SAFETY & HEALTH HAND BOOK
For
Staff & Students

School of Biological Sciences

June 2012

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INTRODUCTION

A safe and healthy working environment is in the best interests of the whole University community and we can all play our parts in ensuring that everything possible is done to achieve this. The aim of this "Safety and Health Handbook" is to make available in one place the great variety of policies and guidelines which exist dealing with different aspects of safety and health in the workplace so that everyone can familiarize themselves with and follow these policies and guidelines.

It is our intention to make this Handbook available to all academic, technical and clerical staff and all research students employed in the School of Biological Sciences, The University of Hong Kong and to ensure that undergraduate students and visitors are made aware of those parts of the Handbook relevant to their activities.

In the end, of course, it is each one of you who bears the responsibility to read and follow these guidelines and to seek guidance where any doubts exist concerning specific activities. Each Department has a Safety Officer and these should be your first point of contact.

I look forward to your support and co-operation in ensuring that our laboratories and other facilities remain a safe and healthy place to work. Most occupational accidents can be prevented if proper thought is given to the risks of any activity and the necessary precautions then taken. So please, read this Handbook, learn to think of the possible risks involved in each and every activity and the precautions that could contain these risks, and follow the guidelines at all times.

Professor Rudolf Wu
Editor
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1 THE UNIVERSITY OF HONG KONG, HEALTH AND SAFETY POLICY

1.1 GENERAL POLICY AND RESPONSIBILITIES

(1) The Council of the University of Hong Kong is committed to ensuring the health and safety of all its employees, students and visitors.

In pursuit of this goal the University will, as far as is reasonably practicable, apply, provide and promote accepted international standards of occupational and environmental health, safety and fire precautions.

(2) The University will take all reasonable steps within its power to meet this responsibility, paying particular attention to:-

(a) The provision and maintenance of plant and systems of work which are safe and without risks to health.

(b) The provision and maintenance of an environment which is safe and without risks to health and adequate as regard facilities and arrangements for the welfare of University employees and students.

(c) The provision of a safe place of work, study and residence (where owned or rented by the University) and safe access to and egress from them.

(d) Safe arrangements for the use, handling, storage and transport of articles and substances.

(e) The provision of information, instruction, training and supervision to enable University employees and students to minimize risk, reduce injuries and ill health and to contribute positively to their own safety and health.

(3) Achievement in occupational and environmental health and safety requires a positive commitment from all University employees and students. Each individual has the responsibility to ensure that by his/her activities or behavior he/she does not create risks for himself/herself or others and to take all reasonable steps to protect himself / herself and others from any foreseeable risks associated with their activities that are associated with the University.

(4) The statement will be brought to the attention of employees and students. It will be reviewed periodically and may be supplemented in appropriate areas by further statements relating to the work of particular departments.

(5) A library of publication relating to environmental health and safely, including Government Ordinances and Regulations is maintained by the University Safety Officer for reference by, or loan to, any member of the University.

1.2 SPECIFIC RESPONSIBILITY FOR ENVIRONMENTAL HEALTH AND SAFETY WITHIN THE UNIVERSITY

(1) Responsibilities of the University Council:-

(a) To establish and maintain the University's environmental health & safety policies, standards and procedures.

(b) To maintain the Environmental Health and Safety Committee.

(c) Through the Vice-Chancellor, to ensure the implementation of the University's environmental health and safety policies.

(2) Responsibilities of the Vice-Chancellor:-

(a) To have overall responsibility for environmental health and safety within the University.

(b) To ensure, so far as is reasonably practicable, the provision of resources for the implementation of the University's environmental health and safety policies established by the Council, and to appraise periodically the extent to which the policies have been implemented.

(c) To take reasonable steps to ensure, where appropriate, through the Environmental Health and Safety Committee, that the University's environmental health and safety policies are understood at all levels.

(d) To ensure that responsibilities concerned with health and safety are properly assigned and accepted at all levels.

(3) Responsibilities of Heads of Departments:-

(a) To draw up a detailed statement of policy reflecting and amplifying the University's statement of policy as it pertains to his/her department, and to establish and implement safety procedures and standards. The statement of procedures and standards shall be submitted through the Environmental Health and Safety Committee to the University Council for approval.

(b) To review his/her own departmental environmental health and safety at work procedures regularly and issue amendments to, or revisions of, their statements as necessary.

(c) To promote and maintain effective environmental health and safety practices and standards for the well-being of students, staff and visitors.

(d) To provide and maintain machinery, equipment, appliances and other plant and systems of work that are safe and without risk to health.

(e) To make provisions for and arrange for all levels of staff to receive adequate and appropriate training on environmental health and safety matters.

(f) To maintain a safety programme pertinent to the personnel and facilities under his/her direction.

(g) To appoint from senior full-time appointees within the department a safety representative and to define his/her duties.

(h) To investigate accidents that happens in his/her department and to send a report to the Safety Office.

(i) To supply prompt information to the Registry on employee accidents for the purpose of reporting to the Labour Department.

(4) Responsibilities of Intermediate Staff:-

(a) Each member of supervisory staff is responsible for the health and safety of his own particular workers and students. This applies equally to academic and administrative staff as it does to technicians.

(b) Staff cannot delegate out of this responsibility and should endeavor to encourage and foster safe working practices in those over whom they have charge.

(c) In those cases where health & safety guidelines have not been prepared at departmental or University level, supervisory staff should raise the issue with the Departmental Head to ensure local arrangements are made.

(5) Responsibilities of all Employees and all Students of the University:-

(a) To make them familiar with, and conform to, the safety policies at all times.

(b) To observe all safety rules at all times.

(c) To wear appropriate safety equipment and use appropriate safety devices in accordance with rules and procedures.

(d) To conform to all instructions issued by the appropriate authorities.

(e) To report all accidents and damage of property to their supervisor and safety representative.

(f) To report any potential hazard or near miss to their supervisor and safety representative.

(g) To make appropriate suggestions designed to improve health and safety to their supervisor and safety representative.

(h) To inform their supervisor or safety representative of any hazard that may be introduced as a result of their work.

(i) To be responsible for their personal safely.

(6) Responsibilities of the Environmental Health and Safety Committee:-

(a) Through the Vice-Chancellor, to recommend to the Council, policies, procedures and standards for adoption by the University Community.

An exception is radiological protection for which separate arrangements are in force.

(b) To establish policies and guidelines under which the Safety Office will operate.

(c) To act as an advisory committee to Council on the consideration of the departmental environmental health and safety policy statements, standards and procedures.

(d) Through the Safety Officer, to be informed of environmental health & safety programmes implemented by departments for reporting to the Council through the Vice-Chancellor on a regular basis.

(e) To review the University's accident experience.

(f) To appoint sub-committees or specialist committees as necessary to which its responsibilities would be delegated.

(7) Responsibilities of the Safety Officer:-

(a) Through the Environmental Health and Safely Committee, to advise and keep the University informed on matters of environmental health, safety, and fire protection, and to assist departments directly on this; to sit on the Council's Committee as well as all its sub-committees or specialist committees so as to act effectively as liaison person among them.

(b) To assist departmental Safety Representative in implementing environmental health & safety policies with respect to standards and procedures.

(c) To undertake the organization of instruction in methods of safety.

(d) To assist the Heads of Departments, in keeping all employees aware of health and safety matters and of their responsibilities for the health and safety of those who work with or study under them.

(e) To conduct accident/incident, fire and dangerous occurrence investigations and compile reports with recommendations for their prevention; to keep and analyze such records.

(f) To report regularly to the Environmental Health and Safety Committee on safety performances and accident trends.

(g) To conduct, in consultation with the Director of the University Health Services or other specialists as necessary, educational activities related to safety for all appointees and students.

(h) To receive information from the officers responsible for the design and construction of new buildings and for the modification of existing buildings and advise on all matters affecting safety.

(i) To seek an utilize the experience of specialists within and outside the University in the examination of general specific problems relating to safety.

(j) To ensure that the University property and persons therein are free from the risk of fire by instigating and maintaining an effective and efficient fire safety programme including but not limited to such activities as fire drills, fire safety instructions and evacuation procedures, five services installation inspection and maintenance programmes.

(k) To ensure that adequate warning will be provided to occupants in the University premises in the event of a fire by maintaining the fire services installations in an effective and serviceable condition.

(l) To maintain liaison with outside officials and ensure that appropriate licenses and certificates are obtained and their conditions observed.

(m) To maintain a library of publications relating to environmental health, safety, and of relevant Government Ordinances and Regulations for reference of, or loan to, any member of the University.

(n) Through the EHSC, to keep the University Council informed of any additions of, or amendment to relevant environmental health & safety legislation and advice Council of the appropriate measures to be taken to comply with such change.

(o) To ensure that the safety cabinets and fume hoods in the laboratories are performing within required safety parameters by instigating and maintaining a checking and certification programme.

(p) To assist the Departments to comply with the statutory requirements of the Environmental Protection Department by rendering the necessary advice and assistance in handling chemical waste and effluent.

(q) To ensure that the risks posed by the Dangerous Goods kept in the University are managed by providing and maintaining a central Dangerous Goods Supply service to all users in the University and keeping the same in designated Dangerous Goods Stores.

(8) Responsibilities of Departmental Safety Representatives:-

(a) To inform his/her Head of Department and the Safety Officer of any special hazards in, or new hazards about to be introduced into the department/unit.

(b) To inform new members of the department, including students, of the University's safety policy, as well as departmental environmental health & safety policy, standards and procedures.

(c) To conduct activities for stimulating and maintaining interest in the safety of personnel in the department.

(d) To ensure that means exist for all machinery and equipment to be maintained and used in a safe condition.

(e) To ensure with the assistance of the Safety Officer that first aid and safety facilities are properly maintained.

(f) In consultation with the Safety Officer, to promote, plan, and direct a regular programme of safety inspections.

(g) To ensure that accidents are reported promptly in accordance with University procedures and to report any case of non-compliance to the Head of Department.

(h) To maintain liaison with the Safety Officer and the Director of University Health Service.

(i) To recommend accident prevention measures to the Head of Department as and when necessary.

(9) Responsibilities of the Director of University Health Service:-

(a) Through the Environmental Health and Safety Committee, to advise the University, and departments and individuals directly, on matters of environmental and occupational health.

(b) To conduct, in consultation with the Safety Officer, educational activities in environmental and occupational health.

(c) To provide first aid materials to various departments.

(10) Responsibilities of Director of Estates:-

(a) To maintain all University buildings, their services, University grounds, and all access and egress in a safe and sound condition.

(b) To ensure that their staff work with due care and attention not only for their own safety but also for the health and safety of others who may be affected by their work.

(c) To employ competent contractors and to supervise them so they do not jeopardize the health and safety of University staff, students or visitors.

(d) To ensure that in all new projects and refurbishment works adequate attention is given in the design to enable the resulting environment to be free of hazards to the health and safety of the occupants.

1.3 ACCIDENTS AND COMPENSATION

Any injury or illness which an appointee suffers as a result of an accident occurring during the course of or arising from his/her employment must be reported immediately to the Director of School who should then, using form 2 of the Employee Compensation Ordinance, report to the Registry with copies to the Director of the University Health Service and the Safety Officer as the University is required under the terms of the Employees' Compensation Ordinance both to report such injuries to the Commissioner for Labour and to provide compensation for any permanent or temporary incapacity, or for death, due to such injuries.

1.4 ENQUIRIES SHOULD BE ADDRESSED TO THE SAFETY OFFICER

Report of Fire, Dangerous Occurrences & Other Untoward Incidents

All fires, dangerous occurrences and untoward incidents are required to be reported immediately to the Safety Office directly or to The Head of Department who should then inform Safety Office for the necessary investigation and appropriate follow up action.

The word "department" in this document, wherever it occurs, refers to all teaching, research, administrative and service departments and includes schools, centres, units, libraries, and halls of residence.

2 HEALTH & SAFETY MANAGEMENT

2.1 RISK ASSESSMENT AND CATEGORY OF RISK

2.1.1 Risk assessment

Definition

A risk is the likelihood of a hazard actually causing harm.

A hazard is something with the potential to cause harm. Some examples are trip hazards in a corridor, glare from VDU's, moving heavy objects and using chemicals.

An assessment is an investigation of the use or potential use of a hazardous substance/equipment/operation in the workplace to understand and minimize the risks to the health or safety of workers using and/or carrying out that substance/equipment/operation.

Aim

Risks associated with a hazard need to be assessed to determine how severe (or dangerous) they are. Assessing the risks allows decisions to be made as to what hazards or risks need to be controlled and to set priorities for introducing controls.

Level of Risk

= *LIKELIHOOD* multiplied by *SEVERITY*

Well kept accident/incident and workers' compensation records can help with estimating the consequence and likelihood of an accident occurring in a group of employees.

Factors

To determine the level of risk, all of the following need to be considered:

Severity**:** This factor concerns the extent of the inquiry or degree of harm caused if exposed to the hazard (e.g. fatality, major injury, minor injury, no injury).

Probability**:** What is the likelihood of harm occurring if a person is exposed to the hazard? This could range from inevitable through to unlikely.

Exposure**:** The significance of the risk of injury on illness/harm may be affected by the level of exposure to a hazard. Exposures would take into account how often employees are exposed to a hazardous situation (frequency) and the length of time of this exposure (duration).

Human Differences**:** Hazards need to be assessed in terms of the individuals who are exposed:

- their skills
- experience
- training
- physical capabilities

2.1.2 Five steps to risk assessment of your work

Step 1: Look for the hazards.

Step 2: Decide who might be harmed, and how.

Step 3: Evaluate the risks arising from the hazards and decide whether existing precautions are adequate or more should be done.

Step 4: Record your findings.

Step 5: Review your assessment from time to time and revise it if necessary.

2.1.3 Category of risk

Individual departments should assess the risk of activities occurring within its area. To help in selecting which risk category an activity fits in, the following qualitative risk rating system should be considered:

Category 1 – Activities of Low Risk

Definition: There are no potentially hazardous conditions involved in the activity.

Example: Reading, writing, use of room for conference purpose, use of computer terminals, etc.

Supervision: No need for a second person to be within call distance. The department may use a log book to keep track on those working outside the normal working hours of the general office. The availability of a telephone set on site would be suggested.

Category 2 – Activities of Moderate Risk

Definition: The activity involves hazards that could cause serious injury/illness or result in temporary disability and the likelihood is there.

Example: Work in a slippery area, certain sports activities, operation of moderate to high power lasers, work in laboratories/workshops/studios etc. that would not involve the use of hazardous chemicals, equipment or machinery.

Supervision: It is desirable for a second person to be present where reasonably practicable to take emergency action. Use of CCTV or routine check by designated staff might serve the purpose.

Category 3 – Activities of High Risk

Definition: The activity involves hazards that could cause permanent disability, loss of life or body part and the likelihood is high if proper control measures are not installed.

Example: Work with exposed electrical equipment at dangerous voltages.
The use of extremely high power laser.
The use of dangerous chemicals.
The use of dangerous machine tools and equipment.
Work within a confined space.

Supervision: Whenever work falling into this category is carried out, a second person should remain within call distance whenever these acute hazards are present. Other emergency materials should be ready for use.

Undergraduates would not normally be allowed to work on activities of this category unless adequate and immediate supervision is provided.

Postgraduate students and research assistants have to be assessed by their supervisors on a case by case basis whether they could work on activities of this category without immediate supervision. A second person should remain within call distance when laboratory work of this category is in progress.

The risk assessment should be performed by the Department Head or his delegate e.g. project leaders, laboratory/workshop managers. The Health and Safety Office and the Department Safety Representative would play an advisory role in this matter.

Competency of the personnel to carry out the activity, i.e., training and experience, together with the provision of control measures on site should be considered before deciding the appropriate risk category of a particular activity.

Postgraduate Students and Research Assistants

This is an identified high risk group. Their desire to finish a project in time may compete with their commitment to work in a safe manner. The supervisor needs to arouse their safety awareness and monitor their work closely. On the other hand, postgraduate students and research assistants should discuss with their supervisors the work proposed and the safety precautions to be taken.

Academic Staff, Technician Supervisors

Before commencing any laboratory or workshop based activities for students, the responsible academic staff, technician supervisor, or his nominee, must either:

(1) Brief the student and ensure that the student is competent to handle the particular experiment or task; OR

(2) receive a declaration written by a member of the academic staff ensuring that the student is competent enough to handle the experiment or task.

In areas of category 2 and 3 a member of the academic or technical staff must always be within call distance.

Permit to Work System

Certain departments adopt a form or permit to monitor working alone. The Environmental Health and Safety Committee would not suggest a single permit for all as it would not suit the diverse nature of the University departments. However, the Environmental Health and Safety Committee would recommend departments to review their permit to work system according to the following principles:

A permit to work system is to ensure a safe system of work in a formal manner with the procedure documented. It defines the work to be done, the way to make the work safe, identifies any remaining hazards and the precaution to be taken, describes checks to be carried out before work can be commenced, and states the name of the person responsible for controlling the job.

For example, for a science research project:

(1) The research student should define what experiment he is going to do and discuss with the supervisor on how it would be done in a proper and safe manner. The nature of the experiment, its procedure, equipment and materials to be used should be stated in a clear manner.

(2) Project supervisor should assess the risk of the student's proposed work step by step. Hazards of each step would be identified and control measures recommended. Working after normal hours and working alone would be one of the hazards to be considered.

(3) The control measures should be agreed with the Laboratory in-charge so that he would make necessary arrangements with every body in the area. Also, he would know what should be done to cope with the experiment in case of emergency. If in doubt, the Departmental Health and Safety Officer and/or the Health and Safety Office should be consulted for advice.

(4) The Head of Department after receiving a declaration produced by the project supervisor with the endorsement of the Laboratory in-charge/Departmental Health and Safety Officer would satisfy himself that the standard of the work system is acceptable and that any risk would be controlled in a proper manner. Then a permit could be issued to approve the project to perform the experiment accordingly.

2.1.4 Checklist of hazards

Moving parts of machinery

(1) Crushing
(2) Cutting
(3) Drawing-in
(4) Entanglement
(5) Ejection
(6) Fluid
(7) Friction/abrasion
(8) Shearing
(9) Stabbing/puncturing

Dangerous Equipment

(1) Lifting Appliances and Lifting Gears
(2) Cartridge Operated Tools
(3) Abrasive Wheels
(4) Hoists
(5) Forklift Truck

Working at Height on

(1) Ladder
(2) Gondola
(3) Tower
(4) Mobil Tower
(5) Platform

Transport

Access

(1) Slips, trips and falls
(2) Falling or moving objects
(3) Obstruction or projection
(4) Confined spaces
(5) Cold room

Ergonomical

(1) Manual handling
(2) Video display units

Electricity

Chemicals

(1) Carcinogenic
(2) Corrosive
(3) Explosive
(4) Flammable
(5) Harmful
(6) Irritative
(7) Sensitizing
(8) Toxic

Fire and Explosion

Particles and Dust

(1) Inhalation
(2) Ingestion
(3) Abrasion of skin or eye

Radiation

(1) Ionizing
(2) Non-ionizing

Biological

(1) Bacterial
(2) Viral
(3) Fungal

Environmental

(1) Noise
(2) Vibration
(3) Light
(4) Humidity
(5) Ventilation
(6) Temperature
(7) Climate
(8) Pressure/vacuum

Organizational

(1) Poor maintenance
(2) Lack of supervision
(3) Lack of training
(4) Lack of information
(5) Inadequate instruction
(6) Unsafe systems
(7) Provision of unsuitable equipment
(8) Inadequate monitoring arrangements
(9) Poor operator/machine interface

The individual

(1) Individual not suited to work
(2) Long hours
(3) High work rate
(4) Violence to staff
(5) Unsafe behavior of individual

2.2 CODE OF PRACTICE FOR WORKING ALONE

2.2.1 Introduction

In any work environment, an employee/student/worker of a contractor might be injured or become ill. If help is not readily available, the injury or condition might worsen, perhaps with serious or fatal results.

Working alone can be defined as the condition that one cannot be seen or heard by others so that, in the event of emergency, no one is able to give prompt assistance.

It is the intention of the Environmental Health and Safety Committee to offer practical and flexible guidelines to Heads of Departments/Centres/Units so that a safe work system for working alone could be established for their staff and students. Based on these principles, individual departments should develop their own departmental Codes on this subject. If the departmental Code deviates fundamentally from the recommendation of this Code of Practice, the Head of Department should consult Safety Officer for advice. If a safe system of work cannot be agreed, the matter should be referred to the Environmental Health and Safety Committee for advice.

2.2.2 Safe system of work

A safe system of work is a formal procedure which results from systematic examination of a task in order to identify all the hazards. It defines safe methods to ensure that hazards are eliminated or risk minimized.

A safe system of work could be achieved according to the following steps:

(1) Assess the task
(2) Identify the hazards
(3) Define safe methods
(4) Implement the system
(5) Monitor the system

2.3 ACCIDENTS/INCIDENT REPORTING

2.3.1 Introduction

Accidents involving personal injuries, including staff, students and visitors etc. and/or property damage may occur on campus. Such accidents/incidents should be reported promptly to the 24-hour manned Campus Security Office for assistance.

When serious injury occurs, the initial action taken is sometimes critical in determining the difference between further injuries, or in some cases life or death. Appropriate action shall be taken by all concerned parties to ensure that the injured person can receive prompt medical attention and to prevent the situation from worsening.

From the viewpoint of prevention, the purpose of accident/incident reporting and investigation is to determine the causes and to recommend corrective action to prevent further recurrence.

This procedure outlines the actions to be taken in the event of an accident occurring and the accident/incident reporting and investigation procedures to be followed.

2.3.2 Terminology

Accident includes any undesired circumstances which give rise to ill health or injury; damage to property, plant, products or the environment; production losses, or increased liabilities. (Note: It results from contact with a substance or source of energy above the threshold limit of the body or structure.)

Incident includes all undesired circumstances and near misses which have the potential to cause accidents.

Ill health includes acute and chronic ill health caused by physical, chemical or biological agents as well as adverse effects on mental health.

2.3.3 In case of accident

When an accident occurs, assistance should be immediately summoned by calling the 24-hour manned Security Office (Emergency Tel. No.: 2859 2882).

In case of fire, sound the fire alarm by activating the nearest breakglass alarm switch.

If medical assistance is required during office hours, call the University Health Service (Tel. No. 2859 1999) for advice. If the condition is serious, dial 999 for help at the same time to avoid delay in treatment.

As a general guidance, when summoning assistance through telephone, the caller must keep calm, avoid panic and clearly state the following information:

(1) Location of the accident.

(2) Nature and severity of the accident e.g. how many persons are injured, the seriousness of the injured, any fire or hazardous chemical spillage etc.

(3) Nature of the injuries, e.g. bleeding, bone fracture etc.

(4) Name, department, telephone number of the caller.

The injured person should not be moved unless his location exposes him to further risk of injury. The general approach to a seriously injured person is to render comfort, and only treatment that is necessary to preserve life until trained medical help arrives.

The security staff on-duty at the Security Office will obtain details of the accident and at the same time dispatch a team to the scene.

