



Machine Safety Guidelines

1.0 Introduction

Workers and students working in machine shops, or using machines and power tools in other areas, are faced with a potential risk of injury from a number of hazards. These risks can be reduced by ensuring that both the employees and the students know the safe operating procedures. Only persons trained and knowledgeable in the use of specific equipment shall be allowed to use that equipment and all work must be performed in accordance with applicable regulatory requirements. Applicable regulatory requirements include, but are not limited to the Ontario Occupational Health and Safety Act and Regulations for Industrial Establishments (Reg. 851) and other applicable standards and guidelines (e.g. CSA Standard Z432-04 (R2009) Safeguarding of Machinery)

The purpose of this guideline is to provide department management with guidance on the safe use of machines including general information for safe use and requirements for training, maintenance and written work procedures.

Hazards associated with machines, power tools, and machine shops can include, but are not limited to:

- Being struck by ejected parts of the machinery
- Being struck by material ejected from the machinery
- Contact or entanglement with the machinery
- Contact or entanglement with any material in motion
- Electrical hazards
- Chemical hazards (from cutting fluids, lubricants, etc.)
- Burns, cuts and other injuries from materials or substances used/exhausted by the machinery
- Noise levels
- Material Storage and handling (manual material handling, ergonomics)
- Safe access to/from machines (access, egress)
- Environment in which the machine is used (in a machine shop, or in a work site)

Objective

The purpose of this guideline is to provide University of Toronto departments that have machine shop areas and/or machine shop-type equipment and powers tools with general guidance on developing their own safe work procedures. Due to the variety of activities that occur at the University's three campuses, each department should develop their own safe work procedures based on the types of activities, machines, power tools and hazards present.

2.0 Responsibilities



The roles and responsibilities for management, supervisors and workers are documented below. Workers should report concerns to their supervisors and at any time, the Office of Environmental Health and Safety (EHS) can be contacted for assistance or consultation.

Supervisors/Managers/Principal Investigators

- Identify and anticipate any machine hazards and machine users that may be present in their work area.
- Develop, document, implement and maintain appropriate work procedures, measures, inspections, and precautions and emergency procedures to control the hazards that may be present by using these guidelines and in accordance to applicable legislation and standards. Where necessary, complete a Job Safety Analysis (JSA).
- Ensure that all designated machine users (staff, faculty students, etc.) have adequate training on the operation of machines and power tools and documenting that such training has taken place (e.g. Department Orientation Checklist, Attendance Sheet). The content of the training will depend on the type of activities, machines, tools and hazards present – Section, Section 3, C: Training for guidance.
- Ensure all written procedures are readily available to machine users.
- Ensure that only qualified persons operate the machines and the power tools.
- Schedule the use of machines and power tools.
- Ensure that the machines and power tools are maintained and in good condition.
- Establish machine-specific Lockout Tagout (LOTO) procedures.
- Ensure that all persons operating the equipment are provided with and wear the appropriate personal protective equipment (PPE). Where PPE is required, signage shall be posted in the work area, and/or provided in work instructions.
- Ensure that all persons working with machines and power tools follow department developed work procedures.

Machine and Power Tool Users/Workers/Students

- Participate in appropriate training to work safely with machines and power tools.
- Review and be familiar with applicable work procedures before start of work.
- Operate the machines and power tools according to work procedures
- Follow safety procedures and use equipment and/or PPE as defined in the work procedure.
- Inspect any equipment for defects prior to its use.
- Report health and safety hazards, injuries, or concerns, including any unsafe machine practices or damaged equipment, to supervisors/principal investigator.
- Practice good housekeeping and hygiene
- Where requested, assist supervisors in identifying situations with potential of machine hazards and participate in the development of the JSA or work procedure.



Office of Environmental Health & Safety

- Provide consultation and assist in machine safety as needed.
- Update and maintain these Guidelines on a regular basis and/or when new information becomes available.

3.0 General Controls for Reducing Machine Hazards

Steps which can help reduce machine hazards fall into the following categories:

- A. Hazard Identification
- B. Work Procedures
- C. Training
- D. Emergency Preparedness

A: Hazard Identification

A workplace hazard is any equipment, procedure, material, environment or situation that may cause personal injury or illness, or property damage. Workplace hazards need to be anticipated, identified, and evaluated based on the degree of risk and exposure. Once the hazards have been identified and evaluated, appropriate control measures should be implemented to minimize the likelihood of injury in the workplace. Some common machine hazards and general safety measures include (click link to go directly to that section):

[General Machinery and Equipment Hazards and Controls](#)

[General Metalworking Machine Safe Practices](#)

[General Woodworking Machine Safe Practices](#)

[Powered Hand Tools](#)

[Specific Equipment Hazards](#)

[Ergonomics, Material Handling and Storage](#)

[Chemical Hazards](#)

[Electrical Safety](#)

[Fire Hazards](#)

[Machine Shop Work Environment](#)

This above list is not exhaustive of all the hazards that may be present in machine shops or when working with machines. Supervisors/PI must determine if there are any additional hazards that may be present. This can be achieved by completing a Job Safety Analysis (JSA) for tasks involved where necessary.

B: Work Procedures

Each workplace is different and has different hazards. Based on the hazards identified above, written work procedures should be provided to machine users on the work they are expected to perform, how to perform this work safely, and what types of tools or PPE they may need to perform this task. This includes work activities that may occur every day, maintenance activities



that occur periodically (e.g. monthly, annually), and emergency procedures. Here are some examples of work procedures that can be developed:

1. Procedures on using, inspecting and maintaining equipment (machines, power tools) – in some cases, additional workplace procedures (such as Lock Out/Tag Out procedures) may be required to supplement manufacturer manuals/instructions.
2. Procedures on handling, mixing, storing and disposing of chemicals and materials used with the machines.
3. Procedures on the orientation of machine users (training requirements, PPE, etc.)
4. Procedures for ergonomic aids (e.g. pallet hand trucks).
5. Procedures for emergency response and injury reporting.

C: Training

Based on the above, appropriate training should be provided as follows:

1. Equipment specific training. Training should be provided on the safe use of equipment and tools, to include routine operations, storage, maintenance and the use of protective devices such as guards, interlocks, two-hand controls, electronic sensing devices, push sticks, emergency stops. Where PPE is required, training should be provided on the proper use and maintenance of the PPE.
2. Additional hazard specific training, such as (but not limited to):
 - Ladder safety
 - Lock Out/Tag Out
 - Manual Materials Handling
 - Noise
 - Respiratory Protection
 - Working in Hot/Cold Environments
 - Workplace Hazardous Materials Information System (WHMIS)

Some of these courses are available online through EHS, or are alternative instructor-led courses. Select specialty hazards (asbestos, lasers, radiation, silica, lead etc.) may have additional requirements. Contact

the EHS office for further information if required, or browse available courses online at the EHS website (<http://www.ehs.utoronto.ca/Training/training.htm>).

3. Worksite specific training, such as emergency preparedness (i.e. where to find emergency equipment, eye wash, first aid kits, fire extinguishers, emergency contact, etc.)
4. In addition to formal training such as the online or instructor-led courses, supervisors can also take the opportunity to review department- or work-specific procedures for working



with machines (or other health and safety requirements) in other forums such as toolbox talks, operations meetings, hands-on demonstrations, etc.

D: Emergency Preparedness

Users of the machines and power tools should know the location of and how to use any emergency equipment that may be in the area such as first extinguishers, first aid kits, eye wash stations or showers and alarms. Elements of emergency preparedness may include the following:

- First aid stations are available, easy to identify, routinely inspected and re-stocked as needed
- First aiders are identified and fully trained. Generally, a list of contacts and phone numbers are posted near the First Aid Station
- A list of emergency numbers should be posted or available.

Fire alarms and emergency exits are visible and accessible. Where chemicals are used, ensure eye-wash stations/showers and spill kits are available and accessible.

