VIU SAFE OPERATING PROCEDURES-CHEMICALS

2018

Department of Health and Safety Services

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1. Introduction

Chemical safety is the application of the best practices for handling chemicals and chemistry processes to minimize risk of exposure, whether to a person, facility, or a community. It involves understanding the physical, chemical, and toxicological hazards related to a specific chemical or class of chemicals.

2. Purpose

The purpose of this program manual is to describe the requirements and procedures established by Vancouver Island University (VIU) to work safely with chemicals and control the risk of exposure to faculty, staff and students in the workplace. This program applies to all VIU employees (faculty and staff) and students who perform work and may be exposed to chemical hazards in the workplace.

3. Scope

This Health and Safety procedure deals specifically with the safe handling, storage and disposal of chemicals that may be encountered while teaching, working or learning at VIU.

4. VIU Health and Safety Policy 41.09

“Vancouver Island University is committed to promoting a safe and healthy working and learning environment. It is the priority of the University to ensure safe working conditions and job safety practices in the planning, budgeting, direction and implementation of the University’s activities.”

5. Responsibilities for this program

At VIU, everyone has a responsibility for safety. In BC, the Workers Compensation Act identifies the health and safety responsibilities of the employer, supervisors, and workers.

6. Regulatory and Best Practice Requirements

BC Workers Compensation Act
BC Occupational Health and Safety Regulations, Part 5
BC Occupational Health and Safety Regulations, Part 30
City of Nanaimo Sewer Regulation and Charge Bylaw #2496
Regional District of Nanaimo Regional Sewage Source Control Bylaw #1730 2015
City of Parksville Sanitary and Storm Sewerage System Bylaw 1319
City of Duncan Sewer Services Bylaw 1844
City of Powell River Sanitary Sewer and Storm Drain Systems Bylaw 2054, 2005
BC Environmental Management Act
Federal Department of Fisheries and Oceans Acts and Regulations
CNSC Acts and Regulations
TDG Act and Regulations
Hazardous Products Act
ANSI Standard Z9.5-2012

7. Chemical Safety Procedures

WHMIS

Canada has recently aligned the original Workplace Hazardous Materials Information System (WHMIS) with the Globally Harmonized System of Classification and Labelling of Chemicals (GHS). The result is WHMIS 2015.

WHMIS is a comprehensive system for providing health and safety information on hazardous products intended for use, handling, or storage in Canadian workplaces. Aligning with GHS provides many benefits, including:

- Hazard classification criteria are more comprehensive which improves ability to indicate severity of hazards.
- New hazard classes are included.
- Physical hazard criteria are consistent with the Transport of Dangerous Goods (TDG regulations).
- Standardized language (hazard and precautionary statements).
- Standardized SDS format and more comprehensive requirements.

The main components of WHMIS are hazard identification and product classification, labelling, safety data sheets, and worker education and training. All of these components are discussed throughout this manual.

A. Hazard Control Measures

At VIU there are many types of work areas, each with very different hazards. However, common control measures can be implemented to prevent accidents, injuries, and disease.

Please refer to the VIU Hazard Identification, Risk Assessment and Control Program for guidance. Once hazards have been identified and assessed, it is necessary to control these chemical hazards used in the work area. There are generally five accepted strategies for controlling exposure to hazardous materials:

1. Elimination
2. Substituting with less hazardous material
3. Engineering controls
4. Administrative controls
5. Personal protective equipment

Most effective

Least effective

Hazard control methodology always follows this hierarchy from most to least effective.

Elimination

The first and most desirable control is elimination. For example, a process could be changed so that a toxic chemical does not need to be used.

Substitution

Substitution means to replace a chemical with a less hazardous chemical, one that is less toxic and more easily disposed of. For example, use water-based instead of solvent-based materials.

Elimination of a hazardous product or substitution with a less hazardous product represents is always the best solution.

Engineering

Engineering controls separate or isolate the hazardous material from the worker. Engineering controls are the next best choice for controlling hazardous materials. They do not require continual monitoring and are more likely to be used; however, they do require regular maintenance and are more expensive to implement.

Administrative Controls

The next type of control is administrative and it includes written procedures, training, supervision and scheduling of activities.

Safe Work Procedures

Implementing safe work procedures helps to reduce exposure to hazardous materials. Safe work procedures are step-by-step descriptions of how specific high risk work-related activities are performed

safely. In the laboratory and Trade Shops, hazards associated with chemicals, processes, equipment, etc. must be identified and assessed. Safe work procedures are then developed based on the identified hazards. These should be written, readily accessible to everyone in the lab/shop, and personnel should be made aware that procedures exist. Procedures should be specific to the lab, shop or research group so that the unique circumstances in the lab or research program can be addressed. Situations that require safe work procedures include:

- Working with hazardous chemicals
- Working alone or after hours
- Emergency response (chemical spills, fire, etc.)

Training

Training is the best way of ensuring that faculty, staff and students are safe when handling hazardous materials. Requirements for training are outlined in Section 8 of this manual.

Personal protective equipment (PPE)

The use of personal protective equipment represents the least effective type of control; its effectiveness is limited by the dependence on individuals wearing it. The choice of appropriate personal protective equipment should be based on the recommendations of the safety data sheet for the substance being used/handled.

PPE needs and selection must be determined based on assessment of exposure hazard, the available control measures and the need for further controls. Hazards must be assessed before the proper PPE can be chosen. Refer to Appendix B for a chart of hazard considerations and the appropriate PPE selection.

Examples of personal protective equipment include:

Eye and Face Protection

Eye protection should be worn in all labs when working with or around chemicals. Selection must meet the guidelines set by the Canadian Standards Association[1].

The type of eye protection required depends on the hazard. For most situations, safety glasses with side shields are adequate. For more hazardous operations where there is potential for chemical splashing or explosion, safety goggles or a face shield which are rated for chemical splash protection should be used. This is especially important for work with corrosive chemicals. The supervisor must determine the level of eye protection required.

[1] CSA Z-94.3-92 Industrial Eye and Face Protectors and Z94.3-15 Eye and Face Protectors

Visitors are required to follow the same eye protection policy as everyone else in the lab. If they do not provide their own eye protection, it is the laboratory's responsibility to provide adequate protection for them or deny them entry.

Gloves and Hand Protection

The right type of glove provides much needed hand protection in the laboratory. It is recommended that appropriate gloves be used when handling hazardous chemicals, toxins and materials of unknown toxicity, corrosives, and hot / cold objects. Particular attention should be given to chemicals which have a “Skin” notation on the (M)SDS sheet.

When choosing a glove, consider the circumstances under which the glove will be used. The degree of protection required will depend on the hazards associated with the chemical in question, the type and scale of experimental work being performed, and individual work habits. For routine work with small amounts of chemicals, disposable gloves of a suitable material are generally acceptable, as they offer the best combination of dexterity and tactile sensitivity, barrier protection and cost. Remove and replace when they become contaminated. Since disposable gloves are not designed for situations where contamination or permeation are more likely (for example, immersion in cleaning baths or handling corrosives, chemical spill cleanup), reusable gloves of heavier construction and suitable material should be used for such applications.

Reusable gloves should be inspected before each use, cleaned and/or decontaminated after each use, and replaced whenever they become discolored or show signs of damage.
Wearing the wrong type of glove when handling chemicals can be more hazardous than wearing none at all. If a chemical permeates the glove, it can be held in prolonged contact with the wearer’s hand and potentially cause serious damage. Selection guides, available from most suppliers or manufacturers, should be consulted when choosing a suitable glove. Under some circumstances double gloves may be used when dealing with chemicals of high or multiple hazards to ensure maximum protection.

When handling hot or cold items in the lab, insulated gloves made of Kevlar® or a similar heat insulating material should be used instead of those containing asbestos. If there are gloves containing asbestos in the lab, dispose of them as hazardous waste.

Lab Coats and Aprons

Lab coats, overalls, or aprons are worn to absorb or deflect spills and prevent corrosive or toxic substances from reaching the skin. Cotton is the preferred material for a standard coat; it is inexpensive and is reasonably slow burning. Coats made of synthetic fibers are not recommended because they may melt and adhere to the skin in a fire. For higher risk situations, use a chemical or flame resistant synthetic material such as Tyvek®. Plastic or rubber aprons should be used when handling large quantities of concentrated acids and other corrosive materials.

Respiratory Protection

With the exception of the Department of Chemistry respiratory protection is not typically required when working in VIU laboratories when handling chemicals. This is because of the combination of engineering controls (such as fume hoods), safe work procedures, and the relatively small amounts of chemicals in use.

However, to determine if there is a need for a respirator, the supervisor or other competent individual must perform a hazard assessment (See the VIU Hazard Identification, Risk Assessment and Control Program for guidance). If it is determined that respiratory protection is required, then the workers requiring the protection must:

- Be fit tested by ***a qualified person*** using the specific make and model of respirator chosen for use in the work area, based on the chemical product being used.

- Receive training on the proper use, care, and maintenance of the respiratory equipment you are expected to use.

Additional information on respiratory protection is available through the Office of Health and Safety Services

B. Chemical Inventory

An annual inventory of hazardous materials is required by all departments that acquire, handle, store, and dispose of chemicals. According to the WorkSafeBC Occupational Health and Safety Regulation, Part 5, Section 5.98, "An inventory must be maintained which identifies all hazardous substances at the workplace in quantities that may endanger workers in an emergency including controlled products covered by WHMIS (1988 and 2015), explosives, pesticides, radioactive materials, hazardous wastes, and consumer products. The inventory must identify the nature, location, and approximate quantity of all such substances, and the location of the (M)SDS."

Annual inventories serve as a reminder to:

1. Check chemicals with limited shelf life;
2. Remove surplus and old chemicals;
3. Correct incompatible storage;
4. Know what you have; and
5. Cleanup containers & shelves.

Develop a system for locating your chemicals and finding information about them. A good system should:

1. Direct you quickly to the chemical;
2. Be easy to use;
3. Be easy to maintain; and

4. Be updated annually.

Laboratories and shops are not storerooms, particularly with respect to chemicals and solvents. Chemicals in laboratories and shops should be stored in areas away from experimental activities, and limited to the requirements of 12 months or less. Excess stock should be kept in a proper chemical storage facility.

Order chemicals in small amounts, based on anticipated need. It is often false economy to order 1 kg of a material because it is cheaper than ordering 100 g of the same product. The materials end up:

1. Taking up valuable space;
2. Present a greater potential hazard (e.g. over time, some chemicals can change in composition, leading to the creation of additional hazardous properties, such as an explosive) ;
3. Becoming a disposal problem, and costing the users and VIU more to dispose of the material.