The attending team, upon arrival at the scene, will decide on the actions required which may include calling of Police/Fire Services/Ambulance and/or assistance from other Department such as the Safety Office, University Health Services for evacuating personnel from the affected areas.

Depending on the nature (e.g. spillage of hazardous chemicals, fire) and seriousness (e.g. fatalities or major injures) of the accident, the security staff on-duty at the Security Office should also inform the Safety Office immediately. In case of such accidents occurring after office hours, senior members of the Safety Office may be contacted through a mobile phone or pagers.

After the incident, details should be given to the attending security staff or the attending civil emergency services personnel in order to assist them for follow-up action. Relevant information should be logged by Security Staff.

2.3.4 Reporting of accidents and incidents

All accidents and incidents must be reported and accident/incident investigations carried out to determine the causes and recommend corrective actions to prevent future recurrence.

After an incident, the supervisor of the injured person or the staff member responsible for the area in which the accident/incident took place should complete an Accident/Incident Report Form (SO Form 2) and send it to Safety Office through their Department Head within 72 hours of the accident/incident.

<u>In case of work related accidents involving HKU staff</u>

The University is required under the Employee's Compensation Ordinance to notify the Commissioner for Labour of any accidents arising out of and in the course of an employee's employment, irrespective of duration of sick leave. Department Heads shall therefore ensure that the Head of Personnel is informed of such cases immediately after such accidents. For more details on employee compensation, please refer to relevant sections of the Staff Manual or contact the Personnel Section, Registry.

<u>In case of an accident that may involve an insurance claim of damage/loss to property and/or equipment</u>

For an accident that may involve insurance claim or damage/loss to property and/or equipment, the Finance Officer (Insurance) should be contacted immediately for insurance claim processing with the University's insurer.

Staff and students are encouraged to report near-miss incidents so that potential hazards can be identified and eliminated before a more serious accident occurs.

3 BIOLOGICAL SCIENCE LABORATORY SAFETY

3.1 GENERAL SAFE WORK PRACTICES

3.3.1 Use of pipettes & pipetting aids

(1) Never conduct mouth pipetting. Use a pipettor instead.

(2) Plug the pipette with a cotton ball for microbiological work.

(3) Do not use a pipette to blow air into infectious materials or solutions for mixing.

(4) The working surface for conducting pipetting should be covered with disinfectant-soaked cloth or absorbent to absorb accidental droppings from the pipette.

(5) Used pipettes or pipette tips should be completely immersed in disinfectants for recommended length of time before autoclaving.

(6) A syringe fitted with a sharp hypodermic needle must not be used for pipetting. Blunt cannulas should be used to replace the needle.

3.1.2 Use of syringes

(1) Use an alcohol-moistened pledget around the stopper and needle when removing a syringe with a needle from a vaccine bottle with rubber-stoppers.

(2) Use a syringe fitted with a needle-locking hypodermic syringe whenever possible.

(3) Expel excessive infectious fluids and bubbles in a syringe vertically into a cotton pledget moistened with disinfectant or into a small bottle of cotton.

(4) Before and after injecting an animal, swab the site of injection with a disinfectant.

(5) Sterilize discarded syringes after use.

3.1.3 Opening of ampoules containing infectious materials

(1) Perform the opening of ampoules inside appropriate biological safety cabinets with the extraction equipment switched on.

(2) Before opening, put on suitable gloves and wrap the ampoules with a cloth soaked with disinfectant.

(3) A file mark is made on the glass tube near the middle of the inside cotton wool plug.

(4) A red-hot glass rod is applied to the file mark to crack the glass.

(5) The top of the ampoule is removed gently and disposed as contaminated waste.

(6) Liquid for re-suspension is added slowly to the ampoule to avoid frothing.

3.1.4 Handling and disposal of specimen and infected materials

(1) All specimens must be regarded as highly infective and should be handled with due care.

(2) Disposable gloves should be worn to avoid direct contact with the specimen.

(3) The gloves should be discarded properly and immediately after completing the procedure and hands washed carefully.

(4) Proper hand washing is absolutely necessary after handling infectious materials or specimen. The use of gloves should not be considered as a substitute for hand washing.

(5) Contamination on any part of the body should be cleaned thoroughly at once.

(6) All specimens should be properly labelled and sealed before storage or disposal.

(7) All spills should be cleaned up immediately and thoroughly with disinfectant.

(8) If the outside of the specimen container become contaminated, it should be wiped with disinfectant.

(9) The working area should be cleaned after use.

(10) All specimens, bacterial cultures and contaminated materials should be autoclaved before disposal.

(11) Contaminated pipettes and Pasteur pipettes should be put into a pipette jar and soaked (completely immersed) in 1% disinfectant (hypochlorite or printol solution) overnight before washing in pipette-washer.

(12) Dead infected animals should be disposed of by putting into a sealed plastic bag (double bag) and destroyed by incineration.

3.1.5 Avoid dispersion of infectious materials

(1) The circle of the microbiological loop should be completely closed and the arm should not be more than 6 cm.

(2) A micro-incinerator should be used instead of a burner in case of spatter of infectious materials. Plastic disposable loops are safer alternatives.

(3) Samples and cultures for disposal should be placed in labelled and leak-proof containers before disinfection.

(4) Work surfaces should be disinfected after each work period.

3.1.6 Personal hygiene

(1) The hands should be kept away from the mouth, nose, eyes, lips and face until the experiment is completed, gloves should then be removed and hands washed with disinfectant.

(2) Smoking, drinking, eating, handling of contact lenses, and the application of cosmetics are strictly forbidden in biological laboratories.

(3) Food and drinks must not be kept in the laboratory.

3.1.7 Housekeeping

(1) Never leave infectious materials, including waste and those no longer required for the experiment, unattended.

(2) Disinfect all contaminated materials before disposal.

(3) Clean out deep-freeze and dry-ice chests in which cultures are stored to remove broken ampoules or tubes. Appropriate gloves and respirators must be worn for this process.

(4) All materials must be properly labelled.

(5) Flammable substances must not be stored in refrigerators without explosion proof devices.

3.1.8 Training, provision of information & sources of assistance

(1) It is important that laboratory personnel performing experiments involving bio-hazardous materials should receive appropriate training on safety measures.

(2) Researchers should provide all available information on the risks involved and suitable protective measures adopted to the laboratory personnel with regard to the experiment.

(3) The Safety Office should be invited to arrange training on biological safety to new staff recruited for research.

(4) The Safety Office should be consulted to provide assistance in assessing the risks involved in new experiments organized by departments.

3.1.9 Other measures

(1) Personnel working with infectious materials or working in areas designated for infectious work must not wear laboratory gowns in non-laboratory areas.

(2) Wear appropriate laboratory gowns that offer maximum protection.

(3) Shake broth cultures in a manner that avoids wetting the plug or cap.

(4) Use forceps, tongs or gloves to handle infectious materials as often as practicable.

(5) Inoculation should be considered as a precaution against highly infectious materials.

3.2 GUIDELINES FOR CHEMICAL SAFETY

3.2.1 Introduction

Many chemicals are poisonous, irritating, corrosive, carcinogenic, pyrophoric, or explosive. Some can have more than two of these properties. Chemicals that may be relatively safe when used alone can become dangerous when mixed with other substances, either in a planned experiment or by accident. Therefore, personnel who handle chemicals must consider the hazards and use appropriate controls and procedures.

In Hong Kong, the storage and use of dangerous chemicals are regulated by the Fire Services Department under the Dangerous Goods Ordinance. Personnel exposure to chemicals is regulated by the Labour Department while the disposal of chemical waste is regulated by the Environmental Protection Department.

This document is intended to provide the user of chemicals with general guidelines on safe storage, use and disposal of such chemicals in compliance with regulatory requirements and international standards.

For advice on specialist chemicals, e.g. carcinogens refer to departmental codes of practice or refer to the Safety Office.

3.2.2 Planning

Users of chemicals should assess the risks associated with the handling of chemicals and reduce the risks by:

(1) Choosing the safest chemical which will perform the task

(2) Considering the hazardous properties of chemical and mixtures.

(3) Setting up waste disposal arrangements (including minimizing waste generated).

(4) Obtaining review of procedures by supervisor, safety representative or Safety Office staff.

References in the Safety Office Library are available to help and guide users during the planning stage.

3.2.3 Responsibilities

Academic staff as student supervisors and laboratory superintendents as technician supervisors are responsible for establishing safe procedures and providing the protective equipment needed in handling chemicals. They must instruct their personnel about potential hazards, safety precautions, waste handling, the consequences of an accident, and the actions to take in case of an accident. It is also their responsibility to assure that employees and students are held accountable for the chemicals they work with.

When employees or students leave The University all chemicals they are responsible for must be properly disposed of or transferred to another responsible person.

Employees and students are expected to discover and understand the properties of the chemicals they work with and to follow all precautions applicable to each task. He or she should also report to the supervisor any unsafe or hazardous condition.

The Safety Office (SO) can assist supervisors, employees and students in maintaining safe work areas by providing information on the hazardous properties of materials, recommending methods for

controlling them, and monitoring the work environment. In addition, the Safety Office provides delivery of dangerous chemicals and liquid nitrogen daily so that users do not have to stockpile quantities of chemicals in the laboratory.

3.2.4 Purchase of chemicals

(1) When acquiring toxic or hazardous chemicals, obtain the smallest quantity required for your work.

(2) Purchase chemicals, especially corrosive materials, e.g. perchloric acid, in shatter-proof containers whenever possible. (i.e. 'Safe-Break' plastic coated bottles) (N.B. with careful cleaning these bottles can then be recycled offering greater safety in the laboratory.)

3.2.5 Material safety data sheets

Many chemical manufacturers prepare Material Safety Data Sheets (MSDSs) for their customers. Each data sheet provides detailed information on the physical, chemical, and physiological properties and on recommended control procedures to be used during handling. Currently data sheets for BDH chemicals are available from Safety Office.

3.2.6 Facilities and equipment

Adequate facilities should be available and the equipment necessary to control the hazards related to specific chemical operations must be obtained before work is started. General requirements for the use of chemicals include the following:

(1) Cabinets and shelving used for chemical storage.

(2) Safety shower and/or eyewash station as applicable.

(3) Fume cupboards for any experiment that produces hazardous quantities of gas, vapour, or airborne particulates (i.e. dust, fumes etc).

(4) Wear safety spectacles when handling small quantities of general laboratory reagents BUT

(5) Use face shields, safety goggles, and gloves when handling larger containers of corrosive chemicals. e.g. Winchesters (2½litre) and for larger containers still (20 litre) wear liquid proof aprons and acid proof shoes or boots.

(6) Isolate hazardous operations in separate rooms and limit the number of personnel involved.

(7) Select chemicals that are the least hazardous. (Consider not only the occupational exposure limit, but also the volatility (vapour pressure) and other routes of contamination other than via the respiratory system).

(8) Use mechanical aids for all pipetting procedures.

(9) Limit the volume of volatile or flammable materials to the minimum required.

(10) Provide a means for containing the chemical if equipment or containers break or spill their contents.

(11) When transporting chemicals from one area to another, convey the chemical bottles in suitable containers.

(12) When opening bottles which may be under pressure (e.g. formic acid, hydrochloric aid, ammonium hydroxide), cover the bottle with a towel to divert any chemical spray.

(13) Operations involving heating of concentrated perchloric acid must be done in special fume cupboards with water wash-down facilities.

3.2.7 Chemical storage

Bulk quantities of dangerous goods (DG) should be and are stored in Central D.G. Stores managed by Safety Office.

General requirements for keeping small quantities of chemicals in laboratories are as follows:

(1) Provide fresh air ventilation

(2) Clearly label the storage area and each container. Container labels must give the chemical name, type of hazard, special precautions, and emergency information where space permits. Labels are available from the Safety Office.

(3) Store heavier items on lower shelves.

(4) Chemicals, particularly those known to decompose with time, should also be marked with the date of receipt.

(5) Carcinogens and highly toxic chemicals should be stored in double containment.

(6) Separate incompatible chemicals by physical barriers. For example, the following classes of chemicals are mutually incompatible: acid, bases, oxidizers, pyrophoric, flammables, toxic, and water reactive.

(7) Provide a means to contain spills (e.g. trays).

(8) Limit quantities and observe shelf-life limits.

(9) Only flameproof refrigerators or those where all electrical contacts (thermostats, lights etc.) are moved externally are suitable for storage of flammable liquids. The storage of volatile, flammable liquids in ordinary refrigerators can lead to and has led to serious explosions.

3.2.8 Handling solid and liquid chemicals

(1) Keep the work area clean and orderly.

(2) Do not eat, drink, smoke, apply cosmetics, or store food in the work area. Read all container labels and, if necessary, the MSDS's.

(3) Use required safety equipment. The minimum protective clothing is a laboratory coat and safety glasses, for additional protection, wear gloves and a face shield.

(4) All works should be carried out in an efficient fume cupboard or at least in well ventilated rooms.

(5) Wipe off splashes on the skin first by dry cloth, then immediately with plenty of cold water followed by washing with hot water and soap. Never use organic solvents because of the risk of adsorption.

(6) Thoroughly rinse eyes affected by chemicals with water and immediately afterward take the patients to a medical centre. Inform medical personnel of the chemical involved.

(7) Immediately remove any items of clothing soaked with corrosive substances.

(8) Wash your hands regularly when working with chemicals, especially before you leave the laboratory.

(9) Breakable vessels must not be carried by the neck and must be supported from below. They must be transported in baskets or carrying frames over longer distances such as up and down stairs, or along corridors.

3.2.9 Flammability hazards

There is high fire risk in many laboratories because of the storage and handling of flammable liquids. It is, therefore, essential that the means of escape from the workplace is not obstructed. The following precautions should be observed:

(1) Do not use an open flame to heat a flammable liquid.

(2) Use an open flame only when necessary and extinguish it when it is no longer actually needed.

(3) Before lighting a flame, remove all flammable substances from the immediate area. Check all containers of flammable materials in the area to ensure that they are tightly closed. Tell your colleagues that you intend to use naked flames.

(4) Quantities of flammable substances in laboratories should be kept to a minimum. The maximum storage is 20L of any one substance but not more than 40L in aggregate. When not in use solvents should be kept in suitable fire resistant cabinets.

(5) Empty containers which have held flammable materials will contain explosive quantities of vapour if the container is not washed out or ventilated.

3.2.10 Highly reactive chemicals and unstable chemicals

Highly Reactive Chemicals

Some chemicals react in combinations with others at ordinary temperatures, sometimes with great violence. This reactivity may be manifested as a corrosive effect or as the liberation of a large amount of heat or even an explosion when the chemical comes into contact with others or is exposed to moisture or air.

Examples:

(1) Powerful oxidizing agents such as perchloric acid, nitric acid or chlorine react violently with easily oxidizable materials such as hydrocarbons.

(2) Metal alkyls such as triethylaluminium burst into flames on exposure to air.

(3) The alkali metals react vigorously with water.

Incompatible chemicals are listed in the Appendix.

Although not themselves explosive, some compounds can cause their containers to burst because of the high pressure of gas generated in them through, e.g. hydrolysis, or decomposition.

e.g. Chlorides of aluminium, titanium and silicon, formic acid.

Unstable Chemicals

Some chemicals can explode if heated or subjected to mechanical shock.

e.g. Metal acetylides, azides, azo and diazo compounds, chlorates and perchlorates, highly nitrated organic compounds, nitrogen halides, organic peroxides, and organic salts of per-acids.

Ethers and Other Peroxidizable Chemicals

Peroxidizable chemicals, when in the presence of oxygen and stored for long periods of time, or when exposed to sunlight, can form unstable peroxides. These peroxides may explode if the container is shaken or heated. Examples of peroxidizable materials are diethyl ether, tetrahydrofuran, dioxan, alkali metals, olefins, and vinyl monomers. The precautions are:

Storage in dark containers, away from direct sunlight; in a storage cabinet for flammable liquids.
The date of opening should be marked on the bottle.
Chemicals should be tested for the presence of peroxide regularly and always prior to use.

Detection of peroxides

To 1ml of a 20% by weight aqueous solution of potassium iodide add 1 ml of sample in a small test tube. After vigorous mixing and shaking a change of colour in the aqueous layer from colourless to yellow is an indication of a low level of peroxide in the sample. A brown-red colour is taken as an indication of high peroxide content. If no colour change is observed, peroxides are considered to be absent.

Removal of peroxides

(1) With iron (II) sulphate.

Shake the solvent with a freshly prepared solution of iron (2) sulphate (5 g iron (2) sulphate dissolved in 20 ml of water/litre of ether) prior to further use. This procedure must be repeated until no further peroxides can be detected in the solvent with the peroxide test.

(2) With aluminium oxide, activated, neutral

If the solvent is dry, 30 g. of aluminium oxide (in a column of 20 mm diameter) is sufficient to remove the peroxides from 250 ml of diethyl ether. This method is often slower and more expensive than method (1); however, the eluted material is often ready for use without further purification.

Any peroxide materials that remain on the alumina column are destroyed by passing a saturated solution of iron (2) sulphate through the column.

Others

Some chemicals which have explosive properties when dry which need to be kept wet or moist for safe storage. Examples:

Dinitrophenols
2,4-Dinitrophenylhydrazine
4-Fluoro-3-nitrophenylhydrazine

Hexanitrodiphenylamine
Picric acid
Picryl chloride
2,4,6-Trinitrobenzenesulphonic acid

For these chemicals, the following safety procedures should be taken:

(1) Inspect containers regularly and add water as necessary.

(2) When the contents have gone completely dry, immerse the container in water, with a small amount of detergent, for at least 24 hours.

(3) With the container still under water, slowly unscrew the cover, allowing water to wet the screw threads.

(4) Once the closure is loose, remove the container from the water bath, remove the cover and add the required amount of water.

3.2.11 Handling gases

Compressed gas cylinders used in laboratories contain a tremendous amount of energy which can be violently released under certain conditions. The flammable and/or toxic nature of some of the gases could pose a serious potential hazard if accidentally released. Compliance with the following guidelines can greatly reduce these risks.

(1) Each cylinder must bear a label identifying its contents. Make sure you know the contents and characteristics of the gas before use.

(2) Use gases in areas having adequate ventilation.

(3) Cylinders should be moved only with a suitable trolley, never rolled or dragged.

(4) Cylinders must not be transported with the regulator attached.

(5) In the laboratory cylinders must be strapped to the wall, bench top or other firm support.

(6) Cylinders should not be subjected to temperature over 5℃ or a direct flame.

(7) Cylinders containing oxygen should be kept away from flammable gases or large quantities of flammable liquids.

(8) Use proper tools to tighten the regulator and to open the cylinder main valve.

(9) Check leakage of all joints after the completion of the connection, using soapy water.

(10) Never tamper with safety devices in cylinder, regulator or valve.

(11) The cylinder main valve should be shut off when it is not in use.

(12) If the gas is corrosive, the cylinder main valve shall be worked frequently to prevent it from corroding and sticking. Regulator and valves should be removed and flushed with dry air or nitrogen after use, not just left on the cylinder.

(13) The date required for pressure test of the cylinder should be noted for all privately owned cylinders as they are required by law to be pressure tested at regular intervals.

3.2.12 Precautions for cryogenic gases

(1) Avoid contact with both the liquid and the gases as they can cause frostbite. Do not touch uninsulated piping.

(2) Wear loose-fitting thermal gloves, goggles and/or face shield and closed shoes.

(3) Work in a well ventilated area. Liquidified gas volatilises and expands rapidly, e.g. nitrogen expands almost 700 fold.

(4) Never attempt to prevent vapours from escaping from cylinders of liquefied, cryogenic gases. Since they are not at thermal equilibrium, vapour is produced as the liquid boils and, if not vented to the atmosphere, could produce excessive pressures.

(5) Use only the special (usually metal) tubing designed for use with these gases. Do not improvise with plastic or rubber tubing.

(6) Be aware that oxygen enrichment and a fire hazard can result from the condensation of oxygen (boiling point -183℃) from the air onto piping cooled by liquid nitrogen (boiling point -196℃).

(7) If a glass dewar flask is used as a container of small quantities of liquid nitrogen, the exposed glass part of the flask should be taped to minimize the flying glass hazards in case of implosion or explosion.

(8) If a domestic thermos flask is used as container of small quantities of liquid nitrogen, the integrity of the plastic sealing ring of the thermos should be checked regularly to ensure that no liquid nitrogen can get into the space between the thermos and the outside container. In every case ensure holes are drilled in the base plate to allow gas to escape.

(9) Avoid contact with the liquid nitrogen directly. Always wear gloves (leather or CRYO-GLOVES) when handling anything that is in contact with liquid nitrogen.

(10) Protect your eyes with safety spectacles with side shields, safety goggles or face shield. Eyes can be damaged even by the cold gas issuing from liquid nitrogen.

(11) When charging a warm container or when inserting objects into the liquid, perform the operation slowly to minimize boiling and splashing.

(12) If skin contacts liquified cryogenic gases, thaw burned area slowly in cold water. Do not rub.

3.2.13 Unattended experiment and working after normal hours

Laboratory operations involving chemicals are frequently carried out continuously or overnight. It is essential to plan for interruptions in utility services such as electricity, water and inert gas supply. Operations should be designed to be safe, and plans should be made to avoid hazards in case of failure.

Experiments involving hazardous chemicals or hazardous procedures should not be undertaken by a worker who is alone in a laboratory.

See Code of Practice: "Work Outside Normal Working Hours"

3.2.14 Emergency response for chemical spill

Introduction

Before handling hazardous chemicals consideration should be given to the action that needs to be taken in event of spillage and a plan of action prepared.

The spillage kit is part of the action plan, the other part relies on the users of chemicals to determine in advance what their correct response should be.

Action

General

(1) On discovery of significant spillage, the affected area should be vacated
(2) At least two people should work to deal with spill
(3) If liquid is flammable, all sources of ignition should be isolated or removed
(4) Area should be ventilated by opening windows, turning on fume cupboards, etc.
(5) Work on spill should be tackled from side closest to exit

Protective Clothing

(1) Wear gloves and laboratory coat.

(2) If chemical is toxic by inhalation, a respirator fitted with appropriate filter should be used.

(3) In extreme cases where the chemical is extremely toxic and volatile the building should be evacuated and expert assistance offered to the Fire Services when they arrive.

Procedure

(1) Use the 3M chemical absorbent to form a dam around the spillage and then cover the spillage adequately until the spill is completely absorbed.

(2) Fill the absorbent into a polythene bag and attach a waste label. If there is doubt about the reactivity of the chemical with the bag, the waste should be placed in a suitable second container.

(3) Call the Safety Office 28592402 for collection of the waste.

Warning

No spills or wastes should be flushed down a drain except where it is clearly known that it is permissible and no harm to plumbing or to the environment will result.

N.B.: 3M chemical sorbent is suitable for treatment of concentrated acids and alkalis, aqueous solutions, organic solvents and thin paraffin oils.

Clean-up

Small spills can usually be cleaned up safely by the employees involved. Employees must be trained to handle cleanup of small spills. Material for clean up of common chemical spills are available from Safety Office. Keep used material in a waste container.

