The University of British Columbia

Department of Civil Engineering

Addresses:
CEME 6250 Applied Science Lane
Rusty Hut 2275 East Mall
EERF 2235 East Mall
MacMillan Building 2357 Main Mall
Pilot Plant 3650 Wesbrook Mall

Safety & Environment Manual & Resource Guide

for Attendees of the
LABORATORY Safety and Environment Course
11 September 2009, 1:00 pm - ~5:30 pm
Room 2020 Kaiser Building

Please keep this manual as a resource.

Name: _____

University of British Columbia

Department of Civil Engineering

SAFETY & ENVIRONMENT COURSE SCHEDULE

Laboratory Safety: Friday 11 September 2009

Time: 1:00 pm - ~5:00 pm Place: Kaiser2020/30

1:00 pm	Opening remarks: Resources/requirements (Civil)
~1:30 pm	Chemical Safety & Waste Management: chemicals, sharps/needles, paint, batteries etc. Hazard controls, PPE, etc. (Noga Levit, HSE)
~2:45 pm	Research activities on and off campus: Field Work (Bernard Laval, Civil)
~3:15 pm	Coffee break (Coffee/juice & cookies supplied)
~3:30 pm	Electrical Safety - dangers associated with the use of electricity; short film (Scott Jackson, Civil)
~4:10 pm	Closing remarks and quiz completion
~4:30 pm	Visit to workshop (Harald Schrempp, Civil)
~5:00 pm	End

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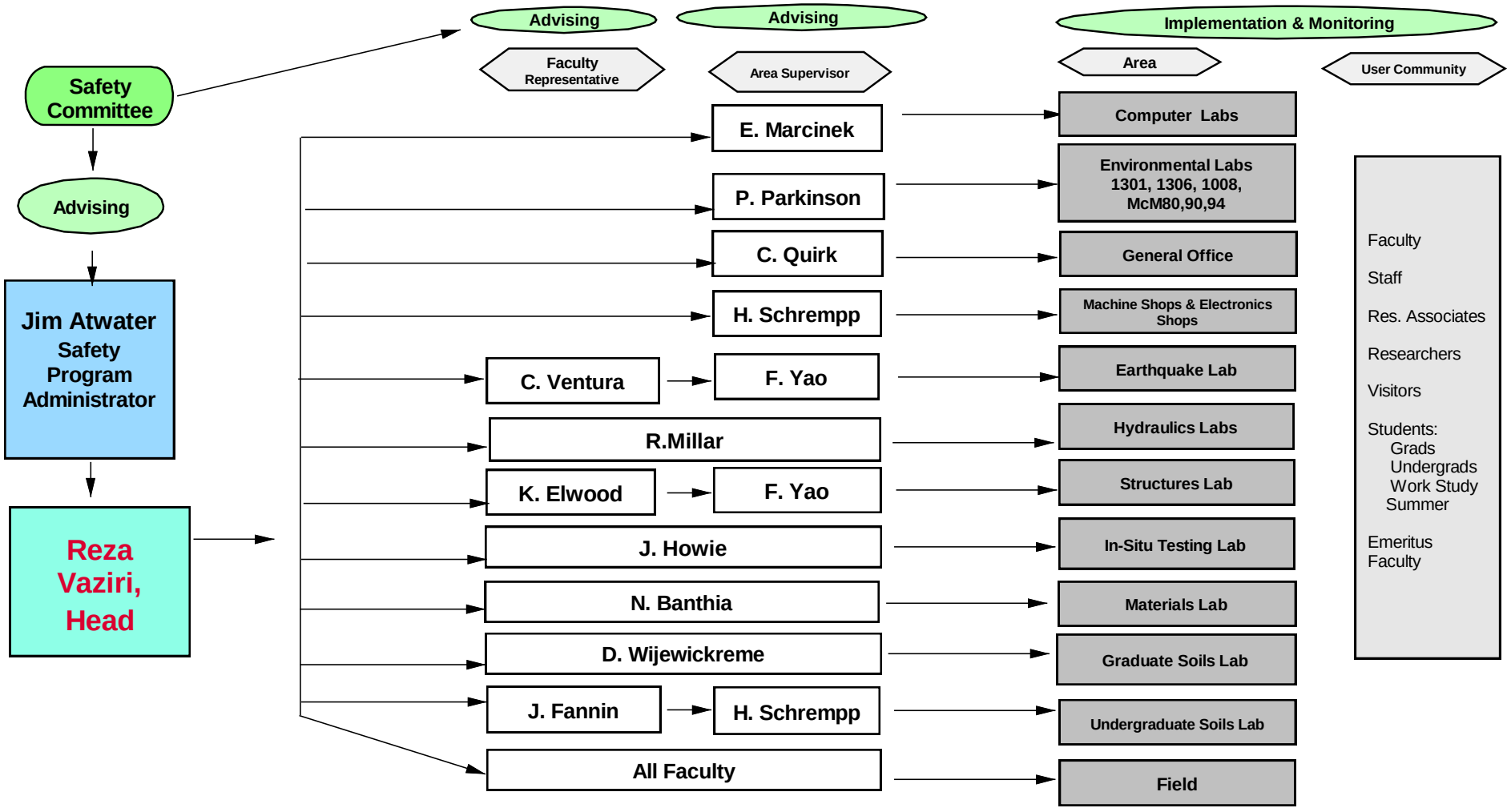
Tree of Safety Responsibilities



Worker Orientation

More on:

Rights and responsibilities: *UBC Policy #7 Safety and Civil Engineering Safety Policy*

- the roles and responsibilities of supervisors and workers, the requirements to observe all rules, be safety conscious, report accidents and hazards to their supervisor and support the safety committee
- the right and duty to refuse unsafe work and the work refusal process.
- the right to know the hazards of the work, and to participate in safety activities through the safety committee.

Workplace Safety Rules – *U*sers of most of the following locations must receive a site orientation and comply with the *Site Specific Safety Rules* (posted at the lab entrance). Use of certain labs and equipment may be subject to scheduling and require work/project forms to be completed after training is received.

Design Studio	CEME Room 1005
Earthquake Lab	EERF
Env. & Geo. Env. Eng. Labs	CEME Rms 1301, 1304 & 1306 MacMillan Rms 80, 90 & 94
Geotechnical Eng., In-Situ	CEME Room 1010
Geotechnical, UG Soils Lab	CEME Rooms 1006 & 1008
Geotechnical Graduate Lab	RH Rm 130
Hydraulics Lab	RH Rm 138-139
Materials Lab	CEME Room 1012
Structures Lab	RH Rm 100
Workshops	RH Rm 140-146

Job hazards, including chemical hazards under WHMIS – with #2, part of your on-site orientation given by your supervisor or designate.

Risk assessments must be performed on all hazardous work processes and equipment operation. Safe operating procedures must be written and training must be conducted to minimize risk of injury or incident.

