GADSDEN TECHNICAL INSTITUTE
CONTINUAL EDUCATION
COVID-19 EMERGENCY LESSONS

Teacher Name:	Mr. Alfred Suber
Dates of Instruction:	March 30 – April 13, 2020
Lesson Title:	Introduction to Power Tools
Grade Levels:	10 – 12; Adult
Subject Area:	Carpentry

Assignment: After reading the material on introduction to power tools, the student will be able to select and use hand and power tools relevant to the carpentry profession. The student will be able to: identify and describe the use of various hand and power tools: state the general safety rules for operating all power tools, regardless of type; clean and care for tools and equipment; demonstrate proficiency in the safe use of hand and power tools; read and use carpenter's measuring tools.

Lesson Instructions:
Week of March 30 – April 3, 2020, read pages 2 - 20. Study and Learn Trade Terms Definitions on page 43.

Week of April 6 – 15, 2020, read pages 21 - 37. Study and Learn Trade Terms Definitions on page 43.

Practice Activities:
Week of March 30 – April 3, 2020, answer review questions on page 38 - 39.

Week of April 6 – 15, 2020, answer trade terms quiz questions on page 40.

Instructional Materials:
1. Carpentry Introduction to Power Tools Module 4 reading packet
2. Carpentry Introduction to Power Tools Module 4 questions packet.

Special Notes from Instructor:
ALL paper work should be kept in your folder, signed and dated to reflect completion date(s) prior to bringing them to class with you on April 16, 2020. If there are any questions, I can be reached at (850) 875-8324; ext. 5121 or email suberj@gcpsmail.com.

SECTION ONE

1.0.0 POWER DRILLS

Objective

Identify and explain how to use various types of power drills and impact wrenches.

a. Identify and explain how to use common power drills and bits.
b. Identify and explain how to use a hammer drill.
c. Identify and explain how to use pneumatic drills and impact wrenches.

Performance Task

1. Safely and properly demonstrate the use of the following tool(s):
   - Electric drill
   - Hammer drill or rotary hammer

Trade Terms

Alternating current (AC): The common power supplied to most all wired devices, where the current reverses its direction many times per second. AC power is the type of power generated and distributed throughout settled areas.

Auger bit: A drill bit with a spiral cutting edge for boring holes in wood and other materials.

Carbide: A very hard material made of carbon and one or more heavy metals. Commonly used in one type of saw blade.

Chuck: A clamping device that holds an attachment; for example, the chuck of the drill holds the drill bit.

Chuck key: A small, T-shaped steel piece used to open and close the chuck on power drills.

Countersink: A bit or drill used to set the head of a screw at or below the surface of the material.

Direct current (DC): An electric power supply where the current flows in one direction only. DC power is supplied by batteries and by transformer-rectifiers that change AC power to DC.

Forstner bit: A bit designed for use in wood or similar soft material. The design allows it to drill a flat-bottom blind hole in material.

Ground fault circuit interrupter (GFCI): A circuit breaker designed to protect people from electric shock and to protect equipment from damage by interrupting the flow of electricity if a circuit fault occurs.

Ground fault protection: Protection against short circuits; a safety device cuts power off as soon as it senses any imbalance between incoming and outgoing current.

Masonry bit: A drill bit with a carbide tip designed to penetrate materials such as stone, brick, or concrete.

Revolutions per minute (rpm): The rotational speed of a motor or shaft, based on the number of times it rotates each minute.

Shank: The smooth part of a drill bit that fits into the chuck.

Trigger lock: A small lever, switch, or part that can be used to activate a locking catch or spring to hold a power tool trigger in the operating mode without finger pressure.

This module introduces three kinds of power tools: electric, pneumatic, and hydraulic.

- *Electric tools* – These tools are powered by electricity. They are operated from either an **alternating current (AC)** source (such as a wall receptacle) or a **direct current (DC)** source (such as a battery).
- *Pneumatic tools* – These tools are powered by air. Electric or gasoline-powered compressors produce the air pressure. Air hammers and pneumatic nailers are examples of pneumatic tools.
- *Hydraulic tools* – These tools are powered by fluid pressure. Hand pumps or electric pumps are used to produce the fluid pressure. Pipe benders, jackhammers, and Porta-Powers® are examples of hydraulic tools.

All power tools can be dangerous. Workers should never attempt to operate these tools without proper instruction and supervision. Operating a power tool incorrectly or unsafely can injure the operator as well as other workers. Safety issues for each tool are covered in this module, but general safety issues—such as safety in the work area, safety equipment, and working with electricity—are covered in the *Basic Safety* module. This information is vital for working with power tools, and trainees must complete the *Basic Safety* module before beginning this module.

WARNING!

The *Basic Safety (Construction Site Safety Orientation)* module MUST be completed before studying this module. Remember that appropriate personal protective equipment (PPE) must be worn when operating any power tool or when near someone else who is operating a power tool. Workers should always read and follow the manufacturer's recommendations when using power tools.

One of the most important power tool safety rules is to make sure that the tool has been disconnected from its source of energy before parts such as bits, blades, or discs are replaced and before any type of maintenance is performed on the tool. Cords and hoses that provide energy to a power tool should be checked to make sure they are not frayed or damaged. If a power tool is equipped with a **trigger lock**, do not use the lock. A trigger lock is a small lever, switch, or part that can be used to activate a locking catch or spring to hold a power tool trigger in the operating mode even when the trigger is released. Locking any power tool in the On position can be very dangerous. Although this was a popular new feature when first introduced, it has proven to be an unsafe choice. Many contractors do not allow their use at any time.

WARNING!

The use of trigger locks may be prohibited by an employer or job site. If a power tool is equipped with a trigger lock, do not activate it.

Regardless of what power tool is in use, safety glasses are required. Some tools require the use of a face shield in addition to safety glasses. Safety shoes should also be worn, and tight-fitting gloves are required for most power tools. Loose gloves can be a safety hazard of their own.

1.1.0 Types of Power Drills

Various types of power drills are often used in the construction industry. A power drill is most commonly used to make holes by spinning drill bits into wood, metal, plastic, and other materials. However, with different attachments and accessories, the power drill can be also used as a sander, polisher, screwdriver, grinder, or **countersink**.

Common types of power drills include the following:

- Electric drills
- Cordless drills
- Electromagnetic drills
- Hammer drills
- Pneumatic drills
- Electric screwdrivers

Most of the basic types of power drills are similar and share some common features. For example, most power drills have a pistol grip with a trigger switch for controlling power (*Figure 1*).

The farther back the trigger of a variable-speed drill is pulled, the faster the drill spins. Drills also have reversing switches that enable the drill to spin backwards in order to back the drill bit out if it gets stuck in the material while drilling. Power drills use replaceable bits for different drilling tasks (*Figure 2*). On variable-speed power drills, a screwdriver bit can be used in place of a drill bit so that the drill can be used as a screwdriver. Only screwdriver bits that are designed for use in a power drill should be used.

Twist drill bits are used to drill wood and plastics at high speeds or to drill metal at a lower speed. A **Forstner bit** is used on wood and is particularly good for boring a flat-bottom hole. A paddle bit or spade bit is also used in wood. The bit size is measured by the paddle's diameter, which generally ranges from ½ to 1½ inches (≈13 to 38 mm). A **masonry bit**, which has a **carbide** tip, is used in concrete, stone, slate, and ceramic material. The **auger bit** is used for drilling wood and other soft materials, but not for drilling metal. The auger bit is designed for use at a very low speed.

