Lesson 2: Safe Use and Maintenance of Power Tools for Metalworking

Many of the machines, tools, and buildings used in agriculture are made of metal and thus a thorough knowledge of power tools for metalworking is essential when working in agricultural mechanics. Before using power tools for metalworking, it is essential to be familiar with the parts and functions of the tools and to know how to operate them safely. This lesson will identify some common power tools (portable and stationary) and discuss safety precautions and maintenance procedures related to these tools.

Basic Procedures for Shop Safety

Each year many agricultural workers incur injuries while working with power tools. These injuries range from minor cuts and bruises to severe lacerations, finger amputations, and eye punctures from flying debris. Massive bleeding from severe injuries and electrocution can cause death. Tool operators sometimes add to the hazards by taking shortcuts to save time, disregarding warnings, and not using safety precautions appropriate for each tool.

The following are general safety procedures for working in a shop area. Safety procedures for specific metalworking tools are discussed later in this lesson.

- Adhere to instructions from the following sources:
  - Labels and warnings on containers and tools
  - The manufacturer's recommendations for use and maintenance of specific power tools
  - Signs posted in the work area
  - Directions given by the instructor
- Wear safety glasses in the shop at all times.
- Wear protective gear, such as gloves, earplugs, and safety shoes, if appropriate.
- Do not wear loose-fitting clothing that could get caught in a moving part.
- Wear a hair net to prevent long hair from getting caught in a tool.
- Keep work areas clean and free of clutter.
- Inspect each tool before using it to make sure it is working properly.
- Tell the instructor about any damaged tool.
- Do not use a tool that does not function properly.
- Return each tool to its proper storage place.

Common Power Sources for Metalworking Tools

Electricity, including battery packs, and compressed air (pneumatic) are two of the most common sources of power for metalworking tools. In addition to the general safety precautions listed above, there are specific safety considerations for each of these types of power.

Safety Precautions for Electric and Pneumatic Power Tools

Electric and Battery-Powered Tools

- Always unplug a tool or disconnect it from its battery before inspecting it and making adjustments.
- Only use a tool that is double insulated or has a grounded plug.
- Always plug a tool into an outlet with a ground-fault circuit interrupter (GFCI or GFI), which will shut off the power if a short occurs. If an outlet is not equipped with a GFCI, a portable GFCI can be plugged into a grounded outlet.
- Do not stand on wet ground or a wet surface while operating an electric tool.
- Make sure stationary power tools are securely anchored to the bench or floor.
- Make sure guards and shields are in place and vents are clear of debris before turning on a tool.
- Do not bend a power cord sharply, do not use a cord to pull the plug from the outlet, and do not use a cord to carry the tool. Broken power cords can cause an electrical shock.
- Use only the battery specified by the manufacturer for the tool being used.
- Use only the type of recharger designed for the batteries being used.
- Always store battery packs safely so that no metal can come in contact with the terminals. This can short-circuit the battery and cause sparks, fire, or burns.

Pneumatic Power Tools

- Disconnect pneumatic tools for all inspections and adjustments.
- Do not join or separate quick-disconnect couplings on high-pressure lines when bystanders are nearby.
- Do not use compressed air for cleanup if the pressure is 30 lb per sq in. (psi) or greater.
- Do not point an air stream at anyone. High-pressure air can drive dust into the eyes, damage eardrums, and cause other injuries.
- Inspect couplings and air lines regularly for evidence of wear and damage.
- Make sure air tanks and air lines are free of moisture and appropriate filters are in place.
- Follow the manufacturer's recommendations for hose size and maximum air pressure.
- Oil pneumatic tools regularly according to the manufacturer's recommendations.