If a spill involving large amounts of hazardous chemicals occurs:

(a) Alert your fellow workers immediately.
(b) Confine spill if safe to do so.
(c) Open the windows and switch on the fume cupboard to ventilate the area.
- turn off all burners;
- switch off all electrical equipment which have hot surfaces, (e.g. hot plate) or/and generate electric spark (e.g. brush type motor) NOT in vincity to the spill and
- do NOT switch on/off or unplug any electrical equipment.

(d) Call nearby Fire Brigade, Security Guard and Safety Office.
(e) If your clothes are contaminated, remove them immediately.
(f) Evacuate the room. Make sure no body stays behind. Close the door(s) of the laboratory after you leave.
(g) Keep at a distance from the laboratory but remain in sight of the entrance, forbid unauthorized entry to the laboratory and wait for the arrival of the fire brigade.

Clean up small spill

Mercury

(a) Dam off the contaminated area and collect all the droplets by means of Hg Absorb sponge and dropper.
(b) Use Hg Absorb sponge to amalgamate mercury residue.
(c) Cover fine droplets in non-accessible cracks with
(d) Collect all reacted mercury into a polyethylene bag with a "waste" label attached.
(e) Inform the Safety Office (2859 2402) to collect the waste.

N.B.: Remember mercury is toxic and volatile. Therefore, mercury spills should be cleaned up immediately and thoroughly.

Solid Spills

Solid spills are usually easily dealt with using the dust pan and brush provided. However, care is required to prevent the generation of air borne dust so it may be necessary to damp the spillage before sweeping using an appropriate liquid, e.g. water, non-flammable and non-toxic solvent, etc.

Spill Kit Contents:

(1) Nitrile Rubber glove	1 pair
(2) Disposable plastic glove	25 pcs.
(3) Disposable plastic bag	4 pcs.
(4) Absorbent pads	1 pc.
(5) Dust pan and brush	1 set
(6) Safety Glasses	1 pair
(7) Chemical Waste label	1 set

Conclusion

These guidelines are brief and are designed to give a quick and easy reference. However, in circumstances outside these guidelines, please call Safety Office on 2859 2402.

3.2.15 Emergency response in a fire

Fire Action

If you discover a fire:

(1) Raise the alarm by operating the nearest fire alarm point
(2) Tackle the fire with the appliances provided, taking no personal risks BUT
(3) If your efforts are not immediately successful leave the building

If you hear the continuous alarm:

(1) Leave the building immediately
(2) Close doors behind you
(3) Go directly to your assembly point (your department should inform you where this is)
(4) Do not stop to collect personal belongings
(5) Do not use lifts
(6) Do not re-enter the building until authorized

3.2.16 References

Safety Manual - Hong Kong University of Science and Technology
Safe Practices in Chemical Laboratories, Royal Society of Chemistry
Hazards in Chemical Laboratories, L. Bretherick, Royal Society of Chemistry
Prudent Practices for Handling Hazardous Chemicals in Laboratories, National Research Council.

3.2.17 Appendix

Table 1: Partial List of Incompatible Chemicals (Reactive Hazards)

Substances in the left hand column should be stored and handled so they cannot possibly accidentally contact corresponding substances in the right hand column under uncontrolled conditions, when reactions may occur.

Acetic acid	Chromic acid, nitric acid, peroxides, and permanganates.
Acetic anhydride	Hydroxyl-containing compounds, ethylene glycol perchloric acid.
Acetone	Concentrated nitric and sulfuric acid mixtures, hydrogen peroxide.
Acetylene	Chlorine, bromine, copper, silver, fluorine, and mercury.
Alkali and alkaline earth metals, Such as sodium, potassium, lithium, magnesium, calcium	Carbon dioxide, carbon tetrachloride, and other chlorinated hydrocarbons. (Also prohibit water, foam, and dry chemical on fires involving these metals – dry sand should be available.)
Aluminium powder	Halogenated or oxygenated solvents.
Ammonia, anhydrous	Mercury, chlorine, calcium hypochlorite, iodine, bromine, and hydrogen fluoride.
Ammonium nitrate	Acids, metal powders, flammable liquids, chlorates, nitrites, sulfur, finely divided organics, or combustibles.
Aniline	Nitric acid, hydrogen peroxide.
Bromine	Ammonia, acetylene, butadiene, butane, and other petroleum gases, sodium carbide, turpentine, benzene, and finely divided metals.
Calcium oxide	Water.

Carbon, activated	Calcium hypochlorite, other oxidants.
Chlorates	Ammonium salts, acids, metal powders, phosphorus, sulfur, finely divided organics, or combustibles.
Chromic acid and chromium trioxide	Acetic acid, naphthalene, camphor, glycerol, turpentine, alcohol, and other flammable liquids.
Chlorine	Ammonia, acetylene, butadiene, butane, other petroleum gases, hydrogen, sodium carbide, turpentine, benzene, and finely divided metals.
Chlorine dioxide	Ammonia, methane, phosphine, and hydrogen sulfide.
Copper	Acetylene, hydrogen peroxide.
Fluorine	Isolate from everything.
Hydrazine	Hydrogen peroxide, nitric acid, any other oxidant, heavy metal salts.
Hydrocarbons (benzene, butane, propane, gasoline, turpentine etc.)	Fluorine, chlorine, bromine, chromic acid, conc. Nitric acid, peroxides.
Hydrogen cyanide	Nitric acid, alkalis.
Hydrogen fluoride	Ammonia, aqueous or anhydrous.
Hydrogen peroxide	Copper, chromium, iron, most metals or their salts, any flammable liquid, combustible materials, aniline, nitromethane.
Hydrogen sulfide	Fuming nitric acid, oxidizing gases.
Iodine	Acetylene, ammonia (anhydrous or aqueous).
Mercury	Acetylene, fulminic acid*, ammonia.
Nitric acid (conc.)	Acetic acid, acetone, alcohol, aniline, chromic acid, hydrogen cyanide, hydrogen sulfide, flammable liquids, flammable gases, and nitratable substances, fats, grease.
Nitromethane, lower nitroalkanes	Inorganic bases, amines, halogens, 13X molecular sieve.
Oxalic acid	Silver, mercury, urea.
Oxygen	Oils, grease, hydrogen, flammable liquids, solids, or gases.
Perchloric acid	Acetic anhydride, bismuth and its alloys, alcohol, paper, wood, grease, oils, dehydrating agents.
Peroxides, organic	Acids (organic or mineral), avoid friction, store cold.
Phosphinates	Any oxidant.
Phosphorus (white)	Air, oxygen.
Potassium chlorate	Acids (see also chlorates).
Potassium perchlorate	Acids (see also perchloric acid).
Potassium permanganate	Glycerol, ethylene glycol, benzaldehyde, sulfuric acid.
Silver	Acetylene, oxalic acid, tartaric acid, fulminic acid*, ammonium compounds.
Sodium	See alkali metals (above).
Sodium nitrite	Ammonium nitrate and other ammonium salts.
Sodium peroxide	Any oxidizable substance, such as ethanol, methanol, glacial acetic acid, acetic anhydride, benzaldehyde, carbon disulfide, glycerol, ethylene glycol, ethy acetate, methyl acetate, and furfural.
Sulfuric acid	Chlorates, perchlorates, permanganates.
Thiocyanates	Metal nitrates, nitrites, oxidants.
Trifluoromethane sulfonic acid	Perchlorate salts.

*Produced in nitric acid – ethanol mixtures.

Table 2: Partial List of Incompatible Chemicals (Toxic Hazards)

Substances in the left hand column should be stored and handled so they cannot possibly accidentally contact corresponding substances in the centre column, because toxic materials (right hand column) would be produced.

Arsenical materials	Any reducing agent*	Arsine
Azides	Acids	Hydrogen azide
Cyanides	Acids	Hydrogen cyanide
Hypochlorites	Acids	Chlorine or hypochlorous acid
Nitrates	Sulfuric acid	Nitrogen dioxide
Nitric acid	Copper, brass, any heavy metals	Nitrogen dioxide (nitrous fumes)
Nitrites	Acids	Nitrous fumes
Phosphorus	Caustic alkalis or reducing agents	Phosphine
Selenides	Reducing agents	Hydrogen selenide
Sulfides	Acids	Hydrogen sulfide
Tellurides	Reducing agents	Hydrogen telluride

*Arsine has been produced by putting an arsenical alloy into a wet galvanized bucket.

3.3 CHEMICAL WASTE MANAGEMENT

3.3.1 Introduction

The Waste Disposal (Chemical Waste) (General) Regulations (hereafter, the Regulations) are introduced under the Waste Disposal Ordinance (Cap. 354) (hereafter, the Ordinance) to control the handling, collection, transport and disposal of chemical wastes.

This guide outlines the standards and requirements on the segregation, packaging, labelling and storage of laboratory chemical waste.

3.3.2 Requirements of the chemical waste regulations

Definition of Chemical Waste

The Regulations define chemical waste as any scrap material, effluent, an unwanted by-product or surplus substance arising from the application of or in the course of any process or trade activity which contains any substances or chemicals specified in Schedule 1 of the Regulation, and if such substance or chemical occurs in such form, quantity or concentration so as to constitute a danger to health or risk of pollution to the environment.

Treatment and Disposal of Chemical Wastes

The Regulations require waste producers to arrange for their chemical wastes to be treated or disposed of at licensed facilities. In the situation where no licensed facility is available for the treatment and disposal of such waste, the waste producer will have to make alternative arrangement for the proper disposal of the waste subject to the approval of the Authority.

A waste producer may discharge his duty on treatment and disposal if he consigns his wastes to a licensed waste collector for disposal.

The Authority may require a waste producer to provide records or any other relevant information to demonstrate that he has made appropriate arrangement for the treatment and disposal of his chemical wastes.

Packaging, Labelling and Storage of Chemical Waste

The Regulations require chemical wastes to be properly packaged, labelled and stored temporarily at the producer's premises before collection for off-site treatment and disposal. The Regulations also apply to the temporary storage of chemical wastes prior to on-site treatment.

The general requirements are set out in the Code of Practice on the Packaging, Labelling and Storage of Chemical Wastes. For asbestos and polychlorinated biphenyl waste, waste producers should refer to the Code of Practice on Handling, Transport and Disposal of Asbestos Waste and the Code of Practice on the Handling, Transport and Disposal of Polychlorinated Biphenyl Waste respectively. Compliance with the Codes could be employed as an evidence of good practice in the course of legal defence.

3.3.3 Chemical waste storage requirements for laboratories

Classification of Laboratory Chemical Waste

Chemical wastes generated from the laboratories are generally of small quantity and relatively dilute in nature. However, a few common waste types are particularly hazardous and are classifiable as chemical waste. They include the following:

(1) Strong acids and alkalis

(2) Spent organic solvents
(3) Surplus or expired chemicals

Any laboratory which generates the above mentioned waste types has to comply with the Regulations in respect of the packaging, labelling and storage requirements, as well as transport and disposal arrangements.

3.3.4 Segregating of chemical waste for storage

Given the varied nature of chemical wastes generated by laboratories, waste producers should segregate their wastes according to the following classification:

A: acids plus wastes compatible with acids.

B: alkalis plus wastes compatible with alkalis.

O: organic solvent.

S: wastes that requires special handling. These include ammonia, hydrogen peroxide, hypochlorite solutions and strong oxidizing acids (nitric, perchloric). Chemical wastes falling into this category must be segregated for storage and should be individually packaged and labelled.

For laboratory chemical waste which also contains other very reactive substances or chemicals (including strong oxidizing and reducing agents), the waste should be stabilized prior to storage in the same container of compatible waste type.

The disposal of surplus or expired chemicals has also to comply with the requirements set out in the Regulation in respect of packaging, labelling and storage of chemical wastes. In general, surplus or expired chemicals should be segregated, individually packaged and labelled for storage.

3.3.5 Packaging of chemical waste

Standard of Containers

Chemical wastes should be packed and held in containers of suitable design and construction so as to prevent leakage, spillage or escape of the contents under normal conditions of handling, storage and transport.

Number and Capacity of Containers

Chemical waste producers should ensure that the chemical waste containers are of such number and of such capacity as to be capable of holding all the chemical waste that may be generated or produced at their premises during such period prior to collection by Safety Office.

Containers to be Securely Closed and with Clean External Surface

Every chemical waste container should be properly closed or sealed and correctly placed. No chemical waste should adhere to the external surface of the container.

Containers to be in Good Condition

The containers should be in good condition and free from corrosion, contamination, damage or any other defects which may impair the performance of the container. Waste producers are required to check and ensure that the containers are in good condition before use.

Separate Containers for Different Waste Categories

Chemical waste producers should use separate containers for different waste categories. Inorganic wastes should be separated from organic wastes and separate containers should also be provided for the storage of acid or alkali wastes.

No Mixing of Incompatible Wastes

Chemical waste producers should not mix or permit the mixing of incompatible types of wastes in the same container. Chemical wastes that are incompatible generally include those that will react with each other:

Violently.
With evolution of substantial heat.
With evolution of toxic or harmful gases.
To produce flammable products.
To provide toxic products.

Sufficient Airspace to be Left When Filling Containers

When filling the container with liquid chemical wastes, sufficient ullage (air space) should be allowed for to ensure that neither leakage nor permanent distortion of the container occurs as a result of liquid expansion caused by changes in temperature or other physical conditions which are likely to occur under normal conditions of handling, storage and transport. Generally 10 cm air space should be sufficient.

Material of Container to be Resistant to its Contents

The material of construction of containers and their closures for storage should not be affected by the chemical waste. The material should not be liable to any reaction with the chemical waste so as to from any product which would create any hazard or dangerous consequences.

Where necessary, the containers and their closures should be protected by an inner liner or coating to ensure compatibility with the chemical wastes (e.g. steel containers should be protected by plastic liner if used for acid storage).

(Note: Where the waste will be collected by the Chemical Waste Treatment Centre (CWTC) contractor, suitable containers will be supplied by the contractor to the waste producer.)

3.3.6 Labelling

Every container for chemical waste storage should be provided with an appropriate label in both English and Chinese in the form specified in the Regulation.

The label should include the following particulars:

The words and character 'CHEMICAL WASTE.
Name, address and contact telephone number of the waste producer.
Chemical name(s), common name(s) or waste type(s).
Appropriate hazard warning symbol.

The dimensions of the label should not be less than 90 mm x 100 mm.

The chemical waste producer should ensure that the information contained on the label is accurate and sufficient so as to enable proper and safe handling, storage and transport of the chemical waste.

The label should be securely attached to a suitable part of the container, which allows the information on the label to be easily read, be kept clean and free from obstruction.

3.3.7 Storage of waste

Chemical wastes can be stored in a storage cupboard which is fitted with leakproof sill or spill catcher trays in its base to retain the capacity of the largest container or 20% by volume of the total storage capacity in that cupboard whichever is the greater in case of spillage or leakage from the containers.

The material used for the construction of the leakproof sill or spill catcher trays should be able to withstand the chemical action of the stored chemical waste. Examples of a stainless steel spill catcher tray to be used with containers or organic wastes, and a heavy-duty plastic spill catcher tray to be used with containers of inorganic wastes (including strong acids and alkalis), are shown in Appendix I.

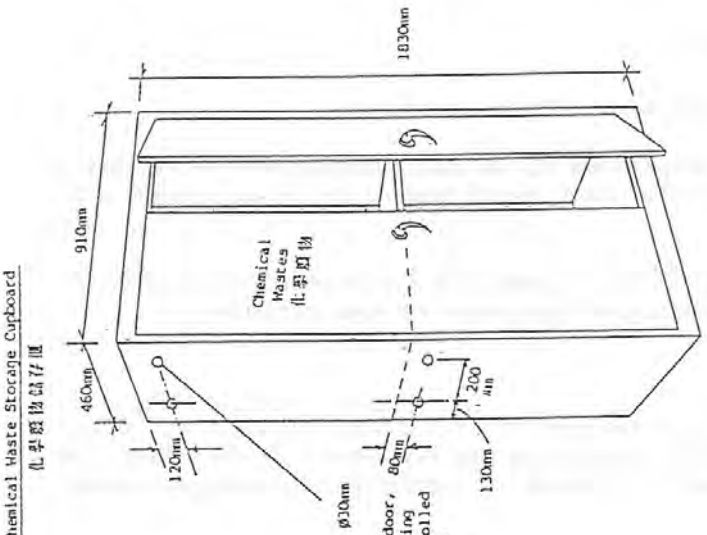
Incompatible chemical wastes which when in contact with one another may produce dangerous consequences should either be stored separately or in a cabinet provided with compartments separated from each other by impermeable partitions.

The storage cupboard should be provided with adequate ventilation by means of openings to prevent the formation of any dangerous or harmful concentration of vapour. An example of such a cupboard, and illustrations of how it could be used to store chemical wastes are shown in Sketches of Appendix I.

3.3.8 Appendix

Appendix I: Chemical Waste Storage Cupboard and Spill Catcher Tray

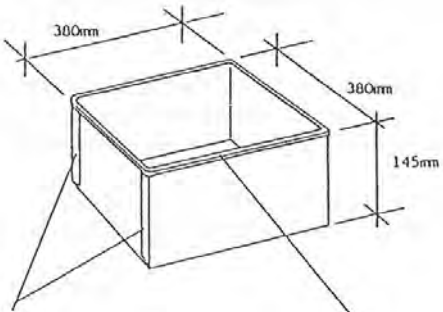
Chemical Waste Storage Cupboard
化學廢物儲存櫃



Cupboard, steel, double-door, fitted with 3 point locking espagnolette bolt, controlled by 6-lever lock with one adjustable shelf.

External Dimension	:	910mm wide x 1830mm high x 460mm deep
Doors and Sides	:	1.2mm (minimum) thickness of steel
Ventilation Holes	:	4 holes of diameter 30mm on each side as shown
Marking	:	Words "Chemical Wastes 化學廢物" (about 6cm in height) should be printed in white on the left door as shown
Adjustable Shelf and Bottom	:	1.2mm (minimum) thickness of steel, strengthened with two U-shape ribs welded along the width underneath the adjustable shelf and bottom of the cupboard, stiff and strong enough to stand the weight of about 70 kilograms
Top and Back	:	0.7 - 0.8mm thickness of steel
Lock	:	Union or Yale
Finish	:	Rust proof with "FOSCOTE" or equivalent preparation and sprayed with three coats of cellulose lacquer
Colour	:	Olive brown

Stainless Steel Spill Catcher Tray
不銹鋼溢瀉盤

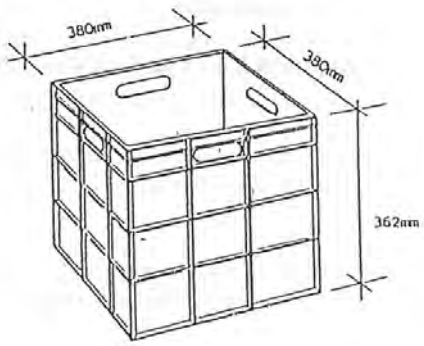


lap joints to be welded to ensure leakproof

seamed edges with a piece of stainless steel rod wrapped inside

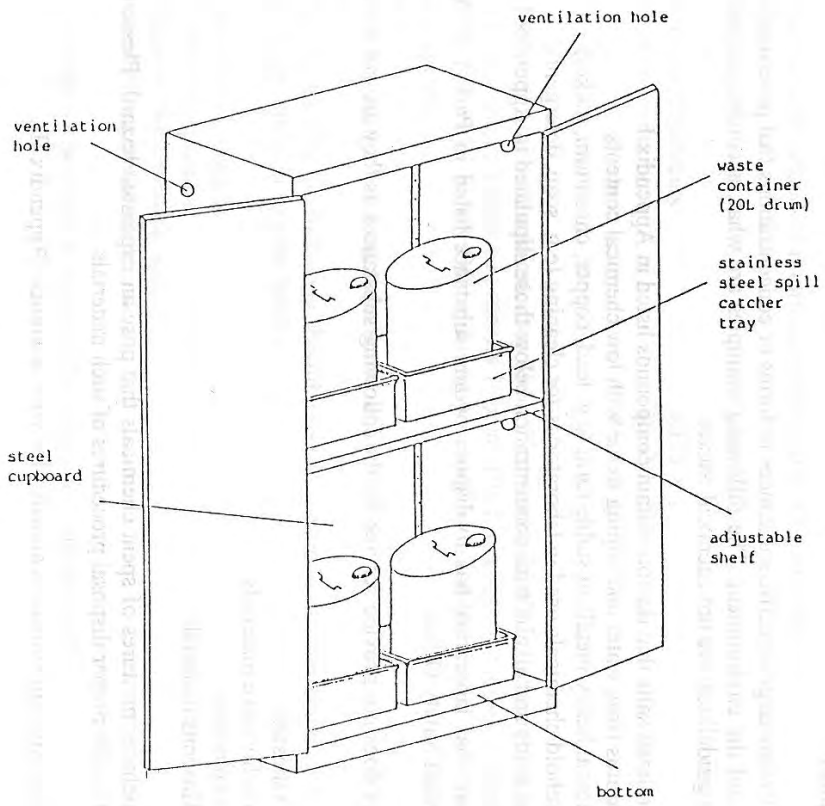
Overall dimension 380mm x 380mm x 145mm, to be made of a SWG 24 stainless steel (type 316) sheet. All edges should be seamed with a piece of stainless steel rod (dia. 5mm) to stiffen and avoid sharp edges. The lap joints should be welded to ensure that the whole tray is leakproof.

