

SAFETY

Robotics



Acknowledgements

Carmen Camuti

Program Coordinator Experiential
Learning Department

Richard Yasui

Centrally Assigned FIRST Robotics Teacher,
Experiential Learning Department

James Corbett

Instructional Leader, Experiential
Learning Department

Joe Flynn

Oakwood C.I.

Ed Sedlak

Central Technical School

Paul Degano

Weston C.I.

Wendell Straker

Etobicoke C. I.

Collin Wilson

David & Mary Thomson C.I.

Table of Contents

General Safety Rules.....	4
Power Saws: General	5
Circular Saws.....	6
Sabre Saws: General.....	8
Reciprocating Saw	10
Portable Sander	13
Router and Laminate Trimmer	14
Angle Grinder.....	15
Power Drills.....	16
Hammers	18
Pliers.....	20
Screwdrivers	21
Utility Knife.....	22
Clamps and Vises.....	23
Snips.....	24
Cold Chisels.....	25
Wrenches.....	26
Bandsaw	28
Belt/Disc Sander	31
Drill Press.....	33
Miter Saw	35
Scroll Saw.....	38
Table Saw.....	40
Electrical Classroom Safety	44
Workplace Hazardous Materials Information System (WHMIS)	45
Lockout and Tagging	46
Power Drill and Cordless Drill	48
Acetylene-Air Torch	50
General Safety for Pneumatic Tools.....	52
Bead Roller.....	54
Air Cut-Off Saw (Rotary).....	55
Air Saw (Reciprocating)	56
Grinders – Bench and Pedestal.....	57
Horizontal Milling Machine.....	58
Vertical Milling Machine.....	60
Engine Lathe.....	61
Horizontal Band Saw.....	62
Welding.....	63
Shielded Metal Arc Welding (SMAW).....	65
Gas Metal Arc Welding (GMAW).....	66

GENERAL SAFETY RULES

- Absolutely no horseplay or running is permitted in the shop area.
- Students must report any damaged or broken equipment or tools to the teacher.
- Students are responsible for returning tools to the appropriate place and cleaning up the shop area.
- Stay focused on your work while operating machinery. Do not distract others when they are operating machinery.
- Electronic entertainment devices will not be permitted in the shop areas.
- Should you have any doubts about the operation or safe set-up of the machinery always ask the qualified technical teacher for clarification and assistance.
- A qualified construction teacher must be present in the machining area while equipment is in use.
- All loose clothing, hair, or jewelry must be secured safely while using machines.
- Safety glasses must be worn at all times.
- Never leave a machine running unattended. Ensure the machine has come to a complete stop.
- Disconnect power supply to machines before making adjustments. Ask the qualified technical teacher to inspect your adjustments before restoring power.
- Ask permission before using any machine.
- Report all accidents, no matter how small, to the teacher.

I have read the above rules and guidelines. I understand them and agree to abide by them at all times to ensure a safe shop for everyone.

Name: _____ Signature: _____

Parent/Guardian (if under 18): _____ Signature: _____

Date: _____ Teacher Signature: _____

POWER SAWS: GENERAL

A power saw is an extremely useful tool that, when using the appropriate blade, can be used to cut wood, metal, concrete and a host of other materials. The two main categories of handheld power saws are reciprocating (sabre saws) and rotary (circular saws). Extreme care must be taken when using these tools.

Personal Protection Equipment (PPE) Requirements

- Eye protection
- Hearing protection
- Dust mask
- Apron
- Face protection where necessary

Operating Procedures

- Wear protective clothing and equipment – eye protection is essential, and hearing protection should also be worn.
- Where ventilation is inadequate, wear a dust mask for protection against the dust.
- Electric saws operated outside or in wet locations must be protected with a GFCI.
- Never wear loose clothing, dangling jewelry, or anything else that might get caught in the saw
- Leave all safety devices and guards in place and properly adjusted on the saw.
- Change and adjust blades with the power OFF – disconnect the saw from the source.
- Do not operate any saw before receiving and understanding instructions from your teacher.
- Be sure no one is standing in front of the saw as you make the cut.
- Concentrate on your work – do not become careless, or allow yourself to be distracted.
- Allow the saw to reach full speed before starting a cut.

Specific Hazards

- Muscle strain from poor posture/stance/grip during use of tool.
- Power saws can cause various accidents and injuries, including cuts, amputations, gashes, puncture wounds, burns, and eye injuries from flying particles or broken bits.
- Use extreme caution whenever using a power saw – be aware of your cut path, and ensure that it is free of electrical wires or other foreign objects.

CIRCULAR SAWS

There are two different types of handheld circular saw: direct drive, and worm drive. A direct drive saw sees the blade attached directly to the motor shaft (arbor), whereas a worm drive saw sees the blade attached to a drive shaft that is driven by the motor through a worm drive gear.



Personal Protection Equipment (PPE) Requirements

- Eye protection
- Hearing protection
- Dust mask
- Apron
- Face protection where necessary



Operating Procedures

- Wear protective clothing and equipment – eye protection is essential, and hearing protection should also be worn.
- Where ventilation is inadequate, wear a dust mask for protection against the dust.
- Electric saws operated outside or in wet locations must be protected with a GFCI.
- Never wear loose clothing, dangling jewelry, or anything else that might get caught in the saw.
- Leave all safety devices and guards in place and properly adjusted on the saw.
- Choose the right blade for the job.
- Change and adjust blades with the power OFF – disconnect the saw from the source
- Do not operate any saw before receiving and understanding instructions from your teacher.
- Be sure no one is standing in front of the saw as you make the cut.
- Allow the saw to reach full speed before starting a cut.
- Ensure the material is free of nails, screws, concrete, and other foreign objects.
- Concentrate on your work – do not become careless, or allow yourself to be distracted
- Take special care to ensure that blades are installed in the proper rotational direction – remember that electrical circular saws cut with an upward motion.
- Never operate saw with the blade guard tied or wedged open.
- Never place the saw on the floor while the motor is spinning down – hold it in your hand until it has stopped completely.
- When setting the depth of cut, the blade should project the depth of *one full tooth below the material*: this keeps blade friction to a minimum, removes sawdust from the cut, and results in cool cutting.

CIRCULAR SAWS (Continued)

Changing, Adjusting, and Setting Blades

- 1 Disconnect the saw from the power source.
- 2 Place the saw blade on a piece of scrap lumber and press down until the teeth dig into the wood. This prevents the blade from turning when the locking nut is loosened or tightened. Some machines are provided with a mechanical locking device.
- 3 Use manufacturer-provided arbor wrench to remove arbor nut. **Note:** arbor bolts characteristically are a reverse-thread: that is, the nut is turned to the *right* to loosen, and to the *left* to tighten. This is counter to the usually - accurate Golden Rule: "Righty-tighty: Lefty-loosey"
- 4 Install new blade, ensuring proper fit on arbor. Tighten arbor bolt firmly.
- 5 Make sure that keys and adjusting wrenches are removed before operating the saw.

Basic Operation

- Place the material to be cut on a rigid support such as a bench or two sawhorses.
- Check the cut-path to make sure that the blade will clear the supporting surface and the power cord.
- The wide part of the saw shoe should rest on the supported side of the cut if possible.
- Large sheet stock should be supported in at least three places, with one support next to the cut.
- Short pieces of material (less than 24" in length) should not be held by hand – use some form of clamping to hold the material down when cutting it (preferable to use two clamps as this negates the possibility of the clamp becoming an unhelpful pivot-point when force is placed on the work piece through the saw.
- The material should be placed with its good side down, if possible: because the blade cuts *upward* into the material, any splintering will be on the side that faces up).
- Use just enough force to let the blade cut without laboring.
- Hardness and toughness can vary in the same piece of material, and a knotty or wet section can put a heavier load on the saw – when this happens, reduce pressure to keep the speed of the blade constant (listen to the sound of the tool for this).
- Use extra caution when cutting plywood, wet lumber, and lumber with a twisted grain, as they tend to tighten around a blade and may cause kickback.
- Forcing the blade beyond its capacity will result in rough and inaccurate cuts - it will also overheat the motor and the saw blade.
- If the cut gets off line, don't force the saw back onto line: withdraw the blade and either start over on the same line or begin on a new line.
- If cutting right-handed, keep the cord on that side of your body.
- Stand to one side of the cutting line while working.
- Never reach under the material being cut.
- Always keep your free hand on the long side of the lumber and clear of the saw – maintain a firm, well-balanced stance.

Specific Hazards

- Muscle strain from poor posture/stance/grip during use of tool.
- Power saws can cause various accidents and injuries, including cuts, amputations, gashes, puncture wounds, burns, and eye injuries from flying particles or broken bits.
- Use extreme caution whenever using a power saw – be aware of your cut path, and ensure that it is free of electrical wires or other foreign objects.

SABRE SAWS: GENERAL

There are two different types of handheld sabre saw: a jigsaw or reciprocating saw (commonly known by its' trade name "Sawzall"). The reciprocating action of the blade means that it cuts on an up and down stroke. A wide variety of blades are available for use on materials like plywood, dimensional lumber, drywall, certain metals, stone, cement, and some plastics/laminates.



Personal Protection Equipment (PPE) Requirements

- Eye protection
- Hearing protection
- Dust mask
- Apron
- Face protection where necessary

Operating Procedures

- The portable jig saw is designed for cutting internal and external contours – the saw should not be used for continuous or heavy cutting that can be done more safely and efficiently with a circular saw.
- The reciprocating saw is a heavier type of sabre saw with a larger and more rugged blade.
- The reciprocating saw must be held with both hands to absorb vibration and to avoid accidental contact.
- Use caution when cutting through walls – beware of electrical wiring and other services in or behind the wall.
- Use the proper blade for the task at hand.
- These saws cut on the upstroke – splintering will therefore happen on the top side of the material being cut (consequently, the good side should be facing down).
- When cutting, material must be clamped and supported as close to the cutting line as possible.
- Before starting a cut make sure that the saw will not contact clamps, the vise, workbench, or other support.
- Never reach under the material being cut.
- Never lay down the saw until the motor has stopped.
- Do not try to cut curves so tight that the blade will twist and break (use *relief cuts* to accomplish tighter curves).
- Always hold the base plate or shoe of the saw in firm contact with the material being cut.

SABRE SAWS: GENERAL (Continued)

External Cuts

- To start an external cut (from the outside in), place the front of the shoe on the material.
- Make sure that the blade is not in contact with the material or the saw will stall when the motor starts.
- Hold the saw firmly and switch it on.
- Feed the blade slowly into the material and maintain an even pressure.
- When the cut is complete, do not lay down the saw until the motor has stopped.

Inside Cuts

- To start an inside cut (pocket cut), first drill a pilot hole slightly larger than the saw blade in the waste stock.
- With the saw switched off, insert the blade into the hole until the shoe rests firmly on the material.
- Do not let the blade touch the material until the saw has been switched on.
- Never try to insert a blade into, or withdraw a blade from, a cut or a pilot hole while the motor is running.

Specific Hazards

- Muscle strain from poor posture/stance/grip during use of tool.
- Power saws can cause various accidents and injuries, including cuts, amputations, gashes, puncture wounds, burns, and eye injuries from flying particles or broken bits.
- Use extreme caution whenever using a power saw – be aware of your cut path, and ensure that it is free of electrical wires or other foreign objects.

