

AS/NZS 2243.3:2022



Australian/New Zealand Standard™

Safety in laboratories

Part 3: Microbiological safety and containment



AS/NZS 2243.3:2022

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- Australian Institute of Health & Safety
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- CSIRO
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- Responsible Care New Zealand
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Safety in laboratories

Part 3: Microbiological safety and containment

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Preface

This Standard was prepared by the Joint Standards Australia/Standards New Zealand Committee CH-026, Safety in Laboratories, to supersede AS/NZS 2243.3:2010.

The objective of this document is to provide requirements and guidelines that promote microbiological safety in laboratories and containment facilities and prevent the unintended spread of microorganisms and prions.

This document is part of a series promoting safety in laboratories. A list of all parts in the AS(AS/NZS) 2243 series can be found in the Standards Australia online catalogue.

Although many of the safety aspects of working in laboratories are addressed in other parts of the series, some are repeated in this document because there is an increase in the risk in containment facilities.

The major change in this edition is the addition of a section for the containment of water-based species, including fish and aquatic invertebrates.

The inclusion of roles and responsibilities in AS/NZS 2243.3:2022, was approved by the Standards Development and Accreditation Committee (SDAC) on 1 November 2018, as a one-off exemption to the directives of Standardization Guide SG-006, Section 35.

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

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Introduction

Microbiological laboratories can pose the following hazards:

- (a) Infection of laboratory personnel, the general public, animals and plants by dissemination of microorganisms inside and outside a laboratory.
- (b) Cross-contamination of research and diagnostic materials or animals.
- (c) Contamination with adventitious microorganisms.

The basic approach to working with microorganisms is to regard them as potential pathogens and to handle them with standard microbiological techniques. Nevertheless, microorganisms vary markedly in both their pathogenicity and ease of transmission. As such, laboratory work conditions, including containment levels, need to be part of a documented risk assessment that takes into account organism-specific characteristics and the work activities to be conducted.

This document includes the classification of microorganisms into four risk groups and specifies work requirements for the corresponding four physical containment levels.

While this document covers the safety and containment aspects of working with microorganisms, including genetically modified microorganisms, it does not cover specific safety measures that may be implemented in response to community interest and concerns in genetic modification work. For these, consult with the relevant authority. This document is also not primarily intended to address containment of organisms for work that does not involve microorganisms.

This document includes information on work health and safety. However, it should not be assumed that conformance with this document means that all aspects of relevant regulations or all legal obligations are being fulfilled. The user of this document needs to refer to relevant regulations and determine the applicable legal requirements.

In recognition of the changes made to this document during its revision, it is recommended that existing facilities are assessed for risk and interim control measures are implemented. It is also recommended that current facilities and procedures are updated and improvements made to conform to this document, within a timeframe that takes into account the cost of upgrading and the severity of the associated risk.

NOTES

Australian/New Zealand Standard

Safety in laboratories

Part 3: Microbiological safety and containment

Section 1 Scope and general

1.1 Scope

This document sets out requirements and practices relating to safe handling and containment of microorganisms and prions in laboratories, including pathology, clinical research and diagnostic laboratories. It includes requirements and practices for terrestrial animal, plant, invertebrate and aquatic organism containment facilities (these may be integral or separate to the laboratory) where microbiological work such as research, teaching, diagnosis, quality control and regulatory analysis (e.g. of foodstuffs, water and effluents, pharmaceuticals and cosmetics) is undertaken.

This document may also provide assistance to other laboratories where specimens that may contain pathogenic microorganisms and prions are handled (e.g. biochemistry and soil laboratories).

NOTE 1 This document uses the term “containment facility” instead of historical terms such as “plant house”, “glass house”, “insectary” and “animal house”.

NOTE 2 This document does not specify specific safety requirements related to the generation or use of genetically modified microorganisms. While aspects of this document are relevant, the relevant authority should be consulted (see [Clause 2.3](#)).

NOTE 3 The principles of containment detailed in this document apply regardless of the scale or quantity of microbiological material being used (see also [Clause 2.3](#)).

NOTE 4 This document is not intended to be used as a substitute for other regulations or guidelines that apply to these organisms, such as those issued by the Department of Agriculture, Water and the Environment (DAWE) and the Office of Gene Technology Regulator (OGTR) in Australia or those issued by the Ministry for Primary Industries (MPI) and the Environmental Protection Authority (EPA) in New Zealand.

1.2 Application

This document should be read in conjunction with AS 2243.1, AS/NZS 2982, the National Construction Code (NCC) or the *New Zealand Building Regulations 1992*, other relevant parts of the AS(AS/NZS) 2243 series, and other relevant standards and national, state and territory legislation.

1.3 Normative references

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

NOTE Documents referenced for informative purposes are listed in the Bibliography.

AS 1210, *Pressure vessels*

AS 1319, *Safety signs for the occupational environment*

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

AS 1324.2, *Air filters for use in general ventilation and airconditioning, Part 2: Methods of test*

AS 1807, *Separative devices — Biological and cytotoxic drug safety cabinets clean workstations and pharmaceutical isolators — Methods of test*

AS 1807.7, *Cleanrooms, workstations, safety cabinets and pharmaceutical isolators — Methods of test, Method 7: Determination of integrity of HEPA filter installations not terminally mounted*

AS 1807.10, *Cleanrooms, workstations, safety cabinets and pharmaceutical isolators — Methods of test, Method 10: Determination of air pressure of cleanrooms and pharmaceutical isolators*

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

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

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

AS 2252.3, *Controlled environments, Part 3: Biological safety cabinets Class III — Design*

AS 2252.4, *Controlled environments, Part 4: Biological safety cabinets Classes I and II — Installation and use (BS 5726:2005, MOD)*

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

AS 4260, *High efficiency particulate air (HEPA) filters — Classification, construction and performance*

AS 4775, *Emergency eyewash and shower equipment*

AS/NZS 1200, *Pressure equipment*

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

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

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

AS/NZS 2982, *Laboratory design and construction*

AS/NZS 3500 (all parts), *Plumbing and drainage*

ISO 3864 (all parts), *Graphical symbols — Safety colours and safety signs*

IATA, *Dangerous Goods Regulations Manual*

New Zealand Ministry of Health, ORS C11, *Code of Practice for Unsealed Radioactive Material*

UN, *Recommendations on the Transport of Dangerous Goods — Model Regulations*

1.4 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

1.4.1

aerosol

suspension in air of finely dispersed solids or liquids

Note 1 to entry: Any procedure that disrupts the surface of a liquid has potential to produce aerosols. Procedures such as shaking, mixing, ultrasonic disruption, and removing a needle from a rubber seal are particularly common examples for microbiological work.

Note 2 to entry: Aerosols may be generated by leakage of contaminated fluids, such as effluent, from systems under pressure.

1.4.2**airlock**

separate, fully enclosable space with two doors designed to limit the air transfer and pressure fluctuations during entry and exit

Note 1 to entry: A shower airlock is an airlock that incorporates full body shower capability, which can be used as part of egress procedures.

1.4.3**animals**

see *terrestrial animal* ([1.4.43](#))

1.4.4**anteroom**

separate, fully enclosable space used during access and egress that has specific identified containment functions

1.4.5**antiseptic**

substance capable of destroying or preventing growth of microorganisms under prescribed conditions of use, and specifically for application to living tissues

1.4.6**aquatic organism**

plant or animal species that lives in water for most or all of its lifetime

1.4.7**biohazard**

potential microbiological source of harm

1.4.8**biological safety cabinet****BSC****1.4.8.1****class I**

cabinet intended to provide protection from hazardous biological agents for personnel and the environment

Note 1 to entry: Class I cabinets are exhaust ventilated, with an inward flow of air away from the operator and HEPA filtration of exhaust air.

1.4.8.2**class II**

cabinet intended to provide protection from hazardous biological agents for personnel and the environment and also to protect the material used in the cabinet from exogenous contamination

Note 1 to entry: Class II cabinets provide this protection by inducing an inflow of air through the work access opening, by delivering recirculated, filtered, laminar flow air downwards through the work zone and by HEPA filtration of exhaust air.

1.4.8.3**class III**

totally enclosed, ventilated cabinet that allows work to be performed through the use of attached gloves

Note 1 to entry: Class III cabinets are gas-tight, maintained under a negative air pressure, have their supply air HEPA-filtered and have their exhaust air passed through two HEPA filters in series. Transfer boxes allow passage of materials into and out of the work zone while maintaining the negative pressure.

1.4.9**biological safety officer****BSO**

person who is competent in the assessment and control of biological hazards and provides advice and guidance on microbiological safety

1.4.10**biosafety**

containment principles, technologies and practices that are implemented to prevent the unintentional exposure to biological agents and toxins, or their accidental release

1.4.11**biosafety committee****BC**

committee providing advice on microbiological safety, associated resources and facilities as are necessary for safe working with biological hazards

1.4.12**calibration**

operation that, under specified conditions, in the first step establishes a relation between the quantity values with measurement uncertainties provided by measurement standards and corresponding indications with associated measurement uncertainties and, in the second step uses this information to establish a relation for obtaining a measurement result from an indication

[SOURCE: ISO/IEC Guide 99:2007, 2.39]

1.4.13**change room****1.4.13.1****inner change room**

separate, fully enclosable space used by personnel for donning and removing facility clothing and PPE on entry and exit

1.4.13.2**outer change room**

space used by personnel to remove or don personal clothing prior to entering or exiting a facility

1.4.14**competent person**

person who has acquired, through education, training, qualification or experience, or a combination of these, the knowledge and skill enabling that person to perform the task required

1.4.15**containment**

act of restricting an organism or prion to a secure place to prevent escape, through a combination of physical components and operational practices and procedures

Note 1 to entry: A containment facility is an example of a secure place. Physical components include buildings, engineering, equipment and systems.

1.4.16**containment facility**

place that is designed, built and operated for the purpose of *containment* ([1.4.15](#))

Note 1 to entry: A containment facility may include a combination of buildings, rooms and laboratories for holding microorganisms, animals, invertebrate and plants within a physical containment barrier. This may also include airlocks, access and support rooms, and interconnecting corridors.

Note 2 to entry: This definition is distinct from that used in New Zealand legislation under the *Biosecurity Act 1993* (NZ).

Note 3 to entry: Tertiary ducts, pipes, and decontamination equipment which remove contaminated material from containment facilities are often located in tertiary containment spaces which do not usually form part of the containment facility (see [Clause 4.4](#)). See [Section 10](#) and [Clause 13.3](#) for information related to protection of these systems against breach of containment.

1.4.17

cross-contamination

undesirable transfer of microorganisms from one source to another

1.4.18

decontamination

physical or chemical process that kills or removes pathogenic microorganisms, but does not necessarily result in sterility

1.4.19

diagnostic specimen

human, animal, plant or invertebrate material submitted for purposes of diagnosis or analysis

Note 1 to entry: A specimen includes material such as excreta, secretions, blood and its components, tissue and tissue fluids.

1.4.20

disinfectant

substance capable of killing a wide range of microorganisms

1.4.21

exotic organism

organism which is not established in the country or location of interest

1.4.22

exposure standard

airborne concentration of a particular substance (not microorganisms) 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

Note 1 to entry: The exposure standard can be of three forms: time-weighted average (TWA), peak limitation, or short-term exposure limit (STEL).

