University of Otago

HSNO Exempt Laboratory Manual

Version 3

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1. Introduction

The small-scale use of hazardous substances in research, development or teaching is currently exempted from the provisions of the Hazardous Substances and New Organisms (HSNO) Act 1996 (under Section 33 of this act), providing the use takes place in a laboratory meeting prescribed requirements. These prescribed requirements are detailed in the Hazardous Substances (Exempt Laboratory) Regulations, 2001. The New Zealand Environmental Protection Authority (EPA) has approved a Code of Practice (The CRI and University Exempt Laboratory Code of Practice) as a legal means of compliance with these requirements. However, it should also be noted that laboratories are also subject to the provisions of the Health and Safety in Employment Act, 1992 and to various University of Otago policies and procedures.

This University of Otago Exempt Laboratory Manual describes the requirements to be met in laboratories operating under the Section 33 exemption at the University of Otago, in order to achieve compliance with;

- The Code of Practice for CRI and University Exempt Laboratories
- The Health and Safety in Employment Act[1]
- University of Otago policies and procedures.

Please note that this manual does not cover requirements for MPI registered Containment or Transitional facilities (covered by the applicable Containment/Quarantine Manual for the facility concerned), other biological hazards (covered by the University of Otago Biological Safety Manual) or requirements relating to the use of ionizing radiation sources (which will be covered in the applicable Radiation Safety Plan).

[1] Note this legislation is due to be replaced with the Health and Safety at Work Act in 2015

2. Laboratory Management

2.1 General

Staff who have management responsibilities for laboratories or for personnel who work in laboratories (including students) are responsible for ensuring that laboratories under their control are operated in a safe and legally compliant manner. However, specific responsibilities and tasks will vary commensurate with position. Key elements of the laboratory management structure, together with the responsibilities and tasks associated with each of these elements are described in the following sections.

2.2 Authorised Laboratory Users (ALUs)

Authorised Laboratory Users (ALUs) are personnel who are trained and authorised to carry out research or teaching work in laboratory areas in accordance with Section 4.2 of this manual. ALUs are required to comply with any instructions and training given by their Laboratory Supervisor or Departmental Laboratory Manager (DLM) in relation to laboratory health and safety, as well as to report any laboratory health and safety incidents or issues to these personnel.

2.3 Laboratory Supervisors (LS)

A Laboratory Supervisor, who may also be known as the Principal Investigator (PI), must be designated for each laboratory (with a list to be maintained by the DLM). In shared laboratories, more than one LS may be designated. The LS is responsible for day-to-day management of laboratory health and safety, including the safe management of any hazardous substances present. The laboratory supervisor meets these requirements by;

- Ensuring that both they and any personnel under their supervision comply with any instructions or training in relation to the management of laboratory health and safety (including hazardous substances) provided by the DLM.
- Providing any details on hazardous substances in use as required by the DLM for the purposes of maintaining inventory or managing specific high-risk substances.
- Notifying the DLM of any general or hazardous substance related laboratory health and safety issues, including any incidents that have occurred.
- Notifying the DLM of any high risk procedures (as described in Section 4.6) and developing appropriate documented risk assessments for these as required.
- Ensuring that any personnel under their supervision complete the training requirements detailed in Section 4.2.

If the LS will be absent for a significant period (defined as more than 3 days), an alternative person to fulfil this role must be nominated if any of their laboratories or laboratory areas under their supervision will remain in use for the period of absence[2]. The contact details for the nominated alternative must be provided to the Departmental Laboratory Manager (DLM).

[2]Where there is no other suitable alternative the DLM may agree to fulfil this role.

2.4 Departmental Laboratory Managers (DLM)

DLMs are appointed to oversee and monitor laboratory health and safety[3] in their departments[4] and to implement systems to meet key compliance requirements through the following;

- Annual audit of all laboratories in their department (refer Section 4.7).
- Investigation of laboratory related incidents.
- Issue and monitoring of corrective actions to rectify any issues identified through audit or investigation.
- Identification of non-compliant laboratory facilities requiring significant upgrade (i.e. in relation to design/construction) and reporting of these to the HoD and Statutory Budget Working Group.
- Reporting to the Head of Department in relation to laboratory health and safety performance in the department and escalation of significant issues as required.
- Implementing systems to;
    - Document lab supervisors and authorised laboratory personnel.
    - Ensure lab personnel are trained in accordance with the requirements of 4.2.
    - Manage disposal of hazardous wastes.
    - In conjunction with laboratory supervisors/PIs, identify high-risk procedures and coordinate and assist with development of risk assessments where required.

If the DLM will be absent for a significant period (defined as more than 3 days), an alternative person to fulfil this role must be nominated if any laboratories will be in use for the period the DLM is absent for. The contact details for the nominated alternative must be provided to the University Laboratory Manager and Laboratory Health and Safety Advisor.

[3] Please note that the responsibilities of the DLM role do not include any matters relating to the use of New Organisms or Imported Risk Good/Uncleared Biologicals (which fall under the jurisdiction of the Sector Manager), or use of ionizing radiation sources (which are the responsibility of the applicable Radiation Licensee and Radiation Safety Officer concerned).

[4] A DLM may be also appointed at a Divisional, Faculty or School level, providing they have sufficient knowledge, experience, time and resources to fulfil the role and have delegated authority to act in this capacity by the applicable Dean. In addition, the University of Otago Wellington and Christchurch campuses have University of Otago Wellington/Christchurch Laboratory Managers.

2.5 Head of Department (HoD)

The HoD[5] has responsibility for ensuring laboratories in their department are operated in a safe and compliant manner through the following;

- Appointing a DLM and ensuring the appointee has sufficient knowledge, experience, time and resources to fulfil the role.
- Monitors laboratory health and safety performance in the department by requesting regular (as a guide, quarterly) reports (e.g. as meetings or written reports) from the DLM.
- Ensure staff and students comply with the instructions of the DLM in relation to laboratory health and safety (e.g. as training, instructions or corrective actions).
- Escalation of any significant laboratory safety issues that cannot be quickly resolved, or which are beyond the control of the department, to the appropriate senior manager (e.g. Dean of the Division, Faculty or School concerned) and to the ULM.

2.6 University Laboratory Manager (ULM)

The University Laboratory Manager is appointed to develop and maintain Health and Safety management systems to ensure that the use of Hazardous Substances within University of Otago laboratories complies with legislative requirements, through the following;

- Providing advice to the HSRC on the development of appropriate University policies, procedures and systems to achieve compliance with legislative requirements.
- Ensuring that HoDs of departments operating laboratories fulfil their obligation to appoint a DLM.
- Communication of laboratory health and safety requirements to Deans and HoDs
- Monitoring compliance through ensuring laboratories are subject to regular audit and through investigation of Hazardous Substance related incidents.
- Reports on matters pertaining to use of Hazardous Substances in Laboratories (including significant non-compliance or other safety matters) to the HSRC and to the Head, Health and Safety and Compliance

[5] Where a DLM is appointed at Divisional, Faculty or School level the Dean should fulfil the responsibilities detailed here.

2.7 Laboratory Health and Safety Advisor

The Health, Safety and Compliance Office employs a Laboratory Health and Safety Advisor to provide advice, support and training in relation to Laboratory Health and Safety and performs the following key functions;

- Provides advice, training and support to the DLMs and laboratory users.
- Provides support to the University Laboratory Manager, Radiation Safety Advisor and Biological Compliance Officer.
- Monitors compliance with the requirements of this manual through audit and investigation of incidents, and reports significant non-compliance to the DLM and HoD concerned, ULM and Head, Health, Safety and Compliance.
- Disseminates information on legislative and policy requirements to Departments via DLMs.
- Assists with development of policies, procedures and resources to manage laboratory health and safety.
- Coordinates the laboratory chemical waste disposal service.

2.8 Hazardous Substances and Radiation Committee (HSRC)

The Hazardous Substances and Radiation Committee is responsible for the development of policies and procedures (including this manual) to manage the safe and legal use of Hazardous Substances, including in laboratories. The Chair of the HSRC and Head of Health and Safety and Compliance both report to the Ethics and Safety Compliance Committee (which in turn reports through the Audit and Risk Committee to the University Council).

3. Laboratory Access and Security

3.1 General

Access to HSNO Exempt laboratory areas is restricted to Authorised Laboratory Users, to personnel who are under the direct supervision of an Authorised User at all times, or to Authorised Visitors as described in Section 3.3.

Laboratories must be secured to prevent access by unauthorised personnel. In the case of laboratories which are located within an area that may only be accessed through proximity card ('swipe card') controlled doors, then the individual laboratory need not be locked during normal working hours (i.e. 8:30am – 5:30pm). However, individual laboratories within proximity card controlled areas should still be locked if they are to be left unoccupied outside of normal working hours.

Laboratories that are not located within areas to which access is controlled by proximity card doors must be kept locked when not occupied.

3.2 Containment and Transitional Facilities:

Please note that there are additional training and access requirements for laboratories that are MPI registered Containment and/or Transitional facilities. These procedures will be documented in the Containment and Quarantine Manual for the facility concerned, a copy of which will be held in any laboratory that is part of such a facility. Sector Managers are appointed for each facility and they may also be contacted for advice on access procedures (alternatively contact the Biological Compliance Officer). The entrances to such facilities will be labelled as 'PCx' (where 'x' is a number from 1-3), followed by wording such as; 'Microbiological', 'Animal', 'Plant' or 'Invertebrate'.

Note that laboratories with 'PC2 Clinical' signage are **not** MPI-registered facilities and do not have Containment and Quarantine Manuals. However, users of such facilities are still required to comply with operating procedures for PC2 laboratories specified in *AS/NZS 2243.3: Safety in Laboratories Part 3. Microbiological aspects and containment facilities.*

3.3 Authorised Visitors

From time to time it may be necessary for personnel who are not Authorised Laboratory Users to enter or work in laboratory areas, e.g. Property Services personnel, contractors, other visitors.

In such circumstances, it is important that appropriate control measures are implemented to protect the health and safety of visitors and to ensure that visitors do not comprise the health and safety of laboratory users or breach laboratory compliance requirements.

Detailed guidance on managing the health and safety issues associated with major categories of visitors is provided in the ***Laboratory Visitor Guidelines (UOOLAB1-2015)***.

3.4 Children in laboratories

Children under the age of 16 years are only permitted in laboratories if on a specifically arranged visit for educational purposes that is authorised by the DLM (in this context the children may be viewed as 'students'). However, where such visits are to take place a risk assessment should be carried out and documented controls implemented to minimise any risk to children, teachers/parent helpers or laboratory personnel. Further guidance on such visits is given in the ***Laboratory Visitor Guidelines (UOOLAB1-2015)*** (refer Section 3.3).

4. Risk Management

4.1 General

Significant laboratory hazards, as well as any laboratory related incidents (including near-miss incidents) present in a department must be identified and recorded on the University Health and Safety Management System (Vault). If you require access or training in use of this system, please contact the Health and Safety Office for assistance.

4.2 Induction and training

All laboratory personnel must receive appropriate induction training (i.e. before commencing laboratory work) in relation to laboratory hazards as specified in in AS/NZS2243.1:2005 (Laboratory Health and Safety Part 1: Planning and Operational Aspects), Section 3.1.3.2, namely;

- The provisions and procedures for laboratory safety, including the use and maintenance of appropriate personal protective equipment.
- An awareness of any relevant legislation (particularly the Hazardous Substances and New Organisms Act 1996).
- The safe handling and use of any chemicals or equipment they will work with.
- The procedures to be adopted in accidents or emergencies.