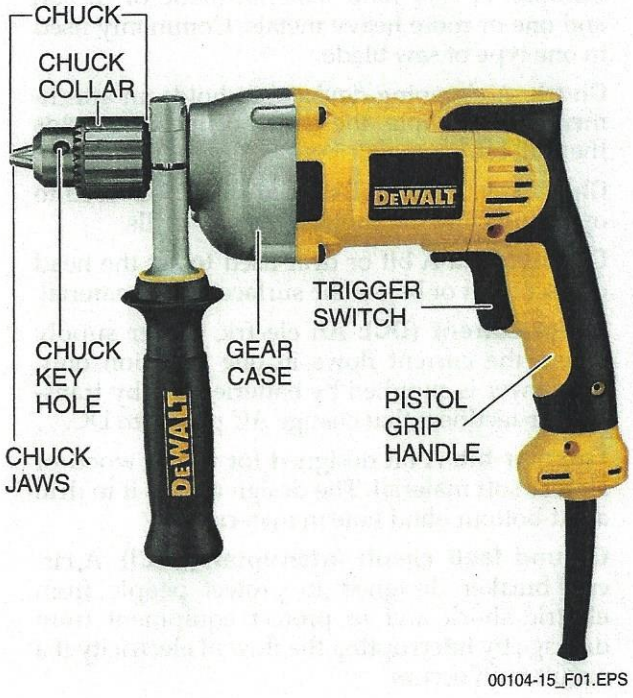


Figure 1 Parts of a power drill.

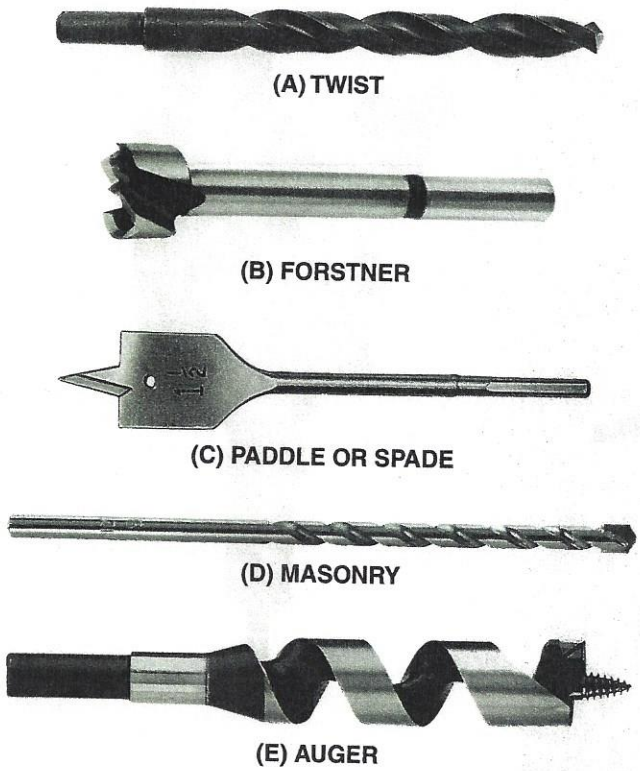


Figure 2 Drill bits.

Drill bit sizes can vary a great deal. For most applications, bits are available in both fractional inch sizes and metric sizes. For twist drill bits, common fractional-inch sizes range from 1/64-inch to 1 inch. Common metric sizes for twist drill bits range from 0.5 mm to 25.0 mm. It is important to note that fractional-inch bits and metric bits are not directly interchangeable. In other words, no fractional-inch bit has a corresponding metric bit, and vice versa. However, twist drill bits are also available in sets of numbered and lettered bits. Numbered sets range from #80 up to #1, which is the largest of the set. The next bit size larger is the A bit, with the Z bit being the largest of the lettered set. These sets correspond to decimal fraction and metric sizes. For example, a #8 drill bit is sized at 0.199 inches and 5.055 mm. Number and letter drills are used or specified when the precise size of the hole is important.

All bits are held in a drill by the drill **chuck**. Keyed chucks are opened and closed using a **chuck key** (*Figure 3*). Chuck keys are typically interchangeable in design, but there are several different sizes. Keyless chucks are also used, normally found on cordless drills. The size of the bit or tool that a drill can accommodate is limited by the size of the chuck.

Some electric power drills are designed to be used in tight spaces, such as between studs and joists. Drills like those shown in *Figure 4* are

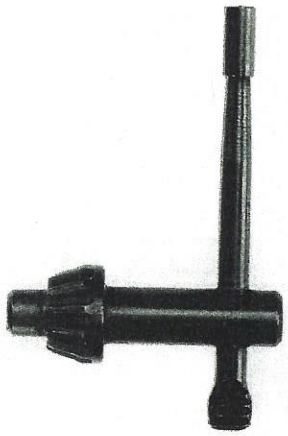


Figure 3 Chuck key.

referred to as right-angle drills. The drill on the right is larger and develops more power for larger holes.

1.1.1 Cordless Drills

Cordless power drills (*Figure 5*) are useful for working in areas where a power source is hard to find.

Cordless drills contain a rechargeable battery pack that runs the motor. The pack can be detached and plugged into a battery charger any time the drill is not in use. Some chargers can recharge the battery pack in short period of time, while others require more time. The quality of charge and the life-cycle of the battery must often be considered when determining how to best charge the battery. Manufacturers provide information regarding the health of the battery in the product literature. Workers who use cordless drills often carry an extra battery pack with them.

Some cordless drills have adjustable clutches so that the drill motor can also serve as a power screwdriver without applying too much power to the screw. Note that most cordless drills are equipped with keyless chucks except the most heavy-duty models.

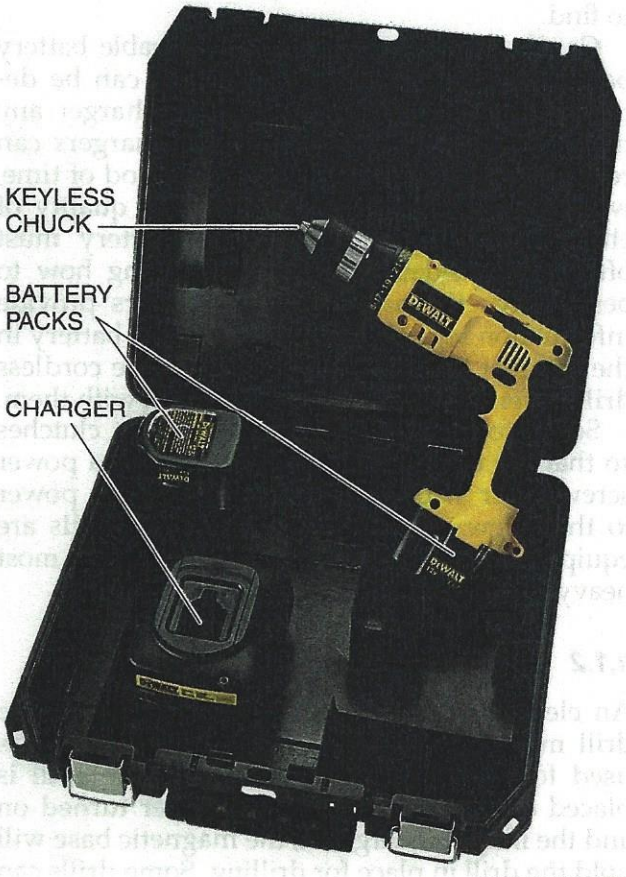
1.1.2 Electromagnetic Drills

An electromagnetic drill (*Figure 6*) is a portable drill mounted on an electromagnetic base. It is used for drilling thick metal. Once the drill is placed on a metal surface, the power turned on and the magnet energized, the magnetic base will hold the drill in place for drilling. Some drills can also be rotated in place while the base remains stationary.

A switch on the junction box controls the electromagnetic base. When the switch is turned

00104-15_F04.EPS

Figure 4 Right-angle drills.



00104-15_F05.EPS

Figure 5 Cordless drill.

on, the magnet holds the drill in place on any surface with magnetic characteristics, such as carbon steel. The drill base must be clean and the surface must be flat. The switch on the top of the drill turns the drill motor on and off. A depth gauge can be used to set the depth of the hole being drilled. It operates like a drill press, with the operator turning a hand wheel to raise and lower the drill against the workpiece. Workers who use electromagnetic drills should be properly trained to safely operate the specific drill being used.

