

## A. Introduction

1. Accidents occurring in the agricultural mechanics shop often occur because students do not have a basic understanding of shop procedures, rules of conduct, and general shop safety. The purpose of this lesson is not only to identify many of the power tools used in the shop, but also to provide students with proper operating procedures and safety techniques involved with each lab.

## B. Woodworking Power Tools

1. **Circular Saw** - The circular saw is the most useful of all woodworking machines. It can be used for crosscutting, ripping, mitering, beveling, chamfering, rabbeting, cove cutting, tapering, shaping, and molding cutting. This tool is used in situations where the work cannot be moved to the shop or in a shop where table saws are not available. Circular saws come in a variety of blade sizes ranging from 6 1/4" to 8 1/2."

### a. Operating Procedures for the Circular Saw

- 1) Secure the material to be sawed in a vise or with clamps to the work table.
- 2) Mark the line of cut with a pencil.
- 3) Install the proper blade suited to the material being cut.
- 4) Grasp the saw firmly with both hands. Start the saw and allow the blade to reach full operating speed before making contact with the material being sawed.
- 5) Allow the saw to move at its own rate through the wood. Do not force the saw.
- 6) Protect the electrical cord from the line of the cut.
- 7) Always use both hands to hold and guide the saw.
- 8) Clear away scraps of wood on the table only after the saw stops running.

2. **Band Saw** - The band saw is a useful wood cutting tool which has an endless blade traveling around two wheels. Size is determined by blade diameter.

### a. Types of Band Saws

- 1) The mill band saw is used for sawing logs into lumber.
- 2) The re-saw type is used to saw thick stock into thin stock.

3) The small band saw is used to saw straight and curved cuts in wood.

b. Adjusting the Band Saw

- 1) Remove the wheel guards and table insert. Loosen the guide pins and blade-support rollers.
- 2) Loop the desired blade through the slot in the table and around the tapered bottom wheels. Make sure the teeth are pointing down through the table.
- 3) Adjust the tilting screw of the top wheel until the top wheel is in line with the bottom wheel.
- 4) Tighten the tension screw.
- 5) Adjust the top guide until the front edges of the guide rollers are just behind the saw teeth. The teeth must never run between the guide rollers.
- 6) Rotate the wheels to see if the saw is properly adjusted. Replace all safety guards.
- 7) Turn the saw on and off to see if it has been properly adjusted.

c. Operating Procedures for the Band Saw

- 1) Always mark the material to be cut.
- 2) Use a thin blade for sawing curves and a thick blade for re-sawing, cross cutting, and ripping.
- 3) Allow the blade to set the pace of the cut. Do not force the material into the blade.

d. Safety Precautions when using a Band Saw

- 1) Wear safety glasses.
- 2) Use a push stick when sawing small wood stock.
- 3) Never use cracked or kinked saw blades.
- 4) Never twist the blade when sawing curves.
- 5) Try to avoid backing out of a cut, because this can bind and break the blade.
- 6) Keep fingers clear of the moving blade.
- 7) Stop the saw before removing scraps.

3. **Portable Electric Saw** - The portable electric saw is a combination of circular saw and a power hand saw. It can be used for ripping, or crosscut sawing. The portability of this saw makes it a valued tool in construction and repair work. The portable electric saw can be used with attachments to perform the same jobs as a table circular saw and a radial arm saw.

a. Operating Procedures for the Portable Electric Saw

- 1) The operating procedures for the portable electric saw are the same as those for the circular saw.

b. Safety Precautions when using a Portable Electric Saw

- 1) Do not use dull or worn blades.
- 2) Bring the saw to full speed before cutting and push the saw slowly and steadily into the work.
- 3) Do not reach over or around a saw that is running.
- 4) Do not use the saw in awkward positions.
- 5) Keep all parts of the body away from the blade while it is in operation.
- 6) Keep the cord away from the blade to prevent electric shock.