DLMs are responsible for implementing a system in the department to ensure that all laboratory personnel are trained in accordance with the above requirements in relation to substances and equipment that are in common use in the department concerned. This system may involve specific aspects of this training being carried out by other personnel with appropriate expertise and/or by the laboratory supervisors themselves (e.g. laboratory-specific inductions).

Personnel who have been trained in accordance with the requirements above (and who are 16 or older) are considered Authorised Laboratory Users. The DLM must maintain up-to-date records of all ALUs, including the date trained and material covered. Laboratory users must complete refresher training at a minimum of 5-yearly intervals to ensure they are familiar with current procedures.

Laboratory Supervisors are responsible for training any personnel under their supervision in relation to any hazards specific to their areas and which are not covered by the general training above, including in relation to high-risk procedures (as per Section 4.6).

Note there are separate training requirements for laboratories that are part of a MPI registered containment/transitional facility – consult with your Sector Manager or the Biological Compliance Officer for advice on these requirements.

4.3 HSNO Hazard Classification System

Under the HSNO legislation and associated regulations, Hazardous Substances are classified according to a system known as the HSNO Hazard Classification System, which is based on the Globally Harmonised System of Classification and Labelling of Chemicals (GHS).

Under this system chemicals may be assigned one or more hazard classifications corresponding to each recognized hazardous property they possess. Each HSNO Hazard classification consists of a three components;

1. A numbered class corresponding to the broad hazard type, e.g. Class 6 corresponds to toxic substances
2. A numbered sub-class providing more detail about the type of hazard, e.g. Subclass 6.1 corresponds to substances of acute toxicity while sub-class 6.7 refers to carcinogens.
3. A letter category indicating the degree of hazard where 'A' represents the highest level of hazard and subsequent letters represent decreasing hazard (in alphabetical order), e.g. a 6.1A substance is more acutely toxic than a 6.1B substance

These classifications codes provide a useful summary of the key hazards associated with a substance but be aware that some substances may possess very specific hazardous properties not covered by a specific HSNO hazard classification and the Safety Data Sheet (see next section) should always be consulted for detailed information on a substance.

A full listing of the HSNO Classification codes and corresponding hazards and hazard symbols is provided in Appendix 1.

4.4 Safety Data Sheets

Under the HSNO legislation and associated regulations, Hazardous Substances are classified according to a system known as the HSNO Hazard Classification System, which is based on the Globally Harmonised System of Classification and Labelling of Chemicals (GHS).

Before working with any Hazardous Substance the user must ensure they are familiar with the hazardous properties of that substance. Detailed information (including the HSNO Hazard Classifications described above) can be obtained from safety data sheets (SDS), also known as material safety data sheets (MSDS). In many laboratories, hard-copy SDS will be maintained in a folder but SDS can also be obtained on-line from any networked University computer using the Chemwatch on-line MSDS retrieval system. The link below will take you to a web-page with the Chemwatch link and a quick guide to using Chemwatch. Contact your DLM for advice and training on this system.

http://www.otago.ac.nz/humanresources/health-and-safety/a-to-z/otago075909.html

Please note that a Safety Data Sheet must be readily available (as a guide, able to be retrieved with 10 minutes) to any person working with a hazardous substance. In areas where ready access to Chemwatch cannot be guaranteed provision of hard-copy Safety Data Sheets is mandatory.

If you cannot locate a safety data sheet for a substance, or the safety data sheet does not provide HSNO Classifications, please contact the Laboratory Health and Safety Advisor for advice.

4.5 Safe Methods of Use

General guidance on the hazards and general safe handling precautions for different classes of hazardous substance are provided in the form of Safe Methods of Use (SMoUs). Safe Methods of Use for substances of class 2, 3, 4, 5.1, 5.2, 6.1 and 6.5-6.9 are available for download through the Health and Safety Website.

http://www.otago.ac.nz/humanresources/health-and-safety/a-to-z/otago120415.html

4.6 Risk assessment for high risk procedures

A laboratory procedure should be considered high risk if;

- It involves use of a substance of intrinsically high risk that may cause serious injury or death through a single exposure, e.g. hydrofluoric acid, tert-butyllithium
- It involves processes or equipment that pose a risk of serious injury or death, (e.g. large volume handling of flammable liquids)
- It involves the use, outside of a fume hood, of substances that pose an inhalation hazard and which are subject to workplace exposure standards or which are otherwise known to pose a significant acute or chronic toxicity hazard by the inhalation route, e.g. use of formaldehyde outside of a fume hood.
- Any other part of this manual requires that a documented risk assessment is carried out for that procedure.

The ***High Risk Lab Procedures Audit Tool (UOOLAB2-2015)*** can be used to help identify high risk substances, procedures and equipment. The use of high risk substances, procedures and equipment should be subject to a formal risk assessment process, including identification of hazards, assessment of risk (including an assessment of the likelihood and consequences of any risks) and identification of any control measures necessary to eliminate or minimise any risks. A ***Laboratory Risk Assessment Template (UOOLAB3-2015)*** is available to document risk assessments and associated controls, although departments may use other documentation providing it covers the elements identified above.

Laboratory Supervisors are responsible for identifying high risk procedures that they (or personnel they manage/supervise) carry out, for notifying the DLM of these and for documenting appropriate risk assessments. Laboratory Users carrying out high risk procedures must receive documented training in these procedures, including the content of any risk assessment. The DLM should record any high risk substances/procedures in the department Hazard Register in Vault.

4.7 Laboratory Audit, Incident Investigation and Compliance

The DLM shall ensure that all laboratories are audited annually using the **Lab Audit Tool (UOOLAB4-2015)** in order to ensure that laboratory facilities and operational requirements are being met.

Audits and any corrective actions arising out of these should be documented on Vault (unless they are able to be immediately corrected at the time of audit). For advice on using Vault to record Audits and corrective actions contact the Laboratory Health and Safety advisor.

The DLM shall also investigate laboratory related incidents (except in circumstances where the Health and Safety Office undertakes the investigation) in order to identify whether failure to comply with any laboratory health and safety requirements contributed to the incident. All incidents details, including findings and corrective actions shall be recorded on Vault.

In general, where operational issues are identified (e.g. unsafe storage of chemicals), corrective actions should be issued to the Laboratory Supervisor concerned. The laboratory supervisor may delegate the task to laboratory personnel under their supervision but is ultimately responsible for ensuring completion of the action.

Where minor remedial work to facilities are required (e.g. replacement of ceiling tile, provision of a chemical storage cabinet, minor repairs to floor or bench surfaces), the DLM should initiate a Property Services request. Where laboratories are identified that require significant upgrade or repair work to meet the required standards, these must be referred to the Statutory Budget Working Group (refer Section 8.1 for more information).

Failure of laboratory supervisors to comply with any corrective action should be escalated to the HoD in the first instance. Where a HoD and DLM are in disagreement about the appropriateness of any corrective action required, advice must be sought from the ULM. Any matters that the department are not able to rectify in a timely fashion (or which are beyond the control of the department) must be escalated to the applicable senior manager (e.g. Dean) and to the ULM.

4.8 Laboratory Supervisors Leaving University of Otago Employment

Where a LS resigns or otherwise leaves their position they must ensure that any Hazardous Substances or other hazardous/regulated materials they are responsible for are either disposed appropriately or transferred to the control of another appropriate Laboratory Supervisor/Principal Investigator[6].

A LS/PI must not leave behind any chemicals (including any working solutions/reagents) unless another LS/PI has confirmed that they are prepared to accept these and have been supplied with the corresponding inventory records (as per Section 6.6). The LS/PI must make arrangements for the disposal of any unwanted substances through the Chemical Waste Collection Service prior to leaving as per Section 6.8. A close-out check-list for resigning/finishing Laboratory Supervisors/Principal Investigators is provided in **The Resigning Lab Supervisor or PI Form (UOOLAB5-2015)**.

[6] Where circumstances result in a LS/PI leaving or being otherwise unable to fulfil their duties at very short notice (e.g. due to serious ill health, death or if they abandon their position) the department concerned has responsibility for ensuring the safe transfer or disposal of any hazardous substances or other hazardous/regulated materials.

5. Operational Requirements

5.1 Standard Laboratory Precautions

The following standard laboratory precautions are the minimum laboratory precautions that must be followed in any HSNO Exempt Laboratories, except with written authorisation of the HSRC;

1. Food or drink (including water) intended for human consumption must not be consumed, stored, prepared or otherwise handled in a HSNO Exempt Laboratory.
2. A laboratory coat or gown and footwear that covers the toes, majority of forefoot and heel must be worn.
3. Eye protection shall be worn wherever there is a risk of injury to the eyes or of harm to the body via contact with the eyes. Where eye protection is required this must be appropriate for the nature of the eye hazard and meet a recognised standard for eye protection (e.g. A/NZS 1337 or ANSI Z87). *Further detail on eye protection is provided in Section 5.2.2*.
4. Hand protection (gloves) shall be worn whenever there is a risk of injury to the hands or of harm to the body via contact with the hands. *Further detail on hand protection is provided in Section 5.2.3.*
5. Substances are not permitted to be pipetted by mouth as this may lead to accidental ingestion of hazardous substances.
6. Headphones or ear-buds are not permitted to be worn in laboratory areas[7]. This is because the use of headphones/earbuds may reduce users situational awareness (e.g. to alarms, incidents, verbal warnings) and may also pose a contamination risk (e.g. if headphones/earbuds are manipulated with contaminated gloves).
7. A chemical fume hood (with current certification) or other appropriate local exhaust ventilation must be used when handling
    a. Large volumes (>1L) of flammable liquids or concentrated corrosive liquids.
    b. Substances likely to produce toxic or corrosive gas, fumes, aerosols or dust.
8. Laboratory work surfaces must be kept clean and free of unnecessary clutter. Any spills must be cleaned up as soon as practical and laboratory work surfaces must be wiped down at the end of each work period.
9. Laboratory users must wash their hands immediately following completion of any task involving the use of Hazardous Substances and prior to leaving the laboratory.

[7] Please note that this requirement does not apply to hearing aids or to hearing protection.

5.2 Personal Protective Clothing and Equipment (PPCE)

Laboratory users must wear personal protective clothing and equipment that is appropriate for;

- The hazards associated with any task that person is undertaking
- The hazards that person may be exposed to through other activities and processes being undertaken in that laboratory (e.g. by other laboratory users or equipment in operation).

The following sections provide more detailed guidance on the selection and use of PPCE.

5.2.1 Use of PPCE outside of laboratories

In general, laboratory PPCE is intended to protect the wearer from hazards that may be present in laboratories and associated chemical storage areas and must not be worn into non-laboratory areas (e.g. offices, tea-rooms, seminar rooms and toilets). However, the wearing of some forms of PPCE may be permitted in shared access ways (such as corridors and stairwells) under the conditions stipulated below.

- Any PPCE that is known to have been contaminated (e.g. through chemical splash) must not be worn outside of the laboratory.
- Hazardous Substances must be transported through such areas in accordance with the provision of Section 6.7.
- The wearing of laboratory gloves in shared access ways is not permitted. Note that the use of gloves should not be required where hazardous substances are being transported in accordance with Section 6.7.
- Laboratory coats/gowns and safety glasses may be worn while transiting through shared access ways between laboratories/chemical storage areas, providing the laboratory coat/gowns/safety glasses do not originate from a laboratory that is part of a MPI registered Containment and/or Transitional facility (to which the following requirements apply).
- No PPCE (including gloves, safety glasses or laboratory coats) used inside a laboratory that is part of an MPI registered Containment and/or Transitional Facility) is permitted to be worn outside of that laboratory (including in shared access ways), except in conjunction with a documented risk assessment (contact your Sector Manager for the current form).