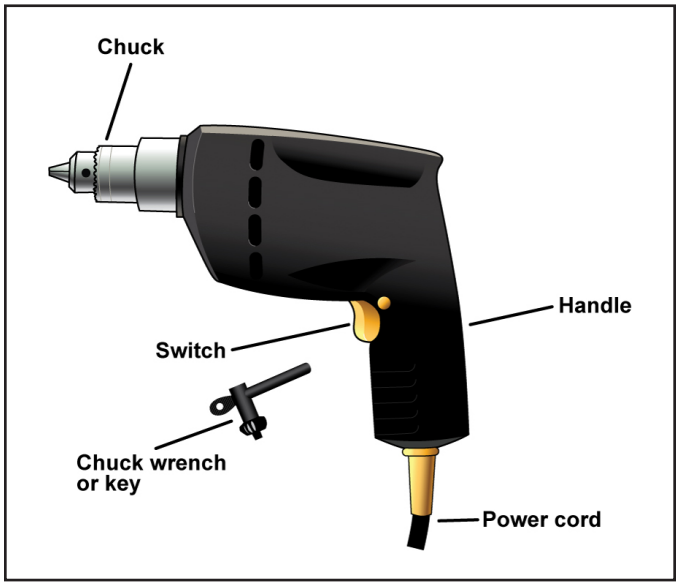
Portable Drills

Portable power tools, such as a drill, are particularly useful because they are easy to take to the job site, do not require extensive setup, and are relatively affordable. Main parts of a portable drill include an on/off switch, power cord, handle, chuck (the part that holds the drill bit), and chuck key. See Figure 2.1. A chuck key, or wrench, is used to loosen and tighten the drill bit in the chuck. In metalworking, the word "drill" is often used to refer to a drill bit.

Depending on the type of drill bit, portable drills are used for many tasks in metalworking, including drilling and boring, driving and removing screws, sanding, polishing, and powering hole saws. Portable drills come in different sizes. The size of a drill is determined by the maximum size of drill bit the chuck will hold. For example, a 1/4-in. drill will hold a bit with a shank no larger than 1/4 in. Many specialized metalworking drills are also available.

The basic drill bit used in metalworking is a general-purpose one that can be used on a number of materials and in a variety of situations. Drill bits used in metalworking are commonly made of carbon steel, high-speed steel, and cemented carbide. Of these three materials, carbon steel

Figure 2.1 – Portable Drill



is the weakest and cemented carbide is the strongest. High-speed steel withstands higher speeds and lasts longer than carbon steel. Cemented carbide withstands very high speeds and outlasts high-speed steel and carbon steel.

Some drills have only one motor speed while others have different speeds. Variable-speed drills are useful for driving screws. Screws can be removed by using the reverse setting.

Safety considerations for a portable power drill include the following:

- Choose the right drill bit for the job. For example, do not use a square-shank bit in an electric drill.
- Make sure the bit is tight in the chuck. Use the chuck key in each hole of the chuck to tighten the bit. Be sure to remove the key before starting the drill to avoid throwing the key.
- Use a center punch to mark stock when working with metal. The indentation helps guide the bit.
- Make sure the work is held securely in place. Use a clamp or vise to hold a small piece.
- Hold the drill perpendicular to the piece to avoid binding the bit.
- Remove the bit from the drill after completing the job.

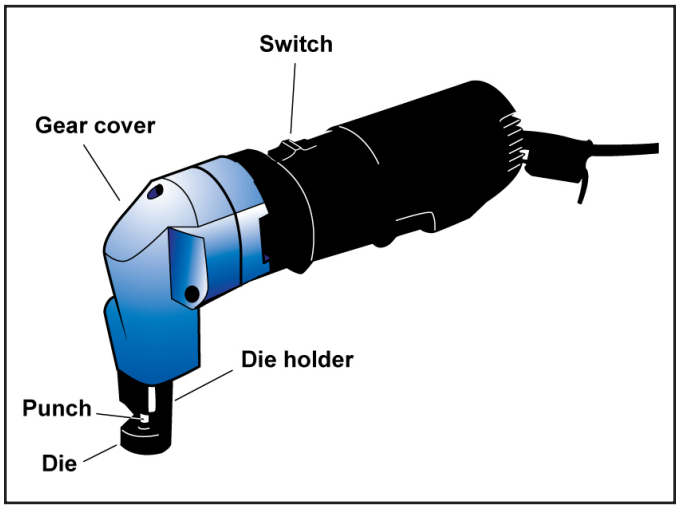
Maintenance considerations for a portable power drill include the following:

- Keep parts lubricated according to the manufacturer's instructions.
- Sharpen or replace dulled drill bits.

Portable Power Nibblers

Portable power nibblers are convenient for taking to the work site to cut sheet metal quickly and efficiently. Main parts of a power nibbler include an on/off switch, gear cover, punch, die, and die holder. See Figure 2.2.