- Hallways, exits and stairs are kept clear of clutter and obstacles.
- All accidents must be reported. Follow the procedures outlined at:
<http://www.ehs.utoronto.ca/resources/wcbproc.htm>



Appendix 1: Best Practice for Machine Safety

This document can be viewed in its entirety, or click on the links below to go directly to those sections:

- A. [General Machinery and Equipment Hazards and Controls](#)
 - [Engineering Controls](#)
 - [Administrative Controls](#)
 - [Personal Protective Equipment](#)
 - [Entanglement Hazards](#)
- B. [General Metalworking Machine Safe Practices](#)
- C. [General Woodworking Machine Safe Practices](#)
- D. [Powered Hand Tools](#)
- E. [Specific Equipment Hazards](#) and safe practices ([Band Saw](#), [Drill Press](#), [Horizontal Band Saw](#), [Grinders](#), [Chop Saw](#), [Jig Saw](#), [Lathe](#), [Drill](#), [Spot Welder](#), [Milling Machine](#), [Table Saw](#), [Shears](#), [Bending Brake](#), [Skill \(circular saw\) hand held](#), [Nail Gun](#))
- F. [Ergonomics, Material Handling, and Storage](#)
- G. [Chemical Hazards](#)
- H. [Electrical Safety](#)
- I. [Fire Hazards](#)
- J. [Machine Shop Work Environment](#) ([Access/egress](#), [Housekeeping](#), [Lighting](#), [Noise & Vibration](#), [Personal Hygiene](#), [Working Alone](#))

Some sections on equipment specific tips and information provided in this document have been adopted from the Canadian Centre for Occupational Health and Safety (CCOHS) and WorkSafeBC.

A. General Machinery and Equipment Hazards and Controls

Several general types of hazards exist on many types of machinery. Machine parts generally move in one of three ways: they rotate, they slide, or they can rupture, fragment, and/or eject. Shop and machine users must be provided protection from these hazards:

Point of Operation: refers to the area where work (e.g. cutting, shearing, shaping, boring) is performed on a stock material.

Nip or Pinch Point: refers to an area other than a point of operation where a belt contacts a pulley or where one or more rotating parts come together, and it is possible for a part of the body to get nipped or pinched by moving parts.



Power Transmission: refers to areas where power is transferred from one part to another such as a drive shaft, belt, pulleys, sprockets, gears, couplings or chains.

Hazards associated with machines, power tools, and machine shops can include, but are not limited to:

- Being struck by ejected parts of the machinery
- Being struck by material ejected from the machinery
- Contact or entanglement with the machinery
- Contact or entanglement with any material in motion

Health Hazards (other than physical injury caused by moving parts)

- Chemicals hazards that can irritate, burn, or pass through the skin
- Airborne substances that can be inhaled, such as oil mist, metal fumes, solvents, and dust
- Heat, noise, and vibration
- Ionizing or non-ionizing radiation (X-ray, lasers, etc.)
- Biological contamination and waste
- Soft tissue injuries (for example, to the hands, arms, shoulders, back, or neck) resulting from repetitive motion, awkward posture, extended lifting, and pressure grip)

Other Hazards

- Slips and falls from and around machinery during maintenance
- Unstable equipment that is not secured against falling over
- Safe access to/from machines (access, egress)
- Fire or explosion
- Pressure injection injuries from the release of fluids and gases under high pressure
- Electrical Hazards, such as electrocution from faulty or ungrounded electrical components
- Environment in which the machine is used (in a machine shop, or in a work site)

Machines must be safeguarded to protect workers from these non-mechanical hazards as well as the more obvious mechanical hazards.

Machine Safety Controls

Many control systems exist to provide protection from hazards. Users must be provided protection from all hazards during their work with a machine. When selecting a safeguard or combination of safeguards, start at the top of the hierarchy – Elimination/Substitution, Engineering controls, Administrative controls, and PPE.



Most effective control is to either elimination or substitution (e.g. eliminate human interaction in the process, eliminate pinch points, and automate material handling). This may not always be practicable.

Next in the hierarchy of controls, in terms of most effective, are engineering controls. Where elimination or substitution is not possible, engineering controls must be given priority. If engineering controls are not feasible, then an appropriate administrative control must be used. If an administrative control will not control the hazard, then PPE must be utilized. A combination of control measures may be required to eliminate or minimize the risk, and can include:

- Guarding (fixed or interlocking)
- Appropriate Ventilation (local exhaust ventilation, dust collection systems)
- Devices to prevent body part contact (push stick, holding device, two-handed activation controls)
- Visible and accessible stopping mechanism (emergency stop)
- Barriers, sensors, signs and alarms (fixed area barriers, visible lights, signage on machines/area, horns and sirens, restricted space painted on floor)
- Preventative inspections/testing (pre-use testing and inspection, documented annual service/maintenance)
- Safe work procedures, LOTO
- PPE (safety footwear, eyewear, hand protection, face shields, hearing protection, respirators)

The most effective safeguard is a device or system that provides the maximum protection with the minimum impact on normal machine operation.

1. Engineering Controls

Engineering controls include guards, controls, general ventilation, local ventilation, and dust collection systems.

Machine Guards

Where machine equipment has an exposed moving part, an in-running nip hazard, or material being processed in a way that creates a hazard, the machine should be equipped with a guard or other device that prevents access to the moving part or pinch point.

There are three main types of barrier guards that physically prevent a worker from reaching around, over, under, and through the guard to the danger area. At least one type of guard can provide protection from most machine hazards.

Fixed Guard: refers to a guard that is a permanent part of the machine, but is not dependent upon moving parts of the machine to perform its guarding function. A fixed guard that can be manually set into the appropriate position before machine operation is sometimes referred to as



an “adjustable guard”. A fixed guard that completely separates the user from the hazard is often called an “enclosed guard”. Fixed barrier guards must be secured with at least one fastener requiring a tool for removal.

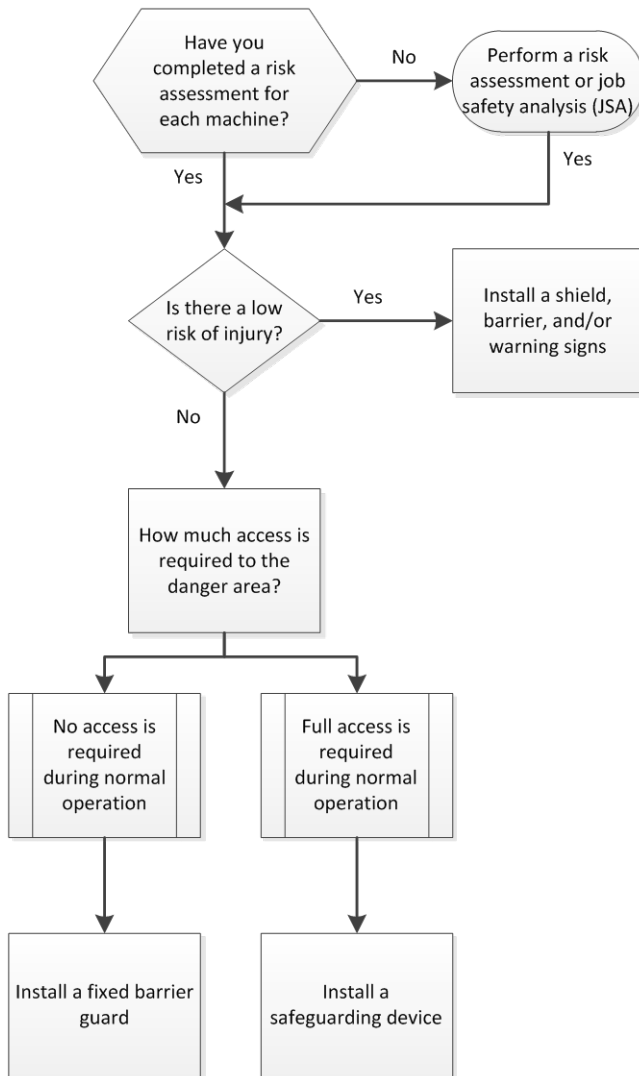
Interlocked Guard: refers to guards that are connected to a mechanism that cuts power to the machine when the guard is tripped or moved out of position. This allows the guard to be moved for the user to access the point of operation and disables the control system until the guard is put back in place and the control system reset.

Self-adjusting Guard: refers to a guard that adjusts automatically to the thickness and movement of the stock material.

Where barrier guards are impracticable, other safeguarding devices can be considered. This can include two-hand controls, interlocked gate guards, presence-sensing devices (light curtains, pressure-sensitive mats), restraint device, speed limiters, and so on.