CAUTION

Do not remove power from an electromagnetic drill while it is in use. Interrupting power to the drill will deactivate the electromagnetic base and cause the drill to fall.

1.1.3 How to Use a Power Drill

To prepare a drill for use, first make sure that the drill is disconnected from its power source. Then turn the chuck counterclockwise (to the left) until the chuck opening is large enough to fit the bit **shank**, which is the smooth part of the bit. Insert the bit shank into the chuck opening (*Figure 7*[*A*]). Keeping the bit centered in the opening, turn the chuck by hand until the jaws grip the bit shank. Make sure the bit is straight in the chuck and not leaning.

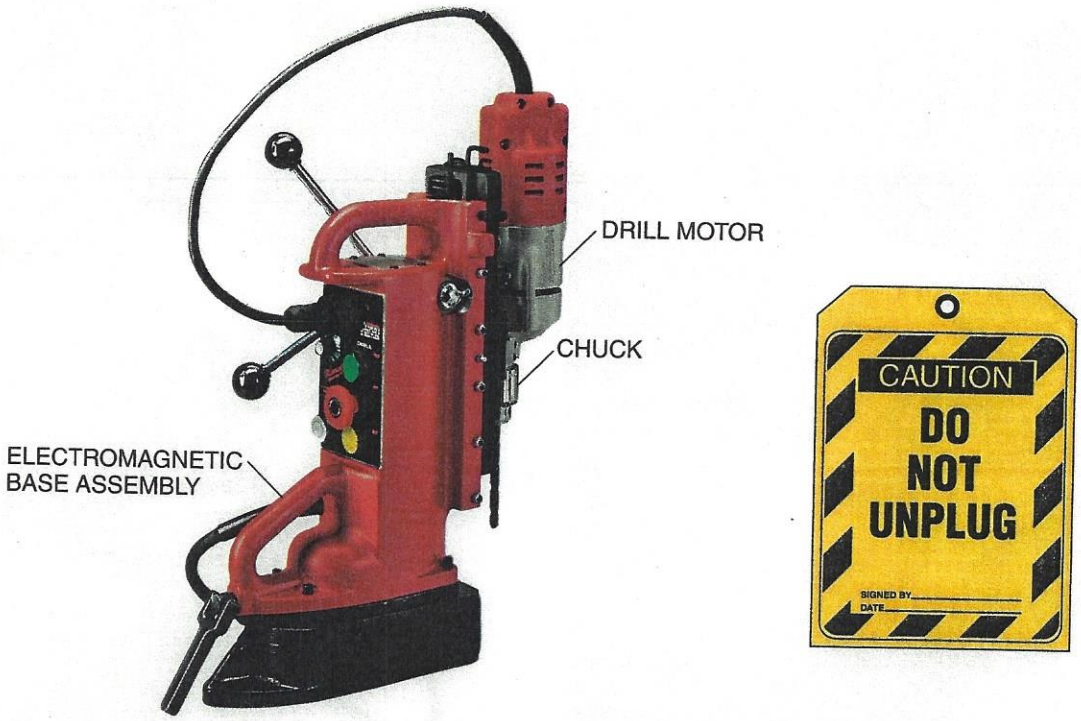


Figure 6 Electromagnetic drill.

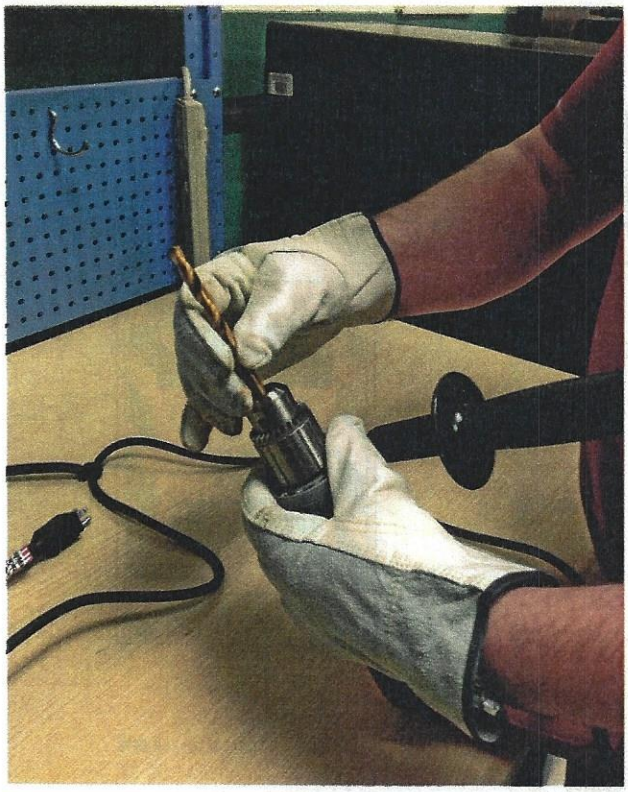
For keyed chucks, insert the chuck key (*Figure 7[B]*) for the drill into one of the holes on the side of the chuck. The chuck key has a grooved ring called a gear. Make sure that the proper size chuck key is used so that the key's gear meshes with the matching gears on the end of the chuck. Turn the chuck key clockwise to tighten the grip on the bit. With larger chucks, tighten the bit by inserting the chuck key into each of the holes in the three-jawed chuck. This tightens the individual jaws and ensures that all the jaws close uniformly tight around the bit. Once the bit has been secured, remove the key from the chuck.

WARNING! Always remember to remove the key from the chuck. Otherwise, when you start the drill, the key could fly out and injure you or a co-worker.

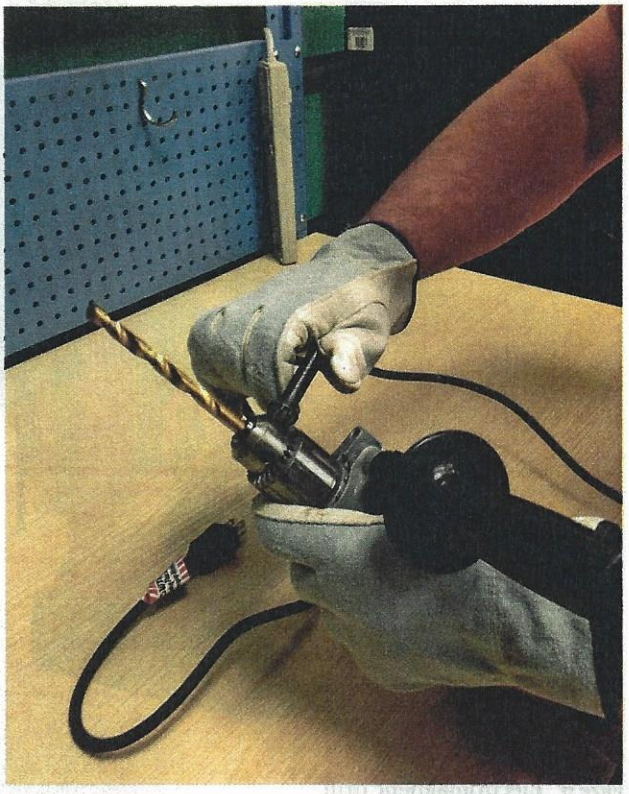
CAUTION Power drills can be dangerous if you do not use them properly. Always wear the proper PPE, including appropriate eye, head, and hand protection.

To drill a hole with a power drill, start by making a small indent in the material exactly where the hole needs to be drilled. In wood, use a small punch to make the indent; in metal, use a center punch. Firmly clamp or support the work that is being drilled. Then, hold the drill perpendicular (at a right angle) to the material surface and start the drill motor. With a variable-speed drill, start the bit slowly. Be sure the drill is rotating in the right direction (with the bit facing away it should be turning clockwise). Hold the drill with both hands and apply only moderate pressure when drilling. The drill motor should operate at approximately the same **revolutions per minute (rpm)** as it does when it is not loaded. If the sound of the drill indicates it is slowing considerably, use less pressure. *Figure 7*(C) shows the proper way to hold the drill.