Those working with hazardous chemical or industrial products must consult with the department chemical safety technician Paula Parkinson, 604-822-4397 Rm 1301 CEME.

Rules for working alone: As mention in the General Safety Session, the Department requires that working alone risk assessments be made and arrangements be developed to ensure the safety of anyone working alone.

Personal Protective Equipment rules – PPE must be worn as required to prevent injury from identified hazards; with #2 part of your on-site orientation by your supervisor. Some laboratories have mandatory requirements for safety footwear, head, eye, ear and hand protection.

Instructing the workers in their tasks – with # 2, 3 and part of your personal orientation by your supervisor. No one is allowed to use equipment anywhere in the department or perform hazardous tasks without complete hands-on training by qualified personnel. A record must be kept of this training and competency reviewed from time to time and re-training performed when necessary. The responsibility for ensuring that training is complete and adequate rests with your supervisor but everyone has the responsibility to ask for more training if they do not feel confident to perform assigned tasks.

Additional Training may be required

- if need is identified during your orientation

- at www.hse.ubc.ca
  - Laboratory Chemical Safety – includes WHMIS & TDG*
  - First Aid Level 1
  - Laser Safety
  - Radionuclide Safety
  - Hazardous Waste Management
  - Diving Safety

- by outside agencies and by arrangement through the department are required for:
  - Fall Protection/Arrest Training
  - Fork Lift Operator
  - Crane operation: fixed or mobile
  - Small boat operator certification

Earthquake Engineering Research Facility
Site Safety Rules

2235 East Mall
Manager: Felix Yao, P.Eng. 604-822-6203 yao@civil.ubc.ca

HAZARDS that may be associated with these labs are:
Electrical: shock/short circuit, fire, loss of power
Ergonomic: muscular/skeletal injury, repetitive strain, noise, heat, cold, respiratory
Falling: slip, trip, from height
Mechanical failure: failure of control systems, crane, hydraulic systems
Struck by (mass acceleration): falling objects, projectiles, mobile crane, forklift
Struck against: injury due to slippage of tools: cuts, scrapes, bruises, pinch points, etc.

Wear CSA certified safety footwear

Personal Protective Equipment
Must be worn when exposed to risk of injury or hazard

Laboratory, Apparatus & Equipment:

No one shall use laboratory, apparatus or equipment until specifically trained to do so by technical staff and before completing Safety Orientation

To receive training, contact the Course Instructor or your Faculty Supervisor.

Environmental Engineering Laboratories
Site Safety

Rms 1301, 1304, 1306 CEME Building 6250 Applied Science Lane
Rms 80, 90 and 94 MacMillan Building 2357 Main Mall
ResearchTechnician: Paula Parkinson, B.Sc. 604-822-4397 parkin@civil.ubc.ca

HAZARDS that may be associated with these labs are:

Chemical: toxic, flammable, corrosive, oxidizing, reactive, fuming
Biological: Hep A & B, giardia (and other parasitic organisms), bacteria from wastewater
Compressed gas: toxic, flammable, oxidizing
Electrical: shock/short circuit, fire, loss of power
Ergonomic: muscular/skeletal injury, repetitive strain, noise, heat, cold, respiratory
Falling: slip, trip, from height
Fire/heat: open flame, hot objects/surfaces, ovens, furnaces
Mechanical failure: centrifuges, stirrers, baths, ovens, regulators, controllers, etc.
Radiation, Ionizing: sealed source (Gas Chromatographs), radioisotopes
Radiation, non-ionizing: microwaves, infrared, UV
Struck by (mass acceleration): falling objects, projectiles
Struck against: injury due to slippage of tools; cuts, scrapes, bruises etc

Wear substantial footwear.

Personal Protective Equipment
Must be worn or used when exposure to hazardous conditions exists






Laboratory, Apparatus & Equipment:
No one shall use laboratories, apparatus or equipment until specifically trained to do so by technical staff and before completing Safety Orientation.
To receive training, contact the Course Instructor or your Faculty Supervisor.

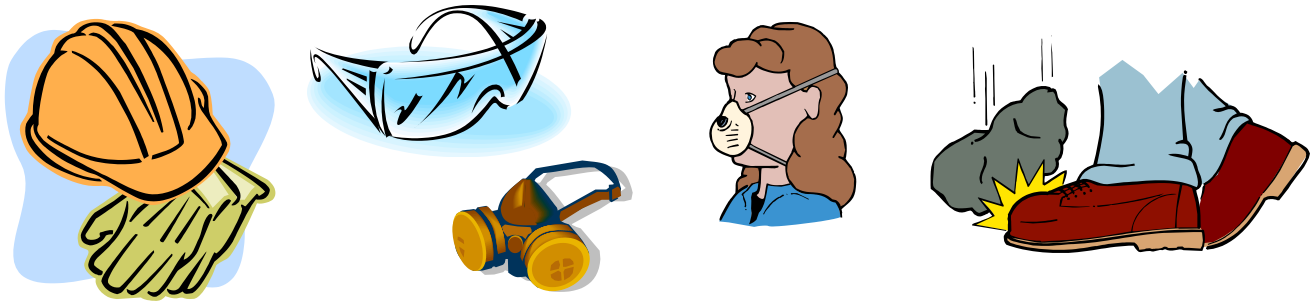
Geotechnical Teaching Laboratory
Site Safety

6250 Applied Science Lane, Rm CEME 1006/1008
Supervisor: Dr. Jonathan Fannin, P. Eng. 604-822-3557 fannin@civil.ubc.ca

Possible hazards that may be associated with this lab are:

Chemical: solvents, cleaning agents, dusts, machine fluids
Compressed gas: inert gas cylinder(s) and building compressed air; pressure release
Electrical: shock/short circuit, fire, loss of power
Ergonomic: muscular/skeletal injury, repetitive strain, noise, heat, cold, respiratory
Falling: slip, trip, from height
Fire/heat: hot objects/surfaces: ovens, heaters, stoves
Mechanical failure: compressed air hoses, testing equipment, control systems.
Struck by (mass acceleration): falling objects, projectiles (sand particles)
Struck against: injury due to slippage of tools: cuts, scrapes, bruises, pinch points, etc

Personal Protective Equipment
Must be worn when exposed to hazardous conditions



Laboratory, Apparatus & Equipment

No one shall use shops, apparatus, or equipment until specifically trained to do so by technical staff and before completing Safety Orientation.
To receive training, contact the Course Instructor or your Faculty Supervisor.