Figure 2.2 – Portable Power Nibbler

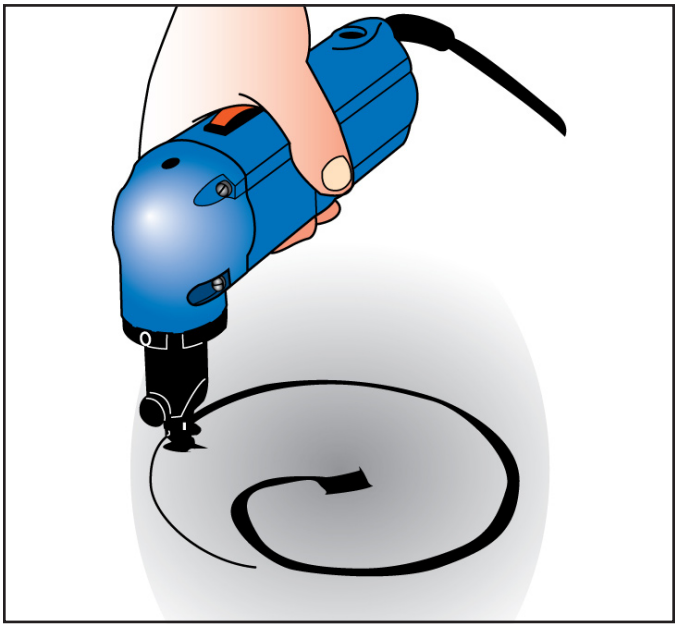


A power nibbler performs functions similar to those of hand shears or snips, but it is more versatile and gets the job done quicker. A power nibbler can make straight, curved, and interior cuts. It can cut thin metal that is bent or formed. Interior cuts are made in metal by using a hollow punch or other tool to make a small hole at the center of the planned cut. The power nibbler is then used to cut the desired shape. See Figure 2.3. Power nibblers are designed to eject metal cuttings down and away from the operator, which is a good safety feature of this tool.

Safety considerations for a portable power nibbler include the following:

- Wear eye protection when doing metalwork.
- Wear gloves when handling metal with sharp, cut edges.

Figure 2.3 – Power Nibbler Making an Interior Cut



- Do not use compressed air or the hands to remove metal chips and cuttings.

Maintenance considerations for a portable power nibbler include the following:

- Make sure the chip-ejection hole is clear of debris.
- Follow the manufacturer's recommendations for regular service.

Cold Circular Cutoff Saws

A cold circular cutoff saw has a flat, round blade and is used for cutting metal to length, making straight or miter cuts, and cutting soft or unhardened metals. Larger models of this type of saw are stationary, similar to the table saw used in woodworking. (See Unit I, Lesson 1 for information about a table saw.) Main parts of a cold circular cutoff saw include an on/off switch, table, blade, guard, handle, motor, and fence. See Figure 2.4. The circular saw can be used on materials such as aluminum, copper, machine steel, and stainless steel.

Safety considerations for a cold circular cutoff saw include the following:

- Wear eye protection when doing metalwork.

Figure 2.4 – Cold Circular Cutoff Saw

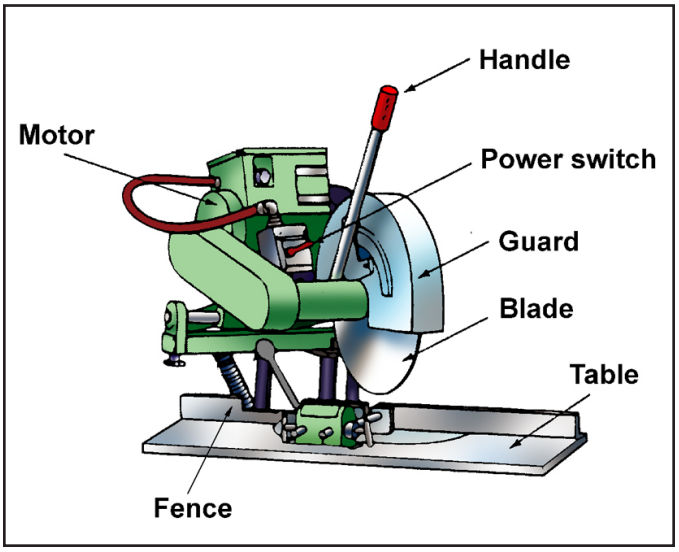
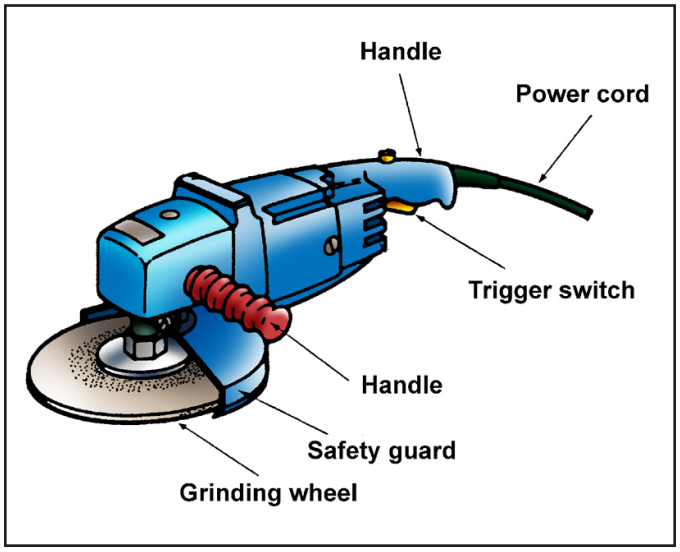