Heavy-Duty Plastic Spill Catcher Tray
耐用塑膠溢瀉盤

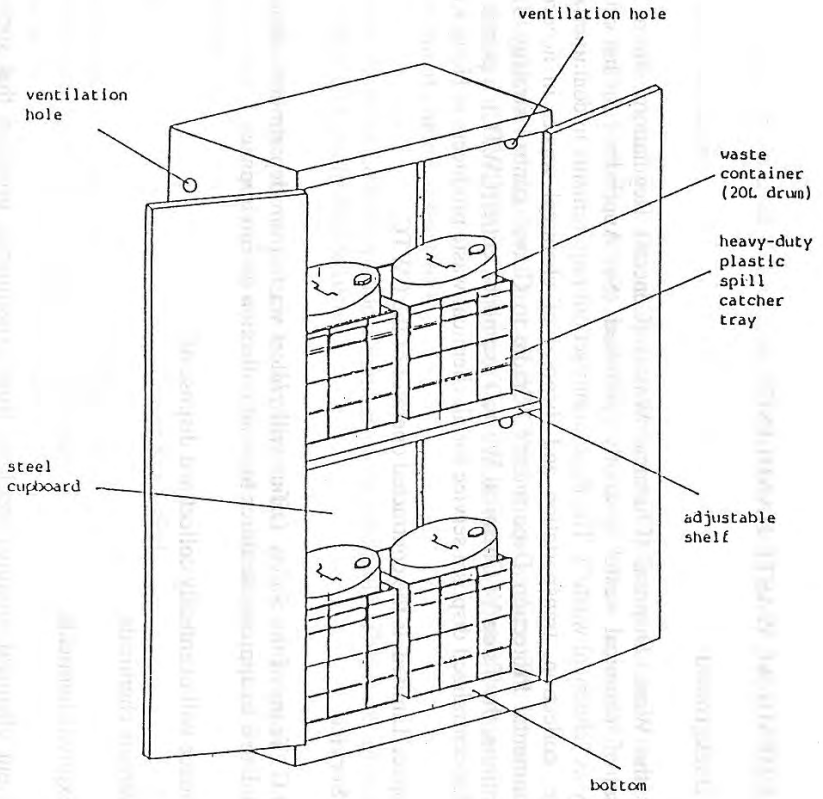


Overall dimension	:	380 x 380 x 362mm
Material dimension	: Top	360 x 360 x 355mm
	Bottom	351 x 351 x 355mm

Storage of Organic Chemical Wastes
有機化學廢物的儲存



Storage of Inorganic Chemical Wastes
無機化學廢物的儲存



3.4 CHEMICAL WASTE HANDLING

3.4.1 Background

Under the Waste Disposal (Chemical Waste) (General) Regulations, from May 1993, the disposal of "chemical waste" is strictly controlled. (See Appendix I for list of substances that qualify as "chemical waste"). The Regulations set out requirements in containerization, labelling, storage, collection, transportation and disposal of chemical waste, in accordance with the Environmental Protection Department's "Cradle to Grave" control strategy. In line with the Regulations, the Tsing Yi Chemical Waste Treatment Centre (CWTC), a public owned facility, provides centralized disposal service for all chemical waste producers in Hong Kong.

Enviropace Limited, is the contracted operator of the CWTC.

3.4.2 Service

The staff of Enviropace will collect waste from departments/laboratories etc. and accumulate it in appropriate stores accompanied by D.G. Team of the Safety Office.

Enviropace will eventually collect and dispose of:

(1) Surplus chemicals.

(2) Expired chemicals.

(3) Spent chemical mixtures resulting from experiments, provided that such chemicals can meet the regulatory definition of "chemical waste", and can be accepted by the CWTC for treatment.

The Regulations target specific substances in forms or concentrations that pose significant threat to health and the environment. The following examples are what, according to the Regulation and EPD's guidelines, are not chemical wastes:

(1) Neutralized salts that do not contain compounds listed in Appendix I
(2) Apparatus rinse water and wiping tissue with low chemical contents
(3) Elemental heavy metals in stable form (e.g. lead, copper, chromium, nickel)
(4) Household chemicals used in laboratories for cleaning (e.g. soap, detergents)
(5) Dilute acids and alkalis with concentration below those stipulated in Appendix I

In the event that laboratory has to dispose of any substance listed in Part A of Appendix I, please contact Safety Office.

Enviropace does not provide service for the following substances as they are not accepted at the CWTC:

- Asbestos
- Radioactive materials
- Explosives
- Gaseous materials

This list includes mixtures of spent chemicals that pose an explosion hazard. Please consult the Safety Office for proper disposal procedures of such materials.

A list of explosive substances is attached for your reference (Appendix II).

Enviropace provides properly labelled 20 litre pails for collection of spent chemical mixtures.

3.4.3 Chemical waste manager

Each department should appoint a Chemical Waste Manager (CWM) to direct and co-ordinate the handling of chemical wastes. This person should be either a laboratory superintendent or an experienced laboratory technician.

An acting CWM should also be appointed in case the CWM is not on duty. The names of the CWM should be supplied to Safety Office as the primary and secondary contact person.

3.4.4 Handling of spent chemical mixtures

For each department, Enviropace will provide a number of 20 litre pails. These are for storage of spent organics, acids and alkalis respectively.

These pails are delivered with completed chemical waste labels and colour dot labels. The colour dot label is a useful aid for easy identification of wastes. Waste names and dot colours correspond as follows:

Waste Name	Colour Dot Label
Mixed Spent Halogenated Solvents	Pink Violet
Mixed Spent Non-halogenated Solvents	Burgundy
Mixed Spent Acids	Red
Mixed Spent Alkalis	Blue
Lubricating Oil	Burgundy

Waste from medical and dental laboratories are assigned a different category:

Waste Name	Colour Dot
Non-Halogenated Solvents	RED X 1
Halogenated Solvents	RED X 2
Acid	RED X 3
Alkali	RED X 4

The CWM is required to initiate a Waste Log Sheet (See Appendix III for sample) for each pail. Every waste entering the pail must be properly logged. The filled log sheet must accompany the pail at time of collection by Safety Office. Enviropace will refuse collection of pails that do not carry a legible log sheet.

N.B.: For waste lubricating oil, a log sheet is not required.

Spent chemicals containing the following should never be mixed with other chemical waste and should be stored separately in smaller bottles:

(1) Highly reactive compounds
(2) Water reactive compounds
(3) Concentrated strong oxidizing agents
(4) Concentrated strong reducing agents

A list of water reactive substances is attached for reference. (Appendix IV)

These bottles should bear an individual log sheet, be labelled and stored as described in the section: *Handling of Surplus Expired Chemicals* below.

Mixtures of organics and inorganics should, upon passing the compatibility test as outlined in Section 3.4.6, be stored according to the following guidelines:

Mixture	Pail to Use
Halogenated Organics	Halogenated Organics
Non-halogenated Organics	Non-halogenated Organics
Heavy Metal Salts & Precipitates	Alkali
Solvent after cleaning oily parts	Non-halog. Organics

For mixtures with two distinctive liquid phases, the phases should be separated for storage in respective appropriate containers. In general, non-acidic substances that are not hydrophobic should be mixed into the alkali pail, as an alkali medium is usually a chemically less reactive environment. Hydrophobic material should be mixed into the organics pail. Solid precipitates can be mixed into the proper container for the co-existing liquid.

At the end of each experimental session, spent chemicals should be collected using 3 beakers of appropriate size, one for each of organics, acids and alkalis. Mixtures of these should be collected according to guidelines given above.

The beakers must be placed in a fume hood with the sash in the working position. Spent chemicals should be added slowly, and in small portions, into the beakers. Stop if excess heat or gas bubbles are generated during the process. Store un-added portion separately in a bottle, compile separate log sheet for the bottle. Follow labelling and storage procedures per Sections 3.3.6 and 3.3.7.

After all spent chemicals are collected in the beakers, perform compatibility test between contents of the beakers and respective chemical waste pails. Procedures of the compatibility test are described in Section 3.4.6. To assure proper safety precaution, check pail log sheet against beaker content before each compatibility test.

Add beaker content into the corresponding pail if individual compatibility test result is O.K. Otherwise store separately. Follow procedures per Sections for storage of incompatible waste.

Upon passing the compatibility test, the new waste can be added to the pail outside the fume hood. Always check the liquid level of the waste pail before adding new waste each time. Use a funnel and a catch tray for spill prevention and control. Enter new waste information onto the log sheet. Ensure that all fields of an entry must be carefully completed in a legible way.

Without referring to the compatibility test, if a superintendent or a technician has any doubt on mixing a new waste into a pail, then the waste should be stored separately. Follow procedures per Sections for storage of incompatible waste.

Chemical waste pails should always be stored in stainless steel (organics) or plastic (inorganics) catch trays, and be placed inside the storage cabinet. The storage cabinet should be kept in a cool area.

3.4.5 Handling of surplus or expired chemicals

Leave chemical in original packing and label. If the original packing is not in good condition and presents a risk of leakage, wrap and seal the bottle in a PE plastic bag, or other overpack of compatible nature.
On each bottle, attach a second label bearing the following items: (1) name of department, (2) name and contact telephone number of laboratory person-in-charge, (3) chemical name, (4) quantities, (5) particular risks and safety precautions. Enviropace does not collect any item without this label.

Store these chemicals in stainless steel (organics) or plastic (inorganics) catch trays in chemical waste storage cabinet.

3.4.6 Compatibility test procedures

The test should be performed by a competent laboratory technician, in a fume hood with the sash at working position.

Using a pipette, draw a 50ml sample of the content from the target waste pail and move to a beaker. Insert a thermometer into the beaker.

Slowly, mix in a portion of the new chemical waste that is to be added to the pail. The volumetric ratio of the test reagents should be similar to that between the original pail content and the new waste.

If bubbling, fuming or noticeable temperature rise of 10 degrees C or more occurs during mixing or within 5 minutes, stop further mixing. Store new waste separately in a bottle, compile separate log sheet. Follow Sections 5.2 and 5.3 for storage and labelling procedures.

If no adverse reaction occur in 5 minutes, the new waste can be added to the corresponding pail.

3.4.7 Personal protective equipment

Chemical goggles and lab. coats should be used at all times when handling or mixing chemical wastes, in spite of whether the operation is performed in a fume hood.

3.4.8 Collection service

The CWM should advise the Safety Office, in the form of a telefaxed summary report (Appendix V) which contains the estimated volume of each pail, as well as the name, nature and volume of each bottle of separately stored waste.

Safety Office will collect the waste. The time of collection will be arranged between Safety Office and CWM.

Department should allocate storage space for empty pails that is enough for four weeks' use and place in containment tray when the full waste pails are collected by Safety Office staff.

Safety Office will liaise with Enviropace for collection of the waste from D.G. Stores and further supply of empty pails.

3.4.9 Guideline for liquid effluents

Introduction

University buildings located in the Water Control Zone are:

	Water Control Zone	Buildings
(A)	Western Buffer (I):	U. Pathology Building University Hall No. 6 Sassoon Road Estates Office Building Pauline Chan Amenities Bldg Laboratory Animal Unit The Hong Kong Jockey Club Clinical Research Centre
(B)	Western Buffer (ii):	Li Shu Fan Building Stanley Ho Sports Centre
(C)	Southern	Swire Institute of Marine Science
(D)	Tolo Harbour	Kadoorie Agricultural Research Centre
(E)	Victoria Harbour	Main Campus Prince Philip Dental Hospital Kadoorie Biological Sciences Building

All liquid effluents from buildings in lists A & E enter the government sewers while List B, C, and D Buildings discharge into coastal waters. The legal conditions that govern liquid effluents discharged into drainage and sewerage systems, and inland and coastal waters of Hong Kong are given in the Hong Kong Water Pollution Control Ordinance Cap. 358. Details of the Ordinance are summarized in the Technical Memorandum on Effluent Standards issued by the Secretary for Planning, Environment and Lands under Section 21(1) of the Water Pollution Control (Amendment) Ordinance 1990.

Standards for Effluents Discharged to Foul Sewers

Standards for Effluents Discharged to Foul Sewers in Hong Kong

The current standards for effluents leading to Government sewage treatment plants are listed below:

Parameter	Unit	Upper Limit
pH	pH	6-10
5 day Biochemical Oxygen Demand	mg/1	1200
Chemical Oxygen Demand	mg/1	3000
Suspended Solids	mg/1	1200
Total Toxic Metals	mg/1	10
Phenols	mg/1	1
Total Nitrogen	mg/1	200
Total Phosphorous	mg/1	50
Surfactants	mg/1	200
Oil & Grease	mg/1	100
Barium	mg/1	8
Boron	mg/1	8
Cadmium	mg/1	0.2

Chromium	mg/1	2
Copper	mg/1	4
Iron	mg/1	30
Mercury	mg/1	0.2
Nickel	mg/1	4
Silver	mg/1	4
Zinc	mg/1	5
Other toxic metals, individually Cyanide	mg/1	2.5
Sulphide	mg/1	10
Sulphate	mg/1	100

The current list of "toxic metals" provided by the EPD for sewer effluents includes antimony, arsenic, beryllium, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, thallium and vanadium.

The following substances are prohibited from being discharged to foul sewers:

- Polychlorinated biphenyls (PCB)
- Polyaromatic hydrocarbon (PAH)
- Fumigant, pesticide or toxicant
- Radioactive substances
- Chlorinated hydrocarbons
- Flammable or toxic solvents
- Petroleum oil or tar
- Calcium carbide
- Waste liable to form scum, deposits

Any substance of a nature or quantity likely to damage the sewer or to interfere with any of the treatment processes. The Authority will not allow dilution as a means of meeting effluent standards. Dilution lowers the concentration of waste by increasing the volume, but the total mass of waste, and thus the loading on the receiving waters and their biota, does not change. This does not necessarily prohibit mixing different effluent streams within the premises.

Standards for Effluents discharged to coastal waters

Parameter pH	Unit pH	Upper Limit 6-9
Colour	Lovibond unit (25mm cell length)	1
Suspended Solids	mg/1	50
Biochemical Oxygen Demand	mg/1	50
Chemical Oxygen Demand	mg/1	100
Oil & Grease	mg/1	30
Barium	mg/1	5
Boron	mg/1	5
Cadmium	mg/1	0.1
Iron	mg/1	15
Other Toxic Metals	mg/1	1
Total Toxic Metals	mg/1	2
Cyanide	mg/1	0.2
Phenols	mg/1	0.5
Sulphide	mg/1	5
Total Nitrogen	mg/1	100
Total Phosphorous	mg/1	10
Surfactants (total)	mg/1	20
E. Coli	Count/100 ml	1000

Prohibited substances for effluents to coastal wasters are:

- Polychlorinated biphenyls (PCB)
- Polyaromatic hydrocarbon (PAH)
- Fumigant, pesticide or toxicant
- Radioactive substances
- Chlorinated hydrocarbons
- Flammable or toxic solvents
- Petroleum oil or tar
- Calcium carbide
- Wastes liable to form scum, deposits or discolouration
- Sludge, floatable substances or solids larger than 10 mm

As with waste water, the Authority will not allow dilution as a means of meeting effluent standards. That would cause excessive loading on the receiving waters and their biological systems.

This does not necessarily prohibit mixing different effluent streams within the premises.

Practice on Effluents at HKU

Because of the legal conditions governing the waste water stream, students, technicians and researchers must be careful to avoid putting any solid or liquid chemical waste into the sinks. Please refer to Guidelines for chemical waste management. In principle, only acids and alkalis that have been neutralized to the pH range 6-10 and non-toxic salts can be disposed into the sewer system.

3.4.10 Appendices

Appendix I: Schedule 1 of the "Waste Disposal (Chemical Waste)(General) Regulation"

Appendix II: List of Explosive Substances

Appendix III:
a) Waste Log Sheet
b) Waste Log Sheet from Medical Sources

Appendix IV: List of Water Reactive Substances

Appendix V: Sample Chemical Waste Summary Report

SCHEDULE OF SUBSTANCES AND CHEMICALS

Part A — Code

Any substance to which the Antibiotics Ordinance (Cap. 137) applies 30
Asbestos 09
Dangerous drugs (as defined in the Dangerous Drugs Ordinance (Cap. 134)) 10
Dangerous goods, category 2, NES .. (As defined in the Dangerous Goods Ordinance (Cap. 295)) ..02
Dangerous goods, category 6, NES .. (As defined in the Dangerous Goods Ordinance (Cap. 295)) ..04
Dangerous goods, category 9, NES .. (As defined in the Dangerous Goods Ordinance (Cap. 295)) ..14
Dibenzofurans 19
Dioxins 19
Pesticides (as defined in the Register referred to in Section 4(b) of the Pesticides Ordinance (Cap. 133)) 06
Poisons (Part I) (as defined in the Pharmacy and Poisons Ordinance (Cap. 138)) 20
Polychlorinated biphenyls 29

Part B

Antimony and its compounds 66
Arsenic compounds 66
Barium compounds 66
Beryllium and its compounds 66
Boron compounds 66
Cadmium and its compounds 66
Chromium bearing solid tannery waste 56
Chromium and its compounds, NES 66
Cobalt and its compounds 66
Copper compounds/copper etchant 66/76
Cyanides 96
Dangerous goods, category 3, NES .. (As defined in the Dangerous Goods Ordinance (Cap. 295)) ...38
Dangerous goods, category 4, NES .. (As defined in the Dangerous Goods Ordinance (Cap. 295)) ...36
Dangerous goods, category 5, NES .. (As defined in the Dangerous Goods Ordinance (Cap. 295)) ...33
Dangerous goods, category 7, NES .. (As defined in the Dangerous Goods Ordinance (Cap. 295)) ...35
Dangerous goods, category 8, NES .. (As defined in the Dangerous Goods Ordinance (Cap. 295)) ...34
Dangerous goods, category 10, NES (As defined in the Dangerous Goods Ordinance (Cap. 295)) ...39
Halogenated organic solvents and compounds 49
Lead and its compounds 66
Manganese and its compounds 66
Mercury and its compounds 66
Mineral oils employed for engine lubrication 73
Mineral oils, NES 63
Nickel and its compounds 66
Non-halogenated organic solvents and compounds 43
Organo lead compounds 86
Organo mercury compounds 86
Organo tin compounds 86
Paints 53
Pesticides (as defined in the Register referred to in Section 4(a) of the Pesticides Ordinance (Cap. 133)) 46
Pharmaceutical products and medicines, NES 40
Phosphorus compounds excluding phosphates 68
Selenium compounds 66
Silver compounds 66
Sulphides 98
Thallium and its compounds 66
Tin compounds 66
Vanadium compounds 66
Zinc compounds 66

Acids, alkalis and corrosive compounds

Acetic acid above 10% acetic acid by weight 48
Acids or acidic solutions, NES with acidity equivalent to above 5% nitric acid by weight 48
Ammonia solution above 10% ammonia by weight 58
Bases or alkaline solutions, NES, with alkalinity equivalent to above 1% sodium hydroxide by weight 58
Chromic acid above 1% chromic acid by weight 78
Fluoroboric acid above 5% fluoroboric acid by weight 48
Formic acid above 10% formic acid by weight 48
Hydrochloric acid above 5% hydrochloric acid by weight 48
Hydrofluoric acid above 0.1% hydrofluoric acid by weight 48
Hydrogen peroxide solution above 8% hydrogen peroxide by weight 55
Nitric acid above 5% nitric acid by weight 48
Perchloric acid above 5% perchloric acid by weight 48
Phosphoric acid above 5% phosphoric acid by weight 48
Potassium hydroxide solution above 1% potassium hydroxide by weight 58
Potassium hypochlorite solution above 5% active chlorine 88
Sodium hydroxide solution above 1% sodium hydroxide by weight 58
Sodium hypochlorite solution above 5% active chlorine 88
Sulphuric acid above 5% sulphuric acid by weight 48

NES = Not elsewhere specified

Appendix II

Explosives

Acetyl azide
Acetyl nitrate
Ammonium azide
Ammonium clolrate
Ammonium hexanitrocobaltate
Ammonium nitrate
Ammonium nitrite
Ammonium periodate
Ammonium permanganace
Ammonium picrate
Ammonium tetraperoxychromate
Azidocarbonyl guanidine
Barium azide
Benzene diazonium chloride
Benzotriazole
Benzoyl peroxide
Bismuth nitride
Boron Triazide
Bromide azide
Butanetriol trinitrate
t-Butyl hypochlorite
Cadmium azide
Cadmium hexamine chlorate
Cadmium hexamine perchlorate
Cadmium nitrate
Cadmium nitride
Cadmium trihydrazine chlorate
Calcium nitrate
Cesium azide
Chlorine azide
Chlorine dioxide
Chlorine fluoroxide
Chlorine trioxide
Chloroacetylene
Choropicrin
Copper acetylide
Cyanuric triazide
Diazidoethane
Diazodinitrophenol
Diethylene glycol dinitrate
Dipentaerithritol hexanitrate
Dipicryl amine
Disulfur dinitride
Ethyl nitrate
Ethyl nitrite
Fluorine azide
Glycol dinitrate
Glycol monolactate trinitrate
Gold fluminate
Guanyl nitrosaminoguanylidene hydrazine
HMX
Hydrazine azide
Hydrazoic acid
Lead azide
Lead dinitroresorcinate
Lead monoitroresorcinate
Lead styphnate
Mannitol hexanitrate
Mercuric oxycyanide
Mercury fulminate
Nitrocarbonitrate
Nitrocellulose
Nitroglycerin
Nitrosoguanidine
Nitrostarch
Pentaerythritol tetranitrate
Picamide
Picric acid
Polyvinyl nitrate
Potassium dinitrobenzfuroxan
Potassium nitrate
RDX
Silver acetylide
Silver azide
Silver nitride
Silver styphnate
Silver tetrazene
Smokeless powder
Sodium picamate
Tetranitromethane
Tetraselenium tetranitride
Tetrasulfur tetranitride
Tetrazene
Thallium nitride
Trilead dinitride
Trimercury dinitride
Trinitrobenzene
Trinitrobenzoic acid
Trinitronaphthalene
Trinitroresorcinol
Trinitrotoluene
Urea nitrate
Vinyl azide
Zinc peroxide

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APPENDIX IIIa

Chemical Waste Log Sheet

Department Name: _____ CWPN # ☐-☐-☐-☐

Waste Name: _____ CWTF-ID: _____

Container # _____

Item	Date	Reagents	Reactions	Waste Name	Vol (ml)	Sign.

