



ECE SAFETY MANUAL

Electrical and Computer Engineering faculty and staff conduct research in laboratories (labs) and provide educational opportunities to many undergraduate and graduate students. People who work in labs are exposed to potential hazards and this manual will provide information on health and safety policies and procedures for safe practices in research and teaching labs.

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Everyone who works in an ECE lab must read and understand the information in this document with regard to laboratory safety and emergency procedures prior to the first laboratory session.

1. EMERGENCY TELEPHONE NUMBERS

AMBULANCE, FIRE DEPARTMENT, POLICE	911
Fire alarm pull station for fire department	
UW POLICE	519-888-4911 or Ext. 22222
HEALTH & SAFETY (8:30-4:30 Monday- Friday)	Ext. 33587
Spill Control	519-888-4911 or Ext. x22222
Health Services	Ext. 33544 or 34096
Electronics Shop (People Trained in First Aid)	Ext. 33324 or 36179
Ontario Poison Centre	1-800-268-9017

Other Important Numbers:

Plant Operations (24 Hour Maintenance)	Ext. 33793
Director of Safety (Kate Windsor)	Ext. 35814
Health & Safety Coordinator (Robert Mullins)	Ext. 31153
Laboratory Director (Roger Sanderson)	Ext. 36184
Administrative Officer (Jayne Dean)	Ext. 33942
Department Chair (Manoj Sachdev)	Ext. 84016

All departmental telephones should have a **yellow** emergency number sticker affixed to them. If you see an ECE phone without a sticker, please notify the Lab Director at extension 36184.

2. FIRST AID

2.1 First Aid Kits

Undergraduate Lab Areas

In the undergraduate lab area, a major first aid kit is located in E2 3349 and a minor kit is located in CPH 1332. Technical staff with first aid training is located in E2 33349, ext. 33324.

Research Areas

First aid kits are located in CPH 1332, CPH 3373, DC 3577A, DC 2548, DC 2568, DC 2741, DC 3577A, EIT 4151, EIT 4177 and PRC 1807.

2.2 First Aid Procedures

Minor injuries may be treated at Health Services or by trained ECE Staff. If in doubt, call Health Services at 33544. Note that vehicle access is off Westmount Road.

Major injuries or illness are best handled by phoning **911**. The ambulance entrance for your area is listed on the first aid poster. First aid posters are located near the door in all undergraduate labs and in EIT 3028.

If you encounter someone who is suffering from a medical condition or injury take the following action:

- If an ambulance is required contact **911** or UW Police Ext. 22222 advising of your location and the condition of the individual. Advise UW Police if you contact **911** direct.
- UW Police will dispatch a constable to the location.
- UW Police will meet the Fire/Paramedic Service and escort them to your location.
- If qualified, administer First Aid, or seek assistance from someone who is qualified.
- Monitor the individual until the arrival of Fire/Paramedic Service personnel.

2.3 Electrical shock:

- **ACT FAST – CALL UW POLICE Ext. 22222**
- **GET EMERGENCY CARE**
- Do not touch the person until the power has been shut off
- Do not remove the person from the electric source until the power has been shut off
- If you cannot shut off the power, use an insulator such as dry rope, cloth, or broom handle to drag the person away from live wire
- If there is not heartbeat and no breathing, do CPR only if you are trained
- If there is a heartbeat but no breathing, immediately start rescue breathing
- Check for burns and treat as third degree burns

- If the person is breathing, put them in the recovery position
- Get person to doctor if heart skipping beats, fever or coughing up sputum.

2.4 Reporting Accidents

All accidents, incidents, and near misses must be reported. Should an injury or incident occur:

1. Obtain medical aid if necessary.
2. Report any injury to your supervisor immediately.
3. Complete injury/incident report with supervisor and forward to the Safety Office, Commissary Building within 1 day of the injury.
4. Should you have any questions or concerns contact Andrew Scheifele at ext. 36359 or Sheila Hurley at ext. 33587.

Major Accidents

Critical injuries must be reported immediately to the Safety Office ext. 35755. Critical injuries meet at least one of the following criteria:

- Place life in jeopardy
- Produce unconsciousness
- Substantial loss of blood
- Fracture of leg or arm, but not finger or toe
- Amputation of a leg, arm, hand or foot, but not a finger or toe
- Burns to major portion of body
- Loss of sight in one eye

In the event of a death or critical injury, do not "interfere with, disturb, destroy, alter or carry away any wreckage, article or thing at the scene of or connected with the occurrence until permission so to do has been given by an inspector", unless necessary to:

- a. save life or relieve human suffering;
- b. maintain an essential public utility service or a public transportation system;
- c. prevent unnecessary damage to equipment or other property.

Minor Accidents

- If you use material from a first aid kit, you must record the details in the first aid log book.

If you require the services of a health professional or lose time from work as a result of an accident, a UW accident investigation form must be completed. This is a government (Workers Compensation Act) regulation and results in a fine if ignored. Remember that breaches of the OHS Act can result in fines of up to \$500,000 to the corporate employer.