RECIPROCATING SAW – “SAWZALL”

The Reciprocating saw, commonly known by one manufacturer's brand name: Sawzall, is one of the most commonly used tools in construction and demolition. It is used by carpenters, plumbers, electricians and other construction trades to cut holes in wood, metal and plastic and to cut metal and plastic pipe. As with all tools it must be treated with respect and operated safely or it can cause serious injury.



Personal Protection Equipment (PPE) Requirements

- Eye protection
- Hearing protection
- Dust mask
- Apron
- Face protection when necessary

Operating Procedures

- Hold power tools by insulated gripping surfaces when performing an operation where the cutting tool may contact hidden wiring or its own cord. Contact with a “live” wire will make exposed metal parts of the tool “live” and shock the operator.
- Use clamps or another practical way to secure and support the work piece to a stable platform.
- Holding the work by hand or against your body leaves it unstable and may lead to loss of control.
- Keep hands away from all cutting edges and moving parts.
- Prevent unintentional starting. Ensure the switch is in the off-position before connecting to power source and/or battery pack, picking up or carrying the tool. Carrying power tools with your finger on the switch or energizing power tools that have the switch on invites accidents.
- Remove any adjusting key or wrench before turning the power tool on. A wrench or a key left attached to a rotating part of the power tool may result in personal injury.
- Do not overreach. Keep proper footing and balance at all times. This enables better control of the power tool in unexpected situations.
- Dress properly. Do not wear loose clothing or jewellery. Keep your hair, clothing and gloves away from moving parts. Loose clothes, jewellery or long hair can be caught in moving parts.
- If devices are provided for the connection of dust extraction and collection facilities, ensure these are connected and properly used. Use of dust collection can reduce dust-related hazards.
- Keep children and bystanders away while operating a power tool. Distractions can cause you to lose control.

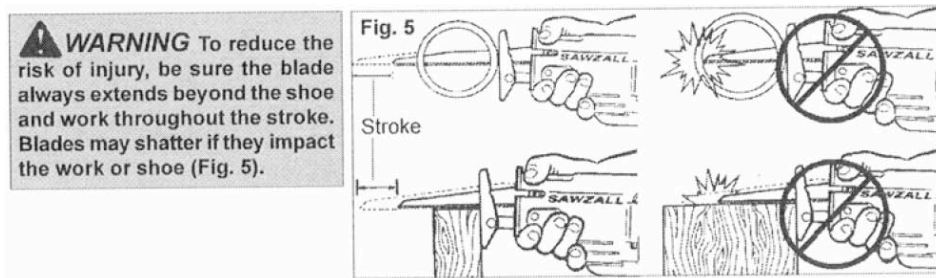
RECIPROCATING SAW – “SAWZALL” (Continued)

Functional Description

Hold power tools by insulated gripping surfaces when performing an operation where the cutting tool may contact hidden wiring or its own cord.

Warning:

Contact with a “live” wire will make exposed metal parts of the tool “live” and shock the operator.



See the diagram above: Make sure the end of the blade will go all the way through the material or pipe. A blade may break and become a dangerous projectile.

Warning

Some dust created by power sanding, sawing, grinding, drilling, and other construction activities contains chemicals known to cause cancer, birth defects or other reproductive harm. Some examples of these chemicals are:

- Lead from lead-based paint.
- Crystalline silica from bricks and cement and other masonry products, and arsenic and chromium from chemically treated lumber.
- Your risk from these exposures varies, depending on how often you do this type of work. To reduce your exposure to these chemicals: work in a well ventilated area, and work with approved safety equipment, such as those dust masks that are specifically designed to filter out microscopic.

Electrical Safety

- Power tool plugs must match the outlet. Never modify the plug in any way. Do not use any adapter plugs with earthed (grounded) power tools. Unmodified plugs and matching outlets will reduce risk of electric shock.
- Avoid body contact with earthed or grounded surfaces such as pipes, radiators, ranges and refrigerators. There is an increased risk of electric shock if your body is earthed or grounded.
- Do not expose power tools to rain or wet conditions. Water entering a power tool will increase the risk of electric shock.
- Do not abuse the cord. Never use the cord for carrying, pulling or unplugging the power tool.
- Keep cord away from heat, oil, sharp edges or moving parts. Damaged or entangled cords increase the risk of electric shock.
- When operating a power tool outdoors, use an extension cord suitable for outdoor use. Use of a cord suitable for outdoor use reduces the risk of electric shock.
- If operating a power tool in a damp location is unavoidable, use a residual current device (RCD) protected supply. Use of an RCD reduces the risk of electric shock.

RECIPROCATING SAW – “SAWZALL” (Continued)

Power Tool Use and Care

- Do not force the power tool. Use the correct power tool for your application. The correct power tool will do the job better and safer at the rate for which it was designed.
- Do not use the power tool if the switch does not turn it on and off. Any power tool that cannot be controlled with the switch is dangerous and must be repaired.
- Disconnect the plug from the power source and/or the battery pack from the power tool before making any adjustments, changing accessories, or storing power tools. Such preventive safety measures reduce the risk of starting the power tool accidentally.
- Store idle power tools out of the reach of children and do not allow persons unfamiliar with the power tool or these instructions to operate the power tool. Power tools are dangerous in the hands of untrained users.
- Stay alert, watch what you are doing and use common sense when operating a power tool.
- Do not use a power tool while you are tired or under the influence of drugs, alcohol or medication.

PORTABLE SANDERS

There are many different portable sanders on the market today, and they can be placed in a few categories: orbital sanders, random orbital sanders, belt sanders, and disc sanders. In all cases, the tool uses a mechanical action to move an abrasive sheet across the surface of the material being worked.



Personal Protection Equipment (PPE) Requirements

- Dust mask
- Eye protection
- Hearing protection
- Apron

Operating Procedures

- Wear eye protection and a dust mask.
- Use the right abrasive for the job.
- Never touch the edge of a moving belt, disk, or pad.
- Clamp small pieces securely in a vise or to the bench.
- Be sure the abrasive belt is installed in the right travel direction, with correct tension and tracking.
- Never place the sander on the bench while it is still running.
- Hold the sander securely, with both hands if possible.
- Always operate the tool in the same direction as the grain of the wood being sanded (only a random orbital sander can operate properly regardless of grain direction).

Specific Hazards

- Abrasions and scrapes can result from skin contact with operating sanding pads.
- Burns can result from skin contact with moving parts, and in some cases, with the work piece itself.
- Repetitive strain injuries can result from prolonged use of rapidly vibrating machinery.

ROUTER AND LAMINATE TRIMMER

A portable router is a tool used to trim edges of millwork, and is used in joining operations.

Personal Protection Equipment (PPE) Requirements

- Dust mask
- Eye protection
- Hearing protection
- Apron
- Face protection where necessary

Operating Procedures

- Routers operate at very high speeds (0 – 25,000 rpm) and turn clockwise – because of the speed and power; it must be operated with both hands.
 - Select the proper bit or cutter for the specific job.
 - When starting a router, get a good grip on the tool to absorb the counterclockwise starting torque.
 - Always support and secure the work in a fixed position by mechanical means such as a vise or clamps – never try to hold the work with your hand or knee.
 - Never rely on a second person to hold the material – human grip is no match for the torque and kickback that a router can generate.
 - Use the proper wrenches to make sure that the bit is securely mounted in the chuck and the base is tight.
 - Adjust the bit or cutter depth.
 - For work along edges such as bevels and moldings, make sure that the cutting edge of the router bit contacts the material to the left of the cutting direction.
 - When routing outside edges, guide the router around the work counterclockwise.
 - Feed the router bit into the material at a firm but controllable speed.
 - Listen to the motor – when the router is fed into the material too slowly, the motor makes a high-pitched whine; push too hard and the motor makes a low growling noise.
 - Cutting through knots may cause slowdown or kickback.
 - When the type of wood or size of bit requires going slow, make two or more passes to prevent the router from burning out or kicking back.
 - Don't try to force the tool to do more work per pass than it is capable of: for deeper cuts (dadoes, rabbets, etc.), make multiple passes that deepen each time.
 - When the cut is complete, switch off power and keep both hands on the router until the motor stops.
- In lifting the tool from the work, avoid contact with the bit.

Specific Hazards

- Router bits have very sharp edges, and can inflict deep cuts (even at a standstill).
- Loose clothing or jewelry can become entangled around the high-speed bit, forcibly drawing the operator to the tool.
- Router and laminate trimmers typically operate at speeds of 20,000 rpm or more – this demands hearing protection.
- Eye injuries are a risk from flying debris as the tool works.



Plunge Router



Laminate Trimmer

ANGLE GRINDER

This is a handheld tool with a right angle drive, used with abrasive discs, for the hand grinding of metal or masonry. There are a wide variety of abrasive discs and cutoff wheels for this tool, depending on the material being worked.



Personal Protection Equipment (PPE) Requirements

- Eye protection
- Hearing protection
- Dust mask
- Apron
- Face protection where necessary
- Foot protection where necessary
- Gloves where necessary

Operating Procedures

- Always wear eye protection – hearing and respiratory protection are also recommended, particularly for longer operating times; gloves, aprons, and foot protection may also be advisable, depending on the job.
- Don't wear loose clothing or jewelry.
- Make sure the maximum speed of the grinder (RPM) doesn't exceed the disc speed – failure to do so may result in the abrasive disk disintegrating with the potential for causing a serious injury.
- Always unplug the tool before making grinder/cutter installations.
- Make sure the safety guards are in place and operating properly before you begin work.
- Always stand aside when starting a grinder, especially with a newly mounted wheel.
- Use light pressure when starting the grinder, especially with a cold wheel.
- Don't use grinders in the vicinity of flammable materials.
- Keep a solid grip on the tool at all times, especially when starting it up - the high-speed motor has a tendency to want to "torque" out of your hands, so hold on tight.

Specific Hazards

- Muscle strain from poor posture/stance/grip during use of tool .
- Always check the condition of the disc or cut-off wheel being used: a damaged abrasive can shatter and disintegrate, sending broken pieces flying at a tremendous speed.
- Cuts, scrapes, amputations, and burns can all result from unsafe operating procedures.

POWER DRILLS

A drill can be used to bore holes into wood, metal, concrete and a host of other materials and surfaces. Increasingly, carpenters and drywallers use them as screw-guns alike.



Personal Protection Equipment (PPE) Requirements

- Eye protection
- Apron
- Face protection where necessary

Operating Procedures

- Proper eye protection is essential.
- Material being drilled should always be clamped or well secured to prevent spinning should the bit bind in the hole.
- Always clamp small pieces when drilling them to prevent them from slipping.
- Always be sure the switch is off before plugging in the tool.
- Make sure the shank of the attachment is tight and square in the chuck and running true before starting the drill.
- For drills with a dual-gearbox, use the fast setting for boring holes; use the slow setting for driving screws.
- Drill a pilot hole in the work so that the bit won't slip or slide when you start drilling.
- Remember that friction builds up in the tip of drill bits and other cutting attachments – avoid contact that could result in a serious burn.
- When drilling into floor, ceilings, and walls, beware of plumbing and wiring.
- While drilling deep holes, especially with a twist bit, withdraw the drill several times with the motor running to clear the cuttings.
- When drilling a through hole, be sure to attach a piece of scrap wood to the exit side of the work piece.
- Never drill through cloth – it will twist around the bit.
- Never support material on your knee while drilling – use a bench or other work surface.
- Never use a bit with a square or tapered tang in an electric drill – the drill's chuck will not hold this type of bit securely.
- Unplug the drill and remove the bit as soon as you are done with the work.

