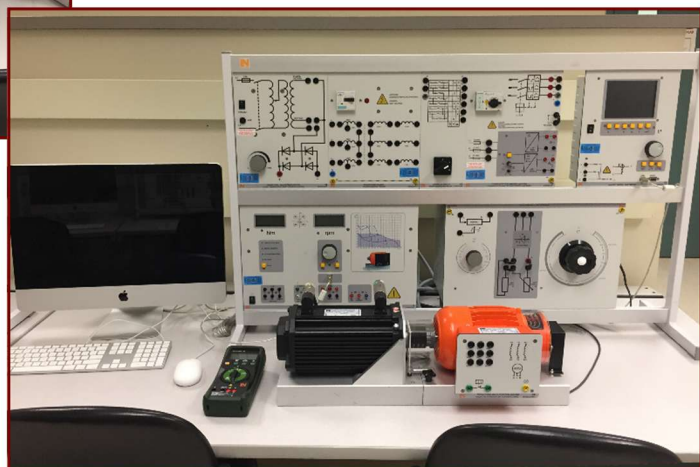
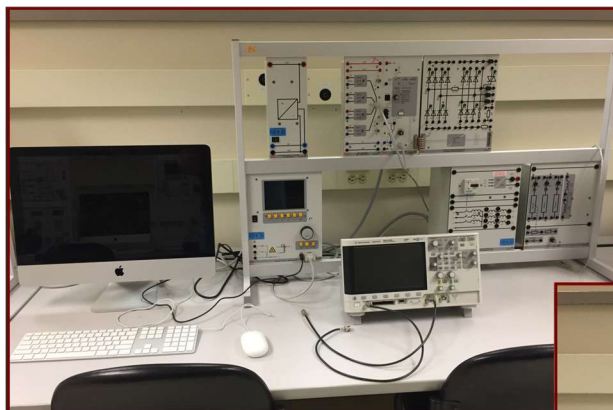




ELECTRICAL AND COMPUTER ENGINEERING
FACULTY OF ENGINEERING
UNDERGRADUATE SAFETY MANUAL FOR
ELECTROMECHANICAL LABORATORIES



Laboratory Information Sheet

Electrical and Computer Engineering

Lab Type: Electromechanical Labs

Hazards Present in this Lab



240 VAC
240 VDC

Protective Equipment

Closed Toe Shoes

Contact List

	Name	Extension	After Hours
Supervisor	Supervising TA	Present in Lab See course outline	
Supervisor	See course outline	outline	"88"
Staff	Steve Spencer	24103	or
Staff	Tyler Ackland	24448	905.522.4135
Departmental Office	Shelby Gaudrault	24826	

Emergency Contacts

- ▶ Emergency assistance (e.g. security, medical): "88" or 905.522.4135
- ▶ First Aid: Stephan Olaizola, ITB 146, ext. 24965
- ▶ First Aid: Robert Li, ITB 242, ext. 23445
- ▶ Safety Information: EOHSS, ext. 24352
- ▶ First Aid Kit Location: Lobby of ITB, near Room 101

Table of Contents

Acknowledgement	1
Introduction	1
Purpose of this Document	1
Responsibilities and Rights	2
Summary of Responsibilities	2
Chain of Reporting for Incidents Relating to Safety in the Lab	3
Hazardous Chemicals or Materials	4
Administrative Controls – Laboratory Operations	4
Emergencies – Accidents & Fires	5
General Guidelines	6
Lab-specific Safety Information for Electromechanical Labs	7
Undergraduate Electromechanical Laboratory Safety Specifics	7
Electric Shock Effects and Minimizing the Risk	9
In Case of Electric Shock	10

Acknowledgement

Parts of this manual have been extracted from the “McMaster University Laboratory Manual 2024” in order to maintain consistent wording when referring to the Occupational Health and Safety Act (OHSA).

Introduction

Safety standards at McMaster University are designed to eliminate the risks inherent in the use of dangerous materials and potentially dangerous procedures or practices. All laboratories can be inherently dangerous places and the attitudes and actions of those who work in the laboratory determine their own safety and that of their colleagues and ultimately that of the community.