3. FIRES AND EVACUATION PROCEDURES

EVACUATION IS MANDATORY DO NOT USE THE ELEVATORS

3.1 Emergency Shutdown Procedures

Lab personnel or the instructor in charge of the class must follow basic steps for an emergency shutdown if time permits.

- STOP ALL ACTIVITIES
- Shutdown experiments that could be affected by the loss of electricity, water, gas or other services.
- Turn off, unplug and cover all electrical or electronic equipment.
CAUTION: Do not cover ventilation vents and/or fan motors that could result in overheating and possible fire.
- Remove all material and equipment from inside ventilated hoods.
Close the sash on all chemical fume hoods in the event that ventilation is lost.
- Cap all chemical containers. Ensure that water reactive chemicals are in sealed containers and stored in areas that are unlikely to become wet.
- Ensure that all chemical, radioactive materials and hazardous waste containers are properly covered and sealed.
- Ensure that all gas valves are closed.
- Vent all containers of cryogenic liquids to prevent buildup of internal pressure.
- Check that all gas cylinders are secured and in an upright position.
Remove regulators and install transport caps where possible.
- Turn off all appliances, computers, Bunsen burners, and other equipment.
- Refrigerator and freezers must be closed.
- Elevate equipment, materials and supplies, including electrical wires and chemicals, off of the floor, particularly in lower elevations that are prone to flooding.
- Close all doors, including cabinets, storage areas, offices and utility chase-ways.
- Secure lab notebooks/CDs, and backup critical data on computers.
- Close and secure windows.
- Lock all exterior lab doors before leaving.

Upon returning to laboratory or facility:

- Visually inspect the lab through the room or door windows to determine lab condition before entering
- Conduct a damage assessment of the lab

3.2 Evacuation Procedure

All undergraduate laboratories have fire and first aid posters located in the lab near the door.

Upon hearing the fire alarm or when an evacuation order is received, WALK immediately to the nearest exit. Remain outside until further instructions are received.

Laboratory supervisors are responsible for ensuring that there are appropriate evacuation procedures in place for those persons with mobility difficulties.

3.3 Fires

1. Notify others in the immediate area that there is a "FIRE"
2. Attempt to extinguish the fire only if you are trained to do so and if you can extinguish the fire without putting your own safety or the safety of others at risk. NOTE the type of fire extinguisher must correspond to the type of fire e.g. Class C for energized electrical equipment (wiring, fuse boxes, circuit breakers, plugged in electrical equipment).
3. Close the windows if you can do this safely.
4. Assist physically impaired to a safe location (stairwell or office with phone)
5. Leave the room and close the door.
6. Activate the nearest alarm or, if there is no convenient fire alarm, call **911** and alert the University Police at ext. 22222.
7. WALK out of the building via the closest safe emergency exit.
DO NOT USE THE ELEVATOR.
8. Report location of fire.
9. Report to the fire department the location of physically impaired or if anyone is thought to be still in the building
(phone 911)

3.4 Fire Extinguishers

All laboratories in E2 and CPH have a fire extinguisher located in the room near the door or in a fire hose cabinet in the corridor just outside. In the Davis Centre they are located in the hose cabinets in the main corridors near each group of project rooms.

4. EMERGENCY PROCEDURES

It is your responsibility to read safety posters and follow instructions during an emergency.

Know the location of the fire extinguisher, eye wash and safety shower in your lab and know how to use them.

Know the building evacuation procedures.

General Advice

- Do not panic
- Size up the situation quickly and decide what to do
- If you are in personal danger, first get to safety and then summon help
- If you are asked to leave the area, make your area safe if time permits by turning off hazardous experiments or equipment, and closing the door. Then leave promptly.

4.1 Earthquake

- **Stay calm**
- Get under a table, desk or bench, or stand in a doorway.
- Avoid windows.
- Leave building by stairs after shaking has stopped.
- Do not use elevators.
- When outside, stay clear of buildings and overhead hazards.

4.2 Flooding/Water Damage/Leaks

Serious water damage can occur from a number of sources: overland flooding, broken water pipes, clogged drains, damaged skylights or windows, or leaking roofs.

If flooding or water leaks occur:

- Contact Plant Operations Ext. 33793 and report the exact location and severity of the flood or leak.
- If there is a hazard of electrical shock evacuate the area immediately;
- If safe to do so take steps to avoid or reduce water damage by covering vulnerable objects;
- If you know the source of the water and are confident of your ability to stop it (e.g. close window) do so.
- If in doubt, phone ext. 22222

4.3 Gas Leaks

When a natural gas odour/leak is detected take the following action:

- Evacuate the immediate area.
- If safe to do so turn off the natural gas supply
- Depending on the strength of the odour or size of the leak, contact Emergency Services **911**, Physical Plant Ext. 33793 or UW Police Ext. 22222 advising them of the location of the odour/leak.
- If the odour/leak is from an off campus site, evacuate the area and contact Emergency Services **911**.

4.4 Utility Failure

All utility failures (electrical, elevators, heat etc.) must be reported immediately to Plant Operations Ext. 33793.

Note phones will not work in power outages; please use your cell phone.