Geotechnical Research Laboratory (In Situ Testing)
Site Safety

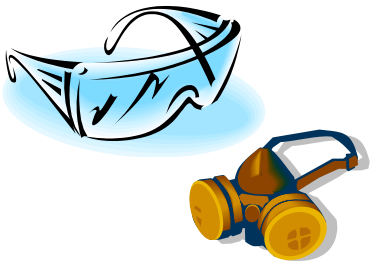
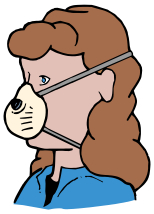
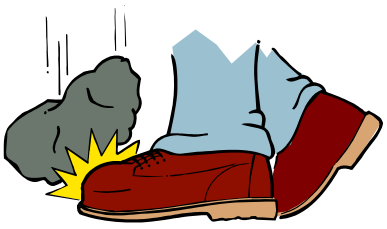
6250 Applied Science Lane, Rm CEME1010
Supervisor: Dr. John Howie, P.Eng. 604-822-2877 jahowie@civil.ubc.ca

Possible hazards that may be associated with this lab are:

Chemical: solvents, cleaning agents, dusts, machine fluids, flammable
Compressed gas: inert gas cylinder(s) and building compressed air, pressure release; propane, flammable
Electrical: shock/short circuit, fire, loss of power
Ergonomic: muscular/skeletal injury, repetitive strain, noise, heat, cold, respiratory
Falling: slip, trip, from height
Fire/heat: hot objects/surfaces: ovens, heaters, stoves
Mechanical failure: cranes, compressed air hoses, hydraulic hoses and clamps, testing equipment, control systems.
Struck by (mass acceleration): falling objects, projectiles (sand particles)
Struck against: injury due to slippage of tools: cuts, scrapes, bruises, pinch points, etc.

Wear substantial footwear.

Personal Protective Equipment
Must be worn when exposed to hazardous conditions

Laboratory, Apparatus & Equipment

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To receive training, contact the Course Instructor or your Faculty Supervisor.

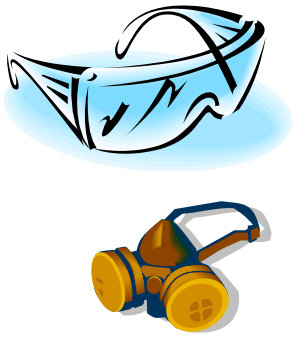
Geotechnical Research Laboratory (Element & Macro-scale Testing)
Site Safety
2275 East Mall, Room RH 130
Supervisor: Dr. Dharma Wijewickreme, P. Eng. 604-822-5112

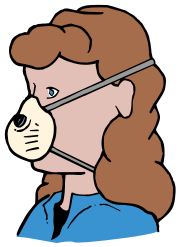
Possible hazards that may be associated with this lab are:

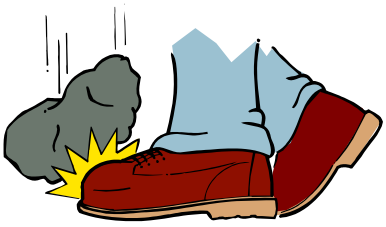
Chemical: solvents, cleaning agents, dusts, machine fluids
Compressed gas: inert gas cylinder(s) and building compressed air; pressure release
Electrical: shock/short circuit, fire, loss of power
Ergonomic: muscular/skeletal injury, repetitive strain, noise, heat, cold, respiratory
Falling: slip, trip, from height
Fire/heat: hot objects/surfaces: ovens, heaters, stoves
Mechanical failure: cranes, compressed air hoses, testing equipment, control systems.
Struck by (mass acceleration): falling objects, projectiles (sand particles)
Struck against: injury due to slippage of tools: cuts, scrapes, bruises, pinch points, etc.

Wear substantial footwear.

Personal Protective Equipment
Must be worn when exposed to hazardous conditions







Laboratory, Apparatus & Equipment
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To receive training, contact the Course Instructor or your Faculty Supervisor.

Hydrotechnical Laboratories

Site Safety

Rooms: RH 138 and RH 139;
Rusty Hut Building; 2275 East Mall; V6T 1Z4
Area Supervisor: Dr. Rob Millar, P.Eng. 604-822-2775 millar@civil.ubc.ca

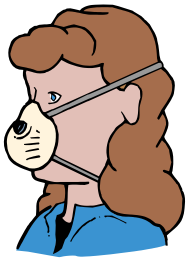
HAZARDS that may be associated with these labs are:

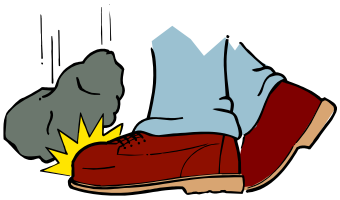
Chemical: toxic, flammable, corrosive, oxidizing, fuming
Compressed gas: toxic, flammable, oxidizing, inert
Electrical: shock/short circuit, fire, loss of power
Ergonomic: muscular/skeletal injury, repetitive strain, noise, heat, cold, respiratory
Falling: slip, trip, from height
Mechanical failure: pumps, turbines, etc.
Radiation, ionizing: class IV laser
Struck by (mass acceleration): falling objects, projectiles
Struck against: injury due to slippage of tools; cuts, scrapes, bruises etc.

Wear substantial footwear.

Personal Protective Equipment

Must be worn when exposed to injury hazard





Laboratory, Apparatus & Equipment:

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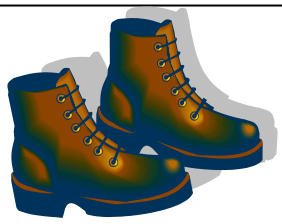
To receive training, contact the Course Instructor or your Faculty Supervisor.

Materials Laboratory & Annex
Site Safety

6250 Applied Science Lane, Rm 1012, 1012A-G
Supervisor: Dr. Nemy Banthia, P.Eng. 604-822-9541 banthia@civil.ubc.ca

Possible hazards associated with this lab are:

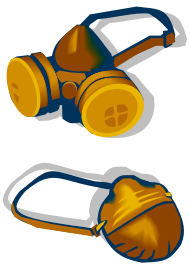
Chemical: toxic, flammable, corrosive, fuming
Compressed gas: inert gas cylinder and building compressed air; pressure release
Electrical: shock/short circuit, fire, loss of power
Ergonomic: muscular/skeletal injury, repetitive strain, noise, heat, cold, respiratory
Falling: slip, trip, from height
Fire/heat: open flame, hot objects/surfaces: ovens, heating chambers, heaters
Mechanical failure: testing equipment, concrete saws, grinders, control systems, etc.
Struck by (mass acceleration): falling objects, projectiles
Struck against: injury due to slippage of tools: cuts, scrapes, bruises, pinch points, etc.



Wear CSA certified safety footwear only

Personal Protective Equipment
Must be worn when exposed to hazardous conditions




Laboratory, Apparatus & Equipment

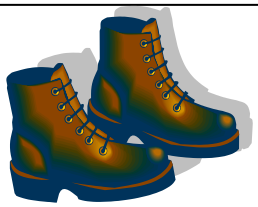
No one shall use apparatus or equipment until specifically trained to do so by technical staff and before completing Safety Orientation.
To receive training, contact the Course Instructor or your Faculty Supervisor.