1.4.23

high-efficiency particulate air filter

HEPA filter

filter that satisfies certain levels of efficiency for capturing contaminated particles

Note 1 to entry: See [Clause 11.10.1](#) for requirements for HEPA filters.

1.4.24

immunization

protective mechanism to provide immunity against a microorganism

Note 1 to entry: See *vaccination* ([1.4.44](#)).

1.4.25

infectious microorganism

microorganism capable of invading a susceptible host and multiplying in it, which may or may not cause a disease

1.4.26

invertebrate

animal without a backbone

Note 1 to entry: This includes annelids, cnidarians, echinoderms, flatworms, nematodes, molluscs and arthropods. Protozoans are not included due to their microscopic size and single cellular nature.

1.4.27**laboratory biosecurity**

institutional and personal security measures designed to prevent the loss, theft, misuse, diversion or intentional release of pathogens and toxins

1.4.28**may**

indicates the existence of an option

1.4.29**microbiological hazard**

potential microbiological source of harm

Note 1 to entry: Also referred to as a *biohazard* [1.4.7](#).

1.4.30**microbiological spill**

incident where control of microbial material has been lost inadvertently

1.4.31**microorganism**

microscopic organism including protozoa, fungi, archaea, bacteria, unicellular algae, viruses and viroids

1.4.32**pathogen**

infectious organism, usually microscopic, capable of causing disease in a host

1.4.33**personal protective equipment****PPE**

device or equipment, including clothing, designed to be worn or held by a person on its own, or as part of a system, to protect against one or more health and safety hazards

1.4.34**plant**

organism belonging to the kingdom Plantae

1.4.35**prion**

proteinaceous infectious particle that lacks nucleic acids, which can cause scrapie and other related neurodegenerative diseases of humans and animals

1.4.36**relevant authority**

agency authorized by legislation or regulation to issue determinations, orders, or other instructions in respect of any subject covered by this document

Note 1 to entry: This may include a local, state or territory or Australian or New Zealand government authority.

1.4.37**risk assessment**

process of estimating the potential of a hazard (source of harm) to give rise to an adverse outcome

Note 1 to entry: This estimation is based on a combination of the likelihood of the hazard occurring and the consequences if the hazard occurs. Control measures are used to limit the risk.

Note 2 to entry: Refer to AS 2243.1 and AS ISO 31000 for further information.

1.4.38**shall**

indicates a statement is mandatory

1.4.39**sharps**

objects or devices having sharp points or protuberances or cutting edges, capable of cutting or piercing the skin

Note 1 to entry: Refer to AS 4031 for information on sharps containers.

1.4.40**should**

indicates a recommendation

1.4.41**sterile**

state of being free from viable microorganisms

1.4.42**sterilization**

validated process used to render a product free from viable microorganisms

Note 1 to entry: The number of microorganisms that survive a sterilization process can be expressed in terms of probability. While the probability may be reduced to a very low number, it can never be reduced to zero.

1.4.43**terrestrial animal**

terrestrial vertebrate animal

1.4.44**vaccination**

administration of a vaccine in order to make a person immune or resistant to infectious microorganisms

1.4.45**viable**

capable of growth even though resuscitation procedures may be required

Note 1 to entry: For example, when microorganisms are sub-lethally damaged by being frozen, dried, heated or affected by chemicals and/or disinfectants.

1.5 Abbreviations

For the purposes of this document, the following abbreviations apply:

BC	Biosafety committee
BCG	Bacille Calmette-Guérin
BICON	Biosecurity Import Conditions system
BSC	Biological safety cabinet
BSO	Biological safety officer
CDSC	Cytotoxic drug safety cabinet
DAWE	Department of Agriculture, Water and the Environment
DNA	Deoxyribonucleic acid
EPA	Environmental Protection Agency (Australia)
EPA	Environmental Protection Authority (NZ)

GMO	Genetically modified organism
HEPA	High-efficiency particulate air
HIV	Human immunodeficiency virus
HSNO	Hazardous Substances and New Organisms
IATA	International Air Transport Association
IBSC	Institutional biological safety committee
IMO	International Maritime Organization
ISO	International Organization for Standardization
MPI	Ministry for Primary Industries (NZ)
NHMRC	National Health and Medical Research Council
NOHSC	National Occupational Health and Safety Commission
NRL	National Radiation Laboratory
NTAC	National Tuberculosis Advisory Committee
OGTR	Office of the Gene Technology Regulator
OIE	World Organization for Animal Health
PC	Physical containment
PCD	Process challenge devices
PPE	Personal protective equipment
QAC	Quaternary ammonium compounds
RPE	Respiratory protective equipment
SCBA	Self-contained breathing apparatus
SDS	Safety data sheets
SPF	Specific pathogen free
SSBA	Security sensitive biological agent
STEL	Short-term exposure limit
TB	Tuberculosis
TST	Tuberculin skin test
TWA	Time-weighted average
UN	United Nations
WHO	World Health Organization
WHS	Work health and safety

Section 2 Organizational responsibility

2.1 Responsibility

2.1.1 Risk assessment

Work with biohazards shall only be undertaken after a risk assessment of the work has been conducted and it has been demonstrated that any biohazards are controlled. This process shall be documented and regularly reviewed to ensure its ongoing validity. Review shall be undertaken whenever a change to the parameters of the original risk assessment is planned.

NOTE 1 Refer to ISO 35001 for a process for managing biorisks for laboratories and other related organizations. In particular, the key contents of ISO 35001 include the following:

- (a) Management of biosafety and biosecurity according to a “Plan-Do-Check-Act” process.
- (b) Definition of a process to identify, assess, control and monitor risk associated with hazardous biological materials.
- (c) Requirement that an organization establishes, documents, implements, communicates, maintains and continually improves a biorisk management system.
- (d) Provision of tools to support the adoption of a biorisk management system according to information contained within ISO 35001.

NOTE 2 Refer also to AS ISO 31000 for risk management guidelines generally.

The risk assessment shall be done prior to commencement of any work to determine the appropriate type and level of containment facility. The risk assessment should include consideration of the following:

- (a) Microorganisms involved, their presence or absence in Australia and New Zealand, their source, risk group, volume, concentration, mode of transmission, host range, minimum infectious dose, vectors and the nature of the proposed work.
- (b) Regulatory conditions for imported organisms, GMOs, *in vivo* work and SSABs (see [Clauses 2.2, 2.3 and 2.4](#)).
- (c) Processes and equipment to be used.
- (d) Storage requirements and safe handling between work areas and storage areas.
- (e) Containment performance of the facility construction, including the seal quality of the facility, air pressure and directional control mechanisms, treatment and filtration of air leaving the facility and emergency backup systems, where applicable.
- (f) Suitability of containment equipment such as BSCs, for the intended work.
- (g) Provisions for handling, decontamination and disposal of potentially contaminated waste, including liquid waste from drains.
- (h) Availability and suitability of PPE for the intended work.
- (i) Training and experience of personnel with the particular microorganisms proposed for the work.
- (j) Any health considerations for personnel, including cleaning staff (e.g. vaccinations and medical monitoring).
- (k) Capability to deal with a spill, such as by facility gaseous decontamination.

All risk assessments that involve biological systems are subject to a level of uncertainty due to a lack of experimental evidence. The level of uncertainty should be considered when conducting the risk assessment.

2.1.2 Establishment and management of a biosafety committee

Each institution that conducts work with microorganisms shall establish or have access to an established biosafety committee (BC). Responsibilities of the BC should include:

- (a) Ensuring that a system is in place for training and assessment of personnel.
- (b) Overall monitoring and surveillance of the continuing implementation of standards and guidelines.
- (c) Review of risk assessments before the work commences.
- (d) Implications of microbiological components of research proposals.
- (e) Inspection, inspection frequency, audits and any licensing of laboratories.
- (f) Review of safety audits.
- (g) Ensuring that appropriate records are kept, including personnel training, immunizations, and relevant WHS-related medical advice.

NOTE Refer to national, state and territory legislation for requirements applicable to biosafety committees.

2.1.3 Biological safety officer

A biological safety officer shall be appointed and contactable to provide advice and guidance on microbiological safety.

2.1.4 Person with responsibility for the operation of the laboratory or facility

The person with overall responsibility for operation of the laboratory or facility shall ensure that safe procedures are documented, put into practice, and reviewed and updated regularly. The person shall implement initial and continuing training programs, ensure personnel are supervised and that maintenance is carried out in accordance with safe procedures. The person shall ensure that casual visitors have restricted access to the laboratory or facility.

2.1.5 Responsibility of laboratory personnel

Responsibility for WHS is outlined in national, state and territory legislation. In addition to relevant legislative requirements, the following requirements apply to all laboratory personnel:

- (a) Individuals shall understand the requirements and recommendations in the laboratory safety manual.
- (b) Individuals shall be familiar with, and correctly use, the appropriate safety equipment provided.
- (c) Individuals, who alone know the nature and contents of their potentially contaminated experimental materials, apparatus and equipment, shall ensure that the apparatus (or the remains, if broken) are decontaminated before maintenance or disposal, and that materials are processed in accordance with laboratory policy before disposal.

NOTE Refer to AS 2243.1 for further requirements for laboratory personnel.

2.2 Biosecurity material

2.2.1 Australia

An organization shall conform to the biosafety requirements set out by the DAWE.

2.2.2 New Zealand

An organization shall conform to the biosafety requirements set out by the MPI and the EPA.

2.3 Laboratories using genetically modified organisms

2.3.1 Australia

Under the Commonwealth *Gene Technology Act 2000* and *Gene Technology Regulations 2001*, certain dealings with GMOs are required to be conducted in facilities that meet and are certified as complying with OGTR *Guidelines for the Certification of Physical Containment Facilities*.

NOTE Organizations seeking information about the regulatory requirements that apply to work with GMOs should contact the OGTR for further information (<https://www.ogtr.gov.au>).

2.3.2 New Zealand

Under the *Hazardous Substances and New Organisms (HSNO) Act 1996*, work with GMOs is regulated by the EPA. In general, all work involving the holding or development of GMOs is carried out in MPI-approved containment facilities (see [Clause 2.2.2](#)) in accordance with approvals granted by the EPA, an IBSC, or the Chief Executive of EPA New Zealand.

2.4 Laboratory and facility biosecurity

Facilities holding pathogens, toxins or potentially hazardous biological material shall ensure that a specific program for the security of that material is prepared and implemented, taking into account the following:

- (a) Nature of the material.
- (b) Source.
- (c) Type of laboratory work being conducted.
- (d) Potential risks.

Measures should include an inventory of hazardous material and microorganisms, including location and access. All personnel in such facilities shall be trained in security measures in relation to the secure handling of biological material.

NOTE 1 In Australia, the regulation of SSBA is governed by the *National Health Security Act 2007* (Cth), which is administered by the Australian Government Department of Health and Aged Care (<https://www.health.gov.au/ssba>).

NOTE 2 In Australia, state and territory governments may also have requirements for the security of biohazardous material that need to be met.

NOTE 3 In Australia, restrictions on microorganisms and toxins as listed in the Defence and Strategic Goods List apply under the *Customs Act 1901* (Cth) and *Defence Trade Control Act 2012* (Cth).

NOTE 4 In New Zealand, the MPI and EPA, as well as regional councils and agencies that manage Crown Land, may also have requirements for the security of biohazardous material that need to be met.