5.2.2 Eye/Face Protection

Laboratories may contain a wide range of substance, equipment and procedures that may cause injury to the eyes or harm to the body through the eyes. The eyes are very vulnerable to injury and any injury that occurs has the potential to cause permanent damage to eye-sight.

Eye protection shall be worn wherever there is a risk of injury to the eyes or of harm to the body via contact with the eyes. Where eye protection is required, this must be appropriate for the nature of the eye hazard and meet a recognised standard for eye protection (e.g. A/NZS 1337 or ANSI Z87).

Laboratory Supervisors are responsible for identifying eye-hazardous tasks present in their laboratories and for ensuring that;

- Appropriate eye protection is provided to laboratory users and is maintained in a fit state to use (e.g. is not scratched, dirty or damaged)
- Laboratory users understand what circumstances any provided eye protection must be used.
- Laboratory users comply with requirements to wear appropriate eye protection.
- Where eye hazardous tasks could pose a significant risk to or via the eyes of personnel not directly engaged in those tasks, that appropriate minimum eye protection requirements or other control measures are implemented to ensure these personnel are protected.

The ***Laboratory Eye Hazard Risk Assessment Tool (UOOLAB6-2015)*** can be used to help identify and document potential eye hazards and eye/face protection requirements in laboratories. The following sections provide more guidance on common types of Eye Protection and the circumstances under which they should be used.

Safety Glasses (Medium impact): These provide a good general level protection from many common laboratory hazards, including low volume splash (e.g. droplets) and from projectiles. However, they may not protect the wearer from large volume splashes, or splashes that contact the face from above (e.g. if pouring a chemical into a tall item of apparatus) and they offer no protection to the face.

Safety Goggles (Medium impact): These provide improved protection from chemical splash and are recommended where there is a significant risk of a large volume splash to the face. However, note that goggles will not protect the face. Goggles rated as resistant to dust or vapour are also available although in laboratory environment dust/vapour hazards should generally be controlled through use of a fume hood or other local extract ventilation (as per Section 5.3).

Face Shield: Face shield provide protection to the face as well as the eyes and are recommended where there is a significant risk of injury to the face as well as the eyes, or where contact of a substance with the face could have serious consequences (e.g. splash to the mouth of a substance of very high acute toxicity). However, note that face shields come in a variety of impact ratings from nil, low impact, medium impact or high impact resistance. Where the primary risk is from projectiles or explosion a high impact face shield must be used.

Fume hood sash: It is important to note that tasks that pose a particularly high risk to the eyes (e.g. decanting concentrated acids) should be carried out in a chemical fume hood where the fume hood sash can act as a protective screen. However, the fume hood sash will only provide protection while it is lowered between the eye hazard concerned and the face of the user. In some circumstances, it may not be possible to lower the sash while working with an eye hazard (e.g. when accessing tall items of apparatus) and the use of Safety Goggles or a Face Shield should be considered, depending on the nature of the hazard. Safety Glasses should be worn while working at a chemical fume hood to provide additional protection.

Protective Screens: In some cases, additional protection for an eye hazardous substance or process may be achieved through use of protective screens, e.g. use of Perspex screens to provide protection from UV light sources or strong Beta radiation emitters (^{32}P). As with

fume hoods, protective screens should be used in conjunction with personal eye protection appropriate for the nature of the hazard.

Please note that while prescription eye-wear such as prescription glasses and contact lenses may be worn in laboratories they may not be used in place of Eye Protection in circumstances where Eye Protection is required. Eye Protection is available in a wide range of styles and forms, including forms specifically designed to be worn over prescription eye-wear. Please contact your DLM for advice if you are having problems wearing Eye Protection in conjunction with your prescription eye-wear (or for other reasons).

It is also possible to purchase Eye Protection with prescription lenses but note that it is not currently University policy to fund prescription Eye Protection although some departments may elect to do so (check with your DLM for procedures in your department).

5.2.3 Hand Protection

Protective gloves must be worn whenever there is risk of injury to the hands (e.g. corrosives, hot materials) or of harm to the body via contact with the hands (e.g. through absorption of toxic substances).

Glove selection needs to reflect the type and degree of hazards present, the nature of the contact expected (e.g. brief accidental contact vs planned extended contact/immersion), as well as practical considerations such as the touch sensitivity and dexterity required to carry out the task.

It is important that laboratory users are aware that disposable gloves provide only limited protection from hazardous substances and that some substances may rapidly penetrate such gloves, particularly organic solvents, strong corrosives and oxidizers. Disposable gloves are also easily torn and punctured during use and offer little or no protection from physical hazard such as high or low temperature, fire, mechanical injury or sharps. As a consequence disposable gloves should only be worn

- As protection against occasional brief accidental contact (e.g. a splash) from substances that are unlikely to cause serious injury or illness from a single contact, or.
- To protect non-hazardous materials from contamination.

The use of powdered gloves should be avoided wherever practical as the particulates released when putting on removing such gloves can trigger respiratory allergic reactions in some persons (including others working in the same area). Note that some persons may also experience skin reactions to gloves (particularly latex, but reactions are also known to occur to compounds present in some other gloves types). Personnel experiencing respiratory or skin reactions when using gloves should seek advice from their DLM in the first instance. Advice can also be obtained from the Health, Safety and Compliance Office.

Where there is a high risk of serious injury or illness to or via the hands, a documented risk assessment should be completed in accordance with Section 4.6 and the use of specific forms of hand protection should be considered as part of this risk assessment.

In particular, chemical resistant gloves selected by reference to glove manufacturer chemical resistance data[8] or which meet some other recognised standard of resistance to the substance concerned must be used when;

- Using a substance that presents a significant risk of serious injury or illness from a single exposure, e.g. substances of very high acute toxicity by the dermal route such as hydrofluoric acid, dimethyl mercury.
- Extended contact or immersion of the hands in a hazardous substance is planned.

In addition, where there is a significant risk of injury from physical hazards such as heat or cold or mechanical injury, gloves appropriate to the nature of this hazard must be used[9]. Note that a wide range of gloves resistant to puncture and cut are now also available for work involving the use of sharps.

5.2.4 Hearing protection

Wherever practical, noisy equipment (e.g. ultracentrifuges, band-saws/grinding/drilling equipment) should be isolated in equipment rooms to minimise exposure of laboratory personnel to excessive noise. However, where noisy equipment or processes cannot be isolated appropriate hearing protection must be worn. Laboratory personnel who are concerned about exposure to excessive noise may request an assessment of noise levels through the Health and Safety Office.

[8] Ansell is one of the major glove manufacturers and provides chemical resistance data for their gloves at http://ppe.ansell.com.au/chemical-glove-guide

[9] The NZ Safety Catalogue section on Hand Protection provides excellent advice on glove selection and on the standards and marking for different types of hand safety hazards. This can be accessed through their website at http://www.nzsafetycatalogue.co.nz/default.htm

5.2.5 Foot protection

In the laboratories the feet may be exposed to a number of hazards, including;

- Splash with hazardous substances, radionuclides or biological hazards (e.g. blood, cultures).
- Thermal injury from hot or cryogenic liquids
- Cut or puncture injury from dropped sharps (e.g. needles, broken glassware)
- Mechanical injury from heavy equipment, e.g. large gas cylinders

As a consequence, the minimum requirement is that footwear worn in laboratories must cover the toes, forefoot and heel. Bare feet, sandals and jandals are strictly prohibited in all laboratory areas.

Where tasks present a risk of serious injury or illness to or via the feet, the use of safety footwear that meets a recognised standard (e.g. the AS/NZS 2210 series) should be considered as part of a risk assessment (as per Section 4.6) for that task, e.g.

- Use of safety shoes/boots (with toe protectors) for personnel who need to move heavy items, e.g. G-sized gas cylinders or 200L drums.
- Use of splash resistant overshoes or other chemical resistant footwear for tasks where there is a risk of splash to the feet by substances that could cause serious injury or illness to or via the feet (e.g. Hydrofluoric acid).

5.2.6 Protective Clothing

A laboratory coat, gown or overalls must be worn in the laboratory. The purpose of a laboratory coat is to protect the laboratory users clothing from contamination. In addition, in the event of a splash to the body, the laboratory coat can be quickly removed without having to be pulled across the face of the wearer.

Cotton and polyester/cotton blend laboratory coats are suitable for most general laboratory activities. However, for high risk activities the use of other forms of protective clothing in addition to, or in place of, a laboratory coat/gown should be considered as part a documented risk assessment in accordance with Section 4.6. In particular;

- Where there is a significant risk from flash fire or contact with highly flammable materials consideration should be given to the use of clothing that meets a recognised standard for flame resistance (e.g. AS/NZS ISO 2801, BS EN ISO 14116, BS EN ISO 11612), e.g. when working with pyrophoric substances (Class 4.2A, e.g. tert-butyllithium) or large volumes of flammable liquids (as a guide, >20L).
- Where there is a significant risk of splash with highly toxic or corrosive substances in quantities likely to cause serious injury/illness, consideration should be given to use of chemical resistant clothing (e.g. overalls, aprons) selected by reference to manufacturer chemical resistance data or which meets a recognised standard of resistance to the substance concerned, e.g. decanting concentrated hydrofluoric acid.

5.2.7 Respiratory Protection

Appropriate respiratory protection must be used whenever there is a significant risk of exposure to toxic or corrosive gases, fumes, dust or aerosols. Wherever practical, exposure to such hazards should be controlled through the use of chemical fume hoods (meeting AS/NZS 2243.8:2014) or other suitable local extract ventilation (as detailed in Section 5.3). A correctly used chemical fume hood will generally provide a higher level of respiratory protection than a respirator and will protect other room occupants (whereas a respirator protects only the wearer). Exceptions to this guidance include;

- Animal laboratories where personnel wear P2 dust masks to minimise exposure to laboratory animal allergens.
- The use of a respirator or mask by an experienced person to manage a chemical spill with inhalation hazards.

Where there are practical reasons that a chemical fume hood/local extract ventilation cannot be used the use of respirators/masks requires careful consideration. Most forms of personal respiratory protection need to be fitted to the individual wearer to work effectively (there needs to be an effective seal between the respirator and face). The selection and replacement of filter cartridges will also depend on many factors, including

- The air contaminant involved
- The level, frequency and duration of exposure
- Work load and environmental factors (e.g. temperature)

Where the use of a respirator or mask for a planned activity is considered necessary a documented risk assessment must be completed (as per Section 4.6). In some cases, environmental monitoring may be required to determine exposure levels during the task and to determine the appropriate level and type of respiratory protection required.

5.3 Ventilation

5.3.1 Use of Chemical Fume Hoods

The laboratory supervisor must ensure that laboratory personnel who need to use a fume hood receive training in the correct operation and use of any hood in the laboratory. There is some variation in the specific operating instructions depending on the make and model but always observe the following;

- Keep any hazardous materials at least 15 cm back from the front of the hood, further if practical. Research has shown that this can reduce the level of contaminants reaching the breathing zone by more than 300-fold.
- Wherever practical, lower the sash so that you are looking through the sash at the items being handled. The sash provides additional protection to the eyes and face from splash, fire or explosion[10].
- Always leave the fume hood in a fit state to be used by the next user. Return chemicals and equipment to their appropriate storage location once you have completed your task and clean up any spilled chemical. Accumulations of chemicals and equipment left in fume hoods will make it difficult for other users to use safely and increase the risk and consequences of accidents occurring.

Property Services arranges annual testing and certification of all chemical fume hoods to AS/NZS2243.8:2014. As part of these requirements, the tester must attach a self-adhesive label to the fume hood that details the inspection date, name of inspector, overall test result (pass or fail) and the date on which the next inspection is due. The DLM must notify the Compliance Manager at Property Services if fume hoods with lapsed certification are identified.