The following diagram (adapted from WorkSafeBC) demonstrates a decision chart that may assist when reviewing what safe guarding devices would be most effective for the equipment:



Machine Controls

Machine controls, should be conspicuously identified and, located in a safe position and within easy reach of the operator.

Emergency or 'E-Stop's is a red mushroom shaped stop manually depressed in the event of an emergency condition or accident. Emergency stops should not be considered a primary safeguarding device, as it requires intentional activation, and seldom prevents accidents. It should also be located within immediate and





unimpeded reach of the operator, mushroom- shaped and red in colour and designed to allow immediate activation with any part of the body.

General Ventilation

All machine shops or areas where machines are used should be adequately ventilated. General ventilation systems are not substitutes for local ventilation where local ventilation is required.

Local Ventilation

Where processes may produce dust, mists, fumes, or vapours which may be hazardous or may form explosive mixtures, local exhaust ventilation should be used to remove the hazardous material.

For instance, when chemical or flammable liquid work is performed, additional ventilation may be required in addition to the building general ventilation. This may include fume hoods or other types of local exhaust ventilation.

Dust Collection Systems

Dust collection systems remove sawdust or other particles from the shop or work area. The particles are generally collected in a bag or other container for disposal. Where woodworking or other dust generation activities are conducted, it is recommended that an appropriate dust collection system be put in place. Dust collection systems must be properly maintained, and care must be taken in disposing of dust which may be toxic, flammable, or pose other hazards.

2. Administrative Controls/Work Practice

Administrative controls include training, standard operating procedures, access control to machines and the shop, maintenance activities, and shop guidelines. Each shop/department should establish these guidelines, put them in writing, make them readily available, and post their location at the entrance to the shop.

Examples of Administrative controls include:

- Sensors, signs and alarms (restricted access, visible lights, signage on machines/area)
- Prevent body part contact (location separation, push sticks)
- Preventative inspections/testing (pre-use testing and inspection, documented annual service/maintenance)
- Work Procedures, training and supervision

3. Personal Protective Equipment (PPE)

Personal protective equipment used in a machine shop and work sites may depend on the specific equipment and materials used, and may include safety glasses, hearing protection,



protective safety shoes, face shields, respirators, gloves, welding gear and disposable clothing. PPE for machine users should be a minimum of:

- a) Eye Protection, which is needed when there is a risk of eye injury from splashes, chemicals, and flying particles.
- b) Foot Protection. Use slip-resistant shoes. Slip-resistant qualities are lost when shoes are dirty or worn out.

Work shoes should preferably be left at work and not used to commute to and from work.

4. Entanglement Hazards

It is dangerous to have any objects or clothing on the body that may get entangled when working around moving machinery parts. Avoid loose clothing, gloves, unconfined long hair and jewelry which can potentially get caught in moving parts and may lead to serious injuries or fatalities.

Clothing

- Be familiar with the EHS Protective Clothing Standard
- Wear close-fitting clothing.
- Tuck any shirts into the pants.
- If long-sleeved shirts are worn and required for protection, make sure to button any cuffs at the wrist. If long-sleeved are not required, wear short-sleeved shirts.

Gloves

- Be familiar with the EHS Hand Protection Standard
- Do NOT wear gloves when working near rotating parts, shafts or other moving machinery parts.
- If you must wear gloves for health and safety reasons, make sure your supervisor has identified them as suitable for your task.

Long Hair and Jewelry

- Tie back long hair, wear it in a bun, or cover it with a cap.
- Keep facial hair short or tie/secure long facial hair to prevent entanglement with machinery parts.
- If you are not sure if your hair/facial hair is safe, speak with your supervisor.
- Do not wear jewelry (i.e. rings, necklaces, bracelets) when working with machines with moving parts.
- If you wear a medical alert bracelet, secure it so that it is held snugly to your skin, and prevent entanglement with moving parts.



General Rules for All Machines

1. The owner or operator manual must be in the Machine Shop/department area with the machine. A standard operating procedure indicating safety features and their appropriate use must be made available to the user.
2. Only trained machine users are to use the specific machine they have been trained on.
3. Follow manufacturer instruction regarding monitoring of equipment that is in operation. Some machines (e.g. enclosed, computer-controlled machines) may be allowed to run without monitoring but other machines may require continuous monitoring during operation. Each machine will be different and users must be knowledgeable about these differences.
4. Ensure users know how and when to make adjustments to the machines. Some machines should not be adjusted while in motion for safety reasons while others may allow adjustments. Always follow manufacturer's instruction on how to safely make adjustments.
5. Applicable engineering controls, administrative controls, and/or personal protective equipment required for the machine must be present and in good condition prior to use.
6. The area of operation must be free and clear of obstructions and entanglement hazards. Space must be provided between each machine and other objects, including other machine operating areas, as needed, to allow safe operation of the machine.
7. Machinery and equipment must be inspected and maintained according to the manufacturer's recommendations. This information, along with safety-related guidelines, can be found in the operator's manual. If a manual is not available, the manufacturers should be contacted to obtain one. As well, many manufacturers post manuals on their websites.

B. General Metalworking Machine Safe Practices

- ✓ Always wear safety glasses or goggles.
- ✓ Wear appropriate safety footwear.
- ✓ Wear respiratory protection where required.
- ✓ Wear hearing protection in areas > 85 dBA. If you have trouble hearing someone speak from one metre (three feet) away, the noise level from the machine may be hazardous.
- ✓ Check and adjust all safety devices before each job.
- ✓ Ensure that guards are in position and in good working condition before operating.
- ✓ Ensure that all stationary equipment is anchored securely to the floor.
- ✓ Ensure all machines have a start/stop button within easy reach of the operator.
- ✓ Each machine should have only one operator at a time. However, everyone should know how to stop the machine in an emergency.
- ✓ Ensure that keys and adjusting wrenches have been removed from the machine before turning on the power. Appropriate storage for tooling should be provided.



- ✓ Ensure that all cutting tools and blades are clean and sharp. They should be able to cut freely without being forced.
- ✓ Stop the machine before measuring, cleaning or making any adjustments.
- ✓ Wait until the machine has stopped running to clear cuttings with a vacuum, brush or rake.
- ✓ Keep hands away from the cutting head and all moving parts.
- ✓ Avoid awkward operations and hand positions. A sudden slip could cause the hand to move into the cutting tool or blade.
- ✓ Return all portable tooling to their proper storage place after use.
- ✓ Clean all tools after use.
- ✓ Keep work area clean. Floors should be level and have a non-slip surface.
- ✓ Use good lighting so that the work piece, cutting blades, and machine controls can be seen clearly. Position or shade lighting sources so that they do not shine in the operator's eyes or cause any glare and reflections.
- ✓ Ensure there is enough room around the machine to do the job safely.
- ✓ Obtain first aid immediately for all injuries.
- ✓ Understand that the health and fire hazards can vary from material to material. Make sure all appropriate precautions are taken.
- ✓ Clean machines, ducts, hoods and other areas if there is the possibility of a combustible dust situation.
- ✓ Use proper lock out procedures when servicing or cleaning the machines or power tools.

- ✗ Do not distract an operator. Horseplay can lead to injuries and should be strictly prohibited.
- ✗ Do not wear loose clothing, gloves, neckties, rings, bracelets or other jewelry that can become entangled in moving parts. Confine long hair.
- ✗ Do not handle cuttings by hand because they are very sharp. Do not free a stalled cutter without turning the power off first. Do not clean hands with cutting fluids.
- ✗ Do not use rags near moving parts of machines.
- ✗ Do not use compressed air to blow debris from machines or to clean dirt from clothes.

C. General Woodworking Machine Safe Practices

- ✓ Always wear safety glasses or goggles and protective footwear.
- ✓ Wear dust masks when required.
- ✓ Wear hearing protection that is suitable for the level and frequency of the noise you are exposed to in the woodworking area. If you have trouble hearing someone speak from three feet away, the noise level from the machine may be hazardous.
- ✓ Use gloves to protect hands from splinters when handling wood but do not wear them near rotating blades and other machinery parts where the gloves can catch.