2.5 Commissioning

A containment facility shall be assessed for conformance with this document when construction or major alteration is completed on one of the following:

- (a) Containment facility.
- (b) Surrounding building(s).
- (c) Surrounding environment.
- (d) Associated air supply.
- (e) Exhaust systems.
- (f) Waste management system.

Assessment shall include confirmation checks, such as utility supply failures and individual pressure controlling equipment failures, where these are critical for containment performance. An itemized checklist should be developed against the relevant requirements of this document and other applicable legislation, regulations and standards. This itemized checklist should be used when conducting the conformance assessment.

2.6 Health management

2.6.1 General

All personnel shall be informed of and understand the risk of occupational exposure to microorganisms to which they may not be immune. Health monitoring of exposure should be put in place and be relevant to the risks associated with the microorganisms.

When working with human pathogens, personnel working in the containment facility shall be offered, and be encouraged to undertake, an initial medical examination. This examination shall include appropriate medical imaging, as well as periodic examinations, where clinically relevant, i.e. unless a risk assessment has been undertaken to show that these are not required.

NOTE 1 See [Clause 2.6.3](#) for further information on obtaining serum samples.

When working with human pathogens, systems shall be set up for reporting accidents and exposures to microorganisms, monitoring employee absenteeism and medical surveillance of illnesses that are potentially laboratory associated.

NOTE 2: See [Clause 2.6.6](#).

2.6.2 Injuries and infections

All injuries that occur in the workplace shall be reported to the supervisor (see [Clause 2.7](#)). Minor cuts and abrasions, which provide routes for infection from contaminated surfaces, should be adequately covered and kept dry. Infections (especially respiratory or wound) can provide sources of contamination for experimental materials and fellow workers. Individual cases should be assessed in relation to the particular laboratory's work.

Immediate action shall be taken after human blood or body fluid exposure and potentially contaminated sharps injuries.

NOTE Refer to the infection prevention and control procedures to minimize the risk of transmission of Creutzfeldt-Jakob disease (CJD) in health care settings on the Australian Government Department of Health and Aged Care website (<https://www.health.gov.au>), as well as the *Australian Guidelines for the Prevention and Control of Infection in Healthcare* (2019) on the NHMRC website.

2.6.3 Blood samples

Baseline blood or serum samples should be obtained as part of an overall health monitoring or surveillance program based on the opinion or advice from a suitably qualified medical practitioner (e.g. an infectious diseases practitioner, an occupational physician or a general practitioner).

NOTE Refer to national, state and territory legislation for requirements relating to the collection, storage and use of blood samples.

2.6.4 Vaccination of workers

Persons working with human or zoonotic pathogens, or samples that may contain human or zoonotic pathogens, shall be immunized in accordance with the potential risks to the worker.

NOTE 1 Refer to *The Australian Immunization Handbook* published by the NHMRC or the *Immunization Handbook* published by the New Zealand Ministry of Health.

All new personnel working with specimens and cultures potentially containing *Mycobacterium tuberculosis* (*M. tuberculosis*) complex should have a tuberculin skin test (TST) or TB gamma interferon assay. Prior vaccination with Bacille Calmette-Guérin (BCG) confounds TST testing but not the TB gamma interferon assay.

NOTE 2 See Bibliography, Reference 1.1.

Personnel with negative test results should be retested on an annual basis.

NOTE 3 For further guidance, refer to the NTAC, *Revised Guidelines for Australian Laboratories Performing Mycobacteriology Testing* or New Zealand Ministry of Health, *Guidelines for Tuberculosis Control in New Zealand* as in force from time to time.

Vaccination against *M. tuberculosis* is not generally recommended. However, BCG vaccination should be considered for personnel with high risk of exposure to TB and as recommended by relevant state and territory TB control authorities.

2.6.5 At-risk persons

Persons who are immuno-suppressed, immuno-compromised, or otherwise unduly vulnerable to infection (such as persons who are diabetic) should inform their supervisor or personnel responsible for microbiological safety of their condition so that appropriate precautionary action may be taken. Medical opinion shall be obtained if working with human pathogens. Some microorganisms that are regarded as part of the normal flora of humans or animals may be pathogenic for immuno-compromised persons.

2.6.6 Risks to pregnant women and the unborn child

All personnel shall be informed of and understand the risks to an unborn child or pregnant woman of occupational exposure to certain microorganisms (e.g. *Toxoplasma gondii*, *Listeria monocytogenes*, *Cytomegalovirus*, *Parvovirus B19*, *Rubella virus*, *Zika virus*, *HIV*, *Coxiella burnetii*, and *Hepatitis B, C and E viruses*) and some fungi.

NOTE See [Clause 2.6.5](#) for further information on at-risk persons.

Pregnant women should inform their supervisor or personnel responsible for microbiological safety of their condition so that appropriate action (i.e. safety precautions) may be taken. Pregnant women with gestational diabetes should be regarded in the same sense as persons who are diabetic and may be unduly vulnerable to infection. The precise steps taken for protection will vary, depending on the microorganisms to which the woman may be exposed, based on a risk assessment. A medical opinion may be required.

2.7 Incident management and reporting

Where an incident has occurred resulting in an injury or illness, priority shall be given to the care of the injured or ill person. Management of incidents potentially involving microorganisms should give consideration to the nature of the microorganism(s), including the risk group, transmission mechanisms, likely hosts and the environment or processes that are at risk as a result of the incident.

NOTE 1 Refer to national, state and territory legislation and national codes of practice for first aid treatment in the workplace.

Incidents shall be reported verbally to the supervisor as soon as reasonably possible, especially if there is potential for contamination from infectious material. It shall also be documented using the institution's health and safety report form and referred to the BC (or referred as required by the equivalent institutional procedures).

NOTE 2 See [Section 10](#) for guidance in response to microbiological spills.

Incidents involving GMOs or biosecurity material resulting in a breach of containment shall be reported to the relevant authorities.

For certain infections, notification of local public health authorities may be necessary.

Personnel should be encouraged to report all exposures or incidents that have the potential to cause harm so that they may be documented and investigated. If necessary, the procedures shall be changed to prevent further similar incidents producing injuries or illness.

2.8 Emergency response plans

2.8.1 Emergency plan

An emergency evacuation plan shall be developed in accordance with AS 2243.1. The plan shall address emergency microbiological issues. It shall include minimization of the microbiological risk associated with any emergency evacuation. The plan should take into account the different arrangements for entry and exit associated with the containment level of the facility.

Plans shall be developed for the spillage of microorganisms and breaches of containment caused by the release of microorganisms outside the laboratory through accident, deliberate action, natural disaster, fire, sabotage, theft, or any other event. Such plans should be trialled to ensure they can be implemented and the necessary equipment is readily available and in workable condition.

2.8.2 First aid kit

First aid kits should be kept in a prominent, accessible location where they can be retrieved quickly. They shall be clearly sign posted and kept unlocked.

NOTE Refer to national, state and territory legislation for the content of first aid kits in the workplace.

Section 3 Degree of hazard from microorganisms

3.1 General

All work with microorganisms requires the use of standard techniques to minimize risk to people and the environment. Such techniques also maintain the purity of strains of isolates in the laboratory.

Microorganisms vary widely in their ability to infect humans, terrestrial animals, plants, aquatic organisms, and invertebrates, or to spread in the environment. There is obvious, but varied, risk to people from work with microorganisms isolated from or infecting humans. With regard to microorganisms infecting animals, many do not cause human disease, but some zoonotic microorganisms are responsible for serious human infections and can be responsible for serious harm to the economy and the environment.

Some microorganisms that infect arthropods are capable of causing human disease. The arthropods are then said to be vectors of disease, for example, mosquitoes may transmit arboviruses and lice may transmit rickettsiae.

Certain soil microorganisms, while not pathogenic to humans, may cause diseases in plants and be spread to new locations from improper handling or practices. Certain microorganisms infecting plants or animals are subject to strict quarantine control in Australia and New Zealand, to protect the environment and primary industry.

Certain microorganisms (e.g. *Clostridium botulinum*) produce small molecules termed toxins that account for their pathogenicity. Some of the microorganisms that produce toxins are listed in Risk Groups 2 and 3. Toxins are also produced by certain plants and animals such as ricin from castor beans and saxitoxin from shell fish. The safety considerations for working with toxins from these sources are not discussed in this document.

The basic approach to working with microorganisms is to regard them as potential pathogens and to handle them with standard microbiological techniques which, in the main, protect the environment and the operator and maintain the purity of the strain or isolate.

Microorganisms vary widely in their infectivity. This is partly due to differences in the portal of entry of the organism (e.g. by skin penetration, ingestion, entry via the respiratory tract or entry via the conjunctiva), the physiology of the microorganism, the infectious dose and the ability of the microorganism to overcome intrinsic immune and other defences of the host.

Surveys of the causes of laboratory-acquired infections (see Bibliography, Reference 1.2) have shown that only about 20 % of cases followed known accidents with infectious material, the most common being skin penetration accidents, e.g. with a needle and syringe and injury from broken glass. Spillage, mouth pipetting, leakage during centrifugation and bites from infected animals are other causes. Simple precautions can reduce the likelihood of such accidents occurring.

Many of the remaining 80 % of infections are believed to be due to inhalation of aerosols that may be produced from common laboratory operations such as:

- (a) vortexing;
- (b) sonicating;
- (c) homogenizing;
- (d) dropping cultures of high-titre material;
- (e) blowing out the last few drops in a pipette;
- (f) removing a needle from a rubber seal;
- (g) centrifuging;

- (h) grinding;
- (i) vigorous shaking or mixing;
- (j) opening containers of infectious material whose internal pressure may be different from ambient pressure;
- (k) intranasal inoculation of animals;
- (l) harvesting of infected tissues from animals and eggs;
- (m) cell counters; and
- (n) unprotected or open robotics sampling operations.

The probability that an aerosol will contain an infectious dose of an organism is broadly related to the concentration (titre) of the organism in the material being handled. The risk is therefore increased when handling bacterial or viral isolates propagated to high titre in culture or in animals, as compared with clinical specimens, food, water and other samples which may contain fewer organisms. Indeed, high titre cultures of some microorganisms (e.g. some arboviruses) may be infectious by the aerosol-respiratory tract route or through broken skin in the laboratory even though in nature they are normally transmitted by insect bite.

A range of special containment equipment and procedures is available to protect laboratory workers from infection with those microorganisms with a “track record” of transmission by the aerosol-respiratory tract route.

When handling blood, serum or other body fluids and substances, refer to *Infection Control Guidelines* on the Australian Government Department of Health and Aged Care website and the *Australian Guidelines for the Prevention and Control of Infection in Healthcare* on the NHMRC website.

This risk extends to sera and derivatives used as control reagents (both positive and negative) in diagnostic and other procedures.

NOTE Although existing test methods for viruses are sensitive, they do not entirely preclude the possibility of viral contamination. The fact that a serum sample is used as a negative control for some particular tests does not necessarily mean that it is free of viruses.

3.2 Classification of microorganisms by risk group

3.2.1 General

Unless otherwise stated, references to particular risk groups (e.g. Risk Group 1) are to human, terrestrial animal, plant, invertebrate and aquatic organism risk groups (see [Clauses 3.2.2](#) to [3.2.5](#)).