Specific Hazards

- Muscle strain from poor posture/stance/grip during use of tool.
- Electric drills can cause various accidents and injuries, including cuts, gashes, puncture wounds, burns, and eye injuries from flying particles or broken bits.

POWER DRILLS (Continued)

Specific Instructions - Impact or Hammer Drill

- Follow operating procedures for power drills.
- Use the extension handle on the body of the drill to stabilize the attachment.
- Feed the attachment slowly and carefully into the material or the drill may jam and stop suddenly, severely twisting or breaking your arm.



Hammer Drill

HAMMERS

Hammers are striking tools designed to drive and remove nails and other fasteners; they can also be used in conjunction with tools like a nail set. In the case of sledgehammers, the tool can be used to heave large framing members into place, or to assist in demolition.



Personal Protection Equipment (PPE) Requirements

- Eye protection (mandatory at all times)
- Safety gloves (if necessary)

Operating Procedures

- Wear safety glasses.
- Make sure the hammer is in good condition so that the handle will not splinter or the head fly off.
- Strike the surface squarely.
- Never use a claw hammer on hardened metal (chisels, punches).
- Watch the head of the nail, not the hammer.
- Look behind and above before swinging the hammer.
- Never use a hammer to strike another hammer.
- Rest your arm occasionally to avoid tendonitis.
- Concentrate on the work being done – inaccurate hammering can cause serious crushing injuries to fingers hit accidentally.
- Lightweight **Claw hammers** (6oz. – 12oz.) should only be used for finish carpentry; Medium weight is best for general carpentry (12oz. – 20oz.); Heavy weight (20oz. – 24oz.) is best for framing and demolition.
- **Warrington/Tack hammers** (3 1/2 oz – 10oz.) should be used for finishing nails and starting brads.
- **Mallets** should be used for assembling and disassembling projects, to ensure the surface not be marred or dented, and as a chisel-striking tool.
- **Hand sledge** (2lbs. – 4lbs.) should be used with striking tools or to drive stakes during site layout.
- **Hammer-tackers** drive staples quickly into materials such as insulation, roofing felt, and building paper.

HAMMERS (Continued)

Specific Processes

Claw Hammer: Driving Fasteners Safely

- To start a nail, hold it in one hand between thumb and forefinger and close to the point; grasp the hammer near the head and tap the head of the nail to seat it straight and true
- Watch the head of the nail, not the hammer
- Be aware of your surroundings – take a look around before you begin swinging a hammer to avoid accidentally hitting someone or something
- When nailing together pieces of very hard wood, such as oak or maple, drill a small pilot hole in the first piece – this makes it easier to drive the nail into the wood

Removing Fasteners Safely

- ○ Force the claw of the hammer under the head of the nail and pull on the handle; when the nail is partway out, slip a piece of scrap wood under the hammer head before continuing to draw the nail out (this not only provides mechanical advantage to the lever, it also helps protect the surface of the stock)
- ○ Use a nail remover (i.e. “*cat’s paw*”) if possible

Specific Hazards

- Vision damage/loss due to flying debris entering eye
- Crushing injuries
- Misdirected/glancing blows to limbs
- Repetitive strain injury (tendonitis, deep bruising)

PLIERS

Pliers are a gripping hand tool with two hinged arms and (usually) serrated jaws. They are designed to grip and hold things.



Personal Protection Equipment (PPE) Requirements

- Eye protection
- Gloves where necessary

Operating Procedures

- Choose pliers with enough space between the handles to prevent pinching of the palm or fingers.
- Pull on pliers – do not push.
- Don't use pliers as hammers – they might crack or break.
- Don't use cheaters to extend the handles – this can damage or spring the tool.
- Pliers should not be used to tighten nuts or bolts – use a wrench.

Specific Instructions and Hazards

- Muscle strain from poor posture/stance/grip during use of tool.
- Impact injuries from slipped pliers, causing hand to strike foreign material.
- Side cutting pliers may cause injuries when ends of wire are cut and fragments fly off.
- Pliers used for electrical work should be insulated – cushion grips on handles are for comfort only and are not intended to protect against electrical shock.

Locking Wrench Pliers (sometimes called “vise grips” or “grip-locks”)

- Don't use them to replace wrenches since they can damage fittings or fasteners.
- Don't hammer or use “cheaters” to increase force to tighten jaws or to cut wire or bolts.
- Severe vibration can cause release of the jaws accidentally – wire or tape them shut as necessary.
- Never clamp them or attempt to use as a step or climbing device.



Side Cutters

- Point cutting area away from eyes when working – wire fragments can fly off with considerable force.
- Cut at right angles to wire – this helps prevent spear-tips from being made on the wire.



Slip-joint / Channel-lock Pliers

- Keep clean and in good condition – if the pliers' joint accidentally slips during use, serious injury or damage could result.



SCREWDRIVERS

Screwdrivers are tools used to insert and remove screws and, in some cases, bolts. They use a twisting force applied to the screw to move it into the material. Screwdrivers come in a variety of shapes and sizes, including the following: Phillips, Robertson, Slotted, and Torx.



Personal Protection Equipment (PPE) Requirements

- Eye protection
- Safety gloves

Operating Procedures

- Use the correct size screwdriver bit to match the screw head.
- Never use a screwdriver as a pry bar – it will damage the shaft of the tool and render it useless.
- Always make a pilot hole before driving a screw.
- Never get any part of your body in front of the screwdriver.
- Never hold the work in your hand while using screwdriver – use a vise, or at least a solid surface.
- Keep handles clean to prevent slippage.
- Start with one or two “soft” turns with the fingers of your free hand holding the screw, then remove for remainder of screw (you may also choose to keep free hand on shaft of screwdriver to help keep it seated and straight).
- Pass the screwdriver by holding the blade securely. Receiver accepts the handle.

Specific Hazards

- Puncture wound from slipping off the head.
- Repetitive strain injury (tendonitis).
- When working around electricity, use screwdrivers with a handle insulated with dielectric material (keep in mind that this is only a secondary precaution – ensure electrical power is off before beginning work).

UTILITY KNIFE

A utility knife is a razor-sharp cutting tool with a retractable blade. They are often used to cut vinyl tiles, carpet, and as a layout tool for marking stock.



Personal Protection Equipment (PPE) Requirements

- Eye protection
- Gloves where necessary

Operating Procedures

- Advance the blade out of the housing only as far as necessary (snap dull blades off properly, as necessary, discarding safely).
- Use the blade locking mechanism on the knife to prevent it from slipping while in use.
- Keep your hands away from the front of the cutting edge when working.
- Cut away from your body – not toward it.
- Retract the blade fully into the housing before putting the tool away, particularly in a toolbox.

Specific Hazards

- Cutting injuries from the exposed sharp blade.


CLAMPS AND VISES

Clamps and vises are used to secure work pieces in place while they are being worked on, and to hold pieces together while gluing.

Personal Protection Equipment (PPE) Requirements

- Eye protection
- Apron

Operating Procedures

- Use the appropriate clamp for the job, and use it as intended.
 - Choose a clamp suited to the size of the job.
 - To stabilize work for certain cutting operations, use more than one clamp.
 - Mount vise securely.
 - Keep work close to jaws.
 - Keep vise cleaned, oiled.
 - Support extra long work.
 - Prop very heavy work in vise with wood blocks to prevent it from falling and causing injury.
 - Don't open jaws beyond their capacity – the moveable jaw may fall, causing injury or damage.
- 

Specific Hazards

- Clamps create pinch-points: be sure to keep all fingers and clothing free and clear

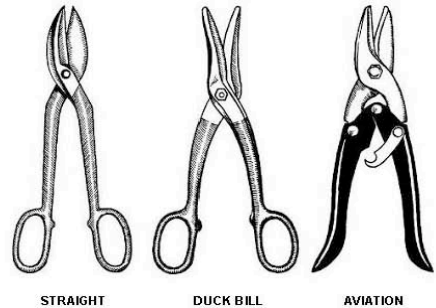


SNIPS

Tin snips are used for cutting sheet metal, 18 gauge or less. Snips can be used for cutting straight lines or curves.

Personal Protection Equipment (PPE) Requirements

- Eye protection
- Gloves



Operating Procedures

- Wear eye protection.
- Keep snips clean and well maintained, including sharpening the blades when necessary.
- Use the right tool for the job – snips are only meant to cut relatively thin, soft material.
- Follow the procedures for making straight, curved and notch cuts.

Specific Hazards

- Muscle strain from poor posture/stance/grip during use of tool.
- Impact injuries from slipped pliers, causing hand to strike foreign material.
- Snips may cause injuries when ends of material are cut and fragments fly off .
- Be careful at cutting edges of material – snips can create razor-sharp conditions, as well as pointed spear-tips.

COLD CHISELS

A cold chisel is a strong, tempered steel tool with a blunt bevel edge at one end. Cold chisels are used to cut and shape metal, and to knock free seized nuts.



Personal Protection Equipment (PPE) Requirements

- Eye protection

Operating Procedures

- Use a ball peen hammer or a hand sledge for cold chisels.
- Strike the tool squarely and in the centre.
- Ensure the head of the chisel is not mushroomed – reshape and grind as necessary.
- Keep cutting edges sharp.
- Keep your hands away from the front of the cutting edge when working.
- Chisel away from your body – not toward it.

Specific Hazards

- Cutting injuries from the exposed sharp blade, particularly during glancing blows.
- Cutting injuries from sharp edges of material being cut.
- Crushing injuries resulting from glancing blows to chisel.
- Repetitive strain injury can result from repeatedly striking the head of the chisel with the palm of your hand.

WRENCHES

A wrench is a tool used for turning nuts, bolts, and pipes, consisting of a bar or handle having jaws to fit the nut, bolt, or pipe. Some have fixed jaws, while others are adjustable to fit any number of nut or pipe sizes.



Personal Protection Equipment (PPE) Requirements

- Eye protection
- Gloves where necessary
- Apron where necessary

Operating Procedures

- A wrench is for turning things – do not use a wrench for other tasks.
- The user should always be braced to maintain balance and keep from being injured in case the wrench slips.
- Always inspect a wrench for flaws, damaged parts, or wear that can cause it to slip and damage fasteners.
- Where possible, use penetrating oil to loosen nuts and bolts.
- Always grip the wrench so it will not cause injury if it slips.
- Use the correct type of jaw to avoid slippage (i.e. box wrenches are safer than open-ended wrenches since they are less likely to slip).
- Never overload a wrench by using a pipe extension on the handle or by striking the handle with a hammer (special striking wrenches are available).
- When using a wrench always pull on the wrench – never push.

Specific Instructions and Hazards

- There are hazards with all types of wrenches: the wrench may slip off the work, the work piece may suddenly turn free, the wrench or work piece may break.
- Muscle strain from poor posture/stance/grip during use of tool.
- Impact injuries from slipped wrench, causing hand to strike foreign material.
- Eye injuries from debris flying off of fasteners (particularly when positioned underneath the work piece).

Adjustable Wrench

- Whenever possible, pull on an adjustable wrench – do not push.
- Force should be applied against the fixed, not the adjustable, jaw.