4. **Cut-off or Radial Arm Saw** - The radial arm saw is used to cut long pieces of wood down to a more usable size. The advantage of a radial arm saw is that the work remains stationary when cross cutting, and the saw comes down onto the work instead of up into it. This eliminates the awkward process of pushing long pieces of lumber across the saw table.

a. Operating Procedures for the Radial Arm Saw

- 1) Set the blade depth at a length that penetrates the width of the work but does not saw through the baseboard.
- 2) Brace the work against the fence, which acts as a support on the baseboard.
- 3) Start the saw and bring it to full working speed.
- 4) While bracing the work with one hand, pull the saw body across the work, keeping both hands clear of the blade.
- 5) Place the saw back in its starting position. Turn the saw off and wait for the blade to stop before removing work pieces and set-ups.
- 6) For ripping, the saw motor must be locked parallel to the fence.
- 7) The work is pushed through the saw with a procedure similar to that of a circular saw. Always push the work into the saw from the direction indicated on the saw guard. If fed from the rear, flying wood chips may injure the operator.

b. Safety Precautions when using a Radial Arm Saw

- 1) Always wear a face shield or safety goggles.
- 2) Hold the work firmly against the fence.
- 3) Stand to one side of the direction of the blade and keep hands and body parts away from the blade.
- 4) Feed the saw into the wood only as fast as it will easily cut.
- 5) Never cut more than one piece of stock at a time.
- 6) Return the saw to the beginning position, turn the power off, and wait until the blade has completely stopped before removing scraps of the work material.

5. **Jigsaw (also called the scroll saw)** - The jigsaw has a short blade that moves up and down, cutting only on the down stroke. The scroll saw is used for cutting curves and fine detail in thinner stock. It can also be used to cut light metal and plastic.

a. Operating Procedures for the Jigsaw

- 1) Mark the line of the cut with a pencil.
- 2) To cut center sections of the material, drill a hole in the work, disconnect the blade and pass it through the hole, and then reconnect it.
- 3) Start the saw and feed the material with gentle pressure along the pencil marks.
- 4) When starting at the edge of the material, simply feed the material with light pressure through the saw blade.

b. Safety Procedures when using a Jigsaw

- 1) Wear a safety shield or goggles.
- 2) Keep hands and body parts away from the moving blade.
- 3) Never feed the material faster than the saw can easily cut. The jigsaw blade is thin and can easily break.
- 4) Check the blade for proper adjustment and alignment before starting in order to prevent broken blades.

6. **Saber Saw** - The saber saw is simply a portable jigsaw. It is also referred to as a sabre or bayonet saw. The saber saw can be used to cut plastics, wood, fiberglass, plexiglass, and thin metals.

a. Operating Procedures for the Saber Saw

- 1) Secure the work to be sawed to a bench or table.
- 2) Mark the line of the cut with a pencil.

- 3) Place the edge of the blade against the material before starting. With all other saws, the blade is brought to speed before touching the material.
- 4) Start the motor and feed the blade through the work. Allow the blade to cut at its own rate.
- 5) When cutting interior sections of the material, drill a hole and place the saw blade through the hole before starting.

b. Safety Precautions when using a Saber Saw

- 1) Wear a face shield or safety goggles.
- 2) Remove all nails, staples, and loose knots from the material.
- 3) Do not force the blade through the material.
- 4) Keep hands clear of the blade.
- 5) Protect the electrical cord from the blade.

7. **Planer or Surfacer** - The planer is used to plane boards smooth to an even thickness.

a. Parts of the Planer or Surfacer

- 1) Planer knives are mounted on the revolving cutter-load. There are usually 24 to 27 knives in each planer. The rotating knife blades remove material from the wood that is passed over it.
- 2) Planer Bed - The planer bed is the flat support that guides the wood over the blades.
- 3) Pressure Bar - The pressure bar holds the lumber down on the bed rollers and keeps the end of the board from being dropped out as it leaves the cutter head.
- 4) Feed Rollers - The two spring rollers operate under spring compression and feed the lumber through the planer.
- 5) Chip breaker - The chip breaker breaks the chips off near the cutter head and deflects them over it; this prevents chip buildup near the blade which will result in uneven cutting or tearing of the wood.
- 6) Material Thickness Gauge - The material thickness gauge indicates the exact thickness to which the material will be surfaced or planed.

b. Operating Procedures when using the Planer

- 1) Set the material thickness gauge to the desired dimension.
- 2) When surfacing several pieces of lumber with varying thicknesses, sort the lumber into piles according to the thickness and plane down until even. This will require fewer adjustments to the surfacer and result in less variation of the final product.
- 3) Feed the lumber through several times while turning the board over each pass. This will insure even planing.
- 4) Continue passing the boards through until one side is smooth and the desired thickness is reached.

c. Safety Precautions when using a Planer

- 1) Wear a safety shield or goggles.
- 2) Wear hand protection.
- 3) Keep the face and body clear of the feed roll area to prevent injury from flying splinters.
- 4) Remove all knots, nails, and staples from the wood before planing.
- 5) Keep the planer knives sharpened and properly adjusted.
- 6) Keep hands at a safe distance from the moving parts in order to prevent them from getting sucked into the blades.
- 7) Wear hearing protection when operating or working near the planer.

