LABORATORY HEALTH AND SAFETY MANUAL

for

GENERAL LABORATORY PRACTICES*

WESTERN UNIVERSITY

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*BIOLOGICAL AND RADIATION SAFETY ARE COVERED IN SEPARATE MANUALS AVAILABLE FROM OHS

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FORWARD

Under the provisions of the Ontario Occupational Health and Safety Act (the Act), the University, as an employer, is responsible for ensuring compliance with the Act and regulations, and for taking every precaution reasonable for the protection of the worker. (Section 25(2) H of the Act)

This manual provides general guidelines, procedures and requirements for the prevention of accidents and exposure to chemicals, and is considered the **minimum** for the safe operation of a laboratory at the University. It highlights sections from the Act that affect the operation of a laboratory and allows the University to meet the requirements of Section 25(2) H of the Act.

1. THE UNIVERSITY HEALTH AND SAFETY COMMITTEE

The University has five health and safety committees, as shown in figure 1 below.

Figure 1.1: Western Health and Safety Committees

The Chair of the University Health and Safety Committee is the Vice President, Resources & Operations. Four other committees report to this committee, including the Environmental and Laboratory Safety Committee

2. THE LABORATORY SAFETY COMMITTEE

Mandate

Western University Laboratory and Environmental Safety Committee is a subcommittee of the University Health and Safety Committee (UHSC) and makes recommendations to the UHSC on all matters pertaining to laboratory and environmental safety at Western. In addition to other responsibilities assigned to it by the UHSC this committee will be responsible for reviewing the operational safety of both teaching and research laboratories at the University, and for recommending policies and procedures to improve health and safety in these areas. It is intended to provide a mechanism whereby knowledgeable input from laboratory practitioners and others is received, reviewed and utilized to advise the UHSC on health and safety matters specific to laboratories and the environment.

Terms of Reference

1. To make recommendations to the University Health and Safety Committee on actions and/or policies related to laboratory and environmental safety at Western University.
2. To assess the impact of new and existing safety and environmental policies and procedures.
3. To monitor and promote compliance with the established policies and procedures as set out in the most current version of the University Laboratory Safety Manual.
4. To have specific responsibility to develop and recommend policies, standards and general direction for the safe storage, use, handling and disposal of hazardous materials in laboratories within the context of the Occupational Health and Safety Act or regulations pursuant to that Act.

5. In collaboration with the University Health and Safety Consultant to review, recommend and act as an expert resource for laboratory and environmental safety education and training programmes at Western.
6. To make recommendations to the University with respect to the appropriate institutional occupational health programmes required to achieve the outcomes stated above.
7. If the Environmental and Laboratory Safety Committee makes a recommendation that has cost implications to capital or operational budgets, this recommendation will be forwarded to the University Health and Safety Committee for further consideration. All such recommendations will clearly outline the purpose and rationale of the recommendation and all potential costs associated with it.

Membership

1. Voting:

   Office of Vice-President Research (1) – Chair
   (appointed by the Vice President Research)

   The following appointed by the appropriate Dean:

   Faculty of Engineering (1 Faculty member)
   Faculty of Health Sciences or Social Science (1 Faculty member)
   Faculty of Medicine and Dentistry (1 Faculty member)
   Faculty of Science (1 Faculty member)

   2 Staff members who have assigned work in laboratories
   (one appointed by PMA and one appointed by UWOSA)

2. Non-voting:

   Health and Safety Consultant
   Director, Occupational Health and Safety
   Facilities Management and Capital Planning Services representative
   Departmental Chair (appointed by a Dean)
   Graduate Student representative

Term

Voting members will be appointed by the Deans of Faculties represented for a maximum of 3 years, renewable.

Quorum

Four (4) voting members must be present.

3. THE LABORATORY SAFETY PROGRAM

- The Health and Safety Consultant (laboratory) is responsible for administering the laboratory safety program on a day to day basis, for providing technical advice on safety procedures, equipment and relevant regulations
- The key component of the laboratory safety program is the Laboratory Self Assessment Checklist which is to be completed for each research laboratory at Western. The purpose of the checklist is to help researchers look at their laboratories and ensure they are following all applicable legislation, policies and guidelines, e.g. The Occupational Health and Safety act, Ontario Fire Code etc.
- The checklist is completed online, please contact OHS ext 84741 or e-mail amccuske@uwo.ca for the link to the checklist.

4. DEFINITIONS

4.1 Teaching Laboratory

A laboratory where a group of students simultaneously receive instruction in, and perform experimental procedures associated with a formally approved Western academic course.

4.2 Research Laboratory

A laboratory set up primarily to conduct research and to train individuals in advanced laboratory practice.

4.3 Supervisor

A person who has charge of a workplace or authority over a worker (the Act Sec 1(1).) At the University this includes all principal investigators, faculty and staff who administer a laboratory. This definition is further expanded in the Occupational Health and Safety Guide for Supervisors, which is available from the Occupational Health and Safety (OHS) section of the Human Resources website. Specific duties are outlined in this manual.

4.4 Laboratory Worker

At the University this includes all individuals who perform procedures in a laboratory. Some of these individuals may have supervisory functions.

4.5 Unattended Procedures

A procedure or piece of equipment that is left operating, either without anyone present in the laboratory or without the personnel present being aware of its existence.

4.6 Hazardous Agent

Any physical, chemical, radioactive, or biological agent that may pose a health or safety hazard to those exposed.

5. RESPONSIBILITIES

Everyone entering or using a laboratory has responsibility for safety. These responsibilities ensure the safety of each lab and persons therein. It is important that all policies, procedures and guidelines are followed. The responsibilities of each person are outlines below

5.1 Supervisor Responsibilities

The supervisor of a laboratory is responsible for the overall safety of the laboratory. It is required that monthly formal safety and housekeeping inspections be conducted by the supervisor with records of these inspections, kept on file, according to the Supervisor Inspection Guidelines. The Supervisors Health & Safety Inspection Guidelines and Inspections Templates can be found on the OHS webpage.

The supervisor is responsible for the following, prior to any work being performed by a new laboratory worker:

- Ensuring all workers complete WHMIS training before commencing work and that they attend the prescribed training provided by OHS (see OHS Training. Matrix)
- Ensuring that an appropriate safety orientation be given to individuals when they are first assigned to a laboratory space and a record of this kept on file.
- Ensuring that workers are aware of safety rules specific to the lab and follow them; and
- Ensuring that training on special or unusual hazards in non-routine work has been provided to laboratory workers. A record of this training must be kept on file.

In addition, the supervisor is responsible for the following:

- Completing a position hazard communication form, available from the Workplace Health Website and reviewing it with the employee;
- Ensuring that adequate emergency equipment, in proper working order is readily available.
- Ensuring that training in the use of laboratory specific emergency equipment and emergency response has been provided and a record of this training is kept on file.
- Completing an accident/incident investigation report for every accident or incident; that occurs in her/his lab. Examples include: accidents requiring first aid, spills, fires, explosions, and near misses;

- Appointing an appropriate alternate supervisor when the laboratory supervisor is absent. If alternate supervisor is not appointed, the departmental chair will assume responsibility for the lab.

- Posting appropriate cautionary signage (in consultation with OHS) (see Warning Sign Book)

5.2 Laboratory Worker's Responsibilities

Every laboratory worker is responsible for:

- Attending all applicable training courses offered by OHS

- Following all applicable safety rules, guidelines and safe work practices outlined in this manual and as directed by the supervisor

- Using and wearing personal protective equipment according to instructions

- Reporting all accidents/incidents to their laboratory supervisor

- Reporting all unsafe conditions to their laboratory supervisor, see Hazard Reporting

- Completion of recommended occupational health screening programs as required by legislation.

5.3 Visitors

All laboratory visitors must:

- Dress appropriately, as required by the laboratory.

- Wear the personal protective equipment required to be worn in the laboratory.

- Be accompanied by a Western representative who is responsible for them in the case of an emergency. The Western rep is either the person being visited or as assigned by the lab supervisor

- Follow the rules and procedures of the laboratory.

Anyone unable to comply with the above will not be allowed entry into the lab.

6 GENERAL PRINCIPLES

Every laboratory worker and supervisor must:

- Not store or consume food and beverages in the lab.
- Use equipment for its designed purpose only.
- Inform the laboratory supervisor of any unsafe condition.
- Know the location and correct use of all available safety equipment.
- Determine potential hazards and appropriate safety precautions before beginning new operations and confirm that existing safety equipment is sufficient for this new procedure.
- Avoid disturbing or distracting another worker while he/she is performing a laboratory task.
- Ensure visitors to the laboratory are equipped with appropriate safety equipment (see 5.3)
- Be certain all hazardous agents are stored correctly and labelled correctly according to WHMIS requirements.
- Use proper procedures when handling or manipulating all hazardous materials. Before using an unfamiliar chemical, determine the precautions that need to be taken by consulting with your supervisor, the msds and the material label. See Section 10.6 (Handling Procedures for Highly Toxic Chemicals)
- Follow proper waste disposal procedures as outlined in the Hazardous Materials Management Handbook.

7 HEALTH AND HYGIENE

All laboratory personnel must:

- Wear appropriate eye protection, as outlined in the Eye Protection Program. (Ont. Reg. 851 Sec. 81 see Eye Protection Program.)
- Use other protective equipment as required.
- Confine long hair and loose clothing. (Ont. Reg. 851 Sec. 83)
- Use a proper pipetting device (absolutely no pipetting by mouth).

- Avoid exposure to gases, vapours, aerosols, and particulates by using a properly functioning laboratory fumehood.

- Wash hands upon completion of laboratory procedures and remove all protective equipment including gloves and lab coats before leaving the laboratory. (Ont. Reg. 851 Sec. 134).

- Consume and store food and beverages only in properly designated areas and not in the laboratory (Ont. Reg. 851 Sec. 131).

8. BASIC SAFETY

8.1 Unattended Procedures

- Unattended procedures should be kept to a minimum.

- The procedure must be thoroughly reviewed and all hazards known and corrected before a procedure can be left unattended

- An unattended procedure should be visited periodically and a sign posted outlining the procedure with the name and phone number of a contact person. The sign should indicate the date and time the procedure was commenced and when it is expected to be completed.

- Unattended procedures using cooling water must have the hoses securely attached and the water adjusted to the minimum flow necessary. Ensure plumbing drains are clear before leaving the procedure.

8.2 Working Alone

In an academic institution, there will be people working after hours and on occasion working alone. In research laboratories special precautions must be taken to prevent injury.

- Working alone should be avoided. Someone must always be within calling distance when a laboratory procedure is being performed.

- Work with hazardous materials or procedures must never be done alone; at least one other person must be present at all times.

- The supervisor is to inform personnel of any material or procedure that may not be used by a person working alone

The supervisor must ensure that the person is familiar with the procedure being used, that the procedure is reviewed and hazards are known.

8.3 Housekeeping

- Work areas such as lab benches, must be kept clean and free of obstructions (Ont. Reg. 851 Sec. 11). Clean the work area upon completion of an experiment or at the end of the day.

- Stairways and halls must not be used for storage. This applies to both equipment and personal property i.e. bicycles. (Ont. Fire Code)

- Walkways and aisles in laboratories must be kept clear of obstructions.

- Access to emergency equipment and exits must never be blocked. (Ont.Reg.851 Sec.120 & 123(2))

- Equipment and chemicals must be stored properly. (Ont. Reg. 851 Sec.45)

- Chemical spills must be dealt with immediately and if safe to do so, be cleaned up by the chemical user (see section 11.6 of this manual)

- Waste must be placed in appropriate, labelled containers (See Hazardous Materials Management Handbook)

- Old or unlabelled materials must not be allowed to accumulate and must be disposed of immediately upon identification. (See Hazardous Waste Disposal Procedures).

8.4 Laboratory Equipment Maintenance

Laboratory equipment must be inspected and maintained by a qualified person. The frequency of the inspection depends on the hazard posed by the equipment, the manufacturer's instructions, or as required by regulations. Records of the maintenance must be kept on file by the laboratory supervisor

8.5 Guarding

All mechanical equipment must be adequately guarded to prevent access to electrical connections or moving parts (Ont. Reg. 851 Sec. 25). All centrifuges must be fitted with an interlock so that they cannot be accessed while moving or started while open (Ont. Reg. 851, Sec. 31).