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APPENDIX IIIb

Chemical Waste Log Sheet

Department: _____

Contact Person: _____ Phone No.: _____

Waste Name: _____ Date: _____

CWPN: _____ CWTFID: _____

Container No.: _____
(container number is filled in by Enviropace)

The following columns should be filled every time when chemical waste is added

Individual Waste Component(s)	Concentration (by weight %)	Process of Waste Arising	Quantity (litres)

The following column should be filled before collection by Safety Office

pH	
Color	
Physical appearance (liquid/sludges/solid/ chuck ... etc.)	
Viscosity (low/medium/high)	
Layering (single/ double/triple ... etc.)	
Comment	

Appendix IV

Water Reactive Substances

Acetic anhyride
Acetyl bromide
Acetyl chloride
Alkyl aluminum chloride
Allyl trichlorosilane
Aluminum aminoborohydride
Aluminum borohydride
Alumimum bromide
Aluminum chloride
Aluminum fluoride
Aluminum hypophosphide
Aluminum phosphide
Aluminum tetrahydroborate
Amyl trichlorosilane
Anisoyl chloride
Antimony tribromide
Antimony trichloride
Antimony trifluoride
Antimony triiodide
Antimony trivinyl
Arsenic tribromide
Arsenic trichloride
Arsenic triiodide
Barium
Barium carbide
Barium oxide
Barium sulfide
Benzene phosphorus dichloride
Benzoyl chloride
Benzyl silane
Benzyl sodium
Beryllium hydride
Beryllium tetrahydroborate
Bismuth pentaflouride
Borane
Boron bromodiiodide
Boron dibromoiodide
Boron phosphide
Boron tribromide
Boron trichloride
Boron triiodide
Bromine monofluroride
Bromine pentafluoride
Bromine trifluoride
Bromo diethylaluminum
n-Butyl lithium
n-Butyl trichlorosilane
Cadmium acetylide
Cadmium amide
Calcium
Calcium carbide
Calcium hydride
Calcium oxide
Calcium phosophide
Cesium amide
Cesium hydide
Cesium phosphide
Chlorine dioxide
Chlorine monofluoride
Chlorine pentafluoride
Chlorine trifluoride
Chloroacetyl chloride
Chlorodiisobutyl aluminum
Chlorophenyl isocyanate
Chromyl chloride
Copper acetylide
Cyclohexenyl trichlorosilane
Cyclohexyl trichlorosilane
Decaborane
Diborane
Diethyl aluminum chloride
Diethyl dichlorosilane
Diethyl zinc
Diisopropyl beryllium
Dimethyl dichlorosilane
Dimethylmethane diisocyanate
Disulfuryl chloride
Dodecyl trichlorosilane
Ethyl dichloroarsine
Ethyl dichlorosilane
Ethyl trichlorosilane
Fluorine
Fluorine monoxide
Fluorosulfonic acid
Gold acetylide
Hexadecyl trichlorosilane
Hexyl trichlorosilane
Hydrobromic acid
Iodine monochloride
Lithium
Lithium aluminium hydride
Lithium amide
Lithium ferrosilicon
Lithium hydride
Lithium peroxide
Lithium silicon
Methyl aluminum sasquibromide
Methyl aluminum sesqichloride
Methyl dichlorosilane
Methylene diisocyanate
Methyl isocyanate
Methyl trichlorosilane

Methyl magnesium bromide
Methyl magnesium chloride
Methyl magnesium iodide
Nickel antimonide
Nonyl trichlorosilane
Octadecyl trichlorosilane
Octyl trichlorosilane
Phenyl trichlorosilane
Phosphonium iodide
Phosphoric anhydride
Phosphorus oxychloride
Phosphorum pentasulfide
Phosphorus trisulfide
Phosphorous (amorphous red)
Phosphorus oxybromide
Phosphorus oxychloride
Phosphorus pentachloride
Phosphorus sesquisulfide
Phosphorus trimbromide
Phosphorus trichloride
Polyphenyl polymethyl isocyanate
Potassium
Potassium hydride
Potassium oxide
Potassium peroxide
Propyl trichloride
Pyrosulfuryl chloride
Silicon tetrachloride
Silver acetylide
Sodium
Sodium aluminum hydride
Sodium amide
Sodium hydride
Sodium methylate
Sodium oxide
Sodium peroxide
Sodium-potassium alloy
Stannic chloride
Sulfonyl fluoride
Sulfuric acid (>70%)
Sulfur chloride
Sulfur pentafluoride
Sulfur trioxide
Sulfuryl chloride
Thiocarbonyl chloride
Thionyl chloride
Thiophosphoryl chloride
Titanium tetrachloride
Toluene diisocyanate
Trichlorosilane
Triethyl aluminum
Triisobutyl aluminum
Trimethyl aluminum
Tri-n-butyl aluminum
Tri-n-butyl borane
Tricotyl aluminum
Trichloroborane
Triethyl arsine
Triethyl stibine
Trimethyl arsine
Trimethyl stibine
Tripropyl stibine
Trisilyl arsine
Trivinyl stibine
Vanadium trichloride
Vinyl trichlorosilane
Zinc acetylide
Zinc phosphide
Zinc peroxide

3.5 TREATMENT OF BIOLOGICAL WASTES

3.5.1 Types of biological waste

Sharps

These are syringes with needles, scalpel blades, Pasteur pipettes, broken glass and generally anything sharp. They cause the most injuries and infections by accident. These items should be placed in a rigid puncture-proof container immediately after use and prior to any other treatment. The container must be labelled with the biohazard warning label.

Large Liquid Cultures

Large liquid cultures should be killed in their growth or separation containers by autoclaving or chemical disinfection.

Radioactive Substances

Radioactive substances are not acceptable in autoclaves. Chemical disinfectants should be used for disinfection of radioactive biological samples and set aside in a shielded area until radioactivity levels are acceptable for standard disposal. The containers for such radioactive substance must be clearly labelled with radioactive and biohazard warning signs.

The Radiation Protection Officer must be informed of such waste.

Instruments & Glassware

Instruments and glassware for recycling should be disinfected by an appropriate method first, then kept separate from other materials to be discarded.

Other Infectious Materials

Other infectious materials are easiest to accumulate according to their destinations, typically autoclaving followed by incineration. Materials containing flammable, volatile, radioactive, or hypochlorite materials should not be autoclaved. The Laboratory-in-charge is responsible to ensure that the materials to be autoclaved are free from chemically hazardous materials before allowing the process to proceed.

Non-Infectious Materials

Non-infectious materials such as plastic ware and paper materials should be accumulated in containers which should be clearly labelled.

3.5.2 Collection & labelling of containers

Containment and security of biological waste, correctly labelled is a priority. Standard biohazard labels should be displayed on containers of all materials accumulated or packed for disposal or transport.

Containers for cultures and glassware should be kept in designated locations and must not be moved around without the approval of the Laboratory-in-charge. Appropriate lids must be kept on the containers for protection at all times.

Disposable infectious materials should be collected in a double-layer robust autoclavable plastic bag, securely supported, with a non-sealing lid.

Animal carcasses for incineration should be sealed in specially marked plastic bags.

3.5.3 Treatment, Washing & Recycling

Sharps

Sharps (see definition previously) are best incinerated in their puncture-proof containers with no further handling.

Reusable sharps should be sterilized by autoclaving rather than by using disinfectants.

Autoclaving

Autoclaving is the preferred treatment method for most wastes.

Special Care Materials

Following autoclaving, cultures containing bulk amounts of genetic material demanding particular caution such as toxic genes and activated oncogenes should be treated with an aliquot of 5M hydrochloric acid sufficient to lower the pH to 2, producing acid denaturization of nucleic acids.

Chemical Disinfection

Chemical disinfection using a hypochlorite solution to give a final concentration of 0.5% available chlorine for at least 30 minutes should be used for liquid cultures and glassware.

Equipment containing metallic parts which are reactive to hypochlorite solutions should be treated with ethanol and/or habitan.

Treatment should be completed before materials are submitted to washing and the recycling system.

3.6 GUIDELINES FOR SPILLAGE CLEAN-UP

Spills can involve amounts of materials ranging from less than a milli-litre up to several hundred milli-litres or more. The amount spilled, the physical characteristics of the material and how the spill occurred may affect the subsequent method of handling.

In all cases, laboratory personnel should ensure that they have appropriate personal protective equipment and disinfectants which are ready and kept in convenient locations to the sites of the experiments before they perform their investigation.

3.6.1 Minor spillage

Spillage that involves a volume less than 500 ml. or organisms classified as bio-hazard class 2 or below are considered as minor spills.

In the occurrence of such a spill, personnel in the laboratory should be able to handle it by following the procedure below.

(1) Immediately warn personnel working nearby and notify the spill to the Laboratory-in-charge. It is not necessary to evacuate personnel from the laboratory in the case of minor spills.

(2) Put on appropriate personal protective equipment such as gloves, splash guards and respirators.

(3) Always work in a team during the clean up. Keep at least one personnel around to observe the response of the clean up staff.

(4) Pour disinfectants such as 0.5% hypochlorite or 0.8% iodophor solution carefully around the outside of the spill and allow the disinfectants to flow into the spill. Lay paper towels wetted with disinfectant over the spill.

(5) Wait 20-30 minutes to allow the disinfectant to work.

(6) Transfer the soaked materials into double waste bags labelled with biohazard signs for disposal. Equipment reclaimed should be washed thoroughly to remove hypochlorite solution before autoclaving if such is required. Plasticware reclaimed should be washed and soaked with fresh hypochlorite solutions again.

(7) Wash and mop the adjacent as well as the spill area with a fresh disinfectant solution.

(8) The decontamination team should wash their boots and gloves before removing them and leaving the area.

(9) Any other protective equipment should also be disinfected.

3.6.2 Major spillage

Spillage volumes in excess of 500 ml. or involving organisms of bio-hazard class 3 or above should be considered as a major spillage and the following procedure should apply.

The following is the recommended procedure only and laboratories can modify them into their own procedures to suit local needs. In such cases, the Safety Office should be informed of the changes.

In the occurrence of major spillage, staff of the Safety Office should be on site to provide assistance. However, the Laboratory-in-charge is responsible for the provision of disinfectants and absorbents for the clean up of spills.

(1) After the spillage has occurred, personnel must hold their breath and leave the laboratory immediately.

(2) Close the laboratory door and place "Do Not Enter" signs. If the laboratory door does not have "Biohazard" signs, these will also be required.

(3) Remove and place in a biohazard bag - laboratory gowns, shoes and any other garment suspected of being contaminated.

(4) Wash hands and face. A full body shower is recommended if skin contacts any biohazardous materials from a spill.

(5) Warn others of the spill and tell them to keep out of the area.

(6) Notify the area supervisor or have someone do it for you as soon as possible.

(7) The contaminated area should be demarcated clearly.

(8) Consult the Safety Office before commencing the clean up to ensure that correct procedures are followed.

(9) Do not attempt to clean up the spill immediately as there are still airborne biohazardous material around. Wait for at least 30 minutes for such materials to settle before beginning clean up operations.

(10) Normally, appropriate respirators and personal protective clothing are required for people performing the clean up operation.

(11) Always work in a team during the clean up. Keep at least one personnel around to observe the response of any contaminated victims.

(12) Pour disinfectants such as 0.5% hypochlorite or 0.8% iodophor solution carefully around the outside of the spill and allow the disinfectants to flow into the spill. Lay paper towels wetted with disinfectant over the spill.

(13) Wait 20-30 minutes to allow the disinfectant to work.

(14) Transfer the soaked materials into double waste bags labelled with biohazard signs for disposal. Equipment reclaimed should be washed thoroughly to remove hypochlorite solution before autoclaving if such is required. Plasticware reclaimed should be washed and soaked with fresh hypochlorite solutions again.

(15) Wash and mop the adjacent as well as the spill area with a fresh disinfectant solution.

(16) The decontamination team should wash their boots and gloves before removing them and leaving the area. Any other protective equipment should be disinfected.

3.7 GUIDELINES FOR USING CARCINOGENS

3.7.1 Introduction

HKU is committed to ensure that the working environment is safe and without risk to health, so far as is reasonably practicable, and employees are required to co-operate in achieving this end.

These rules are written to assist those responsible for the use of and users of carcinogenic substances to meet their obligations under the University Safety Policy. The responsibilities and duties of users cannot be overemphasized nor can their contribution to the safety of themselves and others.

3.7.2 Managerial controls

The Head of Department is, ex officio, responsible to the University for safety in his/her department.

The manner in which the responsibility is discharged will depend upon the size of the department, the general nature of the work being undertaken and the extent of the personal involvement of the head of department in the specific programmed in which carcinogens are used.

The Head of Department must:

(1) Be aware of all work in the department involving the use of carcinogens.

(2) Ensure that no work proceeds until a safety assessment has been prepared, approved and signed by the person immediately in charge of the work and countersigned by him/her.

(3) Ensure that each person involved in the work is adequately trained in the appropriate techniques and possesses the skill and knowledge required and that such persons be registered as users.

(4) Ensure that adequate records are kept in the department.

Consideration must be given to appointing deputies.

3.7.3 Record keeping

Safely assessments and other records must be kept in the Department for at least 30 years. If the department is closed down, or transferred to another place, the records should be handed over to a suitable archive, by negotiation.
The files should be protected against fire and theft. The records should be prepared on the assumption that they may be required as evidence in some future claim against the employer for negligence in Civil Law.

The records should include:

(1) A list of registered users, with their names, I.D. or Passport No., date of birth, sex, status, number, and previous exposure of each registered worker.

(2) A register of all carcinogens in stock and of all accessions and issues from stock.

(3) Details of each issue with the name(s) of the person(s) who will use the compound and the quantity supplied. N.B. Only approved users may be issued with carcinogens.

(4) Copies of safety assessments and any written departmental rules etc.

(5) Records of any inquiries into mishaps.

The records should be reviewed annually and copies sent to the Safety Office for safe keeping.

3.7.4 Basic rules for using carcinogens

(1) Carcinogenic chemicals should not be used for purposes for which a satisfactory non-carcinogenic substitute is available. Higher cost of substitutes is not a justifiable reason to continue using carcinogens.

(2) All work using known carcinogens should be justified by the importance of the experiments or procedure. When the use is justified then the scale of use should also be justified. Any novel compound with a molecular structure closely related to that of a human carcinogen should be treated, in the absence of any information to the contrary, with the same caution which would be employed with the known carcinogen.

(3) Work with carcinogens should be done only by persons who:
   (a) Are aware of the hazardous properties of the substance(s)
   (b) Are suitably experienced personnel
   (c) Have been instructed in appropriate techniques
   (d) Are aware of the necessary precautions

(4) New or unfamiliar techniques should be practiced using a non-carcinogen before commencing work with the carcinogen(s), with due regard to any rules or regulations on work with animals.

(5) The use of carcinogens for teaching purposes should be avoided. If their use in a teaching procedure is unavoidable, the need and conditions of use must be reviewed annually by the Head of Department.

   Before using carcinogens in undergraduate teaching the written agreement of the Chairman of the EHS committee must be obtained, through the Safety Office by the Head of Department.

(6) Carcinogens should be handled only in suitable, designated areas with adequate equipment for their containment. A designated area for handling a significant amount of a carcinogen may be either:

   (a) An appropriately equipped laboratory designated for this purpose.

   (b) A fume cupboard or ventilated enclosure of approved design designated for the purpose and appropriately labelled. Designated areas may be marked as either, a "controlled area", or a "supervised area" in consultation with the Safety Officer. This marking will be made by analogy with the Radiation Safety Policy of HKU with a view to restricting access to the areas concerned.

(7) If it is inevitable that small samples of carcinogenic materials are taken to non-designated areas; e.g. for specialized analysis. The same stringent precautions should be observed in respect of labelling, handling, containment, decontamination and waste disposal as are required in designated areas.

(8) Work with carcinogens, including the disposal of wastes must be conducted according to WRITTEN operating procedures in accord with the safety assessment.

(9) Carcinogenic chemicals should be kept segregated from other chemicals in a locked cupboard clearly labelled "Chemical Carcinogens". Keys should be held only by designated persons.

(10) Work with laboratory animals should be conducted under total containment conditions, and appropriately licensed (see below). If total containment is impossible that work cannot proceed without the written agreement of the Chairman of the EHS committee obtained through the Safety Office.

3.7.5 Control measures

Exposure

It is particularly important that exposure be kept to as low level as is reasonably practicable, bearing in mind that the level of exposure affects only the probability of cancers occurring.

Entry of carcinogens into the body can take place by inhalation, ingestion, penetration of the skin, mucosal surfaces or by contamination of the eyes.

Protective clothing.

(a) Suitable and sufficient protective clothing should be specified and worn at all times. Protective clothing must be disposable. Items which have become contaminated and are not disposable must be decontaminated by approved workers before being removed from the designated area. Contaminated clothing must not be sent for laundering.

(b) *Any procedure which causes contamination of protective clothing is unsatisfactory and must be improved*.

(c) Protective clothing which has been worn whilst working in a designated area is potentially contaminated and must not leave the designated area except for disposal.

Personal hygiene

(a) No eating, drinking, smoking or applying of cosmetics is permitted in any laboratory.
(b) The use of mouth operated equipment is strictly forbidden.

(c) Any exposed cut or abrasion of the skin must be sealed with an appropriate surgical dressing before commencing work or donning protective clothing.

(d) Hands should be washed with lukewarm rather than hot water and dried with disposable towels on the completion of work.

Waste disposal

(a) Methods of waste disposal and decontamination must be determined before work commences and be set out in the safety assessment.

(b) Decontamination methods used for experimental residues and glassware should ensure complete chemical conversion into non-carcinogenic substances.

(c) Contaminated combustible material should be placed in sealed plastic bags, labelled appropriately, and disposed of by high temperature incineration or other approved method.

Equipment

So far as is practicable, equipment which may become contaminated with a carcinogen should be restricted to this use only and should be appropriately labelled. Written instructions for cleaning and decontamination must be prepared. Decontamination must be the responsibility of the user.

Washing-up

Written instructions must be prepared setting out procedures to be followed for washing-up. Only named persons trained for the task may be employed in washing-up potentially contaminated equipment. The training must ensure that proper information and instruction has been given and understood. Employing someone other than the user to wash up is highly undesirable.

3.7.6 Operations considered involving higher than average risks

This list is NOT to be regarded as definitive and may be extended in the light of individual experience and knowledge.

(1) Any process which can produce aerosols or vapour containing a carcinogen.

(2) Procedures such as distillation, crystallization, filtration, electrophoresis, chromatography using carcinogens or in their synthesis.

(3) Manipulations of solid carcinogens likely to result in dust formation, e.g. preparation of animal diets containing carcinogens.

(4) Storage and manipulation of carcinogen gases, volatile carcinogens and compounds that decompose spontaneously evolving carcinogens.

(5) Weighing of carcinogens and the preparation of solutions containing them.

(6) Static electricity particularly during dispensing.

(7) Recovery of carcinogens from TLC plates.

(8) Changing traps and exhaust filters.

(9) Husbandry of animals treated with carcinogens.

N.B. Concern over the long term hazards of carcinogens must not be allowed to divert attention from the precautions essential for protecting against the immediate hazards of acute toxicity, fire, etc.

3.8 RADIATION SAFETY

In accordance with the provisions of section 15(1) of the Radiation Ordinance, Cap. 303, exemption from the provisions of the Radiation Ordinance and Regulations is granted to the University in respect of the use of radioactive substances and radiation producing equipment for teaching and research purposes only. Such

exemption imposes certain responsibilities on the University including the employment of a Radiological Protection Officer who will ensure that the premises, working conditions, personnel supervision, record keeping, etc. are in compliance with the legal requirements. Therefore the University Radiological Protection Officer (URPO) is responsible through the Radiological Protection and Service Committee of Management (RPSCM) to the Vice-Chancellor and the Council for all aspects of radiation safety within the University. Heads of Departments are responsible for radiation safety within their departments; a Departmental Radiation Safety Representative (DRSR) may be appointed by the Head to assist in this duty. Designated Radiation Workers (DRW) are responsible for their own work and for others in their charge, and must ensure that all of the protection and safety practices are observed.

For use of radiation/radioactive substances for clinical purposes, a separate licence will have to be obtained from the Government Radiation Board for the following categories:-

(1) To possess and use radioactive substances for clinical purposes.

(2) To possess irradiating apparatus for clinical purposes (separate licence for each and every apparatus).

(3) To use irradiating apparatus on human body (one licence for each qualified member of staff).

3.8.1 General Information

Access to all Controlled Radiation Areas/radiation producing equipment is strictly prohibited unless permission has been granted by the URPO or the DRSR in the case of maintenance service, etc.

Those who work in approved Controlled Radiation Areas or work with radiation producing equipment must apply for designation on the appropriate form, available from the Radioisotope Unit (RIU) office in Room 319, James Hsioung Lee Building (Tel. 2859 2547).

Granting of designated status is not automatic and it may be necessary for applicants to attend a short training course and/or take a test on Radiological Protection. When designation is granted, it normally relates to a specific project with an approved scheme of work to be carried out in named premises. A personnel radiation monitoring device (PRMD) will be issued in those cases where such monitoring is appropriate. Costs for these devices are chargeable to departmental budgets.

<u>Requisitions for Radioactive Materials</u>

All orders for radioactive materials must be approved by the URPO before dispatch to the supplier. This approval is normally granted immediately provided that:-

(1) each item is identified for use by a designated worker
(2) Its specification is within the approved scheme of work
(3) All designation conditions have been met

Goods received without such prior approval may not be released to the department concerned.

Requisitions may be sent direct to the RIU for approval and onward transmission to the Finance Office. Radioactive materials require an import licence and all requisitions should be marked "*Import Licence Required*".

For radioactive goods not consigned to a local agent, the items will be collected from the airport by RIU staff using a designated vehicle. Information concerning such incoming shipments should be given to the RIU with shipment details and expected delivery date and time as early as possible.

Gifts or samples of radioactive materials brought by hand into Hong Kong or posted directly to a department are subject to confiscation by the Customs service. Should such materials reach University premises they must be reported immediately to the URPO for appropriate action.

Radioactive Waste Disposal

All radioactive waste shall be collected in approved and labelled containers under conditions determined by the URPO. A waste collection service is available from the RIU. It is the responsibility of the user to keep proper records of the nature and content of the waste material in each container and to inform the Unit when collection is required. Appropriate forms may be obtained from the Unit. *Radioactive waste MUST NOT be discharged into sewers or normal rubbish bins*. The URPO shall take measures to monitor waste disposal.

Laboratory Monitoring

Each controlled area is required to install and operate an appropriate radiation monitor for the work performed therein unless exempted by the URPO. Additionally, air-sampling and surface monitoring will be carried out by RIU staff. In the event of significant contamination being located, the persons registered for work in the area are required to undertake the necessary decontamination procedures and to introduce precautions to minimize future similar occurrences.

Working Rules

Each laboratory generally requires its own set of rules and guidelines which will be provided by the URPO.

3.8.2 Responsibilities of University employees and students

Responsibilities of the University Radiological Protection Officer

(1) To be responsible to the Vice-Chancellor and Council through the RPSCM for all aspects of radiation safety within the University.
(2) To ensure that the provisions of the Radiation Ordinance, and the regulations made under it, are complied with.

(3) To control:-

  (a) All acquisitions and uses of radioactive substances and radiation producing equipment.
  (b) Disposal of all radioactive waste and radiation producing equipment.

(4) To provide advice on radiological protection.

(5) In consultation with the Director of the University Health Service, to classify radiation workers and to determine and/or to provide the required protection and monitoring procedures.

(6) To supervise, administer, regularly examine and report as necessary to Council, through the RPSCM, on the arran protection and personnel monitoring.

(7) To maintain adequate records of:-

(a) The types and quantities of radioactive substances and radiation producing equipment held in the University and of their fates.

(b) The persons exposed to radiation and the doses of radiation received.

(8) To report through the RPSCM to Council for information, and action where necessary, on any particularly hazardous operation proposed, with recommendations for special precautions.

Responsibilities of Heads of Departments

To be responsible for all aspects of radiation safety within their departments.

Responsibilities of Departmental Radiation Safety Representatives

(1) To be responsible for the issue and proper use of monitoring devices.

(2) To ensure that records are kept of the usage of radioactive substances.

(3) To supervise the preparation of radioactive waste for collection.

(4) To provide advice to the Head of Department on departmental radiation hazards and to liaise with the URPO.

(5) To inform the URPO of any changes of DRWs.

(6) To inform all staff and students within the department of departmental radiation matters.

Responsibilities of Designated Radiation Workers

(1) To comply with all requirements and conditions associated with designation.

(2) To ensure that radiation exposure to all persons (including oneself) is kept as low as reasonably achievable (ALARA principle) and in any case below the current dose equivalent limits recommended by the International Commission on Radiological Protection (ICRP).

(3) To participate in the medical surveillance and personnel monitoring arrangements. (Failure to take the necessary examinations on schedule may lead to suspension of designation.)

(4) To maintain records of the usage of radioactive substances.

(5) To report herself immediately to a doctor in the University Health Service in case of pregnancy or suspected pregnancy.