In partial electrical power disruption students, faculty and staff should move to areas where there is light and not return to the affected area until power has been restored. Take all personal belongings and secure the room, if possible.

In complete electrical power disruptions students, faculty and staff should leave the buildings and not return until power has been restored. Take all personal belongings and secure the room, if possible.

Students, faculty or staff who need to enter the affected area(s) to pick up personal belongings, should report to the UW Police and request an escort.

**NOTIFY YOUR SUPERVISOR/INSTRUCTOR IMMEDIATELY
AFTER ANY INJURY, FIRE, EXPLOSION OR SPILL.**

5. MANDATORY SAFETY TRAINING

All faculty, staff, students, postdoctoral fellows, research personnel, work term placements, volunteers, and visitors (paid or unpaid) working in any research or teaching laboratory must take the following courses to comply with UW Health and Safety requirements:

Employees include:

- Faculty
 - Staff
 - Graduate Students
 - Undergraduate Students
 - Research personnel e.g. Postdoctoral Fellows, Research Assistants/Associates
 - Visiting Faculty
 - Teaching Assistants
-
- [Employee Safety Orientation](#) (requires 30-60 minutes to complete)
 - [Workplace Violence Awareness](#) (requires 30-60 minutes to complete)

These courses can be found at: <http://www.safetyoffice.uwaterloo.ca/hse/training/cbt.html>

Training is provided to all laboratory users. Emphasis in this training is placed on safe operating procedures; hazards related to specific equipment usage and general laboratory safety. Personal Protective Equipment (PPE) is issued to each laboratory user while working in the facility. This PPE includes, but is not limited to, safety glasses and goggles, masks or respirators as needed. Numerous first aid kits and fire extinguishers are mounted throughout the Laboratory. Eye wash stations are easily accessible to all laboratory users.

5.1 Hazard Specific Training

All lab workers must receive adequate training in the use of specific equipment and how to use the information provided by warning labels and Material Safety Data Sheets (MSDSs).

Safety training and/or information should be provided by a faculty member, teaching assistant, or staff member at the beginning of a new assignment or when a new hazard is introduced into the workplace.

The following training modules are mandatory for those working with the specific hazard or performing the specified functions. Online sessions may be taken at any time. Classroom sessions are scheduled on a regular basis each term.

Format	Title	Course Number	Approximate Duration
Online	BioSafety	SO1069	1.5 hours
Online	Cryogenic and Compressed Gas Safety	SO1030	45 minutes
Classroom	Fire Extinguisher Use	SO1088	1 hour
Classroom	Emergency First Aid	SO1038	8 hours
Classroom	Inspection of Slings & Chains	SO1035	1 hour
Online	Laboratory Safety	SO1010	45 minutes
Online	Laser Safety Training Theory	SO1066	2 hours
Online	Radiation Safety Open Sources	SO1013	3 hours
Online	Radiation Safety Devices	SO1017	45 minutes
Online	Radiation Safety Sealed Sources	SO1015	2 hours
Online	Radiation Safety Transportation	SO1021	2 hours
Online	WHMIS for Employees	SO1002	1 hour
Online	Working in Cleanrooms	-----	2 hours
Online	X-Ray Safety	SO1011	2 hours

Every person working in a laboratory is responsible for ensuring that he or she:

- **Completes all applicable health and safety training**
- **Follows all applicable safety rules and practices**
- **Uses and wears protective equipment as require**
- **Reports unsafe equipment and working conditions to the laboratory supervisor**
- **Reports all accidents/incidents to the laboratory supervisor**

YOU ARE RESPONSIBLE FOR YOUR OWN SAFETY!

6. MATERIAL SAFETY DATA SHEETS (MSDS)

MSDSs provide information about chemical and toxicological properties and hazards, and recommended handling and emergency procedures. MSDSs must be current and available for all controlled products in labs.

Hazardous materials likely to be found in labs include:

- lead/tin solder
- solder flux remover
- humidity calibration salts

- circuit board fabrication chemicals such as developer
- Sodium chloride
- Potassium carbonate and nitrate
- Lithium chloride
- Aluminum
- Adhesives

7. LABORATORY SAFETY

GENERAL LAB RULES

- **No food or drink allowed in the lab**
- **No tampering with wires or network cables**
- **No use of illegal software**
- **No compromising building or network security**

7.1 General Safety

- Be aware of the risks that are present in the particular lab you are working in
- Know and follow the safety rules and safe procedures.
- Fire doors must be kept closed at all times.
- Know and understand the hazards, safe handling and standard operating procedures of the materials, equipment and methods being used.
- Review MSDSs, equipment manuals, and procedures instructions before attempting to operate any machine or instrument.
- Read labels carefully.
- Never hurry. Work deliberately and carefully.
- Learn the location of emergency exits, fire alarms, fire extinguishers, etc.
- If you are unsure of any work to be done, ask the lab supervisor before proceeding
- Running, horseplay, pranks, and practical jokes are prohibited
- Report accidents and new misses promptly to the lab supervisor immediately