Factors that can be considered in relation to the risk from infectious microorganisms include —

- (a) the potential economic and ecological impact;
- (b) the infectious microorganism’s presence in Australia or New Zealand;
- (c) ease of spread;
- (d) use in the facility, *in vitro* or *in vivo*; and
- (e) the host range.

In addition to the above, factors to consider for invertebrates include —

- (i) the size of the invertebrate, and consequent ease of detection;

NOTE In some cases, the invertebrate may be microscopic in size.

- (ii) ability to disperse;
- (iii) use in the facility, *in vitro* or *in vivo*;
- (iv) resistance to pesticides, especially for exotic invertebrates; and
- (v) potential to be carrying exotic or pesticide-resistant parasites and microorganisms.

3.2.2 Human and terrestrial animal infectious microorganisms

The following classification has been prepared, by modification of the WHO guidelines, for microorganisms that are infectious for humans and terrestrial animals for Australia and New Zealand. It is based on the pathogenicity of the agent, the mode of transmission and host range of the agent, the availability of effective preventive measures, and the availability of effective treatments:

- (a) *Risk Group 1 (low individual and community risk)* — A microorganism that is unlikely to cause human or terrestrial animal disease.
- (b) *Risk Group 2 (moderate individual risk, limited community risk)* — A microorganism that is unlikely to be a significant risk to laboratory workers, the community, livestock, or the environment. Laboratory exposures may cause infection, but effective treatment and preventive measures are available, and the risk of spread is limited.
- (c) *Risk Group 3 (high individual risk, limited to moderate community risk)* — A microorganism that usually causes serious human or terrestrial animal disease and may present a significant risk to laboratory workers. It could present a limited to moderate risk if spread in the community or the environment, but there are usually effective preventive measures or treatment available.
- (d) *Risk Group 4 (high individual and community risk)* — A microorganism that usually produces life-threatening human or terrestrial animal disease, represents a significant risk to laboratory workers and may be readily transmissible from one individual to another. Effective treatment and preventive measures are not usually available.

3.2.3 Plant infectious microorganisms

The risk grouping of plant infectious microorganisms is primarily concerned with containment of plant pathogens to avoid risk to the environment. Plant pathogens are infectious agents capable of causing disease in plants and include fungi, oomycetes, bacteria, viruses, viroids, phytoplasmas, nematodes, plasmodiophorids and chytrids.

The following three risk groups are used to manage risks posed by plant infectious microorganisms:

- (a) *Plant Risk Group 1* — A microorganism that is a low risk to plants, industry, a community or region as it is already present and widely distributed.
- (b) *Plant Risk Group 2* — A microorganism that is a moderate risk to plants, industry, a community or region and is present but not widely distributed, or is exotic but with a limited ability to spread without the assistance of a vector.
- (c) *Plant Risk Group 3* — A microorganism that is a high risk to plants, industry, a community or region and is exotic and readily spread naturally without the assistance of a vector.

3.2.4 Invertebrates carrying microorganisms

The risks posed by invertebrates are based on the nature of the microorganism that they may be carrying and the nature of the invertebrate itself.

Examples include viruses in mosquitoes, midges and biting flies, *Borrelia* in soft ticks, trypanosomes in Triatomid bugs, and tospoviruses in thrips.

The following four groups are used to identify the risks posed by infectious microorganisms carried by invertebrates:

- (a) *Invertebrate Risk Group 1* — A microorganism that is carried by an invertebrate where the microorganism is a low risk to humans, animals or to the environment as it is already present and widely distributed.
- (b) *Invertebrate Risk Group 2* — Microorganisms that are carried by invertebrates where the microorganisms are a moderate risk to humans, animals or to the environment and are present but not widely distributed. They have a limited ability to disperse because of low persistence of the microorganism outside the invertebrate host. They are carried by invertebrates that are unlikely to be able to disperse or can be readily controlled.
- (c) *Invertebrate Risk Group 3* — Microorganisms that are carried by invertebrates where the microorganisms are a high risk to humans, animals or to the environment and are exotic and have the ability to disperse with or without the aid of a vector. They are carried by invertebrates that are able to disperse.
- (d) *Invertebrate Risk Group 4* — Microorganisms that are carried by invertebrates where the microorganisms are a very high risk to humans, animals or to the environment and are exotic and readily able to disperse with or without the aid of a vector. The microorganisms may be carried by invertebrates that are difficult to detect visually.

3.2.5 Aquatic infectious microorganisms

The risks posed by aquatic organisms are based on the nature of the microorganism that they may be carrying and the nature of the aquatic animal or plant itself. The risk grouping of aquatic infectious microorganisms is primarily concerned with containment of aquatic pathogens to avoid risk to humans, animals and the environment. Aquatic pathogens are infectious agents capable of causing disease in aquatic animals and plants including fungi, bacteria, and viruses, rickettsiae, protozoan and metazoan parasites.

The following three groups are used to identify the risks posed by infectious microorganisms carried by aquatic organisms:

- (a) *Aquatic Risk Group 1* — A microorganism that is carried by an aquatic organism where the microorganism is a low risk to humans, animals, primary industries or to the environment as it is already present and widely distributed.
- (b) *Aquatic Risk Group 2* — Microorganisms that are carried by aquatic organisms where the microorganisms are a moderate risk to humans, animals, primary industries, or to the environment. They have the ability to disperse with or without the aid of a vector. They are carried by aquatic organisms that are able to disperse.
- (c) *Aquatic Risk Group 3* — Microorganisms that are carried by aquatic organisms where the microorganisms are a high risk to humans, primary industries or to the environment. They are exotic, targeted for eradication or subject to specific import controls and readily able to disperse with or without the aid of a vector. The microorganisms may be carried by aquatic organisms that are difficult to detect visually.

3.3 Risk-grouping of microorganisms by type

3.3.1 General

[Tables 3.1](#) to [3.12](#) are indicative examples of microorganisms categorized into risk groupings, which can be used for a documented risk assessment (see [Clause 2.1.1](#)).

A documented risk assessment shall be conducted on all microorganisms to determine if the work needs to be conducted with additional precautions or in a different level of PC. The risk assessment

should include a review of recent literature to determine if any additional information may warrant changes to the risk grouping or the level of PC. It should also consider antibiotic resistance, *in vivo* work and work with imported organisms, GMOs and SSABs (see [Clauses 2.2](#) to [2.4](#)).

No tables are provided for microorganisms belonging in Risk Group 1, as the number of relevant microorganisms is large.

Use of some infectious microorganisms in [Tables 3.1](#) to [3.12](#) may be subject to regulation by state and territory or relevant Australian or New Zealand government authorities.

3.3.2 Human and animal infectious microorganism risk group examples

3.3.2.1 Bacteria

[Tables 3.1](#) and [3.5](#) list examples of bacteria of Risk Group 2 and Risk Group 3 respectively and additional information is indicated in footnotes to the tables. Currently, no bacteria are classified in Risk Group 4. In addition to the information in the tables, reference should be made to the work practices specified for the relevant level of PC.

NOTE Refer to the *Tuberculosis Laboratory Biosafety Manual* published by the WHO, *Revised Guidelines for Australian Laboratories Performing Mycobacteriology Testing* and *Guidelines for Tuberculosis Control in New Zealand* for specific recommendations related to handling *Mycobacteria tuberculosis*.

3.3.2.2 Parasites

Many parasites are regarded as Risk Group 2, with respect to their infectious stages. Preparations that are known to be free of infectious stages may not require a containment level corresponding to this risk group. [Table 3.2](#) lists examples of Risk Group 2 parasites.

3.3.2.3 Fungi

[Tables 3.3](#) and [3.6](#) list examples of fungi of Risk Group 2 and Risk Group 3 respectively.

NOTE Refer to *Mycology Online* for information on handling fungi.

3.3.2.4 Viruses

[Tables 3.4](#), [3.7](#) and [3.8](#) list examples of viruses for Risk Groups 2, 3 and 4 respectively.

The additional containment requirements for poliovirus set out in [Appendix A](#) shall be applied.

3.3.3 Plant risk group examples

[Tables 3.9](#) and [3.10](#) list examples of plant infectious microorganisms of Plant Risk Groups 2 and 3 respectively.

3.3.4 Invertebrate risk group examples

Invertebrates are able to act as vectors for human, terrestrial animal and plant disease. Infectious microorganisms that use invertebrates as vectors are not listed in separate tables. Instead, examples of infectious microorganisms of Risk Groups 2, 3 and 4 that are vectored by invertebrates are included in [Tables 3.1](#), [3.2](#), [3.4](#), [3.5](#) and [3.7](#) to [3.10](#).

3.3.5 Aquatic risk group examples

[Tables 3.11](#) and [3.12](#) list examples of aquatic infectious microorganisms of Risk Group 2 and 3.

NOTE A number of “transitional” pathogens or “notifiable pathogens subject to control” but whose presence in Australia is confirmed but have not been eradicated have been omitted from [Tables 3.11](#) and [3.12](#). State and territory regulations in respect of organisms that have been detected vary between jurisdictions. As such, in instances where there is doubt as to whether an organism is exotic, advice should be sought from relevant state and territory authorities.

3.4 Human and animal clinical and diagnostic specimens

Diagnostic specimens derived from humans and animals would normally be regarded as Risk Group 2. They shall be handled in PC2 facilities (see [Clause 4.3.3](#)), unless a higher risk group is indicated by the clinical or diagnostic notes. This applies in all microbiology and other pathology laboratories, e.g. for haematology and biochemistry. If a microorganism of a higher risk group is suspected through accumulation of reasonable evidence, isolated or confirmed from a specimen, the isolate and all infectious samples from that source shall be handled according to the corresponding risk group, and at the appropriate PC level.

All clinical and diagnostic specimens shall be treated with care as they may contain multiple types of infectious agents.

3.5 Quality assurance of cultures and materials

Cultures and materials containing microorganisms are regularly transferred within and between institutions and PC levels. Laboratory-acquired infections have occurred because of cross-contamination and ineffective attenuation or inactivation.

Prior to dispatch within and between institutions and PC levels and upon receipt, cultures shall be tested to ensure identity and purity.

If infectious microorganisms are attenuated or inactivated prior to removal to a lower PC level or prior to transfer between institutions, the attenuation or inactivation shall be verified and documented.

Routine quality control testing of registered live vaccine strains should be carried out in a BSC.

3.6 Work with human, animal or plant cells

Work with human, animal, invertebrate and plant cells has the potential to be hazardous to laboratory workers and the environment, depending on the source of the cells and the likelihood that they contain infectious microorganisms. A documented risk assessment shall be carried out to determine what level of containment is required for the cells proposed for use. The preparation of primary cells from human organs or tissues shall be conducted in PC2 containment. The manipulation of these cell lines should be done in Class II BSCs.

Mycoplasma infect many cell lines. Although antibiotics can eliminate mycoplasma contamination, cell lines can become reinfected and pose a hazard to the laboratory worker. Cell lines from an animal source can also contain microorganisms that are capable of causing disease in humans and animals. In some instances, PC1 laboratories can be adequate if good microbiological practices are followed, e.g. work with standard human cell lines.

Plant cells and tissue cultures can contain plant infectious microorganisms that have the potential to spread in the environment if inadvertently released and cause economic and environmental damage.

If cells are no longer required, they shall be decontaminated prior to disposal.

