TIER 1 – HAND TOOLS SAFETY TRAINING

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1. Introduction

The Myhal Centre for Engineering Innovation & Entrepreneurship (MCEIE) Arena, 4th Floor Light Fabrication Facility and Rapid Prototyping Facility, Myhal Fabrication

facility (MYFab) (referred to as “facilities”

herein) pose potential hazards and a degree of risk, so it is necessary that each student be conscious of the safety rules and safety culture shared by the Faculty and the Engineering Society (EngSoc). The purpose of this tiered training (Tier 1 and Tier 2) is to provide knowledge of basic rules and precautions to be observed by students handling and operating the tools and equipment provided for in the facilities.

1.1 Terms

Hazard: An unsafe condition or act that could cause harm to people. A hazard may be an object (e.g. tools, equipment, and materials), environment (noise, vibration, temperature) or a person (when they carry out unsafe acts).

Risk: A risk is the probability that a person will be harmed or experience an adverse health effect if exposed to a hazard.

Preventive Measures: Preventive measures are actions taken to alleviate or eliminate the health, safety and environmental consequences of a risk.

1.2 Tier 1 and Tier 2 Safety Certifications

The behaviours and privileges of students associated with the safe handling and operation of tools and equipment are defined according to two tiers. The CEIE facility administrators have the responsibility to maintain Tier 1 and Tier 2 training records, including training records for unique tools/equipment, and authority to restrict or prohibit use.

Tier 1:

- Tier 1 Safety Certification focuses on training students on safe use of non-powered hand tools, basic facility safety, facility housekeeping and fundamentals of safety culture.
- Tier 1 certification is granted through successful completion of online Tier 1 training including an online evaluation.
- Tier 1 students are only authorized to handle, operate and maintain hand tools only.
- Unauthorized use of Tier 2 equipment (powered tools) by Tier 1 students is unacceptable.
- Tier 1 certification doesn't allow students to work in the facilities.
    - Tier 1 and Tier 2 training should be completed to work in the facilities
        - The facilities are open Monday to Friday from 9:00am to 9:00pm and 10 a.m. to 6:00 p.m. on weekends.

Tier 2:

- Tier 2 certification allows students to handle, operate and maintain portable power tools.
- Tier 2 certification is granted through successful completion of Tier 2 training including an online resource, an in- person training, and an online quiz.
- Safety culture shall be promoted and enhanced by Tier 2 students.
- Tier 2 certified students are allowed to access the workshop after hours if they are active members of a design team operating in the facilities.
- Tier 2 students hold supervisory responsibility over Tier 1 students in the facilities.
- Tier 2 students are not permitted to work in the facilities alone.

1.3 Equipment User's Responsibility

All students are under a duty to:

- Work in a safe manner by taking responsibility for the health and safety of themselves, the environment and any other persons who might be affected by their actions or inactions.
- Use the appropriate personal protective equipment and clothing for the work performed.
- Report workshop hazards and risks to the facility coordinator.
- Inform the facility coordinator of any defective/faulty equipment or protective device that may be dangerous.

In addition, students must not deliberately or recklessly misuse, abuse or interfere with any item provided for the enhancement of health, safety and welfare.

Students are not to bring any personal, Club and/or Team tools or equipment into MYFab without approval of the facility administrators. Any such approved tools or equipment must be removed by the individual when he or she departs the facility.

1.4 Safety Culture

Safety culture is an individual's attitude toward work based on the values placed on safety principles. A healthy safety culture is a key factor in reducing the likelihood of injuries and continuous improvement of safety performance.

Indicators of safety culture include:

- Housekeeping: the neatness and organization of a working environment.

- Compliance with the warning signs and notices (including the use of PPE).
- Compliance with basic safety rules and safe work practices.
- The number of incidents/accidents that occur.

Responsibility and Commitment to a Safety Culture – Students:

1. Safety Responsibilities: All students are required to know the permissions and responsibilities associated with Tier 1 and Tier 2. This includes policies, goals and plans for achieving a culture of safety. Students are to inform the facility administrator in advance of any accommodation requirements or environmental considerations prior to undertaking work using tools and equipment so that suitable arrangements can be made in advance.

2. Safety Vision: The vision of the Faculty and EngSoc is to see that all work is done with utmost regards to safety. We collectively have a zero tolerance for unsafe acts and unsafe conditions. As such, everyone's acts should be in keeping with the establishment of goals and objectives for a good safety culture. Students should ensure that safety and productivity go hand-in-hand.

