rooms, preparation rooms and stores, and may include offices integral to the laboratory function.

NOTES:

- 1 The term ‘laboratory’ is commonly used to refer to individual workrooms used for scientific work. It may also refer to the total portion of the building devoted to scientific work.
- 2 One or more offices may form part of a laboratory where the risks of office contamination by hazardous substances are low, or are otherwise appropriately addressed. There is a general trend to segregate office and laboratory areas. However, as this may compromise supervision, the best approach needs to be assessed against the objectives and circumstances applicable for individual laboratories.
- 3 For some applications the inclusion of offices within the laboratory may be inappropriate (e.g. microbiological laboratories containment complying with AS/NZS 2243.3, ionizing radiation laboratories).
- 4 In a multi-occupancy building, the area occupied by the laboratory may be referred to as ‘the laboratory area’.
- 5 The term ‘laboratory’ is sometimes loosely applied to facilities such as computer rooms, mapping suites and electronic work shops. In general, these facilities are not classed as laboratories covered by this Standard.

1.4.26 Laboratory—biological

A laboratory in which biological materials are handled.

NOTES:

- 1 Where these materials may be infectious to humans, have the potential to contaminate the environment or where cross-contamination of work may occur, then facilities for microbiological laboratories should be considered.
- 2 The laboratory may be a biochemical, veterinary, botanical or zoological laboratory. This definition may also apply to teaching and research laboratories.
- 3 Laboratory animals may be used in biological laboratories.

1.4.27 Laboratory—extreme hazard

A laboratory that presents such potential hazards to humans or the environment that special facilities need to be provided to minimize the risks of those hazards, or special precautions need to be taken by workers in that laboratory. Extreme hazard laboratories include laboratories with a large quantity of flammable material and laboratories that deal with explosives, high toxicity material or highly infectious organisms.

1.4.28 Laboratory—microbiological

A laboratory in which microorganisms are dealt with. This includes laboratories used for genetic manipulation work, animal, plant and invertebrate facilities, and laboratories where microbiological work such as research, teaching, diagnosis, quality control and regulatory analysis, (e.g. of foodstuffs, water, effluents, pharmaceuticals and cosmetics), is undertaken.

NOTES:

- 1 The microorganisms involved or the regulator will determine the level of physical containment required (refer AS/NZS 2243.3).
- 2 Some microorganisms are pathogenic to human beings.
- 3 Any biological specimens should be treated as being potentially infectious unless known to be non-infectious.

1.4.29 Laboratory—radiation

A laboratory in which irradiating apparatus or sealed radioactive sources are used or stored. It does not contain any unsealed radioactive material.

1.4.30 Laboratory—radioisotope

A laboratory in which unsealed radioactive material is used or stored. It does not contain any irradiating apparatus.

1.4.31 Laboratory—radiological

A laboratory that incorporates the functions of both a radiation laboratory and a radioisotope laboratory.

1.4.32 Laboratory—secondary

A laboratory used for training in science at secondary schools and secondary colleges.

1.4.33 Laboratory waste

All liquid, solid or gaseous waste material that results from laboratory operations and is for disposal.

1.4.34 May

Indicates the existence of an opinion.

1.4.35 Mechanical ventilation

The distribution of ventilating air by the use of supply or exhaust fans or other physical air-moving devices.

1.4.36 Ministry of Agriculture and Forestry (MAF) Biosecurity New Zealand

Inspects and assesses imports for exotic pests and diseases.

1.4.37 Natural ventilation

Ventilation by natural airflow through fixed ventilators, doors or openable windows due to thermal or pressure gradients.

1.4.38 NHMRC (National Health and Medical Research Council)

The council that advises the Australian community on the achievement and maintenance of the highest practicable standards of individual and public health. It fosters research in the interests of improving health standards.

1.4.39 Pathogen

An organism capable of causing disease in people, animals or plants.

1.4.40 Physical containment

Containment that is defined as follows:

- (a) *General* The safe methods for managing hazardous or infectious agents in the laboratory environment where they are being handled or maintained. Physical containment reduces or eliminates the exposure of laboratory workers, other persons, and the outside environment to potentially hazardous agents.
- (b) *Primary physical containment* The protection of personnel and the immediate laboratory environment from exposure to hazardous or infectious agents provided by good laboratory practice and the use of appropriate safety equipment.
- (c) *Secondary physical containment* The protection of the environment external to the laboratory, provided by a combination of facility design and operational practices.

NOTE: The risk assessment of the work to be performed with a specific agent will determine the selection of the appropriate combination of primary and secondary physical containment.

1.4.41 Plenum

An air compartment or chamber, intended for the passage of air, to which one or more ducts may be connected and which forms part of an air-handling system.

1.4.42 Potable water

Water that is suitable for human consumption, food preparation, utensil washing and oral hygiene.

1.4.43 Radiation protection adviser (RPA)

A person appointed by the management/employer wherever radioactive substances are used in amounts that require licensing, or wherever irradiating apparatus is used.

1.4.44 Reticulated services

Services such as liquids or gases that are distributed through pipes or conduits.