- ✓ Make sure the guard that is in position is in good working condition, and guards the machine adequately before operating any equipment or machine. Check and adjust all other safety devices.
- ✓ Make sure the equipment is properly grounded before use.
- ✓ Check that keys and adjusting wrenches are removed from the machine before turning on the power.
- ✓ Inspect stock for nails or other materials before cutting, planing, routing or carrying out similar activities.
- ✓ Make sure that all machines have start and stop buttons within easy and convenient reach of an operator. Start buttons should be protected so that accidental contact will not start machine.
- ✓ Ensure that all cutting tools and blades are clean, sharp, and in good working order so that they will cut freely, not forced.
- ✓ Turn the power off and unplug the power cord (or lock out the power source) before inspecting, changing, cleaning, adjusting or repairing a blade or a machine. Also turn the power off when discussing the work.
- ✓ Use a “push stick” to push material into the cutting area. Jigs are also useful in keeping hands safe during cutting procedures. Keep hands out of the line of the cutting blade.
- ✓ Always use a push stick for pieces less than 30 cm (1 ft) in length, or for the last 30 cm of a longer cut.
- ✓ Use a push stick to remove the cut piece from between the fence and the blade.
- ✓ Clamp down and secure all work pieces when drilling or milling.
- ✓ Use good lighting so that the work piece, cutting blades, and machine controls can be seen clearly. Position or shade lighting sources so that they do not shine in the operator’s eyes or cause any glare and reflections.
- ✓ Ensure that the floor space around the equipment is sufficient to enable you to machine the size of work piece being processed safely without bumping into other workers or equipment.
- ✓ Woodworking machines should be fitted with efficient and well-maintained local exhaust ventilation systems to remove sawdust or chips that are produced.
- ✓ Electric power cords should be above head level or in the floor in such a way that they are not tripping hazards.
- ✓ Keep work area free of clutter, clean, well swept, and well lit. Spills should be cleaned up immediately. Floor areas should be level and non-slip. Good housekeeping practices and workplace design will reduce the number of injuries and accidents from slips, trips, and falls.

- ✗ Do not wear loose clothing, work gloves, neckties, rings, bracelets or other jewelry that can become entangled with moving parts. Confine long hair.
- ✗ Avoid awkward operations and hand positions where a sudden slip could cause your hand to move into the cutting tool or blade.



- ✘ Do not remove sawdust or cuttings from the cutting head by hand while a machine is running. Use a stick or brush when the machine has stopped moving.
- ✘ Do not use compressed air to remove sawdust, turnings, etc. from machines or clothing.
- ✘ Do not leave machines running unattended (unless they are designed and intended to be operated while unattended). Do not leave a machine until the power off is turned off and the machine comes to a complete stop.
- ✘ Do not try to free a stalled blade before turning the power off.
- ✘ Do not distract or startle an operator while he or she is using woodworking equipment. Horseplay should be prohibited. It can lead to injuries.

D. Powered Hand Tools

- ✓ Wear or use personal protective equipment (PPE) or clothing that is appropriate for the work you are doing; this may include items such as safety glasses or goggles, hearing protection, dust mask, gloves, safety boots or shoes, or rubber boots.
- ✓ Switch off the tools before connecting them to a power supply.
- ✓ If a power cord feels more than comfortably warm or if a tool is sparking, have it checked by an electrician or other qualified person.
- ✓ Disconnect the power supply before making adjustments or changing accessories.
- ✓ Remove any wrenches and adjusting tools before turning on a tool.
- ✓ Inspect the cord for fraying or damage between each use. Tag defective tools clearly with an “Out of Service” tag and replace immediately with a tool in good running order.
- ✓ During use, keep power cords clear of tools and the path that the tool will take.
- ✓ Use clamps, a vise or other devices to hold and support the piece being worked on, when practical to do so. This will allow you to use both hands for better control of the tool and will help prevent injuries if a tool jams or binds in a work piece.
- ✓ Use only approved extension cords that have the proper wire size (gauge) for this length of cord and power requirements of the electric tool that you are using. This will prevent the cord from overheating.
- ✓ For outdoor work, use extension cords intended and marked for outdoor use.
- ✓ Securely suspend power cords over aisles or work areas to eliminate stumbling or tripping hazards.
- ✓ Eliminate octopus connections. If more than one receptacle plug is needed, use a power bar or power distribution strip that has an appropriate power rating, an integral power cord and a built-in overcurrent protection. Power bars should never be connected to other power bars.
- ✓ Pull the plug, not the cord when unplugging a tool. Pulling the cord causes wear and may adversely affect the wiring to the plug and cause an electrical shock to the operator.
- ✓ Follow good housekeeping procedures – keep the work area free of clutter and debris that could be tripping or slipping hazards.



- ✓ Keep power cords away from heat, water, oil, sharp edges and moving parts. They can damage the insulation and cause a shock.
- ✓ Ensure that cutting tools, drill bits, etc. are kept sharp, clean and well maintained.
- ✓ Store tools in a dry, secure location when they are not being used.
- ✓ Stop using an electric power tool if you feel a tingle in your fingers. This is a warning that the tool is faulty and needs repair.

- ✗ Do not wear gloves, loose clothing or jewelry while using revolving power tools. Tie back long hair or wear appropriate hair protection to prevent hair from getting caught in moving parts of equipment.
- ✗ Do not use a tool unless you have been trained to use it safely and know its limitations and hazards.
- ✗ Avoid accidental starting by ensuring the tool is turned off before you plug it in. Also do not walk around with a plugged-in-tool with your finger touching the switch.
- ✗ Do not bypass the ON/OFF switch and operate the tools by connecting and disconnecting the power cord. Do not disconnect the power supply of the tool by pulling or jerking the cord from the outlet.
- ✗ Do not leave a running tool unattended unless they are designed and intended to be operated while unattended. Do not leave it until it has been turned off, has stopped running completely, and has been unplugged.
- ✗ Do not use electric tools in wet conditions or damp locations unless tool is connected to a ground fault circuit interrupter (GFCI).
- ✗ Do not expose electric power tools to rain or wet conditions; wet tools increase the likelihood of electric shock.
- ✗ Avoid body contact with grounded surfaces like pipes and radiators when using electric powered tools; this will reduce the likelihood of shock if the operator's body is grounded.
- ✗ Do not plug several power cords into one outlet by using single-to-multiple outlet adapters or converters ("cube taps").
- ✗ Do not use light duty power cords.
- ✗ Do not connect or splice extension cords together to make a longer connection: the resulting extension cord may not be able to provide sufficient current or power safely.
- ✗ Do not carry electrical tools by the power cord.
- ✗ Do not tie power cords in knots. Knots can cause short circuits and shocks. Loop the cords or use a twist lock plug.
- ✗ Never break off the third prong on a plug: replace broken 3-prong plugs and make sure the third prong is properly grounded.
- ✗ Never use extension cords as permanent wiring: use extension cords only as a temporary power supply to an area that does not have a power outlet.
- ✗ Do not walk on or allow vehicles or other moving equipment to pass over unprotected power cords. Cords should be put in conduits or protected by placing planks on each side of them.



- ✘ Do not brush away sawdust, shaving or turnings while the tool is running.
- ✘ Never use compressed air for cleaning surfaces or removing sawdust, metal turnings, etc.
- ✘ Do not operate tools in an area containing explosive vapours or gases. Do not clean tools with flammable or toxic solvents.
- ✘ Do not surprise or touch anyone who is operating a tool. Startling a tool operator could end up causing an accident or injury.

E. Specific Equipment Hazards

This list of specific equipment hazards is not exhaustive of all equipment that may be present. If there is a machine you are required to use, and it is not available on this list, speak with your supervisor, or contact EHS

Before using any of the following machine or tool, make sure to do the following:

- Be familiar with the equipment manuals and any written procedures pertaining to their work/equipment they use.
- Make sure you understand the instructions and are properly trained before attempting to use any tool or machine. Ask the supervisor questions to clarify anything you don't understand.
- Learn the applications and limitations before use. Know emergency procedures for shutting off the equipment.

Band Saw

- ✓ Wear eye protection or a face shield at all times.
- ✓ Wear hearing protection that is suitable for the level and frequency of the noise you are exposed to in the machine shop area.
- ✓ Gloves should be worn when handling the band saw blade and the machine should be locked out. Gloves are not to worn when the band saw is in use and the blade is rotating.
- ✓ Make sure all guards are in place and properly adjusted. Band wheel covers must be closed before tensioning band or starting the machine.
- ✓ Ensure the blade is under proper tension.
- ✓ Adjustable guards shall be kept as close over the point of operation as the work permits.
- ✓ The saw shall be at full speed before starting to feed in work. Stock shall be fed into the saw only as fast as the teeth will easily remove material.
- ✓ Use band saw blades that are sharp, properly set and otherwise suitable for the job (e.g. the right tooth pitch, tooth form, blade width).
- ✓ Hold stock firmly and flat on the table to prevent the stock from turning and drawing your fingers against the blade. Keep hands braced against the table.
- ✓ Stop the machine before making measurements.