Housekeeping

- Do not use stairways or hallways for storage
- Aisles must be kept clear
- Never block access to exits, emergency equipment, e.g. fire extinguishers/eye washes/emergency showers, or electrical panels
- Maintain a clear 36" diameter area around all fire sprinkler heads
- Keep work area clear of all materials except those needed for your work.
- Extra books, purses, etc. should be kept away from equipment that requires air flow or ventilation to prevent overheating
- Equipment and chemicals must be properly stored and labeled

- Clean up your work area once experiments are completed and before leaving
- Properly dispose of used materials if any in proper containers. Waste batteries can be deposited into receptacles for recycling
- If leaving a lab unattended, turn off all ignition sources and lock the doors.
- Ensure drawers and doors are closed after use so they do not present a bump or trip hazard
- Store large, heavy or breakable items on lower and middle shelves
- Be careful when lifting heavy objects
- Step stools must be used to access items on high shelves
- Do not overcrowd storage areas and shelves
- Remove empty boxes and packing materials from lab

Food

- Consumption of food, gum and/or drink (including water) in research and teaching labs is **prohibited**.
- Use of lab equipment to store or prepare food is prohibited.
- Wash hands before leaving lab and before eating.

Clothing and Personal Protective Equipment

- No open toes shoes or sandals allowed
- Restrain loose clothing, long hair, and dangling jewelry
- Wear appropriate clothing for the task, for example:
 - Long sleeves should be worn to minimize burn hazards e.g. when using the soldering station
 - short sleeves or long sleeves rolled above elbow should worn around moving parts to minimize entanglement hazards.
 - No shorts.
- Remove any conductive watch bands or chains, rings, wrist watches, etc.
- Personal protective equipment must be used as required and in consideration of the hazards present in each lab
- Gloves must be worn to protect hands and arms e.g. rubber insulated gloves tested to appropriate voltage or lead-lined rubber, plastic or leather gloves for radiation
- Face shields are required over safety glasses when grinding, chipping, brushing and abrasive metal cutting, to provide protection against flying objects
- Safety glasses should be worn to avoid danger from any arc which may occur across the switch terminals
- Do not apply any lip balm or cosmetics in any lab
- Remove gloves before touching computers or phones, opening doors, etc.

Smoking

Smoking is not permitted in any University building or vehicle and in areas within ten metres of all buildings.

7.2 LABORATORY SECURITY

Keep laboratories locked when unoccupied to avoid unauthorized entry.
Leave doors unlocked while working in laboratory in case assistance is needed.

Individual users are responsible for the security of any space to which they have keys and shall not admit unauthorized or non-registered persons into that space. Safeguarding University resources from unauthorized access, misuse or removal is a duty of all faculty and staff. All laboratory users have a responsibility to take reasonable precautions against theft or misuse of materials, particularly those that could threaten the public. Any extraordinary laboratory security measures should be commensurate with the potential risks and imposed in a manner that does not unreasonably hamper research.

7.3 WORKING ALONE

Never work alone in laboratory.

Always work in the lab with another person in case of an accident which might render you helpless to call for assistance.

If you are working with energized circuits or equipment over 50 volts peak, make sure that at least one other person can see you and hear you.

7.4 ELECTRICAL SAFETY

There is always a potential danger of electric shock or fire whenever there are outlets, plugs, wiring or connections. In addition to the usual electrical hazards, some labs have high voltage electrical equipment.

- Familiarize yourself with the location of Circuit breaker panels in labs.
- Maintain an unobstructed access to all electrical panels.
- Electrical cords must be secured
- Connect to the power source **LAST**.
- Turn off and unplug equipment (instead of relying on interlocks that can fail) before removing the protective cover to replace a part, adjust or troubleshoot.
- Do not use an electrical outlet or switch if the protective cover is ajar, cracked or missing
- All electrical apparatus must be properly grounded.
- Never remove the ground pin of a 3-pronged plug.
- Do not run wires over moving or rotating equipment, or on the floor, or string them across walkways from bench to bench as this creates a trip hazard.
- DO NOT use electric wires as supports and never pull on live wires.
- Ensure that all wires are dry before plugging into circuits.

- Remove electrical cords from the receptacle by grasping and pulling the plug not the cord
- Always pick up and carry portable equipment by the handle or base.
- Only use DRY hands and stand on a dry surface when using electrical equipment, plugging in an electric cord, etc.
- If electrical equipment emits smoke or a burning smell, shut off power immediately and take it out of service for repair.

Extension Cords

- Avoid using extension cords whenever possible.
- Extension cords must only be used as a temporary solution and should be appropriately rated for the job.
- Do not run extension cords under doors, across aisles, or hang from ceiling
- Don't overload circuits by using power strips or multiple outlets on regular sockets.
- "Piggy-backing" of extension cords is prohibited.

High Voltage

- Obtain permission before operating any high voltage equipment
- Never modify, attach or otherwise change any high voltage equipment
- Always make sure all capacitors are discharged (using a grounded cable with an insulating handle) before touching high voltage leads or the inside of any equipment even after it has been turned off. Capacitors can hold charge for many hours after the equipment has been turned off.
- When you are adjusting any high voltage equipment or a laser which is powered with a high voltage supply, USE ONLY ONE HAND. Your other hand is best placed in a pocket or behind your back. This procedure eliminates the possibility of an accident where high voltage current flows up one arm, through your chest, and down the other arm.