8. **Jointer** - The jointer is similar to a planer in that it is used to smooth a surface of a board. It can also be used to square an edge, bevel, or chamfer.

a. Operating Procedures for the Jointer

- 1) Adjust the front and rear tables to the same height. If improperly adjusted, a smooth cut is impossible.
- 2) Adjust the fence, which acts as a feed guide and angle indicator.
- 3) Adjust the knives to the desired height to prevent chipping and tearing. The blades should not be raised more than 1/16" above the tables.
- 4) Place the edge of the lumber on the front table. Apply sideways and downward pressure to hold it flat and against the fence.
- 5) Run the board through the jointer.
- 6) To use the jointer to bevel wood:

- a) Use a T-bevel to set the fence at the desired angle.
- b) Set the front table to the desired depth of the cut.
- c) Press the board down and against the fence while pressing over the jointer blades.

7) To use the jointer to rabbet boards:

- a) Rabbeting is a process used to make lap joints in boards.
- b) Adjust the depth of cut to half the thickness of the board.
- c) Remove the front guard.
- d) Set the fence 1/2" from the left end of the cutting blades.
- e) Pass both boards over the jointer.

8) To use the jointer for tapering:

- a) Divide the board into equal lengths of 6" or 8."
- b) Set the blade height to plane the first section.
- c) Plane the first section and readjust the jointer blades. Continue this procedure for the length of the board.
- d) Even the taper using a hand plane.

b. Safety Precautions when using a Jointer

- 1) Wear a safety shield or goggles.
- 2) Use a push block to move the wood across the jointer.
- 3) To prevent injury from the blades never joint lumber less than 10" long.
- 4) Joint with the grain to prevent splinters.
- 5) Keep the knives sharp and properly adjusted.
- 6) Use the fence to support the stock.
- 7) Keep hands away from the cutter-head; never pass hands directly over the cutting head.

9. **Shaper** - The shaper is used to cut specialized shaped edges, moldings, and picture frame stock. Safety should be stressed while using the shaper because wood is fed directly into a rotating, exposed blade.

a. To shape straight edges:

- 1) Adjust the fence of the shaper to the desired depth of the cut.

- 2) Select and install the desired cutting bit.
  - 3) Start the shaper and run the board along the fence, holding it securely with hands to the side of the board away from the blade.
  - 4) Run the board along the fence smoothly and quickly to avoid burning the wood.
- b. To shape curved pieces of wood, remove the fence and follow the same procedure. The wood can still be burned or scored if passed too slowly across the blade.
- c. Test the setup on a sample piece of wood before shaping the project material.
- d. Safety Precautions when using a Shaper
- 1) Wear a face shield or safety goggles.
  - 2) Make sure the stock is free from loose knots, cracks, or other defects.
  - 3) Use the fence whenever possible.
  - 4) Use a push stick whenever possible.
  - 5) Push all work opposite to the direction of the rotation of the cutter.
  - 6) Keep hands well away from the revolving cutters.
  - 7) Turn the power off and wait until the cutter has stopped before removing shavings.

10. **Router-Shaper** - The router is a portable shaper that moves over the work instead of the work being moved through the blade.

a. Operating Procedures for the Router

- 1) Secure the work in a vise or with clamps to a work bench.
- 2) Mark the area to be routed with a pencil.
- 3) Select the desired router bit and router guide and attach securely.
- 4) Grasp the router firmly with both hands.
- 5) Bring the bit to full running speed and slowly ease into contact with the wood.
- 6) The bit will pull itself along the cut. Move the router from the left to the right for the cleanest cut.

b. Safety Procedures when using a Router

- 1) Fasten the bit securely to the chuck. The bit should be at least 1/2" into the chuck.
- 2) Wear a face shield or safety goggles.

- 3) Be sure the switch is in the off position before plugging in the electrical cord.
- 4) Hold the machine firmly with both hands.
- 5) Keep hands clear of the cutting bit.
- 6) Turn the power off and wait until the blade has stopped rotating before resting it on its side.