3. Accountability: All students are accountable for safety in the work area. There is no room for blame culture. Any student is permitted to stop another student from carrying out a task in an unsafe manner. Students should notice and should be able to question unusual signs and occurrences and should seek guidance when in doubt.

4. Reporting of Hazards, Incidents or Accidents: When working in the workshop, students are required to pay attention to the importance of reporting injuries, first aids and near misses. Under-reporting of hazards will lead to an increase in accidents and vice-versa.

5. Integrity in the Investigation of Accidents: Students are required to comply with the accident investigation team. Compliance here would mean providing the team with as much detail as possible to enhance an effective accident investigation for adequate identification of root causes and corresponding corrective action.

6. Support Leadership: Faculty and EngSoc leadership requires the support of all students in demonstrating commitment to safety. This commitment is evident in compliance to all safety standards, instructions and training put in place.

7. Simultaneous Operations: Students should have a good understanding not only of their own work processes, but also of how their processes interact with other processes going on simultaneously.

8. Trust: Students should interact with openness and trust and should routinely offer support to each other.

The value of maintaining a good safety culture ensures:

- That the right thing is done the right way, day-in and day-out, thereby preventing incidents.
- The support of both safe and reliable operations.
- That the financial implications of recovering from accidents are reduced or eliminated.
- Reduced loss of productive work time.

Responsibility and Commitment to a Safety Culture – Faculty & EngSoc. Together:

1. The Faculty and EngSoc shall give high priority to safety documentation, communications and decision making.

2. The Faculty and EngSoc shall look out for student's safety performance by conducting safety walk-about (inspect) in the workshop and observing and listening to students.

3. The Faculty and EngSoc shall intervene vigorously to ensure that safety issues raised by students and situations adverse to safety are remedied.

4. The Faculty and EngSoc shall provide sufficient training to students to ensure competency in carrying out tasks.

5. The Faculty and EngSoc shall respond to student questions openly and honestly and should maintain good relations with them.

6. The Faculty and EngSoc should be trusted by students to act professionally in response to safety concerns or near-miss event reports.

7. The Faculty and/or EngSoc shall provide all necessary safety tools and equipment required for the tasks to be carried out.

8. Periodic Safety Culture assessments shall be conducted and used as the basis for improvement.

2. Hand Tools

Hand tools are tools that are operated manually by hand. They are not electrically or pneumatically (air) driven. It is important to know how to use a hand tool safely because they can be hazardous and have the potential to cause injuries when used or maintained incorrectly.

2.1 General Hand Tool Hazards

The following are general Hazards involved in the use of Hand tools:

- Tool may shatter.
- Handle may come loose.
- Tool may be blunt, requiring excessive force.

- Cuts from knives etc.
- Sprains and strains (wrist, hand, arm, shoulder).
- Dust, flying chips, particles, and pieces of material.

2.2 Safety Controls for the Handling of Hand Tools

The following are control measures that all students should implement to prevent or control hazards:

- Follow manufacturer's and safety instructions.
- Only use tools for their intended purpose.
- Carry out safety checks before use (see section 2.4).
- Do not use faulty or defective tools.
- Do not use tools under the influence of drugs or alcohol.
- Wear appropriate personal protective equipment (PPE).
- Keep cutting-edge tools sharp.
- When cutting, always cut away from the body.
- Do not work where floor is wet or damp.
- Do not improvise repairs (e.g. with tape) or work on improvised platforms.
- Do not place or carry sharp tools in a pocket.
- Ask MYFab staff to remove cracked saw blades from service and replace.
- Ask MYFab staff to replace wrenches when jaws are sprung to the point that slippage occurs.
- Ask MYFab staff to replace tools with mushroomed heads and splintered wooden handles.

2.3 Safety Controls for the Storage of Hand Tools

To ensure that tools remain in good condition, the following guidelines should be adhered to when storing tools:

- Store all hand tools properly.
- Keep tools away from aisle areas and away from other students.
- Do not store iron or steel hand tools, which may produce sparks, around flammable substances.
- Store only spark-resistant tools where flammable gases, highly volatile liquids, and other explosive substances are stored.
- Keep tools organized by placing them in tool box.
- Do not leave tools strewn about the work area.
- Store sharp-edge tools with the sharp edges facing down.