8.6 Shielding

- Use appropriate shielding whenever an operation involves chemicals with the potential for explosion or severe splashing. Examples include:

    - When a reaction is attempted for the first time

- When a familiar reaction is carried out on a larger scale than usual
- Whenever operations are carried out under non-ambient conditions; or
- Whenever a severe splashing potential exists for corrosive materials (Ont. Reg. 851 Sec. 89).

- Shielding or equivalent precautions are to be used when working with non-ionizing radiation sources, magnetic and other fields. Examples include:
  - Lasers
  - Infrared radiation
  - Ultraviolet radiation
  - Microwave radiation

  Refer to the Radiation Safety Manual for shielding of ionizing radiation sources.

- Appropriate shielding is required when using equipment with thermal hazards.

8.7 Glassware

- Repair or dispose of any damaged glassware.
- Ensure adequate hand protection is used when working with glass tubing
- Tape permanent vacuum glassware which presents an implosion risk with either electrical or duct tape or use appropriate shielding. (Ont. Reg. 851 Sec. 84(b&f))
- Wear appropriate hand protection when picking up broken glass.
- Ensure proper instruction is given for the use of specialized glassware.
- Dispose of broken glass in properly labelled plastic or metal containers, which are not used for other garbage. Or use a commercially available disposable glass disposal container.
- Dispose of contaminated glassware as recommended by the Hazardous Materials Management Handbook.

8.8 Flammable and Combustible Material Hazards

- Use a flame only as long as necessary and extinguish it when done.
- Do not use an open flame to heat flammable or combustible materials. It is generally not recommended to perform a distillation at reduced pressure using an open flame due to the possibility of local superheating
- Remove all flammable and combustible materials from the work area before lighting a flame.
- Notify all others in the lab and note any procedure using flammable and combustible gases and liquids before lighting a flame
- Store all flammable and combustible materials according to the Storage and Dispensing of Flammable and Combustible Liquids in Laboratories Policy
- Avoid open flames; use non-sparking equipment and adequate ventilation if a flammable atmosphere may be generated, for example when dispensing flammable or combustible solvents (Ont. Reg. 851 Sec.63)

8.9 Cryogenic Materials and Cold Traps

Cryogenic liquids such as liquid helium and liquid nitrogen have hazards associated with them arising from either the low temperature or the gas that evolves when they boil. These hazards include:

- Cold burns or frostbite from contact with liquid
- Fire/explosion due to the creation of an oxygen rich atmosphere
- Asphyxiation due to evaporation. E.g. a relativley small volume of liquid nitrogen spilled in a room can create an oxygen deficient atmosphere.

The following precautions are to be taken when working with cryogenic materials.

- Wear thermally insulated gloves and a face shield when preparing or using a cold trap below - 70 ^{o}C or cryogenic liquids
- Never use liquid nitrogen or liquid air as a cold trap to collect a flammable or combustible material mixed with air. Oxygen may condense from the air and lead to an explosion hazard

- Always use a Dewar vessel designed for cryogenic liquids not a regular domestic vacuum flask or a sealed container that is not rated for the purpose as pressure can build up and cause the vessel to explode.

- Use appropriate gloves when handling cryogenic materials, including dry ice

- Dry ice/solvent cooling baths should be prepared carefully by the slow addition of small amounts of the solid dry ice to the solvent to avoid excessive frothing and overflow of the solvent

- Never lower your head into a dry ice chest since a high level of CO_2 may accumulate there posing an asphyxiation hazard.

Liquid nitrogen is the most commonly used cryogenic liquid at Western. 1L of liquid nitrogen will generate 682L of nitrogen gas which is a concern when it is used in a room where the amount of nitrogen gas released is enough to displace the oxygen in the room air. This Oxygen Depletion Calculator can be used to determine the extent of oxygen depletion resulting from a release of liquid nitrogen into a room.
If the total amount of liquid nitrogen could deplete the oxygen content to below 18% an oxygen monitor must be installed in the room. The monitor must alert people of the hazard from outside of the room so that a person cannot inadvertently enter the room.

8.9.1 Transportation of cryogenic liquids in elevators

If an elevator must be used for transporting cryogenic liquids the liquid must be transported in an unoccupied elevator. The following steps must be taken to prevent persons from travelling in the elevator while a cryogenic liquid is being transported.

- Cryogenic liquids may only be transported in elevators that have been designated for this purpose. Signs will be attached beside the elevator indicating that it may be used to transport cryogenic liquids and that no person may enter the elevator while the cryogenic liquid is being transported.

- While in transit, a sign will be attached to the container indicating the hazard.

- In elevators where card access can be used to control the elevator the card access will be used to send the elevator to the required floor where the container shall be removed before the elevator is allowed to move again.

- Where there is no card access control of the elevator, a sign will be attached to the container warning people not to enter the elevator and a second person will be waiting at the receiving floor to remove the container from the elevator.

- Suppliers of cryogenic materials are required to follow these steps or follow their own procedures if they have additional requirements.

8.10 Systems Under Pressure

- Never heat or carry out a reaction in a closed vessel unless it is designed or tested to withstand the expected pressure of the reaction.

- Pressurized equipment must have an appropriate pressure release valve.

- Pressurized equipment must be shielded, guarded, or designed to protect the operator against potential explosions.

8.11 Back Flow Prevention

All water faucets to which a hose is attached in a laboratory must be equipped with an appropriate back flow preventer (Ont. Building Code). This prevents the contamination of the drinking water system.

Contact Facilities Management Department (PPD) at 83304 for installation.

8.12 Electrical Equipment and Apparatus

- All electrical installations must conform to the provisions of the Power Commission Act of Ontario.

- All electrical equipment must have certification when purchased or be approved after arrival on site. Certifications and approvals must be from an organization acceptable to the Electrical Safety Authority of Ontario. Refer to Western Electrical Equipment Guidelines (Appendix 1).

- Extension cords must not be used for permanent installations. CSA approved power bars may be used. Contact PPD (ext 83304) for further information or to arrange installation or relocation of outlets closer to the location of the equipment.

- Do not use electrical equipment in the vicinity of wet locations. In all cases, whenever possible, the use of electrical equipment in proximity to conductive liquids should be avoided and every reasonable effort should be undertaken to avoid such exposure. When exposure is unavoidable, pieces of hard wires and/or cord connected electrical equipment that has the likelihood of being exposed to unusual amounts of conductive liquid should be protected by a portable, commercially available or hard wired Ground Fault Circuit Interrupter (GFCI).

- Only trained, qualified personnel may repair or modify electrical or electronic equipment.

8.13 Compressed Gas Cylinders

All compressed gases have two potential health and safety hazards: pressure hazards; and other hazards related to the chemical properties of the gas. Take precautions to protect personnel from both of these potential hazards (See Appendix 5).

- All gas cylinders, empty or full, must be properly secured so that they cannot be knocked over. Cylinders with safety caps in place may be secured together. All others must be secured separately. (Ont. Reg. 851 Sec. 49)

- Compressed gas cylinders must be transported capped and chained on appropriate carts.

- Always wear eye protection when working with compressed gases.

- Always use the appropriate regulator for the gas being used. The regulator should be inspected each time before use, as recommended by the manufacturer. Note: Failure of either the diaphragm or the regulator can occur unexpectedly. Be prepared. When opening the main valve of a compressed gas cylinder do not stand over the main valve or behind or in front of the pressure gauge(s). These are the most probable locations for failure.

- Ensure the tubing and the apparatus downstream from the regulator are designed to withstand the pressures intended to be delivered. The tubing and other components should also be chemically resistant to the gas being used.

- Never use PTFE (Teflon) tape, other lubricants or sealant when installing a regulator. The recommendation of commercial gas suppliers is that regulator fittings in good condition do not require additional sealants.

- Ensure all installations are designed to prevent the hazardous combination of gases except as required by the use.

- Take appropriate precautions to prevent exposure of yourself or others to the other hazardous properties of the gas used. Consult the MSDS.

- Compressed gas cylinders have a finite shelf life. Ensure cylinders are regularly inspected. Any cylinder that is corroded or has damaged valve components should be returned to the supplier. All cylinders older than ten years must be returned to the manufacturer. Manufacturers of corrosive gases recommend that cylinders of corrosives be replaced every six months to guard against valve failure.

8.14 Service Animals in Laboratories

- If a person wishes to enter a laboratory accompanied by their service animal, the laboratory supervisor should contact Occupational Health and Safety. A Health and Safety Consultant will evaluate each case as it arises to determine the risk to people, animals or the research.

Click http://accessibility.uwo.ca/ for information regarding Accessibility at Western

9 .WORKPLACE HAZARDOUS MATERIALS INFORMATION SYSTEM (WHMIS)

9.1 Labelling

All containers of materials in a lab must be labelled. All WHMIS controlled products must be labelled with one of the following labels:

- A manufacture's label - either a WHMIS supplier label or a WHMIS lab supply house label

Or

- A Western WHMIS workplace label, OHS has a limited supply.

Or

- A label with the full chemical name for containers of less than 100 ml or 100 g in a research lab. (Ont. WHMIS Reg. 860 Sec 8,9 & 10

Or

- A Western waste disposal label, contact OHS at 84747 for a supply.

9.2 Inventory Requirements

- An inventory of all hazardous materials must be kept for each laboratory.
- The inventory must include full chemical name; room number, storage location; and normal quantity.
- As a minimum, the inventory must be updated annually or when a major change occurs in the laboratory inventory. An electronic copy of the inventory is to be sent to OHS.

9.3 Material Safety Data Sheets

- All laboratory personnel must have ready access to a material safety data sheet (MSDS) for each material they use or may be exposed to.
- Ont. Reg. 860 Sec. 17(3) requires that MSDS be less than 3 years old.
- The content of the MSDS must conform to the WHMIS requirements.
- It is the responsibility of the laboratory supervisor to ensure that the correct MSDS is readily available to all personnel (Ont. Reg. 860 Sec. 17).
- Material safety data sheets should be obtained from the supplier. The OHS Web page has links to useful MSDS websites
- See Appendix 3 for WHMIS Classifications

9.4 Training

- The laboratory supervisor will provide specific training on location of emergency equipment and facilities; specific hazards of chemicals or processes; and on the hazards and safe operation of specialized equipment.

- **All** personnel in a laboratory where hazardous agents are present must receive necessary university safety training at the next appropriate session from the commencement of employment. The minimum safety training required at Western is:

  a) A New Worker Safety Orientation specific to the position;

  b) WHMIS (Ont. WHMIS Reg.860);

  Both a) and b) must be completed prior to the worker commencing work in a laboratory.

  c) Laboratory Safety; and Environmental Waste Management Workshop

  d) Employee Safety Orientation

  Note: The laboratory supervisor is responsible for ensuring **all** personnel in the laboratory have received training (OH&S Act of Ont. Sec. 27).

- Additional training will be required if Biohazardous or Radioactive agents are used. Please refer to the Training Requirements Matrix For details of all training sessions that are available from OHS

- All laboratory supervisors must attend the Faculty/Supervisor Responsibilities Seminar

- All training outlined in (b), (c) & (d) above will be provided by OHS. OHS will maintain training records; however the supervisor (or department) must keep training records on file.

- It is the responsibility of the individual as well as the supervisor to ensure that WHMIS training is repeated every three years as required by the WHMIS Reg 860.

9.5 Waste Disposal

Refer to the current edition of the Hazardous Materials Management Handbook. If there are further questions, contact OHS at 84747.

9.6 Warning Signs

- All laboratories must be posted with warning signs in accordance with the Western Warning Signs Book. If there are further questions, contact OHS at 84741.

- Emergency equipment must be identified with an appropriate sign. E.g. eyewash, safety shower, fire extinguishers etc.

10. HYGIENE PRACTICES

10.1 Chemical Storage, Transportation and Disposal

- All chemicals must be labelled properly (Section 8.1) and shall be stored according to compatibility groups (Appendix 3).

- Chemical storage shelves must be designed for the anticipated load and should be made of materials resistant to the chemicals being stored Chemically resistant plastic trays can be placed under stored materials, which have chemical properties that are incompatible with the shelving material.

- It is advisable that all shelves have a lip or equivalent to prevent materials from falling off. New shelving for chemical storage must include this feature. It is advisable that fridge shelves have a lip or that breakable containers be stored in trays to prevent them from falling out when the door is opened.

- Hazardous chemicals in breakable containers such as: highly toxic materials (cyanides, neurotoxins); flammables (diethyl ether, acetone); liquid corrosives (mineral acids); or shock sensitive materials (perchlorate salts) should be stored in such a manner that the risk of breakage is minimized. It is advisable that all chemicals in glass containers or those weighing more than 500g not be stored higher than 2 metres from the floor.