11. **Sanding Machines** - There are many types of power sanders including disc, belt, drum, spindle, and sheet sanders. Power sanders use abrasive paper or cloth that spins at high speeds to remove material from the project stock. Sanders can come attached to a stand or as a variety of possible electric models.

a. **Belt Sanders** - The belt sander is the most powerful sander. It is used to strip paint and varnish, remove corrosion and rust, polish surfaces, or remove a large amount of material as quickly as possible.

1) Operating Procedures for the Belt Sander

- a) Secure the material to a vise or to a workbench.
- b) Place one hand on the front knob and the other on the rear handle.
- c) Use the rear hand to press the starter trigger. Bring the belt to full working speed before making contact with the work.
- d) Touch the heel of the sander to the work and then ease the entire belt surface onto the wood.
- e) Use back and forth, and sideways motions to evenly sand

b. **Finishing Sanders** - The finishing sander is used for minor sanding and touch-up jobs. The two types of finishing sanders are straight line movement and orbital. Straight line sanders move back and forth while orbital movement is circular; dual-motion sanders are also available.

1) Procedures for Replacing Sandpaper Sheets or Spring

- a) Lift the front clamp and insert the sandpaper end in until it meets the posts and is even with the plate.
- b) Release the lever and press down firmly.
- c) Fold the paper over the base plate and under the clamp. Draw the paper as tightly as possible and lift the rear clamp. Insert the other end of the

paper squarely, release the lever, and press down firmly.

## 2) Procedures for Replacing Abrasive Paper on Knurled Roller Sander

- a) Insert the abrasive paper between the roller and the top of the base plate.
- b) Turn the roller with a screwdriver while holding the paper edge against the knurled roller.
- c) Fold the paper under the plate.
- d) Repeat the operation for the rear roller.
- e) Draw the paper as tightly as possible.

c. **Disk Sanders** - A disk sander is simply an abrasive paper attachment that is used on portable grinders. Disk sanders are best for paint removal, coarse shaping, and rough sanding. The high speed of the disk sander can cause gouges and chips; consequently, it is not recommended for finish work.

d. **Contour Sander** - The contour sander is used on irregular and curved surfaces. The contour sanding attachment can be used on motor shafts, lathe chucks, drill presses, and electric drills.

### e. Safety Precautions when using Power Sanders

- 1) Wear a safety shield or goggles.
- 2) Check the condition of the abrasives.
- 3) Wear a respirator where no catch bag is available to reduce dust.
- 4) Never touch the moving abrasives.
- 5) Bring the sander to working speed before coming into contact with the work. Remove the sander from the work before stopping the sander.

12. **Wood Turning Lathe** - The wood lathe is used to shape wood into various round, cylindrical shapes. The wood is spun at a high rpm while the operator shapes it with various hand tools.

### a) Operating Procedures for the Wood Turning Lathe

- 1) With a punch or awl mark the dead center on both ends of the wood stock to be used.
- 2) Embed the centers into the dead center of the wood. Use oil or beeswax to lubricate the center before inserting.
- 3) Clamp the tailstock firmly in place.

- 4) Turn the rough stock one revolution by hand.
- 5) Start the lathe at the lowest speed.
- 6) Adjust the tool rest to 1/8" from the rough stock. Use a gauge to rough the wood to round form. Start 2" from the tail stock and work forward.
- 7) Increase the speed to 2,400 - 2,800 rpm's and use various handtools to reach desired shape. Always keep the tool rest 1/8" from the wood.
- 8) Remove the tool rest to sand at high speeds.

b) Safety Precautions for the Wood Turning Lathe

- 1) Wear a safety shield or goggles.
- 2) Make sure the stock is free from loose knots, nails, or other defects.
- 3) Be sure stock is properly mounted and secured to the lathe.
- 4) Make sure the tool rest is properly adjusted and clamped securely.
- 5) Do not shift belt or belt-driven lathe to a different speed while running.
- 6) Hold turning tools firmly against the rest with both hands.
- 7) Never touch the stock while it is revolving.
- 8) Stand to one side when the power is first turned on.