Report any Abnormal Wear, Damage or Equipment Failure

- Inspect electrical cords regularly – replace frayed or damaged cords and repair broken plugs.
- Inspect electrical equipment with power off and unplugged for frayed and damaged connections
- If a piece of equipment fails while being used, report it immediately.
- Report defects/faults to your supervisor.
- If you receive a mild shock from a piece of equipment, turn it in for repair
- Tag/Label equipment UNSAFE – DO NOT USE and describe the problem.
- Do not attempt to repair electrical equipment yourself. Only qualified and trained people should repair or modify electrical or electronic equipment.

All electrical equipment purchased, regardless of voltage, must be certified by an approved authority. Equipment will have a field approval mark from the Canadian Standards Association (CSA), Electrical Safety Authority (ESA), or an equivalent field approval mark

acceptable under the Electrical Safety Code i.e. Ontario Hydro (OH), International Approval Services (IAS), ULc. Do not bring into the lab or use in the lab equipment that does not conform to ESC rules without specific permission from your instructor, TA or Lab Technical personnel.

7.5 HAZARDOUS VOLTAGES, CURRENTS OR ROTATING COMPONENTS

- If you turned on any lab power, turn it off when you leave. Also ensure that all energy storage capacitors are discharged.
- Do not work alone and ensure that the other person is familiar with the location of the emergency switch.
- Ensure that the emergency switch is easily accessible.
- Install proper current protection in your circuit.
- Wherever possible, cover the hazardous voltage points (self-adhesive warning labels are available from ECE stores).
- Turn the power off before making any circuit changes and ensure that all energy storage capacitors are discharged.
- Wherever possible, cover all moving components.
- Ensure that devices are being operated within their specified limits.
- Ensure that instrument grounds are not connected to points which are at voltages higher than ground. Differential/isolation pods are available.

7.6 STATIC ELECTRICITY AND SPARKS

Static electricity and sparks may cause a fire under the right circumstances. Always be conscious of the potential for generating sparks.

- Electrical equipment must have spark protection in areas where there is a danger of fire or explosion.
- Some protection from static electricity and sparks is obtained by proper grounding and bonding of containers and equipment.
- A dry atmosphere promotes the formation of electrical charges.

Common sources of sparks and static electricity are:

- plastic aprons
- metal clamps, nipples or wires used with non-conducting hoses
- gases released quickly from cylinders under high pressure
- switches and thermostats
- Electrical contacts (eg. light switches and thermocouples, refrigerators) may produce sparks.

7.7 CHEMICALS

- Treat every chemical as if it were hazardous
- Make sure all chemicals are clearly and currently labeled with the substance name, concentration, date, and name of the individual responsible
- Never return chemicals to reagent bottles. Try for the correct amount and share any excess
- Comply with fire regulations concerning storage quantities, types of approved containers and cabinets, proper labeling, etc. If uncertain about regulations, contact the Lab Manager/Instructor/Teaching Assistant.
- Use volatile and flammable compounds only in a fume hood. Procedures that produce aerosols should be performed in a hood to prevent inhalation of hazardous material.
- Never allow a solvent to come in contact with your skin. Always use gloves.
- Never “smell” a solvent. Read the label on the solvent bottle to identify its contents.
- Dispose of waste and broken glassware in proper containers.
- Clean up spills immediately.
- Do not store food in laboratories

7.8 COMPRESSED AND CRYONGENIC GASES

Laboratory gases are supplied in high-pressure cylinders. These cylinders present their own hazards and must be stored, handled and used with extra care. There are specific procedures required for handling cryogenic and compressed gases.

Compressed gas cylinders can be extremely hazardous when misused or abused. Certain precautions must be observed when storing, handling, and using compressed gas cylinders in order to keep the hazards to a minimum. The uncontrolled release of a compressed gas can result in serious consequences, not only because of possible toxicity and flammability, but also because a high pressure cylinder can become a lethal missile if the cylinder valve is broken off.

Cryogenic liquids (argon, nitrogen, helium, hydrogen and oxygen) and certain other liquefied gases are at extremely low temperatures (-60/C to -266/C). Very small amounts of these liquids produce large amounts of gas. Consult the product's MSDS for specific guidelines regarding health and safety information, personal protective equipment and emergency recommendations.

Safety precautions that must be taken with compressed gases also apply to cryogenic liquids. There are, however, additional precautions necessary when dealing with cryogenic materials.

- When using compressed air, use only approved nozzles and never direct the air towards any person
- Guards on machinery must be in place during operation

- Exercise care when working with or near hydraulically- or pneumatically-driven equipment. Sudden or unexpected motion can inflict serious injury.

7.9 LASERS

The use of lasers and the corresponding management of their hazards must comply with ANSI Z136.1. The hazards associated with the use of Class 3B or 4 lasers include eye or skin burns, fire and electrocution.