1.4.45 Risk

The probability that—

- (a) a hazard may be realized at a specific level in a given span of time; or
- (b) an individual may suffer a specified level of injury as a result of a hazard, in a given span of time.

1.4.46 Shall

Indicates a mandatory requirement.

1.4.47 Should

Indicates a recommended practice.

1.4.48 Security sensitive agents

A chemical, radiological or biological agent that has potential to be a significant security hazard if accessed or used unlawfully. The physical security, information management, personnel security, handling, storage, disposal and transport of security sensitive agents are required to conform to applicable regulations.

NOTES:

- 1 In Australia, the *National Health Security Act 2007* establishes a national scheme for the registration and regulation of entities and facilities handling security sensitive biological agents. National Health Security Regulations and security sensitive biological agent (SSBA) Standards underpin the NHS Act.
- 2 In New Zealand, these are controlled by the *Chemical Weapons Prohibition Act 1996*.

1.4.49 Storage room for hazardous substances

A compartment or store designed or used for keeping any potentially hazardous substances in a laboratory.

1.4.50 Zoonosis

Any disease that is communicable to human beings from another animal species.

SECTION 2 GENERAL LABORATORY CONSTRUCTION REQUIREMENTS

2.1 SCOPE OF SECTION

This Section applies to laboratory areas (including physical containment areas) where there are risks of contamination from hazardous materials and safety issues related to these materials. Areas physically separated by walls and not at risk of contamination (e.g. office, computer room, paper store) are not constrained by these clauses.

2.2 PROTECTION AGAINST SUNLIGHT

If chemicals or instrumentation that are sensitive to direct sunlight are present in the laboratory, the design of the applicable laboratory shall exclude all direct sunlight penetration that exceeds an intensity of 100 W/m^2 . The solar intensity limit shall be as measured internally in a plane normal to the solar radiation.

NOTE: See also AS/NZS 2243.1.

2.3 STRUCTURAL INTEGRITY

Laboratories shall have adequate structural integrity to suit their intended purpose.

NOTE: Some applications require higher structural strength than mandated by the building code (e.g. pressurized rooms, rooms exposed to risk of explosion and vibration sensitive rooms).

2.4 CONSTRUCTION MATERIALS AND FINISHES

Construction materials and finishes shall be chosen to address the risks of contaminant exposure applicable to laboratory areas.

2.5 FLOORS

Floors in laboratories shall comply with the following:

- (a) All floors in laboratory work areas shall be finished with materials that are—
 - (i) easy to clean;
 - (ii) smooth;
 - (iii) impervious;
 - (iv) resistant to chemicals used in the laboratory;
 - (v) compatible with the nature of the laboratory operations and operator comfort; and
 - (vi) slip resistant in accordance with the requirements of AS/NZS 4586 and AS/NZS 4663.
- (b) Joints in slabs shall be avoided as far as possible but where used shall be constructed in such a way that they are sealed against penetration by hazardous materials.
- (c) Where openings in floors are required they shall be designed to prevent the penetration of liquids.

NOTE: Openings in floors for service pipes can be installed in a raised plinth of the height of the skirting.

- (d) Where there is a risk of spillage of hazardous, potentially infectious or unsealed radioactive material, the intersection of floors with walls and exposed plinths shall be coved to facilitate cleaning.

NOTE: Commercial grade vinyl sheeting with welded joints or similar material laid over a solid impervious base or an approved underlay is acceptable in most laboratories provided the material is laid strictly in accordance with the manufacturer's specifications. However, liquid nitrogen spills will usually cause welded vinyl to split.

2.6 WALLS

All walls in laboratory work areas shall be finished with materials that are—

- (a) easy to clean;
- (b) smooth;
- (c) impervious; and
- (d) resistant to chemicals used in the laboratory.

NOTE: Where practical a viewing panel is desirable to enhance safety and supervision of laboratory activities.

2.7 CEILINGS

Ceilings in laboratory areas shall be constructed of a rigid material in continuous or tiled systems and may include fibrous plaster, plasterboard, fibrous cement, cement render or other suitable material.

Smooth faced, non friable, impervious, washable ceilings shall be provided where—

- (a) contamination of the ceiling can occur;
- (b) decontamination is required;
- (c) very clean conditions are required; or
- (d) fumes, dust or vapours are generated.

If suspended tiles are likely to be displaced by pressure or vibration, they shall be retained in place by an appropriate system.

Access panels shall not reduce the integrity of the ceiling.

2.8 VENTILATION OPENINGS

Refer to Section 5 for door and window opening required for natural and forced ventilation systems.

NOTE: Even mechanically ventilated laboratories may need some openable devices for emergency ventilation.

2.9 BENCHES

Benches in laboratories shall comply with the following:

- (a) Benches shall be stable and of adequate structural integrity.
- (b) Benchtops shall be finished with a material that is—
 - (i) easy to clean;
 - (ii) smooth (free from irregularities);
 - (iii) impervious;
 - (iv) resistant to chemicals used in the laboratory;