Structural Engineering Laboratory
Site Safety Rules

Room 100 Rusty Hut, 2275 East Mall
Manager: Felix Yao, P.Eng. **604-822-6203** **yao@civil.ubc.ca**

HAZARDS that may be associated with these labs are:

Electrical: shock/short circuit, fire, loss of power
Ergonomic: muscular/skeletal injury, repetitive strain, noise, heat, cold, respiratory
Falling: slip, trip, from height
Mechanical failure: failure of control systems, crane, hydraulic systems
Struck by (mass acceleration): falling objects, projectiles, mobile crane, forklift
Struck against: injury due to slippage of tools: cuts, scrapes, bruises, pinch points, etc.



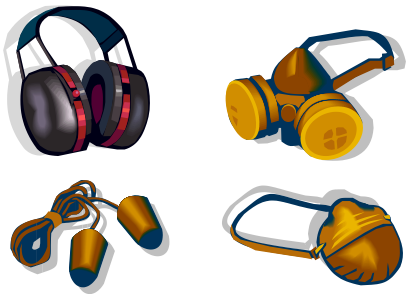
Wear CSA certified safety footwear only

Personal Protective Equipment

Must be worn when exposed to risk of injury or hazard

Hard hat and gloves

Safety eyewear



Hearing and Respiratory Protection

Lab coat

Laboratory, Apparatus & Equipment:

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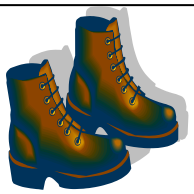
To receive training, contact the Course Instructor or your Faculty Supervisor.

Work Shop, Welding Shop, Wood Shop
Site Safety

2275 East Mall Rms 146, 144, 140
Supervisor: Harald Schrempp 604-822-4851 haralds@civil.ubc.ca

Possible hazards that may be associated with these shops are:

Chemical: toxic, flammable, corrosive, oxidizing, reactive, fuming
Compressed gas: flammable, oxidizing, pressure release
Electrical: shock/short circuit, fire, loss of power
Ergonomic: muscular/skeletal injury, repetitive strain, noise, heat, cold, respiratory
Falling: slip, trip, from height
Fire/heat: open flame, hot objects/surfaces, welding torches, electrical shorts
Mechanical failure: lathes, drills, hand tools, saws, grinders, etc.
Radiation: ultra violet, bright visible light from welding torch and sparks
Struck by (mass acceleration): falling objects, projectiles
Struck against: injury due to slippage of tools: cuts, scrapes, bruises etc.



Wear CSA certified safety footwear only

Personal Protective Equipment
Must be worn when exposed to risk of injury or hazardous conditions







Shops, Apparatus & Equipment

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To receive training, contact the Course Instructor or your Faculty Supervisor.

UBC Hazardous Waste Management

HSE facilitates this process by coordinating the disposal of hazardous waste materials through the Environmental Services Facility located at South Campus. Here, laboratory wastes and hazardous materials generated by the University through research, academic and operational activities are consolidated, recycled, re-used, neutralized or disposed.

For more information on hazardous waste disposal or chemical conservation programs please contact:

HSE Advisor (Environment)
env-program@hse.ubc.ca
(604) 822-9280

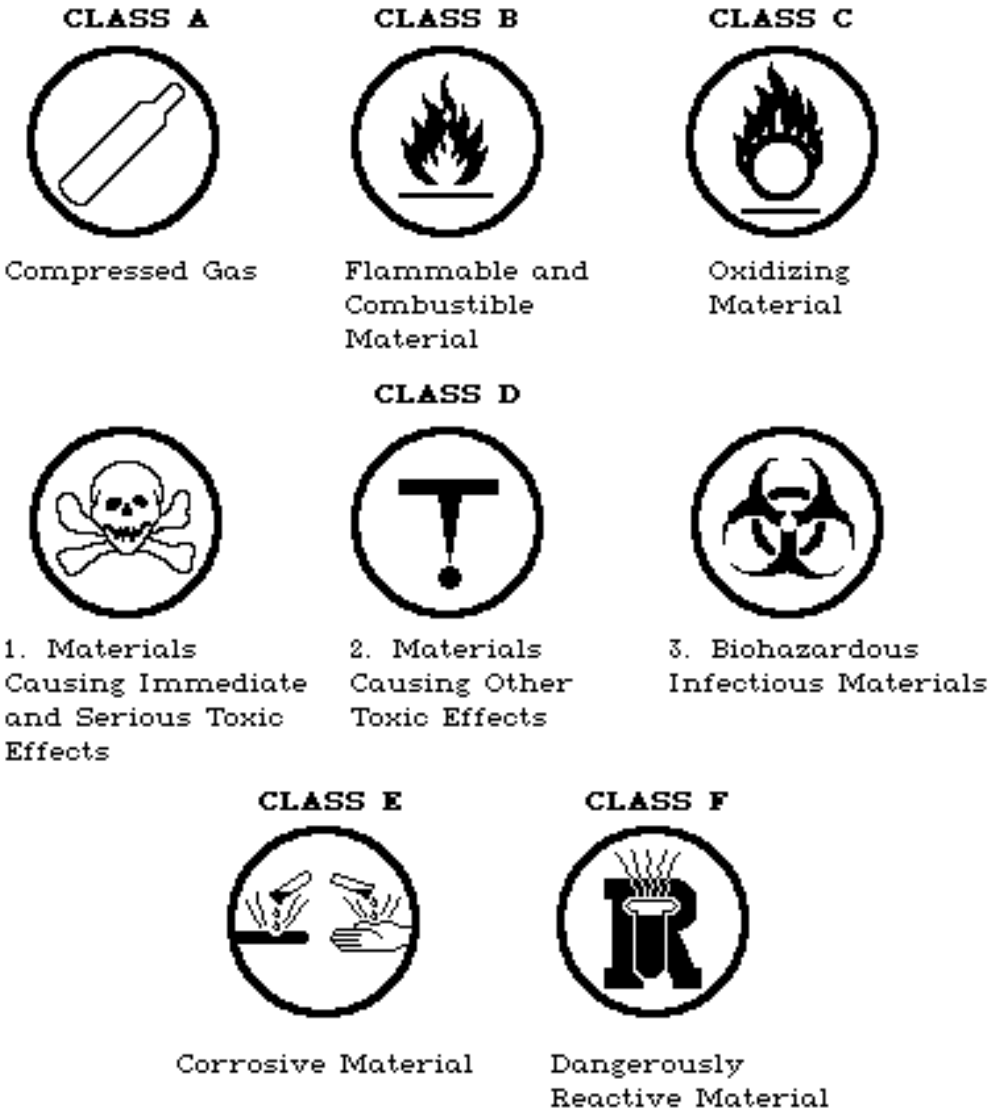
Hazardous Materials Management forms and publications