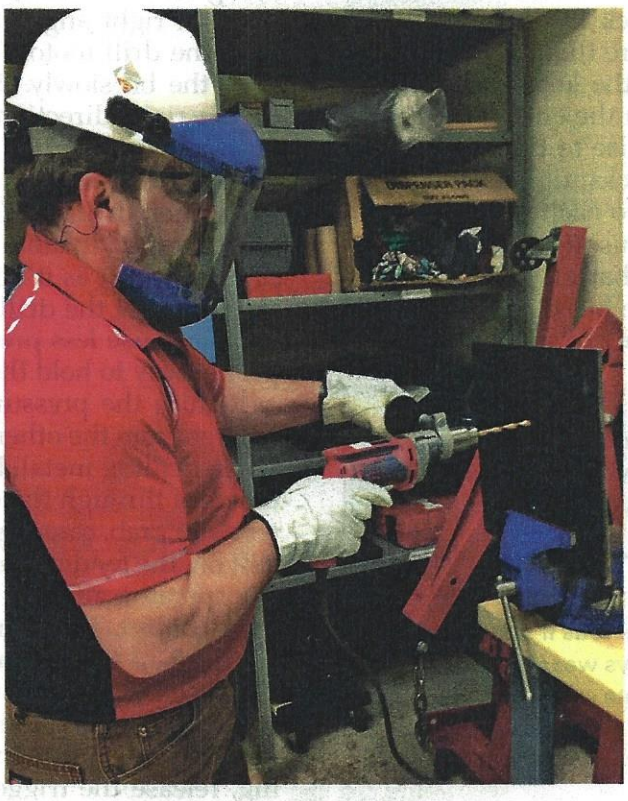
Reduce the pressure when the bit is about to emerge from the other side of the work, especially when drilling metal. Be prepared! As the drill bit emerges through the opposite side of the work, it tends to grab, causing the bit to stall. With power still on, the tendency of the drill motor is to rotate the operator, and not the bit! Be sure to maintain firm control. If too much pressure is being applied when the bit comes out the other side, the drill itself will hit the surface of the material. This could damage or dent the metal surface. If the drill bit gets stuck in the material during drilling, release the trigger, use the reversing switch to change the direction of the drill, and back it gently out of the material. After backing out the bit, switch back to the original drilling position.



(A) INSERT THE BIT SHANK INTO THE CHUCK OPENING.



(B) TIGHTEN WITH THE CHUCK KEY.



(C) HOLD THE DRILL PERPENDICULAR TO THE MATERIAL AND START THE DRILL.

00104-15_F07.EPS

Figure 7 Proper drill use.

Many drills, including most cordless drills, have a keyless chuck. The same basic safety concerns apply to preparing and using these types of drills. Always wear personal protective equipment (PPE), including appropriate eye, head, and hand protection. In addition, make sure that the drill is disconnected from its power source by removing the power pack/battery before loading a bit.

The steps for loading a bit on a cordless drill with a keyless chuck are shown in *Figure 8*. First, open the chuck by turning it counterclockwise until the jaws are wide enough to insert the bit shank (*Figure 8*[*A*]). Keep the bit centered in the opening and tighten the chuck by hand until the jaws grip the bit shank (*Figure 8*[*B*]). Make sure the bit is straight in the chuck and not leaning. Once the bit is properly secured in the chuck (*Figure 8*[*C*]), follow the same operating procedures previously outlined for the power drill.

WARNING! To avoid injury, adjust the drill chuck properly prior to each use. Do not use the tool motor to tighten the chuck while gripping it.

1.1.4 Safety and Maintenance

In addition to the general safety rules covered in the *Basic Safety* module, there are some specific safety rules for working with drills. Always wear the appropriate PPE when working with drills, especially safety glasses. Keep hands away from the drill bit and chuck.

WARNING! Workers must make sure that their hands do not make contact with the drill bit. The spinning bit will easily cut hands. Keep an even pressure on the drill to keep the drill from twisting or binding.

To prevent an electrical shock, operate only those tools that are double-insulated electric power tools with proper **ground fault protection**. Using a **ground fault circuit interrupter (GFCI)** device protects the equipment from continued electrical current in case of a circuit fault. The GFCI monitors the current flow and opens the circuit (which stops the flow of electricity) if it detects a difference between positive and negative flow. The interruption typically takes place in less than one-tenth of a second. Also, make sure that electric tools with two-prong plugs are double-insulated. If a tool is not double insulated, its plug must have a third prong to provide a ground circuit. Double-insulated tools do not connect to a ground circuit. GFCIs should still be used with these tools.

Before connecting a drill to its power source, make sure the trigger is not turned on. Always disconnect the power source before changing bits or working on the drill.

To avoid hitting water lines or electrical wiring when drilling through a wall or partition, know what is inside the wall or on the other side of the work material beforehand.

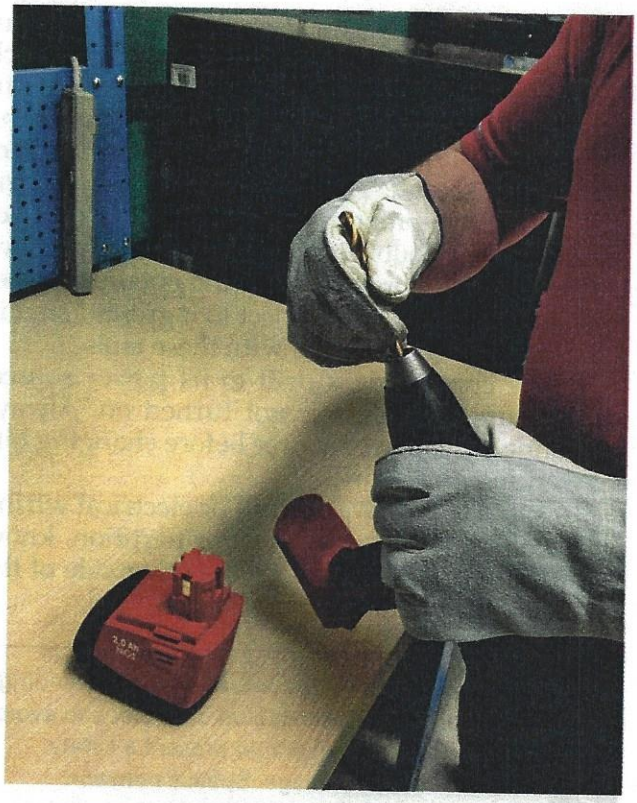
WARNING! Do not drill into or through a wall before finding out what is on the other side. Take steps to avoid hitting anything that would present a safety hazard or cause damage. Spaces between studs (upright pieces in the walls of a building) often contain electrical wiring, plumbing, or insulation. Care must be taken to avoid drilling directly into the wiring, pipes, or insulation.

Prior to drilling, select the proper bit for the job. Always use a sharp bit. Make sure the drill bit is securely tightened in the chuck and the chuck key is removed from the chuck before drilling. Attach the chuck key to the power cord when it is not in use so that it does not get lost. Most chuck keys are provided with a lanyard to connect it to the cord.