Different safety procedures and training are set for different levels of risk. High levels of risk require more stringent procedures than lower levels of risks. Changes are therefore made in setting safety procedures and training so as not to impede student learning while keeping risks of those involved to a safe minimum. Laboratory equipment and design has become more sophisticated and safer, but safe operation still depends on properly trained and genuinely concerned personnel, who are safety conscious at all times.

This Lab Safety Manual is intended to provide basic rules for safe work practices in a laboratory, along with specifics of a particular room or group of rooms. This manual is by no means all-encompassing, and any omission is not an excuse for unsafe practices. If you have questions about how to undertake a task or project safely, contact your TA or the professor/instructor of the course. In all cases the individual professor/instructor is ultimately responsible for teaching safe work practices and standard operating procedures and must insist upon the use of such proper procedures to eliminate unnecessary hazards.

Purpose of this Document

- To define health & safety responsibilities and accountabilities within the University Community
- To outline specific procedures and programs, where applicable
- To explain basic emergency procedures
- To provide information and standards in the form of established Safety Guidelines in laboratories

Responsibilities and Rights

Under the Occupational Health and Safety Act (OHSA) and Regulations, professors together with their teaching assistants must make their students aware of dangerous or potential hazards. Students have a responsibility to report to their TAs or professor the existence of hazardous conditions which are contrary to good health and safety practices, or which contravene any requirements of the Act or applicable Regulations. It is the professor's responsibility, together with ECE technical staff, to ensure that corrective action is taken at once.

It is the unconditional right of all members of the University to bring without prejudice, health and safety concerns to their supervisors, or to Environmental and Occupational Health Support Services (EOHSS) (Human Resources), Faculty of Health Science (FHS.) Safety Office, or to Joint Health and Safety Committees (JHSCs). If possible, the supervisor, in every case, must be informed of a concern before a complaint is taken elsewhere.

It is the responsibility of each member of the McMaster Community to know all emergency procedures, location and use of safety equipment and exit routes in case of an emergency. Consult your supervisor for more information.

Summary of Responsibilities

The following is a summary of responsibilities according to the Occupational Health and Safety Act. Please refer to the OHSA for specific wording.

Employer (McMaster)

- OHSA, Section 25, 26
- the equipment, materials and protective devices provided by the employer are in good condition
- provide information, instruction, and supervision to a worker (student) to protect the health and safety of the worker (student)
- appoint a competent supervisor (professor)
- acquaint a worker (student) or a person in authority over a worker (student, such as a teaching assistant, with any hazard in the workplace
- take every reasonable precaution in the circumstances to protect the worker (student)
- prepare and review a written health and safety policy at least annually and post this in the workplace

Supervisors (Professor)

- OHSA, Section 27
- ensures a worker works in a manner required by the Act and Regulations and with the proper protective devices
- ensures a worker uses or wears the equipment, protective devices or clothing required
- advise the worker of any potential or actual danger to the health and safety of the worker
- provide the worker with written instructions (standard operating procedures) about measures and procedures for protection
- take every reasonable precaution in the circumstances to protect the worker

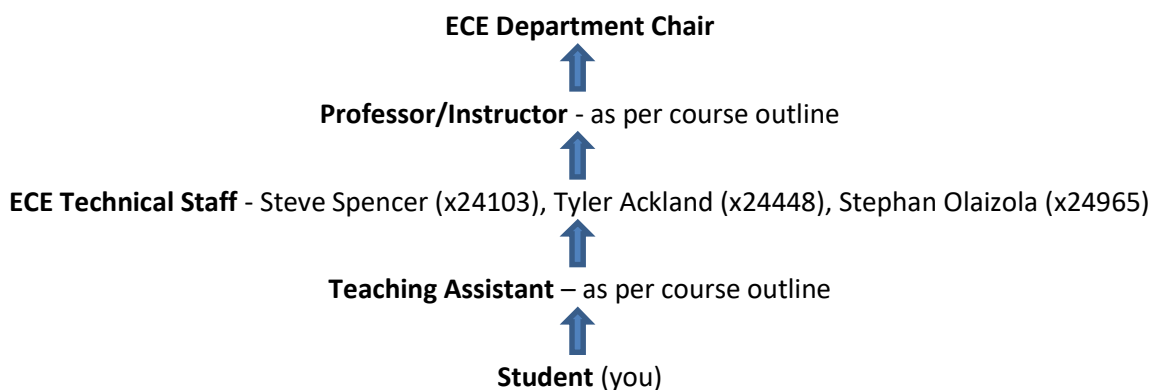
Workers (Students)