MSDSOnline

To assist VIU with the development of chemical inventories, and have quick access to the (M)SDS for the chemicals they have on hand, the MSDSOnline database contains chemical (Material) Safety Data Sheets (SDSs) for each department and service area at VIU.

The site can be accessed through this link.

C. Hazard Classes

Specific hazard information can be obtained by reviewing the Material Safety Data Sheet (M)SDS) for the chemical being handled. [2] (M)SDSs are summary documents that provide information about the hazards of a product and advice about safety precautions. SDSs are usually written by the manufacturer or supplier of the product.

(M)SDSs provide more detailed hazard information about the product than the label. They are an important resource for workplaces and workers to help you learn more about the product(s) used. Use this information to identify the hazards of the products you use and to protect yourself from those hazards, including safe handling and emergency measures.

(M)SDSs tell users what the hazards of the product are, how to use the product safely, what to expect if the recommendations are not followed, how to recognize symptoms of exposure, and what to do if emergencies occur.

[2] https://www.ccohs.ca/oshanswers/chemicals/whmis_ghs/sds.html

The MSDSonline database contains chemical (M)SDSs for each department and service area at VIU and provides the chemical hazards pertaining to the product in use.

The site can be accessed through this link

In the sections below you will find hazard-specific information for the chemical products you will find at VIU.

Flammable and Combustible Materials

Definitions

Flammable and combustible materials are substances that form vapours that can burn or explode. Vapour pressure is the pressure that is exerted by a saturated vapour above its own liquid in a closed container. It is reported in mm Hg, and it is positively correlated with temperature.

Flash point: defines the minimum temperature at which a liquid within a container gives off vapour of sufficient concentration in air that can ignite in the presence of an ignition source.
Flammable liquid: as per the BC Fire Code, is "a liquid having a flash point below 37.8˚C (100˚F), and having a vapour pressure not exceeding 275.8kPa (absolute) at 37.8˚C".
Combustible liquid: A liquid with a flash point at or above 37.8˚C.
Explosive limits: the vapour concentration range of a combustible or flammable material that will ignite in the presence of an ignition source.
Auto-ignition temperature: the temperature at which the vapour from a liquid will ignite without a source of ignition such as a spark or flame.

Examples

Flammable gases	Pyrophoric liquids	Organic Peroxides
Flammable liquids	Pyrophoric solids	Self-reactive substances and mixtures
Flammable solids	Pyrophoric gases	Substances and mixtures which, in contact with water, emit flammable gases
Flammable aerosols		Self-heating substances and mixtures

- Diethyl ether
- Alcohols
- Toluene
- Cyclohexane
- Ethyl acetate
- Formaldehyde
- Gasoline
- Diesel

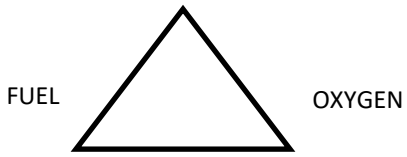
Hazards

Fire hazard related to use and storage.

Some solvents may cause a variety of health effects including skin, eye, and respiratory damage, neurological effects (central nervous system depressant) and acute and chronic organ damage. Solvents may also be absorbed through skin.

1. Flammable substances may readily burn or explode if placed near heat, sparks, or open flames.
2. Flammable liquids give off vapours that, in most cases, are heavier than air and can travel long distances until reaching a source of ignition such as an open flame, hot surfaces, static sparks, etc. at which time a fire or explosion could result. These vapours can also be carcinogenic or otherwise harmful to one's health, and should generally be used in a fume hood.
3. Flammable liquids pose many serious problems. The misuse of a small amount can have a disastrous effect. As liquids, they can flow and thus any spillage will increase the fire hazard. Burning flammable liquids will likewise flow and spread the fire.

There are three elements that must be present in order for a fire to result. Fuel, oxygen and an energy source. One way of pictorially describing this phenomenon is the "Fire Triangle". Removing any of the three components will extinguish a fire.



Safe Handling

Keep away from heat, sparks, and open flames. Keep the minimum quantity of substance in the work area. Store the chemicals away from oxidizers. Label containers FLAMMABLE. Where possible, ensure sprinklers and/or fire extinguishers are available and working. Safe handling practices must be strictly followed in handling and transferring of all flammable liquids.

Grounding of containers used for transferring flammable solvents is required to eliminate static charge build-up.

Because vapours continuously escape from flammable liquids, they must be kept in closed or covered containers. In the **open** laboratory and shop areas VIU restricts the volume of flammable liquids to a maximum of 25 L. Amounts in excess of this must be kept in approved safety cans, or a flammable liquid cabinet.

Oxidizers

Definition

Oxidizing materials are liquids or solids that readily give off oxygen or other oxidizing substances (such as bromine, chlorine, oxygen cylinders or fluorine). They also include materials that react chemically to oxidize combustible (burnable) materials; this means that oxygen combines chemically with the other material in a way that increases the chance of a fire or explosion. This reaction may be spontaneous at either room temperature or may occur under slight heating. Oxidizing liquids and solids can be severe fire and explosion hazards.

Examples

Bromine	Hydroperoxides	Perborates
Bromates	Hypochorites	Perchloric acid
Chlorinated isocyanurates	Inorganic peroxides	Periodates
Chlorates	Ketone peroxides	Permanganates
Chromates	Nitrates	Peroxides (hydrogen peroxide)
Dichromates	Nitric acid	Peroxyacids
Diethyl ether	Nitrites	Persulphates

Hazards

- May react with other products to create hazardous products.
- Speed fire development and/or fire intensity.
- Cause substances that do not normally burn readily in air to burn rapidly.
- Cause combustible materials to burn spontaneously without the presence of obvious ignition sources such as a spark or flame.
- Oxidizing materials may be toxic or corrosive.
- Depending on the material, route of exposure (inhalation, eye or skin contact, or swallowing) and dose, they can harm the body. Corrosive oxidizers can also attack and destroy metal.

Safe Handling

Elimination and Substitution:
If possible, eliminate or substitution for a less hazardous product. This will always be the first recommendation and can be the best way to avoid or reduce exposure to the hazard.

Engineering Controls:

- Properly designed and maintained ventilation systems.
- May require local exhaust ventilation – Depends on specific chemical in use. Please see (M)SDS for details.
- Enclosed processes as required

Administrative Controls:

- Practice to purchase products in ready to use concentrations to minimize handling.
- Develop and follow written safe work procedures specific to the chemical in use.
- Site-specific training for faculty, staff and students on the written safe work procedures to be conducted prior to handling.

Personal Protective Equipment:

Gloves	Eye protection
Chemical-resistant protective clothing	Respiratory protection based on risk assessment

An inventory of all peroxidizable material is required. These substances must be inspected and tested for peroxides regularly after the container is opened (WorkSafeBC Regulation 30.23).

- Frequency of these tests depends on the class of peroxidizable chemical. A simple test procedure for detection of peroxides in substances such as alkali metals, alkali metal alkoxides, amides or organometallics is not available.

Safe Storage

•Store oxidizers separate from flammable or combustible materials and reducing agents e.g. nitrates; chromates; permanganates; chlorates; peroxides

•All peroxidizable compounds should be stored away from heat and light (which catalyze the peroxidation reaction) and reducing agents, and protected from physical damage and ignition sources.

Special Case: Organic Peroxides

Organic peroxides are a particular group of oxidizing materials that are often unstable in nature. They can be among the most hazardous materials handled in laboratories. They are low power explosives, which are sensitive, to varying degrees, to heat or shock. Often they are products of room temperature oxidation of a variety of organic ethers, alkenes, certain alcohols, potassium and other materials. Organic peroxides are especially dangerous when dried.

Ether should not be handled outside of a fume hood unless workers are wearing appropriate respiratory protection.

Peroxide inhibitors are usually added to compounds that readily form explosive peroxides; however, they may not be sufficient to control peroxide formation once the container has been opened. Any peroxidizable compound must have this label attached to the container. The label should be updated every 3-12 months depending on the chemical.
A list of common Peroxidizable compounds is found in Appendix G.

Precautions

If ether peroxidation is visibly evident as a viscous layer in the bottom of the container or crystals around the cap, **do not handle the container**. If the container is more than 2 years old, and has not been opened or tested within the past 12 months, leave container as is, do not open the container and call Health and Safety Services at 250-740-6283 for assistance.

Peroxide Testing Program

Certain ethers such as di-isopropyl ether form peroxides more rapidly than most others and should be handled with particular care. Purchases of large quantities and long term storage are not recommended. There are several methods for the detection of peroxides, two of which are described below.

Test Strips

The simplest method for testing for the presence of peroxides in materials can be done using peroxide test strips available from local laboratory supply houses.

Chemical Testing

To 1 mL of the ether to be tested, add a solution of 100 mg of potassium iodide in 1 mL of glacial acetic acid. A pale yellow colour indicates a low concentration (0.001 to 0.0005 %) of peroxides, and a bright yellow or brown colour indicates a high (> 0.1%) and hazardous concentration of peroxides. This chemical test is more sensitive than the test strips, as it will detect dialkyl peroxides as well as hydroperoxides.

It should be remembered that these tests are valid only for relatively simple chemicals. Complicated organic structures may also act as oxidizing agents and therefore appear to give positive tests for peroxides. There are no testing methods for peroxides of potassium metal.

Testing Schedule

There are four classes of peroxide-forming chemicals based upon the peroxide formation hazard:

1. Class A –Severe Peroxide Hazard
2. Class B –Concentration Hazard
3. Class C –Shock and Heat Sensitive
4. Class D –Potential Peroxide-Forming Chemicals

Class A	Class B	Class C	Class D
Every 3 months	6 moths	6 months	1 year

Handling and Removal of Peroxides

If peroxides are detected, the solvent should be treated prior to use or being disposed of. See VIU's Procedures for Handling and Removing Peroxides for assistance with this process.

Compressed Gas (Gases Under Pressure)

Definition
Gases under pressure include compressed gases, dissolved gases or gases liquefied by compression or refrigeration within reinforced metal cylinders. This includes cryogenic liquids that are hundreds of degrees below zero Celsius, thereby representing an extreme cold hazard. There are four sub-groups of compressed gases: Compressed gas (O2, helium, argon); compressed liquid (chlorine, CO2); dissolved gas in liquid (acetylene in acetone), and cryogenic liquids (N2, O2).