Open-end Wrench / Box Wrench

Use only the correct sized wrench for the job.
Keep handles clean and free of grease or oil.



WRENCHES (Continued)

Pipe Wrench

- Used for tightening or removing pipes, this wrench should never be used on nuts and bolts.
- Face the pipe wrench forward, turn the wrench so that pressure is against the heel jaw.
- Jaws should be kept sharp and clean to prevent slipping.
- The adjusting nut of the pipe wrench should be inspected frequently for cracks.



Allen Wrench (sometimes called a "Hex Key")

- Use only the correct sized wrench for the job (wide variety available, including sets in both Metric and Imperial rule).



Socket Wrench

- Use the right socket for the job – be careful when adapting down in size not to over torque a smaller socket and fastener with a larger driver.
- Make sure the socket fits snugly.
- Never use "Hand sockets" on a power drive or impact wrench – the metal is not as strong and could break, injuring the operator and damaging the work.

BANDSAW

Personal Protection Equipment (PPE) Requirements

- Eye protection
- Dust masks

Set-Up

- Ensure that workspace is clean and clear.
- Remove jewellery, secure loose clothing and tie back long hair.
- Turn on the dust collection system.
- Before making any adjustments to the machine ensure that it is shut-off and locked out.
- Ensure that all necessary push sticks are available for use when necessary.



Blade

- Ensure that all necessary guards are in place and working properly.
 - Check that the correct type and width of blade is being used for the task.
- Blade width will determine the smallest radius you can safely cut. Check that it is sharp, tracking properly and tensioned correctly. Blades tracking to the centre of the wheel offer the greatest room for safety margins.

Side Blade Guides

- Check that the side blade guides are not set beyond the base of the gullet between the teeth. They should be set to almost touch the blade when resting. There are usually two sets of guide blocks, above and below the table. Ensure that the bearing behind the blade is set just off of the blade when resting. This will ensure that the side guides will not alter the set of the teeth once cutting begins.

Guards

- Set and lock the blade guard 1/4" above the surface of the stock to be cut
- Unique set-ups and operations like ripping, beveling, mitre cuts, pattern cutting or use of material other than wood can present a different set of risks. Further research into appropriate set-up and techniques for your specific machine should be done before safely attempting these types of operations.
- Make certain both wheel covers are in place and secure.
- All exposed pulleys and belts should be covered.

BANDSAW (Continued)

Operating Procedures

- Wear safety glasses.
- Bandsaws can be used for re-sawing boards to reduce thickness. Bandsaws are most commonly used to make curved or straight line cuts in material.
- Clearly mark out on the material the cut-out design in pencil.
- Plan out the order that you will make the cuts. Include making relief cuts in this plan.
- Position your hands so they are on either side of cutting path of the blade. **Do not** push material into the blade with hands or fingers aligned with the blade.
- Use push sticks for smaller pieces of material or whenever safe hand placement is compromised.
- Make relief cuts to reduce the risk of snapping a blade or pulling it off of the wheel.
- Avoid excessive twisting of the blade and backing out of cuts.
- Feed the material into the blade at a rate that does not stress the blade or cause burning on the wood.
- The width of the blade will determine the limits of the radius you may cut. **Do not** attempt to cut a radius too small for the size of blade you are using.
- Once work is complete turn the machine off and wait for the blade to come to a full stop on its own or by using appropriate brake before leaving the machine. Consult with the teacher as to the causes of breakage.
- Remove the waste and leave workspace clean for the next operator.
- If a blade breaks switch the machine off and stand back. Wait for the wheels to come to

Bandsaw Quiz

Name: _____ Date: _____

Label the following parts on the image

1. On/off switch
2. Blade
3. Upper Guard
4. Rip Fence lock
5. Rip Fence
6. Wheel Cover



Fill in the blanks from the word list provided.

1. Do not place _____ in line with cutting path.
2. Adjust _____ so it rests just above work surface.
3. Keep material _____ to the table surface.
4. Before cutting curves make _____.
5. _____ blades are best for tighter radii.
6. Sudden twists of material may cause blades to _____.
7. Do not _____ of cuts while blade is moving.
8. Remove _____ after the blade is fully stopped.
9. Use _____ when cutting small pieces of material.
10. Do not leave the machine until the blade has _____.

<ul style="list-style-type: none">• upper guard• tight• waste• fingers or thumbs	<ul style="list-style-type: none">• stopped• break• narrow	<ul style="list-style-type: none">• relief cuts• back out• push sticks
---	--	--

BELT / DISC SANDER

Personal Protection Equipment (PPE) Requirements

- Safety glasses
- Hearing protection
- Dust mask

Set-Up

- Ensure that the workspace is clean and clear.
- Remove jewellery, secure loose clothing and tie back long hair.
- Turn on the dust collection system whenever sanding.
- Before making adjustments to the machine ensure that it is turned off and locked out.
- Ensure that the guards are in place and functioning effectively.
- Check to ensure the belt and or the disc is not loose, torn or worn. Replace if needed.
- Check that belt and disc sander tables are locked and clear of the moving parts.
- Check that belt sander fence is secured and does not touch the belt.



Materials

- Inspect materials for foreign objects.
- **Never** sand metal objects. They may send sparks into the dust collection system.
- Do not sand wet wood or wood with a finish that will clog the belt or disc.

Operating Procedures

- Wear safety glasses.
- Start the machine before introducing material to disc/belt.
- Ensure that the material rests on the table or against the fence at all times.
- Hold the material securely as you gently feed the material to the sanding disc/belt. **Do not** force material into the disc/belt. Allow it to sand material without being forced.
- Sand only on the down side of the disc.
- Move the material side to side to avoid burning but do not go beyond edges of the belt or past the downside of the disc rotation. Maintain a secure hold of material at all times.
- Keep your hands and fingers well away from the disc/belt at all times.
- Upon completion shut machine off and wait for it to come to a complete stop.
- Remove the waste and leave workspace clean for the next operator.

Belt/Disc Sander Quiz

Name: _____ Date: _____

Label the following parts on the image

1. On/off switch
2. Disc Table
3. Belt Table
4. Disc Table Lock
5. Belt Table Lock



Fill in the blanks from the word list provided.

1. Ensure both table surfaces are _____ before starting machine.
2. Do not sand _____ material on this machine it could be a fire hazard.
3. Keep material tight to the _____ surface.
4. Do not _____ material into the belt or disc.
5. Keep material on the _____ side of the disc rotation.
6. Keep _____ away from belt and disc at all times.
7. Do not sand _____ grain.

<ul style="list-style-type: none">• table• downward• force	<ul style="list-style-type: none">• across• metal	<ul style="list-style-type: none">• clear• fingers
--	--	---

DRILL PRESS

Personal Protection Equipment (PPE) Requirements

- Safety glasses
- Hearing protection
- Dust mask when necessary

Set-up

- Ensure that workspace is clean and clear.
- Remove jewellery, secure loose clothing and tie back long hair.
- Before making any adjustments to the machine ensure that it is turned off and locked out.
- Ensure that all necessary aids (hold downs, clamps) are available for use when necessary.
- Check that a secured fence/guard or vise is in place when needed.
- Ascertain that belts are set to provide the speed necessary for the material and bit being used.
- Select the proper size and type of drill bit.
- Secure the drill bit in the chuck making certain that it is centered between all three jaws, using the chuck key to tighten.
- Remove the chuck key from the chuck.
- Put the chuck guard in place.
- Adjust and secure the table height.
- Set the depth gauge if needed.
- Use a flat piece of scrap material beneath the wood that is being drilled.



Materials

- Inspect materials for foreign objects.
- Select the correct bit for the material to be drilled.
- All metal work pieces should be secured in a vise.
- Round or cylindrical shaped pieces should be secured with an appropriate jig or vise.

Operating Procedures

- Wear safety glasses.
- Keep well back from all moving parts.
- Set material on the table or in a vise so it is secure and will not move or spin with the turning force of the bit.
- Pull down on the feed lever at a moderate pace that will not force the operation or cause burning.
- Release the feed lever by slowly bringing it back to its starting point.
- Drill bits can become very hot because of friction when drilling. Do not touch after drilling.
- Stop the drilling operation if you see smoke or smouldering at the work piece by retracting the bit slowly.
- Do not reach behind a rotating bit.
- Turn the machine off and wait for the drill bit to come to a full stop.
- Remove the waste with a brush and leave workspace clean for the next operator.

Drill Press Quiz

Name: _____ Date: _____

Label the following parts on the image

1. On/Off switch.
- 2.
3. Spin
4. Chuck
5. Handle (raise and lower spindle)
- 6.
7. Table Lock lever and
8. Depth stop



Fill in the blanks from the word list provided.

- 1 Remove _____ from chuck before starting.
- 2 Secure material with a _____ or _____.
- 3 Use the appropriate _____ for the material being drilled.
- 4 Ensure all _____ hair, clothing or jewelry is secured out of way.
- 5 Ensure the table is _____.
- 6 Do not _____ bits after they have been drilling it may cause burns.
- 7 Use _____ bits to avoid burning.
- 8 When operation is complete slowly return _____ to the start position in a controlled manner.

- touch
- bit
- key

- fence
- sharp
- clamp

- loose
- locked
- handle

MITER SAW

Personal Protection Equipment (PPE) Requirements

- Safety glasses
- Hearing protection
- Use dust mask

Set-up

- Read and understand the operators manual before using this machine.
- Ensure that the workspace is clean and clear.
- Use appropriate PPE (glasses, hearing protection, dust mask).
- Remove jewellery, secure loose clothing and tie back long hair.
- Check that the dust collector bag is not full - empty when necessary.
- Unplug machine before making adjustments.
- Check that the guard is in place and working effectively.
- Ensure that appropriate rollers or support devices are in place so the operator does not have to use excessive force or strength to maintain control of longer stock.
- Install the blade for the material and procedures being completed (maintain and use sharp blades to avoid burning and using excessive force).
- The bevel and mitre settings must be locked.
- Ensure that the slide lock is set according to the operation you are performing (slide mitre saws only). Do not leave the slide feature unlocked if it is not needed. Ensure that the blade and motor are pushed to the back of the rail (or track) before locking.
- Unique set-ups and operations like compound mitre cuts can present a different set of risks and further research into appropriate set-up and techniques for your specific machine should be done before safely attempting this type of work.



Materials

- Inspect materials for foreign objects such as metal or stone.
- Check for loose knots in the wood.
- Orient material so a straight edge is against the fence and a flat face rests on the table for stability.
- Position the material for crosscutting the grain - not rip cutting.
- Lengths of wood below 12" may need to be cut with an auxiliary fence or hold-downs.

Operating Procedures for crosscutting (Do not rip wood)

- Position the material with an edge tight against the fence. Do not attempt to cut without the use of the fence.
- Do not stack materials.
- The operator should position themselves to the left of the blade assembly, the left hand should secure the material tight against the fence. Keep fingers 6"-8" away from blade. The right hand is positioned on the handle. The operator never crosses hands or arms through the cutting path of the blade.
- Do not shift the material during the cutting operation. The material must remain stationary and secure.
- Consult with instructor about methods for cutting.