Where chemical fume hoods are used for operations where concentrated Perchloric acid or Hydrofluoric acid fumes are likely to be generated for extended periods (such as during Perchloric acid or Hydrofluoric acid digestions) designated fume hoods equipped with scrubbers must be provided for this purpose in accordance with AS/NZS 2243.8:2014.

5.3.2 Other forms of local exhaust ventilation

Some tasks or equipment may necessitate the use of other forms of extract ventilation, for example; the use of movable extraction vents for microscopy of formalin fixed samples, anaesthetic gas scavenging equipment and ducted laminar flow cabinet systems where protection of both the user and experimental materials is required. Such equipment must be used only with the approval and knowledge of the DLM. The effectiveness of such equipment in protecting laboratory users from inhalation hazards should be verified through environmental monitoring (which can be arranged through the Health, Safety and Compliance Office). In addition, there must be regular maintenance and performance monitoring of such equipment.

[10] Where the sash cannot be lowered during hazardous operations a risk assessment should be completed (as per Section 4.6) and consideration given to other forms of eye protection (e.g. goggles or face shields) depending on the nature of the hazard present.

6. Hazardous Substances Management

6.1 Receipt procedures

Packages containing containers of hazardous substances (i.e. as received from the supplier) must be opened in a HSNO Exempt Laboratory or in an associated storage area with floor and work surfaces that are impervious to liquids and easily cleaned (i.e. non-carpeted) and where the following are readily available;

- Appropriate personal protective equipment
- A chemical spill kit
- An eye-wash and drench hose
- Hand washing facilities.

Personnel involved in opening and transporting packages of hazardous substances must be appropriately trained in the safe handling and transport of hazardous substances, including procedures to follow in the event of a spill, accidental exposure to a substance or hazardous substance related emergency.

6.2 Labelling

6.2.1 Original stock containers

Substances that are labelled in accordance with current European Union, USA, Canadian or Australian Requirements are deemed to comply with labelling requirements under HSNO.

In practice, this means that Hazardous Substances that are held in original containers (as supplied by vendor) are likely to meet HSNO requirements providing they were not purchased prior to 2001 and have been purchased from either a New Zealand supplier or imported from a supplier based in one of the jurisdictions identified above.

6.2.2 Working containers, solutions, reagents

Where substances are transferred from a compliant supplier container (as described above) to new containers (e.g. decanting ethanol from a drum to glass bottles for use in laboratories) or where a solution containing one or more hazardous substances is prepared, the resulting containers must be appropriately labelled, including;

- The identity of any hazardous substances present in the container, or
- A reagent name that can be readily cross-referenced to documentation in which these details are recorded (e.g. laboratory recipe book). This documentation must be readily available to all laboratory users. Documentation may be electronic but where this is the case must be stored in a form that is accessible to other laboratory users (i.e. on a shared drive).

In addition, containers should be clearly labelled with hazard symbols to identify the major substance hazards (see section 6.2.3)

6.2.3 Use of hazard symbols

Under the HSNO legislation chemicals may have multiple hazard classifications and a number of hazard symbols may be applicable to any given substance. There are two distinct labelling systems for hazardous substances in common use in New Zealand and there is some overlap between these.

1. Globally Harmonised System (GHS) symbols.
2. Dangerous Goods (DG) symbol.

HSNO Hazard Classifications are represented by GHS symbols. However, many HSNO Classifications are directly equivalent to Dangerous Goods classifications used for transport purposes and may also have corresponding DG symbols. A summary of the different HSNO hazard classifications, together with their corresponding GHS and DG symbols are given in **Tables 1** and **2**.

Where a hazard classification has both a corresponding GHS and Dangerous Good symbol, it is acceptable to use either symbol but note that both should not be used simultaneously. However, it is recommended that Dangerous Goods symbols are used for the physical hazard classifications (Classes 1-5) as these provide a clearer visual distinction between these classes.

The following provides guidance on selection of hazard symbols for labelling purposes.

- Where a substance possesses a physical hazard (Classes 1- 5; explosive, flammable, oxidizing or, organic peroxide) label the container with the symbol applicable to that hazard as shown in Table 1.
- Where a substance is *corrosive* (Class 8), label with the corrosive symbol.
- Where a substance has *high acute toxicity* (6.1A-C), label with the acute toxicity symbol (Table 2). Where an acute toxicity symbol has been applied, symbols for chronic toxicity hazards (Class 6.5-6.9), moderate acute toxicity (6.1D-E), skin/eye irritants (6.3-6.4) or ecotoxicity (Class 9.1-9.4) are not required in addition to this.
- Substances that are not corrosives or of high acute toxicity but which possess chronic toxicity hazards (Class 6.5-6.9) should be labelled with the *health hazard* symbol. Where the health hazard symbol has been used it is not necessary to label with the *harmful* or *environmental hazard* symbol.
- Substances that are of moderate acute toxicity (6.1D-E) or are skin/eye irritants (6.4-6.4), but which have no physical hazard, are not corrosive and do not possess chronic toxicity hazards should be labelled with the *harmful* symbol.
- An *environmental hazard* symbol need only be applied if the substance is ecotoxic (Class 9.1 – 9.4) and does not possess any other hazardous property.

Table 1: Summary of HSNO Classes 1 – 5 with corresponding GHS and DG Symbols

HSNO Classification		DG	GHS
1.1 – 1.6	Explosives		
2.1.1	Flammable gases		
2.1.2	Flammable aerosols		
3.1	Flammable liquids		
3.2	Liquid desensitised explosives		
4.1.1	Readily combustible/may cause fire through friction		
4.1.2	Self-reactive substances[11]		
4.1.3	Solid desensitised explosives		
4.2	Spontaneously combustible		
4.3	Substances that emit flammable gas in contact with water		
5.1.1	Oxidizing substances that are liquids or Solids		
5.1.2	Oxidizing substances that are gases		
5.2	Organic Peroxides[12]		

[11] Self-reactive solids of Type A or B (Class 4.1.2A or B) are potentially explosive and must also be labelled with a Class 1 symbol.

[12] Organic peroxides of Type A or B (Class 5.2A or B) are potentially explosive and must also be labelled with a Class 1 symbol.

Table 2: Summary of HSNO Classes 6, 8 and 9 with corresponding GHS and DG Symbols

HSNO Classification		DG	GHS
6.1A-C	**High acute toxicity**		*'Acute Toxicity'* 
6.1D - E	**Moderate acute toxicity**	*No DG equivalent*	*'Harmful'* 
6.3A-B	**Skin Irritant**		
6.4A	**Eye Irritant**		
6.5A	**Respiratory Sensitizer**	*No DG equivalent*	*'Health Hazard'* 
6.5B	**Skin Sensitizer**		
6.6A-B[13]	**Mutagens**		
6.7A-B[13]	**Carcinogens**		
6.8A-B[13]	**Reproductive/developmental toxins**		
6.8C	**Effects on/via lactation**		
6.9A-B[13]	**Target organ/system toxin**		
8.1	**Corrosive to metals**		*'Corrosive'* 
8.2	**Corrosive to skin**		
8.3	**Corrosive to the eyes**		
9.1	**Ecotoxic in the aquatic environment[14]**		*'Environmental Hazard'* 
9.2	**Ecotoxic in the soil environment**	*No DG equivalent*	
9.3	**Ecotoxic to terrestrial vertebrates**		
9.4	**Ecotoxic to terrestrial invertebrates**		

[13] For Sub-classes 6.6 – 6.9, category A refers to a known hazard (e.g. known carcinogen) while Category B refers to a suspected hazard (e.g. suspected carcinogen)

[14] Please note that HSNO Class 9 (Ecotoxicity) is **not** equivalent to DG Class 9 (Miscellaneous Dangerous Goods).

6.2.4 Labelling requirements for very small containers

Where the size of containers means that it is not practical to meet the labelling requirements above (e.g. small vials or tubes <15mL), containers may be labelled as follows:

- Small containers of mutually compatible substances of similar hazard (e.g. organic synthesis products) may be stored together in suitable secondary containers and the outer container labelled.
- Individual tubes may be labelled with a reference code that can be easily cross-referenced with documentation in which details of the composition are recorded. Note that this documentation must be readily available to all laboratory users and retained in the laboratory.

6.3 Laboratory Storage

6.3.1 General

The following general storage requirements must be met for all Hazardous Substances;

- Dedicated chemical storage cabinets (sometimes referred to as DG cabinets) must be used for large volume storage of substances with physical hazards (Class 3, 4 or 5) and for large volumes of liquid corrosives (Class 8). Further guidance on what constitutes large volume storage is provided in subsequent sections.
- Always use containers made of materials compatible with the substance to be stored and that have not previously held incompatible substances. Please note that even after cleaning, a chemical container may still contain residue that may react with any new contents.
- Storage areas (e.g. shelving, cupboards) must be clearly labelled with the major hazard present using appropriate hazard symbols or wording.
- Secondary containment (e.g. a plastic tray) must be provided for liquids.
- Where open shelving is used for storage, this must have a lip, cable or other means of restraint to reduce the likelihood of containers being accidently knocked off by lab users or in an earthquake.
- Wherever practical, avoid storing hazardous substances at a height (as a guide >1.5m) that could result in containers or their contents falling onto the faces of users, particularly in the case of substances that are corrosive or of high toxicity.
- Where any of the following sections specify that particular substances or classes must be ‘segregated’ this means they must be stored in manner that minimises the risk of the substances contacting each other should the containers leak or break, and means containers of incompatible substances;
    - Must not share the same spill containment
    - Must not be stored in the same cabinet or cupboard
    - Should not be stored immediately adjacent, above or below each other

6.3.2 Segregation Requirements

All practical steps must be taken to minimise the potential for contact between substances (including wastes) that could react dangerously (e.g. causing explosion or fire, or releasing toxic gases) and substances must never be stored together as single group in alphabetical order unless known to be mutually compatible.

Many substances will have more than one hazard classification and where this is the case storage should generally be determined as follows.

a) Where a substance has a Flammable (Class 3 or 4), Oxidizing (Class 5.1.1) or an Organic Peroxide (5.2) classification, this hazard classification should take precedence over Class 6, 8 and 9 for storage purposes, e.g. glacial acetic acid, which is flammable (3.1C) and corrosive (8.2B, 8.2C) should be stored as a flammable liquid.
b) A Class 8 classification (corrosive) will generally take precedence over Classes 6 (Toxic), which in turn takes precedence over Class 9 (Ecotoxic), but please note the segregation requirements detailed below in relation to storage of corrosives.

The following sections provide guidance on the storage of hazardous substances based on their hazard classifications or other chemical or physical properties.

Storage of flammable liquids (Class 3.1): Flammable liquids should be stored in a Class 3 Chemical Storage Cabinet when not in use. The volumes of flammable liquids stored on benches or shelves outside of cabinets should be kept to the minimum practical (as a guide, no more than 10L per laboratory). The maximum size of any individual container should be no greater than 5L to allow safe handling within a fume hood. Flammable liquids must be segregated from Class 4 and 5 substances.

Storage of flammable solids (Class 4): Be aware that there are multiple sub-divisions within this class and some of these are high risk substances that may require special storage conditions. The sub-class most frequently encountered are readily combustible solids (Class 4.1.1), e.g. paraformaldehyde, sulfur. In small quantities (as a guide <2.5Kg) these may be stored in laboratory shelving or cupboards providing they are kept well away from ignition sources, Class 3, 5 and 8 substances. Note that substances of Class 4.2A, 4.3A, 4.1.2 and 4.1.3 are potentially high risk and may require special storage conditions and/or separate storage.