Figure 2.5 – Portable Grinder



- Wear gloves when handling metal with sharp, cut edges.
- Do not use compressed air or the hands to remove metal chips and cuttings.

Maintenance considerations for a cold circular cutoff saw include the following:

- Follow the manufacturer's recommendations for regular service.
- Clean, sharpen, or replace dull blades.

Portable Grinders

A portable grinder is a lightweight tool for grinding, shaping, and cleaning metal. It is useful for performing resurfacing work, such as removal of rust and paint. Grinders work by abrasion, which means the surface of the grinding wheel acts like a cutting tool to remove unwanted material. Main parts of a portable grinder include an on/off switch, grinding wheel, safety guard, handle, and power cord. See Figure 2.5. Some models are equipped with flexible sanding wheels for sanding wood and metal.

Grinding wheels are available in different textures of abrasive material. A wheel with a coarse texture is used for shaping metal and preparing metal for welds, whereas a wheel with a medium texture is used for sharpening tool blades. Grinders can also be used with wire brushes to remove rust.

Safety considerations for a portable grinder include the following:

- Wear appropriate face and eye protection.
- Wear additional protective clothing, such as a dust mask or respirator, if needed.
- Choose the right wheel or disc for the job. It should be rated to turn at speeds higher than the machine will produce.
- Secure small pieces in a clamp or vise.
- Examine the work area to identify areas where sparks might fall and make sure there is no fire hazard. Do not grind metal near combustibles.

Maintenance considerations for a portable grinder include the following:

- Inspect grinding wheels regularly. Do not use wheels that are damaged or out of round.
- Do not use wheels that are less than half of their original diameter.
- Remove the wheel or disc after use.
- Store the grinder and accessories in their proper place.

Bench Grinders

A bench grinder does work similar to a portable grinder, but it is a stationary machine mounted on a bench. Main parts of a bench grinder include an on/off switch, grinding wheels, safety shields, and adjustable tool rests. See Figure 2.6. The adjustable tool rests are used for supporting and guiding small objects for grinding. See Figure 2.7.