- Laboratories are encouraged to purchase only limited quantities of chemicals they need for immediate use. Long term storage of chemicals is not advised.

- Laboratories must maintain an up to date inventory. The condition of stored chemicals must be checked annually. Those chemicals which are no longer needed should be disposed of as soon as possible (see Hazardous Materials Management Handbook).

- Do not store chemicals in direct sunlight or near heat sources.

- In general, the storage of flammables in any refrigerator is not advised and should be kept to a minimum. Regular domestic refrigerators must not be used for the storage of flammable solvents. This type of refrigerator contains ignition sources

such as the door light switch and the thermostat. Refrigerators specially designed or properly modified to exclude ignition sources inside the cabinet should be used for the storage of flammable solvents when cold solvents are needed.

- Flammable solvents and highly corrosive acids and bases must be transported in an appropriate container. Appropriate containers are available in Chemistry Stores.

10.2 Flammable Solvents

For details of flammable solvent storage, refer to - Policy on Storage and Dispensing of Flammable and Combustible Liquids in Laboratories.

10.3 Fumehoods

Laboratory fumehoods serve to contain and exhaust toxic, offensive, or flammable vapours from the laboratory. With the hood sash lowered, a fumehood provides a physical barrier between the laboratory worker and the chemical reaction. **Note: Laboratory fumehoods are not intended as protection from explosion.** Where the risk of an explosion exists, additional measures must be taken for protection. Apparatus used in hoods should be fitted with condensers, traps or scrubbers to contain or collect to the extent possible waste solvents or toxic vapours. The hood is not a means of disposing of chemicals. No work involving harmful micro-organisms is to be done in a fumehood; this work must be done in an appropriate biological safety cabinet.

Procedures outlined in this document do not apply to biological safety cabinets, which are not designed for chemical usage. They are intended to prevent biological materials from escaping the cabinet and to prevent the contamination of biological samples inside the cabinet. Biological safety cabinets used at MRC Level 2 or higher must be certified annually. For further information, contact OHS at 81135.

- Laboratory fumehoods must be evaluated by the user before each use (minimum monthly) to ensure that they are working properly. Some form of continuous monitoring device for adequate flow should be present and checked before use. In the absence of a built-in flow indicator, a strip of tissue on the bottom of the sash will serve as a flow indicator. The airflow across the face of the hood should be 100 fpm +/- 20 %. If there are any questions about the proper operation of the fumehood or the air flow in the fume hood contact Facilities Management at 83304 and have the flow monitored. Contact OHS at 84741 if chemical contaminants have escaped into the lab area or if health and safety is a concern.

- No modification or new devices may be connected to an existing fumehood system without the approval of PPD, who will maintain documentation on any changes.

- Except when making adjustments to equipment and carrying out manipulations inside the hood, the sash should be kept closed. When making these adjustments, the sash should be raised between 30 and 45 cm.

- Equipment and apparatus should be placed at least 15 cm inside the front face of the fumehood and if possible raise equipment a few centimetres This reduces turbulence along the face and thus prevents the loss of contaminants into the laboratory.

- Obstructions: Keep slots of fumehood baffles free of obstruction at all times, this includes any visible dust accumulating on the walls and around the slots. Care should be taken by uses to ensure that lightweight materials such as paper, aluminium foil or paper towel is not sucked up or causes a restriction of the exhaust duct flow.

- Laboratory fumehoods are not intended for chemical storage. This may interfere with the airflow and also adds additional hazard in the event of an uncontrolled reaction. Chemical bottles and waste containers should only be present in the hood when they are being used. They must be stored elsewhere. In special circumstances hoods can be used as storage only and these must be clearly posted.

- Fumehoods must be left running at all times. Lower the sash as much as possible for maximum hood performance and energy conservation. Close the sash when you are not using the fumehood and at the end of the day.

- It is highly recommended and best practice that all operations involving the following WHMIS hazard classes are performed in a functioning fumehood.

    - Class B, Flammable and Combustible Materials
    - Class C, Oxidizing Materials
    - Class D1 a & b, Materials with Immediate and Serious Toxic Effects
    - Class D2 a, Materials with Other Toxic Effects
    - Class E, Corrosive Materials
    - Class F, Dangerously Reactive Materials - See Appendix 5

- Fumehoods are evaluated annually by PPD and tagged appropriately.

- If maintenance or repairs are to be carried out on a fumehood, the supervisor must ensure that it has been cleaned and all chemicals have been removed from the fumehood and all cupboards underneath. See PPD

For further information, see Appendix 6 - Laboratory Fume Hood Containment Systems Use and Maintenance Guide

10.4 Air Monitoring

If there are questions about the presence of airborne contaminants from laboratory operations, contact OHS at 81135. An OHS staff member will conduct a survey and take samples as required.

10.5 Personal Protective Equipment (PPE) – General

- Personal protective equipment appropriate to the hazards will be worn (Ont. Reg. 851 Sec. 79-86).

- The laboratory supervisor is responsible for ensuring that the correct PPE is chosen for a procedure. All personnel in the laboratory should consult with their supervisor regarding protective equipment appropriate to the individual laboratory (Ont. Reg. 851 Sec. 79).

- Personal protective equipment must not be considered the primary means of protection for the laboratory worker. Research procedures and engineering controls, such as fumehoods, must be considered first.

- OHS (84741) can provide assistance in selecting the proper personal protective equipment.

- Personal, protective equipment must be worn by all the personnel in the lab, not just those actively working. Whenever you are in the laboratory, hazards are present even if you are not actively working; from colleagues work etc. Wear the appropriate clothing at all times.

10.5.1 Gloves

- There are many different types of protective gloves available and they should be selected to offer the best resistance to the chemicals that you may be exposed. (See Appendix 7). Glove materials have different chemical resistances and should be checked with the manufacturer MSDS prior to selecting a specific type of glove.

- Select gloves of the correct size and fitting; gloves that are too small are uncomfortable and may tear whereas overlarge gloves may interfere with dexterity. In some cases, such as use of HF, it may be advisable to select gloves that can be removed very rapidly in an emergency

- Always check the integrity of the glove before starting work (even new ones) for physical damage such as tears or pin holes and for previous chemical damage: this is especially important when dealing with dangerous materials such as HF.

Use the correct technique to remove gloves before leaving the laboratory. Consider gloves to be contaminated after use and treat accordingly.

- Dispose of contaminated gloves properly.
- Do not attempt to re-use disposable gloves
- Never wear gloves outside of the laboratory or to handle telephones, computer keyboards, *etc*.
- Chemistry, Engineering and PPD Stores all carry a selection of gloves.

10.5.2 Eye Protection

- Approved safety glasses with side shields are the minimum protection required in a laboratory. See Western Eye Protection Program. Goggles and face shields may also be required for special procedures.
- Non-prescription safety glasses, goggles and forms for prescription safety eyewear may be obtained from OHS in Room 4190 Support Services Building.
- Contact lenses may be worn in laboratories. Contact lenses are not protective devices, and must be used only in conjunction with appropriate protective eyewear in eye hazard areas.

10.5.3 Skin Protection

- Clothing worn should provide maximum coverage of skin in according to the risk to which you are exposed to. The supervisor shall determine the specific requirements in the laboratory. The minimum skin protection in a laboratory in which hazardous chemicals are used requires continuous coverage from shoulders to toes including sturdy closed toed shoes that cover the entire foot.
- Many procedures require additional skin protection. In these situations, gloves, aprons and lab coats are strongly recommended.
- When lab coats are used they should be:
  a) Removed and hung up prior to personnel leaving the lab.
  b) Laundered separately from other clothing.
  c) Buttoned closed when worn.
- Rubber aprons should be worn when handling highly corrosive or reactive materials.

10.5.4 Respiratory Protection

- Under normal circumstances respirators should not be required for laboratory situations. The use of a fumehood generally eliminates respiratory hazards.

- If a respirator is required refer to the "Respiratory Protective Equipment Program".

10.5.5 Hearing Protection

If you think, you are exposed to excessive noise contact OHS at 88730. The noise level will be evaluated and appropriate recommendations made for noise reduction or protective equipment. For further information see the Hearing Protection Program

10.6 Handling Procedures for Highly Toxic Chemicals

Prior to using highly toxic chemicals, the user should consult the MSDS and/or their supervisor for appropriate precautionary measures. Below are general principles for handling these types of materials. Additional precautions may be necessary for some materials and use situations.

- Protect hands and forearms by wearing either: gloves and a laboratory coat or suitable long sleeved gloves.

- Procedures, which could result in the generation of aerosols (dusts, mists or fumes), must be conducted in a glove box that is under slight negative pressure and protected by High Efficiency Particulate Aerosol (HEPA) filters or in a fumehood. A respirator equipped with HEPA filters must be worn if exposure to particulates or aerosols is possible.

- Surfaces, which may be contaminated, must be covered with a suitable disposable bench covering.

- Wash your hands and arms immediately with soap and water unless stated otherwise on the MSDS, after working with these materials.

- Materials contaminated with these substances must be properly labelled and disposed of appropriately.

- All work surfaces where these materials are used must be thoroughly cleaned on a regular basis.

The term Highly Toxic is to some extent imprecise, and exactly how it is defined varies from one regulatory or standards body to another. A typical (and widely-used) definition follows:

Highly toxic - A chemical falling within any of the following categories:

- A chemical with a median lethal dose (LD50) of 50 milligrams or less per kilogram of bodyweight when administered orally to albino rats weighing between 200 and 300 grams each.
- A chemical with a median lethal dose (LD50) of 200 milligrams or less per kilogram of body weight when administered by continuous contact for 24 hours (or less if death occurs within 24 hours) with the bare skin of albino rabbits weighing between 2 and 3 kilograms each.
- A chemical that has a median lethal concentration (LD50) in air of 200 parts per million by volume or less of gas or vapour, or 2 milligrams per litre or less of mist, fume or dust, when administered by continuous inhalation for 1 hour (or less if death occurs within 1 hour) to albino rats weighing between 200 and 300 grams each.

There are many references available detailing chemical toxicity, these include: Ont Regulation 833; Control Of Exposure To Biological Or Chemical Agents . the NIOSH Chemical Hazard Guide and the CCOHS website are some examples.

10.7 Handling Procedures for Corrosive Materials

Corrosive materials cause destruction of tissue through chemical action at the point of contact. As corrosive chemicals can be liquids, solids, or gases, corrosive effects can affect the skin, eyes, and respiratory tract. Examples of corrosive chemicals include: liquids such as acids and bases, bromine, and hydrogen peroxide; gases such as chlorine and ammonia; and solids such as phosphorus and phenol.

Before handling corrosive materials:

- Users must be specifically trained in the use of each chemical.
- Users must be trained in the use and location on emergency equipment.
- Workers must consult the valid Material Safety Data Sheet (MSDS) for the material(s) being used; a valid MSDS is provided by the supplier of the material and has been issued within the past three years.

While handling corrosive or any incompatible materials:

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- A properly functioning fumehood must be used.
- Personal protective equipment (PPE) including chemical splash goggles, splash shield, gloves and protective clothing must be worn as specified in the PPE section of the MSDS.
- Additional protective clothing (i.e., apron, oversleeves) is appropriate where chemical contact with body and/or skin is possible.
- Do not pour water into acid. Slowly add the acid to the water and stir.

- Do not allow residue to build up, wipe drips from containers and bench surfaces especially. Skin contact with dry residue will result in burns

Storage of corrosive materials:

- Store all chemicals according to their compatibility group (Appendix 3).
- Special storage may be required, consult the MSDS
- Secondary containment is recommended.
- If not in specific acid or base cabinets, store all corrosive materials on the shelves closest to the floor level.

Waste procedures:

All chemical waste must be collected and disposed of according to the Hazardous Materials Management Handbook. In preparation for pickup:

- Laboratories must supply and designate labelled containers for the proper segregation of waste material
- Waste collection must be included in all written laboratory procedures.

10.8 Handling Procedures for Hydrofluoric Acid

Hydrofluoric Acid (HF) is one of the strongest and most corrosive acids found in the laboratory. Therefore, special safety precautions are necessary when using this chemical. Anyone using HF must implement the following safety measures. These precautions apply to both concentrated and dilute solutions. HF burns penetrate deeply into skin and muscle tissue and can't be treated by simply flushing the area with water.