3.7 Prions

Prions are resistant to most traditional methods of inactivation used for other microorganisms such as formaldehyde, ultraviolet light, ethylene oxide, ionizing radiation and moist heat at 121 °C. Because of the difficulties in destroying prions or ensuring they are non-infectious, they pose particular laboratory problems. However, they are not easily spread from host to host and the usual mechanism of spread appears to be by the ingestion or grafting of infectious material.

When work involves infectious prions, a Class II BSC shall be used. When it is possible for prions to contaminate voids and exhaust air paths between the operating surface of the Class II BSC and the cabinet exhaust filter, a laminar flow CDSC shall be used. A risk assessment shall be carried out to determine when a CDSC shall be used.

[Table 3.4](#) lists examples of prions of Risk Group 2 (see also [Clauses 11.9](#) and [13.2.1](#)). [Table D.2](#) provides guidance on disinfection of equipment or surfaces contaminated with prions.

For potentially infectious diagnostic samples, see [Clause 3.4](#).

3.8 Scale of cultures

The risk group classifications listed in [Tables 3.1](#) to [3.7](#) are appropriate for small-scale volume laboratory operations with microorganisms of Risk Groups 2 and 3. Where larger volumes or very high concentrations of the microorganisms are to be handled, the risk of infection or inadvertent release from containment can be higher and additional precautions or an increase in PC level may be appropriate. See also [Clause 2.3](#) for large scale GMO work.

Table 3.1 — Examples^a of bacteria of Risk Group 2

Organism	
<i>Acidovorax</i> spp.	<i>Haemophilus</i> spp.
<i>Acinetobacter</i> spp.	<i>Helicobacter</i> spp.
<i>Actinomyces</i> spp.	<i>Kingella kingae</i>
<i>Aeromonas</i> spp.	<i>Klebsiella</i> spp.
<i>Afipia</i> spp.	<i>Legionella</i> spp.
<i>Arcanobacterium haemolyticum</i>	<i>Leptospira interrogans</i> (all serovars) ^c
<i>Bacillus</i> spp. (except <i>B. anthracis</i> ^{i,l})	<i>Listeria</i> spp., <i>L. monocytogenes</i> ^d
<i>B. anthracis</i> Sterne strain ^{e,j,k}	
<i>Bacterioides fragilis</i>	<i>Moraxella</i> spp.
<i>Bartonella</i> spp. (except <i>B. bacilliformis</i>)	<i>Mycobacterium</i> spp. other than <i>M. tuberculosis</i> complex ^e
<i>Bordetella pertussis</i>	<i>Mycobacterium tuberculosis</i> complex (except multi-drug resistant strains ^{e,f,h,l})
<i>Borrelia</i> spp. (serology only)	<i>Mycoplasma</i> spp.
<i>Brucella</i> spp. (serology only), <i>B. ovis</i>	<i>M. pneumoniae</i> ^e
<i>Burkholderia</i> spp (except <i>B. mallei</i>)	<i>Neisseria gonorrhoeae</i>
<i>B. pseudomallei</i> ^{b,e}	unspeciated <i>Neisseria</i> / <i>N. meningitidis</i> ^{b,e}
<i>Campylobacter</i> spp.	<i>Nocardia</i> spp.
<i>Capnocytophaga</i> spp.	<i>Pasteurella</i> spp.
<i>Chlamydia</i> spp. (except <i>C. psittaci</i>)	<i>Pseudomonas</i> spp.
<i>Clostridium</i> spp. ^g	<i>Rhodococcus equi</i>
<i>Corynebacterium diphtheriae</i> , <i>C. pseudotuberculosis</i>	<i>Salmonella enterica</i> serovars
<i>Coxiella burnetii</i> (serology only)	<i>Salmonella</i> Paratyphi A and B ^b
<i>Dermatophilus congolensis</i>	<i>Salmonella</i> Typhi ^{b,f}

Table 3.1 (continued)

Organism	
<i>Eikenella corrodens</i>	<i>Serratia</i> spp.
<i>Enterococcus</i> spp.	<i>Shigella</i> spp. ^b
<i>Erysipelothrix rhusiopathiae</i>	<i>Staphylococcus</i> spp.
<i>Escherichia coli</i> including:	<i>Stenotrophomonas maltophilia</i>
enteropathogenic (EPEC)	<i>Streptobacillus moniliformis</i>
enteroaggregative (EAEC)	<i>Streptococcus</i> spp.
enterotoxigenic (ETEC)	<i>Treponema pallidum</i> ^c
uropathogenic (UPEC)	<i>Ureaplasma ureolyticum</i>
Shiga-like toxin producing (STEC) ^b	<i>Vibrio cholerae</i> , <i>V. parahaemolyticus</i> , <i>V. vulnificus</i>
<i>Fusobacterium</i> spp.	<i>Yersinia</i> spp. (except <i>Y. pestis</i> ⁱ)
<i>Gardnerella vaginalis</i>	
^a This list is not exhaustive. Some species of some genera may be classified as Risk Group 1 subject to a risk assessment and check of current literature. ^b Low infectious dose, high pathogenicity, common source of laboratory-acquired infections. ^c Can penetrate intact skin. ^d May be dangerous for pregnant women. ^e Should be handled in a BSC due to high risk of aerosol spread. ^f Vaccination, see Clause 2.6.4. ^g <i>Clostridium botulinum</i> (botulism toxin-producing strains) — SSBA (see Clause 2.4 Note 1). ^h Less than 5 000 cultures per year. See references in Clause 3.3.2.1. See Clause 3.8. ⁱ SSBA (see Clause 2.4 Note 1). ^j Use of face shields and masks is recommended. ^k High risk of percutaneous infection. ^l See also Table 3.5.	

Table 3.2 — Examples^a of parasites of Risk Group 2 — Infectious stages only

Organism	
<i>Acanthamoeba</i> spp.	<i>Fasciola hepatica</i>
<i>Angiostrongylus cantonensis</i>	<i>Giardia</i> spp.
<i>Anisakis</i> spp.	Hookworm spp.
<i>Ascaris lumbricoides</i>	<i>Leishmania</i> spp.
<i>Babesia</i> spp.	<i>Loa</i>
<i>Balamuthia mandrillaris</i>	<i>Naegleria fowleri</i>
<i>Brugia</i> spp.	<i>Opisthorchis</i> spp.
<i>Clonorchis sinensis</i>	<i>Plasmodium</i> spp. (human and simian)
<i>Cryptosporidium</i> spp.	<i>Rodentolepis</i>
<i>Cyclospora cayetanensis</i>	<i>Schistosoma</i> spp.
<i>Cystoisospora belli</i>	<i>Strongyloides stercoralis</i> ^b
<i>Diphyllobothrium latum</i>	<i>Taenia saginata</i>
<i>Echinococcus</i> spp.	<i>Taenia solium</i> ^c
<i>Entamoeba histolytica</i>	<i>Toxocara</i> spp.
<i>Enterobius vermicularis</i>	<i>Toxoplasma gondii</i> ^d
^a This list is not exhaustive. Some species of some genera may be classified as Risk Group 1 subject to a risk assessment and check of current literature. ^b Filariform larvae may cross intact skin. ^c Accidental ingestion of eggs may lead to cysticercosis. ^d May be teratogenic.	

Table 3.3 — Examples^a of fungi or fungal-like organisms of Risk Group 2

Organism	
<i>Aspergillus fumigatus</i>	<i>Microsporum</i> spp.
<i>Candida albicans</i>	<i>Scedosporium</i> spp.
<i>Cryptococcus gattii</i>	<i>Sporothrix schenckii</i>
<i>Cryptococcus neoformans</i>	<i>Trichophyton</i> spp.
<i>Epidermophyton floccosum</i>	
^a This list is not exhaustive. Some species of some genera may be classified as Risk Group 1 subject to a risk assessment and check of current literature.	

Table 3.4 — Examples^a of viruses and prions of Risk Group 2

Virus			
Species	Family: Genus	Previous/Other name	Notes
Adenovirus	Adenoviridae		All types.
Alphaarterivirus equid	Arteriviridae: Alphaarterivirus	Equine arteritis virus	
Avian orthoavulavirus 1	Paramyxoviridae: Orthoavulavirus	Newcastle disease virus	Non-virulent enzootic strains only.
Avian metaavulavirus 2, 5, 6, 7, 8	Paramyxoviridae: Metaavulavirus	Avian paramyxovirus 2, 5, 6, 7 and 8	
Avian metapneumovirus	Pneumoviridae: Metapneumovirus		
Avian orthoavulavirus 9	Paramyxoviridae: Orthoavulavirus	Avian paramyxovirus 9	
Avian paraavulavirus 3 and 4	Paramyxoviridae: Orthoavulavirus	Avian paramyxovirus 3 and 4	
Astrovirus	Astroviridae: Astrovirus		
Barmah Forest virus	Togaviridae: Alphavirus		
Bluetongue virus	Reoviridae: Orbivirus		Endemic strains.
Cardiovirus A	Picornaviridae: Cardiovirus	Encephalomyocarditis virus	
Cowpox virus	Poxviridae: Orthopoxvirus		
Dengue virus	Flaviviridae: Flavivirus		All serotypes.
Duck hepatitis B virus	Hepadnaviridae: Avihepadnavirus		
Enterovirus A to L	Genus Picornaviridae: Enterovirus	Coxsackievirus, Echovirus, Poliovirus, Human enterovirus	Includes coxsackievirus, echovirus, poliovirus and human enterovirus types in Enterovirus A to D and non-human enterovirus types in Enterovirus E to L. Immunization against poliovirus mandatory (see Appendix A).
Epizootic haemorrhagic disease virus	Reoviridae: Orbivirus		Endemic strains.
Feline calicivirus	Caliciviridae: Vesivirus		
Hepacivirus C	Flaviviridae: Hepacivirus	Hepatitis virus C	
Hepatitis delta virus	Unassigned: Deltavirus		
Hepatovirus A	Picornaviridae: Hepatovirus	Hepatitis A virus	Vaccination available (see Clause 2.6.4).
Human coronavirus 229E	Coronaviridae: Alphacoronavirus	HCoV-229E	
Human coronavirus OC43	Coronaviridae: Betacoronavirus	HCoV-OC43	Subspecies of Betacoronavirus 1.
Human alphaherpesvirus 1 and 2	Herpesviridae: Simplexvirus	Herpes simplex virus 1 and 2	
Human alphaherpesvirus 3	Herpesviridae: Varicellovirus	Varicella zoster virus	

Table 3.4 (continued)

Virus			
Species	Family: Genus	Previous/Other name	Notes
Human betaherpesvirus 5	Herpesviridae: Cytomegalovirus		May be teratogenic.
Human betaherpesvirus 6A, 6B and 7	Herpesviridae: Roseolovirus		
Human gammaherpesvirus 4	Herpesviridae: Lymphocryptovirus	Epstein-Barr virus	
Human Hepatitis B	Hepadnavirinae Orthohepadnavirus		
Human gammaherpesvirus 8	Herpesviridae: Rhadinovirus	Kaposi's sarcoma-associated virus	
Human immunodeficiency virus 1 and 2	Retroviridae: Lentivirus		Serology, tests not involving propagation or culture.
Human metapneumovirus	Pneumoviridae: Metapneumovirus		
Human orthopneumovirus	Pneumoviridae: Orthopneumovirus	Human respiratory syncytial virus	
Human orthorubulavirus 2 and 4	Paramyxoviridae: Orthorubulavirus	Human parainfluenza virus 2 and 4	
Human papillomavirus	Papillomaviridae		
Human polyomavirus 1	Polyomaviridae: betapolyomavirus	BK polyomavirus, BK virus	
Human polyomavirus 2	Polyomaviridae: betapolyomavirus	JC polyomavirus, JC virus	
Human respirovirus 1 and 3	Paramyxoviridae: Respirovirus	Human parainfluenza 1 and 3	
Influenza	Orthomyxoviridae		All strains and candidate vaccine strains except those specified in Table 3.7 . Vaccination available (see Clause 2.6.4).
Japanese encephalitis virus – Nakayama and other vaccine strains	Flaviviridae: Flavivirus		Vaccination available (see Clause 2.6.4).
Kokobera virus	Flaviviridae: Flavivirus		
Lymphocytic choriomeningitis mammarenavirus	Arenaviridae: Mammarenavirus	LCMV	Non neurotropic and laboratory adapted strains (see also Table 3.7).
Macaca mulatta polyomavirus 1	Polyomaviridae: Betapolyomavirus	Simian virus 40, SV40	
Mammalian orthoreovirus	Reoviridae: Orthoreovirus	Mammalian reovirus	
Measles morbillivirus	Paramyxoviridae: Morbillivirus	Measles virus	Vaccination available (see Clause 2.6.4).
Menangle pararubulavirus	Paramyxoviridae: Pararubulavirus	Menangle rubulavirus	
Middle East respiratory syndrome-related coronavirus	Coronaviridae: Betacoronavirus	MERS-CoV	Serology and tests not involving propagation or culture.