Below are key aspects of laser hazard management:

- Never look into any laser beam, no matter how low power or “eye safe” you may think it is.
- Always wear safety goggles if instructed by your Instructor/Teaching Assistant/Lab Manager
- Never lower your head to the level of the laser beam to avoid scattered laser light reflecting off mountings, sides of mirrors, etc.
- The laser beam should always be at or below chest level.
- Always use “beam stops” to intercept laser beams.
- Never walk through a laser beam. Some laser beams of only a few watts can burn a hole through a shirt in only a few seconds.
- Ensure that appropriate protective eyewear and protective clothing are worn as determined by the class of the laser.
- Ensure that operation, repair and maintenance are performed only by competent, trained and qualified personnel.
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- Manufacturer installed safety devices such as shields or interlocks must not be altered, disconnected or removed without written approval from the laboratory supervisor.

If you suspect that you have suffered an eye injury, notify your Instructor/Teaching Assistant IMMEDIATELY. Your ability to recover from an eye injury decreases the longer you wait for treatment.

7.10 NANO MATERIALS

There are concerns about toxicity of nanoparticles that are inhaled, ingested, or absorbed through dermal exposure during initial contact; nanoparticle waste may present a hazard in the environment. The use of good work practices can help to minimize worker exposures to nanomaterials.

There are specific health and safety precautions for the use, cleaning, storage and disposal of nanomaterials. Specific research projects may require additional health and safety precautions.

Handling Requirements:

- Total enclosure of the particle handling process - Nanoparticle stocks that are dry should be handled inside an appropriate glove box. Workers should wear protective equipment, including safety goggles, lab coats, and gloves if handling or transporting materials outside of a glove box.
- Total enclosure of stored stocks and nano-materials.
- Nanoparticle solutions may be handled on the lab bench once placed in solution. Workers should wear protective equipment, including safety goggles, lab coats, and gloves.
- Transport of nano-materials should employ a sealed secondary containment device.
- Limit access in areas where processes are being carried out. Only trained personnel may be permitted to work in these areas while nanomaterials are being used. Training procedures and operating procedures must be implemented before beginning work with nano-materials.
- Nanoparticle waste must be contained and labeled for chemical content in compliance with hazardous waste management requirements. Nanoparticle spills should be cleaned immediately using spill mitigation procedures developed by the laboratory.
- Follow the specified spill control and cleanup protocol.
- Regular cleaning of bench tops, floors and other surfaces should be implemented; the cleaning schedule should be documented. The cleaning solution should be compatible with the vehicle in which the nanoparticles are suspended such as cleaning of work areas using HEPA vacuum pickup and wet wiping methods,
- Prohibition of eating and drinking in laboratories and controlled areas.
- Equipment used for handling of nanoparticles must be evaluated for safety concerns before it may be repaired, reused for other laboratory purposes or released for disposal.
- Use hand-washing facilities and facilities for showering and changing clothes.

7.11 UNATTENDED PROCEDURES

Do not leave an on-going experiment unattended.

Unattended lab procedures should be reviewed by the lab supervisor to ensure all hazards are controlled before leaving the experiment unattended.

- Unattended procedures should be visited periodically
- Post contact information for the person conducting the experiment in case of emergency
- Unattended heating may be done only with heating equipment that reliably maintains stable temperatures
- Remove any flammable or combustible materials from the area

7.12 UNAUTHORIZED EXPERIMENTS

Never do unauthorized experiments. Research or other activities involving the use of lab space, materials or equipment without the knowledge and approval of the responsible Principal Investigator is strictly prohibited.

7.13 ONLINE RESOURCES

The Safety Office serves as a Health, Safety and Environment (HSE) resource for health and safety. The Safety Office oversees many programs on campus and has specific procedures that must be followed to ensure compliance with UW policy and governmental regulations. <http://www.safetyoffice.uwaterloo.ca/>

Most governments have posted regulations pursuant to health and safety on the web and many institutions have placed their health and safety policies, procedures and programs on the web as well.

8. SAFETY TRAINING FOR UNDERGRADUATE STUDENTS

All undergraduate engineering students receive WHMIS and evacuation training in 1A. Upon completion of this instruction, a sticker is awarded to be affixed to the student's ID card.

When students take a course which has some unusual hazards associated with the laboratory, special instructions are given. These are written instructions documenting the hazard and safety procedure and are accompanied by a brief explanation by the lab instructor. The student then signs that he/she understands the safety procedures and will follow them.

Currently, the ECE courses deemed to have these unusual hazards are:

ECE 261, 361, 370, 375, 463, 464, 471, 475, 481, 484 and 486.

NE 320L, 340L, 450 L, 454L and 455L.

8.1 EXPECTATIONS FOR STUDENTS:

- Students must adhere to written safety rules, regulations and standard operating procedures.
- Follow verbal safety instructions throughout the academic term. Since additional instructions may be given at the beginning of laboratory sessions, it is important that students arrive at each session on time.
- Complete mandatory safety training.
- Consult with PI/Lab Supervisor before using hazardous materials or conducting high risk experimental procedures and obtain prior approval if required.