- ✓ Follow manufacturer instructions for making adjustments.
- ✓ The machine shall be stopped only on low speed.
- ✓ LOTO procedures must be followed when removing panels or drive covers.
- ✓ Use a push stick when you remove cut pieces from between the fence and the saw blade or when your hands are close to the blade. Keep your hands on either side of the blade – not in line with the cutting line and the blade.
- ✓ Make release (relief) cuts before tight curves when doing intricate scroll-type work.
- ✓ Keep floor around a band saw clean and free of obstructions or clutter.
- ✓ Keep the machine properly oiled and serviced.
- ✓ Proper speeds and blades shall be used for the material being cut.
- ✓ Provide adequate lighting at the machine table. A light fixture with a flexible connection can provide essential lighting.
- ✓ Dust collector should be used when dust is generated.

- ✗ Do not use excessive force when pushing the material past the blade.
- ✗ Do not back the stock away from the blade while the saw is in motion if the work piece binds or pinches on the blade.
- ✗ Do not reach over the saw line to position or guide materials.
- ✗ Do not stop a band saw by thrusting stock against the cutting edge or the side of a blade immediately after the power has been shut off.
- ✗ Do not remove sawdust or cuttings from the table by hand or with compressed air. Use a stick or brush. Do not leave saw running unattended. Turn off the power and make sure the machine has stopped running before leaving the area.

Drill Press

- ✓ Wear eye protection at all times.
- ✓ Use a vacuum, brush or rake to remove cuttings.
- ✓ Remove burrs and chips from a drilled hole.
- ✓ When making deep holes, clean out the hole frequently.
- ✓ Use a clamp or drill vise to prevent work from spinning whenever possible.
- ✓ The drill bit and speed setting of the drill shall be appropriate to the work being done.
- ✓ Lubricate drill bit when drilling metal.
- ✓ Reduce the drilling pressure when the drill begins to break through the workpiece. This action prevents the drill from pulling into the work and breaking.
- ✓ The bit shall be mounted securely and properly centred in the chuck.
- ✓ The feed stroke shall be adjusted so that there is no possibility of the bit striking the table.
- ✓ The drill spindle shall be allowed to stop on its own accord.
- ✓ Keep drill bits clean and sharp. Dull drills are a common cause of breakage.





- ✓ Keep floor around the drill press free of oil and grease.
- ✓ Keep the working surface clean of scraps, cutting fluid, tools and materials.
- ✓ Keep guards in place and in good working order.

- ✗ Do not wear any loose clothing or ties. Roll sleeves above the elbow to prevent them from being caught in revolving parts. Confine long hair.
- ✗ Do not wear gloves, rings, watches or bracelets while working with a drill press. Do not set speeds, adjust, or measure work until machine is completely stopped.
- ✗ Do not leave chuck key in drill chuck. Make adjustments and remove key immediately. Do not hold work by hand when drilling holes large than 12 mm (1/2 inch) in diameter. Do not place hands under the stock being drilled.
- ✗ Do not stop rotation of chuck and spindle with your hand. Do not tamper with or remove any machine guard.
- ✗ Do not remove a broken drill with a centre punch and hammer. Do not leave the drill press running unattended.

Horizontal Band Saw

- ✓ Wear eye protection at all times.
- ✓ Ensure that all guards are in place and working properly.
- ✓ Guard long material at both ends to prevent anyone from coming into contact with it.
- ✓ Ensure that the blade is completely stopped before removing the stock.
- ✓ Use cutting or lubricating fluid when cutting metals.
- ✓ Keep saw blades clean and sharp. Check blades regularly for wear or damage.
- ✓ Select the correct blade and saw speed for the material being cut. Follow the manufacturer's instructions.
- ✓ Use the stop gauge supplied with most cut-off saws when several pieces of the same length are required.
- ✓ Secure all work in a vise. Place the section to be cut such that the saw blade will clear the vise and table; however, do not place the section so far away from the vise that it will be unstable when being cut.
- ✓ Support long stock with a floor stand.
- ✓ Keep working surface clean of scraps, tools and materials.
- ✓ Keep floor around saw free of oil, grease and debris.
- ✓ Keep hands and fingers well back of the blade/ cutting area while the saw is cutting.

- ✗ Do not place, measure or remove work unless the saw is stopped.
- ✗ Do not apply extra force to the saw blade.
- ✗ Do not leave saw running unattended.





Grinders (Pedestal and Surface)

- ✓ Wear eye protection at all times. In addition, use the eye shield on the grinder, when provided.
- ✓ Examine grinding wheels for cracks before turning the machine on. Wheels that are badly worn or cracked shall be replaced.
- ✓ When starting and stopping the grinder the operator shall stand to one side of the grinding wheel.
- ✓ Before using a new wheel, the wheel shall be left running for a few seconds to ensure it is balanced.
- ✓ If excessive imbalance or wobbling is noted the grinder must be shut off.
- ✓ A proper wheel for the work being done must be used.
- ✓ Check wheels for defects before mounting in according to manufacturer's specifications
- ✓ The gap between the face of the wheel and tool support must be kept to a minimum.
- ✓ Keep the cutting surfaces sharp by properly dressing the wheel.
- ✓ The guard must be present that encloses the wheel as close as possible to the work being ground, ensure that the wheel guard covers at least one half of the grinding wheel.
- ✓ Wheels must be marked with a maximum speed at which they may be used
- ✓ Operate the wheel at a speed which does not exceed the manufacturer's recommendations.
- ✓ The wheel must be stopped before making adjustments.
- ✓ The machine must be stopped when not in use.
- ✓ Users shall keep clear of the rotating grinding wheel.
- ✓ Turn off coolant before stopping the wheel to avoid creating an out-of-balance condition.
- ✓ Keep the working surface clear of scraps, tools and materials.
- ✓ Store the grinding wheel where it is not subject to extreme heat, cold, or damage from impact
- ✓ Keep the floor around the grinder clean and free of oil and grease.
- ✓ No flammable or combustible materials that could be ignited by the sparks from the grinder wheel shall be present nearby.
- ✓ A work rest for a grinding wheel should have a maximum clearance of three millimetres from the grinding wheel, be in a position above the centre line of the grinding wheel, and not be adjusted while the grinding wheel is in motion.

- ✗ Do not wear loose clothing, dangling accessories, jewelry, gloves and other similar items that could get caught in the moving machine. Confine long hair.
- ✗ Do not use a wheel that has been dropped or has received a heavy blow, even if there is no apparent damage.
- ✗ Do not tamper with or remove any machine guard.
- ✗ Do not grind material for which the wheel is not designed. Do not use the side of the straight wheel for grinding.
- ✗ Do not start the machine until the wheel guard is in place.





- ✘ Do not stand directly in front of a grinding wheel when starting a grinder. Do not apply work too quickly to a cold wheel or disk.
- ✘ Do not jam work into the wheel.
- ✘ Do not reach above or around a moving wheel.
- ✘ Do not pass hand underneath a running wheel on a surface grinder.