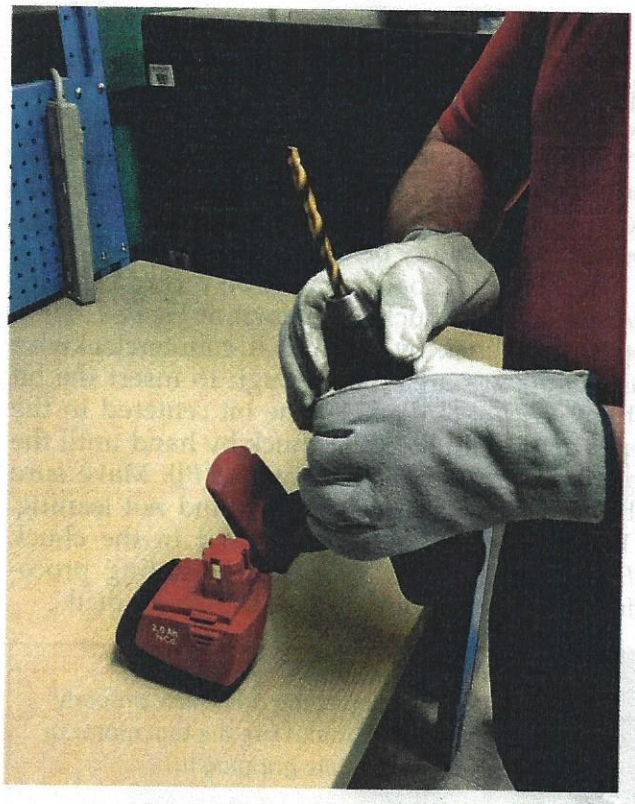
Hold the drill with both hands and apply steady pressure. Let the drill do the work. Never ram the drill while drilling; this chips the cutting edge and damages the bearings. Also, never use a drill's trigger lock to hold the trigger in the operating mode. Do not overreach when using a power drill; maintain a stable, balanced stance. When using a cordless drill, observe the same safety practices that apply to corded electric power drills.

Drilling Metal

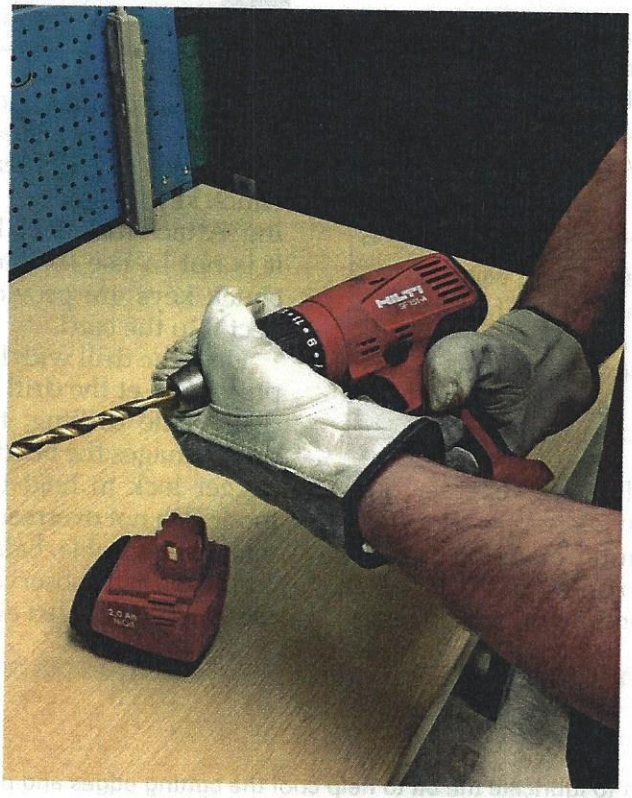
When drilling metal, it is best to lubricate the bit to help cool the cutting edges and produce a smoother finished hole. A very small amount of cutting oil or tapping fluid that is not combustible makes a good lubricant for drilling softer metals. No lubrication is needed for wood drilling. When drilling deep holes, pull the drill bit partly out of the hole occasionally. This helps to clear the hole of shavings.



(A) INSERT THE BIT SHANK.



(B) KEEP BIT STRAIGHT AND PARTIALLY TIGHTEN THE CHUCK.



(C) TIGHTEN THE CHUCK SECURELY.

00104-15_F08.EPS

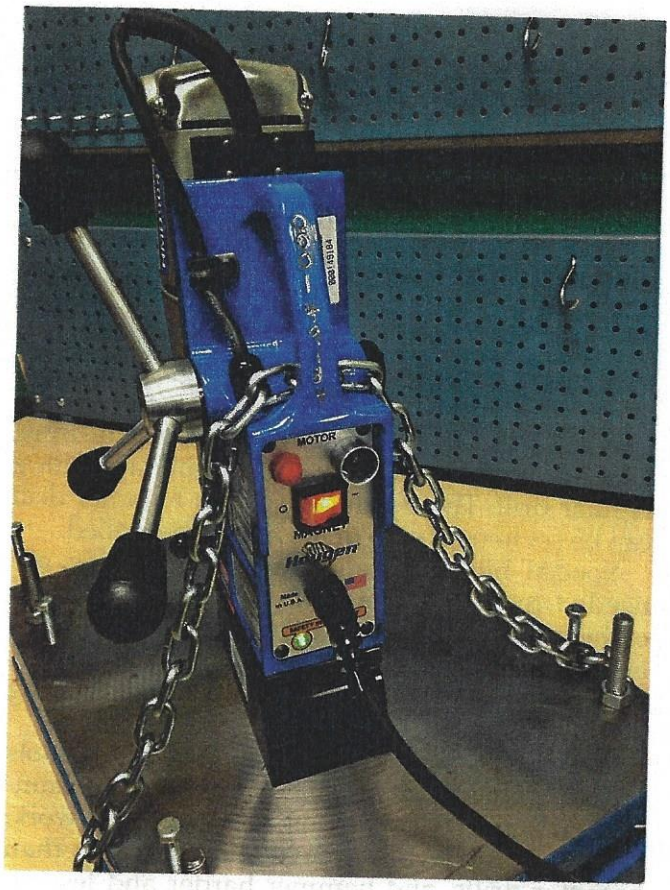
Figure 8 Loading the bit on a cordless drill.

WARNING!

If power tools are shared between workers, it is important to not grab the tool by the bit or any other moving part. Power tools should be disconnected from their source of power whenever they are passed between workers to avoid accidental startups. Hand off tools by their handles and/or bodies only.

Drills do not need much maintenance, but they should be kept clean. Before any maintenance is done, including simple cleaning, always be sure that the tool is unplugged or otherwise disconnected from its power source. Most drills do not require periodic lubrication. Keep the drill's air vent clean with a small brush. Airflow is crucial to the life expectancy of a drill.

There are several specific safety rules that apply to electromagnetic drills. For example, it is important to clamp the material being drilled securely. Unsecured materials can become dangerous flying or spinning objects. In addition, since these types of drills are mounted onto an electromagnetic base, it is important to maintain electrical power to the drill's electromagnet. Make sure the electrical power supply is not interrupted; put a Do Not Unplug tag on the cord (refer to *Figure 6*). Also, use a safety chain to secure the electromagnetic drill in case power is shut off or lost (*Figure 9*). Safety attachments, such as shields



00104-15_F09.EPS

Figure 9 Electromagnetic drill with safety chain.

GOING GREEN

Recycling Rechargeable Batteries

Recycling rechargeable batteries once their power supply has become exhausted is no longer a luxury; it has become a matter of necessity. In fact, there are now federal and state laws in place regulating the disposal of some types of rechargeable batteries.

The US Environmental Protection Agency estimates that more than 350 million rechargeable batteries are purchased in the United States and hundreds of millions of rechargeable batteries and cell phones are retired each year. Rechargeable batteries are made using heavy metals such as nickel, cadmium, mercury, and lead that can be toxic to people and the environment if not disposed of properly. Most dumps are not designed to handle the toxic metals that will eventually leak out of the batteries.

Rechargeable batteries are commonly found in the following:

- Cordless power tools
- Cellular and cordless phones
- Two-way radios
- Laptop computers
- Digital cameras
- Camcorders
- Remote control toys

If a battery is rechargeable, then it is recyclable. Not only are rechargeable batteries better for the environment if properly discarded, they are more cost effective. Using rechargeable batteries can help save money and protect the environment at the same time.

Recently, most cities have added hazardous waste collection centers that collect both rechargeable and regular batteries, along with paint, oil, refrigerant, and other hazardous wastes.

to block flying objects and safety lines to keep the drill from falling if the power is cut off, are available. In some places, these attachments are required. Instructors or supervisors should be familiar with the requirements for safety attachments in their specific areas. Finally, support the drill before turning it off; otherwise, when the power is turned off, the drill may fall over.