Available at: http://www.hse.ubc.ca/about/forms_publications.html

* 2006 Hazardous Laboratory Waste Disposal Manual
* 50 Ways to Reduce Hazardous Waste
* Battery Waste Disposal Procedure
* Biohazardous Waste Disposal Procedure
* Biological Waste Disposal Poster
* Biomedical Waste Disposal Procedure
* Contaminated Sites Procedures - July 2004
* Environmental Reporting Procedures
* Ethidium Bromide Waste Disposal Procedure
* Gas Cylinder Disposal Procedure
* Glass Waste Disposal Procedure
* Laboratory Chemical Disposal Procedure
* Mercury Waste Disposal Procedure
* Non-Indigenous Species Disposal Procedure
* Oil Waste Disposal Procedure
* Organic Solvent Recovery & Disposal Procedure
* PCB Waste Disposal Procedure
* Paint Waste Disposal Procedure
* Photochemical Waste Disposal Procedure
* Picric Acid Handling by Laboratory Personnel
* Pollution Prevention - General Tips
* Primate Anatomical Waste Disposal Procedure
* Radioactive Waste Disposal
* Sewer Use By-Law - Facts
* Sharps & Needles Waste Disposal Procedure
* Spill Reporting Procedures
* Unknown Laboratory Chemical Disposal Procedure

WHMIS Classification

WHMIS (Workplace Hazardous Material 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:



WHMIS Classes and Hazard Symbols

What is a 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.

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.

What is a 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). 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.

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.

What is a 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.

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.

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.

What is a 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.

What is a 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.

Are there any hazardous materials not included in WHMIS?
Yes. There are nine basic categories of materials that are not covered by WHMIS. When WHMIS was created it was recognized that a lot of safety information was already being transmitted to workers for many of these products under other laws. To prevent delay in starting WHMIS,

exclusions were made. They are:

1. consumer restricted products (those products sold to people in regular stores that are already labelled following the rules of the Hazardous Products Act)
2. explosives (as defined by the Explosives Act)
3. cosmetics, drugs, food or devices (as defined by the Food and Drug Act)
4. pest control products (pesticides, herbicides, insecticides, etc) (as defined by the Pest Control Products Act)
5. radioactive materials (as defined by the Atomic Energy Control Act)
6. wood and products made of wood
7. a manufactured article
8. tobacco or products made of tobacco
9. hazardous wastes

Materials which fall under WHMIS follow the Transportation of Dangerous Goods Act and Regulations while they are in transport (shipment).

Source: http://www.ccohs.ca/oshanswers/legisl/whmis_classifi.html

Department Requirements

All users of controlled products must have associated MSDSs on hand, must have read, understood and must follow recommended storage, handling and disposal procedures. Contact Paula Parkinson at 604-822-4397 for information and advice.

Personal Protective Equipment (PPE)

Important: The Department urges personnel, who may be required to use during certain activities, to have their own personal kit that might contain some or all of: a hardhat, safety glasses, high-visibility vest, hand protection, lab coat and safety shoes. As well as being mandatory in some labs, these items are also required at construction sites and many field sites that may be visited during the term. PPE such as eye protection, hand and head protection will be provided for use during course work, however, lab coats and safety footwear must be obtained by students if required.

Protective clothing is worn to guard the body from exposure to hazardous materials as well as from heat, cold, abrasion and sharp objects. WorksafeBC's BC Industrial Health and Safety Regulation 14.02 states "The personal wearing apparel of a worker shall be of a type and condition that will not expose him/her to any unnecessary and avoidable hazards".

Laboratory Protective Clothing

The following safety guidelines apply to all faculty, staff and students who work in areas where hazardous chemical, biohazardous, or radioactive materials are used or where material or physical hazards exist.

The minimum dress in all laboratories, when hazardous materials are used, will be a fastened lab coat that is below the knee in length, safety glasses or goggles and substantial shoes (no sandals). Bare legs are not acceptable when working with corrosives, reactive, toxic materials easily absorbed by the skin, radioactive or infectious materials. Shorts, skirts or dresses are not recommended when working with or near hazardous materials.

Material and physical hazards that must be considered when selecting clothing, gloves, boots and eye protection are: corrosiveness, toxicity, reactivity, flammability, infectious properties, radioactivity, extreme temperatures, heavy objects, overhead objects and sharp objects. Consult the MSDS for specific information or call the HS&E office (604-822-2029).

Protective clothing and gloves shall not be worn outside the laboratory or work area. Additional restrictions may be required depending on the nature of the hazard.

Gloves

Gloves may be an important part of your primary protective equipment, if they are used properly. Gloves are to be worn when handling isotopes, hazardous chemicals or biohazards and NOT when wandering around a lab handling pens, phones, door handles or equipment. Gloves are designed to prevent contamination, not cause it. Choose the glove that is appropriate to the type of hazard that you are handling. Gloves are only to be worn in the laboratory.

Gloves may also be required to protect your hands from physical abrasions, sharp edges or objects, dusts, splinters, heat and cold.

Please consult with your supervisor to assess your specific needs.

Eye Protection
Safety glasses or goggles must be worn whenever there is a potential for splashing of chemical or biological substance or for impact from projectiles or dusts. Selection of eye protection should be made after careful hazard analysis. A hazard analysis will determine what eyewear is necessary.

- A face shield and safety goggles or safety glasses (never wear face shield alone) should be used in more hazardous operations.
- Use more protection conducting reactions which have potential for explosion and using or mixing strong caustics or acids, such as:
  -Washing glassware in acid
  -Grinding materials
  -Using glassware in reduced or excess pressure or temperature (where there is significant hazard of explosion or breakage).

Goggles or Goggles and a Face Shield
Goggles are required where there is a danger of chemical splash according to ANSI Z87.1. The selection of protective equipment is up to YOU, unless a local procedure mandates using this equipment. Wear goggles/face shield:

- If the substance is a serious eye hazard and/or the operation involves a high risk that eye-hazardous material will splash, then use goggles or goggles and face shield. Note that it only takes 30 seconds to cause blindness in the eye of a rabbit instilled with a 1% sodium hydroxide solution). Caustics tend to be more dangerous to eyes then acids HF is also a serious eye hazard
- Hot materials are much more injurious than the same materials at room temperature and they are more likely to splash or spatter. Use goggles or goggles + face shield when handling a liquid hotter than 60 degrees C. Also remember there are many types of "goggles". You want goggles with covered vent ports that block splash from every direction.
- Goggles or Face Shields and Goggles shall be worn if there is need for protection of the entire face, such as where there are flying particles and/or acids.
- Use goggles or goggles + face shield if you do not know what the eye hazard is

The wearing of safety glasses does not excuse personnel from the requirement of wearing safety goggles if deemed more suitable.

Footwear Policy

Protective footwear is designed to protect the foot from physical hazards such as falling objects, stepping on sharp objects or exposure to corrosive chemicals. In many areas of the Department faculty, staff and students are exposed to these hazards. In the recent past the

WCB has issued inspection reports noting that personnel are working on “construction sites” ie Structures and Materials Labs, machine shops and other material handling tasks without wearing adequate foot protection. The WCB has also issued inspection reports noting that workers in laboratories are not wearing substantial footwear in order to provide protection against chemical or physical hazards in the labs.