Table 3.4 (continued)

Virus			
Species	Family: Genus	Previous/Other name	Notes
Mumps orthorubulavirus	Paramyxoviridae: Orthorubulavirus	Mumps rubulavirus	Vaccination available (see Clause 2.6.4).
Molluscum contagiosum virus	Poxviridae: Molluscipoxvirus		
Murine respirovirus	Paramyxoviridae: Respirovirus	Sendai virus	
Murine coronavirus	Coronaviridae: Betacoronavirus	M-CoV	Mouse hepatitis virus.
Murray Valley encephalitis virus	Flaviviridae: Flavivirus		
Norwalk virus	Caliciviridae: Norovirus	Norovirus	All serotypes, genogroups, strains and isolates.
Orf virus	Poxviridae: Parapoxvirus		
Orthohepevirus A	Hepeviridae: Orthohepevirus	Hepatitis virus E	Risk to pregnant women.
Parechovirus A, B, C and D	Picornaviridae: Parechovirus	Human parechovirus, Ljungan virus, Sebokele virus 1 and Ferret parechovirus	
Pegivirus C	Flaviviridae: Pegivirus	GB virus C, Hepatitis virus G	
Porcine epidemic diarrhoea virus	Coronaviridae: Alphacoronavirus	PEDV	
Primate erythroparvovirus 1	Parvoviridae: Erythroparvovirus	Human parvovirus, Parvovirus B19	May be teratogenic.
Primate T-lymphotropic virus 1 and 2	Retroviridae: Deltareovirus	Human T-lymphotropic virus 1 and 2	Serology, tests not involving propagation or culture.
Pseudocowpox virus	Poxviridae: Parapoxvirus	Milkers nodule virus	
Rabbit haemorrhagic disease virus	Caliciviridae: Lagovirus		
Rhinovirus A, B and C	Picornaviridae: Enterovirus		
Ross River virus	Togaviridae: Alphavirus		
Rotavirus A to J	Reoviridae: Rotavirus		
Rubella virus	Matonaviridae: Rubivirus		Vaccination available (see Clause 2.6.4). May be teratogenic.
Sapporo virus	Caliciviridae: Sapovirus		
Saumarez Reef virus	Flaviviridae: Flavivirus		
Semliki Forest virus	Togaviridae: Alphavirus		
Severe acute respiratory syndrome coronavirus (SARS CoV) – related viruses	Coronaviridae: Betacoronavirus	SARS Coronavirus	Serology and tests not involving propagation or culture. SSBA (see Clause 2.4 Note 1).
Simian immunodeficiency virus	Retroviridae; Lentivirus		Serology, tests not involving propagation or culture.
Tacaribe virus complex	Arenaviridae: Mammarenavirus		

Table 3.4 (continued)

Virus			
Species	Family: Genus	Previous/Other name	Notes
<i>Vaccinia virus</i>	<i>Poxviridae: Orthopoxvirus</i>		Vaccination available (see Clause 2.6.4). May be dangerous for pregnant women.
<i>West Nile virus</i> – Kunjin strain	<i>Flaviviridae: Flavivirus</i>		
<i>West Nile virus</i> – Sarafend strain	<i>Flaviviridae: Flavivirus</i>		
<i>Zika virus</i>	<i>Flaviviridae: Flavivirus</i>		May be teratogenic.
Prions			
Gerstmann-Sträussler-Scheinker syndrome			
Creutzfeldt-Jakob disease agent			See Clauses 3.7 and 13.2.1 .
Kuru disease agent			See Clauses 3.7 and 13.2.1 .
^a This list is not exhaustive. Some species of some genera may be classified as Risk Group 1 subject to a risk assessment and check of current literature.			

Table 3.5 — Examples^a of bacteria of Risk Group 3

Organism
<i>Bacillus anthracis</i> ^f <i>Bartonella bacilliformis</i> <i>Burkholderia mallei</i> <i>Brucella</i> spp. (except serology (see Table 3.1) and <i>B. ovis</i>) <i>Chlamydia psittaci</i> (syn <i>Chlamydophila psittaci</i>) <i>Coxiella burnetii</i> (cultures, animal work and concentrates) ^{b,c} <i>Francisella tularensis</i> (Type A) ^f <i>Mycobacterium tuberculosis</i> complex ^{c,d,e} <i>Rickettsia</i> spp. <i>Yersinia pestis</i> ^f
^a This list is not exhaustive. ^b May be dangerous for pregnant women. ^c Vaccination, see Clause 2.6.4 . ^d Respiratory protection should be considered. ^e Greater than 5 000 cultures per year or reference role. Culture, smear microscopy including known multi-drug resistant strains. Identification and drug susceptibility testing. See references in Clause 3.3.2.1 . See Clause 3.8 . ^f SSBA (see Clause 2.4 Note 1).

Table 3.6 — Examples^a of fungi or fungal-like organisms of Risk Group 3^c

Organism
<i>Blastomyces dermatitidis</i> <i>Cladophialophora bantiana</i> <i>Coccidioides immitis</i> ^b <i>Coccidioides posadasii</i> <i>Histoplasma</i> spp. <i>Paracoccidioides brasiliensis</i> <i>Talaromyces marneffe</i> (syn <i>Penicillium marneffe</i>)
^a This list is not exhaustive. ^b May be dangerous for pregnant women. ^c The mycelial forms of these fungi produce highly infectious conidia. The use of plate cultures should be avoided.

Table 3.7 — Examples^a of viruses of Risk Group 3

Virus			
Species	Family: Genus	Previous/Other name	Notes
Australian Bat Lyssa virus	Rhabdoviridae: Lyssavirus		Vaccination available (see Clause 2.6.4).
Avian orthoavulavirus 1	Paramyxoviridae: Orthoavulavirus	Newcastle disease virus	Exotic strains.
Avian Influenza virus	Orthomyxoviridae	Highly pathogenic strains	Propagative activities. SSBA (see Clause 2.4 Note 1).
Chikungunya	Togaviridae: Alphavirus		
Eastern equine encephalitis virus	Togaviridae: Alphavirus		
Hantaan orthohantavirus	Bunyaviridae; Orthohantavirus	Hantaan and related strains	
Human immunodeficiency virus 1 and 2	Retroviridae: Lentivirus		Propagative <i>in vitro</i> activities.
Influenza virus	Orthomyxoviridae	Highly pathogenic strains	Vaccination available (see Clause 2.6.4). SSBA (see Clause 2.4 Note 1).
Japanese encephalitis virus	Flaviviridae: Flavivirus		Vaccination available (see Clause 2.6.4).
Lymphocytic choriomeningitis mammarenavirus	Arenaviridae: Mammarenavirus	LCMV Neurotropic strains	
Mapeura pararubulavirus	Paramyxoviridae: Pararubulavirus	Mapeura rubulavirus	
Middle East respiratory syndrome-related coronavirus	Coronaviridae: Betacoronavirus	MERS-CoV	Propagative <i>in vitro</i> activities.
Oropouche orthobunyavirus	Bunyaviridae; Orthobunyavirus		
Primate T-lymphotropic virus 1 and 2	Retroviridae: Deltareovirus	Human T-lymphotropic virus 1 and 2	Propagative <i>in vitro</i> activities.

Table 3.7 (continued)

Virus			
Species	Family: Genus	Previous/Other name	Notes
<i>Rabies lyssavirus</i>	<i>Rhabdovirus; Lyssavirus</i>	Fixed strain only	
<i>Rift Valley Fever phlebovirus</i>	<i>Phenuiviridae; phlebovirus</i>		
<i>Severe acute respiratory syndrome coronavirus (SARS CoV) – related viruses</i>	<i>Coronaviridae: Betacoronavirus</i>	SARS-coronavirus	Propagative <i>in vitro</i> activities. SSBA (see Clause 2.4 Note 1).
<i>Simian immunodeficiency virus</i>	<i>Retroviridae: Lentivirus</i>		
<i>St Louis Encephalitis virus</i>	<i>Flaviviridae: Flavivirus</i>		Propagative <i>in vitro</i> activities.
<i>Tick-borne viruses</i>	<i>Flaviviridae: Flavivirus</i>		
<i>Venezuelan equine encephalitis virus</i>	<i>Togaviridae: Alphavirus</i>		
<i>Western equine encephalitis virus</i>	<i>Togaviridae: Alphavirus</i>		
<i>West Nile virus</i>	<i>Flaviviridae: Flavivirus</i>		
<i>Yellow fever virus</i>	<i>Flaviviridae: Flavivirus</i>		Vaccination available (see Clause 2.6.4). May be teratogenic. SSBA (see Clause 2.4 Note 1).
a This list is not exhaustive.			

Table 3.8 — Examples^a of viruses in Risk Group 4

Virus			
Species	Family: Genus	Previous/Other name	Notes
Crimean-Congo haemorrhagic Orthonaviruses	Bunyaviridae; Orthonaviruses		
Ebola virus	Filoviridae		
Guanarito virus	Arenaviridae; Arenavirus		SSBA (see Clause 2.4 Note 1)
Hazara orthonaviruses	Bunyaviridae; Orthonaviruses		
Hendra virus	Paramyxoviridae: Henipavirus		
Junin virus	Arenaviridae; Arenavirus		
Kyasanur Forest Virus	Flaviridae; Flavivirus		
Lassa virus	Arenavirus; Arenavirus		
Macacine alphaherpesvirus	Herpesviridae; Alphaherpesvirus	Herpes virus simiae (B virus)	
Machupo virus	Arenaviridae; Arenavirus		
Marburg virus	Filoviridae		SSBA (see Clause 2.4 Note 1).
Mopeia viruses	Arenaviridae; Arenavirus		
Nipah virus	Paramyxoviridae: Henipavirus		
Omsk Haemorrhagic virus	Flaviviridae: Flavivirus		
Sabia virus	Arenaviridae; Arenavirus		
Tick-borne encephalitis virus	Flaviviridae: Flavivirus		
^a This list is not exhaustive.			