Chop Saw


- ✓ Wear eye protection at all times.
 - ✓ Wear hearing protection when necessary.
 - ✓ Wear respiratory protection when necessary.
 - ✓ Handle and store wheels as directed by the manufacturer.
 - ✓ Inspect all wheels for possible damage before mounting.
 - ✓ A proper abrasive cutting wheel for the material being cut must be used.
 - ✓ The centre hole on the blade must fit the mandril and be snugly fastened in place with proper washer and lock nut.
 - ✓ Ensure the blade is stopped before moving material.
 - ✓ Check the machine speed against the maximum safe operating speed marked on the wheel.
 - ✓ Ensure that mounting flanges are equal and the correct diameter (at least $\frac{1}{4}$ of the wheel diameter).
 - ✓ Ensure the far end of the material being cut is supported.
 - ✓ Use mounting blotters when they are supplied with wheels.
 - ✓ Clamp work firmly in place when using non-reinforced cut-off wheels.
 - ✓ Use a properly designed safety guard covering at least one half of the grinding wheel.
 - ✓ Allow mounted wheels to run at operating speed, with guards in place, for one minute before cutting.
 - ✓ Bring wheel into contact with the work without bumping on impact.
 - ✓ Turn off coolant before stopping the wheel to avoid an out-of-balance condition.
 - ✓ Keep working surface clean and free of oil and grease.
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- ✘ Do not use a cracked wheel or one that has been dropped or damaged.
 - ✘ Do not force a wheel onto the machine or alter the size of the mounting hole. If the wheel does not fit the machine properly, get one that will.
 - ✘ Do not exceed the maximum operating speed marked on the wheel.
 - ✘ Do not use mounting flanges whose bearing surfaces are not equal, clean, flat and free of burrs. Do not tighten the mounting out excessively.
 - ✘ Do not grind on the side of the wheel.
 - ✘ Do not start machine until the wheel guard is in place. Do not remove blade guard.
 - ✘ Do not stand directly in front of the cut-off wheel when starting the machine. Do not jam, bend or pinch the wheel.






- ✗ Do not force cutting such that the motor slows. Do not cut without proper ventilation.

Jig Saw

- ✓ Wear eye protection at all times.
 - ✓ Disconnect power supply before changing or adjusting blades.
 - ✓ Use lubricants when cutting metals.
 - ✓ Keep all cords clear of cutting area.
 - ✓ Position the saw beside the material before cutting and avoid entering the cut with a moving blade.
 - ✓ Make sure guards, if present, are installed and are working properly.
 - ✓ Hold jig saw with both hands.
 - ✓ Clamp material down or secure and support stock as close as possible to the cutting line to avoid vibration. Be sure that the clamps will not interfere with the path of the saw.
 - ✓ Keep the base of the saw in firm contact with the stock being cut.
 - ✓ Select the correct blade for the material being cut and allow it to cut steadily. Do not force it.
 - ✓ Use clean and sharp blades.
 - ✓ Always maintain control of the saw. Avoid cutting above shoulder height.
 - ✓ Before starting a cut the operator must make sure the saw will not make contact with the clamps, vise, workbench or other support.
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- ✗ Do not reach under the material being cut.
 - ✗ Do not wear loose clothing, dangling accessories, jewelry, gloves and other similar items that could get caught in the moving machine. Confine long hair.
 - ✗ Do not start cutting until the saw reaches its full power.
 - ✗ Do not force a saw along or around a curve. Allow the machine to turn with ease. Avoid cutting curves that are too sharp due to the possibility of the blade breaking.
 - ✗ Do not insert or withdraw the blade from the cut while the blade is moving. Do not put down a saw until the motor has stopped.

Lathe

- ✓ Wear eye protection at all times.
 - ✓ Stand in a position that is clear of the plane containing the point of operation.
 - ✓ Follow job specifications for the speed, feed and depth of cut for materials being turned. Make sure all work runs true and centred.
 - ✓ All stop controls shall be checked before starting work.
 - ✓ The lathe must be stopped to perform any adjusting, measuring, cleaning or lubricating.
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- ✓ The spindle shall be stopped by shutting the lathe off and letting it coast to a stop. If the lathe is equipped with a break treadle, the break treadle shall be depressed to stop the spindle.
- ✓ All belt and gears, and all related covers and panels, must be in place before starting the machine.
- ✓ All work shall be solidly supported, and tightly mounted in the chuck.
- ✓ Adjust tool and tool rest so that they are on centre or slightly above the centre of the work.
- ✓ Use a lifting device to handle heavy chucks or work.
- ✓ Chucks must be mounted and removed by hand.
- ✓ Inspect chucks for wear or damage. Flying pieces can be very dangerous.
- ✓ Remove chuck wrench/key immediately after adjusting chuck, and before starting the machine.
- ✓ Use a barrier guard when operating the lathe in semi-automatic or automatic mode.
- ✓ Files used shall have sound handles. The file handle must be held in the left hand while the right hand can be used to guide/ support the far end of the file, this will remove your body from reaching over the rotating chuck.
- ✓ Remove all tools, measuring instruments and other objects from saddle or lathe bed before starting machine.
- ✓ If vibration or odd noises develop, the machine shall be stopped immediately.
- ✓ Ensure that the chip and coolant shields are in place.
- ✓ Shut off the power supply to the motor before mounting or removing accessories.
- ✓ Use a vacuum, brush or rake to remove cuttings only after the lathe has stopped moving.
- ✓ Keep working surface clean of scraps, tools and materials.
- ✓ Keep floor around lathe clean and free of oil and grease.

- ✗ Do not wear loose clothing, dangling accessories, jewelry, gloves, watches and other similar items that could get caught in the moving machine. Confine long hair.
- ✗ Do not lean on the machine. Stand erect; keep your face and eyes away from flying chips. Do not stop the spindle with hands or fingers.
- ✗ Do not stop lathe by reversing its direction of rotation.
- ✗ Do not use calipers or gauges on a workpiece while the machine is moving.
- ✗ Do not make heavy cuts on long slender pieces because the work could bend and fly out of the lathe. Do not use air hoses to clean the machine.
- ✗ Do not wrap sand paper or polishing cloth around any revolving part of the lathe. Do not leave the lathe unattended while it is running.

Drill

- ✓ Wear eye protection at all times.
- ✓ The drill must be properly grounded and double insulated.



- ✓ Keep the drill air vents clear to maintain adequate ventilation.
 - ✓ Disconnect power supply before changing or adjusting bit or attachments.
 - ✓ Always keep drill bits sharp.
 - ✓ Choose an appropriate drill bit for the type of work. The bit shall be mounted securely in the chuck.
 - ✓ Clamp down or secure stock to prevent it from moving.
 - ✓ Tighten the chuck securely. Remove chuck key before starting drill.
 - ✓ Keep all cords clear of the cutting area during use. Inspect for frays or damage before each use.
 - ✓ Small work pieces shall be properly secured and supported. The operator must never hold a small work piece with his/her hand while drilling.
 - ✓ Control the drill with both hands.
 - ✓ The drill must be restrained just before the bit or cutting attachment emerges through the material.
 - ✓ Once the drill is no longer being used it shall be unplugged and the bit shall be removed.
 - ✓ While drilling deep holes, the drill shall be withdrawn several times with the motor running to clear the cuttings.
 - ✓ Before starting, the drill shall be turned on for a moment to make sure that the shank of the bit or attachment is centred.
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- ✗ Do not support material on the operator's knee.
 - ✗ Do not wear loose clothing, dangling accessories, jewelry, gloves and other similar items that could get caught in the moving machine. Confine long hair.
 - ✗ Do not use a bent drill bit.
 - ✗ Do not exceed the manufacturer's recommend maximum drilling capacities. Do not use a hole saw cutter without the pilot drill.
 - ✗ Do not use high speed steel bits in metal without cooling or using lubrication.
 - ✗ Do not attempt to free a jammed bit by starting and stopping the drill. Unplug the drill and then remove the bit from the workplace using appropriate tools. Remember that the cutting edges of the drill are sharp, and will cut your fingers and hands.
 - ✗ Do not reach under or around the stock being drilled.
 - ✗ Do not overreach. Always keep proper footing and balance. Do not raise or lower the drill by its power cord.
 - ✗ Do not use AC power drills in wet or muddy locations. Use a battery powered drill instead. Do not use excessive force to drill into hard material. Reduce the drill speed if possible.



Spot Welder

- ✓ Proper eye protection must be worn while using the spot welder.
- ✓ Long or loose hair must be confined.



- ✓ Leather gloves, full length work pants, and a shirt with sleeves shall be worn while welding.
 - ✓ Check workspaces and walkways to ensure that no slip/trip hazards are present.
 - ✓ Check that switchgear and cable are in sound condition.
 - ✓ Check that electrode points are in good condition and meet exactly.
 - ✓ Ensure electrodes are securely mounted and clean from contaminants...
 - ✓ Set pressure clamps to hold work securely without damaging work.
 - ✓ Gloves should be used to position and hold work.
 - ✓ Ensure spot welder has cooled before making any adjustments.
 - ✓ Avoid prolonged use due to heat build-up of electrodes and arms.
 - ✓ Take precaution when holding work due to the heat created during the welding process.
 - ✓ Welding operations shall be conducted in a designated area free from flammable materials.
 - ✓ Welding areas shall be periodically checked for combustible atmospheres.
 - ✓ All portable welding equipment must be properly grounded.
 - ✓ All equipment shall be checked prior to use.
 - ✓ Adequate ventilation shall be provided during electric arc welding.
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- ✗ Do not wear rings and jewelry when using the spot welder.
 - Faulty equipment must be reported and not be used.