- Keep work area safe and uncluttered. Practice good housekeeping and chemical hygiene.
- Use personal protective equipment as required.
- Never work alone in the lab.
- Absolutely no food, drink, or smoking is permitted in the lab at any time.
- Use equipment for its intended purpose only.
- Report all broken equipment, emergencies, injuries, near misses or safety concerns to the PI/Lab Supervisor.
- In the event of an emergency, call **911** and the UW Police ext. 22222

It is expected that each student will work in a responsible manner and exercise good judgement and common sense. If at any time you are not sure how to handle a particular situation, ask your Teaching Assistant or Instructor for advice. ***The area lab manager can give you advice if it is requested, but he/she is probably not totally familiar with your project.***

DO NOT TOUCH ANYTHING WITH WHICH YOU ARE NOT COMPLETELY FAMILIAR.

It is always better to ask questions than to risk harm to yourself or others, or damage to the equipment.

9. TEACHING ASSISTANTS WORKING IN TEACHING LABORATORIES

All Teaching Assistants (TA) are considered supervisors and must ensure the safety of all those who enter the lab. TAs who work in teaching laboratories receive written information specifying their responsibilities with respect to safety in the laboratory.

TAs should provide a lab orientation to ensure that all students are familiar with the use and location of equipment and safety aids. Orientation should include information on:

- Electrical equipment and manuals
- Material Safety Data Sheets (MSDSs)
- Review safety manuals and resources
- Chemical inventories and demonstrated methods of access
- Explain use of and limitations of personal protective equipment (PPE) e.g. safety glasses, face shields, temp resistant gloves, etc.
- Importance of reporting every incident, accidents, and unsafe conditions to a supervisor
- Review emergency procedures and location of emergency equipment and supplies (nearest phone, fire extinguishers, first aid kits etc.)
- Fire alarm pull station
- Evacuation procedures (emergency routes and exits)
- Procedures for medical emergencies and injuries

- Information concerning the existence of, and procedures for dealing with any unusual hazard which may exist in a particular laboratory.

All teaching assistants must sign a form which states that they understand their responsibilities and will follow the specified procedures.

10. STUDENTS ON UNPAID WORK PLACEMENTS

A [Work/Education Agreement Form](#) is to be used by Faculties/Departments arranging unpaid placements. MTCU requires information on placement hours, grant eligible and visa status. The form, adapted from MTCU, includes a student accident/injury report form. To comply with MTCU reporting requirements, Faculties/Departments are to complete the form with the student before placement, then provide the Safety Office with the completed form (including total hours worked) at the end of each term.

11. SAFETY PROCEDURES FOR PERSONS WORKING IN RESEARCH LABORATORIES

All persons working in research labs must:

- Complete all applicable safety training.
- Become familiar with what to do in specific situations.
- Review all lab specific hazards and safety precautions with supervising researcher.
 - Become familiar with any unusual hazards in designated areas, and procedures for dealing with them. Know the specific Materials Safety Data Sheets and equipment manual(s) for these areas.
- Follow all departmental and university safety procedures and policies.
- Report any malfunction of equipment or equipment breakdowns to your project supervisor.
- Read this manual in its entirety and sign the form that they understand these regulations and will comply with them.

11.1 EXPECTATIONS FOR LABORATORY PERSONNEL

- Review and follow relevant lab safety manual(s) and materials and hazards
- Follow oral and written lab safety rules, regulations, and standard operating procedures required for the tasks assigned
- Keep work areas safe and uncluttered

Several ECE research labs have individual operating policies and procedures:

- Center for Integrated RF Engineering (CIRFE)
- Center for Advanced Photovoltaic Devices and Systems (CAPDS)
- Emerging Radio Systems Group (EmRG)

- GIGA-TO-NANOELECTRONICS Centre (G2N)
- High Voltage Engineering Lab (HVEL)

11.2 TRANSPORTING CHEMICALS

Safety Requirements for Transporting Chemicals between Rooms and Buildings

Chemicals in glass bottles must be placed in secondary containers made of non-breakable material when transported between rooms, within buildings or on campus. Should the original container leak or fail, the secondary containment will help avoid chemical spills. A spill in a public area can be liable to fines or legal action by the Ministry of the Environment. Bottle Tote Safety Carriers and Chemical Resistant Secondary Containment Bins are available for purchase from Chem Stores (also Fisher or VWR). Other options must be chemical resistant and designed for safe transport of acids, alkalis, and solvents.

Please Note: Do not transport regulated materials in a personal vehicle or by bicycle. Personal insurance may not provide coverage for incidents involving hazardous materials.

Bottle Tote Safety Carriers - designed for the safe transport of acids, alkalis, and solvents. Carry only one tote per person. If transporting two totes, two people are required, one person to open doors. Alternatively, a cart with containment bin can be used. The small carriers can accommodate 500mL or 1L bottles. The large carriers accommodate bottle sizes to 4L. Totes may be used indoors and outdoors



Chemical Resistant Secondary Containment Totes - must be used as a means of containment when glass bottles containing chemicals are transported using a lab cart (recommend Rubbermaid 68.1L size). Do not use bins without a cart. Segregate incompatible chemicals by using separate containment bins or by transporting separately. Ensure the height of the bin is greater than ½ the height of the largest bottle. Use the containment bin with lid securely in place whenever possible.