2.4 Pre-use Check for Hand Tools:

Check that:

- The outside of the tool is free of grease, oil and accumulated foreign matter.

- Blades or bits are not damaged or cracked.
- Jaws and handles are not cracked, damaged or loose from heads.

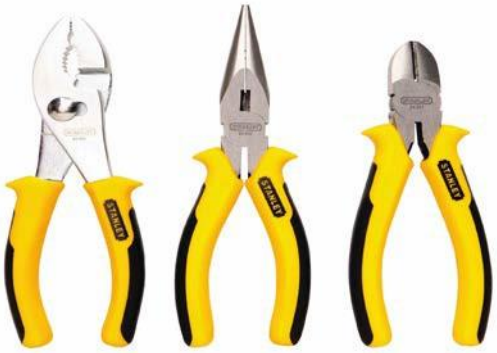
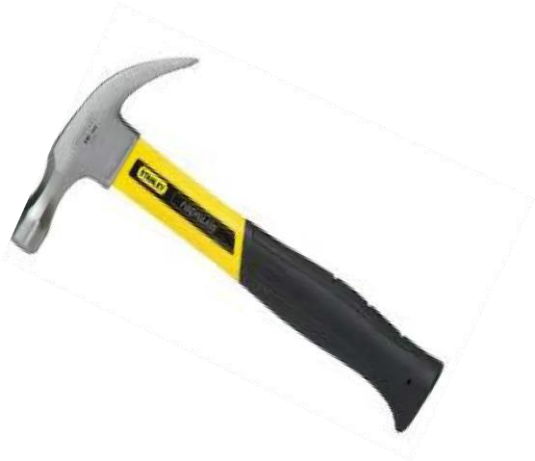
- Tips of screwdrivers, chisels or other similar tools show no excessive wear.
- Gripping surfaces pliers, wrenches or other similar tools are not worn out.
- Tools such as chisels and punches do not have mushroomed heads.
- Cutting tools are sharp.
- Tool appears to be in generally good and usable condition.

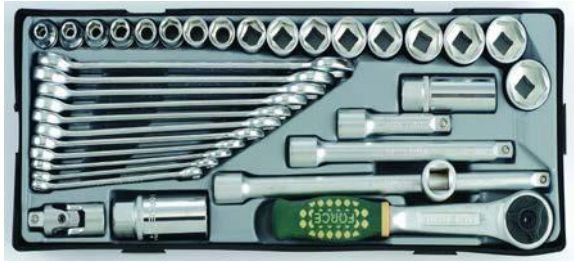
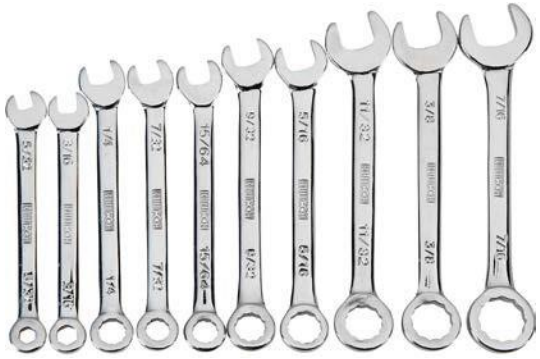
For those hand tools provided in MYFab, consult with staff who can assist in the pre-use check and usage techniques as well as in the provision of information resources e.g. from the manufacturer.

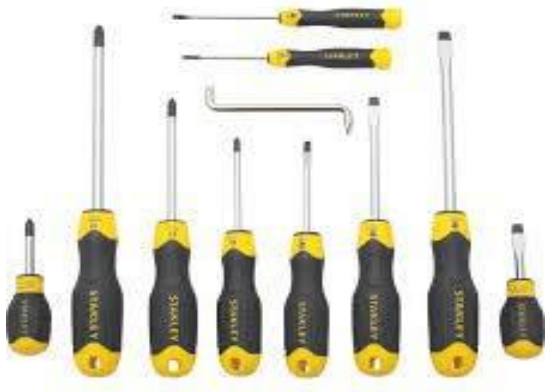
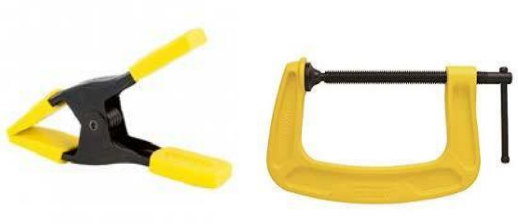
2.5 Basic Safety Rules of Hand Tools