Examples

Compressed gases	Liquefied gases
Dissolved gases	Refrigerated liquefied gases

Hazards
Compressed gases present a physical danger resulting from the sudden, out-of-control release of these materials from their containers. This release is associated with a concomitant discharge of energy due to great expansion in volume of the material leaving the cylinder (i.e. the energy released is akin to a jettisoned rocket that is capable of bursting through walls or any other objects in its way). The rapid diffusion of compressed gas can increase the exposure radius, increasing the potential for acute exposure and damage (corrosive or toxic gases). The release of compressed gas can also cause asphyxiation through the displacement of oxygen in the air. Compressed gases may be flammable, pyrophoric, toxic, corrosive, oxidizer, or reactive; their additional hazards will depend on the chemical nature

Handling
The following are basic precautions should be implemented when handling compressed gas cylinders:
- Chain or strap in upright position
- Protective cap in place while being moved
- Use cart to move
- Do not empty (not less than 30 psi)
- Cylinder valves closed when not in use

Compressed Gas Cylinders – Pressure Regulators:
Pressure regulators are used in a system using compressed gas to reduce pressure from high-pressure sources, such as gas cylinders or gas supply pipelines, to a safe working pressure range. The pressure

regulator should be attached to a cylinder without forcing the threads. A poor fit may indicate that the regulator is not intended for use on the gas chosen.

Special Case: Cryogenic Liquids (e.g. liquid nitrogen)
Most cryogenic liquids, such as liquid nitrogen, can cause frostbite to the skin. A few cryogenic liquids, such as hydrogen, propane and liquefied natural gas, are flammable. When handling these materials, the appropriate hand and eye protection against cold hazards as well as chemical hazards must be used.

Take additional precautions when working with cryogenic liquids:
• Use proper Personal Protective Equipment
  - Wear clothing that cover arms & legs
  - Wear cryogenic gloves under sleeves
  - Wear safety glasses and face shield
  - Wear non-slip closed shoes and apron

• Use specially designed storage, transport, and dispensing containers
• When working indoors, make sure the dispensing area is adequately ventilated as an oxygen-deficient environment may be created.

Insulated vacuum jacketed pressure vessels are equipped with safety relief valve and rupture disk to protect from pressure build up, check them regularly.

When transporting large volume of cryogenic liquids in an elevator, always send the cryogen container in an elevator *without* any passengers, and ensure that no passengers get on the elevator while the cryogen is being transported. In a power failure, a passenger could be trapped in the confined space of an elevator with the cryogen. Excessive amounts of the cryogen could vaporize and displace the oxygen leading to potential asphyxiation.

Corrosive Materials

Definition
Corrosive substances are materials that, upon contact, cause visible destruction of, or irreversible alteration to, tissue or metal. The eyes are especially sensitive to permanent damage by corrosive substances. Most corrosives are either acids or bases.

Examples

Corrosive to metals	Serious eye damage/eye irritation
Skin corrosion/irritation	

Common acids include: hydrochloric acid, sulfuric acid, nitric acid, chromic acid, acetic acid and hydrofluoric acid. Common bases are ammonium hydroxide, potassium hydroxide (caustic potash) and sodium hydroxide (caustic soda).

Hazards
Large quantities of corrosive chemicals are used routinely in manufacturing and laboratory procedures. Many household chemicals are corrosive in nature and deserve the same respect and care.

Corrosives comprise both acids and bases (caustics). The pH of a solution describes the degree of acidity or alkalinity of a solution, on a scale of 0 to 14. Materials with pH 7 are considered neutral and non-corrosive; those below 7 are acidic and those above 7 are caustic or basic. The further away from pH 7 that a substance is, the more corrosive it is.

Handling
When mixed together, acids and bases will react vigorously with each other through an exothermic (heat releasing) neutralization reaction. Proper handling and usage of corrosives require protective clothing to prevent skin, eye, or lung exposure. Serious burns and eye or lung damage can result from contact with corrosive materials.

Exposure requires immediate action to wash away the material away with copious amounts of water. Thick, oily corrosive liquids such as sulphuric acid and 40% sodium hydroxide are especially hazardous as it is difficult for water to quickly penetrate and dissolve these materials. Washing, in this situation, may include wiping off the oily layer with a cloth while keeping the affected body part in the water stream. Proper and prompt decontamination can prevent or minimize serious injury.

Volatile corrosive materials, such as concentrated ammonium hydroxide or hydrochloric acid, should be handled in the fume hood. Personal protective equipment, such as splash goggles, rubber gloves, substantial shoes and a lab coat or rubber apron, should always be worn when handling corrosive materials.

Acids
The common inorganic acids include hydrochloric, nitric, sulphuric, and phosphoric acids. Phenols and the halogens, such as bromine and chlorine are also acidic in nature. All hydrogen halides are acids that are serious respiratory and skin hazards.
Sulphuric acid is a very strong dehydrating acid. When preparing aqueous solutions of this and other concentrated acids, always add acid to water, very slowly. The reaction is extremely exothermic, producing a rapid increase in temperature during mixing. Continual stirring of the solution, as well as the use of distilled water ice for cooling (substitute for water), is recommended.

Hydrogen fluoride presents a special hazard. Both the gas and liquid form are highly toxic and able to penetrate deeply into the tissues and bone. Symptoms (pain) of contact with hydrogen fluoride solutions (e.g. Hydrofluoric Acid) may be delayed with serious burns resulting. When skin is exposed to hydrogen fluoride solutions, flush with water for at least 15 minutes, apply calcium gluconate gel after washing with water, and in all cases of exposure, seek medical attention.

Bases (caustics)

The most common bases found in laboratories are the alkali metal hydroxides, ammonium hydroxide and organic amines. The alkali metal hydroxides are especially destructive to the skin. The skin has a slippery feel when exposed to these materials because the hydroxyl radicals bond to the skin's peptides (saponification). Since the pain of exposure is delayed, it is extremely important that the skin be washed thoroughly for at least 15 minutes after exposure to these alkali solutions. The vapours from ammonium hydroxide (ammonia) present serious respiratory hazards.

Toxic Materials

Chronic and Acute toxicity – Oral, Dermal, Inhalation - toxicity with *short term exposure*

- Acute toxicity – Oral, Dermal, Inhalation (Category 4)
- Skin corrosion/irritation – Skin irritation (Category 2)
- Serious eye damage/eye irritation – Eye irritation (Category 2 and 2A)
- Respiratory or skin sensitization – Skin sensitizer (Category 1, 1A and 1B)
- Specific target organ toxicity – Single exposure (Category 3)

Definition
Toxic materials are substances that may cause harm to an individual if it enters the body. A toxic chemical is any substance that may cause damage to a structure or disturbance to a function when it is ingested, inhaled or absorbed, or when applied to, injected into or developed within the body, in relatively small amounts, by its chemical action.

The effects of toxic chemicals are related to the routes of entry, dose, and duration.

Examples

Methylene chloride	Isopropyl alcohol (2-propanol)	Acetone
l-Limonene	Formaldehyde	Hydrogen peroxide (>35%)
Asbestos		

Hazards

Toxic materials can cause serious health effects in an exposed individual. The degree of hazard associated with any toxic material is related to the exact material you are exposed to, concentration of the material, the route into the body and the amount absorbed by the body (the dose). Individual susceptibility of the user also plays a role. Important factors surrounding susceptibility include general health, heredity, diet, age, and sex.

The health effects may occur immediately or the effects may be delayed. Health effects that occur immediately after a single exposure are called ***acute effects***. In other cases, health effects will not occur until some point after the exposure. This is called a ***chronic effect***. A chronic effect may occur hours, days, months or even years after exposure. Generally, acute effects are caused by a single, relatively high exposure. Chronic effects tend to occur over a longer period of time and involve lower exposures (e.g., exposure to a smaller amount over time). Some toxic materials can have both acute and chronic health effects.

Chronic effects:
If a substance identified as any of the following is present in the workplace, it must be replaced, if practical, with a material which reduces the risk to workers:
ACGIH- American Conference of Governmental Industrial Hygienists
IARC- International Agency for Research on Cancer
NTP- National Toxicology Program

(a) **ACGIH A1**- Confirmed human carcinogen or **ACGIH A2**- Suspected human carcinogen, or **IARC 1**- Human carcinogen, **IARC 2A**- Probable human carcinogen or **IARC 2B** - Possible human carcinogen, or **NTP**- Known to be Human Carcinogen (KC) or **NTP**- Reasonably Anticipated Human Carcinogen (RAC).
(b) **ACGIH reproductive toxin**- a substance that has the potential for an adverse reproductive effect, including effects on both female and male reproductive organs, tissues, or cells; effects on fertility; effects on the embryo or fetus; effects that have been demonstrated to cause developmental abnormalities; tumor-causing effects; and effects on the newborn.
(c) **ACGIH sensitizer**- This critical health effect refers to the potential for a substance to produce sensitization as confirmed by human or animal data. Depending on the substance, workers can become sensitized to the substance through the respiratory system, the skin, or the eyes. Sensitization often involves a response by the body's immune system. Initially, there may be little or no response to a sensitizing substance. However, after a person is sensitized, subsequent exposure may cause severe reactions even at low exposure concentrations, including at levels below the exposure limit.

If it is not practicable to substitute with a material which reduces the risk to workers, an exposure control plan must be maintained to ensure workers' exposure as low as reasonably achievable below the exposure limit established.

It is important to remember that toxic materials can have other hazards associated with it. For example, a toxic material may also be corrosive and flammable. *Always* read the (M)SDS and labels to be sure you understand what is in the product and how to work with it safely. If you do not understand the instructions, or if you are not sure, check with your supervisor.

Handling

Whenever possible, it is always best to avoid using a toxic material either by eliminating its use (by changing the method or process for example) or by substituting the toxic material with a less hazardous material. Unfortunately, it is not always possible to find a non-toxic substitute that still does the job effectively and safely.

To prevent exposure to a toxic material, control measures are used. Ventilation is a very common control measure for toxic materials. Well-designed and well-maintained ventilation systems remove toxic vapours, fumes, mists or airborne dusts from the workplace before workers (and students) are exposed. Removing the contaminated air reduces the hazard of toxic materials.

When considering exposure control measures such as ventilation, there are many considerations, including:

- Physical state of the toxic material (e.g. is it a paste? a powder? a liquid?).
- Chemical properties (e.g. vapour pressure, boiling point, odour threshold, etc.).
- Toxicity (e.g. LD_{50}, LC_{50}).
- Other potential health effects (e.g. eye or skin irritation? sensitizer?).
- Potential routes of exposure (inhalation? skin absorption?).
- Quantity used.
- Frequency of use (Once a day? Every day?).
- The job requirements (e.g. how the material is handled).
- Size and layout of the work area.

An assessment of the specific ways toxics are stored, handled, used, and disposed of is the best way to find out if existing ventilation controls (and other hazard control methods) are adequate. The result from the assessment will determine your specific handling requirements.

In general, when handling toxic materials:

- Use only the smallest amount necessary to do the job.
- Prevent the release of toxic vapours, dusts, mists or gases into the workplace air.