- OHSA, Section 28
- work in compliance of the Act and applicable Regulations
- wear any equipment, protective devices, or clothing that the employer requires
- report any defect in protective gear that may endanger him/herself or someone else
- report any contravention of this Act, applicable Regulations, or any hazards
- shall not remove or alter any protective device
- operate or use any equipment in such a manner as to endanger him/herself or someone else
- shall not engage in any prank, contest, feat of strength, unnecessary running, or rough and boisterous conduct

Chain of Reporting for Incidents Relating to Safety in the Lab

You will be provided with a health and safety lecture at the beginning of the first lab for each course. You are responsible for ensuring that you understand this safety information. The ECE technical staff members are responsible for ensuring that all equipment is in good working order. In the event of an emergency, notify your Teaching Assistant (TA) or one of the ECE technical staff members if a TA is not available. They are responsible for calling medical aid if needed. If they are unavailable, or the incident occurs after regular working hours, dial 88.

You must report any hazardous situation of concern to one level up according to the chart below. In case this person is not available, either contact the person delegated in their absence or the person positioned at the next level up. You are expected to know this chain of reporting:



Hazardous Chemicals or Materials

ECE technical staff intentionally do not place any hazardous chemicals or materials inside any of our undergraduate instructional laboratories. There are also no Designated Substances (as identified by the Ontario Government) placed intentionally in our labs.

Students are not allowed to bring any such chemicals or materials into an ECE undergraduate lab. There are no chemical storage facilities in any of the ECE undergraduate labs.

Administrative Controls – Laboratory Operations

- Always be prepared and informed. Know the safety rules, emergency procedures and standard operating procedures. Be familiar with your emergency exit route.
- According to the Ontario Fire Code all laboratory doors are fire doors and must be kept closed at all times.
- Never prop open doors or block emergency exits, emergency equipment or electrical panels.
- Eating and drinking is not allowed in any ECE undergraduate laboratory.
- The Electrical Safety Code prohibits the use of extension cords in laboratories as a permanent source of power.
- Know the location of emergency equipment in your area and how to use it.
- Wear the appropriate personal protective equipment for the level of hazard. Open toed shoes are not permitted, and long pants should be worn in the lab. Long hair, loose clothing and dangling jewelry should be constrained.
- Working alone especially at off hours is discouraged; always check with your professor if specific procedures require a buddy system. Check the standard operating procedures in your department regarding "working alone" during off hours. Consult Risk Management Manual (RMM) # 304: Persons Working Alone Program

- Practice good housekeeping - promptly dismantle equipment when no longer needed. All lab benches should be kept clear of clutter. Dispose of any waste appropriately.
- No rough-housing or pranks in laboratories. Always report unsafe conditions and accidents promptly to your professor.
- Hallways and stairwells are to be clear and with unobstructed egress in case of fire. These areas are not at any time to be used for storage.

Emergencies – Accidents & Fires

Medical Emergency

On McMaster University campus, call Security at 88 from any campus phone or dial 905-522-4135 on your cell phone for assistance or if medical aid is required. Report all incidents to your supervisor and to EOHSS as quickly as possible. Completed Injury/Incident Reports must be submitted to EOHSS and where applicable to FHS. Safety Office within 24 hours of its occurrence.

Fire Emergency

The RMM# 1201: Fire Safety Plan provides instruction and direction during a fire emergency for all persons working, studying, or visiting campus buildings – familiarize yourself with this policy.

In Case of a Fire:

- Immediately vacate the building via the nearest Exit Route. DO NOT USE ELEVATORS
- Everyone is responsible for knowing the location of the nearest fire extinguisher, the fire alarm, and the nearest fire escape.
- The safety of all people in the vicinity of a fire is of foremost importance. But do not endanger yourself.
- In the event of a fire in your work area shout "FIRE" and pull the nearest fire alarm.
- Do not attempt to extinguish a fire unless you are confident it can be done in a prompt and safe manner, utilizing a hand-held fire extinguisher. Use the appropriate fire extinguisher for the specific type of fire.

Most labs are equipped with Class A, B and C extinguishers. Do not attempt to extinguish Class D fires which involve combustible metals such as magnesium, titanium, sodium, potassium, zirconium, lithium, and any other finely divided metals which are oxidizable. Use a fire sand bucket for Class D fires.