1.2.0 Hammer Drills

A hammer drill (*Figure 10*) has a light pounding action that enables it to drill into concrete, brick, or tile. The bit rotates and hammers at the same time, allowing faster drilling in these materials than a regular drill. The depth gauge on a hammer drill can be set to the depth of the hole to be drilled.

Special bits that can take the pounding are needed for a hammer drill. Hammer drills use carbide-tipped masonry bits whenever they are being using in masonry. Common drilling tasks can be done with other bits when the hammering action is disabled.

The term *hammer drill* is often used for all tools that hammer and drill. However, rotary hammers (*Figure 11*) are for more heavy-duty work. They usually have slower rotational speeds than hammer drills, and hammer harder and less often than a hammer drill. Most rotary hammers require bits that fit into special chuck designs (*Figure 12*). You must select masonry bits that are compatible with the particular type of chuck on the tool. The chucks are not keyed, but rely upon the design of the bit and chuck to hold it in place. Adapters are available to use one bit shank design with another type of chuck when necessary.

00104-15_F10.EPS

Figure 10 Hammer drill.

00104-15_F11.EPS

Figure 11 Rotary hammer.

1.2.1 How to Use a Hammer Drill

When using a hammer drill, follow the same safety practices that apply to electric power drills. Always wear proper PPE, including appropriate eye, head, and hand protection. If the drill is being used on concrete or similar materials that produce airborne dust, respiratory protection is needed as well.

Most hammer drills will not hammer until pressure is applied to the drill bit against a surface. An adjustable ring is turned to adjust the number of blows per minute. The hammer action stops when pressure applied to the drill is stopped.

1.3.0 Pneumatic Drills and Impact Wrenches

Pneumatic power tools are powered by compressed air. An air hose transfers the compressed air from an air compressor to the tool. Pneumatic tools tend to have more power for their weight than comparable electric tools. Two common pneumatic power tools used by construction workers are pneumatic drills and impact wrenches.

1.3.1 Pneumatic Drills

Pneumatic drills have many of the same parts, controls, and uses as electric drills. Since there is no motor, they are generally more compact in size. A pneumatic drill is typically used when there is no available source of electricity, or when a high rate of production is desired. Like electric drills, they can also be used as power

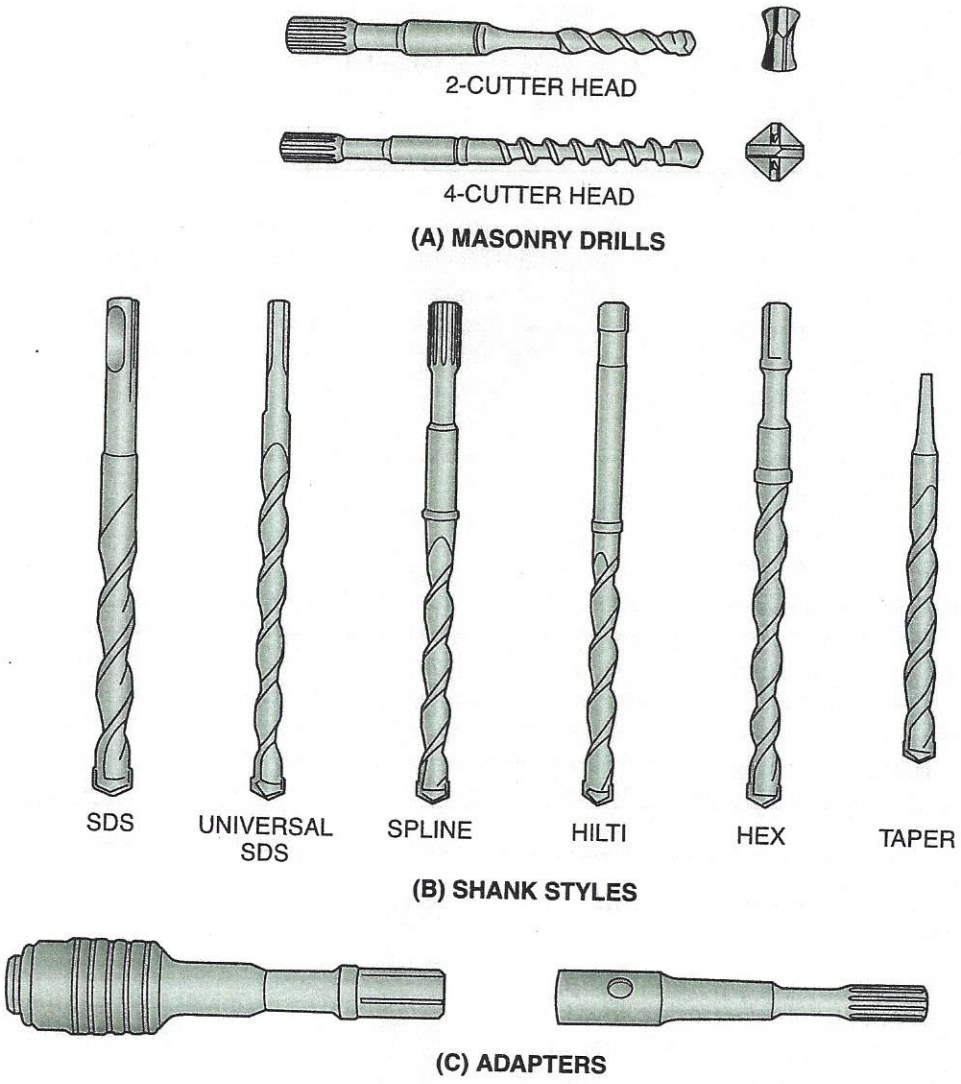


Figure 12 Rotary hammer bit designs.

screwdrivers. The pneumatic drill in *Figure 13* has a Phillips-head screwdriver bit in the chuck. They are sometimes equipped with a keyed chuck.

Common sizes of pneumatic drills are ¼-, ⅜-, and ½-inch. The size refers to the diameter of the largest bit shank that can be gripped in the chuck, not the drilling capacity. Some common metric sizes are 8 mm, 10 mm, and 13 mm.

1.3.2 Impact Wrenches

Pneumatic impact wrenches (*Figure 14*) are power tools that are used to fasten, tighten, and loosen nuts and bolts. As with a pneumatic drill, a pneumatic impact wrench must be connected with a hose to an air compressor. The speed and strength (torque) of these wrenches can easily be adjusted depending on the type of job. Note that although pneumatic impact wrenches are more popular, there are electric models as well.

Figure 13 Pneumatic drill.

Around the World

Power Sources

Each country provides power to its residents at a voltage and frequency that they believe best for their own needs. While the voltage often varies slightly from the target voltage, most power tools can accommodate these minor day-to-day differences. However, users must always ensure that the power supply for a given tool is appropriate. Although slight changes in voltage do not represent a problem, changes in power frequency and significant changes in the voltage will damage or destroy a power tool.

Here are the power characteristics for single-phase power from several different countries to show their differences. Note that the frequency, reported in hertz (Hz), refers to the cyclic nature of alternating current and how many cycles are completed per second:

- Portugal: 230 volts @ 50Hz
- Hungary: 220 volts @ 50 Hz
- England: 240 volts @ 50 Hz
- Sweden: 230 or 400 volts @ 50 Hz
- United States: 115 or 230 volts, 60 Hz

Note that the United States is one of very few countries that provide power at 60 Hz. Many devices can operate using power from almost all international power systems. These devices are often battery-charging devices that use a transformer to reduce the voltage and change the voltage to direct current (DC) to charge a battery. Other devices, such as computers and printers, may be equipped with external switches to allow the use of different power sources. However, few if any portable power tools have been designed with such a switch, and corded tools have no transformer. So before packing away your favorite power saw for work in another country, be sure that there is a power supply in place that can support the tool's required voltage and frequency.

1.3.3 How to Use Pneumatic Drills and Impact Wrenches

Using a pneumatic drill or a pneumatic impact wrench safely and effectively requires a few basic considerations. Always read the tool manufacturer's instructions for guidance and wear the appropriate PPE. Make sure that the air compressor is set to the appropriate pressure. Also, ensure there is an oiler if the tool requires one, either at the air source or at the tool (*Figure 15*).