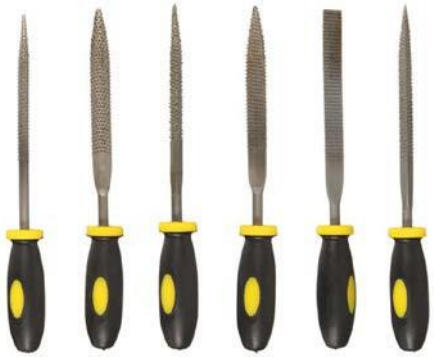
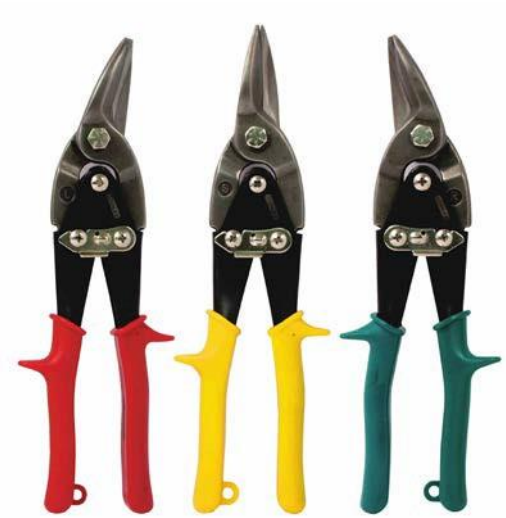
Hand-held tools and their basic safety rules are shown in **Table 1** below.

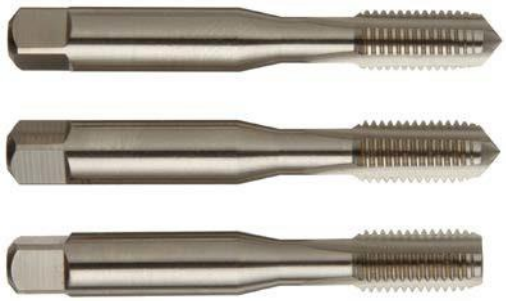
Table 1: Hand Tools and Basic Safety Precautions

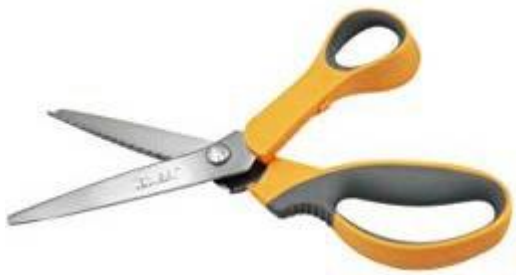
	Hand held tools		Basic Safety Rules
1	Pliers - Needle-Nose Pliers - Channel lock Pliers - Vice-Grip Pliers - Slip-Joint - Side Cutter		- Always pull on pliers — do not push. - If there is risk of flying debris, wear appropriate eye protection - Do not expose pliers to excessive heat. - Don't use pliers as hammers — to prevent them from breaking or cracking. - Don't use cheaters to extend the handles. This can slip and cause injury. - Do not use pliers to tighten nuts or bolts. When needed, use a wrench.
2	Hammer		- Before using a hammer, ensure that its handle is not loose, cracked or splintered. - Use hammers or mallets with electrically insulated handles for work on or around exposed energized parts. - If there is risk of flying debris, wear appropriate eye protection - - Choose a hammer with a cushioned handle to protect you from vibration, impact and squeezing pressure. - Select a hammer with a weight appropriate to your size and capacity, as well as the job at hand. - Ensure that you have secure footing and good balance while using a hammer. - You can use clamps or a vise to secure the piece you are striking with a hammer. - Use only a hammer when driving nails into an object or material. Never use other tools for this purpose.