Figure 2.6 – Bench Grinder

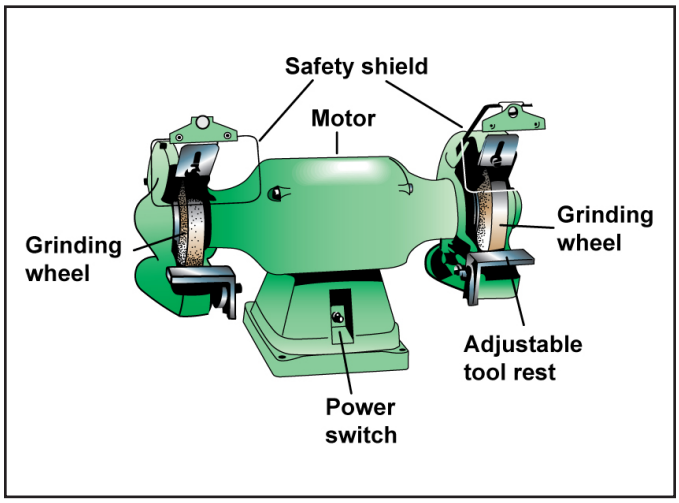
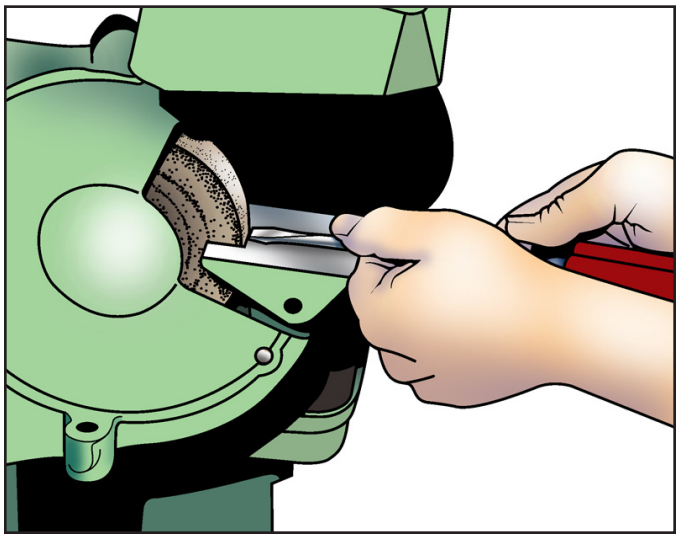


Figure 2.7 – Reconditioning a Screwdriver on a Bench Grinder, With Tool Supported by the Tool Rest



Bench grinders are used for sharpening and reconditioning tools and for shaping and cleaning metal. Another type of stationary grinder is called the pedestal grinder. It is similar to a bench grinder but is larger and is anchored to the floor. Both a bench grinder and a pedestal grinder have a double-shafted motor, which allows a wheel to be mounted on each side. Usually one wheel is coarser in texture and is used for removing material from the surface of the piece. The other wheel is finer in texture and is used for finishing work.

Safety considerations for a bench grinder include the following:

- Wear appropriate eye and face protection.
- Wear additional protective clothing, such as a leather apron or an appropriate filter or respirator, if needed.
- Adjust the tool rest for the job.
- Stand to the side of the wheel when starting the grinder and let the wheel run for a short period before using it. Wheels that are going to break usually do so within the first minute of use.
- Move the work slowly back and forth across the face of the wheel to avoid overheating the metal.
- Do not force work into the grinding wheel. Allow the speed and grit of the wheel to do the work.

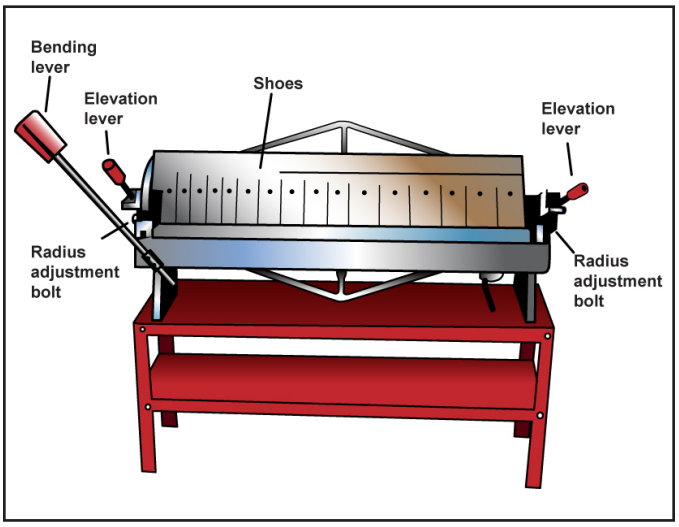
Maintenance considerations for a bench grinder include the following:

- Do not use the wheel to grind soft metals, such as copper and aluminum. They quickly clog the grinding wheel. For soft metals, use an abrasive belt grinder.
- Inspect wheels frequently. A good wheel makes a ringing sound when it is suspended by a string and tapped lightly. A wheel that does not make such a sound should be replaced. (Mounted wheels cannot be tested this way.)
- Recondition used wheels to restore their abrasive work surface and bring them back into round. This is called dressing. Receive proper instruction and permission before dressing a wheel.

