





























- While ripping, be sure to feed the material from the infeed end of the saw guard, never from the kickback end. Make no exception to this rule.
- Before making any special adjustment, the saw must be fully stopped.
- Before starting the motor, make sure everything is clear of the cutter.
- Remove scraps from the path of the radial-saw blade with a piece of wood while the saw is at a dead stop.
- Stand to one side and keep your hands away from the direction of travel of the radial-saw blade.
- A radial arm saw is used primarily for crosscutting stock. Use a table saw for ripping, when possible.

### Drill Press

- Eye protection must be worn at all times.
- Restrain loose clothing and hair. Remove hand jewelry.
- Select an appropriate speed for the bit and material (see chart below), fast for small holes, slow for large ones. Too slow is better than too fast. Be sure to replace guards if removed for a speed change.
- Tighten the bit and remove the chuck key.
- Clamp the material to the table, when possible. All small work must be secured. Be cautious when drilling thin stock like sheet metal.
- Use cutting oil when drilling metal.
- If the material becomes caught by the bit, step back and turn off the machine. Do not reach for the stock if the stock is spinning with the drill.

Materials	SFM* Range		Drill Diameter			
			1/4"	1/2"	1"	1½"
Aluminum and its Alloys	200	300	3,820	1,910	955	637
Brass and Bronze (Ordinary)	150	300	2,292	1,146	573	382
Bronze (High Tensile)	70	150	1,070	535	267	178
Die Castings (Zinc Base)	300	400	4,584	2,292	1,146	764
Iron-Cast (Soft)	100	150	1,528	764	382	255
Cast (Medium hard)	70	100	1,070	535	267	178
Hard Chilled	30	40	458	229	115	76
Malleable	80	90	1,222	611	306	204
Magnesium and its Alloys	250	400	3,820	1,910	955	637
Monel Metal or High-Nickel Steel	30	50	458	229	115	76
Plastics or Similar Materials (Bakelite)	100	300	1,528	764	382	255
Steel - Mild (.2 carbon to .3 carbon)	80	110	1,222	611	306	204
Steel (.4 carbon to .5 carbon)	70	80	1,070	535	267	178
Tool (1.2 carbon)	50	60	764	382	191	127
Forgings	40	50	611	306	153	102
Alloy - 300 to 400 Brinell	20	30	306	153	76	51
High Tensile (Heat Treated)						
35 to 40 Rockwell C	30	40	458	229	115	76
40 to 45 Rockwell C	25	35	382	191	96	64
45 to 50 Rockwell C	15	25	229	115	57	38

Materials	SFM* Range		Drill Diameter			
			1/4"	1/2"	1"	1½"
50 to 55 Rockwell C	7	15	107	53	27	18
Stainless Steel						
Free Machining Grades	30	80	458	229	115	76
Work Hardening Grades	15	50	229	115	57	38
Wood (soft)	300	400	4,584	2,292	1,146	764

\*SFM = surface feet per minute

\*\*Based on RPM = SFM\*3.82/diameter

### Planer/Surfacer

- Operate only after you have received instruction.
- Wear proper clothing while operating the machine. Remove jewelry, eliminate loose clothing, and confine long hair.
- Wear safety glasses or goggles.
- Make sure guards are in place and operative.
- Do not plane two or more pieces of stock with various thicknesses. The stock could be kicked out. Plane only one thickness at a time. (Note: Some planers have sectional feed rollers, which could allow planing various thicknesses. Instructors/supervisors, make the appropriate decision.)
- Keep your fingers from under the stock as it is fed through the planer.
- Stock must be at least 15 inches long or greater than the distance between the centers of infeed and outfeed rollers. True one face of the stock on the jointer before planing.
- Always make sure the machine is turned off before leaving.
- Make sure no one is behind the machine while it is operating.
- Always stand erect and to one side of work being planed.
- Do not look into the planer as the board passes through.
- Plane no thickness less than three-eighths inch.
- Stock that is 8 inches in width or less should not be planed more than one-sixteenth inch per cut.
- Stop the planer and run all pieces through, reducing all to the same thickness.
- With a rule, measure the thickness of the stock at the thickest point.
- Place the stock on the bed of the planer with the working face down and the grain turned so that the knives will cut with the grain. Hold the board flat on the feed-in table when starting the cut. The knives on a single-surface planer cut on the upper side and revolve in a direction opposite to the direction of feed.
- Never attempt to plane cross-grain.