Chemical Resistant Lab Carts - shelf cart can be purchased from a safety supply store. Other carts with a lip edge (minimum 1 inch or 2.5 cm high) may also be used and must be in good condition. (eg. Supplier Tenaquip, Rubbermaid cat# 450088 ergonomic model or equivalent; must have minimum 500 lb. capacity). The cart/bin combination is for indoor use only.



Effective October 1, 2014
Without adequate secondary containment requirements,
Chem Stores will refuse sale

Safety Office August 2014

12. VISITING RESEARCHERS/SCIENTISTS

The Department is host to many visitors who use ECE facilities to pursue their own research or conduct collaborative research under faculty supervision. Those who are engaged in research activities in ECE are expected to comply with the University's policies designed to ensure that their work is conducted safely and in a professional manner. In particular, visitors who will participate in laboratory research must receive appropriate safety training and be familiar with the University's policies concerning laboratory safety and the handling and disposal of hazardous materials. Visitors to the laboratory are expected to follow the same requirements as the laboratory workers in regards to such items as personal protective equipment (PPE), proper dress, food and drink, etc.

The faculty host/supervisor or designate is responsible for the appropriate lab safety orientation and other project hazards. It is expected that visitors to the Laboratory have similar worker's compensation coverage from their own institutions or companies. It is required that visitors to ECE labs provide evidence of insurance coverage.

13. FIELD WORK RISK MANAGEMENT

Field Work Risk Management Form must be completed and approved prior to undertaking field work in any location external to UW that involves higher risk. The Field Work Risk Management Form is available on the Safety Office website.

Includes any activity that may cause personal harm and examples include, but are not limited to:

- Field work, field trips and internships outside Canada and USA
- Field work at industrial sites such as factories, mining operations and construction sites
- Activities that require specialized safety training and/or certification in the use of personal protective or safety equipment
- Field work at any international or remote location
- Travel to areas where immunization and/or significant health and safety precautions are required
- Work at sites with hazardous substances
- Field work which by nature entails risk (e.g., travelling on water or ice, high altitude work, etc.).

14. RESPONSIBILITIES

The Principal Investigator/Laboratory Supervisor has overall responsibility for safety in the lab. All lab users (employees, students and visitors) must be provided with appropriate safety orientation when they are assigned to a lab. These apply to all persons working in any research laboratory and computer area whether they are receiving remuneration or not.

The Principal Investigator/Laboratory Supervisor should explain lab expectations, hazards, safety requirements/resources, and emergency procedures associated with the particular materials, equipment, procedures, etc. associated with their lab. The PI/LS is responsible for training staff and visitors on the use of all lab equipment and processes, and ensure that they work in a safe manner, follow standard operating procedures, and use the required personal protective equipment.

PI/Lab Supervisors are responsible for inspections of their lab and ensuring deficiencies are corrected. In addition, they must inform all lab users of any required corrective actions.

The responsibilities with respect to safety of university employees and students are outlined in Policy 34.

The lab supervisor or designate should escort all visitors to the lab due to potential hazards and to protect the security of the research, equipment and supplies. The lab supervisor must not knowingly permit entrance to anyone not qualified to be in the lab i.e. has not completed the mandatory training, or unauthorized persons without appointments.

Any critical injury at a workplace, whether suffered by a student, visitor, or another employee, may give rise to immediate reporting and evidence preservation obligations under the *Occupational Health and Safety Act* (the OHSA). These employer accident reporting obligations are initiated when any person, not just a worker is killed or critically injured.

Safety of visitors is the responsibility of the person in the department who is hosting them or bringing them into the department. If a visitor will only be in the department for one day or less, AND will not be performing any laboratory duties, they should be accompanied at all times to ensure they are kept safe. If the visitor will be staying for longer than one day AND/OR they will be working in a lab, they should read this safety manual.

Supervisors are required to have Supervisory Training:
[SO1100 Supervisor Safety Awareness](#)

15. UNIVERSITY SAFETY COMMITTEES

15.1 UW Joint Health and Safety Committee

Described in Policy 34 (available on the UW website)

15.2 Advisory Committee to the Dean of Engineering on Safety

This committee has two representatives from each department – usually one faculty and one staff member.

The current ECE department representatives are R. Sanderson and S. Jayaram.

15.3 Department of Electrical and Computer Engineering Safety Committee

The membership consists of:

- Department Chair or designate
- Laboratory Director
- Administrative Officer
- Department Health & Safety Coordinator
- Faculty member
- Manager Representative
- Administrative Staff Member
- Technical staff member

This committee meets at least once a term to perform the following duties:

- Review and update the Safety Manual
- Review any incident reports
- Emergency planning
- Ensure that laboratory areas are inspected regularly and that any safety infringements found are corrected promptly
- Ensure that all persons using laboratory facilities have acknowledged (by signature) that they will comply with the regulations pertaining to the laboratory that they are working in.