The following safety rules are proposed for our construction sites, machine shops, and laboratories. Many other work areas of the department may also require that protective footwear be worn. Omission of these work areas from this document is not an indication that protective footwear is not required.

Chemical Laboratories Footwear (Environmental, GeoEnvironmental, Soils)
All faculty, staff and students working in laboratories shall wear substantial footwear to protect against the hazards commonly encountered in laboratories. These hazards include chemical, biological, and radiation hazards as well as physical hazards associated with sharps, broken glassware, material handling and electricity.

"Substantial footwear" should be made of a solid material which completely encloses the foot (for example, an oxford or athletic style leather shoe). Open toe or open heel sandals or shoes with a ventilated construction are not acceptable.

Machine Shop, Wood Shop, Structures, Earthquake and Materials Labs
All faculty and staff who are working in these areas shall wear substantial footwear equipped with steel toes. Boots or shoes must be CSA rated with either a green or yellow triangle or square to meet the requirements of this section. Students whose studies require the use of machine shop facilities shall abide by the same rules. “Loaner” boots are available. Certain activities may require footwear which will also protect the soles of the feet from punctures.

Those personnel whose duties may require them to enter these areas must have similar protection. Supervisors may authorize exceptions to these requirements after ensuring that hazards will be avoided by other means. Hazardous areas shall be cordoned off so that faculty, staff and students who are not equipped with safety footwear will not enter these areas. When personnel must enter such areas barricades and dedicated walkways shall be provided to ensure equivalent protection.

Respiratory Protection

When should a respirator be used?
Workers should use respirators for protection from contaminants in the air only if other hazard control methods are not practical or possible under the circumstances. Respirators should not be the first choice for respiratory protection in workplaces. They should only be used:

* when engineering or administrative controls are not technically feasible
* while engineering controls are being installed or repaired
* when emergencies or other temporary situations arise (e.g., maintenance operations).

How should you control respiratory hazards?
Respiratory hazards can include airborne contaminants such as dusts, mists, fumes, and gases, or oxygen-deficient atmospheres. Well designed and maintained engineering controls are the preferred methods of controlling worker exposure to hazardous contaminants in the air. These control methods include:

* mechanical ventilation
* enclosure or isolation of the process or work equipment
* proper control and use of process equipment, and
* process modifications including substitution of less hazardous materials where possible.

Administrative controls limit workers' exposures by scheduling reduced work times in contaminant areas or by implementing other such work rules. These control measures have many limitations because the hazard is not removed. A respiratory protection program includes several components such as:

- hazard identification and control
- exposure assessment
- respirator selection
- respirator fit-testing
- training program
- inspection and record keeping
- cleaning and sanitizing respirators
- repairing and maintaining respirators
- proper storage of respirators
- health surveillance
- standard operating procedures (available in written form)
- program evaluation.

Types of respirators:
-particulate respirators (previously called dust, fume, and mist respirators or masks),
-chemical cartridge respirators that can have a combination of chemical cartridges, along with a dust prefilter: this combination provides protection against different kinds of contaminants in the air
-gas masks (contain more adsorbent than cartridge-type respirators and can provide a higher level of protection than chemical cartridge respirators)
-quarter-mask (covering the nose and mouth),
-half-face mask (covering the face from the nose to below the chin), or
-full facepiece (covering the face from above the eyes to below the chin).

Respirators with a full facepiece also protect the eyes from exposure to irritating chemicals.

Harald Schrempp is the Respirator Coordinator in the Department. Please see him in order to select the correct respirator and do a fit test.

Hearing Protection

How can I protect my hearing at work?

The surest method of preventing occupational deafness is to reduce noise at the source by engineering methods. However, in certain workplace conditions, there is very little or nothing one can do to reduce noise at the source. In such workplaces, workers wear hearing protectors to reduce the amount of noise reaching the ears. Select hearing protection that is:

- Correct for the job.
- Capable of providing adequate protection. Check the manufacturer's literature.
- Comfortable enough to be accepted and worn during all exposure to noise.

What are the advantages and limitations of ear plugs and ear muffs?

There are advantages and disadvantages associated with the use of either ear muffs or ear plugs.

Comparison of Hearing Protection

Ear Plugs	Ear Muffs
Advantages: • small and easily carried • convenient to use with other personal protection equipment (can be worn with ear muffs) • more comfortable for long-term wear in hot, humid work areas • convenient for use in confined work areas	**Advantages:** • less attenuation variability among users • designed so that one size fits most head sizes • easily seen at a distance to assist in the monitoring of their use • not easily misplaced or lost • may be worn with minor ear infections
Disadvantages: • requires more time to fit • more difficult to insert and remove • require good hygiene practices • may irritate the ear canal • easily misplaced • more difficult to see and monitor usage	**Disadvantages:** • less portable and heavier • more inconvenient for use with other personal protective equipment. • more uncomfortable in hot, humid work area • more inconvenient for use in confined work areas • may interfere with the wearing of safety or prescription glasses: wearing glasses results in breaking the seal between the ear muff and the skin and results in decreased hearing protection.

General Tips on Pollution Prevention

HSE TOOL # 21

"Pollution prevention focuses on avoiding the creation of pollutants rather than trying to manage them after they have been created" (Pollution Prevention: A Federal Strategy for Action, 1995)

Plan your projects thoroughly:

- ✓ Know the environmental impacts of your project, and plan to minimize the impacts
- ✓ Prevent pollution at all stages (ie, before, during, after)

Before

- ✓ Incorporate 3 R's (reduce, reuse & recycle)
- ✓ Substitute less hazardous materials for hazardous ones
- ✓ Scale down experiments to use less materials
- ✓ Anticipate wastes to be generated
- ✓ Review proper disposal procedures
- ✓ Contact Chemical Exchange Program and Solvent Recovery Program for available chemicals
- ✓ Purchase products with less packaging
- ✓ Order minimal amounts of reagents

During

- ✓ Follow the previously planned procedures
- ✓ Label all laboratory reagents to eliminate unknown substances
- ✓ Segregate different classes of hazardous wastes into proper containers

After

- ✓ Participate in UBC Chemical Conservation Programs
  - Chemical Exchange Program
  - Solvent Recovery/Recycling Program
  - Silver Recovery Program
  - Oil Recycling Program
  - Battery Recycling Program
- ✓ Dispose of waste as per site procedures
- ✓ Recycle/dispose of unused reagents as per the procedure

For more information on Pollution Prevention Initiatives, please contact the Environmental Programs Officer at 604-822-9280

UBC HAZARD AND EXPOSURE CONTROL ASSESSMENT FORM

√ Means that a hazard or hazard control exists. If hazard exists, there must be a means of controlling it. Check off (√) if it exists (column 2). Evaluate controls available and check off (√) once a control is in place (last column).