- Wear appropriate personal protective equipment (if necessary) to avoid exposure (eye, respiratory or skin) or contact with contaminated equipment/surfaces.
- Be aware of the typical symptoms of poisoning and first aid procedures. Report any signs of illness or overexposure immediately to the supervisor. Depending on the material, medical attention for an exposure may be required even if the exposure did not seem excessive. With some materials, symptoms of a severe exposure can be delayed.
- Do not return contaminated or unused material to the original container.
- Ensure containers are clearly labeled and inspect containers for leaks or damage before handling.
- Keep containers tightly closed when not in use.
- Ensure suitable emergency equipment for fires, spills and leaks are readily available.
- Ensure emergency eyewash/shower stations are readily available and are tested regularly.
- To prevent spillage, use proper tools to open containers and to transfer material.
- Pour toxic liquids carefully from the container to avoid splashing and spurting.
- Avoid any welding, cutting, soldering or other hot work on an empty container or piping until all toxic liquid and vapours have been cleared.
- Maintain good housekeeping (e.g. clean surfaces, no accumulation of dust).
- Do NOT pipette by mouth
- Do NOT store or consume food or drinks in the lab or shop
- Wash hands after working with chemicals, before leaving the lab, and before eating

Exposure Limits (Prescribed by ACGIH- American Conference of Governmental Industrial Hygienists)
Definitions:

- "8-hour TWA limit" means the time weighted average (TWA) concentration of a substance in air which may not be exceeded over a normal 8 hour work period;
- "Short-term exposure limit" or "STEL" means the time weighted average (TWA) concentration of a substance in air which may not be exceeded over any 15 minute period, limited to no more than 4 such periods in an 8 hour work shift with at least one hour between any 2 successive 15 minute excursion periods;
- “Ceiling limit" means the concentration of a substance in air which may not be exceeded at any time during the work period;

Workers must not be exposed to a substance concentration that exceeds the ceiling limit, short-term exposure limit, or 8-hour TWA limit prescribed by ACGIH.

If a TWA, STEL or other exposure limit is not available, there are other toxicity measures:

- LD50: "Lethal Dose“ the amount of a material given at once, which causes the death of 50% of a group of test animals (units in mg/kg)
    - Extremely Toxic: 1 or less (a drop)
    - Highly Toxic: 1-50 (4 ml)
    - Moderately Toxic: 50-500 (30 ml)
    - Slightly Toxic: 500- 5000 (600 ml)
    - Practically Non-toxic: 5000 and above
- LC50: for inhalation experiments, the concentration of the chemical in air that kills 50% of the test animals in a given time (usually four hours) (units in ppm)
    - Extremely Toxic: 10 or less
    - Highly Toxic: 10-100
    - Moderately Toxic: 100-1000
    - Slightly Toxic 1000: 10000
    - Practically Non-toxic: 10000 and above

More information on toxicity classes and relative amounts/concentrations can be found on the CCOHS website.

For the Table of Exposure Limits for Chemical and Biological Substances, refer to the WorkSafeBC BC OHS regulations.

Additional information can be found in the (M)SDS of specific chemical being handled.

Health Hazards

- Respiratory or skin sensitization (immune response) – Respiratory sensitizer (Category 1, 1A and 1B)
- Germ cell mutagenicity (Category 1, 1A, 1B and 2)
- Carcinogenicity (Category 1, 1A, 1B, and 2)
- Reproductive toxicity (Category 1, 1A, 1B and 2)
- Specific Target Organ Toxicity – Single exposure (Category 1 and 2)
- Specific Target Organ Toxicity – Repeated exposure (Category 1 and 2)

- Aspiration hazard (Category 1)

Examples:
Formaldehyde = skin and respiratory sensitization;
Asbestos exposure potentially leading to asbestosis and cancer (mesotheliosis)
Vinyl chloride = carcinogen
Ethanol, mercury compounds, lead compounds, phenol, carbon disulfide, toluene and xylene = teratogens

Highly Reactive and Explosive Chemicals

Dangerously Reactive Materials
Definition
Dangerously Reactive Materials are unstable or highly reactive materials that can undergo extremely hazardous uncontrolled reactions. They can cause explosions, fires, or extreme heating, with potential for significant personal injury and property damage. These materials are not commonly used in workplaces because of their hazards. When used, they must be handled and stored in stringently controlled environments. Specialized training and supervision is required.

Dangerously reactive materials (liquid and solid) can:
a) Undergo vigorous polymerization, decomposition or condensation;
b) Become self-reactive under conditions of shock, or increase in pressure or temperature; or
c) React vigorously with water to release poisonous, sometimes lethal, gas.
d) Spontaneously combust in air (pyrophoric)

Examples

Hydrogen cyanide	Benzoyl peroxide	Chlorine dioxide	Organic peroxides
Acid halides (water reactive)	Sodium metal	Lithium aluminum hydride	

Hazards
Some materials can react vigorously with water to rapidly produce gases which are deadly at low airborne concentrations. For example, sodium or potassium phosphide release phosphine gas when they contact water. Alkali metal cyanide salts, such as sodium or potassium cyanide, slowly release

deadly hydrogen cyanide gas on contact with water. The cyanide salts of alkaline earth metals such as calcium or barium cyanide react at a faster rate with water to produce hydrogen cyanide gas. This can result in a life-threatening problem in confined spaces or poorly ventilated areas.

Highly reactive chemicals may undergo vigorous, uncontrolled reactions that can cause an explosion or a fire, or rupture sealed reaction vessels or storage containers.

Acid halides, such as acetyl chloride or phosphoryl chloride, react violently with water. Lithium aluminum hydride and butyl lithium spontaneously combust in air. Some organic monomers, such as butadiene, will self-polymerize in air. Read labels and material safety data sheets carefully to determine reactivity and compatibility characteristics of the chemicals being used.

Handling
When working with these types of chemicals, work should be performed in a fume hood and if there is the possibility of a vigorous or explosive reaction, a blast shield should be used. Workers (and students) should consider wearing a face shield in addition to protective eyewear as well. If the chemical is highly flammable or air reactive, a fire resistant lab coat should be worn.

WorkSafeBC BC OHS Regulation 30.20 states that:
a) Quantities of explosive and highly reactive material available in the work area must be restricted to amounts immediately required for the work day;
b) If the nature of the work suggests that explosions or implosions may result, the apparatus or equipment involved in such work must be adequately shielded;
c) Subsequently, the operators must be provided with and must wear suitable protective devices; and
d) Wherever practicable, the work must be safely isolated from workers by distance.

Potentially Explosive chemicals –can release tremendous amounts of destructive energy rapidly. If not handled properly, these chemicals can pose a serious threat to the health and safety of workers, emergency responders, building occupants, chemical waste handlers, and disposal companies.

Most chemicals that are used in teaching are stable and non-explosive at the time of purchase. Over time, some chemicals can oxidize, become contaminated, dry out, or otherwise destabilize to become Potentially Explosive Chemicals (PEC) (e.g., isopropyl ether, sodium amide, and picric acid).

PECs are particularly dangerous because they may explode if they are subjected to heat, light, friction, or mechanical shock. For PECs disposal, the VIU campus uses a hazardous waste contractor that follow special procedures for these chemicals. As a result there is a high disposal cost associated with such disposal.

Before ordering new chemicals:
Review the attachments and the chemical's (M)SDS. If the material you are about to purchase is a potentially explosive material:

• Consider substituting it with less hazardous material
• If substitution is not practical purchase the smallest amount possible
• Limit storage duration

Contact Health and Safety Services at 250-740-6283 for information on hazardous waste disposal

Picric Acid
Dry picric acid is a highly explosive material that is widely used as a DNA marker. Section 30.22 of the WorkSafeBC BC Regulation states that "solid picric acid must be stored with at least 10% moisture content and **regular inspections** must be made to ensure that the minimum **moisture content is maintained**. Solutions of picric acid must not be allowed to accumulate and dry around cap threads. It is important to:

- dispose of old stocks;
- order minimum amounts; and
- check current stocks routinely to ensure solid material has not dried out.

Do not handle/move dry picric acid containers; call Health and Safety Services at 250-740-6283 immediately for advice if dry picric acid containers are located on campus.

D. Storage of Chemicals

General Rules for Safe Storage
Chemical storage, whether in a laboratory or central storeroom, should be under the supervision of a qualified person; storerooms must have adequate security. Specialized cabinets should be used for specific groups of compatible substances.

Best practices include:

1. Do not overcrowd shelves.
2. Store solvents in a proper flammable liquid cabinet and keep door closed, being cognizant of the maximum allowable quantities. Consult the latest BC Fire Code and your local fire department for specific details
3. Use appropriate containers for solvents and waste.
4. Store highly toxic or controlled materials in a secure (locked) cupboard.
5. Store in central, properly ventilated area that includes forced ventilation from floor to ceiling and with exhaust above roof level.
6. Store working quantities (small containers that are used daily or frequently) on bench side shelving.
7. Shelving should be accessible with chemicals at eye level or lower; no high shelf chemical storage.
8. Avoid floor chemical storage (even temporary).
9. Shelf assemblies are firmly secured to walls.
10. Provide anti-roll lips on all shelves.
11. All chemical containers must be sealed, intact, properly labeled and made of compatible material

12. Regularly vent materials capable of building up pressure; e.g. formic acid, nitric acid, and hydrogen peroxide
13. Do not store chemicals in fume hoods unless the fume hoods are used exclusively for this purpose and are labeled as a storage area only.
14. Do not store chemicals near exits.

(More information: WorkSafeBC Sections 5.20-26 Containers and Storage)

Chemical Segregation for Storage

Each chemical must be evaluated to determine where and how it should be stored. Manufacturers' recommendations should be followed at a minimum but you will also find specific information on the (M)SDS. As a general rule, flammable or combustible liquids, toxic chemicals, explosive chemicals, oxidizing agents, corrosive chemicals, water-sensitive chemicals, and compressed gases *should be segregated from each other*. As such, they must be stored in such a way that they will not mix with each other if a container leaks or breaks.

It is important to segregate chemicals for storage in a compatible manner.

Storage segregation based on the WHMIS Hazard Classes

• Sort according to the categories described below.
• Prioritize the separation process in the following order:

1. FLAMMABLE & COMBUSTIBLE MATERIALS
2. OXIDIZING MATERIALS
3. CORROSIVE MATERIALS
4. GASES UNDER PRESSURE
5. TOXIC MATERIALS

Incompatible Chemicals

For a detailed list of incompatible chemicals see Page 30, Table 7 in the WorkSafeBC Laboratory Health and Safety Handbook. Also check your (M)SDS for additional information. Contact Health and Safety Services at 250-740-6283 for advice as required.