- Do not attempt to fight a major fire on your own.
- If possible, make sure the room is evacuated, close but do not lock the door and exit the building using the stairs.

Main Campus: Using a campus phone dial 88 or from a cell phone, dial 905-522-3135. Give the location and details of the fire.

Report all incidents to your supervisor. Completed Injury/Incident Reports must be submitted to EOHSS and where applicable to FHS Safety Office within 24 hours of its occurrence.

Clothing on Fire

Roll on the floor and scream for help OR smother the flames with material made from non-flammable fiber. Do not wrap a standing person, rather, lay the victim down to extinguish the fire. The material should be removed once the fire is out to disperse the heat. DO NOT use a fire extinguisher on people.

General Guidelines

- Conduct yourself in a responsible manner at all times in the laboratory.
- Know what to do if there is a fire drill during a laboratory period; turn off any electrical equipment in the event of a fire drill.
- Follow all written and verbal instructions carefully. If you do not understand a direction or part of a procedure, ASK YOUR TA or ECE TECHNICAL STAFF MEMBER BEFORE PROCEEDING WITH THE ACTIVITY.
- Perform only those experiments indicated by the lab manual or your TA. Carefully follow all instructions, both written and oral. Unauthorized experiments are not allowed.
- Carry out the experiments in such a way that nobody will be injured or hurt.
Carry out the experiments in such a way that the equipment will not be damaged or destroyed.
- Be prepared for your work in the laboratory. Read all procedures thoroughly before entering the laboratory.
- Observe good housekeeping practices. Work areas should be kept clean and tidy at all times. Keep backpacks and overcoats out of traffic areas.
- Be alert and proceed with caution at all times in the laboratory. Notify the TA or lab technician immediately of any unsafe conditions you observe.
- Labels and equipment instructions must be read carefully. Set up and use the equipment as directed by your lab manual.
- Experiments must be personally monitored at all times. Do not wander around the room, distract other students, startle other students or interfere with the laboratory experiments of others.
- Dress appropriately for each laboratory activity as outlined by the lab supervisor and door signage for each lab.
- Report any accident (breakage, etc.) or injury (cut, burn, etc.) to the TA or ECE technical staff member immediately.
- Cell phones and use of music headphones should be avoided while working in the lab. They can be distracting and thereby increase the potential for an accident to occur.

- Soldering is not allowed in ECE undergraduate labs due to the lack of smoke filtration and potential damage and injury. Soldering operations can be performed in the IEEE Student Branch room where soldering facilities have been set up. Contact the IEEE Student Branch regarding rules of access.
- Fire extinguishers in ITB are in the hallways, not in individual rooms.

Lab-specific Safety Information for Electromechanical Labs

Undergraduate Electromechanical Laboratory Safety Specifics

Electric machines and power electronics experiments involve electrical currents, voltages, power, and energy quantities that should be handled with extreme diligence and care. These may include three-phase AC voltage (208 V, 230 V, or 480 V), up to 250 V DC voltages, and currents that can reach 10 A. Electrocutation occurs when an electrical path is established through the body with very low currents that can damage vital organs, such as a person's heart, and may cause immediate death. All experiments must be performed in the presence of the instructor or teaching assistant who has been trained to handle electricity at these voltage and current levels. In case of emergency, evacuate the lab through any of the exits and dial 88.

Do not attempt to use any equipment in the lab until after you have been given a safety presentation.

Avoid loose wires, cables, and connectors, and maintain a workspace clear of extraneous material such as books, papers, and clothes.

Remove or secure loose clothing or jewellery that could get caught in rotating equipment.

Familiarize yourself with the ON/OFF button or switches on the equipment

If something unusual happens during the operation of the equipment, shut it down. Failure to do so may cause fire, injury, and electric shock.

Turn off the power to equipment before inspecting it.

Never change wiring with circuit powered on.

Before equipment is turned on, circuit connections and layout should be checked by the TA.

Never leave a running experiment unattended.

Avoid contacting circuits with wet hands or wet materials, or while standing on a wet floor.

Check circuits for proper grounding with respect to the power source.

Do not insert another fuse of larger capacity if an instrument keeps blowing fuses - this is a symptom requiring expert repairs. If a fuse blows, find the cause of the problem before putting in another one.