Milling Machine

- ✓ Eye protection must be worn at all times.
- ✓ Users of the milling machine must fully understand all the machine controls before starting the work.
- ✓ The clutch and feed controls must be in neutral before the machine is started.
- ✓ The work table must be kept free from tools and loose material.
- ✓ Proper feed rate and spindle speed must be used.
- ✓ The holding device shall be solidly mounted to the table and the work firmly held before commencing work.
- ✓ The cutter must be stopped to check the work and clear away metal waste.
- ✓ Chips shall be removed with a brush, not the hand. Air hoses shall not be used to clean the machine.
- ✓ Before any cleaning, follow LOTO procedures. .
- ✓ Before changing a workpiece, the milling fixture, the vise or the clamp must be withdrawn well clear of the cutting area.
- ✓ Sharp edges shall be removed from completed work, unless specified otherwise.





- ✘ Do not wear rings, jewelry, loose clothing, long hair, dangling accessories, gloves and other similar items that could get caught in the moving machine.
- ✘ The machine must not be started until the guards are in position.
- ✘ Do not use machine if guards are not present. Report all faulty guards or equipment immediately. Heavy attachments such as the vise, dividing head, or rotary table shall not be moved without help. Adjustments must not be made near a moving cutter.

Table Saw

- ✓ Eye protection must be worn at all times.
 - ✓ Hearing protection should be worn if the noise level is excessive (sound levels exceed 85dBA).
 - ✓ The guards must be in place during the saw operation.
 - ✓ The operator shall stand to one side of the blade when cutting. The operator or any other person must never stand directly behind the blade when cutting.
 - ✓ The rip fence shall be aligned for slightly more clearance behind the blade than in front. Clamp a clearance block to the fence as a stop when cutting short pieces to length.
 - ✓ A proper blade must be used for the material being cut. The blade must be sharp to prevent kickback.
 - ✓ The machine must be fully stopped before making adjustments.
 - ✓ Stock should be free of knots, splits, and warps.
 - ✓ When ripping narrow and short pieces push sticks and feather boards shall be used.
 - ✓ The saw shall be cleaned after use and scraps placed in the appropriate scrap bin.
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- ✘ The guards must not be removed or tampered with during the operation of the saw.
 - ✘ The operator must not leave until the saw has come to a complete stop. Do not stand behind the blade
 - ✘ Do not place your hands in line with the cut
 - ✘ Users must never reach around, over, or behind a running blade to control the stock.



Shears

- ✓ Eye protection must be worn at all times.
- ✓ Before the machine is used, all cuttings and scrap from the shear table and the surrounding area shall be removed.
- ✓ Users shall avoid touching knife edges when taking measurements.
- ✓ The shear table shall be kept free of loose tools and materials.
- ✓ When clamping, the user shall keep the other hand away from hold down.
- ✓ Only the persons operating the machinery shall be in close proximity of the shears.
- ✓ Appropriate gloves should be worn when handling sheet metal.





- ✓ Scraps shall be removed promptly and deposited in the appropriate scrap bin.
- ✓ Shears must only be used to cut materials specified in the manufacturers' instructions.

- ✗ Safety guards shall not be removed or tampered with.

Bending Brake

- ✓ Eye protection must be worn at all times.
- ✓ Leather gloves should be worn when handling sheet metal.
- ✓ Operator's hands must be located at a safe distance from the point of operation.
- ✓ Only the persons operating the machinery shall be in close proximity.

- ✗ Machine capacity must not be exceeded.



Skill (Circular saw) hand held

- ✓ Eye protection must be worn at all times.
- ✓ The operator shall stand to one side of the saw when cutting.
- ✓ Adjust the height and position of the work surfaces if necessary where feasible.
- ✓ Turn your whole body (i.e. move your feet) rather than twisting your back when working or retrieving stock materials
- ✓ Select tools size, shape and grip to maintain a comfortable straight wrist position and comfortable grip.

- ✗ No person shall reach under the material being cut.



Nail Gun (hand-held)

- ✓ Eye protection must be worn at all times.
- ✓ Should be operated only by a competent trained person
- ✓ Hand-held nail gun and similar tool should be capable of being operated only when in contact with the work surface



F. Ergonomics, Material Handling and Storage

- ✓ Organize your work. Store frequently used materials and equipment between shoulder and hip height and within your reach.
- ✓ Stock materials must be stored in such a manner as to prevent falling, tipping, slipping or rolling.
- ✓ Use shelves, racks, and cabinets, as appropriate to store materials.



- ✓ Make sure the shelves are firmly secured in place against walls and on the floor.
- ✓ Reach only as high and far as is comfortable for you. Use a stool or ladder when necessary.
- ✓ When standing for long periods of time, consider placing an anti-fatigue mat/slip mats
- ✓ Wear appropriate safety shoes with enough cushioning to relieve stress on knees and back when standing for long periods.
- ✓ Lift and carry only what you can handle; ask for help or speak to your supervisor if the object or stock material is too heavy
- ✓ Use mechanical aids (i.e. hoists, dollies, hand carts) whenever possible, especially for heavy loads
- ✓ Wear appropriate gloves or other protective equipment when handling objects with sharp objects, or chemicals.
- ✓ Scrap materials should be contained in bins or containers such that they do not present a hazard.

- ✗ Materials should not be stored on the floor, and may not be stored where they impede egress from the area.
- ✗ If using mechanical aids for moving materials, do not overload (obstructed view, overweight).

G. Chemical Hazards

- ✓ Flammable and combustible liquids include, but are not limited to, materials such as gasoline, oils, some paints, lacquers, thinners, cleaners and solvents. To determine if a material or product is flammable or combustible, review the Material Safety Data Sheet (MSDS) or read the manufacturers label on the product.
- ✓ Staff or students who uses chemicals that are controlled should receive WHMIS training
- ✓ The Material Safety Data Sheets for all chemicals used must be maintained in the shop/department area easily accessible to all users
- ✓ Read the label and MSDS and manufacturer's instructions for use including the use of PPE
- ✓ Chemicals must be stored in cabinets approved for that use, as appropriate.
- ✓ Store any cloth or paper rags, or material that has been saturated with flammable or combustible liquids, in an approved metal can with a tight-fitting lid.
- ✓ Always remove/replace clothing that has become saturated with flammable or combustible liquid, even if it is only a small amount. Saturated clothing can easily ignite if exposed to an ignition source such as radiant heat, flame, sparks or slag from hot work or an electrical arc.

- ✗ Do not store incompatibles chemicals together.



Metal Work Fluids (MWFs) or Cutting Oils

Metalworking fluid (MWF) is the name given to a range of oils and other liquids that are used to cool and/or lubricate metal workpieces when they are being machined, ground, milled, etc. MWFs reduce the heat and friction between the cutting tool and the workpiece, and help prevent burning and smoking. Applying MWFs also helps improve the quality of the workpiece by continuously removing the fines, chips, and swarfs from the tool being used and the surface of the workpiece.

There are different types of MWFs and they include:

- Straight Oils are made up of mineral, animal, marine, vegetable or synthetic oils and is severely solvent refined. This refining process significantly reduces toxic chemicals such polynuclear aromatic hydrocarbons (PAHS) to trace amounts. Straight oils are not diluted with water but may contain other additives.
- Soluble or Emulsifiable oils contain 30-85% severely refined petroleum oils and emulsifiers to disperse the oil in water.
- Semi-synthetic fluids contain 5-30% severely refined petroleum oils, 30-50% water and additives.
- Synthetic fluids do not contain petroleum oils. They use detergent-like components and other additives to help “wet” the workpiece.