Storage of Oxidizers (Class 5.1.1): Small volumes of Oxidizers (as a guide, <1L or Kg) may be stored on laboratory shelving/cupboards, providing they are segregated from Class 3, 4 and 8 substances, readily combustible materials, magnesium, zinc and powdered metals. Larger volumes should be stored in Class 5 chemical storage cabinets. However, be aware some Oxidizers (e.g. hydrogen peroxide solutions) may require temperature controlled storage.

Please note that some Oxidizers (particularly, hydrogen peroxide) may undergo decomposition reactions that generate heat and/or gas as a result of contamination or improper storage. This may lead to pressure build-up within storage containers, potentially causing explosion. In 2012, a 12% hydrogen peroxide solution stored on an open laboratory bench in a glass bottle decomposed resulting in an internal pressure build up and explosion that left glass fragments embedded in the ceiling.

As a consequence, when preparing working solutions of hydrogen peroxide or other Oxidizers with decomposition hazards, observe the following precautions;

- Keep the volume of working solutions to a minimum (ideally no more than 250mL)
- Avoid use of glass where possible or use containers/caps that are designed to safely release any pressure build-up (note that Schott supply a range of bottles/caps that allow for pressure equalisation.
- Check and follow any supplier/SDS instructions in relation to storage, e.g. in relation to temperature, light.
- Clearly identify and date containers and dispose of old working stocks (as a guide >6 months or in accordance with manufacturer recommendations).
- Never re-use chemical containers that may have held incompatible substances (e.g. flammable liquids and other organic solvents). Even if these have been cleaned, traces of residue that remain may be sufficient to initiate decomposition.

Organic Peroxides (5.2): Organic peroxides are typically used only in small quantities and usually require temperature controlled storage (e.g. in a refrigerator). Note that organic peroxides may decompose over time leading to a pressure build up within the container and should only be stored in the original manufacturer supplied container (this will typically be designed to contain any pressure build up or allow any pressure build up to be vented safely (e.g. through a bursting cap). Organic Peroxides must be segregated from other hazard classes e.g. by placing inside a secondary container (e.g. plastic tub with lid) labelled with the Class 5.2 hazard pictogram.

Corrosives (Class 8): Storage of **corrosives** requires careful consideration as many corrosives may react dangerously with one another.

- Store corrosives that are flammable (Class 3) or Oxidizers (Class 5) by these classifications rather than as corrosives, e.g. store glacial acetic acid as a Flammable Liquid, store perchloric acid as an Oxidizer.
- Note that most corrosive organic liquids (e.g. acetic acid, formic acid, formaldehyde) are flammable or combustible and are best stored as flammable liquids.
- Do not store strong acids (e.g. Sulfuric, Hydrochloric) with strong bases (e.g. ammonium hydroxide, sodium hydroxide) as these will react dangerously if mixed. In addition, ammonia vapours will often react with acid vapours resulting in containers being coated in salt residues.
- Never store acids where they could mix with cyanides or azides.

Concentrated liquid corrosives should be stored in a Class 8 storage cabinet wherever practical but remember not to store incompatible acids together. Corrosive solids (e.g. sodium hydroxide pellets) do not need to be stored in a corrosive a cabinet and may be stored in laboratory shelving/cupboards.

Please note that most liquid corrosives are volatile (produce fumes). After decanting, always wipe the outside of the container clean (particularly around the bottle neck where drips may run during decanting) and make sure the bottle is well sealed to prevent fumes accumulating in the cabinet.

Toxic (Class 6) and Ecotoxic (Class 9): Class 6 and 9 substances that do not have a physical hazard classification can generally be stored together as a group on laboratory shelving or in cupboards. Class 6 chemical storage cabinets are also available for larger quantities, particularly where secondary containment for liquids is required or for storage of highly toxic substances (e.g. of Class 6.1A such as cyanides).

Compressed gas cylinders: Compressed gas cylinders must be stored in appropriate gas cylinder restraints (these may be ordered through Property Services). Large cylinders (e.g. G size) should be restrained with two chains (top and bottom) but small cylinders (e.g. small medical oxygen cylinders) may be kept in stands. Care should be taken to position cylinders and associated regulators and piping such that these not likely to knocked or caught by personnel or equipment moving past. Storage of cylinders indoors should be kept to the minimum practical and reticulation of gas from outdoor storage areas (e.g. secure cages on the exterior of the building) should be considered wherever practical.

6.3.3 Storage in fridges and freezers

In some cases, it may be necessary to store hazardous substances at low temperature for either experimental purposes or to prevent deterioration/decomposition of the substance concerned. In such cases the following precautions must be observed;

- Label fridges/freezers used for storage of hazardous substances with hazard warning symbols corresponding to the major hazards present (in accordance with section)
- Where practical, avoid storing incompatible substances together in the same fridge. Where this cannot be avoided, segregate incompatible substances through the use of sealed secondary containers clearly identified with the hazard class symbol.
- Laboratory fridges and freezers which do not meet the requirements specified below for storage of flammable liquids must be clearly labelled as "*Not to be used for storage of flammable liquids*".

Where flammable liquids are to be stored in fridges or freezers, the following additional precautions must be followed;

- Fridges and freezers used for storage of Class 3.1A or B (highly flammable liquids that may have flash points at, or well below, the operating temperature of fridges and freezers) must be free of internal sources of ignition. Such fridges/freezers should either be scientific fridges/freezers that are specifically designed for the purpose of storing flammable liquids (and which meet a recognised standard/certification for this purpose) or domestic fridges/freezers which have been modified in accordance with AS/NZS2243.2. Where a fridge is modified, details of the modifications performed and who carried these out must be documented using the ***Fridge Modification Record Template (UOOLAB7-2015)*****.**
- Fridges meeting the requirements above should be clearly labelled as "*This fridge may be used for storage of flammable liquids*" or similar.
- Never store open containers of flammable liquids in any fridge or freezer, even if it meets the requirements above.

6.4 Cryogenic Liquids

Cryogenic Liquids are liquids (or liquefied gases) with boiling points below -90°C at atmospheric pressure (101.3kPa). The most common example found in University of Otago laboratories is Liquid Nitrogen which has a boiling point of -196°C.

Cryogenic liquids pose a number of hazards, including;

- Eye or skin contact with cryogenic liquids (or with materials that have been in contact with these) may cause permanent tissue damage (cold contact burns)
- Cryogenic liquids undergo a large expansion in volume as they evaporate back into gas and this can deplete Oxygen levels in the surrounding area, potentially causing asphyxiation.
- Use of storage containers not designed for holding cryogenic liquids (e.g. domestic thermos flasks) can lead to explosions due to a pressure build-up within the container and/or failure of components of the container not designed to withstand cryogenic temperatures.

Please note that these hazards are not currently addressed by the HSNO Hazard Classification system although some cryogenic liquids may have additional hazardous properties that are subject to one or more HSNO Hazard Classifications, e.g. flammability or toxicity.

All use of Liquid Nitrogen must comply with the Safe Method of Use for Liquid Nitrogen or with a documented risk assessment (as per Section 4.6) for the specific procedure concerned. A documented risk assessment must also be completed for the use, storage or handling of any other Cryogenic Liquid.

6.5 Bulk storage

6.5.1 Location Test Certification

Many departments operate bulk storage facilities for the supply of substances to Exempt Laboratory areas. Where the quantity of hazardous substances present in such bulk stores exceeds the quantities specified in **Table 3**, a Hazardous Substance Location must be established and the facility must hold a current Location Test Certificate (issued by a Test Certifier) to verify that it meets the legal requirements for such locations.

Annual re-certification of Hazardous Substance Locations is arranged by Property Services and a list of currently certified Hazardous Substance Locations associated with laboratory areas is maintained by the Laboratory Health and Safety Advisor. A current list of certified Hazardous Substance Locations is given in **Hazardous Substance Locations (UOOLAB8-2015).**

Departments are responsible for the following;

- Notifying the Laboratory Health and Safety Advisor if they require Test Certification of a facility not currently listed.
- Notifying the Laboratory Health and Safety Advisor if they require any changes to the conditions listed on the Location Test Certificate (e.g. in relation to quantity, classes or substances).

- Ensuring that the quantity of substances stored complies with any quantity limit specified on the relevant Location Test Certificate.
- Ensuring the safe operation of such facilities, including by ensuring that substances incompatible with any class or substance listed on the Location Test Certificate are not brought into or held in the store, except where specifically allowed for in Location Test Certificate[15].

Table 3: Quantities of hazardous substances above which a Location Test Certificate is required

Hazard Classification	Quantity above which a Location Test Certificate is required (for storage of closed containers)
2.1.1A and B	100 Kg (liquefied or dissolved gas) 100m^3 (compressed gas)
3.1A	20 L
3.1B	100 L in containers >5L 250 L in containers ≤5L
3.1C	500 L in containers >5L 1500L in containers ≤5L
3.2A-C	1 L
4.1.1A	1 Kg
4.1.1B	100 Kg
4.1.2A and B	1 Kg
4.1.2C and D	25 Kg
4.1.2E, F and G	50 Kg
4.1.3A, B and C	1 Kg
4.2A	1 Kg
4.2B and C	25 kg
4.3A	1 Kg
4.3B	25 Kg
4.3C	50 Kg
5.1.1A	50 Kg
5.1.1B	500 Kg
5.1.1C	1000 Kg
5.1.2A	100 Kg (liquefied or dissolved gas) 200m^3 (compressed gas)
5.2A and B	10 Kg
5.2C and D	25 Kg
5.2E and F	100 Kg

[15] Note that Class 6, 8 and 9 are not currently subject to test certification requirements in any quantity and a Test Certifier may not list these classes on the Location Test Certificate. This does not preclude departments from storing Class 6, 8 or 9 substances in a store certified for another class, providing these substances are not incompatible with the class or substance specified on the certificate.

6.5.2 Hazardous Area Zoning

Please note that the interior of Class 3.1 (Flammable liquid) storage areas are generally classified as 'Hazardous Areas', i.e. an area in which there is potential for an 'explosive gas atmosphere' to develop (e.g. as a result of a leak or spill). As a consequence, any electrical equipment within these areas is required to meet specific standards to ensure that it cannot act as an ignition source in the event that a potentially explosive air/vapour mixture forms in the location. Property Services is responsible for ensuring that periodic compliance checks on any fixed electrical equipment are carried out and that appropriate documentation is maintained.

In addition, personnel must not bring portable electrical equipment (other than those designed for use within explosive gas atmospheres) or other ignition sources into such areas, e.g. cell phones, lighters, matches, radios, mp3 players. Smoking inside a Class 3.1 store or in the immediate vicinity of the entrance is strictly prohibited (as it is all areas of the University under the Smoke-free Policy)

6.5.3 Approved Handlers

Where the quantity of substance present in a Hazardous Substance Location (outside of an Exempt Laboratory) exceeds the trigger thresholds specified in **Table 4 (page 29)**, the substances must be under the control of a person holding an Approved Handler Test Certificate (issued by a Test Certifier) that covers any applicable classes of substance. Personnel must not enter or work in a test certified Hazardous Substance Location unless they are an Approved Handler or are working under the direct supervision of an Approved Handler. The DLM is responsible for ensuring appropriate numbers of Approved Handlers (recommended minimum is two) are available for any hazardous substance location. Approved Handler training and certification costs must be met by the department. For information on Approved Handler training contact the Laboratory Health and Safety Advisor.