### Jointer

- Operate only after you have received instruction.
- Wear proper clothing while operating the machine. Remove jewelry, eliminate loose clothing, and confine long hair.
- Wear safety glasses or goggles.
- Make sure the guard is in place and operating freely.
- Always check the depth of cut before starting the machine.
- Joint no thickness greater than one-quarter inch.
- Keep your fingers well away from the cutter head and never placed on the stock above the cutter head.
- Stock must be at least 18 inches long.
- Always use a push stick to push the end of the stock across the cutter head.
- Always make sure the machine is turned off before leaving.
- Make sure everyone is from behind machine while it is operating.

- Always stand erect and to one side of work being jointed.
- Never attempt to joint cross-grain.

### *Wood Lathe*

- Operate only with the instructor's/supervisor's permission and after you have received instruction.
- Remove jewelry, eliminate loose clothing, and confine long hair.
- Make sure all guards are in place and operating correctly.
- Always use proper eye protection.
- The tool rest must be close to the work when cutting tools are being used.
- The cutting tools must be kept sharp.
- Do not feel for smoothness of work while machine is running.
- Work must be centered, balanced, and secured.
- The tool rest must be removed while sanding.
- Examine set up and turn work by hand before turning on the power.
- Shut off the power while cleaning the machine.

### *Power Miter Saw*

- Operate only after you have received instruction.
- Wear proper clothing while operating the machine. Remove jewelry, eliminate loose clothing, and confine long hair.
- Wear a face shield, goggles, or safety glasses.
- Make sure all guards are in place and are operating properly.
- Be sure the power is disconnected before making angle adjustments or changing blades.
- Always hold the work firmly against the fence and table.
- Never reach across your body to operate the saw.
- Allow the motor to reach full speed before starting to cut.
- Apply smooth, steady pressure to the motor when cutting.
- Lock the slide (if equipped) when not in use. When using the slide, start your cut at the front of the work and push the saw into the work.
- Use the brake to stop the blade before removing scraps or chips from the work area.

### *Portable Jig Saw*

- Operate only after you have received instruction.
- Wear proper clothing while operating the machine. Remove jewelry, eliminate loose clothing, and confine long hair.
- Always use proper eye protection.
- Inspect the cord for damage. Repair or replace damaged cords before use.
- Do not abuse the cord. Never carry the tool by its cord or yank the cord to disconnect the tool from the receptacle. Keep the cord away from heat, oil, and sharp edges.
- Make sure all guards are in place and are operating correctly.
- Make sure the blade is the correct type for the material and that it is tightly clamped in the chuck.
- Be sure the switch is off before connecting to the power source.
- Use vises or clamps to securely hold the material to be cut.
- Keep cutting pressure constant; do not force the blade into the work.
- Always keep the base tightly against the materials being cut.
- Do not set the saw down on the bench until it has stopped.
- If the blade is in the tool, be sure to lay the tool on its side.

## *Circular Saw*

- Operate only after you have received instruction.
- Wear proper clothing. Remove jewelry, eliminate loose clothing, and confine long hair.
- Make sure all guards are in place and operating properly.
- Wear a face shield, goggles, or safety glasses.
- Inspect the cord for damage. Repair or replace damaged cords before use.
- Do not abuse the cord. Never carry the tool by its cord or yank the cord to disconnect the tool from the receptacle. Keep the cord away from heat, oil and sharp edges.
- Make sure the telescoping guard returns automatically to cover the blade after each cut. Test before operation.
- Check the base setting for the proper depth of cut.
- Make sure the power cord is clear of the blade.
- Make sure your hands are away from the blade before starting. Do not support material with your leg or foot.
- Be sure the material you are cutting is adequately supported.
- Start the saw away from the work. Do not start the cut until the blade has reached full speed.
- Advance the saw slowly, straight through the work. Do not twist or turn.
- If the saw blade binds or smokes, stop cutting immediately.
- The blade should be extended below the work until the blade gullets clear the material.
- Do not set the saw down until the blade stops.