13. **Mortiser** - The mortiser is used solely for making mortises. A drill attachment can also serve the same purpose. Mortises are required on door jams and in specially built furniture. Chisel bits are inserted into the mortise chuck to cut different size mortises.

a) Operating Procedure for the Mortiser

- 1) Select a chisel and place it in the casting. Slightly tighten the setscrew.
- 2) Push a mortising bit up through the hollow chisel. Tighten the assembly.
- 3) Turn the feed lever down, and lock the quill in its lowest position.
- 4) Adjust the fence so that the chisel and fence are square with each other.
- 5) Cut the mortise by evenly pushing the chisel onto the wood.

b. Safety Precautions when using a Mortiser

- 1) Clamp all stock securely to the table.
- 2) Wear a face shield or goggles.
- 3) Keep hands away from the chisel when the machine is turned on.
- 4) Feed the chisel only as fast as the machine will easily cut.
- 5) Lift the bit clear of the mortise before moving table.

## C. Metalworking Tools

1. **Bar Folder/Brake** - The bar folder and the brake are used to bend and fold a variety of metal stock and to bend sheet metal. The procedures for using the tools varies depending upon the size of the metal used, the type of bend desired, and the angle of the bend. Read the manufacturer's directions for operating procedures.

a. Safety Precautions when using a Bar Folder/Brake

- 1) Keep hands clear of movable parts.
- 2) Remove all sharp burrs and edges from the metal before folding.
- 3) Fold only single thickness of sheet metal within the capacity of bar folder or the brake.
- 4) Let the bar down slowly after completing the bend.

2. **Metal Shear/Floor Shear** - The metal shear is used to cut large pieces of sheet metal. Bench shears come in different sizes, the most common shop size being a 30" shear with a 7" cut.

a. Operating Procedures for the Metal Shear/Floor Shear

- 1) Lift the top handle and feed the metal through the front.
- 2) Push the top handle down with both hands through the sheet metal.
- 3) Use the guide to cut straight strips of metal.

b. Safety Precautions when using a Metal Shear

- 1) See that all guards are in place.
- 2) Stand directly in front of the machine.
- 3) Keep fingers away from the clamp and blade.
- 4) Cut only single pieces of metal.

3. **Bench Grinder** - The bench grinder is a motor driven wheel made of various abrasives. It is used to remove or polish the metal.

Different grinding wheels are installed depending on the job to be performed or the amount of material to be removed.

a. Operating Procedures for the Bench Grinder

- 1) Adjust the tool rest to no more than 1/8" from the grinding wheel. The tool rest should be no closer than 1/16" from the wheel.
- 2) Start the grinder while standing to the side of the wheel.
- 3) Grasp the object to be ground firmly in both hands.
- 4) Slowly move the tool to the moving grinding wheel while supporting it on the tool rest.

b. Safety Precautions when using a Bench Grinder

- 1) The tool rest must be properly set at 1/16" to 1/8" from the wheel to prevent the wheel from pulling the tool down between the tool rest and the wheel.
- 2) Wear a safety shield or goggles even if the grinder is equipped with a face shield.
- 3) Keep hands away from the shield when it is in motion.
- 4) Do not wear loose clothing or gloves near the wheel.
- 5) Grind only on the face of the wheel; grinding on the side may cause the wheel to break.

4. **Buffer** - The buffer is used to polish metal. A buffing wheel is attached to a bench or portable grinder.

a. Operating Procedures for the Buffer

- 1) See operation procedures for the bench grinder.
- 2) A buffing compound is generally applied to polish the material being buffed.

b. Safety Precautions when using a Buffer

- 1) Wear a safety shield or goggles.
- 2) Apply compound sparingly.
- 3) Keep hands away from the wheel when it is in motion.
- 4) Buff flat surfaces from the center toward the lower edge. All sharp edges should point downward when being buffed.

5. **Portable Grinder and Disk Sander** - The portable grinder and disk sander are useful tools for removing excess material from objects that are too large or too heavy to place on a bench grinder.

a. Operation Procedures for the Portable Grinder and Disk Sander

- 1) Secure the object to be ground in a vise or to a table with a clamp.
- 2) Hold the grinder firmly with one hand on the handle and the other on the body and trigger.
- 3) Hold the grinder away from the body and start it, bringing it to full speed.
- 4) Ease the grinder wheel to the project. The wheel face should be flat on the project.