Table 4: Approved Handler Quantity Thresholds

HSNO Hazard Class/Sub-class		Category	Trigger threshold above which substance must be under control of an Approved Handler
2.1.1	Flammable Gas	A	100 Kg or 100m^3
2.1.2A	Flammable Aerosol	A	3000 L (Aggregate water capacity[16])
3.1	Flammable Liquid	A B B	Any amount (except Petrol[17]) 250 L (in containers >5 L) 500 L (in containers ≤5 L)
3.2	Liquid Desensitized explosives	A B	Any amount 100 L
4.1.1	Readily combustible	A	100Kg
4.1.2	Self-reactive substances	A and B C and D E and F	Any amount 25 Kg 50 Kg
4.1.3	Solid desensitized explosives	A B	Any amount 100 Kg
4.2	Spontaneously Combustible	A B	Any amount 100 Kg
4.3	Dangerous When Wet	A B	Any amount 100 Kg
5.1.1	Oxidizing Solid or Liquid	A B C	Any amount 500 Kg or L 1000 Kg or L
5.1.2	Oxidizing Gas	A	250Kg or 200 m^3
5.2	Organic Peroxide	A and B C, D, E, F	Any amount 10 Kg or L
6.1	Acutely Toxic	A, B and C	Any amount
6.7	Carcinogenic	A	> 10 Kg or L
8.2	Skin Corrosive	A	Any amount
9.1 – 9.4	Ecotoxic	A	Any amount[18]

[16] The combined total volume of water that any aerosol containers stored in a location can hold.
[17] The Approved Handler quantity limit for Petrol is 100L.
[18] There are some exceptions for specific Pesticides

6.6 Inventory Management

6.6.1 General Inventory

Departments operating HSNO Exempt laboratories must maintain a record of the substances held and used in such laboratories, as well as any associated bulk storage locations.

These records must include the following information;

- Identity of any hazardous substances
- Approximate quantity (i.e. as container size and number)
- Hazard classifications
- Location of the substances down to room level.

6.6.2 Tracking

Under New Zealand legislation, certain hazardous substances are classified as 'Tracked Substances' if they possess one or more of the classifications specified in Table 5.

Table 5: Tracked Substances

Class	Description
All Class 1	Explosives (but note that signalling and emergency flares of Class 1.3G, 1.4G and 1.4S are exempt).
Class 3.1A	Flammable liquids of very high hazard
Class 3.2A	Liquid desensitised explosives, category A
Class 4.1.2A and B	Self-reactive substances of Type A or B
Class 4.2A	Pyrophoric substances, high hazard
Class 4.3A	Solids that emit flammable gas when in contact with water, high hazard
Class 5.1.1A	Oxidizing substances that are liquids or solids, high hazard
Class 5.2A and B	Organic Peroxides of Type A or B
Class 6.1A, B and C	High acute toxicity
Class 9.1A	Substances that are very ecotoxic in the aquatic environment
Class 9.2A	Substances that are very ecotoxic in the soil environment
Class 9.3A	Substances that are very ecotoxic to terrestrial vertebrates
Class 9.4A	Substances that are very ecotoxic to terrestrial invertebrates

Under the Exempt Laboratory Regulations we are required to maintain an accurate record of such substances and to keep such records for not less than 12 months after the substance is consumed or removed from the laboratory.

In order to comply with these requirements, exempt laboratories must

- Keep a record of the number and size of any tracked substances, as specified in Inventory above.
- Where a container of a tracked substance has been used up, disposed or transferred elsewhere, the date this occurred and the fate of the container or any remaining substance must be recorded (e.g. empty container rinsed and disposed to general waste, or disposed to

chemical waste collection service). This record must be retained for a minimum of 12 months from this date.

- Where a substance is to be transferred to a University of Otago HSNO Exempt Laboratory in another department, this transfer must be notified to and approved by the Departmental Laboratory Manager in the recipient department before the substance is transferred.

6.7 Transport

6.7.1 General requirements

When transporting Hazardous Substances there is an increased risk of breakages and spills and appropriate consideration to spill prevention and containment, as well as segregation of incompatible substances is required.

1. Transfer hazardous substances between laboratories by one or more of the following
   - Use of secondary containers such as plastic tubs with lids.
   - Use of bottle carriers for large glass bottles (>2L). Note that bottle carriers must provide secondary containment, i.e. be able to contain spills or leaks.
   - Use of a trolley that has a lip or tray able to contain spills and prevent containers sliding off.
   - Compressed gas cylinders must be transported using a trolley specifically designed for the purpose and which has a chain or other means to secure the cylinder to the trolley.
   - Wherever practical the use of stairs should be avoided. Substances can be transported in lifts in accordance with (4) below.
2. Do not transport incompatible substances together unless they can be kept segregated (e.g. inside separate secondary containers).
3. Any use of PPCE outside of laboratories must comply with the requirements stipulated in Section 5.2.1
4. Where substances are transported in accordance with the above requirements they can generally be safely transported in lifts with other personnel (although a separate goods lift should be used, where this is available). However, transport of substances or materials that pose a significant risk of asphyxiation or which are highly toxic by inhalation should be subject to a risk assessment (refer Section 4.6) and may require additional precautions (e.g. additional containment or unaccompanied transport), e.g. liquid nitrogen and other cryogenic liquids, toxic gases, substances likely to release highly toxic fumes if spilled.

6.7.2 Transport by vehicle

Please note that some hazardous substances are classified as Dangerous Goods for transport purposes and are subject to specific requirements detailed in Section 6.7.3 In the case of hazardous substances that are not dangerous goods, the following precautions must be followed

- Any person transporting hazardous substances must have appropriate knowledge and training, and have access to appropriate personal protective equipment and other resources (e.g. spill kit) to be able to manage any leak, spill or other incident that could be reasonably foreseen to occur during transport.

- Substances must be clearly identified by name and with the use of appropriate hazard pictograms.
- Substances must be stored and transported in a manner that minimises the risk of spills or contact between incompatible substances (e.g. through the use of secondary containers).
- Very careful consideration must also be given to ensuring that containers of hazardous substances do not create an additional hazard for vehicle occupants in the event of a traffic accident. Where possible, substances should be transported in a separate compartment from passengers. Where this is not possible, precautions must be taken to otherwise contain and secure containers of hazardous substances.
- Note that any use of vehicles must comply with the University of Otago Safe Driving Policy and Workplace Vehicle Guidelines.

6.7.3 Dangerous Goods

Some hazardous substances will also be classified as Dangerous Goods for transport purposes and will be subject to specific requirements. In most cases, the small-scale transport of Dangerous Goods will be subject to the 'Tools-of-trade' provisions that provide for some specific exemptions from these requirements, namely;

- The driver does not need have Dangerous Goods endorsement on their drivers licence.
- A Dangerous Goods Declaration does not need to be prepared.
- The vehicle does not require placarding.
- The segregation requirements do not apply (although reasonable precautions to ensure incompatible substances do not mix must be taken).

However, please note that;

- These provisions are subject to maximum quantity limits and may exclude certain high risk substances altogether.
- The packaging and labelling requirements must be met. In many cases, packaging must meet specific standards and the substance must be labelled with the appropriate Proper Shipping Name, UN number and applicable DG Class symbols.
- Appropriate emergency management information and procedures must be implemented, i.e. PPE and a spill kit must be carried, together with copies of the safety data sheets or a copy of SAA/SNZ HB76: Dangerous Goods – Initial Emergency Response Guide.

An up-to-date copy of the regulations, including schedules of maximum permitted quantities under the tools of trade provision can be obtained from the NZ Transport Agency web-site (http://www.nzta.govt.nz/licence/getting/dangerous-hazardous.html)

To obtain further advice or training on transporting Dangerous Goods under 'Tools of Trade' provisions contact your DLM or Laboratory Health and Safety Advisor.

Use of couriers: If you intend to courier substances that are Dangerous Goods you must notify the courier concerned. There are a number of commercial courier/freight service providers who specialise in transporting Dangerous Goods. Contact your DLM or Laboratory Health and Safety Advisor for advice.

6.8 Disposal of Hazardous Substances

DLMs are responsible for ensuring appropriate processes are implemented within their departments to ensure that any hazardous substance related wastes routinely generated in their departments are disposed of in a safe, legal and responsible manner. Laboratory users must notify their DLM if they are intending to conduct work likely to generate hazardous substance wastes not covered by existing procedures within that department.

The Health, Safety and Compliance Office operates a free hazardous substance waste collection service, managed by the Laboratory Health and Safety Advisor. In most cases the DLM is expected to coordinate the collection of hazardous substances wastes within their department, including;

- Coordinating the collection of any information relating to these required by the hazardous waste collection service
- Liaising with the service to arrange removal of wastes.

However, the DLM may delegate this task where personnel with appropriate knowledge and training are available within the department (e.g. chemical store person).

Please note that laboratory drains enter the city waste water system and do not undergo any special pre-treatment. In particular, substances must not be disposed to drains, if;

- They could cause damage to the drain system e.g. corrosives, oxidizers, reactive solids (4.2, 4.3)
- They could breach any applicable trade waste restrictions or environmental exposure limits in relation to the physical properties (e.g. pH) or specific chemical contaminants.
- Create a hazard to laboratory personnel, building occupants, maintenance personnel or others, e.g. through release of toxic or flammable vapours, or by reacting with other wastes.

In addition, please note that the yellow biohazard bags and bins provided in many laboratory areas are intended primarily for the disposal of biological hazards and must not be used for disposal of unwanted hazardous substances. Biohazard waste is treated by steam sterilization, followed by shredding and disposal to landfill. Disposal of hazardous substances to biohazard waste may result in exposure of laboratory personnel or waste contractors to hazards associated with the substances (e.g. toxic fumes, hazardous reactions, fire) and may contribute to contamination of land-fill sites.

More detailed guidance on hazardous substance waste disposal can be found in the ***Laboratory Chemical Waste Disposal Guidelines* (UOOLAB9-2015).**

6.9 Use of hazardous substances in fieldwork/off-campus activities

The use of Hazardous Substances in field-work needs to be considered as part of the risk assessment for that field-work, in accordance with the University of Otago *Health and Safety Guidelines for Fieldwork and Off-campus Activities (January 2015)*.

The following should be addressed as part of any risk assessment for the use of Hazardous Substances in fieldwork or other off-campus activities;

- Provision/identification of a suitable work area (e.g. plastic tray) that is impervious to the substances in use and which will contain spills.
- Provision of appropriate PPCE.
- Provision for procedures and equipment to manage any reasonably foreseeable incident such as a spill or splash to eyes/skin (e.g. provision of portable eye-wash, spill kit).
- Provision of a means to clean or decontaminate the hands/skin (e.g. through cleaning wipes).
- Transport of substances in accordance with the requirements of Sections 6.7.
- The safe, legal and responsible disposal of any hazardous wastes to be generated.

Field activities involving the use of Hazardous Substances for research, development or teaching purposes may still be covered by the Exempt Laboratory provisions, providing that any controls or procedures to manage the hazardous substances to be used are documented and approved by the DLM.

Note on fuels: Some field activities may also involve the storage, use and transport of fuels for the purposes of operating vehicles associated with the field activity. The use of fuels for the operation of vehicles falls outside the scope of this manual. However, it is recommended the risk assessment for a field based activity involving the storage and handling of fuels (other than those contained only in the fuel tank of a vehicle and supplied directly from a commercial service station) should take this hazard into consideration. In particular, consideration should be given to;

- The use of appropriate fuel containers and liquid handling equipment.
- The management of static electricity hazards when transferring petrol.
- The risk of fire and provision of appropriate safety equipment (e.g. fire extinguishers, fire blankets, flame retardant overalls for personnel involved in bulk fuel handling)
- The prevention and containment of spills.