(6) To inform the DRSR and URPO immediately of any change in the nature of work.

(7) To inform the DRSR and URPO as early as possible prior to termination of radiation work or resignation.

(8) To report immediately to the DRSR and URPO any untoward incidents which may introduce a radiation/contamination hazard.

General Responsibilities of All University Personnel

(1) To familiarize themselves with University radiation safety regulations.

(2) To refrain from unauthorized radiation work and/or entry to Controlled Radiation Areas.

(3) To report all suspected radiological accidents and any irregularities in radiological protection services to the departmental or section head.

(4) To suggest improvements for radiation safety to the URPO.

Abbreviations

DRSR	Departmental Radiation Safety Representative
DRW	Designated Radiation Worker
PRMD	Personnel Radiation Monitoring Device
RIU	Radioisotope Unit
RPSCM	Radiological Protection and Service Committee of Management
URPO	University Radiological Protection Officer

3.9 GUIDELINES FOR HANDLING AND STORAGE OF COMPRESSED GASES

3.9.1 General

(1) Only experienced and properly instructed persons should handle compressed gases.

(2) Observe all regulations and local requirements regarding the carriage and storage of cylinders.

(3) Do not remove or deface labels provided by gases supplier for the identification of the cylinder contents.

(4) Ascertain the identity of the gas before using or transporting it.

(5) Know and understand the properties and hazards associated with each gas before using it.

(6) Before using or transporting compressed gases, establish plans to cover any emergency situations that might arise.

(7) When doubt exists as to the correct handling procedure for a particular gas contact gases suppliers.

(8) If you own your cylinders you must be aware of your statutory obligations with regard to maintenance and testing.

3.9.2 Handling and use

(1) Wear stout gloves.

(2) Never lift cylinder by the cap or guard, unless supplier states it is designed for that purpose.

(3) Use a cylinder trolley or other suitable trolley for transporting cylinders even for a short distance.

(4) When valve protection guards are fitted, leave them in place until the cylinder has been secured against either a wall or bench or placed in a cylinder stand or trolley and is ready for us.

(5) Check for gas leaks using approved leak detection solution.

(6) Ascertain that an adequate supply of water is available for first aid and/or fire fighting in the event of leakage.

(7) Employ suitable pressure regulating devices on all cylinders when the gas is being emitted to systems with a lower pressure rating than that of the cylinder.

(8) Before connecting the cylinder for use ensure that back feed from the system into the cylinder is prevented.

(9) Before connecting cylinder, check the complete gas system for suitability, particularly for pressure rating and materials.

(10) Never permit liquefied gas to become trapped in parts of the system as this may result in hydraulic rupture.

(11) Ascertain that all electrical systems in the area are suitable for service with each gas.

(12) Never use direct flame or electrical heating devices to raise the pressure of a cylinder. Cylinders should not be subjected to temperatures above 45°C.

(13) Never re-compress a gas or a gas mixture from a cylinder without consulting the supplier.

(14) Never attempt to transfer gases from one cylinder to another.

(15) Do not attempt to increase liquid draw-off rate by pressurizing the cylinder without first checking with the supplier.

(16) Do not use cylinders as rollers or supports, or for any other purpose than to contain the gas as supplied.

(17) Never permit oil, grease or other readily combustible substances to come into contact with valves of cylinders containing oxygen.

(18) Keep cylinder valve outlets clean and free from contaminants, particularly oil and water.

(19) Do not subject cylinders to abnormal mechanical shocks which may cause damage to their valves or safety devices.

(20) Never attempt to repair or modify cylinder valves or safety relief devices. Damaged valves should be reported immediately to the supplier.

(21) Close the cylinder valve whenever gas is not required even if cylinder is still connected to equipment.

3.9.3 Storage

(1) Cylinders should preferably be stored in a purpose built compound which should be well ventilated.

(2) Store cylinders in location free from fire risk and away from sources of heat and ignition.

(3) The cylinder storage compound should be kept clear and access should be restricted to authorized persons only. The compound should be clearly marked as a cylinder store and appropriate hazard warning signs displayed (e.g. flammable, oxidant, compressed gas etc.).

(4) Smoking and the use of naked flames either inside or in the vicinity of the cylinder storage area should be prohibited. A notice to this effect in English and Chinese, should be conspicuous by displayed outside the store.

(5) Cylinders should be stored in the vertical position and properly secured to prevent toppling. The cylinder valves should be tightly closed and where appropriate valve outlets should be capped or plugged. When cylinder is fitted with valve guards or caps, there should be in place and properly secured.

(6) Protect cylinders against rusting. It is advisable to stand cylinders on open galvanized steel grid work to reduce corrosion of the cylinder base.

(7) Store full and empty cylinders separately and arrange full cylinders so that the oldest stock is used first.

(8) Gas cylinders should be segregated in the storage area according to the various categories (i.e. toxic, flammable, etc.).

(9) Cylinders containing oxygen and oxidants should be separated from those containing flammable gases.

(10) Do not mix cylinders in the cylinder store. Store full cylinders of different gases separately, each in a well-marked place.

(11) The amounts of flammable or toxic gases in storage should be kept to a minimum.

(12) Cylinders containing flammable gases should be stored away from other combustible materials.

(13) Cylinders held in storage should be periodically checked for general condition and leakage.

3.9.4 Carriage

(1) Make sure that the driver who carries cylinders in a vehicle; particularly flammable and toxic gas cylinders, has been properly instructed in the method of handling and loading cylinders, in dealing with any emergency and carries the required information, including the HKO Data and Safety Sheet.

(2) Closed vehicles may be used to carry small quantities of cylinders if well ventilated.

(3) Ensure cylinders are properly secured on the vehicle and that propane cylinders are kept upright during carriage.

3.10 GUIDELINES FOR HANDLING AND STORAGE OF LIQUID NITROGEN

The potential hazards in handling liquid nitrogen arise from its important properties:

(1) It is extremely cold.

(2) The rate of conversion into gas is high i.e. small amounts of liquid can be converted into a very large volume of gas in a short duration.

The following general precautions have been devised to avoid any potential injury or damage resulting from these two properties.

Points to be Considered When Keeping Stock of Liquid Nitrogen

(1) Use only containers designed for holding low-temperature liquids.

(2) Use only the stopper supplied with the container.

(3) Where a special vented stopper/container is used, check the vent at regular intervals to make sure it is not plugged with ice.

(4) Do not move a container by "walking" or rolling on its lower rim.

(5) If a glass dewar flask is used as a container of small quantities of liquid nitrogen, the exposed glass part of the flask should be taped to minimize the flying glass hazards in case of implosion or explosion.

(6) If a domestic thermos flask is used as container of small quantities of liquid nitrogen, the integrity of the plastic sealing ring of the thermos should be checked regularly to ensure that no liquid nitrogen can get into the space between the thermos and the outside container.

(7) Never plug small containers of liquid; cover them with aluminum foil or cotton when not in use to prevent an accumulation of moisture and plugging of the outlet with ice.

(8) Make sure that there is no heat source near the container.

3.10.1 Points to be considered when handling liquid nitrogen

(1) Always handle liquid nitrogen in well-ventilated areas to prevent excessive concentration of nitrogen causing asphyxiation.

(2) Avoid contact with the liquid nitrogen directly. Always wear gloves (leather or CRYO-GLOVES) when handling anything that is in contact with liquid nitrogen.

(3) Protect your eyes with safety spectacles with side shields, safety goggles or face shield. Eyes can be damaged even by the cold gas issuing from liquid nitrogen.

(4) When charging a warm container or when inserting objects into the liquid, perform the operation slowly to minimize boiling and splashing.
(5) Use tongs to withdraw objects immersed in liquid

(6) Do not expose liquid nitrogen to the air to minimize condensation of oxygen from air.

3.10.2 First Aid procedure

(1) If any liquid nitrogen contacts the skin, remove any clothing that may constrict blood circulation to the frozen area. Immediately warm the areas affected by frostbite with water that is near room temperature.

(2) If the skin is blistered, or there is any chance that the eyes have been affected, get the affected person to a physician immediately for treatment.

3.11 BIOLOGICAL CONTAINMENT

When a laboratory involved in biological experiments has been classified, it should be provided with the corresponding level of containment. The Department in control of the laboratory is responsible for the provision of the containment and advice can be sought from the Safety Office on details of containment required for the laboratory.

Containment levels have four components, namely: standard laboratory practices, special laboratory practices, safety equipment (primary barrier), and laboratory facilities (secondary barrier).

There are four containment levels each of which corresponds to equivalent bio-hazard classification. For example, Containment Level 1 is for bio-hazard class 1 laboratory, Containment Level 2 is for class 2 laboratory, and so on.

Only details of Containment Level I to 3 can be obtained from Safety Office as the use of Bio-Hazard Class 4 organisms is banned in the University for safety reasons.

The Laboratory-in-charge is responsible to ensure that materials containing organisms belonging to higher bio-hazard classes are not to be used in laboratories designated as having lower bio-hazard classification.

The provision of information to the laboratory-in-charge on the bio-hazard classification of the materials employed in the experiments is the responsibility of the personnel in-charge of the experiments or investigation. In case of violation, the laboratory-in-charge may take appropriate actions including removal of bio-hazardous materials away from the laboratory.

3.11.1 Disinfection, sterilization & decontamination methods

Disinfection Methods

Chemical disinfectants should be used to disinfect work benches and equipment after use. The frequencies of disinfection would depend on the hazardous materials handled in the laboratories.

In chemical disinfection, concentration of the disinfectant and contact time are the most important factors that affect the efficiencies of the disinfectants. Advice should be sought from infection control experts on the appropriate type of methods employed for disinfection in individual experiments in particular or work in general.

Chemical disinfectants may be in one or more of the following forms:

Sodium Hypochlorite

This chemical is known to be effective against HIV and Hepatitis B virus.

Solution with 0.5% strength (5,000 ppm of available chlorine) should be effective in disinfecting, surfaces confirmed with contamination by blood or body fluids. The contact time should be at least 10 minutes. The use of such disinfectant may generate a smell of chlorine within the laboratory. Although the level of chlorine should be of no concern to the health of the personnel, it is recommended that air extraction devices in the laboratory should be switched on during the use of the disinfectant to prevent the built-up of gas over long soaking periods.
For surfaces (work benches, floor, walls etc.) and equipment suspected to be soiled, a 0.05% strength solution should be used. In most cases, it is not required to switch on the air extraction devices in the laboratory when this strength of sodium hypochlorite solution is in use.

Hypochlorite solution-should be prepared fresh daily to maintain the level of chlorine in the solution. It is important that the solution should be prepared inside fume cupboards and the personnel responsible for this process must put on appropriate personal protective equipment and follow safety precautions.

Glutaraldehyde Solution

A 2% glutaraldehyde solution may be used for disinfecting equipment in closed containers because of the hazardous nature of its vapour. A glutaraldehyde solution should not be used to disinfect open benches and work surfaces unless the laboratory is well-ventilated by natural means.

Personnel using a glutaraldehyde solution must have appropriate personal protective equipment including neoprene gloves, respirator, aprons and splash guards.

Ethanol

A 95% strength ethanol may be used for disinfection. However, a longer contact time is required for ethanol since it is not very effective on a Hepatitis virus.

Also, ethanol is volatile and flammable and all naked flames must be removed and electrical appliances cut off when this disinfectant is being used.

Iodine

Iodine dissolved in 70% ethanol may also be used for disinfection. The same limitation and precautionary measures as described above also applies to iodine.

Formaldehyde

Unless absolutely necessary, the use of formaldehyde solution, also known as formalin, as a disinfectant is not advisable since the chemical is proven to pose significant health hazards to personnel.

Personnel who need to use formaldehyde for disinfection must seek advice from the Safety Office before using this chemical.

Other Disinfectants

Personnel can seek advice from infection control experts in choosing the best disinfectants suitable for their work. On occasions, personnel are responsible to obtain relevant material safety data sheets (MSDS) of the disinfectants from the suppliers. The information on the MSDS must be studied in detail before designing appropriate procedures in the laboratory. The staff of the Safety Office should be consulted on issues concerning safety precautions and procedures for uses.

3.11.2 Sterilization

Sterilization is performed in autoclaves in most laboratories. This process has the advantage of simplicity, cleanliness and is chemical-free.

However, autoclaves fall into the categories of pressure equipment which, by law, require a licence before it is used. Hence, user departments must obtain the relevant licences or appropriate exemptions for their equipment from the Labour Department. Personnel who wish to apply for licences or exemptions for their pressure equipment may seek advice from the Safety Office.

3.11.3 Decontamination

Sterilization and disinfection are two forms of decontamination.

As safe laboratory practice, liquid cultures are required to be decontaminated before disposal. Instruments should also be decontaminated before being washed and sterilized for reuse. This can be achieved by one or more of the above methods and should be the responsibility of the Laboratory-in-charge.

3.12 GENETICALLY MODIFIED ORGANISMS

3.12.1 Introduction

The Genetically Modified Organisms (Control of Release) Ordinance, Cap.607, and its subsidiary legislation, the Genetically Modified Organisms (Documentation for Import and Export) Regulation (the Regulation), commenced on 1 March 2011. The Ordinance and the Regulation give effect to the Protocol to the Convention in Hong Kong and control the release into the environment and the transboundary movements of GMOs, and provide for related matters.

GMOs are defined as living organisms that possess a novel combination of genetic material obtained through the use of modern biotechnology (e.g. recombinant DNA technology). GMOs cover a variety of food crops (such as BT corn, anti-frost tomatoes and herbicide-tolerant soya beans), GM seeds, GM fish, GM flowers, etc. However, GMOs do not include non-living food products produced from GM crops, such as corn oil, soymilk and polished rice. Living organisms with genetic material altered through traditional breeding and selection techniques (e.g. hybrid rice and golden sweet corn) are also not GMOs.

The Ordinance establishes a mechanism for applying to the Agriculture, Fisheries and Conservation Department for prior approval of a GMO for release into the environment and requires that shipments containing GMOs, when being imported or exported, have to be accompanied by prescribed documents. Detailed documentation requirements are laid down in the Regulation

3.12.2 Genetically Modified Organisms (Control of Release) Register

A Biosafety Clearing-House is established under Article 20 of the Protocol as part of the clearing-house mechanism under Article 18 of the Convention, in order to facilitate the exchange of scientific, technical, environmental and legal information on, and experience with, GMOs; and to assist Parties to implement the Protocol.

This GMOs Register is developed for the implementation of the Protocol and to cater for the requirements of the Biosafety Clearing-House. The register contains non-confidential information on applications received (including information and documents received in support of applications), decisions made, exemptions granted, and any other information relating to the enforcement of the legislation, including the risk assessment reports received.

In this Register, you can find out what controls are ordained by the Ordinance (Controls of the Ordinance), the guidelines on how to comply with the controls (Guidelines for GMO Approval Application and Guidelines for Documentation Requirements), application forms (Downloadable Public Forms) and information on GMOs in Hong Kong and the international market (Education and Publicity).

For the detail of the Ordiance, please refer to the home page of the Agriculture, Fisheries and Conversation Department (http://www.afcd.gov.hk/english/conservation/con_gmo/con_gmo.html).

4 ELECTRICAL FAULTS

4.1 ELECTRICITY HAZARDS

Electrical injuries caused by contact with or exposure to live electrical conductors

(1) Electric shock
(2) Indirect injury
(3) Electrical burns
(4) Fire of electrical origin
(5) Explosions

4.1.1 Electric shock

Electric shock is the physical stimulation that occurs when electric current passes through the body. The effect depends on

(1) The magnitude of the current
(2) The body parts through which the current flows
(3) Duration
(4) AC or DC
(5) AC frequency
(6) Physical condition of the person being shocked

Nervous System of Human Body

(1) Controls all movements, both conscious and unconscious.

(2) The nervous system carries electrical signals between the brain and the muscles, which are thus stimulated into action .

(3) The signals are electrochemical in nature, with levels of a few millivolts.

(4) When the human body becomes part of a much more powerful external circuit, its normal operations are swamped by the outside signals.

Electrical Impedance of Human Body

(1) Human body is composed largely of water, and has very low resistance

(2) Most of the resistance to the passage of current through the human body is at the points of entry and exit through the skin

(3) Internal impedance - depends on:
   (a) The length and cross sectional area of the path
   (b) Conductivity of the tissues in the path

(4) Skin impedance - depends on
   (a) Surface area of contact
   (b) Pressure of contact.
   (c) Degree of moisture on the skin
   (d) Applied voltage (at high voltage, skin breaks down)
   (e) Duration of current flow (the flow of current cause the victim to sweat, reducing the resistance very quickly after the shock commences)

Threshold of Perception

(1) Is the minimum value of current which results in a sensation for person in contact with the touch voltage.

(2) Usually assumed as 0.5 mA.

Electric Shock

(1) Thresholds of perception depends on skin impedance and other factors with increasing current, the sensations of tingling will result in contractions of muscles and finally loss of voluntary control.

(2) When current exceeds the "Let-go Current", one cannot release his grasp of the conductor due to involuntary muscular contractions.

(3) Typical let-go thresholds for men:
(a) direct current - 75 mA
(b) 5OHz AC - 15 mA
(c) 1O,OOOHz AC - 75 mA

Direct current produce sensations of internal heating rather than severe muscular contractions.

(4) Current exceeding the "Let-go Current" and flowing through the chest, head or nerve centers controlling respiration may produce respiratory inhibition.

(5) Further increase in current will produce overstimulation in the heart (ventricular fibrillation). The normal rhythmic expansion and contraction of the heart muscles is disturbed. The pumping action ceases, and death usually follows within minutes.

(6) Very high current will cause severe burning, resulting in serious injury and even death.

(7) The protective devices should cut off the supply to prevent shorting. Socket outlet circuits should be cut off within 0.4 s and fixed equipment within 5 s.

Effect of Direct Current

(1) Higher values of DC than the AC value are required to produce the same effect
(2) Many effects of DC occur only when DC current is made or broken

Effect of Higher Frequency Alternating Current

The body is less sensitive to electric current as frequency increases. The insensitivity at high frequencies is utilized in medical applications, where the heating, effect is used in electro-surgical procedures for cutting and cauterizing in operations

4.1.2 Indirect injuries

Accidents may be caused by involuntary muscular movement. For example:
(1) Falling from a ladder due to loss of balance
(2) Not-let-go effect by grasping more tightly the conductor
(3) Thrown away by powerful muscular contractions

4.1.3 Burns due to electric faults and arcing

Low Voltage Contact Burns

(1) Due to heating effect of electric current passing through the body tissues burns destroying the protective resistance of the epidermis, thereby permitting greater currents to flow.

(2) For radio frequency systems, direct contact for heating is not required. Burns may take place deep within the body and possibly without the sensation of electric shock.

High Voltage Burns

(1) The capacitance layer represented by the skin is punctured by the high voltage and significantly lowers the body resistance.

(2) The current increases proportionally to the touch voltage and the heating effect increases as the square of the current. This results in burns along the current path and damage to internal body organs.

(3) Severe burning effects occur when current level is 4-5 Amps.

(4) A portion of the current flows over the skin surface (aided by moisture on the skin) and the other path is through the body interior.

Radiation Burns

(1) Result from high temperature produced by electric arc, vaporized metals, hot gases released by the arc, overheated conductors, etc.

(2) Typical electric arc temperature is 8000 – 10000℃ (combustible flame temperature is about 1000 ℃). It produce intense radiation fields which have a peak in the short wavelength (ultraviolet) region.

(3) This radiation can cause severe burns to any personnel in the immediate vicinity of high current arcing faults.

4.1.4 Electrical arcing

(1) Takes place when current flows through air or insulation between conductors at different potentials.

(2) Current path becomes conducting due to ionization of the gas (air).

(3) Severity of burn increased because of molten metallic particles (typically at a temperature of about 2000℃.

(4) Arc will also release very large quantities of energy in the ultraviolet part of the E&M spectrum.

Discharge Faults

Discharge faults can be initiated by:
(1) Insulation contamination or thermal degradation (tracking discharge)
(2) Contact overheating
(3) Dielectric breakdown

(4) Separation of contacts

4.1.5 Fires of electrical origin

(1) Overheating of conductors

(2) Current leaking

(3) Overheating of adjacent flammable materials

(4) Ignition of flammable materials as a result of electric arcing or of scattering of hot particles due to explosion

(5) Combustion of electrical cable insulation often gives off toxic fumes, particularly polymeric insulation such as polyvinyl chloride (PVC)

Fire due to Short Circuit

(1) A short circuit current of 100 times the normal current value will increase the heat dissipation by 10,000 times (power = I^2R). If the current is not cleared quickly, the temperature of the conductors will rise and ignite.

(2) The normal short circuit current will be high enough to operate the protective devices.

(3) Under high resistance short, the current may be less than the normal load and therefore too low to operate the protective devices. The fault will persist and may cause arcing and ignition of the insulation system.

(4) With high resistance developed in the conductors' terminals due to loose connection or corrosion, the power absorbed by the connection may be high enough and result in arcing or ignition of the insulation. Because the current is normal, the protective device cannot detect this type of fault.

4.1.6 Explosions

When an electric arc occurs, it superheats the air instantaneously, this causes a rapid expansion of the air with a wavefront that can reach pressures of 100 to 200 lb/ft^2. Such pressure is sufficient to explode switchgear, turn sheet metals into bullets, push over concrete walls and blow molten metal at extremely high velocities

4.2 LINES OF DEFENCE AGAINST ELECTRIC SHOCK

Three lines of defence occur in a typical installation:

(1) The current carrying live circuit is insulated (by functional insulation). Failure of the insulation due to damage or aging can result in direct contact.

(2) The appliance frame is either

   (a) Earthed - to limit the touch voltage in the event of fault, the low impedance earth will normally cause protective device to operate.

   (b) Double insulated - which provides a protective insulation as a backup in the event of failure of the functional insulation.

(3) Resistance of footware and floor coverings will increase the overall shock path resistance.

4.2.1 Examples of failure of defence systems

(1) Earth wire in an appliance cord broken or disconnected
(2) Cross connected extension cords
(3) High resistance electrical system earth
(4) Presence of moisture

4.2.2 Prevention of electric shock

Prevent or limit shock by:
(1) Preventing a dangerous potential difference from being applied across the body
(2) Increasing the resistance of the current path

Basically there are three categories of protection
(1) Protection against direct contact
(2) Protection against indirect contact
(3) Switching off and isolation

4.3 DIRECT AND INDIRECT CONTACT

4.3.1 Direct contact

Contact with a conductor which forms part of a circuit and would be expected to be live

Protection Against Direct Contact

(1) Protection by Insulation of Live Parts.

(2) Protection by Barriers or Enclosures. Select equipment with suitable degree of protection (IP) to withstand the ingress of solid objects and liquids.

(3) Protection by Obstacles.

(4) Protection by Residual Current Devices.