## *Woodworker's Vise*

- Keep the vise tight on the bench. A loose vise is inefficient.
- Keep your work clean. Never oil or grease a woodworker's vise.
- Do not overtighten.
- Normal handle leverage holds jaws securely. Do not hammer the handle. Never pound to tighten or loosen. Do not use a handle extension.
- Avoid using a woodworker's vise to clamp glue joints. Dried glue on a vise screw, etc., makes vise operation difficult.
- Do not use the vice to hold metal objects.

## *Router*

### **Read and understand the operator's manual.**

- Wear safety glasses or goggles, or a face shield (with safety glasses or goggles), and appropriate hearing protection.
- Disconnect the power supply before making any adjustments or changing bits. Inspect bits carefully before installing
- Inspect the cord for damage. Repair or replace damaged cords before use.
- Do not abuse the cord. Never carry the tool by its cord or yank the cord to disconnect the tool from the receptacle. Keep the cord away from heat, oil and sharp edges.
- Ensure that the bit is securely mounted in the chuck and the base is tight.
- Put the base of the router on the work, template or guide. Make sure that the bit can rotate freely before switching on the motor.
- Secure the stock you are working on. Never rely on yourself or a second person to support or hold the material. Sudden torque or kickback from the router can cause damage and injury.
- Before using a router, check the stock thoroughly for staples, nails, screws, or other foreign objects.
- Keep all cords clear of the cutting area.
- Keep both hands on the router handles always, until the motor has stopped. Do not set the router down until the exposed router bit has stopped turning.
- Do not overreach. Keep proper footing and balance.
- When inside routing, start the motor with the bit above the stock. When the router reaches full power, lower the bit to the required depth.

- When routing outside edges, guide the router counter-clockwise around the work.
- When routing bevels, moldings and other edge work, make sure the router bit is in contact with the stock to the left of a starting point and is pointed in the correct cutting direction.
- Feed the router bit into the material at a firm, controlled speed.
- With softwood, you can sometimes move the router as fast as it can go.
- With hardwood, knotty and twisted wood, or with larger bits, cutting may be slow.
- The sound of the motor can indicate safe cutting speeds. When the router is fed into the material too slowly, the motor makes a high-pitched whine. When the router is pushed too hard, the motor makes a low growling noise.
- When the type of wood or size of the bit requires going slow, make two or more passes to prevent the router from burning out or kicking back.
- To decide the depth of cut and how many passes to make, test the router on scrap lumber similar to the work.

### *Palm Sander*

- Do not sand paints that contain lead.
- Use safety glasses and a dust mask to avoid breathing any dust.
- Wear proper clothing while operating the machine. Remove jewelry, eliminate loose clothing, and confine long hair.
- Disconnect the plug from the power source before making any adjustments, changing accessories, or storing the sander
- *Do not* wet sand with the sander. Liquids may enter the motor housing and cause electric shock.
- *Do not use* torn sandpaper. Damage to the rubber backing pad may occur.

### *Belt Sander*

- Do not sand paints that contain lead.
- Use safety glasses and a dust mask to avoid breathing any dust.
- Wear proper clothing while operating the machine. Remove jewelry, eliminate loose clothing, and confine long hair.
- Inspect the cord for damage. Repair or replace damaged cords before use.
- Do not abuse the cord. Never carry the tool by its cord or yank the cord to disconnect the tool from the receptacle. Keep the cord away from heat, oil and sharp edges.
- Disconnect the plug from the power source before making any adjustments, changing accessories, or storing the sander
- Be sure that the sander is turned off before starting. Start the sander only when over the work.
- Hold securely when starting the sander, because it will pull away from the operator.
- Keep the cord clear of the sander.
- When operating the sander, check that the belt remains centered and tracking smoothly on the rollers. Adjust as necessary.
- Always keep the sander moving back and forth over the work.
- Be sure the sander is at a complete stop before setting on the workbench.