6.10 Supply of Hazardous Substances to other parties.

Hazardous Substances may not be supplied to any persons or facilities that are not University of Otago HSNO Exempt Laboratories (i.e. either to non-HSNO Exempt facilities within the University of Otago or to external persons/facilities) without approval from the DLM. In approving any supply of hazardous substances to other parties, the DLM must be satisfied of the following;

- The recipient has a legitimate use for the substance.
- For recipients located in New Zealand, that they have the appropriate approvals to use the substance for the intended purpose, i.e. they can confirm they are operating under an applicable approved Code of Practice, Group Standard or EPA approval[19], and that where the substance is required to be under the control of an Approved Handler[20], the recipient holds a current Approved Handler certificate covering the applicable classes or substances.
- For recipients located outside of New Zealand (e.g. research samples being sent to an international collaborator) that the recipient is a legitimate research/analytical facility and the substance is being supplied for a research related purpose (including analysis of the substance).
- The recipient is provided with, or otherwise has access to, a Safety Data Sheet for the substance concerned (where available) as well as for any other hazardous substance used for the purpose of dissolving or suspending that substance.

Please note that the sale of any Hazardous Substance (or product containing a Hazardous Substance) from a HSNO Exempt Laboratory to another party is subject to strict legal restrictions and any laboratory wishing to do this must obtain approval from the ULM.

[19] E.g. in the form of a letter from the recipient confirming the identity of the facility concerned (company, organisation) and specifying what Code of Practice, Group Standard or other approval they intend to use the substance under.

[20] The recipient should be asked to provide a copy of the Approved Handler certificate where Approved Handler certification is required.

7 Laboratory Equipment

7.1 Selection and Use of Laboratory Equipment

Where possible, laboratory equipment should be selected and used as follows;

- Use equipment that is specifically designed and sold by the manufacturer/supplier for the purpose it is intended to be used in the laboratory.
- Use in accordance with the manufacturer instructions.
- Where possible, use equipment that meets an applicable New Zealand, Australian or other reputable international standard.

In circumstances where it is necessary to use an item of equipment for a purpose other than the normal use of that equipment, or to use equipment in a manner that contravenes any safety instruction by the manufacturer, a risk assessment in accordance with Section 4.6 must be completed. This risk assessment should consider the following;

- The intrinsic hazards associated with normal use of that equipment.
- The risks associated with any substances (including water) or materials that will be used in conjunction with the equipment and for which the equipment is not specifically designed or intended to be used with (e.g. ignition of flammable vapours by sparks, hot surfaces).
- Whether the intended use could subject the equipment to forces, temperatures and pressures beyond what it is designed for, and the potential consequences of any resulting equipment failure.

Construction or repair of equipment for laboratory use must be carried out by a competent person only. The use of custom or purpose built equipment must be subjected to a risk assessment as described above.

7.2 Glassware

Glassware is a frequent cause of cut/puncture injuries in laboratory personnel and such injuries can result in tendon or nerve damage that require surgery.

To minimise the risk of cut injuries from glassware

- Check glassware before use for signs of damage (e.g. cracks or chips) and arrange for disposal or repair of any damaged glassware. Damaged glassware may pose a sharp hazard in itself and is also more likely to break during use.
- Do not apply excessive force to glassware (e.g. when trying to remove a stuck lid or insert a glass pipette into a pipetting aid)). Consult with your Laboratory Supervisor or DLM for advice on separating stuck items. Note that a number of products are available for assisting in removing lids
- Dispose of glassware into a container designated for this purpose, never dispose of glassware into general waste bins (even if not broken).

The use of glassware under vacuum can lead to implosions resulting in a projectile hazard to the eyes and body. To minimise the risk of implosions;

- Use only glassware that is designed to be used under vacuum and check for signs for damage before use as above.
- Personnel working in areas where glass equipment under vacuum is in use must wear Eye Protection (refer Section 5.2.2).
- Consider if other protective measures can be implemented (in addition to eye protection), e.g. use of protective screens, plastic netting for glassware.

7.2 Electricity Hazards

7.2.1 General

The following general precautions must be observed when working with electrical equipment;

- Never use faulty or damaged electrical equipment (irrespective of whether it bears a current test tag as described in 7.2.2 below).
- Position items of electrical equipment (e.g. power-packs, power-boards) to minimise the risk that these could be splashed by any solutions in use (e.g. by placing power-packs on a shelf above the work bench).
- Minimise use of power-boards and multi-socket adaptors as overuse of these may lead to overloading, potentially causing overheating or tripping fuses.
- Regularly check and clean any air intakes on electrical equipment as these may become blocked with dust over time, causing equipment to overheat (e.g. fridges, freezers, computers, and other scientific equipment.)
- Wherever practical, electrical equipment should be designed so that users cannot contact energized electrical circuits. For example, electrophoresis apparatus should be designed so that removing the lid from the buffer tank will break the electrical circuit.

7.2.2 Electrical Testing Requirements

Please note that any items of electrical equipment that are connected to the power supply by a flexible cord and plug and which are able to unplugged and moved are considered 'portable electrical equipment' and are subject to the requirements of the University of Otago *Testing of Portable Electrical Equipment Health and Safety Policy* and associated *Testing of Portable Electrical Equipment (Non-specialised) Guidelines*.

Under these requirements, specific procedures for the safety inspection and testing of portable electrical equipment (in accordance with *AS/NZS3760 – In-service safety inspection and testing of electrical equipment*) must be followed prior to new equipment being placed into service and then at regular intervals (annually, in the case of laboratory equipment). As part of these procedures, portable electrical equipment must be tagged to verify that the safety inspection/testing has been performed.

Electrical equipment that is to be connected to humans or animals (e.g. medical monitoring equipment) should be selected and tested in accordance with the AS/NZS 3200 series (Medical electrical equipment) and electrical installations in areas where such equipment is used should comply with AS/NZ 3003:2011 (Patient Areas).

7.3 High Risk Equipment

Some items of laboratory equipment may pose a significant risk of injury to users or others, including by one or more of the following;

- Mechanical injury, e.g. being struck by moving parts/heavy objects.
- Serious cut injury.
- Projectile hazards (e.g. equipment under pressure or vacuum).
- Entanglement hazards, e.g. lathes.
- Exposure to thermal or cryogenic hazards (very hot/cold surfaces or materials).
- Exposure to hazardous radiation (e.g. UV radiation).
- Potential for contact with exposed energized electrical systems (>50V AC or 120V DC).

Examples of potentially high risk items of equipment include lasers of Class 3B or higher, compressed gas cylinders, microtomes, ultracentrifuges, rotary evaporators, band-saws, lathes, heavy lifting equipment and autoclaves.

Where equipment poses a risk of serious injury a risk assessment must be completed in accordance with Section 4.6 and the following must be documented;

- A Safe Operating Procedure (SOP) for the equipment, including any PPCE or guarding required.
- The process for training and assessing the competence of users, including clearly identifying which personnel are authorised to train and assess the competence of others.
- Any supervision requirements and/or working in isolation restrictions associated with use of the equipment.
- Records of training/assessments of competence.
- Any records of usage required to maintain the equipment in a safe condition, e.g. records of rotor usage for ultracentrifuges.

High risk equipment and associated equipment must be recorded in Vault, together with any periodic servicing or checks required to maintain the equipment in a safe condition.

8. Laboratory Design and Construction

8.1 Approval Process

Plans for all new laboratories, as well as significant upgrades/modifications of existing laboratories must be must be approved by the Departmental Laboratory Manager in the department concerned and by the Statutory Budget Working Group. The University of Otago Statutory Compliance Budget is specifically provided to allow upgrade or modification of existing laboratory facilities to meet current standards or to address significant health and safety concerns. Details on this process are contained within the ***Statutory Budget Laboratory Upgrade and/or New Facilities Process*** document. However, please note that new laboratories or laboratory upgrades/modifications funded through other sources must still be approved as described above.

8.2 Standards

By default, new laboratories shall be designed in accordance with the latest applicable version of AS/NZS 2289 (in relation to general requirements) and in accordance with requirements for PC2 facilities specified in AS/NZS2243.3, except where more stringent requirements (e.g. PC3) are dictated by the nature of the work to be carried out in the laboratory. Note that the requirement to meet PC2 requirements is to ensure that laboratories can be readily adapted for use as PC2 laboratories, even if this is not originally planned or anticipated. Any exceptions to these default requirements must be approved by the Statutory Budget Working group.

8.3 Laboratory Signage

In order to clearly identify all HSNO Exempt Laboratory areas, the entrances to all such laboratories shall by identified by standard University of Otago laboratory signage (provided by property services) with the following information;

- A panel including the wording “Caution: Restricted Entry Authorised Personnel Only”
- For Entry Authorisation please contact: (*DLM name and phone number*)
- A panel including the wording “HSNO Exempt Laboratory”.
- A pane specifying the Physical Containment Level and Type (where applicable)
- A panel displaying hazard pictograms for the major hazard classes present (see below).

In relation to the selection of hazard pictograms for door signage (for hazardous substances) the quantity thresholds for signage given in **Table 6 (Page 39)** should be used as a guide. These values are taken from Schedule 5 (Quantities requiring signage) of the Hazardous Substances Emergency Management Regulations 2001. Please note that some thresholds for hazard classification that would be very unlikely to be present in laboratories in quantities requiring signage have been omitted from this Table (including for; Class 1, 2.1.2A, 3.1D, 4.1.2C-G, 6.1D, 9.1D, 9.2D and 9.3C).

Table 6: Quantities requiring signage

HSNO Hazard Classification	Physical State	Quantity at or above which signage is required
2.1.1A	Liquefied/dissolved gases	250 Kg
	Compressed gas	100 m^3
2.1.1B	Liquefied/dissolved gases	500 Kg
	Compressed gas	200 m^3
3.1A, 4.1.3A, 4.2A, 4.3A	Liquid	50 L
	Solid	50 Kg
3.1B, 4.1.3B, 4.2B, 4.3B	Liquid	250 L
	Solid	250 Kg
3.1C, 4.1.3C, 4.2C, 4.3C	Liquid	1000 L
	Solid	1000 Kg
4.1.1A	Solid	250 Kg
4.1.1B	Solid	1000 Kg
4.1.2A or B	Solid	50 L
	Liquid	50 Kg
5.1.1A	Liquid	50 L
	Solid	50 Kg
5.1.1B	Liquid	500 L
	Solid	500 Kg
5.1.1C	Liquid	1000 L
	Solid	1000 Kg
5.2A or B	Liquid	1 L
	Solid	1 Kg
5.2C – 5.2F	Liquid	10 L
	Solid	10 Kg
6.1A	Liquid	50 L
	Solid	50 Kg
6.1B	Liquid	250 L
	Solid	250 Kg
6.1C	Liquid	1000 L
	Solid	1000 Kg
6.1A-C	Liquefied/dissolved gas	5 Kg
	Compressed gas	2.5 m^3
8.2A	Liquefied/dissolved gas	5 Kg
	Compressed gas	2.5 m^3
	Liquid	50 L
	Solid	50 Kg
8.2B	Liquefied/dissolved gas	50 Kg
	Compressed gas	25 m^3
	Liquid	250 L
	Solid	250 Kg
8.2C, 8,3A	Liquid	1000 L
	Solid	1000 Kg
9.1A, 9.2A., 9.3A, 9.4A	Liquid	100 L
	Solid	100 Kg
9.1B-C, 9.2B-C, 9.3B-C, 9.4B-C	Liquid	1000 L
	Solid	1000 Kg

8.4 Laboratory decommissioning

Where a laboratory is to be decommissioned (e.g. prior to major upgrade/renovation or conversion for use as a non-laboratory area), appropriate procedures must be followed to ensure the laboratory is safe for Property Services and Contractor personnel involved in demolition, removal or construction work.