Table 3.9 — Examples^a of plant pathogens of Plant Risk Group 2^b

Organism
Onion smut (<i>Urocystis magica</i>) — soilborne, under control
Citrus canker (<i>Xanthomonas axonopodis</i>) — exotic, splash-dispersed
Fire blight (<i>Erwinia amylovora</i>) — exotic, needs vector
Plum pox potyvirus — exotic, needs vector
Potato cyst nematode (<i>Globodera rostochiensis</i> and <i>G. pallida</i>) — soilborne, under control or exotic
Pierce's disease (<i>Xylella fastidiosa</i>) — exotic, needs vector
Chestnut blight (<i>Cryphonectria parasitica</i>) — under control, splash-dispersed
Pine pitch canker (<i>Fusarium circinatum</i>) — exotic, splash-dispersed
^a This list is not exhaustive.
^b Use of plant pathogens may also be subject to regulation by state and territory or relevant Australian or New Zealand government authorities.

Table 3.10 — Examples^a of plant pathogens of Plant Risk Group 3^b

Organism
Karnal bunt (<i>Tilletia indica</i>) — exotic, wind borne
Grapevine rust (<i>Phakopsora euvitidis</i>) — exotic, wind borne
Sudden oak death (<i>Phytophthora ramorum</i>) — exotic, wind borne
Potato late blight (<i>Phytophthora infestans</i>) exotic strains — wind borne
Guava rust/eucalyptus rust/myrtle rust (<i>Austropuccinia psidii</i>) — required for States not already affected, and for exotic strains, wind borne
^a This list is not exhaustive.
^b Use of plant pathogens may also be subject to regulation by state and territory or relevant Australian or New Zealand government authorities.

Table 3.11 — Examples^a of aquatic pathogens of Risk Group 2^b

Organism	Family
Abalone herpesvirus	<i>Malacoherpesviridae</i>
<i>Aphanomyces invadans</i>	<i>Leptolegniaceae</i>
<i>Aeromonas salmonicida</i> subspp. (excluding subsp. <i>salmonicida</i>)	<i>Aeromonadaceae</i>
<i>Batrachochytrium dendrobatidis</i>	Not assigned
<i>Bonamia exitiosa</i>	<i>Haplosporidiidae</i>
<i>Bonamia</i> sp.	<i>Haplosporidiidae</i>
<i>Edwardsiella ictaluri</i>	<i>Enterobacteriaceae</i>
Epizootic haematopoietic necrosis virus	<i>Iridoviridae</i>
Gill-associated virus	<i>Roniviridae</i>
Infectious hypodermal and haematopoietic necrosis virus	<i>Parvoviridae</i>
<i>Macrobrachium rosenbergii</i> nodavirus	<i>Nodaviridae</i>
<i>Marteilia sydneyi</i>	<i>Marteiliidae</i>
Nervous necrosis virus	<i>Nodaviridae</i>
Ostreid herpesvirus-1 including μ Var	<i>Malacoherpesviridae</i>
<i>Perkinsus olseni</i>	<i>Perkinsidae</i>
<i>Ranavirus</i>	<i>Iridoviridae</i>
^a This list is not exhaustive.	
^b Use of aquatic pathogens may also be subject to regulation by state and territory or relevant Australian or New Zealand government authorities.	

Table 3.12 — Examples^a of aquatic pathogens of Risk Group 3^{b,c,d}

Organism	Family
<i>Aeromonas salmonicida</i> subsp. <i>salmonicida</i>	<i>Aeromonadaceae</i>
<i>Aphanomyces astaci</i>	<i>Leptolegniaceae</i>
<i>Bonamia ostreae</i>	<i>Haplosporidiidae</i>
<i>Candidatus Hepatobacter penaei</i>	<i>Rhizobiaceae</i>
Channel catfish virus	<i>Alloherpesviridae</i>
European catfish virus/European sheatfish virus	<i>Iridoviridae</i>
Grouper iridovirus	<i>Iridoviridae</i>
<i>Gyrodactylus salaris</i>	<i>Gyrodactylidae</i>
Infectious haematopoietic necrosis virus	<i>Rhabdoviridae</i>
Infectious myonecrosis virus	<i>Totiviridae</i>
Infectious pancreatic necrosis virus	<i>Birnaviridae</i>
Infectious salmon anaemia virus	<i>Orthomyxoviridae</i>
Koi herpesvirus	<i>Alloherpesviridae</i>
Laem-Singh virus	Not assigned
<i>Marteilia refringens</i>	<i>Marteiliidae</i>
<i>Marteilioides chungmuensis</i>	<i>Marteiliidae</i>
<i>Mikrocytos mackini</i>	<i>Mikrocytiidae</i>
<i>Myxobolus cerebralis</i>	<i>Myxobolidae</i>
<i>Perkinsus marinus</i>	<i>Perkinsidae</i>
<i>Piscirickettsia salmonis</i>	<i>Piscirickettsiaceae</i>
Red sea bream iridovirus	<i>Iridoviridae</i>
<i>Renibacterium salmoninarum</i>	<i>Micrococcaceae</i>
Salmonid alphavirus	<i>Togaviridae</i>
Spring viraemia of carp virus	<i>Rhabdoviridae</i>
Taura syndrome virus	<i>Dicistroviridae</i>
<i>Vibrio parahaemolyticus</i> (VPA _{HHPND} ^e)	<i>Vibrionaceae</i>
Viral haemorrhagic septicaemia virus	<i>Rhabdoviridae</i>
<i>Xenohaliotis californiensis</i>	<i>Anaplasmataceae</i>
Yellow head virus	<i>Roniviridae</i>
<i>Yersinia ruckeri</i> — Hagerman strain	<i>Enterobacteriaceae</i>

^a This list is not exhaustive.

^b Use of aquatic pathogens may also be subject to regulation by state and territory or relevant Australian or New Zealand government authorities.

^c For diagnostic purposes, excluding culture of pathogens, organisms categorized as Risk Group 3 may be handled in PC2 facilities (see [Clause 4.3.3](#)) with permission from the relevant authority.

^d A number of examples of megalocytiviruses are listed in Biosecurity Australia, *Importation of freshwater ornamental fish: review of biosecurity risks associated with gourami iridovirus and related viruses – Provisional final import risk analysis report*, Department of Agriculture, Canberra, Australia, 2010, pp. 7–8. At least one of the viruses listed in this publication have already been detected in Australia in aquaculture and others are recorded in imported ornamental fish. Before work commences with such viruses, advice should be sought from relevant state, territory or Australian or New Zealand government authorities (see Bibliography, References 1.31 and 1.32).

^e VPA_{HHPND} is a newly emerging disease of farmed prawns in Asia — information on this disease is changing on a regular basis.

Section 4 Principles of containment

4.1 General

Containment of microorganisms involves a combination of buildings, engineering function, equipment, and workplace practices to handle microorganisms safely. Physical containment (PC) is the term used to describe procedures and structures designed to reduce or prevent the release of viable organisms into the outside environment and to protect laboratory occupants, the wider community and other susceptible organisms from exposure and infection. Four PC levels, PC1 to PC4, are assigned for work with microorganisms.

Viable microorganisms and terrestrial animals, plants, invertebrates, or aquatic organisms inoculated with microorganisms from defined risk groups shall be used, stored or housed in corresponding or higher level containment facilities. Before any work is carried out at a lower level of containment, a risk assessment shall be carried out. The necessary control measures shall be documented, implemented, maintained and monitored to ensure the ongoing protection of the laboratory or facility, the wider community and the environment.

Some facilities may be required to house animals, plants, invertebrates and aquatic species. They also may be used simultaneously to carry out microbiological work. These facilities shall be constructed in accordance with the applicable sections of this document.

4.2 Containment measures

4.2.1 General

The general measures by which microbiological containment is achieved are known as primary, secondary and tertiary containment measures. Optimal microbiological containment is provided by the “box-within-a-box” principle (see [Figure 4.1](#)), where the highest hazards are enclosed by multiple containment measures.

4.2.2 Primary containment measures

Primary containment measures are the constraints immediately surrounding the source of infectious material, such as a BSC, a ventilated animal enclosure, a sealed animal room with appropriate air pressure controls, or the leak-proof container forming the inner receptacle of an approved IATA infectious materials transport container.

4.2.3 Secondary containment measures

Secondary containment measures include the design of a laboratory or device that encloses the primary containment. Facility design and engineering operations providing laboratories with air pressure control and directional air flow (supplemented by HEPA filtration of exhaust air) are examples of secondary containment measures. Another example is the secondary receptacle of an approved IATA transport container. In the laboratory or animal room, secondary PC measures are invariably supplemented by defined work practices, including PPE use.

4.2.4 Tertiary containment measures

Tertiary containment measures provide protection of the wider environment by supporting the secondary containment, e.g. using the outer packaging of an approved IATA transport container, an isolated building complex, control of people movements, and provision of support services such as decontamination and laundering of clothing and disposal of infectious wastes.

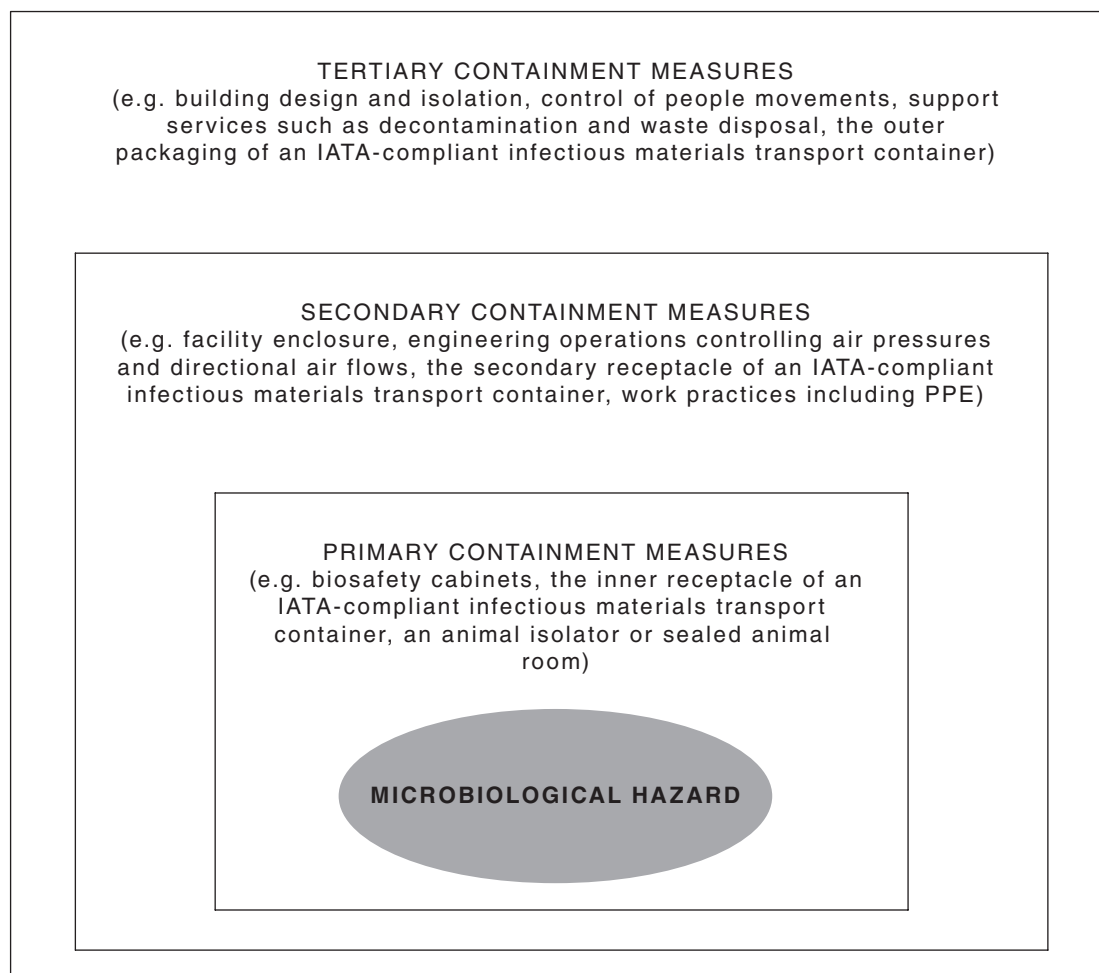


Figure 4.1 — Relationship between containment measures

4.3 Physical containment classifications

4.3.1 General

The risk posed by different microorganisms varies greatly and this is reflected by the organization of microorganisms into the risk groups given in [Section 3](#). The PC level used when working with microorganisms shall be at least the appropriate level for the risk group of the microorganism, e.g. PC level 1 for Risk Group 1, PC level 2 for Risk Group 2.