Note: Reference to procedures means specific procedures for materials/equipment/processes being used and includes relevant training.

Hazard	√	UBC Procedure or Relevant Reg.	Hazard Control	√

1. Hazardous materials used and stored
- hazards identified
- Potential significant inhalation exposures assessed
		WCB Occupational Health and Safety Regulation; WHMIS; BC Fire Code; UBC Laboratory Chemical Safety Manual	- appropriate containers & storage units;
			- appropriate labels & MSDS available (WHMIS)
			- appropriate controls
			  - substitute/minimize
			  - fume hood
			  - personal protective equipment
			- appropriate handling, disposal and emergency procedures
			- monitoring and alarm equipment, procedures, signage, training	

2. Compressed gas used		WCB Occupational Health and Safety Regulation; BC Fire Code; Gas Safety Act	- means of securing and transporting - minimum quantities in lab or shop - monitors and alarms as required; signage - written work and emergency procedures; training	
3. Potentially violent reaction via: rapid decomposition; impact sensitive; stability on storage to cold, heat, light, water, metals, etc.; mischarge or wrong addition order; quantity and rate of evolution of heat and gases; **water or air contact**		WCB Occupational Health and Safety Regulation	- fume hood - minimization of quantities; heat; other - isolation or shielding; PPE - means of pressure relief, - redundant controls; automatic shutdown mechanism - ability to vent all parts of system before breaking any lines - appropriate storage area - appropriate handling & emergency procedures	
4. Radioactive material or source used?		WCB Occupational Health and Safety Regulation; UBC Radiation Safety Manual; AECB Regulations	- Canadian Nuclear Association Procedures; - UBC Radionuclide Safety and Methodology Procedures - Fume hood - appropriate emergency procedures	
5. Infectious or biohazardous material used or handled?		WCB Occupational Health and Safety Regulation; WHMIS; UBC Biosafety Manual; MRC Guidelines	- medical surveillance - UBC protocols & procedures - controls: e.g. biosafety cabinet; PPE - appropriate emergency procedures	

1. Catalysts, inhibitors, or contaminants (like iron) affect reactions?		WCB Occupational Health and Safety Regulation; WHMIS	- appropriate handling procedures - written procedures & training - appropriate emergency procedures	
7. Energy Sources/Failures - heating/cooling systems - power (high voltage) - machinery - water; air - ventilation - automatic controls or equipment - pressure - materials/equipment/container integrity		WCB Occupational Health and Safety Regulation; UBC Lock-Out procedures; Electrical Code	- automatic shut-off system for: - power - temperature - HVAC; ventilation; - pressure, - water and air supply systems (back-up system) - signage - lock-out procedures - appropriate handling & emergency procedures - fires/explosions; spills	
8. Possible generation of: - unacceptable odour - air pollution, - excessive noise, - excessive heat, - sewer contamination		WCB Occupational Health and Safety Regulation; Special Waste & Environmental Regulations	- appropriate controls: - fume hood : PPE - trap or back-flow presenter (1-way valve) - substitute materials - noise testing and absorption - cooling system - waste trap - appropriate emergency procedures	
9. Hazardous waste generated		WCB Occupational Health and Safety Regulation; Special Waste & Environmental Regulations	- appropriate containers for storage - written procedures & training - appropriate emergency procedures	
10. Potential for impact of hazards of materials and process upset on neighbours, service, medical, emergency response personnel, etc.		WCB Occupational Health and Safety Regulation; Environmental Legislation	- notification of relevant personnel & organizations prior to incident - process for notification of relevant personnel & organizations post incident - appropriate emergency procedures	
11. Space for equipment, materials and experimental set-ups		WCB Occupational Health and Safety Regulation	- adequate and appropriate space	
12. Asbestos containing material present.		WCB Occupational Health and Safety Regulation; UBC procedures	- awareness training - reporting procedures - removal/substitution	

Research in Progress Sign

Project Title:	
Name of Researcher:	
Project Work Number:	
Emergency Tel. # (Day):	**Emergency Tel. # (Night):** **Contact:**
Faculty Advisor:	**Tel.#:**
Instructions for emergency shutdown:	

Set-up Approved by:	**Date:**

Comments:

SAFETY PLAN

Project Title			
Project No.		Account. No.	
Researcher/Grad Student		Tel.	E-mail
Faculty Supervisor		Tel.	E-mail
Lab. Supervisor			

Potential Hazards/Risks	Y/N	Elaborate	Control measure	Training : Trainer & Trainee sign
Pressure/Vacuum				
Cuts/abrasions/burns				
Crushing/pinching				
Electrical				
Chemical				
Dusts/fumes				
Radiation: Ionizing, non-				
Slips/trips				
Falls from height				
Confined Space				
Machinery				
List:				
Equipment				
List:				
Gas cylinders				
Biological, bacteria, mold, virus				

ENVIRONMENTAL PLAN

Project Title			
Project No.		**Account. No.**	
Researcher/ Grad Student		**Tel.**	**E-mail**
Faculty Supervisor		**Tel.**	**E-mail**
Lab. Supervisor		**Signed**	

Environmental Hazard / Waste Product	**Emergency Procedures and Spill Containment Measures** (Reference info source)	**Waste Disposal Arrangements** (List quantities and reference info source)

Use additional pages if necessary

Field Activity Procedures and Guidelines

Course work, research and work requirements may result in faculty, staff and students leaving the Department, either within the endowment lands or farther afield.

All such activities must be prepared for and may include a risk assessment if there is potential for injury. The circumstances may also involve working alone or in isolation and therefore it is mandatory that a procedure be developed and be on file in the department, either with the supervisor or the safety administrator or both.

These procedures pertain to all activities carried out for the purpose of education or research undertaken by employees or students of the Department at a locality beyond the geographic boundaries of the University.

A draft document is available that can be used as a resource to draw your attention to issues. Please discuss with your supervisor.

Contents:

This manual is available at:

http://www.civil.ubc.ca/home/safety/info/ #58

Civil Engineering Electrical Safety Guidelines

Almost every workplace has a source of electrical power. If this electrical energy is used improperly, electrical shock and injury may result. With the knowledge of a few basic guidelines, most people can avoid electrical hazards.

1. All electrical equipment shall be properly grounded. Contact a department technician if unsure.

2. Learn where the disconnect switches or circuit breakers are for the electrical equipment and receptacles in your area. All circuit breakers and switches shall be labeled to clearly indicate the "on" and "off" position, and what equipment they serve.

3. Design, construction and modifications of all research electrical apparatus shall either be done or approved by a department electronic technician. Any previously built research apparatus must be inspected by a department technician before being put into service.

4. Equipment, appliance and extension cords shall be inspected regularly and be kept in good working condition. Any problems should be reported to a department technician immediately.