- Prior to using HF for the first time, all users must be trained in its use.

- Read the Material Safety Data Sheet (MSDS) for the product or reagent that contains Hydrofluoric Acid.

- Personal protective equipment (PPE) must be used and it must provide effective protection against HF exposure. Always check protective gloves for holes and degradation.

- Before using HF, be sure that you know the first aid measures that need to be taken in the event of exposure (see below). **First aid and medical treatment for HF exposure is very specific and critical.**

- As it reacts with glass, waste HF must be collected in a Teflon container.

Hydrofluoric Acid First Aid

BEFORE beginning work with Hydrofluoric Acid ensure:

HF Antidote Gel (calcium gluconate) is available in the laboratory and you have read the instructions for use.

- Hydrofluoric acid is corrosive and can cause severe burns.
- Contact with skin may not cause pain immediately.
- Appearance of symptoms can be delayed for up to 24 hours.

First aid must be started immediately following **any** exposure to hydrofluoric acid (HF). Medical attention must be sought in all cases, regardless of the amount or concentration involved.

Skin Exposure:

- Immediately remove contaminated clothing and flush skin with water for at least 15 minutes using a safety shower.
- Apply **calcium gluconate gel** to affected area.
- Massage and reapply gel for at least15 minutes after pain subsides **while seeking medical attention.**
- Nitrile gloves should be worn to prevent secondary burns.

Eye Contact:

- Flush with water for at least 15 minutes using an eyewash.
- Seek medical attention immediately.
- **Do not** apply calcium gluconate gel to eyes

Inhalation

- Remove to fresh air.
- Seek medical attention immediately.

Ingestion

- Seek medical attention immediately.
- **Do not** induce vomiting.
- Drink water or milk.

11. EMERGENCY EQUIPMENT AND PROCEDURES

Ensure all laboratory personnel are familiar with all emergency procedures, which pertain to the building or facility. In addition, individual laboratories must develop procedures for specific significant hazards. Consult the emergency procedures posted beside each pull station.

11.1 Emergency Phone Numbers

Campus Community Police Department (CCPD) must be contacted at 911 (from a campus phone) in the event of any type of emergency. Explain the situation and they will contact the appropriate emergency service (police, fire, ambulance and student emergency response team). Contacting CCPD will allow them to direct the outside service to the proper campus location. See UWO Policy 1.3 – Policy on Emergency Response and Preparedness

11.2 Emergency Equipment

- An eyewash and safety shower must be accessible at all times in all areas where chemicals dangerous to the skin and eyes are used. Personnel must not have to travel more than 25 m (75 ft) or through more than one door, in the direction of travel to reach the eyewash/shower station (Ont. Reg. 851 Sec. 124 & 125). See, PPD&CPSD Emergency Shower and Eyewash Installations Policy

- All laboratories must be equipped with sufficient fire extinguishers of the correct type for the materials being used or produced (Ont. Reg. 851 Sec. 123). Contact Fire Prevention at 83304 for further information.

- All emergency equipment must be checked periodically. Eyewashes are flushed according to the Eyewash Inspection Program and Testing Procedure. Eyewashes/safety showers shall be tested annually by the plumbing shop of Facilities Management. Safety showers are flushed and the fire extinguishers are inspected monthly by Facilities Management Caretaking. A record of the check will be recorded on a tag attached to the equipment.

11.3 First Aid

It is the responsibility of the Laboratory Supervisor to ensure compliance with the First Aid Regulations 1101, Workplace Safety Insurance Board (WSIB) Act (located at each first aid station). It is the responsibility of the Laboratory Supervisor to ensure that all lab personnel are familiar with the location of the nearest first aid station. There must be one trained representative for each first aid station.

For emergency care and ambulance contact CCPD at 911 (from a campus phone). For care of non-serious occupational injuries contact Workplace Health at ext. 82047 in room 25 UCC.

If first aid is performed, an Accident/Incident Investigation Form must be completed by the supervisor and sent to Rehabilitation Services Room 4150 Support Services Building. For further information contact the First Aid Program Coordinator at ext. 84747.

11.4 Skin Exposure

- Wash all exposed areas for 15 to 20 minutes with running water.
- Do not use soap or detergent unless stated on the MSDS.
- Obtain further medical treatment at a hospital if irritation persists, damage is apparent or if the MSDS states that further treatment is required. Take a current copy of the MSDS along with you. Attach MSDS to persons clothing if an ambulance is required.
- Large splashes require the use of a safety shower. Safety showers are most effective when all clothing is removed.

11.5 Eye Exposure

- Flush the eyes for 15 to 20 minutes with running water. Hold the eye open while flushing.
- Always seek further medical attention at a hospital in the case of eye exposures to hazardous materials. Take a current copy of the MSDS along with you.

11.6 Chemical Spills

- The hazardous material user is responsible for cleaning up a spill. This duty must not be delegated to other staff such as caretakers. If the spill is beyond the resources or abilities of the user to cleanup, contact CCPD at 911 to activate Westerns HAZMAT team.
- In cleaning up a spill the following guide should be followed:

    a) Determine what was spilled and if the area is safe. If there is any doubt about the safety of an area or the nature of the spilled material evacuate the area using the fire alarm pull station. If the pull station is used, meet emergency personnel.

    b) Administer first aid where needed.

    c) Secure the area to prevent others from entering.

d) Gather required information such as MSDSs. Consult your supervisor and/or OHS. Carefully evaluate the situation and form an action plan.

e) Put on all required personal protective equipment.

f) Using appropriate cleanup agents, cleanup spill.

g) Dispose of residue according to Hazardous Materials Management Handbook, or contact OHS at 84747 for advice.

h) Complete an accident/incident investigation report.

Spill kits are located in each department/building; see appendix 9.

11.7 Laboratory Fires

Before using any chemicals you should familiarise yourself with all the potential fire hazards associated with the chemical. This information will be found on the MSDS in the fire & explosion and reactivity sections. The information will include the decomposition products, critical temperatures, and the most applicable type of fire fighting equipment to be used should a fire start.

If a small fire does start in a lab and is contained in a beaker, flask or other small container, and is no larger than a basketball you may attempt to extinguish the fire with the proper fire extinguisher or by smothering it. Pull the fire alarm before using the extinguisher or send someone to do so.

If the fire is not limited to a small area, if volatile or toxic materials are involved, if you are unfamiliar, are unsure of how to use a fire extinguisher, or if you have failed in your attempt to extinguish a small fire, you should GET OUT AND STAY OUT. Never enter a room if you suspect a fire inside.

- Activate the fire alarm.
- If possible close all doors that will isolate the fire from the rest of the building.
- Evacuate the building using the stairs. Do not use the elevators.
- Meet the Fire Department at the entrance of the building and explain the nature of the fire, and the identity of all possible associated hazards such as toxic fumes, explosive potential, fire extinguishing media, etc.
- Use a fire extinguisher after you have pulled the alarm, and only if you feel that the fire is small enough to be extinguished. The ABC dry chemical/multi-purpose 10-pound extinguisher is the best fire extinguisher to use in this situation.
- The supervisor must complete an accident/incident investigation report.

CLASSES OF FIRE

A Class - ordinary combustibles (wood, paper, cloth, plastic, etc.)

B Class - flammable and combustible liquids

C Class – energizes electrical fires

D Class - combustible metals

K Class – Cooking oils

TYPES OF EXTINGUISHERS

ABC Dry Chemical. This extinguisher will extinguish class A, B and C fires.

Pressurized water extinguishers will only work on A Class fires. Do not use this type of extinguisher on a charged electrical fire since electrical shock may result. When used on a flammable liquid it will cause the fire to spread.

Class D These extinguishers will work on a combustible metal fire (D Class). If you are using combustible metals, consult with Fire Prevention at extension 83304 for the proper extinguisher.

Fire extinguisher training is available from Fire Prevention and it is recommended that all persons using flammable materials attend the training.

11.8 Laboratory Doors

In laboratories where the door from the hallway into the lab has a window; the window must have a view panel that is never obscured. The purpose of the window is to prevent accidents from opening the door into a person on the other side, and to allow observation from a safer location prior to entry in case of an emergency

12. COMPLIANCE ENFORCEMENT POLICY

Western University has a primary duty under the Occupational Health and Safety Act (the Act) to "take every precaution reasonable in the circumstances for the protection of a worker". It is implicit in the legislation and in its interpretation by the Supreme Court of Canada that an employer has a positive duty to put in place a proper system to prevent the occurrence of offences under the Act and to take reasonable steps to ensure the effective operation of that system. It is therefore not enough to rely on a purely reactive stance in health and safety matters, but it is vital that health and safety be deliberately managed. All laboratories will be categorised as one of four levels of compliance reflecting the category of the most severe deficiency found during an inspection. This policy is intended as a means to categorize and give guidance for the anticipated response that is needed, when issues of non-compliance are identified by Occupational Health and Safety. All deficiencies must be corrected and reported in writing to the Health and Safety Consultant issuing the compliance order.

A compliance level four (non-compliance) would result from violations, which could increase the risk of personal injury, property damage or cause a release of chemicals to the environment or community. One of the following deficiencies would be an example of a non-compliance issue:

1. Use or storage of food/drink or smoking in the laboratory
2. Inadequate training of personnel
3. Inappropriate storage of chemicals or waste
4. Inappropriate storage/use of solvent
5. Unsafe use of equipment
6. Inappropriate personal protective equipment
7. Unlabelled chemicals

A compliance level three (requiring improvement) would be an infraction, which poses no immediate risk or threat to safety, health or the environment. One of the following deficiencies would be an example of an issue requiring improvement:

1. Inadequate signage
2. Inadequate posting
3. Inappropriate use of warning labels
4. Out of date MSDS

Level Four Compliance Actions:

1. If a lab is in a state of non-compliance a written notification will be sent by the Health and Safety Consultant to the Principal Investigator, copied to the Department Chair, the Director OHS and the Laboratory Safety Committee Chair. Immediate corrective action of the violation is required and a written reply within 7 days. If the written reply is not received after 7 days, a second notice will be sent. A meeting will be arranged with a minimum of the Principal Investigator, Department Chair and the

Health and Safety Consultant if there is no response from the Principal Investigator after 7 days of the second notice.

2. If the deficiencies leading to the non-compliance are not corrected following the meeting, the Laboratory Safety Committee (LSC) will be informed and the chair will respond on behalf of the LSC. The LSC will determine what steps will be taken including suspension of laboratory operations until the non-compliance is corrected.

Level Three Compliance Actions:

1. A written notification will be sent to the Principal Investigator, copied to the Department Chair, Director OHS and the Laboratory Safety Committee Chair. Corrective action of the violation is required, written reply in 21 days. If the written reply is not received until after 21 days, a second notice will be sent. A meeting will be arranged with at least the Principal Investigator, the Department Chair, and the Health and Safety Consultant if there is no response from the Principal Investigator after 14 days of second notice.
2. If the deficiencies requiring improvement are not corrected following the meeting, the compliance status of the lab will be change to non-compliance (Level Four) and the LSC will be informed. The chair will respond on behalf of the LSC. The LSC will determine what steps will be taken to resolve the non-compliance.

Compliance Level Legend

Compliance Level	Description
1 - Exceeds Requirements	Meets all requirements and has features that are beyond those required to meet compliance e.g. schedule of safety related tasks, descriptive labelling, original documentation or signage.
2 - Meets Requirements	Meets all requirements with no issues identified.
3 - Requires Improvement	Issues identified that do not increase risk of personal injury or property damage (e.g. poor labelling, out of date MSDS, minor housekeeping issues, poor signage)
4 - Non Compliance	Issues identified that increase the risk of personal injury or property damage (e.g. unlabelled chemicals, obstructed safety equipment, insufficient PPE, incompatible chemical storage, unsafe procedures or equipment) or failure to correct low risk issues.

APPENDIX 1

ELECTRICAL EQUIPMENT GUIDELINES

PURPOSE

The Electrical Equipment Guidelines will ensure that all electrical equipment currently in use at the university or purchased by, loaned to, demonstrated to, fabricated or modified by, or otherwise obtained by the University shall meet the provisions of the Power Commission Act of Ontario.

RESPONSIBILITY

Compliance with these guidelines is the responsibility of:

a) In the case of new equipment, the requisitioner;

b) In the case of equipment on loan or used during a demonstration, the person responsible for the equipment; or

c) In the case of equipment currently in use at the university, the budget unit head.