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- 5) Angle the grinder so that the sparks fly away from the operator.
- 6) Use a circular or a side-to-side and up-and-down motion to remove the metal.

b. Safety Procedures when using a Portable Grinder or Disk Sander

- 1) Use the face of the wheel only. Grinding with the edge may cause the wheel to shatter.
- 2) Always use both hands to support the grinder or disk sander. The tool rotates at high rpm's and can fly from the project if not properly supported.
- 3) Wear a safety face shield, gloves, and a long sleeve shirt for protection from flying sparks and metal fragments.
- 4) Make sure no one is within a distance where they can be hit by the sparks.
- 5) Allow the grinding wheel or disk to come to a complete stop before setting it down on its side.
- 6) Do not touch the metal immediately after it has been disked or ground. The abrasive action will heat the metal.

6. **Metalworking Lathe** - The lathe holds and rotates the work while a cutting tool that is fed against the work is shaping it. Metalworking with a lathe requires much more precise measurement than woodworking. Measurements must be accurate to the thousandths of an inch. Therefore, a micrometer and a set of calipers is required for accurate measurements.

a. Operating Procedures for the Metalworking Lathe

- 1) Determine the dead center of each end of the metal to be

lathed. A pair of dividers or a center head can be used for this purpose.

- 2) Use a center punch to mark the centers. If the initial punch is not accurate, the center punch can be driven at an angle to move the drilling hole.
- 3) Drill both ends of the metal. The drill holes should fit the lathe center perfectly to insure the correct true of the metal.
- 4) Use oil or grease in the drilled holes and attach the metal stock to the lathe using the lathe centers.
- 5) Mount the cutting tool in the tool holder and the tool holder in the tool post. Mount the tool holder in the tool post so that in case it slips, it will swing away from the work and not gouge.
- 6) Set the cutting depth using a micrometer.
- 7) Turn the machine on. Make a light trial cut that is shallower than the setup for thread cutting.
- 8) If accurate, adjust the tool holder to make the actual cut.

#### b. Safety Procedures when using a Metalworking Lathe

- 1) Wear safety shield or goggles.
- 2) Avoid loose clothing and tie back long hair that may get caught in the lathe.
- 3) Start the lathe at a slow speed while standing away from the direction of the rotation.
- 4) Never touch the metal while it is rotating.
- 5) Never remove scraps while the lathe is in operation.
- 6) Keep fingers and hands away from all moving parts.

7. **Milling Machine** - The milling machine is very useful in cutting and shaping metal. Metal is removed by a rotating multi-tooth cutter that is fed into the work.

#### a. Operating Procedures for the Milling Machine

- 1) Seat the work against the parallels on the machine or the bottom of a vise using a mallet or a soft hammer.
- 2) Securely fasten the work.
- 3) Set the milling machine for the proper cutting depth.
- 4) Disengage all handles if the machine has an automatic feed.
- 5) Turn the machine on and make sure it is turning in the proper direction.
- 6) Feed against or opposite to the direction of rotation of the cutter.

- 7) Release the automatic feed after the machine has been turned off and has stopped.

b. Safety Precautions when using a Milling Machine

- 1) Wear a safety shield or goggles.
- 2) Make adjustments to the machine only when it is at a dead stop.
- 3) Be sure the work is securely fastened.
- 4) Stand to one side of the machine when starting.
- 5) Use a brush to remove chips. Never use a hand or blow the chips clear. The chips are sharp and may cut the hand or eye.
- 6) Keep hands clear of moving parts.

8. **Oxygen-acetylene Welding** - Welding is useful for joining metals together. The oxyacetylene system combines oxygen and acetylene gas to produce extreme heat that fuses the metal together.
9. **Arc Welding** - The arc welding machine uses electric current to weld metal together.
10. **Spot Welder** - Spot welding is known as resistance welding. The weld is produced by heat obtained from the resistance of the work to a flow of electric current and the application of pressure. Spot welding is frequently used in agriculture to weld sheet metal parts. It is a fast method of welding light gauge metals and produces a clear, uniform, and strong weld. It is an easier, safer, and more accurate method of welding than either arc or oxyacetylene welding.

## D. Tools used in Both Woodworking and Metalworking

1. **Drill Press** - The drill press is a stationary machine used to drill holes. If used with attachments, the drill press can also be used for boring, routing, and mortising.

a. Operating Procedures for the Drill Press

- 1) Set the speed of the drill, according to the diameter of the bit.
- 2) Select the drill bit and chuck to use. Place the chuck in the drill.
- 3) Insert the drill bit and tighten with the chuck key.
- 4) Align work under the bit. Clamp the work securely.