MITER SAW (Continued)

- Start the saw when the blade is in the upright position above the materials. The guard should cover the blade in this position.
- Bring the blade down with a consistent motion at a moderate pace.
- When the cut is complete immediately return the motor housing and blade to an upright position, as you release the on/off switch. Ensure that the guard has returned to its original position - fully covering the blade.
- When using the slide feature pull the blade and motor housing forward while upright. Start it then plunge it into the material. Once the blade is fully descended push it towards the fence to the back of the rail then switch off and return it to the upright position. Lock slide feature upon completion.
- Wait for the blade to come to a full stop on its own.
- Remove the waste and leave workspace clean for the next operator.

MITER SAW QUIZ

Name: _____ Date: _____

Label the following parts on the image

- 1 On/off switch
- 2 Fence
- 3 Blade
- 4 Guard
- 5 Handle
- 6 Slide Lock
- 7 Miter Lock
- 8 Bevel Lock



Fill in the blanks from the word list provided.

1. Before making cuts the operator should do the following checks:

a) Secure the _____ and _____ locks; b) Release or secure the _____ depending on the width of the material; c) Place material _____ against the table and _____; d) Ensure that long material is _____; e) Ensure that the _____ is in place and working.

- 1 Do not start the blade while it is _____ the material.
- 2 Do not _____ stock while the blade is spinning.
- 3 Do not _____ or arms through the cutting path when holding stock.
- 4 Use _____ or hold downs to secure small stock.

hand should secure the material tight against the fence while the right hand is positioned on the handle.

<ul style="list-style-type: none"> • fence • supported • clamps • touching 	<ul style="list-style-type: none"> • cross hands • bevel • mitre • move 	<ul style="list-style-type: none"> • tight • guard • slide lock
--	---	--

SCROLL SAW

Personal Protection Equipment (PPE) Requirements

- Safety glasses

Set-up

- Ensure that workspace is clean and clear.
- Remove jewellery, secure loose clothing and tie back long hair.
- Use the dust collection system.
- Before making any alterations or adjustments to the machine ensure that it is shut-off and locked out.
- Check that all guards are in place and working properly before starting the machine.
- Use the correct type of blade for the work being completed.
- Make certain that table is secured in the proper position.
- Set the lower guide assembly to rest on top of the material to be cut.
- Adjust the blade tension before beginning.



Materials

- Inspect materials for foreign objects.
- Clearly mark out cuts on the surface of the material to be cut.

Operating Procedures

- Always keep your fingers and thumbs out of cutting path of blade.
- Keep your hands to the side of blade.
- Feed the material slowly following the marked line with the blade.
- Avoid turning material too quickly. Do not force the material.
- Stop the machine if excessive vibration occurs. Reset the hold down.
- If the blade bends or breaks shut the machine off and wait for it to stop before following blade-changing procedures.
- Upon completion, shut the machine off. Wait for it to stop then remove the waste and leave workspace clean for the next operator.

Scroll Saw Quiz

Name: _____ Date: _____

Label the following parts on the image

1. On/off switch.
2. Blade
3. Lower guide assembly
4. Guide assembly lock
5. Table
6. Table Lock



Fill in the blanks from the word list provided.

- 1 The _____ should be set to rest on top of stock.
- 2 Keep material _____ to the table surface
- 3 Ensure that you are using the correct _____ for the material you are cutting.
- 4 Keep your fingers and thumbs out of the _____.
- 5 _____ out cuts on material before starting.
- 6 Remove waste after the _____ has come to a stop.

<ul style="list-style-type: none">• mark• lower guide assembly	<ul style="list-style-type: none">• tight• cutting path	<ul style="list-style-type: none">• blade
---	--	---

TABLE SAW

Personal Protection Equipment (PPE) Requirements

- Safety glasses
- Shop apron
- Roll up long sleeves

Set-up

- Ensure that workspace is clean and clear.
- Remove jewellery, secure loose clothing and tie back long hair.
- Turn on the dust collection system.
- Before making any alterations or adjustments to the machine ensure that it is shut-off and locked out.
- Make certain appropriate rollers or support devices are in place so the operator does not have to use excessive force to maintain control of longer stock.
- Ensure that all necessary aids (push sticks) are available for use.
- Check that all necessary guards are in place and working effectively.
- Test that splitter and anti-kick back pawls are in place for through cutting operations.
- Ascertain that the appropriate blade is being used for the material and procedures being completed.
- Ensure that the blade bevel and height settings are locked (set blade to 1/4" – 1/2" (6.35mm – 12.7mm) above material thickness).
- Check to see that the blade and fence are parallel to one another.
- Lock the fence in position before starting the cutting operation.
- Make sure that others are not in harms way should a kickback occur.
- Ensure that anyone assisting with supporting the stock on the outfeed knows the safe operating procedures (they are to support material only).
- Unique operations and set-ups like bevel ripping or dado cuts can present a different set of risks. Further research into appropriate set-up, additional jigs or fixtures and techniques should be done before safely attempting these types of operations. Read and understand the operator's manual for complete instructions on specialized cuts.



Materials

- Inspect materials for foreign objects such as metal or stone.
- Check for loose knots or splintered edges that may catch on the fence or table surface and prevent a smooth feeding operation.
- One face and one edge of your material must be flat and straight. They must be oriented to the table surface and fence when cutting to ensure the stability of the stock.
- If the wood is slightly cupped keep the concave side down so that the material rides on the two outside ridges to maintain stability.
- Be aware of the properties of the materials you are using. Different species of wood and man-made sheet goods do not react the same when being machined. Some woods are less forgiving and have greater tendency to bind together or peel apart as they are cut. The same can be true for some sheet goods like plywood.

TABLE SAW (Continued)

Operating Procedures for Rip Cuts

- Adjust the blade guard on the machine. It should prevent fingers and hands from coming into contact with the blade.
- The rip fence should be used to rip pieces along the length of the material.
- Do not use the fence to make crosscuts.
- Only rip boards that are at least 12" long.
- The operator should position himself slightly to the left of the machine.
- Maintain a stable balanced stance.
- Support and feed the stock with the right hand while the left hand guides the stock against the fence.
- Both hands are used to ensure that the material always remains flat on the table and tight to the fence. The material must not be allowed to lift from table or veer off of the fence.
- As the material is fed towards the blade the left hand applies light pressure to keep the wood against the fence. The hand should remain stationary allowing the stock to slip underneath it and advance forward without dragging the hand and fingers into the path of the blade.
- The right hand supports and feeds the material at a moderate rate that enables the blade to freely cut without bogging down.
- Do not place any part of your hand directly in line with the blade as you feed the stock. Keep all parts of your hand well away from the blade, 6" – 8" (150mm) and outside any guards.
- A push stick must be used to feed the material whenever the rip fence is set below 6" (150mm) and whenever short lengths, below 18" (45 cm), are being cut.
- As the cut nears completion the left hand is removed from the stock so that it never advances beyond the front of the guard.
- The right hand must continue to push the stock through until it clears the outfeed or back end of the blade (material must continually be moved forward slowly).
- Turn the machine off and wait for the blade to come to a full stop on its own.
- Remove the waste and leave workspace clean for the next operator.

Operating Procedures for Crosscutting

- Use an appropriate miter gauge.
- Do not use the rip fence to make crosscuts unless a spacer block is attached.
- Check that the meter gauge slides freely in table groove but without any lateral movement. Ensure that material will not be obstructed in any way.
- Slide the rip fence out of the way so that any off cuts will not be trapped between the rip fence and the blade. If you are trying to use the rip fence to gauge multiple cuts of the same length you must use a spacer block attached to the rip fence near its front.
- Lock the mitre gauge to the selected cutting angle.
- Position material to be cut tight against the table and meter gauge.
- Position hands to hold the material tight to the table and mitre gauge while advancing forward.
- Do not reach over top of the blade.
- Do not position hands directly in line with the cutting path.
- Push the gauge and material through until the cut is complete.
- Do not allow the material to shift during the cutting operation.
- Shut the machine off and wait for the blade to stop.

TABLE SAW (Continued)

Kickbacks

Kickbacks can occur for the following reasons:

- the material is not held securely
- the material wanders away from the mitre head
- the material lifts off of the table
- there is no splitter in place to maintain the saw kerf distance between the stock and off cut
- the blade and the rip fence are not parallel
- the rip fence is used to crosscut a piece of material when the mitre gauge should have been used
- the mitre gauge and rip fence are used at the same time without an appropriate spacer block

Guards, splitters and anti-kickback pawls do not ensure that kickbacks will be eliminated entirely. The operator must still be following all of the safe operating procedures. Proper hand and body positioning is essential to ensure the additional safety of the operator.

Read and understand the operator's manual for all operations using the table saw.

TABLE SAW QUIZ

Name: _____ Date: _____

Label the following parts on the image

1. Mitre gauge
2. Rip Fence
3. On/off switch
4. Rip Fence lock
5. Guard
6. Splitter
7. Blade height crank
8. Bevel crank



Fill in the blanks from the word list provided.

1. Kickbacks can occur for the following reasons:

- a) the material is not _____
_____;
 - b) the material _____ away from the _____;
 - c) the material _____ off of the table;
 - d) there is no _____ in place to maintain the saw kerf distance between
the stock and off-cut;
 - e) the blade and the _____ are not parallel;
 - f) the rip fence is used to _____ a piece of material when the mitre fence
should have been used;
 - g) the mitre fence and rip fence are used at the _____.
2. Use _____ to protect your fingers.
 3. Rip fence must be _____ before using it.
 4. Ensure that area behind the operator is clear to protect everyone from _____.
 5. Ensure that the _____ of the blade will enable you to cut through stock (material)

<ul style="list-style-type: none"> • lifts • kickbacks • same time • fence 	<ul style="list-style-type: none"> • cross cut • held securely • locked • moves 	<ul style="list-style-type: none"> • rip fence • splinter • push sticks • height
--	---	--

ELECTRICAL CLASSROOM SAFETY

General Rules

- 1 Never work on an electrical circuit that is live. If you are not sure, verify with the teacher and test the circuit with a circuit tester.
- 2 When using any circuit tester or meter to check for the presence of electrical power test the meter on a known live circuit first to ensure that it is working. (a fault, broken lead or blown fuse could develop in the meter or tester at any time).
- 3 Keep the shop area floor clean and free of debris especially pieces of conduit and armored cable which pose an extreme slip hazard if they are stepped on inadvertently.
- 4 Report any unsafe conditions to the teacher immediately.
- 5 Report any injuries to the teacher immediately.
- 6 Know where the safety shut-off buttons are in the classroom and use them immediately if you think a fellow student is in trouble or if you observe an unsafe condition in the shop.
- 7 Know where the fire extinguishers and fire blankets are located in the classroom. The teacher should give instruction on their use on the first day of class.

Eye Protection

- Wear safety glasses at all times. The ends of wires protruding from electrical boxes are often at eye level and pieces of wire and insulation ejected from pliers and wire strippers can easily cause eye damage.
- Keep the safety glasses or goggles clean and protect them from being scratched or damaged.

Hearing Protection

- Wear hearing protection when necessary. Earmuffs and earplugs can reduce the noise level by up to 30db.

WORKPLACE HAZARDOUS MATERIALS INFORMATION SYSTEM (WHMIS)

INTRODUCTION

The **W**orkplace **H**azardous **M**aterials **I**nformation **S**ystem (WHMIS for short) is a comprehensive national system for safe management of hazardous chemicals, which is legislated by both the federal and provincial jurisdictions. WHMIS is an effort of labour, industry, and government that took several years to develop; it is unique in that it represents a consensus of these three groups.