Prior to any work commencing on the laboratory the ***Laboratory Decommissioning Form (UOOLAB10-2015)*** Must be completed by the Laboratory Supervisor/Principal Investigator responsible for laboratory concerned and signed off by the Departmental Laboratory Manager. Sign-off may also be required from the Sector Manager (for Containment and Transitional Facilities) and Radiation Licensee (where sources of ionizing radiation have been used). The check-list must then be sent to the Laboratory Health and Safety Advisor who will check and arrange final approval from the Health and Safety Office (signed off by the University Laboratory Manager, Biological Compliance Officer and Radiation Safety Advisor). The Health, Safety and Compliance Office will then notify the Department (via the DLM) and Property Services that the laboratory has been decommissioned and that it is safe for Property Services and Contractors personnel to commence work.

8.5 Laboratory Register

The laboratory Health and Safety Advisor is responsible for maintaining a register of all University of Otago HSNO Exempt Laboratories. DLMs are responsible for notifying the Lab Health and Safety Advisor of any changes (e.g. new or decommissioned laboratories or laboratories that have divided or amalgamated). The Laboratory Health and Safety Advisor shall send out a copy of the Laboratory Register to all DLMs annually and DLMs are responsible for checking and updating any information and returning this to the Laboratory Health and Safety advisor by the date requested.

9. Spill and Emergency Management

9.1 Provision of Emergency Eye-Wash and Safety Showers

All University of Otago laboratories are required to be equipped with Eye-wash stations that can be used to rinse both eyes simultaneously and which can be pulled out and used as drench hoses if required. These must be available within 15m (or 10 seconds travel time) of any area where Hazardous Substances may be in use and should provide effective first-aid in the event of small-scale splashes to the eyes or skin.

Emergency Safety Showers shall be provided in all newly constructed laboratories in accordance with AS/NZS 2289:2010, except where a documented risk assessment demonstrates that provision of a safety shower is not required. To justify not providing a Safety Shower in a new laboratory or to make a case for provision where none currently exists, complete the **Safety Shower Risk Assessment (UOOLAB11-2015)** and forward to the Laboratory Health and Safety Advisor.

9.2 Provision of spill kits

All Exempt laboratories must have a chemical spill kit that meets the minimum requirements detailed below. The LS must ensure that all laboratory personnel are shown the location of, and know how to use the spill kit;

Minimum spill kit requirements[21]

- Loose absorbent material (e.g. vermiculite, clay kitty litter (bentonite clay)
- Absorbent pads or paper towel.
- An absorbent sock/boom
- A plastic dustpan and brush
- A container with lid that can be used to dispose of any contaminated spill materials (e.g. plastic pail, this may double as the spill kit container)

In addition, depending on the volume and nature of substances that may be present, consideration to inclusion of the following is recommended;

- P2 dust masks with carbon cartridge (i.e. for protection against nuisance level toxic organic/acid gas vapours)
- Shoe covers
- Chemical resistant gloves (i.e. a glove for which chemical resistance data is available or which meets a recognised standard for chemical resistance in relation to the type of substances for which it is likely to be used).

[21] It is expected that laboratory personnel will have access to Safety Glasses, disposable gloves and laboratory coats as part of normal PPCE provision.

9.3 Provision of respirators for spill response

In general, the provision of respirators in general laboratory spill kits is not recommended as respirators need to be fitted to the user to work properly and respirator cartridges may expire. The use of a poorly fitting respirator by an untrained user could place the user at risk. Instead, where a department identifies that there is a potential for spills to occur for which a respirator would be required, the department should identify specific personnel with appropriate knowledge and training to respond to such incidents. These personnel should be issued (and fitted) with respirators and the respirator cartridges placed on a replacement schedule based on their manufacturer expiry (this can be managed through Vault).

9.4 Monitored Alarms

Campus Watch maintains contact details for any Campus Watch monitored alarms (e.g. Freezers, Oxygen depletion alarms). The Laboratory Health and Safety Advisor shall circulate a list of such contacts annually to DLMs. DLMs are responsible for checking and updating any information and notifying the Lab Health and Safety Advisor of any errors or changes. The Laboratory Health and Safety Advisor shall in turn provide the updated contact information to Campus Watch.

9.5 Emergency Response Plans

Procedures to be followed in the event of fire, chemical (Hazardous Substances) spills/releases or Gas (LPG or Natural) Gas Leaks are detailed in the University of Otago Emergency Procedures flip-chart. A copy of this flip-chart must be available in all laboratories (ideally close to phone and/or exit).

In some cases, specific procedures or substances may require additional procedures not detailed in the plan (e.g. bulk storage of cryogenic liquids). In such cases, the department concerned should document an appropriate emergency response plan in consultation with the Health, Safety and Compliance Office.

All laboratory users must be trained in any applicable emergency procedures as part of the training requirements for Authorised Laboratory Users, specified in Section 4.2. Emergency response plans are required to be tested annually. Annual testing of plans shall be accomplished by the following;

- Where a plan (or part of plan) calls for activation of a fire alarm and evacuation of a building, the completion of a fire drill can be considered as having tested this part of the plan. It is recommended that DLMs maintain records of such drills or ensure they have access to such records.
- Property Services shall verify that all plumbed Eye-wash stations and Safety Showers comply with the performance requirements specified in AS 4775 through regular testing (at a minimum, annually).
- The provision of appropriate emergency management equipment and documentation (e.g. spill kits, gas shut-off valves, eye-wash, emergency procedures, SDS) shall be checked annually through the laboratory audit process (as specified in Section 4.6).

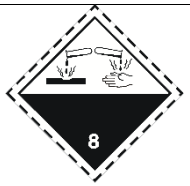
Appendix 1: Summary of HSNO Hazard Classifications

HSNO Classification		Hazard	DG	GHS
1	Explosives	• Substances or articles that are or contain explosives		
2.1.1	Flammable gases	• Gases that are flammable and which may form explosive air/gas mixtures		
2.1.2	Flammable aerosols	• A substance packaged under pressure in such a way that it is designed to be released as a spray of solid or liquid particles and which contains flammable ingredients.		
3.1	Flammable liquids	• Liquids that produce flammable vapours and which may form explosive air/vapour mixtures		
3.2	Liquid desensitised explosives	• Liquid substances that consist of an explosive substances that is dissolved or mixed with another substance to render the substance non-explosive (but which are typically highly flammable and may still pose an explosion hazard if not handled or store appropriately)		
4.1.1	Readily combustible solids or may cause fire through friction	• Solids that may burn rapidly and intensely on contact with an ignition source (in the presence of air) or which may cause fire through friction.		
4.1.2	Self-reactive substances	• Substances that may decompose in the absence of air to release heat and gas. • Type A and B may detonate if heated under confinement (i.e. in sealed container). • May be subject to a SADT[22].		
4.1.3	Solid desensitised explosives	• Solid substances that have been mixed with another substance (often water or an organic solvent) to render them non-explosive (but which are typically highly flammable and may still pose an explosion hazard if not handled or stored appropriately)		

[22] Self-Accelerating Decomposition Temperature (SADT): Substances subject to a SADT may spontaneously decompose (potentially causing fire or explosion) if stored or heated at temperatures above the SADT.

HSNO Classification		Hazard	DG	GHS
4.2	Spontaneously combustible	• Class 4.2A may ignite on contact with air in even small quantities. • Class 4.2B-C may heat dangerously in contact with air and may ignite in large quantities.		
4.3	Substances that emit flammable gas on contact with water	• Substances that may emit flammable gas and heat on contact with water. • 4.3A substances heat sufficiently that they may ignite the flammable gas emitted.		
5.1.1	Oxidizing substances that are liquid or solid	• May intensify fire by supplying Oxygen. • May react dangerously (fire, explosion) with flammable liquids, combustible materials, magnesium, zinc and powdered metals.		
5.1.2	Oxidizing substances that are gases	• May intensify or increase risk of fire by increasing the Oxygen content of the air. • May react dangerously (fire, explosion) with flammable liquids, combustible materials, magnesium, zinc and powdered metals.		
5.2	Organic Peroxides	• Organic (carbon-containing) substances that contain a reactive peroxy (Oxygen-Oxygen) bond. • Highly flammable substances that may react dangerously (fire, explosion) with incompatible substances (including; flammable liquids, combustible materials, magnesium, zinc and powdered metals) or if subjected to heat or shock. • Type A or B may detonate in subjected to heat, shock or contaminated with incompatible substances • May be subject to a SADT[23].		

[23] Self-Accelerating Decomposition Temperature (SADT): Substances subject to a SADT may spontaneously decompose (potentially causing fire or explosion) if stored or heated at temperatures above the SADT.

HSNO Classification		Hazard	DG	GHS
6.1	Acute Toxicity	• Substances that may cause fatal poisoning from a single exposure		
6.3	Skin irritants	• May cause pain and inflammation of the skin	***No DG Equivalent***	
6.4	Eye Irritants	• May cause pain and inflammation to the eyes		
6.5A	Respiratory sensitizer	• Substance may cause respiratory sensitization, i.e. development of allergic responses in the airways or lungs, including asthma		
6.5B	Skin sensitizer	• Substance may cause skin sensitisation, i.e. development of allergic skin reactions, e.g. inflammation, eczema		
6.6	Mutagens	• Substance may cause heritable damage to DNA		
6.7	Carcinogens	• Substance may increase risk of cancer		
6.8A-B	Reproductive/ Developmental Toxin	• Substances that may cause harm to reproduction, fertility or development.		
6.8C	Effects on/via Lactation	• Substances that may affect lactation or cause harm to infants via lactation.		
6.9	Target Organ/System Toxin	• May cause harm to organs or systems not covered by other toxicity classifications, e.g. damage to eyesight, central nervous system effects.		
8.1	Corrosive to metals	• May damage metals.		
8.2	Corrosive to skin	• May cause permanent tissue damage to the skin or eyes.		
8.3	Corrosive to eyes	• May cause permanent tissue damage to the eyes		
9.1	Aquatic Ecotoxin	• May cause harm to aquatic organisms (e.g. fish, invertebrates, algae)		
9.2	Soil Ecotoxin	• May cause harm to soil organisms (e.g. plants, invertebrates, microorganisms)	***No DG Equivalent***	
9.3	Vertebrate Toxin	• Toxic to non-human vertebrates		
9.4	Terrestrial Invertebrates Toxin	• Toxic to land invertebrates (e.g. honeybees)		

Appendix 2: Links to referenced documents

University Policies/Guidelines
Smoke-free Policy
Safe Driving Policy
Workplace Vehicle Guidelines
Health and Safety Guidelines for Fieldwork and Off-Campus Activities
Testing of Portable Electrical Equipment Policy
Testing of Portable Electrical Equipment (Non-specialised) Guidelines
Laboratory Procedures/Guidelines All documents below may be accessed under Laboratory Safety/Hazardous Substances on the Health and Safety Compliance Web-site at the link below: **http://www.otago.ac.nz/humanresources/health-and-safety/hazards/laboratory-safety/hazardous-substances/otago060501.html**
Laboratory Visitor Guidelines (UOOLAB1-2015)
High Risk Lab Procedures Audit Tool (UOOLAB2-2015)
Lab Risk Assessment Template here (UOOLAB3-2015)
Lab Audit Tool (UOOLAB4-2015)
Resigning Lab Supervisor/PI Form (UOOLAB5-2015)
Laboratory Eye Hazard Risk Assessment Tool (UOOLAB6-2015)
Fridge Modification Record Template (UOOLAB7-2015)
Hazardous Substance Locations (UOOLAB8-2015)
Laboratory Chemical Waste Disposal Guideline *(*UOOLAB9-2015)
Lab Decommissioning Form (UOOLAB10-2015)
Safety Shower Risk Assessment Tool (UOOLAB11-2015)
Statutory Budget Laboratory Upgrade and/or New Facilities Process