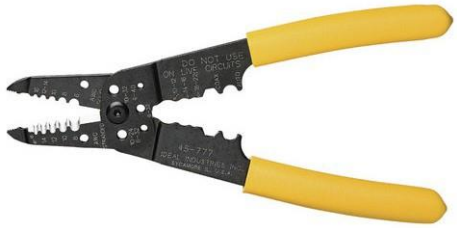
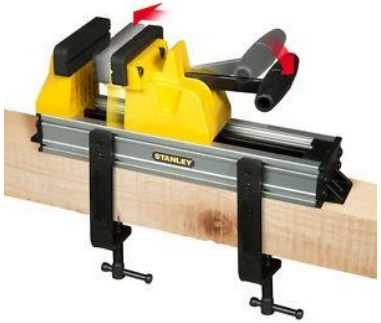
			- Avoid using hammers with sharp edges as they can cut off circulation in your finger after long periods of use. - When pulling nails or prying material apart, ensure that the claw of the hammer is in the proper position and the right leverage is applied.
3	Socket Set		- Do not over torque a smaller socket and fastener with a larger driver. - Always use the correct size of socket that fits snugly. An oversize fit can slip and cause injury and wear to both the socket and the fastener. - Do not use hand sockets on a power drive or impact wrench.
4	Wrench Set		- Always grip firmly to prevent slippage. - Use the correct type of jaw to avoid slippage. - Dispose of any damaged box or open-end wrench. - Don't attempt a wrench repair with rounded or damaged points on the box end or worn out jaws on the open end. - Do not push on the wrench, always pull on a wrench whenever possible. - Do not overload a wrench by using a pipe extension on the handle or by striking the handle with a hammer.

5	Screw driver set: - Torx - Allen Key - Hex Nut Driver	  Hex Nut Driver	- Ensure that the screwdriver blade is pointed away from you or any other person. - Do not hold the work in your hand while using a screwdriver. - Ensure that the screwdriver handles are clean and free of grease to ensure good grip. - Use screwdrivers with insulated handles when working around electricity. - Before beginning work, be sure that the electrical power is off. - Use screwdrivers only to screw. Screwdrivers should not be used as chisels, hammers or pry-bars. - Check that the right screwdriver is used for the screw being turned. The screwdriver blade must fit the screw type and should seat perfectly in the screw slot. - Replaced defective handles.
6	Clamps: C-Clamp, Spring Clamp	 Spring Clamp C Clamp	- Ensure the clamp size is suitable for the job to prevent bending or breaking the clamp. - Do not overextend the screw.

7	File		- Ensure that there is a handle on a file before use to prevent an uncovered tang from being jammed into your hand.
8	Aviation Snips		- Aviation snips are color coded for a reason. Ensure the right one is used. They will only perform well when cutting in the direction they were intended for. - Yellow handled snips are made to cut in a straight line. They can also cut wide curves and are ideal for flat pieces of metal. - Green handled snips are designed to make straight and right (clockwise) cuts and are perfect for right handers cutting duct. - Red handled snips cut best straight and to the left (counter-clockwise). You can use any of the snips in either hand but they will only perform well when cutting in the direction they were intended for. - Ensure the right size and type of snips is selected for the job. Do not cut wire with snips — make use of wire cutters.
9	Hack Saw		- To prevent blade breakage, install the blade taut and keep it not too tight. - Ensure that the material is firmly held in a vise or by other devices such as clamps. - If there is risk of flying debris, wear appropriate eye protection

10	Tap Set		- Ensure taps and dies are clean and well-oiled when not in use. - Ensure taps and dies are stored so that they don't contact each other or other tools. Where taps are to be stored for a long time, ensure they are coated with rust preventive compound and stored in a dry place. - Do not sharpen taps or dies. - Do not use diestocks or tap wrenches as hammers or pry-bars.
11	Box Cutter X-ACTO Knife	 	- Ask MyFab staff to replace dull blades and ensure that the blade is sharp. Never use a broken blade. - Keep the blade as short as possible. Do not use full length of the blade. - Retract the blade after each use and before storage. - Cut in an angle away From Your Body. - Apply a firm (but not excessive) pressure while cutting. - Pay attention to the material to be cut and watch the blade at all times. Do not multi-task while cutting to prevent being cut. - Keep your thumb and other hand away from the blade while cutting to prevent injury. - If possible, wear hand gloves when you use a box cutter and X-ACTO knife to prevent any small nicks and cuts from minor errors. - If the blade needs to be changed, please ask a MYFab staff to do that for you