- 5) Start the drill and bring it to full working speed.
- 6) Lower the bit using the pilot wheel feed. Do not force the bit through the metal. Use cutting oil on thick pieces of metal. Allow the bit to cut at its own speed.
- 7) After the bit has gone through the material, slowly release the pilot wheel feed and turn the machine power off.

b. Safety Precautions when using a Drill Press

- 1) Shift belt and make other adjustments only when the power switch is off.
- 2) Be sure that the belt guard is in place.
- 3) Secure the work to be drilled. Use a drill press or vise when possible.
- 4) Remove the chuck key immediately after using it.
- 5) Wear a safety shield or goggles.
- 6) Never wear loose clothing or gloves or allow long hair to be near the drill bit when turning.
- 7) Stop the drill press before attempting to remove work, chips, or cuttings.

2. **Portable Hand Drill** - The hand drill is used to drill holes into different material. Portable hand drills are made in various sizes and vary in power from light to heavy and in speeds from slow to fast.

a. Operating Procedures for the Portable Hand Drill

- 1) Select the bit to be used, insert it into the chuck, and tighten with the chuck key.
- 2) If drilling metal, use a center punch to indent the point of the hole to be drilled.
- 3) Holding the drill firmly, bring it to full working speed.
- 4) Ease the bit towards the work. Do not force the bit.
- 5) After breaking through, immediately back off on the pressure.
- 6) Remove the drill from the hole and release the trigger or power switch.

b. Safety Precautions when using a Portable Hand Drill

- 1) Wear a safety shield or goggles.
- 2) Remove the chuck key immediately after using it.
- 3) Make sure the drill is grounded either internally or with a ground wire to the outside of the drill.
- 4) Always hold the machine firmly.

- 5) Keep hands away from the revolving drill bit. Never wear loose clothing or gloves that may become entangled in the bit.
- 6) Apply straight and steady pressure. Do not force the drill bit. It may break and injure the operator.

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- 7) Ease up on the pressure just before the drill begins to break through the material.
- 8) Turn the power off and allow the machine to come to a complete stop before putting it down.

## **E. Additional Shop Equipment**

1. **Forges and Furnaces** - Gas and electric furnaces and coal forges create very high temperatures in order to heat metal for shaping.

a. Operating Procedures for the Forge and Furnace

- 1) Consult the manufacturer's directions for operation procedures of forges and furnaces.

b. Safety Precautions when using a Forge or Furnace

1) Gas Furnace

- a) Check for gas leaks.
- b) Light the furnace while standing to one side and with the doors open.
- c) Use tongs to remove metal from the furnace.
- d) Use a flint lighter and not materials to light a gas furnace.
- e) Wear a face shield or safety goggles.

2) Electric Furnace

- a) Be certain the furnace is properly grounded and the cable is insulated to prevent electrical shock.
- b) Remove all scale from the furnace grating. The scale can short and burn out the electric coils.
- c) Use tongs to remove hot metal from the furnace.

3) Coal Forge

- a) Keep the area around the forge clean.

- b) Use tongs to remove hot metal from the forge.
- c) Wear a face shield or safety goggles.

2. **Storage Battery** - Extra batteries are often used in the shop for faster service of tractors and other farm equipment. These batteries should be regularly serviced and charged even when not being used.

a. Servicing Procedures for the Storage Battery

- 1) Use a hydrometer to test the charge of the battery.
  - a) Remove the cell caps from the battery.
  - b) Hold the hydrometer tube vertical and suck in a small amount of electrolyte.
  - c) Read the hydrometer with the electrolyte at eye level.
  - d) Add distilled water if the electrolyte level is low.

2) Charging the Battery

- a) Remove all cell covers.
- b) Provide ample ventilation.
- c) Connect the positive and negative lead wires to the respective battery terminals.
- d) Set the charge setting.

b. Safety Precautions when using a Storage Battery

- 1) Do not overfill the battery when servicing.
- 2) Use water and baking soda to clean the top of the battery to neutralize acid.
- 3) Always use a battery lifter to remove and transport batteries.
- 4) Immediately wash clothing and any part of the body that comes in contact with the acid.
- 5) Wear goggles when using a battery charger.
- 6) Turn off charger before disconnecting leads from the charger to the battery.