All work done in a laboratory or facility of a specific PC level shall follow procedures prescribed for that level of physical containment.

4.3.2 Physical containment level 1 (PC1)

A PC1 laboratory or facility is suitable for work with microorganisms or material likely to contain microorganisms of Risk Group 1. It is suitable where laboratory or facility personnel can be adequately protected by standard laboratory practices and equipment. This level of laboratory or facility is usually suitable for student and undergraduate teaching laboratories. Specimens that have been inactivated or fixed may be handled in PC1 facilities.

4.3.3 Physical containment level 2 (PC2)

A PC2 laboratory or facility is suitable for research and diagnostic work with microorganisms or material likely to contain microorganisms of Risk Group 2. A BSC shall be used when working with specimens containing microorganisms transmissible by the respiratory route, or if the work produces a significant risk to humans or the environment from the production of infectious aerosols.

4.3.4 Physical containment level 3 (PC3)

A PC3 laboratory or facility is suitable for research and diagnostic work with microorganisms or material likely to contain microorganisms of Risk Group 3.

A PC3 laboratory or facility provides additional building features and services to minimize the risk of infection to individuals, the community and the environment.

4.3.5 Physical containment level 4 (PC4)

A PC4 laboratory or facility is suitable for work with microorganisms or material likely to contain microorganisms of Risk Group 4.

A PC4 laboratory or facility is situated in a building separate from other laboratories or facilities or constructed as an isolated area within a building. The facility is maintained under negative pressure and includes secondary barriers such as sealable openings, airlocks or liquid disinfection barriers, a clothing change and shower room contiguous to the laboratory or facility ventilation system, and exhaust air and liquid waste decontamination systems to prevent the escape of microorganisms to the environment.

A PC4 laboratory or facility may be of two types: one where work is conducted in a Class III BSC exhausting outside the facility; or one where the work is conducted without being isolated in such a manner and staff wear fully encapsulated positive pressure suits.

4.4 Design

The design of the facility shall take into account the potential impact of severe environmental and climatic events (such as seismic events, flooding, snow, wind storms, fire, cyclones and hail storms) that are likely to occur in the area in which it is located so that the risk of damage to the containment barrier is minimized.

Section 5 Laboratory containment facilities

5.1 Laboratory physical containment

The PC level used when working with microorganisms in laboratories shall be at least the appropriate level for the risk group of the microorganism, as set out in [Section 4](#). Requirements for Laboratory PC1, PC2, PC3 and PC4 facilities are set out in [Clauses 5.2](#), [5.3](#), [5.4](#) and [5.5](#) respectively.

All work done in a laboratory of a specific level shall follow procedures prescribed for that level of PC.

5.2 Requirements for Laboratory PC1 facilities

5.2.1 General

A Laboratory PC1 facility is suitable for work which may be safely carried out on the open bench and where no special containment equipment is required (see [Clause 4.3.2](#)).

A sign conforming to [Appendix B](#) showing the level of containment, together with hazard symbols as appropriate and any access restrictions, shall be prominently displayed at all entrances.

5.2.2 Construction

Laboratories shall be constructed in accordance with AS/NZS 2982 and the following requirements to facilitate microbiological safety and reduce the likelihood of microorganisms escaping from containment:

- (a) The floors, doors and any window furnishings shall be smooth, easy to clean, impermeable to liquids, and resistant to commonly used reagents and disinfectants.
- (b) Window furnishings shall not be located next to major sources of heat or potential fire hazards such as hotplates or Bunsen burners.
- (c) Bench tops shall be able to withstand heat generated by general laboratory procedures, e.g. flaming loops and heating of media.
- (d) Open spaces between and under benches, cabinets and equipment shall be accessible for cleaning to prevent build-up of material providing refuge for invertebrates and microorganisms.
- (e) The laboratory construction shall prevent infestation by vermin.
- (f) Furniture shall be ergonomically suitable and appropriate for the specific purpose of the laboratory, the safety of laboratory users and the manipulation of microorganisms in containment. This shall include adjustable height stools and the use of smooth impervious seat coverings to facilitate cleaning.
- (g) Dedicated hand basins or an alternative means of decontaminating the hands shall be provided inside laboratories at, or near, all exits in positions which facilitate hand decontamination as part of the recommended exit procedure.

NOTE 1 Hand decontamination equipment should be located such that operators can use them easily.

NOTE 2 Exits which are only intended for emergency egress purposes may be excluded.

- (h) Backflow prevention for water supplies shall conform to [Appendix C](#).
- (i) Gas supplies in the facility shall conform to the general requirements specified in [Clause C.3.1](#).
- (j) Eyewash facilities in accordance with AS/NZS 2982 shall be provided.

NOTE 3 Refer to AS 4775 for emergency eyewash and shower equipment requirements.

- (k) Storage for PPE shall be provided.

5.2.3 Work practices

The work practices specified in AS 2243.1 shall apply to PC1 laboratories as well as the following (see also [Clause 2.1.5](#)):

- (a) Access shall be limited to authorized personnel. Doors shall be kept closed.
- (b) Eating including the preparation, storage or consumption of food, drinking, smoking, shaving and the application of cosmetics including the handling of contact lenses shall be prohibited in the laboratory.

NOTE 1 This includes offices within the containment facility boundary.

NOTE 2 This includes the chewing of gum and inserting items such as fingers and pens in the mouth.

- (c) PPE worn and used in the laboratory shall conform to the requirements in AS 2243.1 (see also [Clause 11.2](#) for further information). The minimum PPE worn and used shall be protective clothing to afford protection to the front part of the body, and closed shoes (i.e. footwear that covers the toes, upper foot and heels) in accordance with a risk assessment. Protective eyewear shall be worn if a risk assessment of the task requires it. PPE shall be decontaminated or laundered at regular intervals, based on appropriate protocols.

NOTE 3 A back-fastening gown is preferable PPE for the front part of the body.

- (d) Production of aerosols shall be minimized, particularly where work is carried out on the open bench (see also [Clause 3.1](#)).
- (e) Dissemination of microbiological material shall be minimized while flaming a wire loop, by drawing the loop gradually from the cooler to the hotter parts of the Bunsen burner flame, or by using a hooded or an electric Bunsen burner.

NOTE 4 Disposable loops may be used as an alternative.

- (f) Cultures shall be clearly identified and dated. The time for which cultures are kept on the bench shall be minimized. They shall be transferred to a dedicated storage area, such as a refrigerator or part of a cold room.

- (g) Mouth pipetting shall not be used.

NOTE 5 The generation of aerosols should be avoided when pipetting.

NOTE 6 Blowing out residual volumes from pipettes creates aerosols.

- (h) Diagnostic kits, control sera and products manufactured from microbiological sources shall be handled using appropriate safety measures to avoid contact with, and spread of infectious organisms which may be still present.

- (i) Cultures of spore-producing fungi shall be covered or sealed as appropriate to prevent dispersal.

NOTE 7 Airborne spores can spread in a similar manner to aerosols.

- (j) Chemicals shall be stored in accordance with AS 2243.2.

- (k) Local exhaust ventilation or a fume cupboard shall be used for work with toxic, volatile, corrosive or odoriferous substances.

NOTE 8 BSCs are not designed for this purpose (see [Clause 11.1](#)).

NOTE 9 Refer to AS/NZS 2982 and AS/NZS 2243.8 for local exhaust ventilation requirements and fume cupboard construction and installation.

- (l) Items that are frequently handled shall be regularly decontaminated (e.g. door handles, fridges, telephones, keyboards, pipetting equipment, reading and writing materials).
- (m) Work benches shall be decontaminated at least daily and after all work involving microorganisms.
- (n) Staff shall be trained in the cleaning up of microbiological spills. Spills shall be contained, any affected personnel attended to and the area cleaned up and decontaminated with appropriate disinfectant (see [Section 10](#)).
- (o) Wastes (e.g. broken glassware, biological and radioactive substances) shall be segregated and disposed of.

NOTE 10 Refer to national, state and territory legislation for relevant requirements (see also [Section 13](#)).

- (p) Laboratory gowns shall be removed and hands decontaminated before exiting the PC1 laboratory.

NOTE 11 Where personnel are moving directly to another laboratory that is not separated via public thoroughfare, they may continue to wear their laboratory gown, provided it is clean and free from contaminants.

- (q) Personal devices such as mobile phones shall not be used in locations where they could become contaminated. This includes personal earphones and earplugs.
- (r) Where contamination of personal devices occurs or is suspected, decontamination shall take place prior to removal of the device from the laboratory.

5.3 Requirements for Laboratory PC2 facilities

5.3.1 General

A Laboratory PC2 facility incorporates all the requirements of a Laboratory PC1 facility with additional requirements relating to conditions of access, safety equipment and staff training requirements.

A PC2 laboratory is appropriate for research and diagnostic work which may be carried out on the open bench with good microbiological techniques. If working with specimens containing microorganisms transmissible by the respiratory route or if the work produces a significant risk from the production of infectious aerosols, a BSC shall be used (see [Clause 4.3.3](#)).

5.3.2 Multiple room PC2 facilities

Where PC2 laboratories include large areas such as entire floors, multiple floors or multiple buildings, access shall be restricted to authorized personnel. This includes access via lifts and stairs, preventing the use of laboratories as thoroughfares and ensuring that eating and drinking is prohibited in the entire PC2 area.

Where lifts operate through multiple PC2 levels, the lift itself shall not be classified as PC2 as it may be used by unauthorized persons. The lift shaft and lift motor areas are required to be accessed by lift technicians and cannot be readily decontaminated. If the lift is required to transport potentially infectious or infectious materials from one floor to another, the potentially infectious or infectious materials shall be either double-bagged or placed in a secondary sealable, unbreakable container for the transport (e.g. to a steam sterilizer). Where the materials are double bagged, the outer bag should be sealed during transport.

Potentially contaminated laboratory gowns and gloves shall not be worn in lifts.