12	Wood Saw – Hand		- Before use, inspect hand saws for defects such as cracked handles, missing saw-blade teeth, loose saw-blade connections and bent saw blades. - Before cutting, inspect the wood for nails or other imbedded objects that could damage the hand saw. - Do not check for sharpness of saw by testing saw teeth on hands or fingers. - Start the cutting with your hand placed beside the cut mark with your thumb upright and pressing against blade. - Start cutting with partial cut, then set saw at proper angle. Apply pressure on down-stroke only. - Always carry a hand saw by its handle with the saw end pointed down. - Use the length of the blade during each saw stroke. - Ensure the hand-saw blades are sharp and clean. - If there is risk of flying debris, wear appropriate eye protection - - Use a helper, a supporting bench or vise to support long material if required.
13	Scissors		- Concentrate on the task at hand when using scissors. Do not try to multi-task. - Always cut away from your body and fingers in regular, small strokes. - Ensure the area is well lit when cutting. - Do not engage in horseplay with scissors. - Only use scissors for its intended purpose. Do not use scissors for prying, screwing, scraping, or pounding.

			- Don’t over-stretch/over-reach or bend over a table when cutting with scissors. - Ensure scissors are kept sharp so they require less hand force to use. - Clean dust, fluff, and cut fragments from the scissor cutting edges and blades regularly. -
14	Wire Strippers		- Ensure the stripping blades are sharp and free from nicks and dents. - When using a wire stripper, hold it perpendicular to the cutting blades. - Make sure the insulation is clean-cut with no frayed or ragged edges; trim if necessary. - Ensure all insulation is removed from the stripped area. - The strippers will only strip about 3/4 inch at one time. - Be sure to slot the wires into the proper cutting tooth.
15	Bench Vice - Wood Vice - Metal Working Vice		- To prevent interference, ensure that the vice is mounted so that the stationary jaw projects slightly beyond the edge of the workbench. - Ensure that the workbench is firmly secured to its base with bolts placed in the right order. - Before clamping the vice, check that there are no cracks or other damages. - Ensure the vice is large enough to hold the work without strain. - To prevent vibration when sawing or filling, keep the work-piece in the vice as close as possible to the jaws.

			- Ensure all threaded and moving parts are kept clean, oiled and free of chips and dirt. - Replace a bent handle and worn out jaw inserts. - Use safety glasses and/or face shield to protect face from flying particles. - Take a look over the work surface whether the table or the surface holds firm under duress. - Keep the vice and material size at a substantially compatible range. - Do not widen the jaws of the vise more than they have been designed for. - Keep body away from the handle extension and avoid extra clamping pressure to ensure the vice is not damaged. - Do not tighten the vice more than is required. - Replace damaged parts of the vice immediately if stress fractures occur.

3. Ergonomic Considerations

An ergonomic tool is a tool that fits your hand and the task you are performing without causing awkward postures, harmful contact pressures, or other safety and health risks.

Adhere to the following safety precautions to prevent ergonomic injuries (e.g. carpel tunnel syndrome):

- Do not bend/strain your wrist when using tools.
- Ensure you have a good grip on the tool when using it.
- Ensure the tool fits your hand.
- Use the right tools.
- Hold the tool as close to the body as possible to prevent over stretching.
- Rest your hands by keeping the tool down or inserting it in a holster when not in use.
- Do not overstretch while using tools.

4. Personal Protective Equipment (PPE)

Typical safety personal protective equipment used with hand tools includes:

- Lab coats: Avoid wearing synthetic clothing because it has low flashpoints which can result in severe burns.
- Head protection: Hard hats, bump caps.
- Eye protection: Safety googles/glasses.
- Hand protection: Safety gloves (e.g. anti-vibration glove, Leather gloves).
- Respiratory Protection: Respirator.
- Hearing Protection: Ear muff, Ear plugs.
- Face protection: Face shield.
- Foot protection: Safety-toed shoes, High-top shoes.

5. Basic Workshop Hazards and Safety Precautions

Mechanical Hazards: they result in contact injuries e.g. entanglement, drawing-in, abrasions, cuts, burns.

Control Measures:

- Only authorized persons are allowed into the workshop.
- Do not operate tools unless you have been certified (e.g. Tier 1 and/or Tier 2).
- Long hair must be tied back and completely covered while allowing for suitable eye protection to be worn.
- Do not wear loose fitting garments, jewelry, and long loose hair near moving equipment.
- Wear closed-toe shoes at all times

Hazardous Substances: these substances, if ingested can cause affect organs and lead to dermatitis and other skin diseases if absorbed by the skin.