DEFINITIONS

a) Electrical Equipment

For the purpose of these guidelines, electrical equipment means any equipment which operates with or from a power supply of 30 (thirty) volts or greater.

b) Requisitioner

For the purpose of these guidelines, the requisitioner means the person who initiates and signs the purchase requisitions for the electrical equipment.

PROCEDURE

a) New Equipment

Western Purchasing shall state clearly on all purchase or tender documents, that all electrical equipment must be certified by a testing laboratory acceptable to the Electrical Safety Authority of Ontario.

Requisitioners of electrical equipment shall ensure compliance by inspecting the equipment upon delivery for one of the acceptable certification marks. In the event that the equipment is not approved it must not be used until a field approval acceptable to the Electrical Safety Authority.

b) Equipment currently in use

These guidelines do not apply where an electrical system is constructed for research or instruction, out of components that may be interchanged, added,

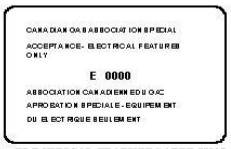
removed or altered in any way. However, any individual component of the system must be in compliance with the Program.

The Power Commission Act of Ontario prohibits the use of unapproved electrical equipment in the province, and it is therefore the responsibility of each budgetary unit to arrange for an inspection of unapproved equipment. The Facilities Management Department can be contacted to arrange for special, inspection by the Electrical Safety Authority of Ontario or other field approval testing laboratory, the cost to be borne by the budgetary unit.

Field Approval Marks

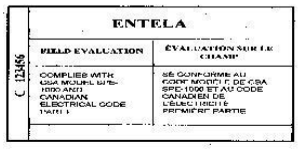
IAS

FUEL FEATURES APPROVAL



ELECTRICAL FEATURES APPROVAL

Entela



ITS

CSA

Ontario Hydro / Electrical Safety Authority

ULC

APPENDIX 2
THE ESSENTIALS OF CHEMICAL COMPATIBILITY FOR STORAGE AND SEGREGATION

Chemicals must be evaluated to determine how they are to be stored. Generally, the following groups of chemicals must be stored separately from chemicals in other groups and away from the general chemical storage.

MINERAL ACIDS

Mineral acids are incompatible with bases, flammables and oxidisers. They must be stored separately away from water sources (e.g. under sink) and in some cases from each on plastic trays.

- Examples – hydrochloric acid, hydrofluoric acid, nitric acid, sulphuric acid, phosphoric acid, chlorosulfonic acid, perchloric acid*

- *Perchloric acid should be stored with mineral acids. However, it should be kept on a tray separate from the other acids. If sulphuric acid is spilled on a wooden shelf and then perchloric is spilled in the same spot an immediate fire will result. Perchloric acid must be used in a special fumehood if used in quantities greater than 10 ml.

FLAMMABLE SOLVENTS

Flammable and combustible liquids are liquids that can burn; flammable liquids have a flashpoint of less that 37.8°C and combustible liquids have a flashpoint between 37.8°C and 93.3°C. They are to be stored according to the Storage and Dispensing of Flammable and Combustible Liquids in Laboratories Policy. They are incompatible with acids, bases and oxidisers.

- Examples: acetone, ethyl alcohol, petroleum ether, diethyl ether, benzene, acetonitrile, formamide, toluene, xylene are all flammable

- Examples of **non-flammable solvents** include chloroform, methylene chloride, and carbon tetrachloride. These do not need to be kept in a flammable storage cabinet.

- **Organic acids** such as acetic, butyric, and formic acids are combustible materials and should be stored in a flammable storage cabinet. In fact any organic acid can be stored with the flammable solvents.

INORGANIC OXIDIZERS

Inorganic oxidizers are compounds that supply their own oxygen and heat (ignition source) when in contact with organic compounds. These chemicals can react vigorously and explode.

- Examples: nitrates, nitrites, chlorates, perchlorates, periodates, permanganates, persulfates

BASES (ALKALINE MATERIALS)
Bases are incompatible with acids, flammables and oxidizers and should be stored on their own away from water sources (e.g. under sink)

- Examples: sodium hydroxide, potassium hydroxide, ammonium hydroxide, and organic amines

CYANIDE CONTAINING MATERIALS
Cyanide containing materials release hydrogen cyanide gas when mixed with acids.

- Examples: sodium cyanide, cyanogen bromide, potassium ferricyanide, potassium ferrocyanide, and sodium thiocyanate

MATERIALS REQUIRING SPECIAL STORAGE CONSIDERATIONS
Many materials in the lab are time sensitive and may become explosive with prolonged exposure to the atmosphere. It is important that these chemicals are given an expiry date and that they are disposed of when they expire. Other chemicals are shock sensitive when dry. If you have chemicals that have explosive potential, do not move them and contact OHS (84847) for proper disposal.

Picric Acid
Inspect monthly and keep wet with distilled water. Dry only the amount required for immediate use. Dry picric acid is a shock sensitive explosive and must not be move.

Peroxide Formers
Peroxide forming materials should be dated when opened and disposed of when the recommended time limit has expired.

- After 3 months - isopropyl ether, divinyl acetylene, vinylidene chloride, butadiene, chloroprene, tetrafluoroethylene

- After 12 months - ethyl ether, tetrahydrofuran, dioxane, acetal, vinyl ether, diacetylene, methyl acetylene, cumene, cyclohexene.

- Most of these materials are flammable materials and should be stored in a flammable storage cabinet.

Other Shock Sensitive Materials

- Nitro compounds, organic nitrates, acetylides, azides, diazomethane, fulminates

- Purchase these materials in small quantities and dispose of when the research project is finished.

Organic Peroxides
Purchase in small quantities, keep refrigerated, and dispose of 12 months after opening.

- Examples: benzyl peroxide, peracetic acid

Water Reactives
Water reactive chemicals must be stored according to the MSDS for the chemical and away from sources of water and steam.

- Examples: sodium and potassium metal, phosphorus pentoxide, aluminum chloride, titanium trichloride

Air Reactives (Pyrophorics)
Air reactive chemicals must be stored under an appropriate gas according to the MSDS.

- Examples: alkyl lithium compounds, Grignard reagents, white phosphorus

All other chemicals including: inorganic salts, and organic liquids and solids may be stored together.

APPENDIX 3

WHMIS CLASSIFICATIONS

WHMIS (Workplace Hazardous Materials Information System) uses classifications to group chemicals with similar properties or hazards. The Controlled Products Regulations specifies the criteria used to place materials within each classification. There are six (6) classes although several classes have divisions or subdivisions. Each class has a specific symbol to help people identify the hazard quickly. The classes are:

Class A - Compressed Gas
Class B - Flammable and Combustible Material

Division 1: Flammable Gas
Division 2: Flammable Liquid
Division 3: Combustible Liquid
Division 4: Flammable Solid
Division 5: Flammable Aerosol
Division 6: Reactive Flammable Material

Class C - Oxidizing Material
Class D - Poisonous and Infectious Material

- Division 1: Materials causing immediate and serious toxic effects
  - Subdivision A: Very toxic material
  - Subdivision B: Toxic material
- Division 2: Materials causing other toxic effects
  - Subdivision A: Very toxic material
  - Subdivision B: Toxic material
- Division 3: Biohazardous Infection Material

Class E - Corrosive material
Class F - Dangerously reactive material

Class A - Compressed Gas

Any material that is normally a gas which is placed under pressure or chilled, and contained by a cylinder is considered to be a compressed gas. These materials are dangerous because they are under pressure. If the cylinder is broken, the container can 'rocket' or 'torpedo' at great speeds and this is a danger to anyone standing too close. If the cylinder is heated (by fire or rise in temperature), the gas may try to expand and the cylinder will explode. Leaking cylinders are also a danger because the gas that comes out is very cold and it may cause frostbite if it touches your skin (for example: carbon dioxide or propane). Common examples include: compressed air, carbon dioxide, propane, oxygen, ethylene oxide, and welding gases. The hazard symbol is a picture of a

cylinder or container of compressed gas surrounded by a circle.

Additional dangers may be present if the gas has other hazardous properties. For example: propane is both a compressed gas and it will burn easily. Propane would have two hazard symbols - the one for a compressed gas and another to show that it is a flammable material.

Class B - Flammable and Combustible Material

Flammable means that the material will burn or catch on fire easily at normal temperatures (below 37.8 degrees C or 100 deg F). Combustible materials must usually be heated before they will catch on fire at temperatures above normal (between 37.8 and 93.3 deg C or 100 and 200 deg F). Reactive flammable materials are those which may suddenly start burning when it touches air or water, or may react with air or water to make a flammable gas. The material may be a solid, liquid or gas which makes up the different divisions that fall under this class. Common examples include: propane, butane, acetylene, ethanol, acetone, turpentine, toluene, kerosene, Stoddard solvent, spray paints and varnish. The symbol for this class is a flame with a line under it inside a circle.

What is a Class C - Oxidizing Materials?

Oxygen is necessary for a fire to occur. Some chemicals can cause other materials to burn by supplying oxygen. Oxidizers do not usually burn themselves but they will either help the fire by providing more oxygen or they may cause materials that normally do not burn to suddenly catch on fire (spontaneous combustion). In some cases, a spark or flame (source of ignition) is not necessary for the material to catch on fire but only the presence of an oxidizer. Oxidizers can also be in the form of gases (oxygen, ozone), liquids (nitric acid, perchloric acid solutions) and solids (potassium permanganate, sodium chlorite). Some oxidizers such as the organic peroxide family are extremely hazardous because they will burn (they are combustible) as well as they have the ability to provide oxygen for the fire. They can have strong reactions which can result in an explosion. The symbol for oxidizing materials is an "o" with flames on top of it inside a circle.

Class D - Poisonous and Infectious materials

Class D materials are those which can cause harm to your body. They are divided into three major divisions.

Division 1: Materials Causing Immediate and Serious Toxic Effects

These are materials that are very poisonous and immediately dangerous to life and health. Serious health effects such as burns, loss of consciousness, coma or death within just minutes or hours after exposure are grouped in this category. Most D-1 materials will also cause longer term effects as well (those effects that are not noticed for months or years). Examples of some D-1 materials include carbon monoxide, sodium cyanide, sulphuric acid, toluene-2,4-diisocyanate (TDI), and acrylonitrile. The symbol for Class D - Division 1 (D-1) is a skull and crossed bones inside a circle.

Division 2: Materials Causing Other Toxic Effects

These materials are poisonous as well. Their effects are not always quick, or if the effects are immediate but they are only temporary. The materials that do not have immediate effects, however, may still have very serious consequences such as cancer, allergies, reproductive problems or harm to the baby, changes to your genes, or irritation / sensitization which have resulted from small exposures over a long period of time (chronic effects).

Division 2 of Class D has two subclasses called D2A (very toxic) and D2B (toxic). While it is not a legal requirement for the WHMIS sub-classification to be reported on the Material Safety Data Sheet (MSDS) nor is it a requirement for classes D2A or D2B to be distinguished on the label, it is often possible to make this distinction using the health hazard information on the label and/or the MSDS.

Products are typically classified as D2A (very toxic) if the chemical has been shown to be carcinogenic, embryo toxic, teratogenic, mutagenic (to reproductive cells), reproductive toxic, sensitizer (to respiratory tract) or chronic (long-term) toxicity (at low doses). Subdivision D2B (toxic) covers mutagenic (to non-reproductive cells), sensitization of the skin, skin or eye irritation, as well as chronic toxic effects.

Examples include: asbestos fibres, mercury, acetone, benzene, quartz silica (crystalline), lead and cadmium. The symbol for materials causing other toxic effects looks like a "T" with an exclamation point "!" at the bottom inside a circle.

Division 3: Biohazardous Infectious Materials

These materials are organisms or the toxins they produce that can cause diseases in people or animals. Included in this division are bacteria, viruses, fungi and parasites. Because these organisms can live in body tissues or fluids (blood, urine), the tissues and fluids are also treated as toxic. Biohazardous infectious materials are usually found in a hospital,

health care facility, laboratories, veterinary practices and research facilities. Workers in these places do not usually know which tissues or fluids contain dangerous organisms. For this reason, the workers assume that every sample is dangerous and proper protection is used all the time. Examples of biohazardous infectious materials include the AIDS/HIV virus, Hepatitis B and salmonella. The symbol for this division looks like three "c"s joined together with a little circle in the middle all inside a circle.