### *Pneumatic Nail Gun*

#### **Read and understand the operator's manual.**

- Always wear safety glasses.
- Do not touch the trigger unless firing the tool against a work piece.
- Use extreme caution when using an air tool around other students.
- Never point the tool at anyone. Treat the tool like a firearm and assume it is loaded.
- Never load the gun while it is connected to a compressor.
- Disconnect the air hose before clearing a jam or making adjustments.
- Use manufacturer's specified pressures for the tool.

- Keep your free hand safely out of the way of the tool.
- Always know what type of trigger mode the nail gun is equipped with.
- Secure the hose when working on scaffolding to prevent the weight of the hose from dragging the tool off the scaffold if you set the tool down.

Ricochet accidents can occur if you nail into another nail, the surface is too hard, or the tool is at an angle. Work with a nail gun only from a sturdy and stable surface. Do not press your finger on the trigger unless you are ready to fire, especially when climbing ladders.

Sequential mode and bump mode are the two basic trigger mechanisms used in pneumatic nailers and staplers. It is important to understand the differences between the two triggers in order to prevent injuries.

In the sequential mode, also known as a restrictive trigger or operating in the trigger fire mode, you must first press the nail gun firmly against the workpiece and then press the trigger. One nail is fired and you must release the trigger before you can begin the next nailing cycle.

In the bump mode trigger, also known as dual action, bottom fire, or contact trip, you must press the trigger before you bring the nail gun into contact with the workpiece. Each time you press the nailer against the workpiece, a nail is fired and a nailing cycle begins. You must keep the trigger pulled while moving the tool along the work surface with a bouncing motion, depressing the safety element where you want to drive a nail or staple. By repeatedly “bumping” the nail gun against the workpiece, you can rapidly fire any number of nails.

To find out whether your nail gun is a sequential trigger or bump trigger model:

- Fire a nail as usual and keep the trigger depressed.
- Lift the nail gun and carefully press its nose against the work surface again. If the gun fires a second nail, you have a bump trigger model.
- If the gun does not fire, you have the sequential trigger model.

### *Gas-powered Concrete Mixer*

- Transport and handle fuel only when it is contained in an approved safety container.
- Do not smoke when refueling or during any other fuel-handling operation.
- Do not refuel while the engine is running or while it is still hot.
- If fuel is spilled during refueling, wipe it off of the engine immediately and discard the rag in a safe place.
- Do not operate the equipment if fuel or oil leaks exist—repair immediately.
- Never operate this equipment in an explosive atmosphere.
- Avoid contact with hot exhaust systems and engines.
- Allow all components in the engine compartment to cool before performing any service work.
- Never leave the mixer unattended while it is running.
- Mix only concrete.
- Never perform any work on the mixer while it is running.
- Before working on the mixer, stop the engine and disconnect the spark plug wire(s) to prevent accidental starting. On electric models, disconnect the electric cord at the mixer.
- Keep the cowl closed and latched during operation; close and latch the cowl immediately after starting.
- Keep hands, clothing and jewelry away from all moving parts.
- Keep all guards in place, including drum guards.
- Never place your hands or any solid object into the drum while the mixer is operating.
- Starting fluid (ether) is highly flammable; do not use or an explosion or fire may result.
- Never operate a unit in a poorly ventilated or enclosed area.
- Avoid prolonged breathing of exhaust gases.
- Engine exhaust fumes can cause sickness or death.
- Wear close-fitting clothing and safety equipment appropriate to the job.
- Prolonged exposure to loud noise can cause impairment or loss of hearing.