Segregation for storage based on Table 3.2.7.6 of the BC Fire Code (BCFC 2012)

Class	Flammable gases	Non-flammable /non toxic	Toxic/ corrosive gases	Flammable liquids	Flammable solids	Substances subject to spontaneous ignition	Water reactive	Oxidizing substances	Organic Peroxides	Poisonous Substance	Corrosives
Flammable gases	-	P	X	P	P	A	DS	X	X	X	X
Non-flammable /non toxic	P	-	P	P	P	P	P	P	P	P	P
Toxic/ corrosive gases	X	P	-	X	A	A	DS	A	X	DS	A
Flammable liquids	P	P	X	-	P	A	A	X	X	DS	A
Flammable solids	P	P	A	P	-	A	DS	X	X	DS	A
Substances subject to spontaneous ignition	A	P	A	A	A	-	DS	X	X	DS	A
Water reactive	DS	P	DS	A	DS	DS	-	X	X	DS	X
Oxidizing substances	X	P	A	X	X	X	X	-	X	A	X
Organic Peroxides	X	P	X	X	X	X	X	X	-	X	X
Poisonous Substance	X	P	DS	DS	DS	DS	DS	A	X	-	A
Corrosives	X	P	A	A	A	A	X	X	X	A	-

P Permitted; items may be stored together.
X Incompatible items; do not store together in same storage facility.
A Incompatible items; separate by minimum of 1 meter distance.
DS Defer to Safety Data Sheet.

Flammable and Combustible Materials

Flammable and Combustible Liquids

Flammable liquids should be stored in a dry, cool well-ventilated area, preferably a flammable materials storage cabinet or room.

Laboratory Storage

Flammable liquids should be stored:

- Storage cabinets must be conspicuously labeled to indicate that they contain flammable liquids.
- No combustible material is permitted in hazardous materials storage rooms, flammable storage cabinets and hazardous waste storage rooms.
- Do not store in or adjacent to exits, elevators, or routes that provide access to exits.
- Consult the 2012 BC Fire Code and your local fire department for specific details.
- If flammable liquids are to be stored cold, the refrigerators and freezers must meet explosion proof standards.
- In listed approved metal safety cans which meet the fire code requirements that are equipped with a flash arrestor and self-closing lid.
- In appropriate solvent containers that are capped when not in active use.

Do not exceed the allowable storage limits based on the BC Fire Code (2012). Contact Health and Safety Services for assistance as required.

Water sensitive chemicals

- Store in cool, dry areas designed to prevent accidental contact with water and other incompatible substances.
- Storage construction should be fire-resistant.
- Protect chemicals from water from sprinkler systems
- For air reactive chemicals use a glove box or fill the head space of the container with an inert gas before sealing the container.

Flammable Liquid Cabinets

An approved flammable liquid storage cabinet may be used when quantities of flammables are near or exceed 25 litres. An approved flammable liquid storage cabinet must be listed by an acceptable testing agency and approved by the local Fire Department.

Flammable liquid cabinets provide:
- A safe means of storage over a short period of time.
- A time-saving method of storage by locating cabinets in, or adjacent to work areas which reduces the frequency of trips to storage areas.

Flammable liquids cabinets must:
- Be Underwriters Laboratories of Canada (ULC) listed and approved.
- Be closed at all times, with door latches operable.
- Have vents that are either plugged or vented directly to the outside.
- Be either wood (must meet specifications of fire code) or metal.
- Be suitably placed; i.e. not located near an exit door or blocking access to an exit route.
- May have to be in a room which has a second exit depending on the quantity and hazards of flammable liquids in the room.
- Contain no more than 500 litres maximum of flammable and combustible liquids of which no more than 250 litres may be flammable.

There should not be more than one (1) flammable liquid storage cabinet per fire compartment, unless approved by the Fire Department.

Flammable Liquid Storage Rooms

A properly designed flammable liquids room must satisfy many requirements, e.g. location, ventilation, electrical equipment, fire protection, etc. It must also meet the needs of the user, e.g. adequate size, conveniently located, etc.

The flammable liquids storage room should be easily accessible to firefighting; i.e. located in corners of buildings over window openings and doors all providing sufficient entry. Explosion venting can then be incorporated into the exterior walls.

Specific guidelines for flammable liquid storage rooms include the maximum number of litres per square metre (m^2) of floor space, maximum room size with and without a sprinkler system (or other automatic extinguishing system) and the fire resistance rating of the interior walls.

d) Refrigerator Storage

Refrigerators must be approved (ULC) for storage of flammable liquids (explosion-proof), or acceptably tested and approved. A number of refrigerators have exploded due to flammable vapours.

Oxidizers

A number of inorganic and organic chemicals can become dangerous with age due to a tendency to form peroxides, especially on exposure to light and air. Chemicals which have undergone peroxidation are sensitive to heat, shock, and friction and may explode violently.

Store oxidizers separate from flammable or combustible materials and reducing agents e.g. nitrates; chromates; permanganates; chlorates; peroxides

All peroxidizable compounds should be stored away from heat, and light (which catalyze the peroxidation reaction) and reducing agents, and protected from physical damage and ignition sources.

An inventory of all peroxidizable material is required. These substances must be inspected and tested for peroxides regularly after the container is opened (WorkSafeBC Regulation 30.23). Frequency of these tests depends on the class of peroxidizable chemical: see Appendix G for a non-comprehensive list.

A simple test procedure for detection of peroxides in substances such as alkali metals, alkali metal alkoxides, amides or organometallics is not available.

Compressed Gases (Gases under Pressure)

- Protect cylinders from excessive variations in temperature, ignition sources, and direct contact with the ground.
- Label empty cylinders and store them separately from other cylinders.
- Use smallest, returnable size containers and quantities
- Keep all compressed gas cylinders upright and fully secured against falling
    - *Individually* chain or strap compressed gas cylinders. The use of a single strap or chain around multiple cylinders is not always effective.
    - Handcarts are not meant to secure cylinders when in use; use carts for transporting cylinders only.
- Store lecture bottles upright and chain, or secure in a proper holder.
- Position cylinders so that the valve is easily accessible and the contents label clearly visible.
- Store in central, properly ventilated area that includes forced ventilation from floor to ceiling and with exhaust above roof level.
- Storage according to compatibility
- If flammable gasses are stored indoors, the room must have a 2-hour fire separation with entry from the exterior. Natural ventilation to outside wall must exist, and the room must have no other purpose.
- Separate flammable gases from oxidizing gases with noncombustible partitions.
- If pressure testing is required, indicate on the cylinder when it was pressure-tested.
- Routinely check hazardous gases for leaks. Monthly is best practice, but more frequently if it is determined that the risk associated with the specific gas warrants it.
- Store hazardous gases with poor warning properties in exhausted enclosures (fume hood)

The laboratory/shop should not be used as a storage area for gas cylinders. Only those cylinders in use should be in the lab. Keep cylinders in a cool, dry, well-ventilated area away from incompatible materials and ignition sources.

To eliminate any chance of accidental connection of an empty cylinder to a gas line or system, which could result in flashback or back flow, empty gas cylinders should be labelled as such and stored away from full cylinders.

Corrosive Materials

Store corrosive materials in corrosion-resistant containers.

Store strong acids and bases separately from each other. Reactions readily occur between ammonia vapour and some acid vapours (hydrochloric and nitric acids in particular), resulting in potentially hazardous precipitates forming on the outsides of bottles and throughout the storage area. If space limitations do not permit separate storage, segregate using secondary containment.

Inorganic acids (e.g. nitric acid) and organic acids (e.g. acetic acid) should also be separated or segregated.

Organic acids may be stored with flammable and combustible liquids, provided there are no specific incompatibilities.

Perchloric acid, concentrated nitric acid and hydrofluoric acid should be separated or segregated from each other and all other chemicals. If an acid or corrosive cabinet is used for storage, polyethylene / polypropylene or Nalgene containers can be used to isolate these acids from others in the same cabinet.

Toxic Materials

For the storage of toxic materials, ensure that the storage area is clearly identified with warning signs, is clear of obstructions, and is accessible only to trained and authorized personnel.

Before storing toxic materials, inspect all incoming containers to ensure that the containers are undamaged and are properly labelled. Do not accept delivery of defective containers. Also, be sure to store toxic materials in the type of containers recommended by the manufacturer or supplier.

Some other important points for storage of toxic materials include:

- Keep the amount of toxic material in storage as small as possible.
- Inspect storage areas and containers regularly for any deficiencies, including leaking or damaged containers, expired shelf-life or poor housekeeping. Correct all deficiencies as soon as possible.
- Ensure that containers are tightly closed when not in use and when empty. Keep empty containers in a separate storage area. Empty containers may contain hazardous toxic residue -- keep closed.
- Store containers are kept at a convenient height for handling, below eye level if possible. High shelving increases the risk of dropping containers and the severity of damage, injury and/or exposure if a fall occurs.

- Store material within the temperature range recommended by the chemical manufacturer/supplier.
- To contain spills or leaks, the toxic material containers should be stored in trays made of compatible materials. For larger containers such as drums or barrels, provide dikes around the storage area and sills or ramps at door openings. Storage tanks are above ground and surrounded with a dike capable of holding entire contents.
- Store in secured area.
- For carcinogenic and reproductive toxins, ***secondary containment is required***.

The storage area for toxic materials should have the following characteristics. Many of these recommendations apply for safe chemical storage in general.

- Ensure that the storage area is well-ventilated and out of direct sunlight.
- Store toxics separately, away from processing and handling areas, eating areas and protective equipment storage. Separate storage reduces the amount of damage and/or injury caused in case of fires, spills or leaks. If totally separate storage is not possible, use physical separation to keep toxics away from incompatible materials.
- The storage area should be fire-resistant and constructed from non-combustible materials.
- Ensure that emergency eyewash/shower stations are readily available nearby and are tested regularly.
- Ensure that suitable fire extinguishers and spill clean-up equipment are available.

Highly Reactive and Explosive Chemicals

Store according to the MSDS/SDS for the specific chemical. Some require segregation from heat, light, physical movement (shaking, jarring, compression), water, moisture, or incompatible materials/substances as exposure may cause a dangerous reaction (burn, explosion, produce a dangerous gas).

If a reaction can be violent, use barriers to isolate it.

Special Case: Picric acid

Picric acid has specific regulations that must be followed. Please consult Sections 30.21 and 30.22 of the WorkSafeBC BC OHS Regulation for further information if you plan to use these substances.

Picric Acid

- Solid picric acid must be stored with at least 10% moisture content and regular inspections must be made to ensure that the minimum moisture content is maintained.
- Solutions of picric acid must not be allowed to accumulate and dry around cap threads.