Class E - Corrosive Material

Corrosive is the name given to materials that can cause severe burns to skin and other human tissues such as the eye or lung, and can attack clothes and other materials including metal. Corrosives are grouped in this special class because their effects are permanent (irritants whose effects may be similar but temporary are grouped in Class D-2). Common corrosives include acids such as sulphuric and nitric acids, bases such as ammonium hydroxide and caustic soda and other materials such as ammonia gas, chlorine, and nitrogen dioxide. The symbol for a corrosive is a picture of two test tubes pouring liquid on a bar (piece of metal) and a hand with lines coming off of them inside a circle.

Class F - Dangerously Reactive Materials

A material is considered to be dangerously reactive if it shows three different properties or abilities: first, if it can react very strongly and quickly (called "vigorously") with water to make a toxic gas; second, if it will react with itself when it gets shocked (bumped or dropped) or if the temperature or pressure increases; and thirdly, if it can vigorously join to itself (polymerization), break down (decomposition) or lose extra water such that it is a more dense material (condensation). If a material is dangerously reactive, it will most likely be described as "unstable". Most of these materials can be extremely hazardous if they are not handled properly because they can react in such a quick manner very easily. Examples of these products are ethyl acrylate, vinyl chloride, ethylene oxide, picric acid and anhydrous aluminum chloride. The symbol for dangerously reactive materials is a picture of a test tube with sparks or lines coming out of the tube surrounded by a letter "R" inside a circle.

Ref. Canadian Centre for Occupational Health and Safety

APPENDIX 4

CARCINOGENS

The following are references, which may help in the identification of potential carcinogens. Materials, which are thought to be carcinogenic, should only be used within a properly functioning fumehood.

- NIOSH Pocket Guide to Chemical Hazards
- NIOSH Carcinogen List
- IARC (International Agency for Research on Cancer) Monographs on the Evaluation of Carcinogenic Risk to Humans - Overall Evaluations of Carcinogenicity - Current Edition
- ACGIH (American Conference of Governmental Industrial Hygienists) TLV Handbook - (Suspect carcinogens are identified)

APPENDIX 5

COMPRESSED GASES

GENERAL CONSIDERATIONS

- Compressed gases present three potential safety problems. The first two problems are pressure and volume. A third problem is the nature of the contained gas. Fuels burn, Oxygen supports combustion and other gases may have special characteristics.

- The primary safety rule for handling compressed gas cylinders is: An empty cylinder is never out of gas. The same handling rules apply to it that applies to a full cylinder of the same gas. If the gauge reads zero and the cylinder is at sea level, the cylinder still contains gas at 14.7-psi absolute pressure.

GENERAL HANDLING RULES

- Always secure individual gas cylinders upright to secure structure such as a wall, cylinder rack or post.

- Always replace the cylinder cap when the cylinder is not in use or when it is being moved. If the valve of a high-pressure gas cylinder is accidentally broken off, the contents of the cylinder will jet from a hole about the diameter of a pencil. The escaping gas could have enough thrust to turn the cylinder into a rocket, depending on the cylinders size and weight.

- Always use an approved cart when moving a cylinder. Never drag a cylinder along the floor. For short (a few feet) moves tilt the cylinder and roll it on its bottom edge.

- If a valve will not open by hand contact the cylinder distributor. Never hammer, or pry a stuck or frozen cylinder valve to loosen it, and never use a wrench.

- Do not allow grease, oil or other combustibles to come in contact with valve threads. This is particularly important when dealing with oxidizing gases.

- Never use a gas cylinder unless the contents are clearly identified with a supplier label.

- Do not rely on the colour of the cylinder to identify the gas inside.

- Never ground a cylinder or place it near an electrical conductor, including plumbing.

- Do not transfill gas from one cylinder to another.

VALVES AND REGULATORS

- Always use the proper regulator for the gas in the cylinder. Gas regulators reduce the pressure inside the cylinder to a safe level for use. They are designed for use with specific gas, within prescribed pressure ranges. Different gases have different densities. The spring inside the regulator is designed to provide the correct flow rate for a particular kind of gas. In addition, using the wrong regulator may cause some gases to react with the materials inside the regulator. For example, materials used in some regulators are not designed for oxygen and will ignite if used for oxygen. Plaques or decals on the regulator may indicate which gas the regulator is designed for. Cylinder valve connections on regulators are also designed to minimize the chances of using the wrong regulator. Always verify that you have the correct regulator for your application.

- Always check the regulator before attaching it to a cylinder, if the connections do not fit together readily, the wrong regulator is being used. Damaged threads on the connecting nut or valve outlet can also make a regulator difficult to attach and likely to leak.

When attaching a regulator to a cylinder certain procedures should be followed in a specific sequence. Refer to the manufacturer's specifications when in doubt. The following is a general outline (specific situations may require a different sequence):

1. With all gases, wipe the outlet with a clean, dry, lint free cloth. The threads and mating surfaces of the regulator and hose connections should also be cleaned before the regulator is attached.

2. Always use a cylinder wrench or other tightly fitting wrench to tighten the regulator nut and hose connections. Using an oversized wrench, adjustable wrench, pliers or a pipe wrench may damage the fittings and make it impossible to tighten them properly. A connection problem caused by dirty or damaged threads will result in leaks when the cylinder is used. If installed correctly, once finger tight, the regulator only needs a ¼ turn with a wrench.

3. Attach the regulator securely and ensure the valve on the regulators' pressure gauge is cracked slightly before opening the main cylinder valve. This will ensure that the regulators' diaphragm seats properly once the main cylinder valve is opened.

4. When opening the main cylinder valve stand to the side, away from the regulator, crack the valve open slightly at first, to verify that the regulator's diaphragm is working, before opening the valve wide. Note: cylinder regulators have a relief device to prevent excessive pressure from developing. High- pressure cylinder regulator gauges have solid-front, safety-back construction. When subject to

excessively high pressure, the light-metal safety back will blow off to relieve the pressure.

5. Check with "snoop" for leaks.

CYLINDER STORAGE

1. Store all cylinders in a designated area. Do not store near exits.

2. Store and use cylinders on a first-in, first-out basis.

3. Never remove identifying labels.

4. Chalk "MT" or "empty" on all empty cylinders.

5. Keep fuel gas cylinders away from oxygen cylinders. They should be kept 6 m apart or be separated by a wall, minimum 1.5 m high or with a 1.5 hr fire resistance rating

6. Never store any gas cylinder where the temperature may rise above 54^{o}C.

7. Never move a gas cylinder when the regulator is in place. Place safety caps on cylinders that are being stored or moved.

8. Never try to refill cylinders, to mix gases in a cylinder or to transfill gas from one cylinder to another.

9. If a cylinder develops a leak or the main valve sticks open, evacuate the area. Then contact CCPD at 911 and the cylinder supplier.

APPENDIX 6

LABORATORY FUME HOOD CONTAINMENT SYSTEMS

USE AND MAINTENANCE GUIDE

DEVELOPED JOINTLY BY:

FACILITIES MANAGEMENT DEPARTMENT

AND

OCCUPATIONAL HEALTH AND SAFETY

FUMEHOOD USER'S GUIDE

PREAMBLE

Laboratory fumehoods serve to contain and exhaust toxic, offensive, or flammable vapours from the laboratory. With the hood sash lowered, a fumehood provides a physical barrier between the laboratory worker and the chemical reaction. **Note: Laboratory fumehoods are not intended as protection from explosion.** Where the risk of an explosion exists, additional measures must be taken for protection. Apparatus used in hoods should be fitted with condensers, traps or scrubbers to contain or collect to the extent possible waste solvents or toxic vapours. The hood is not a means of disposing of chemicals. No work involving harmful micro-organisms is to be done in a fumehood; this work must be done in an appropriate biological safety cabinet.

Procedures outlined in this document do not apply to biological safety cabinets, which are not designed for chemical usage. They are intended to prevent biological materials from escaping the cabinet and to prevent the contamination of biological samples inside the cabinet. Biological safety cabinets used at MRC Level 2 or higher must be certified annually. For further information contact OHS at 81135.

- Laboratory fumehoods must be evaluated by the user before each use (minimum of monthly) to ensure that they are working properly. Some form of continuous monitoring device for adequate flow should be present and checked before use. In the absence of a built-in flow indicator a strip of tissue on the bottom of the sash will serve as a flow indicator. The airflow across the face of the hood should be 100 fpm +/- 20 %. If there are any questions about the proper operation of the fumehood or the air flow in the fume hood contact Facilities Management Service Centre at 83304 and have the flow monitored. Contact OHS at 84741 if chemical contaminants have escaped into the lab area or if health and safety is a concern.
- No modification or new devices may be connected to an existing fumehood system without the approval of PPD, who will maintain documentation on any changes.
- Except when making adjustments to equipment and carrying out manipulations inside the hood, the sash should be kept closed. When making these adjustments, the sash should be raised between 30 and 45 cm (12 to 18 in.).
- Equipment and apparatus should be placed at least 15 cm (6 in.) inside the front face of the fumehood. This reduces turbulence along the face and thus prevents the loss of contaminants into the laboratory.
- Obstructions: Keep slots of fumehood baffles free of obstruction at all times, this includes any visible dust accumulating on the walls and around the slots. Care should be taken by uses to ensure that lightweight materials such as paper, aluminium foil or paper towel is not sucked up or causes a restriction of the exhaust duct flow.

- Laboratory fumehoods are not intended for chemical storage. This may interfere with the airflow and also adds additional hazard in the event of an uncontrolled reaction. Chemical bottles and waste containers should only be present in the hood when they are being used. They must be stored elsewhere. In special circumstances hoods can be used as storage only and these must be clearly posted.

- Fumehoods must be left running at all times. Lower the sash as much as possible for maximum hood performance and energy conservation. Close the sash when you are not using the fumehood and at the end of the day.

- It is highly recommended and best practice that all operations involving the following WHMIS hazard classes be performed in a functioning fumehood.

  - Class B, Flammable and Combustible Materials
  - Class C, Oxidizing Materials
  - Class D1 a & b, Materials with Immediate and Serious Toxic Effects
  - Class D2 a, Materials with Other Toxic Effects
  - Class E, Corrosive Materials
  - Class F, Dangerously Reactive Materials - See Appendix 5

- Fumehoods are to be evaluated annually by PPD and tagged appropriately.

FUME HOOD CLASSIFICATION*

Class A (Radioisotope)

Any fume hood used for radioisotope work will fall into this category.

Class B (Standard)

Fume hoods in this classification are used for all other materials and operations in the laboratory.

Class C (Perchloric)

A properly designed perchloric acid fume hood is required when using perchloric acid on a regular basis in quantities greater than 5 ml or in any situation where digestions are being carried out. This fumehood incorporates a wash down system in the ductwork to prevent the build up of perchloric acid salts.

*Adapted from CSA-Z316.5 Laboratory Fume Hoods (The CSA Standard does not include perchloric acid fume hoods)

FUMEHOOD TESTING PROCEDURES

Fumehood testing is the responsibility of Facilities Management Department

Annually

1. **Face Velocity**: Using an instrument equipped with a hot wire anemometer (or equivalent) measure the face velocity of the fumehood averaging a minimum of nine grid points evenly distributed over the fumehood face. The measurements will be taken with a sash opening of 12 inches.

    - Measurement Standard - Average face velocity 100 fpm + or - 10 fpm
    - Individual points measured should be 100 + or - 20 fpm
    - This face velocity requirement applies to all categories of fumehoods.

2. **Smoke Pencil**: The perimeter of the sash opening will be checked with a smoke pencil to ensure containment and the absence of turbulence.

Additional Tests

3. **Cross Drafts**. Using, the same instrument as in 1 above measure the cross draft at the level of the midpoint of the sash opening. The instrument probe will be situated at 90 degrees to the fumehood face.

    - Measurement Standard - cross drafts less than 30 fpm.

4. **Smoke Challenge:** A smoke generator will be set up inside the fumehood with the sash open as in one above. The test will provide a visual evaluation of the adequacy of containment.

The additional tests will be conducted when there is any concern about the adequacy of containment and capture when the fumehood is in use or when the average face velocity of 100 fpm cannot be attained.

MAINTENANCE SCHEDULE

Annual Maintenance

- Inspect sash mechanism for deterioration and proper functioning.
- Check services to ensure they function.
- Check motors, pulleys and fans for proper function.
- Inspect fan impeller for wear.
- Check stability of discharge stack.
- Inspect ducting especially joints for deterioration (where feasible).
- Check and balance lab make up air.
- Balance fumehood airflow.
- Check flow indicator.
- Complete inspection tag.