4.3.2 Indirect contact with exposed conductive part

Contact with a part of the electrical installation which would not normally be expected to be live, but has become so as the result of a fault. e.g. metallic casing of the appliance

Protection Against Indirect Contact

Protection by Earthed Equipotential Bonding and Rapid Isolation of Supply

(1) The earth connects the metallic components of the equipment or system which are not normally part of the current carrying electrical conductor system. It provides a low resistance path back to the power source.

(2) Equipotential bonding involves connecting together all non-current carrying metalwork to form a zone within which it is not possible for exposed metalwork to be at different voltage levels which could cause a shock (i.e. to create an earthed equipotential zone).

(3) Need to bond together all exposed conductive parts and extraneous conductive parts. Within the zone there is no danger because in the event of a fault the protective system cuts off the supply within a safe time.

(4) Earthing, provides two safety functions:
   (a) The low resistance limits the touch voltage of bare metal which may become live if there is an insulation failure.
   (b) It provides a reference for fault current. The low and stable earth resistance generates high fault current which will operate the protective device quickly.

(5) Errors associated with earthing:
   (a) Incorrect wiring
   (b) Mechanical failure - may cause disconnection of earth
   (c) High resistivity soil
   (d) High contact resistance - caused by loose connection or corrosion

Protection by Double Insulation

(1) Human error and mechanical failure of earthing cannot occur if there is no earth.

(2) Remove the earth and replace by added layer 6-f insulation, i.e. a functional layer plus a protective layer of insulation.

(3) Double insulated appliance has no earth connection.

Protection by Separation (Isolation Transformer)

(1) Electric shock require two conditions :
   (a) A current path flow back to the power source via the body
   (b) The voltage is high enough to drive the current

(2) By using an isolating transformer with both primary and secondary windings well insulated, the direct current path from live conductor to the power source is cut off.

Use of Extra-low Voltage

(1) Use central tap earthed step down transformer to limit the supply voltage. e.g. an 110V transformer will has 55V live to earth voltage.

(2) Need to use double pole switches and fusing in both live poles of the supply.

(3) It is particularly useful for portable equipment.

(4) In wet environments use a maximum of 25 volts.

(5) Has limitations on appliance operation.

4.3.3 Indirect contact with extraneous conductive part

Contact with a conducting part which is totally unconnected with the electrical installation, but which has become live as the result of a fault. e.g. window frames, shower curtain rails, water pipes.

Switching Off and Isolation

A basic safety requirement for maintenance and modification operations on electrical installation.

Carelessness is the prime cause of accidents:
(1) Not checking that the installation is electrically dead
(2) Inadvertent energisation by other personnel
(3) Failure to discharge energy storage capacitors
(4) Inadvertently knocking a control handle to start equipment
(5) Dropping of tools onto bare, live busbars

To avoid these accidents, we need to switch off and isolate the portion of installation and equipment under repair . An isolator must:
(1) Be in an accessible position
(2) Have the control circuits and systems clearly marked
(3) Be protected from unauthorized or unexpected reclosing
(4) Be lockable
(5) Completely separate the system or circuit from the source of supply

Switching Off

Breaking of normal load current.

Isolation

(1) Cutting the already dead circuit
(2) Ensure a definite break of all live conductors

Need to test the circuit to ensure that it is dead.

4.4 PORTABLE APPLIANCES

More than 25% of electrical accidents at work involve portable electrical appliances. The appliances should be inspected and tested periodically. The frequency depends on the type of appliance and its usage.

4.4.1 Inspection of portable appliances

Look for:
(1) Damaged flexible cords with exposed live cables or failure of protective conductor
(2) Damage to plugs
(3) Damage to appliance and exposed live conductors
(4) Failure of cord grip
(5) Wrong connection
(6) Other visible damage
(7) Blocked ventilation for equipment
(8) Adjacent flammable materials
(9) Sign of equipment overheating

(10) Ingress of foreign materials

4.4.2 Maintenance

The installation may deteriorate due to normal aging, may have substandard additions installed, or may be damaged. Preventive maintenance is required to

(1) Ensure the initial safely level of a system is maintained
(2) Make early detection of faults or deterioration of system performance
(3) Keep proper keeping records to allow comparison of results and performance

4.5 SAFE WORKING PROCEDURES

4.5.1 Working dead

(1) Switch off
(2) Isolate
(3) Post warning notices
    (a) Prevent reclosing
    (b) Inform other people to stay away from the work
(4) Lock off
(5) Test
(6) Earth - prevent shocks if circuits have been charged

4.5.2 Live working

Precautions to be observed:
(1) Only involve fully trained and competent persons
(2) Use suitable equipment, protective clothing and insulated tools
(3) Gather information concerning the task and the system
(4) Provide with insulating screens and barriers
(5) Provide notices with details of emergency resuscitation
(6) The working area must be properly controlled
(7) Never work alone. Workers should be accompanied by at least one other who will be able to apply rescue and resuscitation techniques or to call for help in case of accident

5 EQUIPMENT SAFETY

5.1 USE OF AUTOCLAVE (BOILER, PRESSURE VESSELS, STEAM RECEIVERS)

Under the Boilers & Pressure Vessels Ordinance Cap. 56., operators of boilers, pressure vessels, steam receivers, etc should hold a valid certificate.

(1) There should be an adequate volume of water in the chamber or reservoir before the autoclave is switched on - if the autoclave is not operated on mains steam.

(2) The pressure relief valve must be set at a pressure not exceeding the designed pressure of the equipment.

(3) The maximum working pressure should be clearly displayed on the autoclave at all times.

(4) The chamber must not be overloaded or packed in such a way that loose paper or other materials can block the safety valve orifices.

(5) Before increasing the chamber pressure above atmosphere, door should be properly and tightly locked, steam leaking out of the door can be very dangerous and wasteful.

(6) After sterilization, the autoclave door must not be opened until atmospheric pressure is reached inside the chamber, the vent is opened and sufficient time has elapsed for the content to be at a safe temperature (below $80^{o}C$).

(7) Insulated gloves should be worn when unloading the autoclave (asbestos gloves are not recommended).

(8) Bottles and sealed containers must not be opened until the content is cooled below $80^{o}C$.

(9) Don't autoclave cellulose nitrate ware, which is liable to explode when autoclaved.

(10) Don't autoclave organic solvents, such as benzene, acetone, chloroform etc.

5.2 USE OF BIOLOGICAL SAFETY CABINETS

(1) Check whether the classification of the cabinet is suitable for handling infectious materials.

(2) Switch on the cabinet and ensure that the reading on the pressure gauge is appropriate before placing infectious materials inside.

(3) Keep only the minimum quantity of infectious materials inside the cabinet.

(4) Keep only the equipment necessary for the experiment inside the cabinet.

(5) Always keep the sash in the lower position to protect personnel against splashing.

(6) Keep the use of a naked flame inside the cabinet to as little as possible since the hot air produced can distort the HEPA filter and affect its efficiency.

(7) All experiments must be performed from the middle to the rear of the cabinet.

5.3 USE OF CENTRIFUGE

(1) Centrifuges can be very dangerous if not operated correctly. Incorrect operation may lead to both microbiological and physical hazards.

(2) Only authorized persons are allowed to use the centrifuge.

(3) The manufacturer's Operation Manual should be read and the machine should be operated according to the instructions as specified in the manual.

(4) The loads should be carefully balanced and distributed symmetrically around the head before starting the centrifuge.

(5) Don't exceed the maximum speed for the rotor.

(6) The recommended maximum speed is only applicable to samples with density less than 1.2 gm/ml.

(7) The centrifuge must be stopped by returning the speed control to zero, not by switching it off at the main.

(8) Never try to stop a rotating head by hand.

(9) The lid should remain closed until the head has come to a complete stop.

(10) The heads and buckets should be washed, dried and inspected each time after use; and decontaminated if necessary.

(11) Centrifuge tubes should be loaded properly before putting into the rotor head compartments.

(12) Never overfill centrifuge tube with infectious samples, a space of 2cm should always be left between the level of fluid and the rim of the tube.

(13) Thick-walled glass or plastic centrifuge tubes with screw-caps are recommended for spinning infectious material and should be inspected for defects before use.

(14) To avoid creation of aerosols and droplets of infectious material, all tubes should be capped or wrapped by parafilm before putting into the centrifuge.

6 PERSONAL PROTECTIVE EQUIPMENT

6.1 OVERVIEW OF CONTROL MEASURES

In the control of occupational hazards, there are three levels of preventive control measures:-

6.1.1 Control at source

- Elimination
- Substitution
- Modification
- Regular maintenance of machines and equipment
- Other controls such as wet methods

6.1.2 Control in the transmission path

- Enclosure, or enclosed system
- Isolation
- Ventilation: local exhaust units and general ventilation

6.1.3 Control at the worker level

- Work practices and work organization
- Education and training (including emergency response)
- *Personal protective equipment*
- Rotation of exposure time (administrative)
- Personal hygiene

Personal protective equipment (PPE) is the classical method of control in occupational hygiene. It is a control at workers' level or the third level. It is often described as the last line of defense, because most of the other methods when properly designed and applied, can provide adequate continuous protection of a worker against harmful contaminants under normal working conditions. Personal protection often finds its chief usefulness as an emergency or rescue measure, or as a short term means of protection during inspection, maintenance and repair work. It should be used as a primary device for normal operations only when no other method of control is possible or when the other systems are shut down temporarily. Often, when a very toxic substance is involved, PPE may be used as an adjunct to exhaust ventilation or the other control measures because a single control measure cannot safely be relied on. PPE often serves as stand-by equipment for operators working in a dangerous or high risk situation.

6.2 TYPES AND APPLICATION OF PROTECTIVE DEVICES

6.2.1 Types of devices

Head	helmets
Feet	boots, safety shoes
Eyes	**goggles, spectacles...**
Eyes/Face	**face shields...**
Hearing	ear muffs, ear plugs
Hands	***gloves***
Whole body	**protective garments**
PPE	**mask, breathing apparatus**

Personal protective devices are often regarded as a cheap alternative for the protection of workers. However, it may not be correct when the running cost is being considered. The protection of protective equipment is not 100% guaranteed nor it can be free from contact. Rather, it precludes the operators from exposure to the hazard by reducing it to an acceptable level. Yet, the wearer often suffers **from discomfort and physiological cost**. Also, its contribution to the protection of the environment is nil, but it is an extra burden.

6.2.2 Application of protective devices

(1) Physical hazards like sharp or falling objects, radiation, heat or cold
(2) Chemical health hazards like splashes or vapours from toxic or corrosive substances

- Know the steps of operations well.
- Match the equipment to the hazard.
  (Check if they are the approved items)
- Make sure it is in good condition.
- Use at work all the time.

6.3 EYE PROTECTION

6.3.1 Toughened glasses and plastic devices

For example: polycarbonate, PVC, acetate, and methyl methacrylate

- GOGGLES
- SHATTER-PROOF SPECTACLES
- FACE SHIELDS

Using Eye Protection Devices
(1) Check fit before wearing.
(2) Clean regularly with soap and water.
(3) Replace lens if pitted or scratch.
(4) Store in dust-proof case.
(5) Ensure elastic headbands are tight enough.

In the work environment, it is important to keep flying objects and hazardous dusts, vapours, heat, gases, fumes and liquid splashes out of the vulnerable eyes. The most common forms of protection are goggles, shatterproof spectacles and face shields. The lenses are made of toughened glass or plastic such as polycarbonate. They are often coated with additional material for improvement of quality: for scratch prevention and radiation shielding, Polycarbonate lenses are cheaper and can be readily replaceable. In selection, light weight and non-allergic material is important.

If the wearers needs glasses to correct eye sight, it is important to ensure either the eye glasses are made of protective lenses or use goggles, etc. that can be worn over the eye glasses. **No contact lenses** should be used if there are hazardous dusts, vapours, gases, or liquids in the work environment. These materials could become trapped and concentrated underneath the lenses.

6.3.2 Protection for Optical Radiation

Both ultraviolet and infra-red rays are well known to be harmful to eyes. Although the cornea effectively filters out rays less than 295nm, cellular changes have a cumulative effect (causing e.g. arc eyes to welders) on the eye tissues. Ocular hazards from lasers can induce cataracts and retinal burns. Thermal effect due to exposure to microwave is certain but its induced non-thermal effect is still under debate. Ionising radiation with neutrons or heavy charged particles could induce damage to biological

tissues. The effect on tissue frequently involves a latent period of months or even years before detectable signs are noted.

Shade No. 1.2 for general purpose:
for reduction of UV, VIS, IR

Shade No. 1.5 to 3 for
"low temperature" hot work: gas shielded arc welding, flame cutting and against glare from snow, ice and strong reflecting surface

Shade No. 4 -5 UV and bright Light :
mercury lamp (UV-A to LTV-C)

Shade No. 9 or 10 for intense light and UV- protection
No tinted glasses are required for normal indoor activities

6.3.3 Laser protection

No one type of glass or filter offers protection from all laser wavelengths. The basic design is for protection against accidental diffuse or reflection but **NOT** for direct hit from the beam. Safety goggles are usually not recommended for laser protection, especially for the high power laser source. It will give a false sense of security and tempt the wearer to be exposed to unnecessary hazards. Nevertheless, laser user does use eye protection but he has to know the function, wavelength and the intensity of the source before selection.

Laser filters may be made of glass or plastic (polycarbonate). A coated glass filter is vulnerable to scratches but it gives better visibility than plastics. The absorbers for plastic filters can penetrate into the lens. They are therefore less affected by scratches and protect the wearer better than glass filters. However, absorbers are available for only limited bands of light waves.

6.3.4 Degree of laser protection

Laser filters are graded into units of optical density (OD) and usually cover only a narrow band of the light waves. OD value is determined by measurement with spectrophotometer: **$OD = -1 \log T_{\lambda}$** .
Laboratory instruments can measure the transmission up to OD 4.5 only. In the market, filters, with the OD value estimated by extrapolation, are available up to 20. However, the practice of extrapolation is still under dispute, because the protection is not guaranteed. For OD of 6, the transmission of the filter is 0.000001 or 0.0001 of 1% of the original. For using laser with power at this level (OD = 6), it requires full body protection too.

Coated glass filter - vulnerable to scratches, covering a full range, better visibility
Polycarbonate filter - absorbers penetrate into lens, less affected by scratches, limited bands of protection

6.3.5 Face protection

Common full face coverage protection includes devices against light impact, sparks, molten metal or liquid splashes and welding related hazards. Specially treated face shields have a clear silicone coating for longer wear in chemical splash situations with mild acids, caustics, aromatics, and methylene chloride. Polycarbonate shields with gold coating and LTV protective coating can reflect 99% UV and IR but provide a clear vision. PVC, acetate, and methyl methacrylate are also suitable materials.
Good eyesight, visibility and protection are important for working in the hazardous work environment.

6.4. PROTECTIVE GARMENTS

Personal protective garments are work clothing designed for protection against the various harmful factors due to exposure to physical or chemical hazards. They are tailored to meet specific requirements.

(1) For toxic dirt, grease and particulate protection,
(2) For acids, alkali, pesticides, solvents & other chemicals

Re-usable or disposable types of shirts, pants, aprons, hoods, overalls, two pieced suits, sleeves, vests, gowns, shoe covers, and gloves are all available.

6.4.1 Materials for protective garments

(1) All materials are permeable
(2) No single material is resistant to all chemicals
(3) No acceptable garment material for some hazards

Common materials: butyl chlorinated polyethylene, natural rubber, neoprene, nitrile, polyethylene, polyurethane, polyvinyl alcohol PVC, treated woven fabrics, leather; supported on cotton, polyester and nylon for improvement of puncture- and tear-resistant.

6.4.2 Evaluation for degree of protection

The potential hazard should be evaluated before considering the right choice. It is often based on anticipative or predictive methods. In the first step, the degree of exposure to the chemical substance should be assessed: chemical nature, physical form physiological action. Then, its work profile should be determined: normal production, accident-splash and escape, entry/maintenance, and cleanup/disposal. Exposure will be minimal during normal operation. Splash would increase the risk of intermittent exposure but the greatest harmful effect may occur during cleanup and disposal due to long term, direct and continuous exposure to the toxic substances. A safety margin should be introduced for protection against the unforeseeable situation.

Identification of the hazardous agent is the first step: anticipative or predictive, the degree of exposure, chemical nature, physical forms, physiological response. **Work profile** should be determined: normal production, accident-splash and escape, entry/maintenance, and cleanup/disposal

Steps for donning, sealing, and doffing

(1) Read the instructions carefully.

(2) Check for tears, leaks, punctures or signs of wear before putting on; make sure the equipment was not contaminated the last time.

(3) Fit the clothing correctly, no loose clothing.

(4) Fasten and secure all openings; use tape to secure cuffs and pants if needed

(5) Remove contaminated clothing as soon as possible.

(6) Remove carefully but do not contaminate the inner body part and the changing area as far as possible.

(7) Remove the most contaminated parts first, then take off items on the upper body; work down so as not to drop contaminants on uncovered parts of the body.

(8) Wear gloves to unfasten possibly contaminated zippers, tape, or snaps or let the partner do this.

(9) Place contaminated clothing in the proper containers for cleaning or disposal.

(10) Only authorized personnel are permitted to clean contaminated protective clothing. Otherwise, use the disposable type.

6.5 HAND PROTECTION BY GLOVES

Raw materials : natural rubber, latex, cotton, nitrile rubber, neoprene, PVC, butyl rubber, PE, PVA, stainless steel, and leather. Double or multi-layered gloves made from different materials.

Chemical protection (ideal situation)

(1) Non-penetrative - no liquid chemical goes through zippers, stitched seams, pores.

(2) Non-degradable - exposed products would not get hardened, stiffened or brittle, nor get soft, weak or swell.

(3) Non-permeable - molecules of liquid chemicals cannot pass through a protective material without going through pinholes, pores or visible openings.

However, as mentioned for protective garments, there is no ideal glove material: To a certain extent, it will give way to chemical attack. This depends on the time or extent of contact or immersions. Gloves would be different from protective garments because contact with chemicals would often be essential and expected to be longer. It is important to select the best for the job.

6.5.1 Other properties for glove selection

Mechanical strength

The physical toughness and its ability to protect against abrasion, tear, puncture and flame should match the working conditions. If cut or abrasion resistance is essential, pick a fabric-lined glove.

Comfort and dexterity

Maximize the factors of comfort and dexterity. The following are some extremes:

(1) *Unlinted gloves* provide comfort to hands and give excellent sensitivity.
Linted gloves (cotton) absorb perspiration and help insulate the hands but reduce sensitization.

(2) Light gauge gloves improve touch sensitivity and flexibility. Heavy gauge gloves add protection and strength because of increase in thickness but it may also reduce the sense of touch.

6.5.2 Choose heavy duty type for greater protection or durability

Grips

Non-slip grip gloves allow for easier and safer handling. Select the palm finish to provide the grip needed for the job - smooth, sprayed, dipped, raised, etched or embossed finishes. Sprayed and dipped grip best when wet. Embossed is next. Dot or raised coating provides better grip for mechanical handling.

Sizes and length of protection

Measure the proper size and length. Choose only the right size. Loose fitting gloves affect dexterity and can be hazardous. Tight fitting gloves can cause fatigue and tend to wear out faster. Gloves should fit comfortably without restricting motion. Check whether it is long enough and adequate for protection. There are lengths available to cover wrist, forearm, elbow or entire arm.

Hints for protective gloves:-

(1) Identify the hazard: the harmful effect and severity. Test for resistance to harmful chemicals before use when necessary.

(2) Plan the activity and ensure the degree of exposure: possible splash, occasional contact, prolonged contact.

(3) Choose suitable glove that fit the wearer. Check for no leakage.

(4) Put the gloves on. Use dry powder. Seal or tape at the top. Alternatively, fold with a cuff to keep Liquids from running inside the glove or onto the arm. It is dangerous to wear gloves while working on moving machinery.

(5) Remove the gloves carefully to avoid self contamination. Ask help from a partner.

(6) Disposable gloves are sometimes more cost effective than expensive re-usable gloves. The disposable gloves provide "true touch". Reusable gloves are usually long wearing and chemical resistant.

Skin disorders

Rubber gloves have been identified as the cause of allergic rashes. In a study, 93% complaints came from using rubber or latex and 7% from plastic ones. This relates to additives mixed in the matrix material as catalysts and anti-oxidants. The skin disorder is essentially a delayed reaction with symptoms of urticaria, running nose, stinging and running eyes, shortness of breath and asthma.

6. 6 RESPIRATORY PROTECTION, TYPES OF RPE

Respirator is one of the most important protections against chemical hazards, such as hazardous dusts, mists, vapours or gases. There are two main types of RPEs: air purifying and air supplying, with more than 30 different designs. To select the most suitable type, the following conditions have to be considered: oxygen sufficiency, nature of contaminants (gas, vapour or dust), any recommended occupational exposure limit or the protective guideline, the anticipated level of contaminant in the said conditions. Respirator training is important to select, put on, take off, store and maintain. Learning how to test fitness and change contaminated filters or parts is essential too.

6.6.1 Air purifying type

These range in style from simple dust masks to canister-type gas masks. Air purifying respirators cannot supply oxygen, but remove the air-borne contaminants from the breathing zone. There are

negative mask and positive powered mask designed into quarter mask (nose & mouth piece), half face mask and full face mask.

Dust filter mask

Dust filter mask protects from solid particulate matter. Efficiency depends on nature of material and size of particles. Some filtering respirators do not provide adequate protection against aerosols or metal fumes in the atmosphere.

Gas mask

Gas mask protects from gassing by adsorbing the gas or vapour onto the surface of materials such as activated charcoal in a filter cartridge. Different types of adsorbent are required for different gases. In the adsorption process, gas molecules are deposited on the surface of the adsorbent in filter cartridge or canister. Once the surface is covered with gas molecules (saturated), no filter adsorption can take place and gas will then pass straight through the filtering material - breakthrough. The filter will have a limited working life. It is NOT recommended for use with toxic gases and vapours that do not have a warning property and have immediate and acute effects such as loss of consciousness or asphyxiation.

6.6.2 Air supplying type

These include self contained breathing apparatus-portable tank (SCBAs) and airline respirators that provide air through a hose from a tank or compressor. They are recommended when the air purifying type does not provide enough protection or there is too little oxygen, or in critical situations which are immediately dangerous to life and health (IDLH).

Simple compressed air supply equipment

Simple compressed air supply equipment provides a source of clean air for breathing from an independent compressed air supply to a blouse, visor or hood. It is usually from a low pressure source without valve control and is unlike breathing apparatus. It may be used for protection against irritating substances or gases without immediate harmful effects.

Fresh air hose equipment

Fresh air hose equipment takes air from a clean source near to the contaminated area and delivers it to a face mask unassisted, manually assisted or power assisted.

Breathing apparatus: compressed air and compressed oxygen types

These include equipment with supply from a compressed airline to full face mask or airfed suit, open circuit self-contained breathing apparatus, closed circuit self contained breathing apparatus and self contained breathing apparatus for escape purposes. Also, there are two different methods of supplying compressed air to the wearer: negative pressure demand (valve controlled by the breathing action) and positive pressure demand (a slight positive pressure maintained inside the mask). Training and regular drilling to use the breathing apparatus may be required.