E. Transporting Chemicals

Many chemical spills occur as a result of improper transport of chemicals from storerooms to labs/shops, and between labs/shops. When transporting chemicals outside the work area:

1. Carry glass containers in specially designed bottle carriers or a leak resistant, unbreakable secondary container.
2. When transporting chemicals on a cart, use a cart that is suitable for the load and one that has high edges or spill trays to contain leaks or spills.
3. When possible, transport chemicals in freight elevators to avoid the possibility of exposing people on passenger elevators. Do not take the stairs.

Chemicals should be transported by hand for short distances only within buildings or between adjacent buildings.

The ***Transportation of Dangerous Goods Act & Regulations*** govern the transportation of chemicals by vehicle on public roadways. For details, please refer to the regulations or contact Health and Safety Services at 250-740-6283. ***TDG training is required to transport chemicals off of any VIU campus or accepting/disposing of chemicals by a third party***.

If you are not trained currently in the Transportation of Dangerous Goods and you require chemical transport on or off of any campus, please confirm the chemical shipment PRIOR to transport and ensure that any documentation is signed off *by a person who is trained and certified* in the Transportation of Dangerous Goods.

F. Equipment

Laboratory/Shop Equipment

Prior to the start of all new projects, tasks, or processes, a hazard assessment should be done. See the VIU Hazard ID, Risk Assessment and Control Program for details on how to conduct one.

• All operators of equipment must be adequately instructed and trained in the safe use and the precautions to be taken when the equipment is used. This includes the use of distillation, filtration and low pressure apparatus as well as more expensive and sophisticated instruments such as gas and liquid chromatographs, spectrometers and specialized glassware.
• Equipment that presents a physical hazard to workers must be adequately safeguarded, shielded, or isolated by location.
• Equipment must be properly maintained in order for it to operate safely and correctly.
• Keep up-to-date emergency phone numbers posted next to the phone.
• Have appropriate equipment and materials available for spill control; replace when necessary.
• Always keep up with housekeeping in all work areas (floor must be dry at all times).
• Floors, walkways, hallways, and stairways must be kept clear at all times to eliminate slipping and tripping hazards.
• Access routes to emergency equipment (emergency showers and eyewash facilities, fire extinguishers, first aid kits) must be kept clear of any obstruction.
• Written procedures are required wherever the equipment, process or materials used are potentially hazardous. This includes emergency procedures for responding to utility shutdowns and interruptions requiring evacuation.

Refrigerators
When chemicals need to be stored in a refrigerator or freezer, certain guidelines must be followed. The materials must be securely packaged, tightly sealed and properly labeled. The containers for highly reactive materials must be inspected regularly to ensure they are secure, tightly sealed and in

good condition. Refrigerators should be frost free to prevent water drainage. Flammable materials (flash point < 37.8°C) that require cold storage must be stored in an *explosion proof unit*. All volatile materials must be compatible with the construction materials of their containment.

Glassware

Laboratory glassware may be made of several different types of glass. Select the appropriate glassware based on the application:

- Borosilicate glass (ex: Pyrex™, Kimax™, or similar) for situations involving thermal and mechanical shock use.
- Soft glass may be used for applications in which the glassware is not exposed to these conditions, such as for reagent bottles, glass tubing, and measuring equipment.
- Vacuum work, use only round bottom or thick walled borosilicate glassware designed to withstand low pressures.

Before beginning any experimental work, check glassware for flaws such as chips, star cracks, scratches and etching marks, which may result in structural failure. Note also that repaired glassware is subject to thermal shock and subsequent failure, and should be used with caution. Choose glassware sizes that can properly accommodate the operation being performed. At minimum, there should be at least 20% free space.

To prevent cuts from trying to force glass tubing into rubber / cork stoppers or tubing:

- Use appropriate hand protection and a soap solution, glycerine or other lubricant on the ends of glass rods or tubing before inserting into a stopper.
- The rod or tubing should be inserted into the stopper with a turning motion - never forced.
- Always aim the rod or tubing away from the palm of the hand which holds the stopper.
- The ends should be fire polished to remove sharp edges, and ensure that the stopper hole is large enough to accommodate the rod or tubing.

Electrical Equipment
Electrical equipment may cause electrical shock, and act as an ignition source for flammable or explosive chemicals. To minimize the possibility of either of these, a number of precautions can be taken:

- All laboratory/shop receptacles and equipment should be equipped with 3-prong grounded plugs.
- Equipment should be located to minimize the possibility of chemical spills on or under it.
- Inspect cords on a regular basis for frayed and/or damaged connections.
- Devices equipped with motors used where there are flammable vapours present should be either non-sparking induction or air driven motors.
- On-off switches, speed controllers, and similar devices can produce sparks every time they are adjusted. If electrical equipment is to be used in the fume hood, all controls should be outside the hood. Place a switch in the power cord if necessary.
- Unplug electrical equipment before making repairs or modifications.
- All electrical equipment must be CSA approved. Imported equipment that has not received CSA approval, and equipment designed and assembled in the lab/shop must be approved by an electrical engineer.

In labs, electrical devices such as stirrers and mixers are often operated over extended periods of time with the possibility of mechanical failure, electrical overload or blockage of stirrer. If they are to be left unattended, the associated equipment should be fitted with a suitable fuse or thermal protection device that will shut down the apparatus in the event of such problems.

Vacuum Pumps and Systems
Working at reduced pressure carries with it the risk of implosion, and the subsequent dangers of
flying glass, splashing chemicals and possibly fire. Any apparatus under reduced pressure should be shielded to minimize that risk.

When using a rotary pump or a building vacuum line:

- Place cold traps between the apparatus and the vacuum source to minimize the amount of volatile material that enters the system.
- Vent rotary pumps to an air exhaust system, not directly into the laboratory.
- Belt driven pumps must have protective guards, to prevent accidental entanglement.

Heat Sources

In Labs, whenever possible, use suitable electrically heated sources such as hotplates, heating tapes, heating mantles, or similar devices in place of gas burners as they are inherently safer. Water or steam baths are best for temperatures under 100 °C, since they present neither shock nor spark risks and the temperature is guaranteed not to rise above 100 °C.

Heating Mantles

Heating mantles enclose a heating element in layers of fiberglass cloth, and are free of shock or fire hazard if used properly. Some precautions that should be taken when using mantles include:

- Do not use if the fiberglass cloth is worn or broken, exposing the heating element.
- Take care to avoid spilling water or other chemicals on the mantle, as this presents a serious shock hazard. Depending on the spilled chemical, it may also present a fire or explosion hazard.
- Always use with a variable transformer to control input voltage. Never plug directly into an electrical outlet. High voltage will cause the mantle to overheat, damaging the fiberglass insulation and exposing the bare heating element.

Ovens and Furnaces

Ovens are most commonly used for drying glassware and samples. Only laboratory approved ovens that have the heating elements and temperature controls separated from the interior atmosphere should be used. Note also that lab ovens generally vent directly into the lab. If toxic vapours or gases may be released while using a lab oven, the vapours should be vented into a fume hood, a local canopy hood, or by some other means.

Furnaces are used for high temperature applications. Ensure reaction vessels and other equipment used are designed to withstand high temperature.

Laboratory Fume Hoods

An important exposure control measure used in many laboratories is the ventilated work enclosure commonly called a fume hood. Fume hoods protect workers from hazardous exposure to airborne contaminants by capturing fumes, dusts, vapours, and gases generated inside the hood and discharging them safely to the outside environment. Because of the large amounts of air that pass through an operating fume hood, the fume hood is also an important component of the laboratory's general ventilation system.

Labelling

Fume hoods must be clearly labelled with any use restrictions that apply. For example, a perchloric acid fume hood must be labelled to keep combustibles out. A fume hood used for storing chemicals must be labelled to warn workers against using the hood for any other purpose.

Monitoring airflow

Air velocities across the operational face of a fume hood must be measured and recorded at least once a year. Air velocities must also be measured if the system does not seem to be working well, and after any repairs or maintenance that could have affected the airflow. As fan belts age, for example, they may loosen and slip, resulting in a loss of air flow.

Air velocities can be measured with direct reading air velocity meters such as hot-wire anemometers. To determine the average and minimum fume hood air velocity, it is usually enough to measure the air velocity at about nine points in a grid pattern across the operational face.

Fume hoods in laboratories must provide *average* air velocities across the operational face opening of between 0.4 metres per second (80 linear feet per minute) and 0.6 metres per second (120 linear feet per minute). The face velocity must not be less than 80% of the average face velocity or greater than 120% of the average face velocity. For more information on fume hood airflow requirements refer to Section 30.8 of the BC Occupational Health and Safety Regulation.

If very toxic or radioactive materials are used in a fume hood and harm to workers may result from inadequate air flow, the airflow must be continuously monitored. This involves continuous air velocity or flow measurement (using manometers, pressure gauges, pressure switches, and other devices that measure the static pressure in the air ducts) coupled with an effective warning device to alert workers if the airflow stops or is reduced to unacceptably low levels.

Cross drafts created by personnel traffic, air supply inlets, or the opening and closing of doors or windows can disrupt the airflow across the operational face. Fume hoods must be located so as to prevent or minimize these and other disruptive forces. Smoke tests (for example, using air current tubes) should be made to visually assess the uniformity of air currents entering the fume hood. The baffles of the hood should be adjusted to provide a uniform airflow across the operational face.

Location of controls

The controls for operating a fume hood must be located outside the fume hood and be immediately accessible to the laboratory worker. Water taps may be located inside the fume hood if the main shutoff valve is outside the hood.

Ducting

Fume hoods located in the same room or separate rooms may be connected to a common exhaust duct or manifold system if the following conditions are satisfied:

- The requirements of ANSI/AIHA Standard Z9.5-2012, Laboratory Ventilation are met.
- Effective controls are installed to prevent backdrafts and pressure imbalances between rooms.
- The ventilation design and installation is certified by a professional engineer.

Fume hoods used for perchloric acid or radioactive materials must not be connected to a manifold system. Infectious agents must be handled in biological safety cabinets that exhaust to the outdoors through dedicated ducting. Other restrictions regarding the design and use of fume hoods can be found in the Occupational Health and Safety Regulation.

Maintenance

Fume hoods are certified annually at VIU by a third party contractor. If a fume hood does not pass the annual certification (e.g. does not meet WorkSafeBC regulations), the fume hood is repaired. Depending on the nature of the work involved (e.g. whether the actual fume cupboard is included or whether the fume hood system has leaks or not) there are standard procedures that must be performed by fume hood users prior to work being done by maintenance contractors. Users will be informed in advance of the repairs what procedure needs to be followed.

Safety Showers and Eyewash Stations

Emergency showers and eye washes should be available to all workers who work with large quantities of hazardous materials.

In order to clear eye washes of particulate material that could damage the eyes during emergency use, supervisors are responsible for ensuring that eye washes are flushed at least once per month for at least 1 minute to completely flush the branch of the water line supplying the eyewash (WorkSafeBC regulation 5.93(2) Testing) The frequency of this flushing can be increased depending on the conditions of the pipes in the facility.