The Facilities Management Department is responsible for all aspects of maintenance.

The fume hood user must evaluate the fumehood before use for proper operation and will be asked to consult with the maintenance personnel to ensure the fumehood and associated vented space (including cupboards underneath are free from hazard. Users are to report any obvious fumehood malfunctions to PPD.

Occupational Health and Safety will only become involved in the maintenance process at the request of either the user or Facilities Management Department.

Facilities Management Department Work Procedure Policy WP51. Handling of Fumehoods and Ductwork in Research Laboratories.

FUME HOOD TESTING

Fume hoods must be tested for minimum control functions and face velocity as follows:

1. New installation

2. When modifications are made to the fume hood or exhaust system

3. At least once per year

PREVENTATIVE MAINTENANCE

For all classes of fumehoods

The Work Control Centre of the Facilities Management Department shall co-ordinate preventative maintenance with the users and trades. The fumehood user is responsible for ensuring the fumehood is free from hazard. Occupational Health and Safety will only become involved if there are unresolved health and safety issues.

LABELLING OF FUMEHOODS

All fumehoods on campus are required to have a label fixed to the front with the following information. If your fumehood does not have one, contact PPD.

Sample:

FUMEHOOD IDENTIFICATION	
CLASS:	NUMBER:
FAN NUMBER:	FAN LOCATION:
FAN SWITCH LOCATION:	
For maintenance and repairs contact Maintenance and Repairs Service Centre at 83304	

APPENDIX 7

PROTECTIVE GLOVES

In many University laboratories, exposure to chemicals, infectious agents, sharp objects, extreme temperatures and other hazards can create a potential for injury to the hand. Wherever practicable, these hazards should be eliminated or reduced through the use of engineering and/or administrative controls. The use of appropriate hand protection can protect against those hazards, which continue to exist. Occupational Health and Safety can assist in making the proper selection.

Responsibility

It is the responsibility of all supervisors, instructors and teaching assistants to ensure that all employees, students and visitors wear appropriate protective gloves when involved in a procedure where potential hand and skin hazards exist. It is the responsibility of all persons to wear the appropriate gloves required.

Personal Protective Gloves:

Hand injuries may be prevented, by using appropriate protective gloves, which protect against the specific hazards presented and which provide a comfortable and secure fit. Gloves should not be worn around moving machinery.

The following outlines the general types of protective gloves:

- **Fabric gloves** are made of cotton or fabric blends. They offer moderate abrasion protection. They can help insulate the hands from mild heat or cold. They can also be used to improve grip when handling slippery objects.

- **Leather gloves** offer good puncture resistance, abrasion resistance and impact absorption. They can be used when handling hot or cold objects, and offer greater thermal protection than cotton or knitted fibres.

- **Cut resistant gloves** are made from stainless steel; kevlar or spectra mesh fabrics and protect the hands against cuts and scratches. They are commonly used when working with cutting tools or other sharp instruments.

- **Cryogenic gloves** are generally designed to protect the hands from intense cold or heat.

- **Chemical resistant gloves** are designed to protect the hands against skin contact or absorption of chemicals and other hazardous materials. Gloves are available in a wide range of natural and synthetic materials, such as latex rubber, neoprene, butyl rubber, polyvinyl chloride (PVC), polyvinyl alcohol (PVA), and nitrile rubber, as well as in a variety of blends of these materials. No single glove

material will protect against all chemicals. Glove materials only temporarily resist chemical breakthrough and the contacted chemical will permeate through the glove material over time. An inappropriate choice of glove material can result in worker exposure due to chemical permeation. It is essential to select a glove material, which provides an effective barrier against the specific chemical(s) used. In particular, extreme care must be taken in selecting the appropriate glove material for use with highly toxic substances, particularly for those chemicals, which are readily absorbed through the skin and into the bloodstream. In such cases, gloves, which have a very high resistance to chemical permeation, must be used, such as laminated synthetic gloves.

Proper selection of an appropriate glove material must include:

- an assessment of the workplace hazards, including the specific chemical(s) to be used, the conditions and duration of use, and the specific tasks to be performed;
- consultation of each chemical's MSDS for the recommended glove material to use;
- A review of the glove manufacturer's chemical resistance data on glove degradation and permeation for the specific chemicals to be used with it. A suitable glove must demonstrate no significant degradation, a high breakthrough time and a low permeation rate upon contact with the given chemical.
- Refer to the Guide to Selection of a Chemical Resistant Glove

- **Disposable gloves** are usually made of lightweight plastic or rubber materials, and offer greater sensitivity and dexterity to the user. Users should be aware of the limitations of such gloves in protecting against chemical or physical hazards. Disposable gloves are generally intended to provide a barrier to infectious materials and guard against mild chemicals or other materials, and provide little or no protection against many chemicals. Although the need for high dexterity and low cost are often major factors in the selection of gloves, the potential for permeation of toxic materials though the glove must be of prime consideration. Disposable gloves should be replaced frequently, and should never be reused or washed with either water or alcohol, as washing increases the likelihood of permeability.

- **Hand washing and other personal hygiene practices** are important measures for preventing or reducing contact with chemical contaminants. Current evidence tends to indicate that barrier creams and lotions offer little protection against chemical hazards, and often increase the likelihood of contact dermatitis. Such products often contain mineral oil lubricants that can weaken glove materials such as natural rubber latex. When finished the procedure involving the use of chemically resistant gloves, the gloves should be removed and either disposed of properly, or if being reused, decontaminated, dried and stored so as to avoid chemical contamination**,** sunlight and heat.

- **Inspection and care** of chemical resistant gloves should be conducted routinely. Chemically resistant gloves will break down after repeated chemical exposures, and from heat and sunlight. As a result gloves should be inspected each time they are reused. Reusable gloves should be thoroughly rinsed and allowed to air dry. Gloves should be replaced on a regular and frequent basis. They should be replaced immediately upon signs of degradation, and particularly after contact with toxic chemicals. Once a chemical has been absorbed into the glove material, the chemical can continue to diffuse through the material even after the surface has been washed.

Glove Selection Guides

Glove manufactures are excellent sources of information on glove selection, here are a few links.

- Best Glove
- Ansell

GUIDE TO SELECTION OF A CHEMICAL RESISTANT GLOVE
Chemical Degradation and Permeation Properties

In order, to adequately prevent exposure to potentially harmful chemicals, an appropriate protective glove must provide an effective barrier between the chemicals being used and the skin of the hand. This table is intended as a guideline in the selection of the appropriate chemical resistant glove material by informing users of the limitations of glove materials, as well as the type of information that is available to indicate the degree of protection a glove material can provide. An inappropriate choice of glove material can result in worker exposure. In particular, extreme care must be taken in selecting the appropriate glove material for use with highly toxic substances, particularly for those chemicals, which are readily absorbed through the skin and into the bloodstream.

The selection of an appropriate glove when working with chemicals must include an assessment of the hazards related to the specific chemical(s) being used, the conditions of use and the tasks being conducted. The degree of protection from such hazards provided by a protective glove will depend on factors related to the glove material itself, including its chemical make-up, thickness, and method of construction.

Glove Limitations

- No single glove material will protect against all chemicals. Different materials interact differently with different types of chemicals. Natural rubber latex gloves may be suitable for dilute aqueous solutions; however, oils, greases, and many organic solvents will easily permeate latex material. Nitrile gloves may be used

for oils and greases but are generally unsatisfactory for use against aromatic or halogenated solvents.

- No glove material is totally impermeable. Glove materials only temporarily resist chemical breakthrough and the chemical will permeate through the glove material over time. Once a chemical has been absorbed into the glove material, the chemical can continue to diffuse through the glove. Even the best chemically resistant glove will break down after repeated chemical exposures.
- Chemical resistance of a particular type of glove material (e.g. nitrile) can vary significantly from product to product and from manufacturer to manufacturer.

Chemical Resistance Properties of Gloves

The selection of a glove material, which provides the best protection against a particular chemical, should be based on the glove material's resistance to degradation and permeation upon contact with the chemical. When selecting gloves, degradation properties must first be considered. Once a glove material, which demonstrates no significant deterioration when in contact with the intended chemical, has been selected, its permeation properties in terms of breakthrough time and permeation rate must be considered. Glove manufacturers generally provide chemical resistance charts containing degradation and permeation data on their own products.

- **Degradation** is the physical deterioration of a glove material due to contact with a chemical. Degradation may cause the glove to soften, swell, stretch, shrink, dissolve, or become hard and brittle. Glove manufacturers frequently conduct degradation tests on their glove products and rate them from poor to excellent. Glove materials having a good to excellent rating should initially be selected, and then evaluated with respect to its permeability characteristics. A glove with a good or excellent degradation rating may perform poorly in terms of chemical permeation and breakthrough.

- **Permeation** is the process by which a chemical moves through a glove material at the molecular level. The permeation process start with absorption of the chemical at the outside surface of the glove material, followed by diffusion of the chemical through the glove material, and finally desorption of the chemical molecules from the inside surface of the glove. Permeability test data indicate that all glove materials are permeable to some extent, and only temporarily resist chemical breakthrough. Chemical permeation can take place with obvious signs of degradation, swelling or weight changes. Frequently, however, it occurs with little visible physical degradation of the glove material.

- In order to characterize the permeation properties of a glove material, permeation tests are conducted in accordance with standards established by agencies such as the American Society for Testing and Materials (ASTM). Permeation testing can provide two important pieces of data that can aid in selecting the best glove material for a particular chemical - breakthrough time and permeation rate. An

appropriate glove is one that has an acceptably high breakthrough time and low permeation rate for the conditions of use.

- **Breakthrough time** is the time from initial contact of a given chemical on the glove exterior to the time it is first detected on the inside surface. The breakthrough time is usually expressed in minutes or hours. A typical test runs for up to 8 hours. If there is no measurable breakthrough after 8 hours, the result is reported as a breakthrough time of >480 minutes or >8 hours.

- The breakthrough time is often the most important factor used to indicate the degree of protection a particular glove material will provide, particularly with highly toxic chemicals. In general, the glove material with the highest breakthrough time should be selected. The expected duration for handling the particular chemical should be well within the breakthrough time of the selected glove material. A standard eight-hour breakthrough time is commonly used; otherwise, more frequent changes of the gloves are warranted.

- **Permeation Rate** is the rate at which a test chemical passes through the glove material. The permeation rate is generally expressed in terms of the amount of a chemical, which passes through a given area of clothing per unit time (micrograms per square centimetre per minute). The permeation rate will increase with an increase in the duration of exposure, an increase in the area exposed to the chemical, and a decrease in the thickness of the glove material. Some manufacturers provide descriptive ratings from poor to excellent.

Other Considerations

Other factors that affect the final performance of glove materials and which should be considered when selecting a suitable glove include the following:

- **Degree of exposure.** The performance of glove materials can decrease significantly as chemical exposure increases, such as with the resultant shortening of the breakthrough time with increase in chemical concentration, or with direct immersion into the chemical.

- **Temperature**. In general, permeation rates increase and breakthrough times decrease with increasing temperatures. Permeation test data are obtained at room temperature (20^{o}C to 25^{o}C). If chemicals are being used at temperatures higher than this, glove performance may be significantly affected.

- **Glove thickness**. A thicker glove offers better chemical resistance than a thinner one. In general, permeation rate decreases and breakthrough time increases with increasing thickness of glove material. A general rule of thumb is that double the thickness will quadruple the breakthrough time. Double gloving or choosing a stronger glove material may be necessary for adequate protection. Although thinner gloves offer greater dexterity, some chemical resistance may be sacrificed.

Thick gloves can impair grip, dexterity and safety; a good balance needs to be struck.

- **Manufacturer**. Because of variations in the manufacturing process, the permeability characteristics of the same glove material from different manufacturers can vary widely. It is essential to consult a specific manufacturer's test data for their particular glove product, including information on permeability, breakthrough time, and degradation.

- **Chemical mixtures vs. pure chemicals**. Permeation testing is conducted using pure chemicals. Mixtures of chemicals can significantly change the permeation rates and the physical properties of a given glove material. In general, for mixtures of chemicals, a glove having the lowest chemical permeation rates should be chosen. A chemical mixture, however, can have a significantly higher permeation rate than one of its components. Users may need to conduct further evaluation for instances where information is not available.