Sheet Metal Brakes

Many small repair jobs in agricultural mechanics, such as bending metal, are performed by hand, but machines like folders and brakes can do larger jobs better and faster. Hand-operated sheet metal brakes are available in a variety of sizes, from smaller bench-mounted models to industrial-sized brakes. Main parts of a brake include radius adjustment bolts, bending lever, elevation levers, and shoes. See Figure 2.8.

Figure 2.8 – Sheet Metal Brake



Sheet metal brakes are used for making angle and radius bends, seaming, flattening, and punching. These brakes increase work force by using cams and levers and can exert thousands of pounds of pressure.

Safety considerations for a sheet metal brake include the following:

- Keep fingers clear of the working mechanism.
- Leave bending machines closed when not in use.

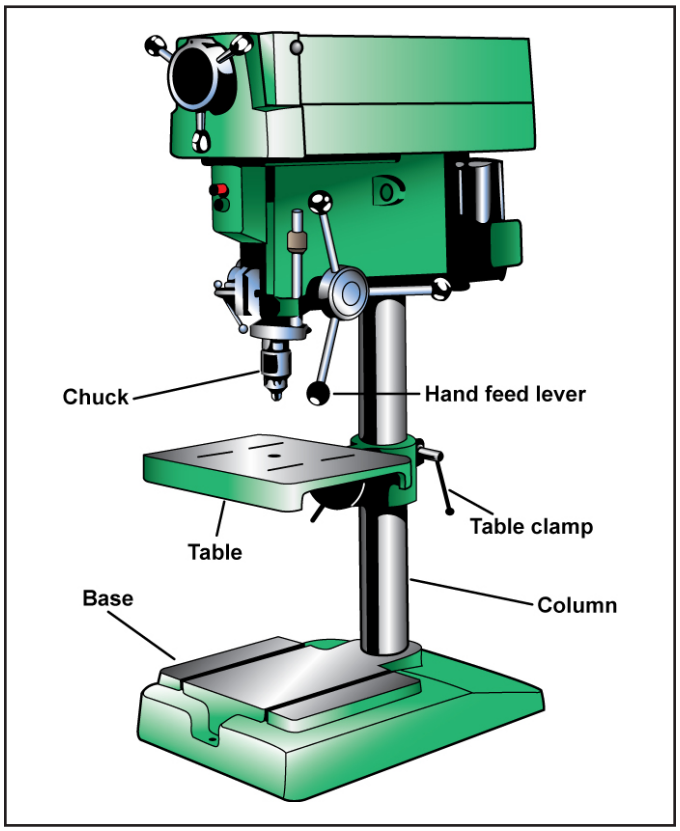
Maintenance considerations for a sheet metal brake include the following:

- Follow the manufacturer's recommendations for regular service.

Drill Presses

A drill press performs operations similar to those of a portable drill, but it is a large stationary machine capable of heavier work. Common uses for drill presses are drilling or boring holes and countersinking (making a recess where a screw can be driven). Main parts of a drill press include an on/off switch, column, table clamp, hand feed lever, chuck, table, and base. See Figure 2.9. The hand feed lever lowers and raises the chuck, which holds the drill bit.

Figure 2.9 – Drill Press



Drill presses are available in bench and floor models. The size of a drill press is determined by doubling the distance between the front edge of the column and the center of the drill bit.

Safety considerations for a drill press include the following:

- Secure the piece before beginning to drill. Clamp the piece on the left side of the table to keep it from rotating.

- Use a center punch to mark and start the hole.
- Choose the right bit for the material and for the drill. Straight-shank bits should be used with geared chucks and taper-shank bits with taper chucks.
- Make sure the table is properly aligned before turning on the drill press to avoid drilling into the table.
- Reduce the pressure as the drill breaks through the work.

Maintenance considerations for a drill press include the following:

- Inspect bits regularly. Sharp bits cut better and are less likely to break.
- Follow the manufacturer's recommendations for regular care. Light grease on the spindle spline provides lubrication and reduces noise.

Summary

Power tools can help make metalworking tasks quick and efficient, but they can be dangerous to use if an operator does not know how they work and what safety procedures to follow. Electricity, batteries, and compressed air are common sources of power for metalworking tools. It is important to follow the general safety precautions for electric and pneumatic tools. Portable power tools commonly used in metalworking include drills, nibblers, and grinders. Stationary machines include cold circular cutoff saws, bench grinders, sheet metal brakes, and drill presses.

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