All users should be familiar with the MSDS for the types of MWFs they use. With use, MWFs may become contaminated with bacteria, metal swarfs and other nearby chemicals Common health hazards associated with MWFs include:

- Skin conditions such as irritation, allergic contact dermatitis, folliculities (inflammation of hair roots or follicles, typically associated with prolonged and regular contact with straight oils), oil acne (caused by contact with clothing soaked with straight oil). The small metal fines and swarfs collected by the oil may also cause or worsen existing skin irritation.
- Respiratory conditions such as asthma, bronchitis and irritation of the respiratory tract. MWF-induced asthma is more commonly associated with synthetic MWFs but can occur from exposure straight or soluble fluids as well.

MWFs can enter the body via inhalation (mist, aerosol or vapour) and by skin contact, particularly via hands, forearms and contaminated clothing. Strategies for reducing overall exposure to MWFs or cutting oils include:

- **Elimination and Substitution:** Choose MWFs with the least toxic materials whenever possible.
- **Engineering Controls:**



- Fine mists are more commonly when the fluid is moving a high speed. Ways to reduce the amount of mist include: using a low pressure delivery system, adding mist suppressants, lowering the MWF flow rate, covering fluid reservoirs and return systems to prevent contamination, proper maintenance to reduce leaks/contamination and where possible interrupting the flow of the MWF when a part is not being machined (vs. continuously running the fluid).
- Use of [local] exhaust ventilation to prevent accumulation/recirculation of contaminants. Enclosed operations are easier to ventilate.
- Where feasible, installation of enclosures or splash guards.
- Biocides are used to control the growth of bacteria in MWFs. Over use can cause biocide- resistant strains. Biocides themselves can have hazardous properties and users should be familiar with the MSDS ahead of time and follow supplier/manufacturer instruction.
- **Administrative controls:**
 - Regular maintenance to reduce the amount of contaminants by keeping the equipment in good working order and ensuring that all systems (ventilation, guarding, tec.) are in good working order.
 - Maintain good personal hygiene such as always washing your hands before eating, drinking and smoking, keeping extra clothes on hand in case clothing becomes soaked with oil and keeping your hands and forearms clean by using gentle soaps and clean towels. Barrier creams are available but their effectiveness is not well documented. They can also worsen certain skin conditions and should be applied to normal health skin (no cuts, rashes, scratches, etc.).
- **Housekeeping:** All machines should be cleaned and MWF changed periodically. When changing the MWF, thoroughly clean the entire system to remove bacterial deposits.
- **Personal Protective Equipment (PPE):** PPE may be required when working with metal working machines and metalworking fluids. The type of PPE used should be based on a hazard assessment. Some types of PPE, such as gloves, may not be permitted while the parts and workpieces are in motion because of entanglement hazards. However, gloves and other forms of skin hazard may be appropriate when the machine has been properly locked out/tagged out (i.e. no moving parts) during maintenance of MWF systems.

H. Electrical Safety

- ✓ Inspect equipment, power cords, and electrical fittings for damage prior to each use.
- ✓ Report any equipment defects to the supervisor so it can be repaired or replaced.
- ✓ Repairs should be performed by a trained professional.
- ✓ Switch equipment OFF before connecting them to a power supply and before making adjustments.



- ✓ Ensure that electrical equipment is properly grounded or double-insulated. The ground equipment must have an approved 3-wire cord with a 3-prong plug. This plug should be plugged in a properly grounded 3-hole outlet.
- ✓ Keep power cords clear of the equipment during use.
- ✓ Securely suspend power cords over aisles or work areas to eliminate tripping hazards.
- ✓ Tools or other equipment capable of conducting electricity should not be used in such proximity to any live electrical installation or equipment that they might make electrical contact with the live conductor.

- ✗ Do not bypass the switch and operate the tools by connecting and disconnecting the power cord.
- ✗ Do not use AC powered electric tools in wet conditions or damp locations, unless the tool is connected to a GFCI. Do not clean electric equipment and tools with flammable or toxic solvents.
- ✗ Do not carry electrical tools by the power cord.
- ✗ Do not tie power cords in knots. Knots can cause short circuits and shocks. Do not plug several power cords into one outlet.
- ✗ Do not disconnect power supply by pulling or jerking cord from the outlet. Pulling the cord causes wear and may cause a shock. Disconnect by pulling the plug, not the cord.
- ✗ Do not use extension cords as permanent wiring.
- ✗ Do not allow carts and trolleys to pass over unprotected power cords. Cords should be put in conduit or protected by placing planks alongside them.

I. Fire Hazards

- ✓ Be informed about the fire safety procedures in your workplace; post written procedures in a visible location.
- ✓ Know the different types of fire extinguishers and how to use them.
- ✓ Ensure fire extinguishers are inspected regularly.
- ✓ Know where fire extinguishers and alarms are located.
- ✓ Keep exits, passageways and access to fire extinguishers and alarms clear at all times.
- ✓ Tag faulty electrical equipment and cords and take them out of use until they are repaired or replaced.
- ✓ Flammable liquids should be stored in appropriate cabinets or storage locations approved for that use, as appropriate.
- ✓ Keep exits and passageways clear.
- ✓ Oily rags should be kept in suitable waste containers and disposed appropriately.
- ✓ Cutting and welding on the St. George Campus must be approved by Fire Prevention prior to commencement of work. Hot Work Permits are issued on a 'per job' basis, with the exception of U of T personnel carrying out routine maintenance in designated 'Permanent Permit' areas.



- ✘ Do not accumulate combustible materials such as or cardboard boxes in the machine shop or work areas, in hallways or near exits.
- ✘ Do not use electrical wires and equipment which are wet, broken or not working properly.

If a fire occurs:

- ✓ Sound the alarm.
- ✓ Follow the safety procedures.
- ✓ If you catch on fire, stop, drop to the ground and roll to smother the flames.

J. Machine Shop Work Environment

Access/Egress

- ✓ A machine shop and work area must be accessed only by those persons who have received appropriate training and is approved by the supervisor to do so.
- ✓ Aisles and walkways must be kept free of debris and obstructions and a clear path must be maintained to the exit.
- ✓ Machinery should be placed and secured so that a clear and safe operating area is maintained for each machine.

Housekeeping

- ✓ Floors, machines, and other surfaces must be kept free of dirt and debris. Review machine and work area for dirt and debris before and after use.
 - ✓ If floor surfaces are wet or slippery or become wet during work activities, they should be protected with a non-slip coating or covering.
 - ✓ Wood and metal chips, sawdust and other debris must be routinely cleaned if collection systems are not in place and operating.
 - ✓ Spills must be cleaned up immediately
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- ✘ Do not use compressed air to blow off dirt or other debris on clothing or work surfaces.
 - ✘ Do not accumulate scrap materials; they should be removed promptly from the work area.

Lighting

- ✓ The shop area must have adequate lighting to perform the work safely and see hazards (e.g. trip hazards, sharp blades)
- ✓ The lighting should be placed to reduce glare and prevent too much contrast between work areas and adjacent areas.
- ✓ Ensure that covers are intact on all light fixtures to prevent accidental breakage.



Noise, Vibration

- ✓ Noise may be too loud when:
 - You have difficulty talking to someone.
 - You hear a ringing sound in your ears after prolonged exposure.
 - Your hearing is numb at the end of the work shift and returns to normal the next morning.
- ✓ If any of the above is happening, speak to your supervisor. EHS can be contacted to evaluate.
- ✓ Minimize the time you spend near noisy equipment.
- ✓ The best method of protection is to use quieter equipment and maintain existing equipment in good condition. As an interim measure hearing protection (e.g. ear plugs, ear muffs) can be used.
- ✓ Keep all machines, guards, and equipment in good running condition.
- ✓ If a machine is causing vibration or excessive noise, it may require cushioning or noise control as recommended by manufacturer.

- ✗ Do not remove noise control retrofits from equipment, walls and ceilings.
- ✗ Do not use defective machines, guards or equipment.

Personal Hygiene

- ✓ Maintain good personal hygiene.
- ✓ Wash your hands regularly. Scrub hands after touching any work material, after going to the washroom and before performing the next job function.

- ✗ Do not smoke in the machine shop or work areas.
- ✗ Do not eat in the machine shop or work areas.

Working Alone

- ✓ Hours of operation should be established to avoid working alone outside regular business hours. If working alone outside regular hours of operations is required, special arrangements should be made between the user and management (e.g. checking in by phone, etc.). Emergency contact numbers must always be readily available.