The WHMIS legislation provides that workers must be informed about the hazards in the workplace and receive appropriate training to enable them to work safely. To accomplish this, WHMIS requires all suppliers (manufacturers, importers, packagers and processors) to label and prepare Material Safety Data Sheets (MSDSs) for products they make, import, package, or process that meet the hazard criteria set out in the Controlled Product Regulations under the federal *Hazardous Products Act*. The buyers of these controlled products must make sure that these products are correctly labeled and that MSDSs are available. Employers must set up worker education programs that instruct workers about the contents and significance of labels and MSDSs and how to work safely with hazardous materials.

In summary, WHMIS delivers the necessary information by means of:

- cautionary **labels** on containers of controlled products
- the provision of an **MSDS** for each controlled product (Material Safety Data Sheet)
- a worker **education** program. The ultimate goal is to create a safer workplace by providing workers with the knowledge and tools to enable them to work safely.

The Material Safety Data Sheets (MSDSs)

The material safety data sheet or "MSDS" is an important source of information for the worker at the worksite. It is one of the three basic elements of the WHMIS right-to-know-system.

The MSDS includes the following:

- relevant technical information on the substance
- a list of its hazardous ingredients, (*if it's a mixture*)
- chemical hazard data
- control measures such as proper engineering controls and personal protective equipment
- instructions in accident prevention while using the substance, specific handling, storage and disposal procedures
- emergency procedures to follow in the event of an accident

The information provided is expected to be comprehensive and must include what can reasonably be expected to be known about the material and the hazards it may present. MSDSs from different companies may not look the same but they should contain the same basic information.

LOCKOUT AND TAGGING

WHAT IS LOCKOUT AND TAGGING?

Lockout and tagging ensures that hazardous energy sources are under the control of each worker. Serious or fatal accidents can occur when people assume that machinery is turned off or made harmless—*but it isn't*.

Lockout is a procedure that prevents the release of hazardous energy. It often involves workers using a padlock to keep a switch in the “off” position, or to isolate the energy of moving parts. This prevents electric shock, sudden movement of components, chemical combustion, falling counterweights, and other actions that can endanger lives. Lockout is a physical way to ensure that the energy source is de-energized, deactivated, or otherwise inoperable.

Tagging tells others that the device is locked out, who has locked it out, and why. Tagged devices and systems must not be re-energized without the authority of those named on the tag.

INSTALLING LOCKOUT DEVICES After the circuit has been de-energized and locked out by the person in charge, each worker involved in the lockout must be protected by placing his or her personal lock on the isolating device.

Remember—even though the disconnect is already locked out, you are not protected until you attach your own personal safety lock. Each worker must retain his or her key while the lock is in place. Only the worker in charge of the lock should have a key.

Remember . . . Merely removing a fuse doesn't constitute lockout. The fuse could be easily replaced. The fuse should be removed and the box locked out. The lockout devices attached to one system should not prevent access to the controls and energy-isolating devices of another system.

Locks

Locks should be high-quality pin-type, key-operated, and numbered to identify user.



Multiple locks, lockout bars and scissors

When several workers or trades are working on a machine, you can add additional locks by using a lockout bar or scissors (pictured on right).



Each worker working on the machine can put their own lock on the bar or scissors. This way ALL of the locks have to be removed before the machine can be turned on.

You can add any number of locks by inserting another lockout bar into the last hole of the previous bar or through the holes on the scissors (see right).



LOCKOUT AND TAGGING (Continued)

TAGGING

Section 188 of the Construction Regulation (O. Reg. 213/91) requires each worker involved in a lockout operation to attach a durable tag to his or her personal lock.

The tag must identify:

- the worker's name
- the worker's employer
- the date and time of lockout
- the work area involved
- the reason for the lockout

A tag in itself offers no guarantee that a machine or system is locked out. It simply provides information. Signs must be placed on the system indicating that

- it must not be energized or operated
- guards, locks, temporary ground cables, chains, tags, and other safeguards must not be tampered with or removed until:
 - a) the work is complete, and
 - b) each worker has removed his or her personal lock.



Front

Back

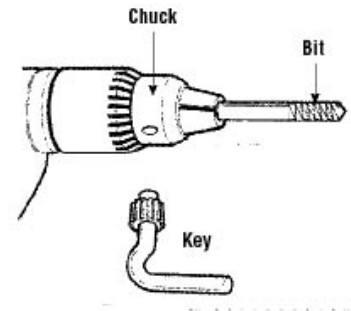
POWER DRILL AND CORDLESS DRILL

Personal Protection Equipment (PPE) Requirements

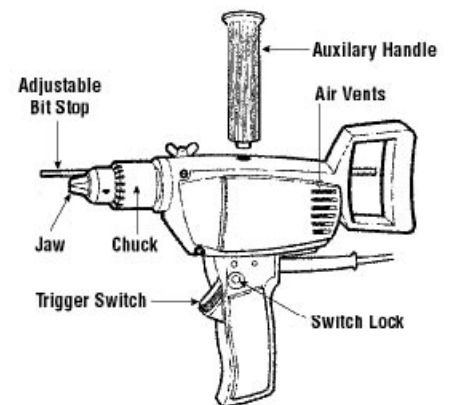
- Safety glasses or goggles

Operating Procedures

Follow manufacturers' instructions when selecting and using a bit or attachment, especially with unfamiliar drills or work.



- Select the bit or attachment suitable for the size of the drill and the work being done. .
- Follow manufacturers' instructions when selecting and using a bit or attachment, especially with unfamiliar drills or work.
- Ensure that the bit or attachments are properly seated and tightened in the chuck.
- Use only bits and attachments that turn true (are not bent or twisted).
- Use the auxiliary (second) handle for larger work or continuous operation.
- Wear safety glasses or a face shield. Keep drill air vents clear to maintain adequate ventilation.
- Keep drill bits sharp.
- Keep all cords clear of the cutting area during use. Inspect for damage before each use.
- Disconnect power supply before changing or adjusting bit or attachments.
- Tighten the chuck securely. Remove chuck key before starting drill.
- Secure work piece being drilled to prevent movement.
- Slow the rate of feed just before breaking through the surface.
- Drill a small "pilot" hole before drilling large holes.



Working with small pieces

- Clamp stock so work will not twist or spin.
- Do not drill with one hand while holding the material with the other.

Working with powered hand drills

- Follow the manufacturer's recommended maximum drilling capacities.
- Use a hole saw cutter only with the pilot drill in place.
- High-speed steel (HSS) bits may require cooling or 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 work piece.
- Never reach under or around stock being drilled.
- Always keep proper footing and balance.
- Do not raise or lower the drill by its power cord.
- Avoid use in wet or muddy locations. Use a cordless drill instead.
- Use less force to drill into hard material. Reduce drill speed if possible.

POWER DRILL AND CORDLESS DRILL (Continued)

Working with Cordless Drills

It is important to learn to use your cordless drill properly; the following tips will help you do so:

- Read the safety section of your drill's instruction manual.
- Avoid wearing loose sleeves or clothing.
- Beware of hot drill bits.
- Wear safety goggles. Splintering pieces of wood or other material may be projected out from your work area.
- Look before you drill. Buildings that comply with the National Electric Code should have metal plates covering internal wall wiring, but when drilling into a floor or ceiling, carefully inspect the area for live electrical wires.
- Regularly check your drill and charger for loose, broken or melted parts.
- Securely clamp your project to a table or other stable work area.
- Keep your drill dry.

ACETYLENE-AIR TORCH

Personal Protection Equipment (PPE) Requirements

- Safety glasses or goggles

Description

The acetylene-air torch is the most commonly used torch used for soldering copper pipe. It mixes air in the torch handle with Acetylene gas which when lit creates a very hot blue flame. Acetylene gas is extremely EXPLOSIVE and should be handled with care. It has a unique odor when it leaks from a torch. If you should smell this odor do NOT operate the torch. Do NOT allow anyone in the area to operate the torch. Notify your teacher IMMEDIATELY.

Students are responsible for implementing the following safety procedure EVERY time they wish to use the torch.

If a student has any doubt as to whether the torch is safe to operate they should inform the teacher immediately.

To begin operation:

1. Lift torch handle and hose from the red regulator.
2. Examine the grey round valve handle and turn it to the right to ensure that it is closed.
3. There is a small knob on the handle turn it to the left and then right to make sure it is operating and that the gas is shut off.
4. Examine the hose to make sure that there are no splits or holes in it.
5. Twist the nuts back and forth where the hose connects to the handle and at the regulator to ensure it is tightly connected.
6. If in doubt as to the tightness of the hose connections spray a soap and water mix on them and watch for bubbles on the connections.
7. Hold the rough brass top of the torch handle in one hand and the tip of the torch in the other and turn the tip to the left until it is removed from the handle.
8. Examine both the top of the handle where the tip was and the bottom of the tip to ensure that nothing is stuck into either end.
9. Replace the tip into the top of the handle and turn to the right until the tip is tight into the handle.
10. Turn the Red Regulator knob to the left until it is loose. (but not off)
11. Turn the grey round valve handle to OPEN (left) 1 turn.
12. Turn the Red Regulator knob to the right until the dial on the regulator points to 5.
13. Gas is now turned on as far as the handle.

ACETYLENE-AIR TORCH (Continued)

To light, adjust and shut off:

1. Take a striker in one hand and using your thumb drag the flint end over rough end to create a spark.
2. Once you can create a spark with one hand, turn the gas knob on the handle to the left slowly until you hear a small hissing sound of gas escaping from the tip.
3. Place the tip over the striker and light the torch.
4. Adjust the flame up until you have a blue flame of about 3 centimetres.
5. Never turn the knob on the handle full open before lighting. It is dangerous to let out too much gas.
6. To shut off the flame turn the knob on the handle to the right. You should hear a popping sound, this is normal.

To close the torch:

- 1 Turn the grey round valve **to close (right)**
- 2 Open the small knob on the handle to the left until the gauge reads 0.
- 3 Close the small knob on the handle to the right.
- 4 Turn the Red Regulator knob to the left until it turns freely.
- 5 Hang up the hose and handle over the regulator.

GENERAL SAFETY FOR PNEUMATIC TOOLS

Pneumatic tools are powered by compressed air. Common types of these airpowered hand tools that are used in industry include buffers, grinders, drills, chipping hammers, riveting guns and wrenches.

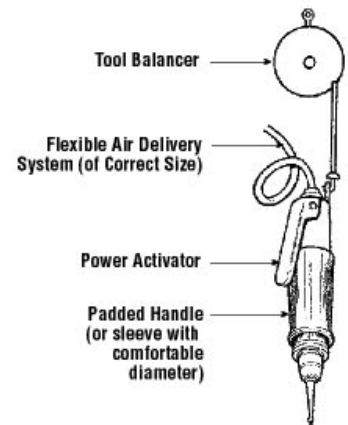
Personal Protection Equipment (PPE) Requirements

- Wear safety glasses or a face shield and, where necessary, safety shoes or boots and hearing protection.
- NIOSH respirator

Operating Procedures

Pneumatic Tools

- Read instruction safety sheet for specific tool carefully.
- Before operating any tool or machine, competency must be displayed to the teacher and be signed off by the teacher in the equipment passport.
- Make sure you understand instructions before attempting to use pneumatic tools. Ask questions of your teacher if you have any doubts about doing the work safely.
- Some pneumatic tools by the nature of their purpose will produce particulate matter (dust, metal debris etc). Always wear a NIOSH approved respirator for the materials being worked with.
- Post warning signs where pneumatic tools are used. Set up screens where nearby workers may be exposed to flying fragments, chips, a
- Ensure that the compressed air supplied to the tool is clean and dry corrosive fumes can damage a tool. An in-line regulator filter and lubricator.
- Use only the attachments that the manufacturer recommends for the tool.
- Be careful to prevent hands, feet, or body from injury in case the tool breaks.
- Reduce physical fatigue by supporting heavy tools with a counter-balance.