When connecting the tool, make sure that the pneumatic connection between the tool and the supply hose is good, and install a whip check as required (*Figure 16*). A whip check is a safety attachment that is used to prevent whiplashing in hoses that are inadvertently uncoupled.

WARNING!

The air hose must be connected properly and securely. An unsecured air hose can come loose and whip around violently, causing serious injury. Some fittings require the use of whip checks to keep them from coming loose.

Use only those drill bits and impact sockets that are designed for use with the applicable tool. Operate the tool safely and when the work is completed, disconnect the tool from the air hose.

WARNING!

Using handheld sockets can damage property and cause injury. Use only impact sockets made for pneumatic impact wrenches.

00104-15_F14.EPS

Figure 14 Pneumatic impact wrench.

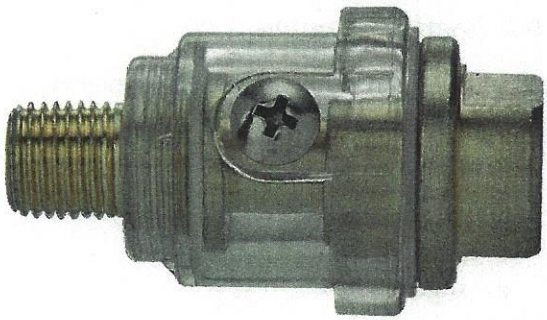
1.3.4 Safety and Maintenance

The safety practices that should be followed when using a pneumatic drill or an pneumatic impact wrench are similar to those that apply to power drills. Always wear the appropriate PPE, including eye, hand, and ear protection. Make sure that the workpiece is secure. It is also important to maintain a balanced body stance when operating the tool and keep hands away from the working end of the tool. If hardware being tightened is a bolt-and-nut combination, use a backup wrench to keep the bolt or nut from spinning.

The air supply should be clean, dry, and at the proper pressure. Before changing attachments or performing any maintenance on a pneumatic drill or pneumatic impact wrench, make sure that the air supply is turned off and the tool is physically disconnected from the supply hose.

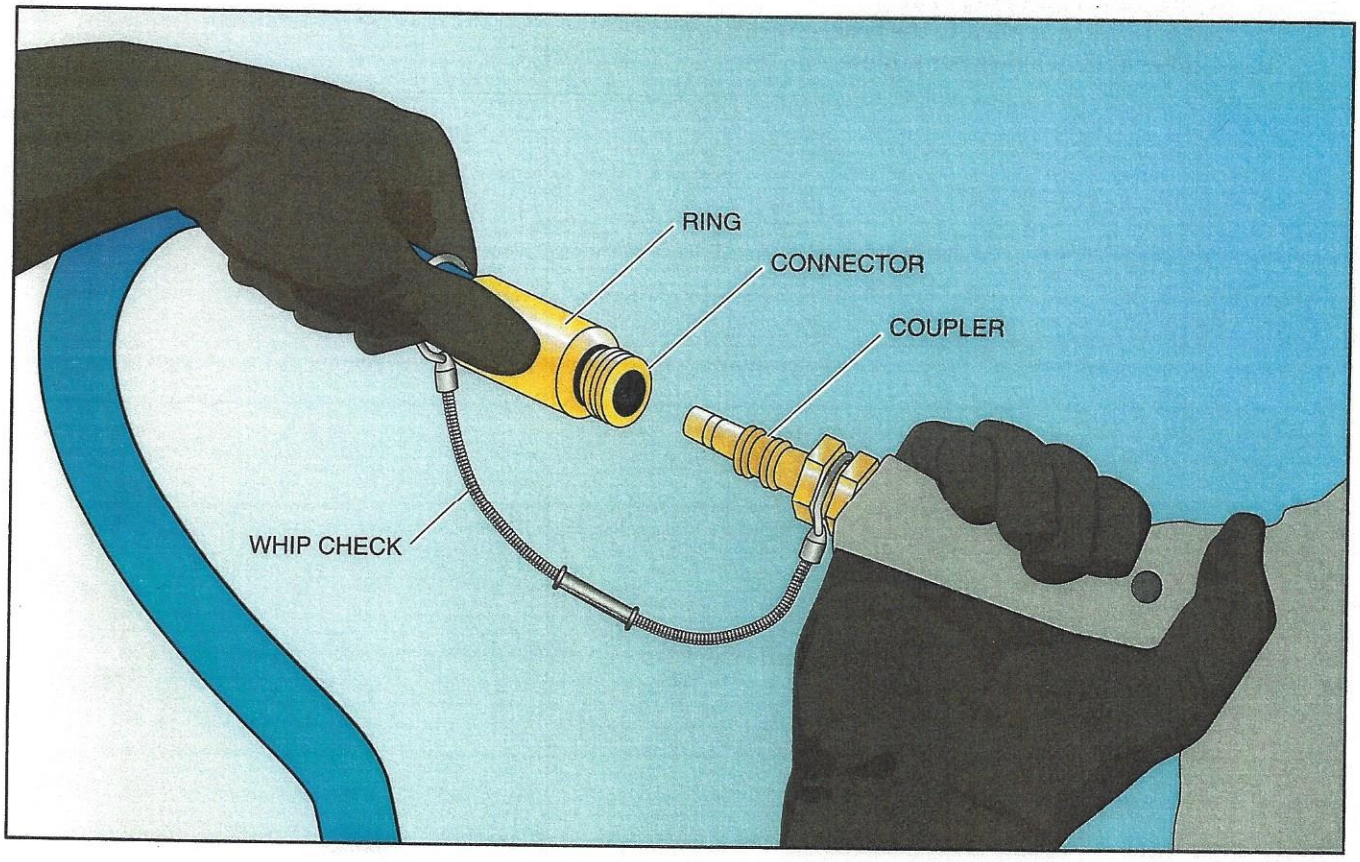
WARNING!

The amount of air pressure used to power a pneumatic drill is higher than the OSHA recommendation for cleaning a work area or similar activities. Improper use of pressurized air can lead to injuries as well as damage to the tool or materials.



00104-15_F15.EPS

Figure 15 Inline pneumatic oiler reservoir.



00104-15_F16.EPS

Figure 16 Properly connecting a pneumatic tool.

Additional Resources

29 *CFR* 1926, *OSHA Construction Industry Regulations*, Latest Edition. Washington, DC: Occupational Safety and Health Administration, US Department of Labor, US Government Printing Office.

All About Power Tools. Ortho Books; Larry Johnson, ed. 2002. Des Moines, IA: Meredith Books.

Power Tool Institute, Inc. 1300 Sumner Avenue Cleveland, OH 44115-2851. **www.powertoolinstitute.com**.

1.0.0 Section Review

1. A device on a power drill that enables a user to back out a drill bit that is stuck in the work material is called a(n) _____.
   a. chuck key
   b. reversing switch
   c. whip check
   d. auger switch

2. A hammer drill has an adjustable ring that can be turned to adjust the _____.
   a. voltage reaching the drill motor
   b. depth of the hole being drilled
   c. magnetic force applied to the base
   d. number of drill blows per minute

3. A pneumatic power tool that is best suited for fastening, tightening, and loosening nuts and bolts is a _____.
   a. cordless screwdriver
   b. hydraulic ratchet
   c. pneumatic impact wrench
   d. right-angle drill

SECTION TWO

2.0.0 POWER SAWS

Objective

Identify and explain how to use various types of power saws.

a. Identify and explain how to use a circular saw.
b. Identify and explain how to use saber and reciprocating saws.
c. Identify and explain how to use a portable band saw.
d. Identify and explain how to use miter and cutoff saws.

Performance Task

1. Safely and properly demonstrate the use of the following tool(s):
   - Circular saw
   - Reciprocating saw
   - Portable band saw
   - Miter or cutoff saw

Trade Terms

Arbor: The end of a circular saw shaft where the blade is mounted.