Safety showers provide an effective means of treatment in the event that chemicals are spilled or splashed onto the skin or clothing. Safety shower facilities should be installed wherever corrosive chemicals are used (e.g. Acids or alkalis) and must be readily available to all personnel.

Safety showers and eyewash stations should be in a clearly marked location. The location of the shower/eyewash station is based on a risk assessment as per WorkSafeBC OHS Regulations Table 5-2 and Table 5-3.

Table 5-2: Risk assessment (WorkSafeBC)

Risk level	Description of the workplace	Examples
High risk	Workplaces at which corrosive chemicals or other materials are used in a manner, concentration and quantity which present a risk of irreversible tissue damage to the eyes or skin, or of serious illness resulting from rapid absorption of a toxic substance through the eyes or skin, or where the work activity presents a risk of ignition of the clothing.	Maintenance of ammonia refrigeration equipment or chlorine bleaching or disinfection equipment, handling corrosive materials such as corrosive cleaning products or chemical reagents where there is a high risk of skin or eye contact, filling chemical storage batteries. The following Health Hazard Classes and Categories in the HPR are included: (a) skin corrosion (1A), (1B), (1C); (b) serious eye damage (1).
Moderate risk	Workplaces at which chemicals or other materials are used in a manner, concentration and quantity which present a risk of irritation or other reversible harm to the eyes or skin, or of illness resulting from absorption of a toxic substance through the eyes or skin.	Spraying automotive paints and finishes, operating solvent degreasing equipment, handling irritant materials such as cleaning products or chemical reagents where there is a moderate risk of skin or eye contact, handling dry-cleaning solvents and spotting agents. The

		following Health Hazard Classes and Categories in the HPR are included: (a) eye irritation (2A), (2B); (b) skin irritation (2).
Low risk	Workplaces at which chemicals or other materials are used in a manner and quantity which present a risk of mild eye or skin irritation.	Using detergents, silicone-based mold-release agents, some hair-dressing solutions, rosin-cored solders, welding and grinding, working in dusty areas.

Table 5-3: Provision and location of emergency washing equipment (WorkSafeBC)

	High risk	**Moderate risk**	Low risk
Eye Equipment	Tempered, continuous flow eyewash facility with a minimum duration of 15 minutes (or more if required by the nature of the material).	Tempered, continuous flow eyewash facility with a minimum duration of 15 minutes.	Effective means to flush the eyes.
Location	Within 5 seconds walking distance of the hazard area, but no further than 6 m (20 ft). For high risk corrosive gases such as ammonia or chlorine, the facilities must not be located in the gas storage or use area, but rather, adjacent to it.	Within 10 seconds walking distance of the hazard area, but no further than 30 m (100 ft). May be located further than 30 m, provided that (a) a supplementary eyewash facility such as a personal eyewash unit or a non-tempered drench	Within 10 seconds walking distance of the hazard area but

		hose is located within 10 seconds walking distance of the hazard area but no further than 30 m, and (b) first aid services are maintained to start treatment of an affected worker within 5 minutes of the contact.	no further than 30 m (100 ft).
Skin Equipment	Tempered, continuous flow emergency shower facility with a minimum duration of 15 minutes (or more if required by the nature of the material).	Tempered, continuous flow emergency shower facility with a minimum duration of 15 minutes.	Emergency flushing equipment, such as a non-tempered drench hose.
Location	Same location criteria as for high risk eyewash facility except that the shower may be located further than 6 m if (a) a supplementary emergency washing facility such as a non-tempered drench hose is located within 5 seconds walking distance of the hazard area but no further than 6 m, and (b) a tempered shower facility is available within the building to start emergency washing within 5 minutes of the contact.	Same location criteria as for moderate risk eyewash facility except that the supplementary emergency washing facility for locations beyond 30m must be a unit such as non-tempered drench hose.	Same location criteria as for low risk eyewash facility.

For assistance determining the best location for your work area, please contact Health and Safety Services at 250-740-6283 for assistance.. Workers should be able to locate the shower/eyewash with their eyes closed as emergency situations may leave victims temporarily blind. Safety showers are often operated by grasping a ring chain or triangular rod.

Decontamination of Laboratory Equipment

Any equipment that has been used in a lab that contains hazardous materials will become contaminated over time. Thus lab equipment should be decontaminated prior to removal. This applies whenever equipment is transferred to another lab, sent for repair or calibration, or disposed of as waste or surplus equipment.

Decontamination includes the removal of all hazardous products, containers, or other potentially contaminated items from places such as refrigerators, cabinets, etc. The equipment should then be visually inspected for stains, residues, or other evidence of chemical contamination, and this contamination must be removed by washing with soap and water, a decontaminating solution, or whatever other means necessary.

For further information contact Health and Safety Services at 250-740-6283.

G. Inspections

At VIU, various individuals, groups, and regulatory agencies conduct inspections. Periodically WorkSafeBC carries out unannounced inspections. Nanaimo Fire and Rescue also conduct inspections of fire extinguishers and other fire-safety issues such as storage of flammable liquids and the condition of fire exits.

Regular workplace inspections play a key role in preventing accidents, incidents, injuries and illnesses by identifying and recording hazards, implementing corrective measures, and monitoring the effectiveness of the controls.

VIU must ensure that regular inspections are made of all workplaces, including buildings, equipment, work methods and practices to prevent the development of unsafe working conditions. Any deficiencies found during inspections should be reported immediately to the supervisor. If corrective action is not taken in a timely manner (within 30 business days) the deficiency should be brought to the attention of Health and Safety Services for support.

Inspection Types

• Daily (conducted by each individual, employee or student, of their own work area, to identify and correct hazardous conditions or report them to their supervisor).

• Monthly (conducted by area supervisors or their designate to identify hazardous conditions, using an abbreviated checklist that is posted at the work site).

• Annually (formal laboratory inspections that are the responsibility of the local safety committee; detailed checklist and report to supervisor with appropriate follow-up).

• Special (equipment; post-incident; post-repair; etc.)

Sample inspection forms can be obtained from Health and Safety Services. These forms can be customized to work best in your area. Please contact Health and Safety Services for assistance customizing the forms to ensure they meet both your needs and regulatory compliance requirements.

H. Hazardous Chemical Waste Management

Definition

Hazardous Waste means those materials defined in the Hazardous Waste Regulation, B.C. Reg. 63/88 as dangerous goods that are no longer used for their original purpose, and meet the criteria for Class 2, 3, 4, 5, 6, 8, or 9 of the transportation of dangerous goods regulations.

Such materials include:

- PCB wastes;
- waste containing dioxin;
- biomedical waste;
- waste oil;
- waste asbestos;
- waste pest control product containers;

- waste containing pest control products, including waste produced in the production of treated wood products;
- leachable toxic waste;
- waste containing tetrachloroethylene;
- waste listed in Schedule 7 to Hazardous Waste Regulation B.C. Reg. 63/88; and
- waste containing polycyclic aromatic hydrocarbon.
- Products and materials classified as 'Hazardous Waste' include goods that are: recycled, treated, abandoned, stored or disposed of;
- intended for recycling, treatment or disposal; or
- in storage or transit before recycling, treatment or disposal.

Dangerous goods classifications & descriptions	
Class 2:	Gases - compressed, deeply refrigerated, liquefied or dissolved under pressure
Class 3:	Flammable and combustible liquids.
Class 4:	Flammable solids; substances liable to spontaneous combustion and substances that emit flammable gases when in contact with water.
Class 5:	Oxidizing agents; organic peroxides.
Class 6:	Poisonous (toxic) and infectious substances.
Class 8:	Corrosive substances.
Class 9:	Miscellaneous products, substances or organisms that are considered by the Lieutenant Governor in Council to be dangerous to life, health, property or the environment when transported and are prescribed to be included in this class.

Handling and Storage of Hazardous Waste

As a general rule, all the precautions followed when handling, storing and using lab chemicals apply to hazardous lab waste. Hazardous waste is partially exempt from requirements of WHMIS. An employer must ensure the safe handling and storage of hazardous waste generated at the

worksite, through proper identification and worker education. Supervisors must develop safe work procedures for the storage of hazardous waste until it is picked up for disposal, and must ensure all workers are trained in these procedures. Some specific points to keep in mind:

1. Keep the exterior of the container free of chemical contamination.
2. Segregate by chemical compatibility.
3. Do not mix incompatible chemicals in the same container.
4. Leave at least 20% air space in bottles of liquid waste to allow for vapour expansion, and to reduce the potential of spills occurring from moving overfilled containers.
5. Dispose of hazardous waste regularly to avoid accumulation in the work area. Note also that any hazardous waste must be included in chemical inventories when determining the maximum quantities of flammable and combustible liquids present in a lab.

Waste containers should be kept closed at all times, except when contents are being added. Do not leave filter funnels in the open necks of containers, *even* if the waste is in a fume hood. Fume hoods are not to be treated as a worry free method of waste containment or disposal. Wastes should be separated as follows:

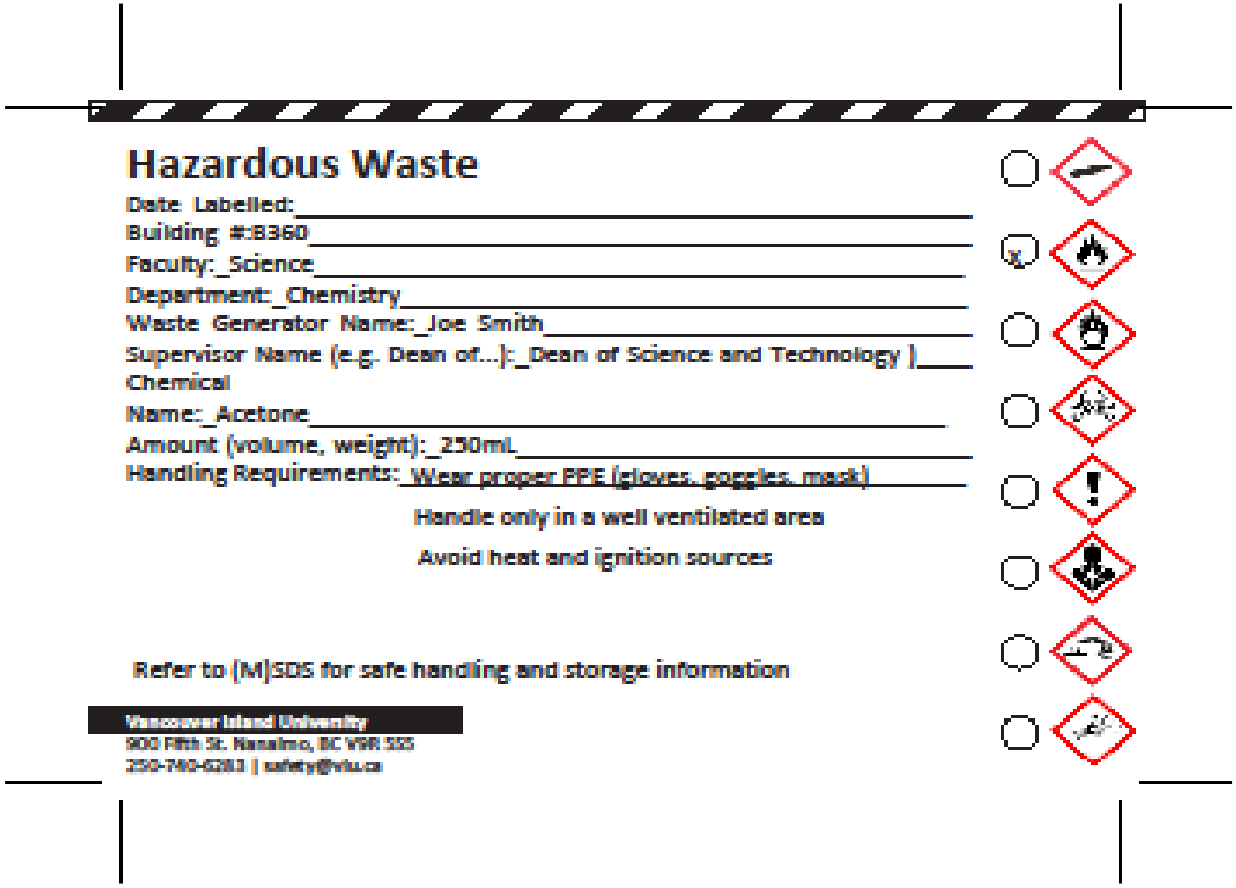
• Separate liquid and solid waste.
• Separate liquid organic waste from liquid aqueous waste.
• Separate strong acids and bases from other aqueous waste.

Note: though it is not necessary to separate halogenated from non-halogenated waste, it is recommended due to the different methods used to treat the various waste streams. Consult with the chemical waste management company on the preferred method of waste-material segregation and storage.

Labelling Hazardous Waste

The individual generating the waste is responsible for proper labelling of hazardous waste. All waste containers must be properly labelled to accurately identify the contents of the container. Containers should have the following information:

- Building number and room number
- Name of waste generator: This can be a technician, student, instructor, supervisor, principal investigator, etc.
- Contact phone number.
- Name of chemical contents in the container



Do not label waste containers with generic, vague terms such as “chemical waste”, “inorganic waste”, or “solvent waste” or “hazardous waste”. Use specific names that clearly identify the contents, and do not use abbreviations, acronyms, trademarked names, and chemical formulas. In the case

that the waste container consists of a mixture of materials (in the case of communal solvent waste containers used in labs), list the major components of the contents of the waste container (typically solvent). Attach a label to the container prior to being filled, and maintain a list of contents as waste is added to the container. Deface or remove old labels on containers used for chemical waste. There should never be any question of whether a container contains waste or the original contents. Old and unused chemicals should have their original label left attached, or re-labelled to indicate the contents if the original is missing or illegible.

UNIDENTIFED WASTE: It is the responsibility of the waste generator to have this waste identified and disposed of by a commercial hazardous waste contractor. The cost to have the waste identified is at the waste generator's expense.

Packaging Hazardous Waste

The waste generator is responsible for proper packaging of waste. Whenever possible, use the original container of the chemical for disposal. Otherwise, choose a container based on the following:

- Use a sealable container with a screw lid that does not leak when inverted. Foil, parafilm, corks or other plugs are not acceptable.
- Use a container that is compatible with the waste it contains (e.g. no hydrogen fluoride in glass containers).
- Visually inspect the container for damage or defects. Do not use a damaged container.
- Package old and unused chemicals in bags, and box according to compatibility.

Hazardous Waste Pickup

All hazardous waste generated by VIU is disposed of by a 3rd party hazardous waste contractor. Please contact Health and Safety Services for advice on how to safely dispose of your waste. The waste generator is responsible for ensuring that hazardous waste is disposed of in a safe manner.

8. Education and Training

Education: The Minimum Requirements

VIU, the employer, is responsible for ensuring that WHMIS education is provided at the workplace. It's also VIU's responsibility, acting through the supervisor, to ensure that any staff member or student worker or student who works with a hazardous product independently (unsupervised) or may be exposed to a hazardous product in the course of their activities is informed about:

a. all hazard information received from a supplier concerning that hazardous product; and
b. any further hazard information related to the safe use, storage and handling of that hazardous product.

If a hazardous product is produced during a work activity at VIU, the supervisor/instructor must ensure that any staff member or student who works with or is learning in proximity to the hazardous product or may be exposed to the hazardous product in the course of their activities has access to all hazard information related to the safe use, storage and handling of that hazardous product.

WHMIS 1988 and WHMIS 2015

Until the end of 2018, all VIU administration, faculty, and staff members (including VIU student workers) are required to participate in WHMIS 1988 and 2015 education. After December 2018 only WHMIS 2015 will be required. Training is to occur on or before the first day of employment with VIU.

It is in the best interest of VIU to also provide this training to students as part of their academic course when chemicals are being used.

Online training is available at https://d2l.viu.ca/

Training: The Additional Requirements

The supervisor/instructor must ensure that any staff member and student worker (or non VIU-employed student working on a VIU-sanctioned activity) who works with a hazardous product or may be exposed to a hazardous product in the course of their work activities is trained in the following:

1. the contents required on a supplier label and workplace label, on an (M)SDS, and the purpose and significance of the information contained on those label and (M)SDSs;
2. procedures for the safe use, storage, handling and disposal of the specific chemical;
3. procedures for the safe use, storage, handling and disposal of the specific chemical that is contained and/or transferred in
   (i) a pipe or a piping system including valves
   (ii) a process or reaction vessel
4. procedures to be followed where fugitive emissions are present if workers may be exposed to those fugitive emissions;
5. procedures to be followed in case of an emergency involving the hazardous product.

The instruction provided must be *specific to the workplace* where the chemicals are to be used and it must include the safe work procedures and emergency response procedures (printed or electronic) to be used in that particular workplace.

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9. Tools and Resources Available to the VIU Community

WHMIS for Employers Video:

https://www.worksafebc.com/en/resources/health-safety/videos/whmis-2015-for-employers?lang=en

WHMIS for Workers Video:

https://www.worksafebc.com/en/resources/health-safety/videos/whmis-2015-for-workers?lang=en

Personal Protective Equipment:

Glove Selector Tool: http://www.showagroup.com/

APPENDIX A

Please see the Health and Safety Services website for chemical information specific to your work area. If the information is not there, please contact Health and Safety Services to have the information added.

APPENDIX B: Personal Protective Equipment Hazard Reference Guide

Chemical Hazards			
Check All That Apply	**Task**	**Potential Hazard**	**Recommended PPE**
☐	Working with ml amount of less hazardous chemicals (TLV >100).	Slight skin or eye damage	Safety glasses Light chemical resistant gloves, closed shoe, pants
☐	Working with small volumes of corrosive liquids (< 1 liter).	Skin or eye damage	Safety glasses or goggles Light chemically resistant gloves Lab coat, closed shoe, pants
☐	Working with large volumes of corrosive liquids (> 1 liter), acutely toxic corrosives, or work which creates a splash hazard	Large surface area skin or eye damage, poisoning, or great potential for eye and skin damage	Safety goggles and face shield Heavy chemically resistant gloves Lab coat, closed shoe, pants, and chemically resistant apron
☐	Working with small	Skin or eye damage Slight poisoning	Safety glasses or goggles Light chemically resistant gloves Lab coat, closed shoe, pants

	volumes of organic solvents (< 1 liter).	potential through skin contact	
☐	Working with large volumes of organic solvents (> 1 liter), very dangerous solvents, or work which creates a splash hazard	Major skin or eye damage, or potential poisoning through skin contact	Safety goggles and face shield Heavy chemically resistant gloves Lab coat, closed shoe, pants, and chemically resistant apron
☐	Working with toxic or hazardous chemicals (solid or liquid).	Potential skin or eye damage, potential poisoning by skin contact.	Safety glasses (goggles for large quantities), light chemically resistant gloves, lab coat, closed shoe, pants.
☐	Working with acutely toxic or hazardous chemicals (solid or liquid).	Great potential skin or eye damage, great potential poisoning through skin contact.	Safety goggles, appropriate heavy chemically resistant gloves, lab coat, closed shoe, pants Coveralls and booties if necessary.
☐	Working with explosives.	Skin or eye damage from flying projectiles or chemicals.	Blast shield, safety goggles or full face shield, chemically resistant gloves, lab coat, closed shoe, pants.
☐	Working with chemical dusts.	Skin or eye damage, respiratory damage.	Safety glasses or goggles, appropriate gloves, lab coat, closed shoes or boots if necessary, pants, Approved respiratory protection

☐	Chemical spill cleanup.	Skin or eye damage, respiratory damage.	Safety glasses or goggles, appropriate gloves, lab coat, closed shoes or boots, pants, (contact hazmat for clean-up if respiratory protection necessary)
☐	Working with cryogenic liquids.	Major skin, tissue, or eye damage.	Safety glasses or goggles for large volumes, heavy insulated gloves, lab coat, closed shoe, pants.
☐	Working with very cold equipment or dry ice.	Frostbite, hypothermia.	Safety glasses, insulated gloves & warm clothing, lab coat, closed shoe, pants.
☐	Working with hot liquids, equipment, open flames (autoclave, bunsen burner, water bath, oil bath).	Burns resulting in skin or eye damage.	Safety glasses or goggles for large volumes, insulated gloves, lab coat, closed shoe, pants.
☐	Instrument repair	Eye damage from foreign objects.	Safety glasses, no loose clothing or jewelry.
☐	Metal or woodworking.	Eye damage from foreign objects, lacerations.	Safety glasses, gloves, no loose clothing or jewelry.
☐	Working in nuisance dusts.	Skin or eye damage, respiratory damage.	Safety goggles, appropriate gloves, lab coat, closed shoes or boots if necessary, pants, NIOSH approved dust mask or other respiratory protection

☐	Glassware washing.	Lacerations.	Heavy rubber gloves, lab coat, closed shoes, pants.
☐	Working with sharp objects or potential for glass braking	Cuts	Cut resistant gloves, safety glasses
☐	Working with loud equipment, noises, sounds, or alarms, etc.	Potential ear damage and hearing loss.	Ear plugs or headphones as necessary.