Control Measures:

- Do not eat, smoke, or drink inside the facilities.
- Always use protective clothing / equipment where specified.
- Ensure chemicals are stored in the appropriate place, in secure containers with correct labelling (WHMIS), and segregated by Class (e.g. flammables away from oxidizers).
- Never hold tools, including mini-flashlights, in your mouth.
- Refer to material safety data sheet (MSDS) for material handling of hazardous chemicals.

Slips, trips and falls: Hazards that could lead to falling on the floor or on a dangerous equipment

Control Measures:

- Working areas must be clear of obstructions.
- Spills (chemical, oil, water) should be cleaned up immediately (refer to MSDS for material handling). Know, in advance, where the nearest spill kit is located.
- Trip and fall hazards e.g. trailing cables should be kept out of the paths of travel.
- Any defects to floor coverings should be reported immediately.
- Workshop area should be well lit when in use.
- Keep work areas clean and organized.

Fire

Control Measures:

- Equipment should be switched off after use.
- Flammable substances must be kept away from ignition sources and naked flames.
- Flammable substances must be kept in an appropriate fire-resistant metal cabinet.
- Do not accumulate rubbish in the facilities. This may act as a source of fuel for fire.
- Do not use tools where flammable gases or vapours are present.

Excessive noise:

Control Measures:

- Always use the specified ear protection for the job.

- Prior to the use of a tool or equipment that will cause excessive noise, inform others in the vicinity to either exit or use specified ear protection as well.

Working Alone:

Control Measures:

- Do not work alone at any time.

Temperature: extreme temperatures can lead to heat stress and frost bites.

Control Measure:

- Inform the facilities supervisor if the temperature is unsuitable.
- Wear appropriate protective clothing.

6. Facility Housekeeping

- Students must ensure that the facilities are kept clean after use.
- Ensure stored materials do not obstruct aisles, stairs, emergency exits, fire equipment, emergency eyewash stations, emergency showers, or first aid stations.
- Ensure that saw blades, knives or any other harmful object are kept away from walk ways and students working in proximity.
- Floors should be kept clean and dry to prevent accidental slips around dangerous hand tools.
- Electric cords and other wires should be coiled and placed away from paths.
- Tools should be cleaned and stored in the right place after use.
- All material off cuts or scraps are marked and disposed of properly.
- Ensure all storage areas are clearly marked.

7. Reporting of Accident and Incidents

- Students are to immediately inform the supervisory authority of the facility of any incidents, accidents or injury in a facility within the scope of this directive.
- In the event of an incident, accident or injury involving students, contractors or other visitors (including visiting students conducting research) in the facilities; using the University of Toronto's "Online Accident/Incident eForm for Students, Contractors and Visitors," the supervisory authority of the facility is to complete and submit (i.e. report) the form within 24 hours of notification. Online access to the form requires UTORid authentication.

  https://ehs.utoronto.ca/report-an-incident/online-accidentincident-eform-for-students-contractors-and-visitors/

- The online form should also be used to report incidents like near misses, where there was no injury, but the potential for injury existed.

8. Emergency Response Procedures

- Emergency response procedures for a variety of situations, including medical and fire, are detailed at:

  https://ehs.utoronto.ca/report-an-incident/emergency-procedures/

- Medical
  - Using the facility's first-aid station, together with a first-aider (if available), give any necessary first aid to the injured person until help arrives. Do not attempt to move the injured person unless in danger of further injury.
  - For a **major injury call 911** on external Bell lines to get assistance, or 9-911 from a University phone.
  - After calling 911, call the **University Police at 416.978.2222 for the St. George Campus** and inform the police that you have called 911.
  - Report the incident to the facility's supervisory authority **immediately** and assist the supervisory authority to fill out the Accident/Incident Report form **within 24** hours.

- Fire. In case of Fire in one of the facilities:
  - Attempt to extinguish the fire only if you can do so safely.
  - Close the doors.
  - Pull the nearest fire alarm (located at any exit).
  - Evacuate the building by the stairs. Do not use elevators.
  - Report all fires, no matter how small including the smell of smoke of undetermined origin, to the **University Emergency Control Centre at 416.978.2222 for the St. George Campus**.