- **Physical resistance**. The physical properties of a particular glove material must also be considered during glove selection and must be compatible with the conditions of intended use. Penetration of chemicals through a tear or hole in a glove can lead to much greater chemical exposure potential than via molecular permeation. The likelihood of factors such as puncture, tearing, abrasion or snagging should be determined. It may be necessary to wear two different types of gloves - one for its chemical resistance properties, and the other for its physical resistance properties.

APPENDIX 8

LABORATORY TRANSFER GUIDELINES

Introduction:

These guidelines outline the procedures that are to be followed at Western University to ensure that laboratory space is reassigned, transferred or handed over to another researcher in a safe manner. Prior to leaving a laboratory for the last time, whether it is being reassigned, renovated or demolished, it shall be cleared of any biological, chemical or radioactive materials. Biological and radioactive decommissioning is outlined under those specific programs.

Applicable Legislation/policies:

Occupational Health and Safety Act and Regulations pursuant to the Act
UWO policy 1.31 - Hazardous Chemical Waste Policy.
UWO policy 2.9: - Disposal of University Assets.

Accountability:

The principal investigator/laboratory supervisor is accountable for safely removing all chemical materials according to these guidelines.

Vacating a laboratory including identification or disposal of hazardous materials and the cleanup of equipment and facilities are the responsibility of the principal investigator and the chair of the applicable department and /or applicable administration unit.

Hazardous chemical waste is to be disposed of according to UWO policy 1.31: *Hazardous Waste Policy.* Advice on hazardous materials disposal and on the cleanup of equipment and facilities is available from Occupational Health and Safety (OHS).

An Asset Disposal Requisition form must be completed for the transfer of any equipment from a Western department according to the UWO policy 2.9: *Disposal of University Assets.*

Guidelines:

1. Lab is to be clean, tidy and free of hazardous materials.
2. Laboratory glassware is to be empty and cleaned.
3. Ovens, refrigerators, freezers, incubators, fumehoods, storage cabinets, etc. are to be cleaned – inside and out.
4. Lab bench tops are to be cleaned (washed down).
5. Compressed gas cylinders are to be removed and returned to the supplier(s).

6. Dispose of unused hazardous consumer products as hazardous waste (i.e. cleaning solvents, paints, thinners, oils, pesticides, etc.);
7. Dispose of hazardous chemical waste according to the Western *Hazardous Waste Disposal Policy*
8. Hazard signs are to be removed from doors, (empty) fridges etc
9. All documents or statements are to be left with department chair/director for any equipment that the department has agreed to have remain in the laboratory (i.e. MSDS, services manuals, inventory, etc.).

Laboratory Transfer Form:

A Laboratory Transfer Form (Appendix 1) is to be completed by the principal investigator/laboratory supervisor and OHS before vacating the laboratory.

The principal investigator/laboratory supervisor must contact OHS and arrange for an OHS representative to inspect the vacant laboratory together with him/her.

Appendix 1

Laboratory Transfer Form

Principal Investigator/ Lab supervisor:	_____
Location: Building _____ Room _____	
Reassignment/transfer ☐ Renovation ☐ Demolition ☐	
New location (if applicable) Building	Room
New Principal Investigator/ Lab supervisor:	_____

	Yes	No	NA
All chemicals have been transferred to a new owner or disposed of according to Western Hazardous Chemical Waste Policy.			
All laboratory surfaces and equipment have been cleaned.			
Equipment for disposal has been checked for hazardous materials.			
Equipment slated for disposal has been processed according to the Disposal of University Assets policy			
Ovens, refrigerators, freezers, incubators, fumehoods, storage cabinets have been cleaned – inside and out.			

Laboratory Supervisor	OHS Representative
_____ Print Name	_____ Print Name
_____ Signature	_____ Signature
_____ Date	_____ Date

APPENDIX 9

LOCATION OF CHEMICAL SPILL KITS

Building	Floor	Room number		Building	Floor	Room number
AFAR	TBD	TBD		NCB	3	336
					4	417
BGS	G	0162				
	1	1040		PAB	2	226
	2	2006				
	2	2062		SDRI	G	19
	3	3062			1	117
					2	217a
Biotron	G	20G-1				
	G	20H		SEB	G	16
	G	20J			1	1028
	1	Lobby			2	2038
					3	3049
ChB	3	310 (Hall)				
	2	213(Hall)		SSC	1	1310
	2	202(Hall)			3	3318
	1	125(Hall)			9	9322
	1	111(Room)				
	G	22(Hall)		StaB	G	105
	B	071(Hall)			1	215
	B	036(Hall)				
	B	003(Hall)		TEB	1	28
	B	003a(Loading)			2	221
					3	324
CMLP	G	55			4	417
	2	2316				
	3	3335		TH	2	2170
					3	3110
DSB	LLG	00011				
	LG	0025		VAC	1	135
	G	141			2	234
	1	1007E			3	302
	2	2016				
	3	3008		WSC	G	G23
	4	4028			G	G54
					3	G352
H.S.A	2	H207				
	3	H310				
	4	H415				

MB	1	105				
MBL	G	C12				
	1	C103				
	2	C202				
	3	C301				
MSA	B	TBD				
	G	TBD				
		084				
	1	1220				
	3	TBD				
MSB	G	M011				
	1	M122				
	2	M299				
	3	M315				
	4	M419				

APPENDIX 10

Western University
LABORATORY SAFETY SELF ASSESSMENT CHECKLIST
Principal Investigator/Designated Supervisor:
Date:
Building: Room: Department:
Laboratory Designation: (Check All that Apply) **Biohazard: Level 1 □ or Level 2 □; Animal Use □; Radiation: Basic □ or Intermediate □ or High Level □; Chemical □; Nanotechnology □, Other □.**
If other describe:
Equipment with Special Safety Considerations: (Check All that Apply) **Ultra Low Temp. Freezer □; Pressurized Equipment □; Class 3b or 4 Laser □; NMR □; X-ray □; Autoclave □; Incubator □; High Temp Oven □ Other □.**
If other describe:

Please check YES, NO, or NOT APPLICABLE for each item. Comments may be in comments area at the end of the survey. Note that questions marked NO require your attention and action, which is to be described in the corrective action items section. References are to the appropriate section(s) of the Western Laboratory Health and Safety Manual for General Laboratory Practices

Please refer to the OHS Website for further information on the following

Y	N	NA	LABORATORY SAFETY SELF ASSESSMENT CHECKLIST
			A. Written Laboratory Safety Policies/Procedures/Records
			1. The lab has information readily available for the following:
			a. Chemical spills (Section 11.6)
			b. Radiation spills (Radiation Safety Manual)
			c. Biohazard spills (Biosafety Manual)
			2. The Lab has a Fire/Safety Emergency Plan.
			3. Standard Operating Procedures (SOPs) on specialized lab procedures have been written which include up-to-date safety information.
			4. Records are kept of any safety inspection Compliance Orders received and corrective actions.
			B. Laboratory Worker Training
			1. Laboratory personnel working with hazardous materials have received training in the following subjects: (Section 9.4)
			a. WHMIS
			b. Laboratory and Environmental/Waste Safety
			c. Location and use of safety deluge showers.
			d. Location and use of eyewash station.
			e. Biosafety and Radiation Safety Training as applicable
			2. Substance or task-specific training has been given by the supervisor or designee, including the proper selection, use, and maintenance of personal protective equipment. (Section 5.1, Section 9.4)
			3. The lab keeps records of what training was provided. (Section 5.1, Section 9.4)
			4. Safety procedures are discussed at staff, department, or other meetings and records/minutes are kept of the safety procedures/ issues discussed at these meetings.
			5. Employees have been instructed in the following: (Section 11)
			a. The phone number to call for emergency assistance.
			b. The location of the nearest fire alarm pull station
			c. The location and class of the nearest fire extinguisher.
			d. The building evacuation route upon hearing fire alarm.
			e. The location of chemical spill kits.

			f. Fire extinguisher. and agent use.
			g. The location and use of secondary exits
Y	**N**	**NA**	**LABORATORY SAFETY SELF ASSESSMENT CHECKLIST**
			C. Hazardous Material Safety (Materials considered potentially hazardous include cleaners, solvents, lab chemicals, grease, disinfectants, dental products, etc.)
			1. All lab personnel have ready access to all the Material Safety Data Sheets (MSDSs). (Section 9.3)
			2. A current inventory of hazardous materials is available which includes the proper name of the hazardous material. (Section 8.4)
			3. Incompatible hazardous materials are isolated from each other (I.e., stored according to chemical class) (Appendix 2)
			4. Refrigerators containing hazardous materials are labelled to identify contents and restrictions. (Section 10.1)
			5. Storage and use of flammable and combustible liquids is consistent with the requirements of the Policy on the Storage and Dispensing of Flammable and Combustible Liquids in Laboratories. (Section 8.13, Appendix 2)
			6. Piping (tubing), valves, and fittings used in experimental equipment are compatible with the hazardous materials for which they are used, and checked periodically for integrity.
			7. Compressed gas cylinders are handled, stored and used properly (Section 8.13, Appendix 5)
			8. Storage of organic peroxides or peroxide –forming compounds (e.g. aldehydes, and ethers) are restricted to one year after opening.
			D. Hazardous Wastes (The generator bears the responsibility for handling the waste according to all Federal, Provincial, Local, and University Regulations. Waste reduction and minimization are important in reducing laboratory hazards.)
			1. Information on proper procedures for hazardous waste disposal is available in the lab.
			2. Employees comply with hazardous waste pickup procedures.
			3. Process waste streams are segregated.
			4. Glass waste is segregated and disposed of separately from general waste. (Section 8.7)
			5. Sharps are placed in sharps containers at point of generation and autoclaved and verified prior to disposal when required.
			E. Laboratory Safety
			1. Laboratory personnel remove hazardous materials residues on floors, bench tops and fume hood counter tops.
			2. Laboratory floors and bench tops are uncluttered.
			3. Laboratory fume hoods are free from stored materials.
			4. Laboratory aisles are clear of obstructions that may inhibit or block safe exiting.
			5. There is easy access to electrical panels.
			6. Electrical equipment is plugged into permanent wiring outlets or a single power bar (not extension cords).
			7. Multi-plug fused power strips are used if permanent wiring outlets are not available.
			8. Electrical equipment or power strips with frayed or damaged cord insulated or damaged plugs are removed from service.
			9. All electrical equipment is certified or approved acceptable to the Electrical Safety authority of Ontario.(Appendix 1)
			10. Belts, pulleys, and other exposed moving equipment parts are guarded. (Section 8.5)
			11. Vacuum equipment is provided with a filter or trap. (Filter or trap between process and vacuum equipment).
			12. Pressurized vessels or a similar high-pressure system has been pressure tested and is equipped with an over pressure device. (Section 8.10)
			13. Equipment is serviced to ensure that it functions safely and records are kept. (Section 8.4)
			14. A safety shower is within 25 m with no more than one door in travel path. (Section 11.2)
			15. An Eye Wash is within 25 m with no more than one door in travel path.
			16. Explosion shields are used if needed. (Section 8.6)
			17. Hazardous procedures or processes using hazardous materials are conducted in a fume hood. (Section 10.3)
			18. A fumehood is used for work with hazardous materials. (Appendix 6)
			19. The fumehood has a valid identification sticker.

			20. Receptacles (plugs) are located outside the fume hood.
Y	**N**	**NA**	**LABORATORY SAFETY SELF ASSESSMENT CHECKLIST**
			F. Personal Protective Equipment (PPE)
			1. Laboratory personnel use personal protective equipment suitable for the hazard(s) encountered. (Section 10.5)
			2. Safety glasses with side-shields are worn at all times, goggles and face shields are used as required for a process. (Section 10.5.2)
			3. All laboratory personnel receive instruction on proper PPE selection.
			4. All laboratory personnel know how to select, use, and maintain equipment to protect eyes, skin, and respiratory system.
			5. All laboratory personnel know to remove contaminated protective clothing such as lab coats in the laboratory before leaving.
			G. General Emergency Preparedness
			1. Emergency instructions are posted.
			2. An emergency phone contact list is posted in the lab and a copy kept elsewhere.
			3. Chemical, biological, radiation, and fire emergency instructions are posted.
			4. Hazard Signs are posted as required by Western Sign Book.
			5. Staff knows to call 911 for all types of emergency.
			H. Occupational Health
			1. A Position Hazard Communication Form has been completed for each employee and graduate student and filed with Staff/Faculty Health Services.
Corrective Action Items:			

Completed by: _____ _____ _____

Signature Printed name Date

Principal Investigator: _____ _____ _____

Signature Printed name Date