- Wear a suitable hearing protective device, such as earmuffs or earplugs, to protect against objectionable or uncomfortable loud noises.
- Operating equipment safely requires the full attention of the operator. Do not wear radio or music headphones while operating machine.
- Keep a first aid kit and fire extinguisher handy.
- Keep emergency numbers for doctors, ambulance service, hospital, and fire department near your telephone.
- Always wear splash goggles when operating a mixer.
- Warning: Do not tow the mixer with the drum in the dump position. The mixer may become unstable and tip over when hitting a curb, pothole, or other obstruction.
- Warning: Always properly attach safety chains before the mixer is towed. The maximum towing speed is 55 mph (90 kmh). Reduce speed according to highway conditions.
- Use safety chains and hitch pins with a safety pin.
- Understand the service procedure before doing work. Keep your work area clean and dry.
- Never lubricate, service, or adjust the machine while it is moving. Keep hands, feet, and clothing from power-driven parts. Disengage all power and operate controls to relieve pressure. Lower equipment to the ground. Stop the engine. Remove the key. Allow the machine to cool.
- Securely support any machine elements that must be raised for service work.
- Keep all parts in good condition and properly installed. Repair damage immediately. Replace worn or broken parts. Remove any buildup of grease, oil, or debris.
- Disconnect battery ground cable (negative) before making adjustments on electrical systems or welding on machine.

### *Foot (Squaring) Shear*

- Obtain permission from your teacher before using the shear.
- See that guards are in place.
- Follow manufacturer's specifications as to the gauge of sheet metal that can be safely cut.
- Cut narrow strips of metal crosswise only.
- Make sure that no one but you is inside the operator's zone.
- Stand directly in front of the machine.
- Feed pieces of metal into shear from the front (operator's position).
- Keep your fingers away from the clamp and blade.
- Hold the stock securely against the guide.
- Make sure the foot that is not being used to operate the treadle is clear before pushing down on the treadle.
- Regulate pressure on the treadle according to gauge and type of stock. Keep your foot on the treadle to ease its return to the normal position.
- Allow small pieces of metal being cut to drop to the floor or into a container.
- Use care when picking up trimmings.

### *Hydraulic Shear (Ironworker)*

- **Shearing**
  - Pre-operation
    - Read and understand the operational manual before using the machine.
    - Wear safety glasses.
    - Shear only mild steel. The machine is designed to handle SAE-1020 steel. This is a grade of steel, not a thickness.
    - Keep the punch section clear.
    - Stay within rated shearing capacities. The ironworker is designed to shear mild steel.
  - Operation
    - Turn on the motor switch.
    - Place the material to be cut between the shear blades.
    - Check that the area below the foot pedal is clear.

- Always keep the guard in place and adjusted for minimum clearance.
- Move hands away from shear blade. Make the shear stroke by depressing the foot pedal.
- At the conclusion of the stroke, remove the foot from the pedal and the machine will return and stop in readiness for the next stroke.
- **Punching**
  - Pre-operation
    - Read and understand the instruction manual before operating the ironworker.
    - Wear safety glasses.
    - Keep the shear section clear.
    - Check the punch-securing nut, die, stripper and die at the start of each shift and periodically throughout the day for tightness.
    - Check the punch and die for alignment before punching the first hole and intermittently during the day.
    - Do not punch anything thicker than one punch diameter. Remember that the higher the grade of steel, the more punch power is required.
    - Punch full and complete holes; do not punch partial holes. The side thrust encountered in punching a partial hole can force the punch against the die and result in punch or die breakage.
    - Before operating the ironworker, remove all tools or other objects from under the beam and punch ram. Failure to do so could result in danger to other personnel and to tools.
    - Stay within rated punching capacities. The ironworker is designed to punch mild steel.
  - Operation
    - Turn on the motor switch.
    - Place the material to be punched beneath the punch.
    - Check that the area below the foot pedal is clear.
    - Move hands away from the punch area. There is no need to hold the material being punched.
    - Depress the foot pedal.
    - At the conclusion of the stroke, the foot should be removed from the pedal and the machine will return and stop in readiness for the next stroke.

### *Cornice Brake*

There are many types of brakes available to use when working with sheet metal. The cornice brake is the most commonly used. Safety is important when it is time to use the brake.

- Do not place your hand in the cornice brake when someone else is operating the handle.
- Make sure when going to use the brake that no one else is near the counterbalance balls so they will not be hit by them.
- If you are standing in front of the brake, stand back so that you will not be struck by the handles that project from the leaf when it is swung up.
- Never bend rod or wire on any sheet metal brake. This will damage the blade and the bending leaf.
- Never pound on a brake with any type of steel hammer. Always use a wooden mallet.