Air Hoses

- Use the proper hose and fittings of the correct diameter.
- Use hoses specifically designed to resist abrasion, cutting, crushing and failure from continuous flexing.
- Choose air-supply hoses that have a minimum working pressure rating of 1035 kPa (150 psi) or 150% of the maximum pressure produced in the system, whichever is higher.
- Check hoses regularly for cuts, bulges and abrasions. Inform teacher immediately if defective.
- Blow out the airline before connecting a tool. Hold hose firmly and blow away from yourself and others.
- Make sure that hose connections fit properly and are equipped with a mechanical means of securing the connection (e.g., chain, wire, or positive locking device).

- Install quick disconnects of a pressure-release type rather than a disengagement type. Attach the male end of the connector to the tool, NOT the hose.
- Do not operate the tool at a pressure above the manufacturer's rating.
- Turn off the air pressure to hose when not in use or when changing power tools.
- Do not carry a pneumatic tool by its hose.
- Avoid creating trip hazards caused by hoses laid across walkways or curled underfoot.
- Do not use compressed air to blow debris or to clean dirt from clothes.

Specific Hazards

- Cleaning with compressed air is dangerous. You should not use the compressed air for cleaning.
- Compressed air may be used only if no alternate method of cleaning is available. The nozzle pressure **must** remain below 207 kPa (30 psi). Personal protective equipment and effective chip guarding techniques must be used.
- When using compressed air to blow off a car in preparation for paint use a lint free cloth to loosen surface dust and be sure to perform this task in a well ventilated area wearing all appropriate PPE.



BEAD ROLLER

Personal Protection Equipment (PPE) Requirements

- Always wear work gloves to protect your hands from sharp metal.



Operating Procedures

- Make sure you understand instructions before attempting to use any tool
Ask questions of your teacher if you have any doubts about doing the work safely.
- Use bead rollers only after proper instruction and training.
- Never over tighten the rollers on the bead roller.
- On intricate beads use multiple passes increasing pressure after each pass until the desired bead is created.
- Apply a thin layer of oil to the metal to aid in the creation of a bead.
- Always ask for help when working with large pieces.
- Always use the bead roller in an area without obstructions.
- Never operate a bead roller without proper instruction and training.

AIR CUT-OFF SAW

Personal Protection Equipment (PPE) Requirements

- Wear glasses, hearing protection, respiratory protection, work gloves and protective clothing for the operation being completed.



Operating Procedures

- Make sure you understand instructions before attempting to use the air cut-off saw. Ask questions of your teacher if you have any doubts about doing the work safely.
- Always use the air cut-off saw with the guard installed.
- Never use the air cut-off saw with a damaged disc.
- Never force the disc through the work. Use light steady pressure allowing the disc to cut.
- Always allow for the thickness of the disc when marking your work. Make sure you cut to the correct side of the line to avoid too large of a gap after cutting.

Specific Hazards

- Be aware of where the sparks from cutting are going. Always provide protection for surrounding glass, paint and other students.

AIR SAWS

Personal Protection Equipment (PPE) Requirements

- Wear safety glasses.



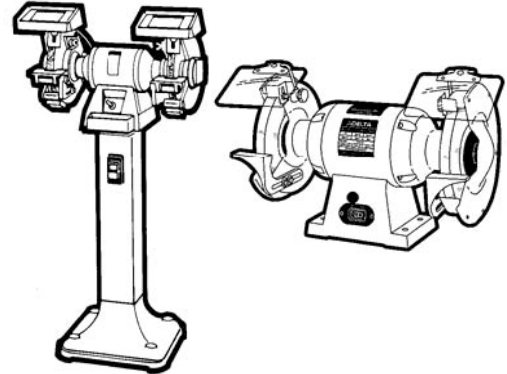
Operating Procedures

- Before operating any tool or machine, competency must be displayed to the teacher and be signed off by the teacher in the equipment passport.
- Make sure you understand instructions before attempting to use the air saw. Ask questions of your teacher if you have any doubts about doing the work safely.
- Check to make sure that the blade is of the proper pitch for the job and that the teeth point **away** from the handle.
- Make sure the blade is tight in the chuck and visually inspect the blade for cracks.
- If possible, mount the stock in the vice so that the cut will be about 1/4 in. (6 mm) from the vice jaws.
- When using an air saw, assume a comfortable stance, standing erect with the left foot slightly ahead of the right foot.
- Start the saw cut just outside and parallel to a previously scribed line.
- Note: File a V-shaped nick at the starting point to help start the saw blade at the correct spot.
- After the cut has started, apply steady pressure only. Excess pressure will tend to jamb the blade possibly causing it to shatter. When cutting thin material, hold the saw at an angle to have at least two teeth in contact with the work at all times. When nearing the end of the cut, slow down to control the saw as it breaks through the material.

GRINDERS – BENCH AND PEDESTAL

Personal Protection Equipment (PPE) Requirements

- Eye, ear and face protection
- Safety boots, where required
- Respiratory protection may be required, depending on the work



Operating Procedures

- Before operating any tool or machine, competency must be displayed to the teacher and be signed off by the teacher in the equipment passport.
- Make sure you understand instructions before attempting to use any tool or machine. Ask questions of your teacher if you have any doubts about doing the work safely.
- Ensure all the guards are in place and secure before using a grinder.
- Adjust tool rests to within 3 mm (1/8 in.) of wheels. Never adjust rests while wheels are moving. Work rest height should be on horizontal centre line of the machine spindle.
- Stand to one side of the grinder until the wheel reaches operating speed.
- Bring work into contact with the grinding wheel slowly and smoothly, without bumping.
- Apply gradual pressure to allow the wheel to warm up evenly. Use only the pressure required to complete a job.
- Move the work back and forth across the face of the wheel. This prevents grooves forming.
- Wheels are made only for grinding certain items. Do not grind rough forgings on a small precision grinding wheel
- Dress wheels regularly. Do frequent, light dressings rather than heavy dressings.
- Support dressing tools to apply leverage without undue effort. With revolving cutter dressing tools use the lugs as anchors.
- Replace worn wheels you cannot dress.
- Ensure the grinder speed does not exceed the operating speed marked on the wheel.
- Visually inspect wheels for possible damage before mounting.

Specific Hazards

- Do not use a wheel that has been dropped.
- Do not grind wood, plastics and non-iron metals on ordinary wheels.
- Do not leave grinding wheels standing in liquids. The liquid can cause balance problems.
- Do not grind on the side of a regular wheel.
- Never operate without the grinder shield in place.

HORIZONTAL MILLING MACHINE

Used mainly for facing, end milling and drilling operations. This type of machine is very versatile and its spindle is normally in a horizontal plane.

Operating the horizontal milling machine is not much different from operating the vertical milling. However, when using the over-arm support and arbor driven cutters, a new set of operating principles needs to be taken into consideration to ensure good work practice and a safe working environment.

Personal Protection Equipment (PPE) Requirements

- Safety glasses
- Coverall/Apron
- Protective footwear

Operating Procedures

- Safety glasses shall be worn when operating the milling machine.
- Before operating the horizontal milling machine you should be properly trained in its safe use operation.
- Ensure that all guards are in place before attempting to operate the machine.
- Ensure that the milling machine has a start/stop button within easy reach of the operator.
- Make sure that the work holding device is mounted firmly to the machine table and the work piece is held solidly.
- Care should be taken to make sure the cutter is mounted securely to the spindle or arbor before making a cut.
- When setting up or removing a milling cutter from its holder or arbor, proper precautions should be taken to avoid injury.
- To avoid injury to you hands move the machine table to a safe distance from the cutter while setting up the work.
- Always use a coarse tooth cutter instead of a fine tooth when possible. A coarse tooth cutter has a larger clearance area for the chips and will not clog up quickly.
- When setting up a cutter on the arbor always make sure that the cutter is keyed to the arbor.
- When assembling or disassembling a tool on the arbor setup using the over-arm support, always leave the support in place when loosening or tightening the arbor nut.
- Tighten the arbor nut by hand with a wrench never use a hammer to strike the wrench to tighten the arbor nut.



Specific Hazards

- Do not move the operating levers without knowing what they control and what action is going to take place.
- Do not use a blunt or chipped cutter to machine work-piece.
- Keep hands, brushes and rags away from the rotating milling cutter.
- Keep floor around the milling machine free of oil and grease.

HORIZONTAL MILLING MACHINE (Cont'd)

- Do not use excessively heavy cuts or feeds as it can cause the cutter to break.
- Never attempt to make any adjustments or measurements to the work piece set-up until the milling machine is completely stopped.
- Always ensure that the cutting tool is sharp, in good working condition and is safe to use.
- Never reach over or near a rotating cutter.
- Over tightening the arbor nut can crack the nut or strip the threads.
- Tightening the arbor nut without the over arm in place will ruin the arbor.
- Do not leave the machine unattended while it is running.
- While the machine is in operation keep hands away from the rotating cutter.
- Use a brush **only** to clean metal cuttings from work piece once the cutter has stopped rotating.

VERTICAL MILLING MACHINE

Used mainly for facing, end milling and drilling operations.

Personal Protection Equipment (PPE) Requirements

- Safety glasses
- Coverall/Apron
- Protective footwear

Operating Procedures

- Safety glasses shall be worn when operating the vertical milling machine.
- Gloves should not be worn when operating the milling machine.
- Before operating the milling machine you should be properly trained in its safe operation.
- Ensure that the milling machine has a start/stop button within easy reach of the operator.
- Ensure that the work piece and cutter are mounted securely before making a cut.
- When setting up or removing a milling cutter from its holder, proper precaution should be taken to avoid getting injured.
- To avoid injuring your hands move the machine table as far as possible away from the cutter while setting up or measuring work.
- Do not attempt to setup, measure or adjust work-piece until the cutter is completely stopped.
- Do not use excessively heavy cuts or feeds as it can cause the cutter to break.



Specific Hazards

- Use a brush **only** to clean metal cutting from work-piece once the cutter has stopped rotating.
- Do not move the operating levers without knowing what they control and what action is going to take place.
- Do not use a blunt or chipped cutter to machine work-piece.
- Keep hands, brushes and rags away from the revolving milling cutter.
- Keep floor around the milling machine free of oil and grease.
- Make sure the cutting tool is properly tightened in the holder.
- Do not leave machine unattended while it is running.
- Ensure that all guards are in place before attempting to operate the machine.

ENGINE LATHE

ENGINE LATHE:

Used mainly for turning cylindrical shaped work-pieces.