5. Exercise caution when it is necessary to work on electrical equipment in damp conditions. Use a ground-fault circuit interrupter (GFCI) in all areas (inside and out) that may pose a potential water hazard. A GFCI protection device or outlet must be used for all portable equipment being operated outdoors.

6. Electrical cords or other lines shall not be suspended unsupported across rooms or passageways. Do not route cords over metal objects such as emergency showers, overhead pipes or frames, metal racks, etc. Do not run cords through holes in walls or ceilings or through doorways or windows. Do not place under carpet, rugs, or heavy objects. Do not place cords on pathways or other areas where repeated abuse can cause deterioration of insulation. All cords must be placed such that they do not present a tripping hazard. If such placement can not completely rule out a hazard, appropriate warning signs must be displayed.

7. Power bars (multi-outlet plugs) shall not be used unless they have a built-in circuit breaker and are CSA approved. Surge protected power bars are recommended. The following conditions shall be met when using power bars:
    - Users must check before hand to ensure that total amperage of all equipment plugged into the power bar does not exceed the power bars rated current (typically 15 amps.).
    - The amperage of electrical equipment is usually stamped on the manufacturer’s plate and, if in doubt, consult a department electronic technician.
    - Power bars must be plugged directly into mounted electrical receptacles. They can not be daisy chained.

8. Extension cords shall be CSA approved with three separate insulated wires and three pronged connectors all in good condition. In addition the following apply to their use:

    - Extension cords can only be used for temporary work and should not be used through walls, ceilings, doorways, floors, etc.

- Extension cords should only service a single piece of electrical apparatus which does not exceed the current rating of the cord (see manufacturer's rating on equipment).

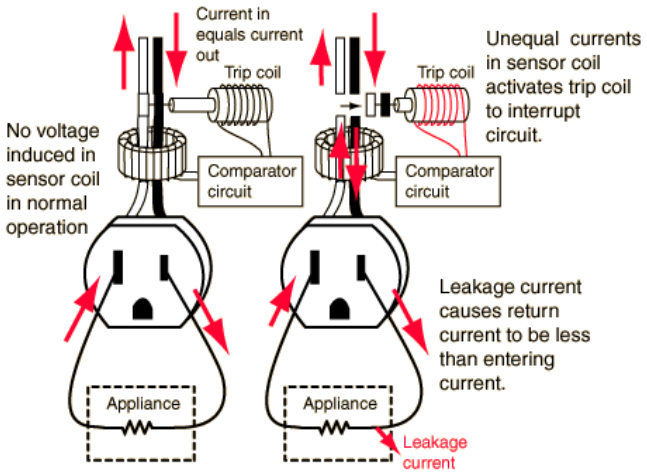
9. Never override fuses, circuit breakers or interlock switches. Blown fuses should be replaced by qualified personnel and only with the properly rated substitute.

10. All building electrical repairs, splices, and wiring shall be performed by the Physical Plant Electrical Department.

last revised 28/04/07

Ground Fault Interrupter

Ground fault interrupters are designed to protect from electrical shock by interrupting a circuit when there is a difference in the currents in the "hot" and neutral wires. Such a difference indicates that an abnormal diversion of current from the "hot" wire is occurring. Such a current might be flowing in the ground wire, such as a leakage current from a motor or from capacitors. More importantly, that current diversion may be occurring because a person has come into contact with the "hot" wire and is being shocked. When a circuit is functioning normally, all the return current from an appliance flows through the neutral wire, so the presence of a difference between "hot" and neutral currents represents a malfunction which in some circumstances could produce a dangerous or even lethal shock hazard.



The "hot" and neutral wires are passed through the sensing coil so that the currents in the two wires at any instant are traveling in opposite directions, giving a net zero current in the coil if the two currents are exactly equal. Since a current-carrying wire produces an AC magnetic field external to the wire, a non-zero current would induce a voltage in the sensing coil. The sensing coil is wound longitudinally to capture more of the wire's magnetic field and therefore be a more sensitive net current detector. Even so, the difference that it is supposed to detect is quite small. The GFI is designed to trip when there is more than 5 milliamperes of leakage current out of the normal pathway. The neutral return would then have 5 mA less current than the "hot" wire, but that might be out of a 20A load. So the circuit would have to detect a 0.025% deviation from 20A return current. Fortunately, comparator circuits such as an op-amp comparator are quite capable of detecting such differences. The voltage in the sensor coil is rectified and applied to the input of the sensitive comparator. The comparator activates a trip coil which opens both the "hot" and neutral wires. If all circuits were wired with correct polarity, opening the "hot" wire would be sufficient, but since it is not uncommon for them to be accidentally wired backward, it is prudent to interrupt both leads.

Visit to Workshop - Rusty Hut Room 146

Please make notes here while being shown around.

Introduction to Basic Shop Rules

- Interaction with Technicians

- Personal footwear and Safety gear requirements

- Safe Machine operation (Training log)

- First aid procedures

- Material storage and disposal (Recycling)

Name_____**Advisor**_____**Email:**_____

Please print

Department of Civil Engineering Safety & Environment Course

Laboratory Safety Session Questionnaire

Must be handed in to obtain credit for this session

1. Everyone is responsible for:

   - ☐ Following safety and environment rules and working safely
   - ☐ Getting trained
   - ☐ Correcting or reporting all unsafe conditions
   - ☐ Reporting all injuries

2. A Research in Progress sign on unattended experiments is designed to:

   - ☐ Provide shut-down procedures if something should go wrong
   - ☐ Provides your contact information so that you can be informed immediately if something goes wrong.
   - ☐ Provides important safety information about potential physical hazards or hazardous materials

3. Protection barriers such as personal protective equipment, engineering controls, screens and guards are sometimes the only way to prevent being in the line-of-fire because the hazards cannot always be predictable.

   - ☐ True
   - ☐ False

4. A plastic syringe used for applying glue is:

   - ☐ Considered a biomedical waste and therefore prohibited in Vancouver's landfill.
   - ☐ Can go in regular garbage as long as it has no needle.

5. You have dispensed 400 mls of a hazardous solvent into a bottle to use for cleaning oily parts while on a field trip.

   - ☐ It does not have to be labelled because it is less than 500 mls.
   - ☐ It does not have to be labelled because you know what it is.
   - ☐ All bottles must be labelled no matter the volumes or the contents.

6. Carefully planning and communicating field activities makes sense because:

   - ☐ Sometimes remote areas are visited and emergency response may be delayed
   - ☐ Work may be done alone or in isolation and no one may know a crisis has occurred
   - ☐ Checklists will ensure that all the right gear has been packed
   - ☐ Developing safe procedures is a regulatory requirement

7. When using electricity around water, what electrical safety devise should you use?

   - ☐ Steel-toed shoes
   - ☐ A GFCI device
   - ☐ Leather gloves

8. Before using equipment in the machine shop or laboratories, what must you do first?

   - ☐ Get training and authorization.
   - ☐ Book the equipment.
   - ☐ Put on personal protective equipment.