Keep access to electrical panels and emergency disconnect switches mounted on the wall clear and unobstructed.

Do not touch the rotating or moving parts during operation. You might get injured.

Never override electrical safety equipment such as the clear guards over rotating parts of the equipment or electrical interlocks. Remove of these guards will cause a break in the circuit, causing power to be disconnected.

When unplugging a device, be sure to pull from the plug to prevent wiring damage

Any of the following circumstances requires that the user immediately take the equipment out of service:

- Experiencing shocks, even mild shocks, when the equipment is touched
- Abnormal heat generation
- Arcing, sparking, or smoking from the equipment.
- Frayed cords
- Damaged connection

Laboratory TAs must tag the equipment, "Do Not Use" and should arrange for equipment repair through their department support as appropriate.

Do not attempt to disassemble any of the equipment in the lab. Only qualified technicians should attempt repairs on equipment.

When combining pieces of rotation equipment, be careful not to apply abnormal force to the bearing or shaft.

Objects with a magnetic force may cause motor function to stop.

Do not remove any name plates on the equipment in the lab.

High Voltage is found in the Power Lab. Receptacles for the lab benches in the room can supply 3 Phase 208 Volts at 20 Amps. These outlets are controlled by circuit breakers in the electrical panels on the rear wall of the room.

There are two red Emergency Stop button mounted on the front and back walls of the lab. Pushing these in disables the 208V supplies in the room. Pulling these back out will re-enable the 208V supplies. Know the location of these buttons before starting work.

Electric Shock Effects and Minimizing the Risk

The ever-present hazard in an electromechanical lab is electric shock. Most people equate the severity of electric shock with the voltage, i.e., a 1,000-V shock is deadlier than a 100-V shock. This is not true. The real measure of a shock is the amount of current that flows through the body. Table below lists the impact of ac (alternating) current on the body:

<u>Current</u>	<u>Effect</u>
1 - 5 mA	Threshold of sensation
5 - 20 ma	Involuntary muscle contraction ("can't-let-go")
20 - 100 mA	Pain, breathing difficulties
100 - 300 mA	Ventricular fibrillation (changes in heartbeat), possible death
> 300 mA	Respiratory paralysis, burns, unconsciousness

The amount of the current flowing through the body during an electric shock depends on the voltage and the resistance between the terminals of the voltage source. This resistance consists of:

1. resistance of the contact point between body and circuit (e.g., a ring or a watch),
2. skin resistance at the point the current flows into the body,
3. internal resistance of body,
4. skin resistance where current flows out of the body (e.g., shoes).

Obviously, the larger the resistance, the smaller would be the current. Therefore, to minimize the electric shock hazard:

1. Always power down the electrical equipment, disconnect the power cord, and wait for a few seconds before touching exposed wires. Remember that circuit breakers are usually set for much larger currents (e.g., household breakers are at 15 A and higher) than the current that kill a person (200-300 mA).
2. Do not wear rings, watches, necklace, and any other loose metallic objects. Rings and watches are especially dangerous as the skin beneath them is wet by sweat, making the resistance of skin much lower.
3. Make sure that your hands are dry. Resistance of wet skin can be as low as 1 k Ω as opposed to dry skin which is about 500 k Ω .
4. Make sure that your shoes are dry (specially in rainy days). Do not lean on metallic objects (like legs of the bench tables) as you are providing a very large contact area for the current to flow out of your body to ground.

In Case of Electric Shock

- ACT FAST. Have someone call 88 on the wall-mounted phone in the lab.
- Do not touch the victim until the power has been shut off. Use the power switch at the station or the wall-mounted Emergency Stop buttons.
- Do not remove the victim from the electric source until the power has been shut off.
- If you cannot shut off the power, use an insulator such as a dry rope, cloth or leather belt to drag the person away from the live wire.
- If there is no heartbeat and no breathing, start CPR. Get Emergency Care (CPR to be performed by qualified personal only).
- If there is a heartbeat, but no breathing, immediately start rescue breathing. Get Emergency Care.
- Check for burns and treat as third-degree burns. Get Emergency Care.
- If the person is breathing, put them in the recovery position. Get Emergency Care.
- In the event of a mild shock, and the following symptoms are observed, see a doctor: Heart skipping beats, fever or coughing up sputum.