Personal Protection Equipment (PPE) Requirements

- Safety glasses
- Coverall/Apron
- Protective footwear

Operating Procedures:

- Safety glasses shall be worn when operating the lathe.
- Do not operate the lathe without proper instructions from your instructor.
- Do not operate the lathe until you are familiar with all the controls and levers.
- To avoid injury only one person should operate a machine at anytime. Observers should be at a safe distance.
- Ensure that the lathe has a start/stop button within easy reach of the operator.
- Remove the chuck key before turning on the lathe.
- Ensure that the headstock, tailstock, tool and tool holder are properly secured before operating.
- Ensure your material is secure in the chuck before switching on the machine.
- Ensure all tool bits are sharp and properly secured at the correct height and location before attempting to remove any material from the work piece.
- Do not operate the lathe until you have obtained the proper speeds and feeds for the type of material to be machined.
- Ensure you have the proper cutting tool for the type of material and type of machining operation to be performed.
- Do not lean on the lathe while it is in operation.
- Ensure that your body is located to the side of the cutting tool while it is in operation.
- Be sure to have a firm footing or stance when operating the lathe.
- Do not attempt to remove a large depth of cut from material at a single pass.
- When turning a small diameter work piece over a long length, use a work steady attachment and a rotating centre.
- When turning a work piece that overhangs 4 inches or more from the chuck, a rotating centre must be used to secure the work piece to avoid it from slipping out of the chuck.



Specific Hazards

- To avoid any injury no loose clothing, rings, watches or any other jewelry should be worn when operating the lathe.
- To avoid any injury stop the lathe and move the tool to a safe location before taking any measurements on the work piece.
- Keep the floor around the lathe clean and clear of tools, oil and metal chips.
- Turn the lathe off immediately if you hear any unusual sound or if there is excessive vibration.
- Remove cut off material or metal chips with a brush **never** use your hands.
- Compressed air should **never** be used to clean the lathe.

HORIZONTAL BAND SAW

Personal Protection Equipment (PPE) Requirements

- Safety Glasses
- Gloves for material handling only.
- Protective Footwear
- Apron/coverall

Operating Procedures

- Safety glasses shall be worn when operating the horizontal band saw.
- Operate only after you have received instruction.
- Be sure that all guards are in place and operating correctly.
- Gloves should not be worn when operating equipment.
- One person at a time operating the machine, observers at a safe distance.
- If the material requires coolant, be sure that the system is working and that the correct coolant is used.
- Place material in the vise, supporting long pieces with a floor stand.
- Lower the saw blade until it just clears the work. Keep it in this position by closing the hydraulic valve.
- Adjust the roller guide brackets until they just clear both sides of the material to be cut.
- Hold a steel rule against the edge of the saw blade and move the material until the correct length is obtained.
- Tighten the vise and recheck the length from the blade to the end of the material to make sure work has not moved. Always allow 1.5mm for each 25mm thickness you are cutting.
- Raise the frame slightly so the blade is off the work, open the hydraulic feed lever and then start the machine.
- Lower the blade slowly until it just touches the work, adjust feed rate so blade does not bounce or plunge into work when starting the cut.
- Keep hands away from cutting area and brush away chips only when the machine is turned off.
- When the cut has been completed, the machine will shut off automatically.



Specific Hazards

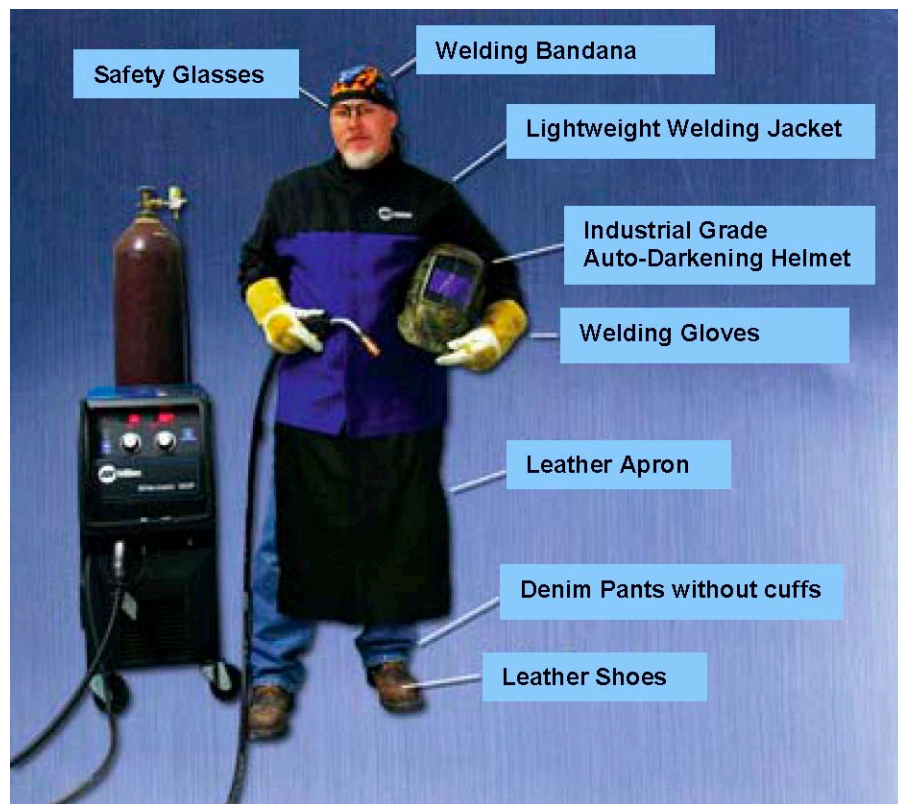
- Remove jewellery, eliminate loose clothing, and confine long hair.
- Keep the work area and floor clean and free of oil and grease.
- Never attempt to mount, measure, or remove work unless the saw is stopped.
Guard long material at both ends to prevent anyone from coming in contact with it or tripping over it.
- When sawing thin pieces, hold the material flat in the vise to prevent the saw teeth from breaking.
- When holding short work in a vise, be sure to place a short piece of the same thickness in the opposite end of the vise. This will prevent the vise from twisting when it is tightened.

WELDING

Personal Protection Equipment (PPE) Requirements

- Always wear cotton clothing; the shirts should be buttoned up to the neck, long sleeves and no open pocket.
- Welding helmet, with proper lens shade for the process.
- Safety glasses should be worn under the helmet.
- Welder's cap or bandana, to protect the welder from sparks that can get behind the welding helmet and into the welder's hair.
- Gloves, of strong leather, with long gauntlets to protect the hands and wrists from arc rays.
- Fire resistant leather apron, jacket or coveralls, should be worn to protect the welder from sparks, heat and light, that is given off during the welding process.
- High safety shoes with steel toes should be worn.

SAFETY WEAR



Courtesy www.millerwelds.com/educational/articles/images

WELDING (Continued)

Operating Procedures

Start-up Procedures

- Obtain instructions and the teacher's permission before operating any Welding Equipment.
- Check the condition of the workstation, welding equipment, and personal protective equipment.
- Put up adequate screening to protect people in the immediate area.
- Ensure proper ventilation.
- Make sure all connections are correctly attached.
- Check for gas leakage.

Shut-down Procedures

- Carefully remove and cool all hot welding materials.
- Turn off power supply to the welding unit.
- Hang all cables and store away all equipment.
- Clean up work station.
- Turn off gas lines.

ALWAYS KNOW THE LOCATION OF THE NEAREST FIRE EXTINGUISHER, FIRE EXIT, FIRE BLANKET, AND FIRE ALARM, BEFORE YOU START WORKING

Websites for more information on safety:

www.lincolnelectric.ca

www.aws.org

www.nadddonline.org

SHIELDED METAL ARC WELDING (SMAW)

SMAW is also known as arc welding, stick welding, and stick electrode welding.

Personal Protection Equipment (PPE) Requirements

- Welding helmet
- Safety glasses
- Welder's cap or bandana
- Leather gloves
- Leather apron, jacket or coveralls
- High safety shoes



Operating Procedures

- Obtain instructions and the teacher's permission before operating any welding equipment.
- Ensure you are dressed properly. (PPE – welding helmet and cap or bandana, safety glasses, leather gloves leather apron, and safety shoes).
- Locate the welding power supply and know where the power switch to the unit is located.

In case of an emergency the machine can be shut off.

- Ensure the area around the machine and your workspace is dry.
- Remove all flammable materials from around your workspace.
- Ensure fire fighting materials are close at hand (fire extinguisher, water, and fire blanket).
- Set the welding polarity and current on the welding machine.
- Set out the welding cable and attach the lead to the work securely.
- Make sure you have an empty container at hand for the stubs.
- Select the electrode for your job.
- Turn on the machine, then insert the electrode in the holder; flip down your helmet, strike an arc and begin to weld.

Specific Hazards

- SMAW should not be done in rain or snow; or when the base metal is below -20 degrees Celsius.
- Remove all jewellery from your person before welding.
- Never strike an arc on a compressed gas cylinder.
- Never weld where gas cylinders are stored.
- Never weld while standing on a wet floor.
- Don't use defective welding equipment.
- Don't work in areas with poor ventilation.
- Don't weld parts that are coated with zinc or aluminum.
- Remove all combustible materials from your workspaces before welding.
- Do not weld on any container suspected of holding flammable substances.

ALWAYS KNOW THE LOCATION OF THE NEAREST FIRE EXTINGUISHER, FIRE EXIT, FIRE BLANKET, AND FIRE ALARM, BEFORE YOU START WORKING

GAS METAL ARC WELDING (GMAW)

GMAW is also known as MIG or wire feed welding

Personal Protection Equipment (PPE) Requirements

- Welding helmet
- Safety glasses
- Welder's cap or bandana
- Leather gloves
- Leather apron, jacket or coveralls
- High safety shoes



Operating Procedures

- Obtain instructions and the teacher's permission before operating any welding equipment.
- Ensure you are dressed properly. (PPE – welding helmet and cap or bandana, safety glasses, leather gloves leather apron, and safety shoes).
- Locate the welding power supply and know where the power switch to the unit is located. In case of emergency the machine can be shut off.
- Ensure the area around the machine and your works pace are dry.
- Remove all flammable materials from around your workspace.
- Ensure fire fighting materials are close at hand.
- Set the power supply and adjust the voltage and current.
- Check the wire feeder, and the wire feeding gun; ensure you are using the proper shielding gas, and, electrode filler wire.
- Turn on the power switch on the welding machine and squeeze the button on the gun for a few seconds, to remove any air from the hose and fill it with the shielding gas.
- Feed the wire and ensure the proper tension on the feed rolls. (Manufacturer's information on data sheet attached to the machine).
- Adjust the shielding gas.
- Attach the lead on the work piece.
- Set the wire speed by adjusting the amperage control, the arc voltage and amperage can be fine tuned by running a bead on a piece of scrap metal.
- The electrode must not stick out more than 1 cm from the gun.
- Aim the gun and put your welding helmet on; touch the work piece hold the gun at an angle between 5 and 10 degrees, from the vertical position.
- Squeeze the trigger on the gun, and begin to weld.

Specific Hazards

- SMAW should not be done in rain or snow; or when the base metal is below -20 degrees Celsius.
- Remove all jewellery from your person before welding.
- Never strike an arc on a compressed gas cylinder.
- Never weld where gas cylinders are stored.
- Never weld while standing on a wet floor.
- Don't use defective welding equipment.
- Don't work in areas with poor ventilation.
- Don't weld parts that are coated with zinc or aluminum.