6.6.3 Training & maintenance

Good RPE fit is vital. The respirator has to have a good seal around the face so that no contaminated air can get in. Check for cracks or holes. Check the fit and make sure it is comfortable enough to work in before each wearing. Dispose or clean the parts after use before storage.

6.6.4 Degree of protection by RPE

Nominal protection factor (N-PF) = concentration of the test material outside the mask divided by the concentration inside the mask in an experimental test. The actual performance of the mask depends on many other factors while used in the field, such as respiratory load, work capacity, time for use, thermal effect, speech communication, vision, freedom of movement, mass and weight distribution, compatibility with other PPE, ease of use, hand/face dimensions, seal pressure and area, ease of fitting. The use of RPE would become a burden to the users especially in hot and humid work environment.

Medical fitness

This is another factor to be considered for workers to use RPE. Wearers should not be subjected to any additional health risks by wearing the equipment. People with respiratory disorders such as asthma may find difficulty with respirators and should seek medical advice.

6.7 GENERAL COMMENT ON PPE

(1) Readily available
(2) Essential for emergency or rescue work
(3) Standby equipment for dangerous or high risk job
(4) The last line of defense
(5) Short term means of protection
(6) High running cost
(7) Not 100% guaranteed
(8) Burden to the user (discomfort and physiological cost)
(9) Not green

The best PPE product is one which is easy to wear.
The best working condition is where there is no need to wear any PPE.

7 FIELDWORK SAFETY

7.1 GENERAL INSTRUCTIONS

(1) It is a matter of individual responsibility to decide whether field activities should be cancelled because of bad weather. If researchers have already set off or if, during, the course of field activities, bad weather occurs, it is for the driver and the researcher to make the decision, based on local field conditions whether or not to cancel the activity. No field work should be initiated in bad weather conditions.

(2) The Boatman will make the decision as to whether vessel activities can be safely undertaken or not. His position is similar to that of a vessel captain.

(3) If possible, take a mobile phone for communication between the field worker and the department and between a field worker and driver.

(4) Carry a portable first aid kit and know how to use it.

(5) Undergraduates participating in either group projects or final year projects in the field should have a safety briefing by the Safety Representative before working in the field.

(6) Anyone carrying out field work is responsible for nor endangering their own safety, that of their colleagues or members of the public.

(7) A knowledge of the day's tides is essential. Always allow ample time to reach and leave a study site. This is especially important when working on flat inter-tidal areas, such as a mudflat.

(8) Obtain a detailed weather forecast immediately before departure (Hong Kong Observatory Tel. 1878 200). Do not attempt any work if the weather forecast is unsatisfactory or if the weather deteriorates quickly.

(9) Always understand the local terrain. It is preferable to carry a map that covers your working site.

(10) Determine your clothing requirements.

(11) Assess your field equipment requirements. Replace any faulty units. Distress signals for use in an emergency are useful. Carry a whistle.

(12) Wear eye and ear protection when either hammering or drilling-rock.

(13) Take extra precautions during prolonged spells of hot, dry, weather in summer. Take with you something to drink, and wear a hat and sun-tan lotion. Cover the back of your neck.

(14) Be aware of possible health risks arising from pollution by industrial, agricultural and domestic effluents.

(15) Field work at night is potentially dangerous and must be carried out in pairs. Use torches.

(16) Some animals, such as sea urchins, stonefish and the Cnidaria in general, are dangerous. Please exercise care when handling all animals.

7.2 MUD AND MARSHES

(1) Of the several types of wet unstable ground you may encounter, mud is the most dangerous; you should never try to gain access to soft mud alone. Reed swamps and mangroves are difficult to cross on foot; take great care.

(2) Careful preparation is important before you undertake work in these areas. The period available for work is usually limited by the tides and knowledge of the local tidal situation is essential. You must make allowance for local conditions and changes in the weather, for example, a change to an on-shore wind can bring forward the time of high tide. When the terrain is flat the tide advances quickly, and you should allow ample time to return before the flood tide starts to advance across the work area.

(3) Conditions underfoot in mud and mangroves are often highly variable and can be dangerous. When traversing soft mud, test before each footstep, probing ahead with a pole. If the mud becomes too soft and your feet sink in, do not make violent movements to try and get free as this inevitably makes the situation worse. If your boots or trousers become stuck, gradually slip one foot out, rest the leg on the mud surface and carefully free the other foot.

(4) If you find yourself sinking in mud, lie flat on your back and call for assistance. Make a deliberate effort to keep calm. If possible, free your legs and feet to the horizontal. If you are carrying a bucket, collecting basket or any other object with a flat bottom, use that to support you. A plastic bag or waterproof garment may be used to trap air and so provide limited support.

(5) By lying on the surface you can spread your weight so as to avoid sinking. Move to firm ground using a "leopard crawl" (spread-eagled face down, keeping the maximum area of your body in contact with the ground all the time) using any solid object for support.

(6) If you become immobilized, try to get behind some vegetation for shelter. Keep calm. Try and attract attention.

7.3 ROCKY BEACHES

(1) Rocks are often slippery with damp algae and have uneven surfaces due to crevices and fissures. Do not run on these shores. Walk slowly and carefully.

(2) Rocks are often covered with sharp barnacles and urchins: always wear lace-up beach shoes and not flip flops.

(3) Never visit highly exposed rocky beaches alone. If you have any concern with regard to wave action, then clearly it is not safe to work and the field trip should be abandoned

(4) Only visit rocky beaches at low tide and when wave action is low.

(5) Wave height is often very variable. Always be aware of the possibility of a 'King' wave!

(6) If you are swept off a rock by a wave, above all else, keep calm. Float on your back and scan the shore for a place where you can climb out of the sea without cutting yourself on either oyster or barnacle-covered rocks.

(7) If you cannot exit the sea easily, attract the attention of anyone, either on the shore or in a boat, for assistance.

7.4 SNAKES

(1) When you see a snake, maintain a distance between it and you and make a detour.

(2) Do not walk bare-foot.

(3) If you are bitten, stop bleeding by direct pressure.

(4) If necessary, call police by dial 999.

7.5 VILLAGE DOGS

The following are guidelines only for when confronted by a dog:

(1) As you get near the village, pick up a big stick.

(2) Continue walking, do not run, maintain visual contact and be very careful if the dog(s) rushes at you.

(3) If you are bitten, cover the wound with a clean handkerchief and apply direct pressure to stop bleeding. Contact a doctor or get to a hospital immediately and inform the Safety Representative as soon as possible.

(4) If necessary, call police by dial 999.

7.6 EXTREMELY WEATHER CONDITION

Field work under extremely weather conditions, e.g. typhoon, heavy rain, extremely hot or cold weather, is dangerous. Always follow the weather information and warning system which in effect.
Do not attempt any outdoor field work if the weather forecast is unsatisfactory or if the weather deteriorates quickly. For rapid weather information, visit the web page of Hong Kong Observatory (http://www.hko.gov.hk).

7.7 DIVING

(1) Refer to the Safety Manual of The Swire Institute of Marine Sciences (SWIMS) in case the diving activities are launch with SWIMS staff or by SWIMS vessels.
(2) Diving activities should be allowed for research only.

8 OFFICE SAFETY

8.1 PREAMBLE

In view of the growing concern on the health effects related to the use of visual display units, the following guidelines are prepared to give general information on its radiation emission, ergonomic design and work environment and job pattern.

8.2 VISUAL DISPLAY UNIT

In the office setting, Visual Display Unit, VDU for short, generally refers to the monitor which converts a digital electrical signal into an image and serves as communication link between the computer and the human. There are several display technologies, such as liquid crystal (LCD) and thin film transistor (TFT) and the conventional cathode ray tube. As the vast majority of VDUs depend on cathode ray tube (CRT) technology, most of the research findings and radiation information will be focused on the this type of VDU.

8.3 RADIATION EMISSION

The principle of cathode ray tube technology involves the generation of electronic beams striking on a photo-sensitive screen. The process of electron beam generation, beam steering and the conversion of electrical energy into visible light results in the emission of electromagnetic radiation of the non-ionizing range (ultraviolet, visible, infrared radiation, radio-frequency fields, extremely low frequency fields and electrostatic fields). The non-ionizing radiation means that they are low frequency, low energy level and unable to cause ionization (removal of an electron from an atom) when reaching the body. As a matter of fact, VDU emits electromagnetic fields similar to many electrical appliances such as TV.

In Hong Kong, there are no occupational exposure standards for VDU emission. Commonly accepted international standards include Threshold Limit Values of American Conference of Governmental Industrial Hygienists (ACGIH) and MPR II of Swedish Board for Technical Accreditation (SVYEDAC,). **Exposure to X-ray, infrared, ultra-violet, radio frequency and microwave arising from the use of VDU had been investigated in the UK and USA. The results concluded that such exposure was below the international acceptable limits. In most cases the emissions detected were very substantially below the existing limits.** *(Health Guide on the Use of Visual Display Unit, Labour Department, Hong Kong)*

8.4 RECOMMENDATIONS ON EQUIPMENT

(1) Check the product information and standards before purchase. If such products have met certain standards, such as MPRII, manufacturers usually give such details in their product catalogue.

(2) Desirable characteristics of screen:
   (a) Adequate size for comfortable viewing
   (b) Screen brightness and image contrast can be adjusted to meet the user's preference
   (c) Tilt and rotation can be adjusted to meet the user's preference
   (d) No flickering of displayed characters
   (e) Non-reflective surface
   (f) Energy saving features

(3) Desirable characteristics of keyboards:

(a) Matt surface
(b) Detachable
(c) Stable
(d) With separate numeric keys
(e) Shallow keyslope (about 10 to 15 degree)

8.5 RECOMMENDATIONS ON FURNITURE

(1) The principles of ergonomics should be applied to the design of furniture to encourage the comfortable positioning, of fingers, wrist, arms, shoulders, and other body parts to attain work efficiency and safety.

(2) Desirable characteristics of workstation:
(a) Separate vertical adjustable adjustment for keyboard, screen and source material
(b) Movable keyboards on the table
(c) Adequate space to support hands and forearms
(d) Height-adjustable seats with backrest, adjustable for height and inclination
(e) Documents to allow visual distance of 300 to 700mm

8.6 RECOMMENDATIONS ON THE WORKING ENVIRONMENT

(1) Office lighting should be adequate and properly focused at the source documents and screen without causing glare. An illuminance of 300 to 500 lux (unit of measuring light intensity) on the desk surface is considered adequate.

(2) Glare from windows should be eliminated by means of film, curtains, blinds or the like.

(3) The screen should be perpendicular to the light source or windows. i.e. the direction of vision of the VDU user should be parallel to the light source.

8.7 RECOMMENDATIONS ON THE POSTURE AND JOB PATTERN

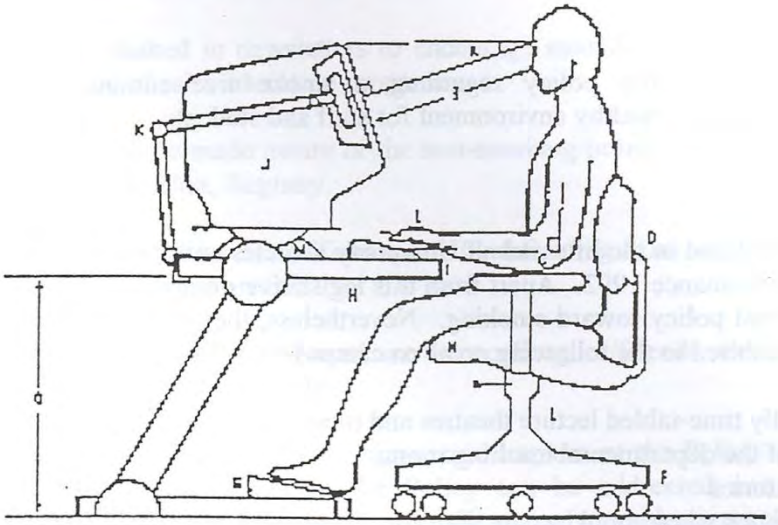
(1) User should be in correct posture to reduce muscle fatigue. Recommendations include:
(a) Viewing distance of 35-60cm
(b) Head inclined downward between 15 to 20 degrees
(c) Upper arms and lower arms are at right angles
(d) Lower arms approximately horizontal
(e) Wrist inclined no more than 10 degrees
(f) Thighs horizontal

(2) Job rotation and work breaks are also effective means to reduce fatigue and eyestrain. User can perform VDU job and non-VDU job on alternate patterns. If the use of VDU is inseparable from work, appropriate work breaks should be taken. This helps relaxation of eye muscles and reduction of occupational stress.

(3) Depending on the working environment and nature of work, VDU users are encouraged to discuss with their supervisors implementation of the above recommendations.

8.7.1 Reference

1. Health Guide on The Use of Visual Display Unit. Labour Department, 1991.
2. Occupational Safety and Health (Display Screen Equipment) Regulation, Cap 509B, 2003.



A Viewing angle 15^{o} - 20^{o}

B Viewing distance 35 - 60 cm

C Forearm and arm about 90^{o}

D Adjustable back rest

E Adjustable seat height 34 -52 cm

F 5 pronged base with castors

G Firm foot rest if required

H Acceptable knee clearance

I Support for forearms/hands if required

J Screen at right angles to line of sight

K Adjustable document holder

L Wrist incline $\leq 10^{o}$

M Screen support adjustable for rotation and tilting

N Round or scrolled edged seat pad

O Adjustable table height

9 FIRE HAZARD AND EMERGENCY REPORTING

9.1 FIRE

9.1.1 Introduction

Fire safety has persistently received much attention of the Senior Management of the University. It is important to everyone because of the potential high risk to life and property if a fire breaks out. Procedures are set out below by the Senior Estates Officer (Security & Fire Protection) of the Estates Office for all staff members and students to follow in case of fire:-

9.1.2 Procedures to be taken in case of fire

In case of fire

(1) Do not panic.

(2) Sound the fire alarm by activating the break-glass alarm switch in the corridor.

(3) If time permits phone the Security Office/Safety Office by dialing
2859 2882 (24 hours), or
2859 2400 (office hours)

(4) Switch off power/fuel supply to machinery and plant.

(5) Close doors.

(6) **Do not** use the lifts, use the stairs and leave the building, as quickly as possible.

(7) Do not return for valuables or for any reason until area is declared safe by firemen or the Security staff

On hearing the fire alarm:

(1) Leave the building as quickly as possible and go via the stairs to the ground level or to the podium level and assemble in the open air.

(2) Urge and assist other people in the building to leave if necessary.

Only tackle the fire if you are absolutely sure that danger is not imminent. Fire hose reels and/or portable fire extinguishers can usually be found in corridors or lobbies.

9.2 EMERGENCY REPORTING

9.2.1 Introduction

In case of emergency when life and/or property on the campus are endangered, staff members and students are encouraged to report promptly to the 24-hour manned Security Control Office for assistance. The well-trained security team will be dispatched to the scene to render on-the-spot assistance. If the situation demands, the Security Office will request assistance from other departments or Government bodies such as Police, Fire Services, Ambulance etc.

9.2.2 Nature of Incident

(1) Fire
(2) Any accident/injury
(3) Electric shock
(4) Person reported seriously sick
(5) Person reported shut in lift
(6) Leakage/spillage of chemical
(7) Flooding
(8) Any crime
(9) Any other incidents that life or property is endangered

Security Office

The Security Office is located at G/F, Kadoorie Biological Sciences Building and is manned by security staff 24 hours a day. In case of emergency, staff members or students can report the incident to the Office either in person or by dialing

9.2.3 Reporting

Particulars to be reported to the Security Office when there is an emergency on the campus

(1) Your name and department
(2) Your contact telephone number
(3) Nature of incident with brief description
(4) Full details of location of incident
(5) Any person(s) injured in the incident

After the incident, you should give the details to the attending security staff or the attending Fire Services / Police personnel in order to assist them for their follow-up investigation.

9.3 FIRE WARDENS

9.3.1 Role of Fire Wardens

In carrying out the following actions Fire Wardens should not put themselves in any danger.
On hearing the alarm each fire warden is requested to:

(1) Immediately leave his/her place of work and encourage others to evacuate.
(2) Check rooms within previously agreed area to ensure all people have left.*****
(3) Spur on people to leave their place of work and to direct them to appropriate exit.
(4) Note which rooms or areas were not checked due to smoke/fires and to inform fire brigade upon its arrival without delay.
(5) Encourage people to move quickly down stairwell and out of building.
(6) Move people away from building exits to the assembly point.
(7) Report any problems (missing persons, non-evacuated staff etc.) to the Fire Officer of the Fire Brigade in charge of the operation directly and without delay.
(8) Identify key holders should the fire brigade wish to enter locked rooms.
(9) A fire warden should under no circumstances be responsible for more than one floor. Appoint sufficient fire wardens for additional floors.

N.B. * If some people are unwilling to leave – do not delay but continue to search other rooms.

9.3.2 Consideration

It will be of benefit for fire wardens to consider the following points before the next real event or fire drill.

(1) Bring fire safety issues to the attention of your supervisor/Dept Head.
(2) Identify the other fire wardens/safety representatives on your floor.
(3) Identify who checks common areas or rooms belonging to departments located elsewhere on campus.
(4) Identify likely people who would be willing to act as deputies or assistants in fire warden activities.
(5) Ensure that all persons on your floor are kept updated of the actions to be taken in the event of a fire by circulating the fire procedures* to them at least twice yearly.
(6) Inform the new comers to your Dept./Unit, the "**Action in Case of Fire and Evacuation Procedures**" of the University.
(7) If the population in your department is generally static and a roll call is practicable at the assembly point, prepare a list for use.
(8) Identify any needs for special arrangements for persons who may require particular attention in the event of a fire.
    If there are physically handicapped persons in your area, evaluate before hand whether the handicapped person can negotiate the escape route without undue risk. If they cannot, smoke lobbies offer well protected temporary refuges where physically handicapped persons can wait for the assistance of the fireman. When such arrangement is in force, make sure that someone remains with the physically handicapped person and another person informs the fire brigade upon its arrival.
(9) In your daily work watch out for and report to the Head or the Safety Office any fire hazards that occur e.g. locked exits, blockage of fire exits, unsafe or excessive storage of flammable solvents, damaged fire services installations etc.
(10) Report defaced, out of date or missing fire notices to Safety Office for replacement.

* It should consist of a copy of the "Action in Case of Fire".

10 PLANNING FOR EMERGENCY

10.1 DEFINITION

An emergency is an abnormal and dangerous situation needing prompt action to control, correct and return to a safe condition.

It may be considered as a situation:

(1) Which may not be contained by staff using the available resources
(2) Where injuries, illness or damage to property have or could be incurred

10.2 TYPES OF EMERGENCIES

An emergency may develop from a number of causes, including

FIRE
EXPLOSION
SPILLS (Chemical, radioactive or biohazard materials)
GAS LEAK
NATURAL EVENTS
    Typhoon
    Rainstorm
    Adverse weather conditions
MAN-MADE EMERGENCIES
    Bomb threats
    Civil disorder
OTHERS

Emergencies can arise at any time. Simple events may result in serious injuries and property damage.

10.3 EMERGENCY PLAN

There is no point in waiting until an emergency occurs and risking panic. The key element is planning for any emergency before it occurs. Planning for emergencies aims to ensure the safety of occupants of buildings in the event of an emergency and minimize damage.

10.3.1 Goals

The goals of an emergency plan are to:

(1) Decrease the level of risk to life, property and the environment.

(2) Control any incident and minimize its effects.

(3) Provide the basis for training of all people who could be involved in any local emergency as well as emergency services fire, police, ambulance, utility companies.

10.3.2 Elements of an emergency plan

The emergency plan must be designed specifically for each workplace, as it must reflect the layout of each workplace.

The following points should be included in an emergency plan:

(1) A general description of likely emergencies together with a statement of the specific risks that could be associated with each.

(2) A plan of the organization's premises showing the general layout, the location of emergency equipment, medical and first aid services, fire control equipment, evacuation routes and staff assembly points.

(3) Information on the emergency warning signals and how they operate.

(4) Identification of those with authority and their responsibilities in an emergency situation, plus responsibilities of all staff.

(5) A list of emergency agencies, their contact names and telephone numbers.

Provision should be made to conduct emergency drills with each of the agencies involved and rehearse the plan. The plan should then be modified in the light of any shortcomings noticed.

The success of pre-emergency planning depends on the co-operation and participation of all members of staff and their awareness of the emergency services and the layout and location of services at each site.

10.4 EMERGENCY TRAINING AND EMERGENCY PROCEDURES

Procedures should be developed to cover emergency situations and all staff should receive training in the emergency procedures. This training should include clear instructions on what to do if a staff member discovers an emergency or hears the alarm. All staff need to know the emergency procedures to be followed and should be given a copy of emergency procedures to ensure that they understand the content.

11 IMPORTANT TELEPHONE NUMBERS

All emergencies:	999
Ambulance Control Room (Fire Service Department):	2735 3355
University Health Service Emergency:	2859 1999
University Security Office	2859 2882
University Radiological Protection Officer (Office hours):	2859 2548
University Safety Office (Office hours):	2859 2400
Estates Office (HKU) Emergency Repair:	2540 1999
Hong Kong Observatory:	
General Enquiries	2926 8200
Hong Kong Weather Forecast	1878 200
Tropical Cyclone Warning Signal Enquiries (Signal No. 3 or above)	2835 1473
Fire Services Communication Centre (Recompression Unit, Stonecutters Island)	2723 2233
South China Coastal Waters Bulletin	2187 800 (Chinese) 2187 8670 (English)
Marine Police	2312 6500
Government Flying Service	2305 8301
Maritime Rescue Co-ordination Centre	2545 0181-3
Hospitals providing Accident and Emergency Service:	
Alice Ho Miu Ling Nethersole Hospital	2689 2000
Caritas Medical Centre	3408 7911
Kwong Wah Hospital	2332 2311
North District Hospital	2683 8888
Pamela Youde Nethersole Eastern Hospital	2595 6111
Pok Oi Hospital	2486 8000
Prince of Wales Hospital	2632 2211
Princess Margaret Hospital	2990 1111
Queen Elizabeth Hospital	2958 8888
Queen Mary Hospital	2255 3838
Ruttonjee Hospital	2291 2000
St. John Hospital	2981 9441
Tseung Kwan O Hospital	2208 0111
Tuen Mun Hospital	2468 5111
United Christian Hospital	3513 4000
Yan Chai Hospital	2417 8383

Acknowledgement and thanks are given to the following organizations for providing information on their Health and Safety procedures

Chinese University of Hong Kong
City University of Hong Kong
Hong Kong Polytechnic University
Hong Kong University of Science and Technology
The University of Hong Kong

DECLARATION

I have read the 'Safety and Health Handbook' posted on the SBS intranet and am fully aware of my personal responsibility both to familiarize myself with the procedures and guidelines contained within, and to make every attempt to help ensure a safe and healthy place in which we can all work.

Signed: _____ Date: _____

Name: _____ Supervisor: _____

Please return this slip to General Office of School of Biological Sciences.