Kerf: The channel created by a saw blade passing through the material, which is equal to the width of the blade teeth.

Reciprocating: Moving backward and forward on a straight line.

Using the right saw for the job will make your work much easier. Always make sure that the blade is right for the material being cut. This section focuses on the following types of power saws:

- Circular saws
- Saber saws
- **Reciprocating** saws
- Portable handheld band saws
- Power miter box saws

2.1.0 Circular Saws

Many years ago, a company named Skil® made power tool history by introducing the portable circular saw. Today many different companies make dozens of models, but a lot of people in the United States still call any portable circular saw a Skilsaw. Other names you might hear are utility saw, electric handsaw, and builder's saw. The portable circular saw (*Figure 17*) is designed to cut lumber and boards to size for a project.

The size of a circular saw is based on the diameter of the circular blade. Circular saws used in the United States typically use fractional-inch measurements with blade diameters that range from 3⅜ to 16¼ inches. The most popular blade size for corded saws is 7¼ inches. Many smaller cordless circular saws use a 6½-inch blade. The hole in the center of a circular saw blade fits onto the **arbor**, or shaft, of the saw. The most common arbor size for a circular saw blade is ⅝ inch.

Circular saws are also available in metric sizes. Metric circular saws typically have circular blades of 165 mm, 190 mm, or 235 mm. Most metric circular saws have a 20 mm arbor, although some have a 25.4 mm arbor. It is important to note that standard saws with fractional-inch measurements are not interchangeable with metric saws. For instance, a 7¼-inch blade with a ⅝-inch arbor hole is not the same as a 190 mm blade with a 20 mm arbor hole. Only metric blades can be used on metric saws and only fractional-inch blades can be used on standard saws.

Circular saw weights can vary, but most of them weigh between 7 and 14 pounds (3.175 kg and 6.35 kg). The handle of the circular saw has a trigger switch that starts the saw. The motor is protected by a rigid housing. Blade speed when the blade is not engaged in cutting is stated in rpm. The teeth of the blade point in the direction of rotation.

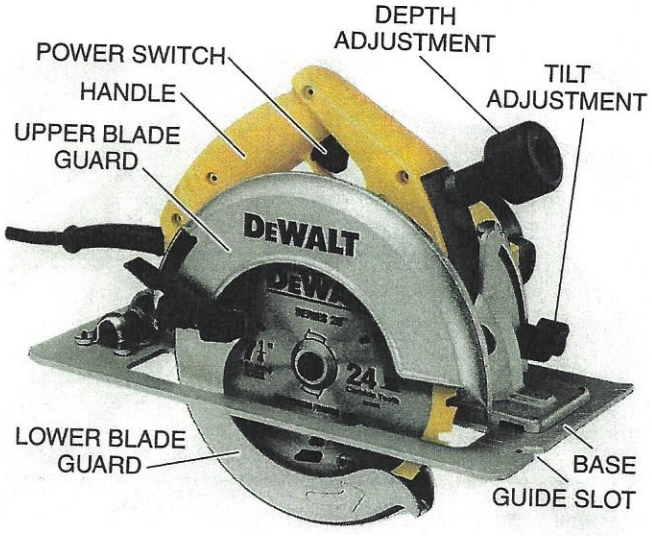


Figure 17 Circular saw.

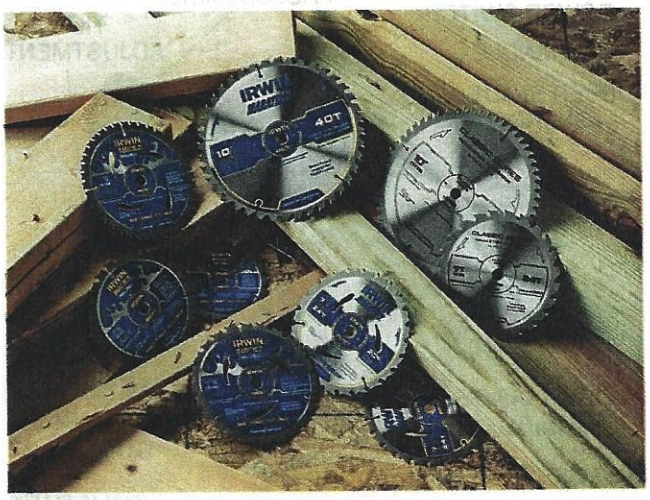
The blade is protected by two guards. On top, a rigid plastic guard protects workers from flying debris and from accidentally touching the spinning blade. The lower guard is spring-loaded—when the saw is pushed forward, it retracts up and under the top guard to allow the saw to cut.

WARNING!

Never use the saw unless the lower blade guard is properly attached. The guard protects the user from the blade and from flying particles.

Saw blades fall into two categories: standard steel, which must be sharpened regularly, and carbide-tipped. Carbide-tipped blades are very common, but you must use the appropriate saw blade for the job. Some common types of saw blades include the following (refer to *Figure 18*):

- *Rip* – These blades are designed to cut with the grain of the wood. The square chisel teeth cut parallel with the grain and are generally larger than other types of blade teeth.
- *Crosscut* – These blades are designed to cut across the grain of the wood; that is, at 90-degree angle. Crosscut teeth cut at an angle and are finer than rip blade teeth.
- *Combination* – These blades are designed to cut hard or soft wood, either with or across the grain. The combination blade features both rip and crosscut teeth with deep troughs (gullets) between the teeth.
- *Nail cutter* – This blade has large carbide-tipped teeth that can make rough cuts through nails that may be embedded in the work.



00104-15_F18.EPS

Figure 18 Circular saw blades.

- *Nonferrous metal cutter* – This blade has carbide-tipped teeth for cutting aluminum, copper, lead, and brass. It should be lubricated with oil or wax before each use.

Always follow the manufacturer's instructions when using saw blades.

2.1.1 How to Use a Circular Saw

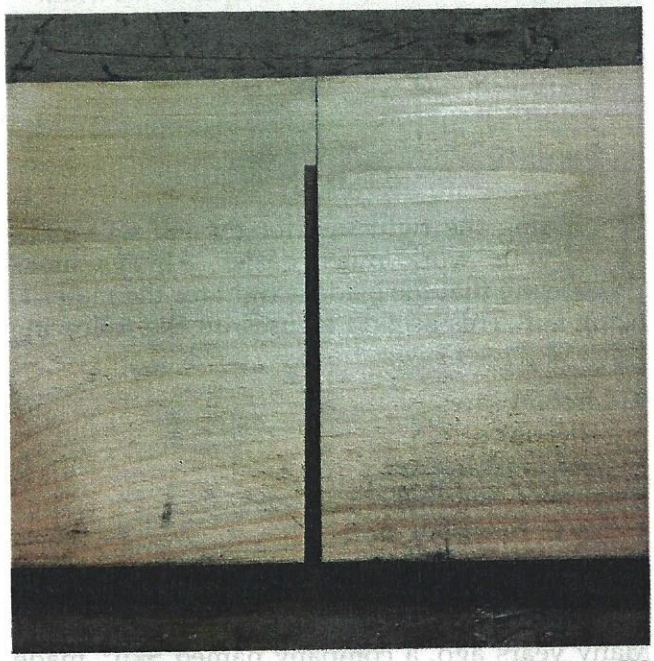
Using a circular saw safely and efficiently requires the user to wear the appropriate PPE. The material to be cut must be secured and properly supported. If the work isn't heavy enough to stay in position without moving, it should be weighted or clamped down. The cut to be made should be marked with a pencil or other marking tool.

With the tool unplugged, the blade depth can be adjusted to the thickness of the wood being cut plus ¼-inch (≈6 mm). That way, the blade does not protrude through the material farther than necessary. The front edge of the baseplate should be placed on the work so the guide notch and the blade are in line with the cut mark.

CAUTION

Make sure the blade is appropriate for the material being cut.

Circular saw blades leave a **kerf** (*Figure 19*) that is roughly ⅛-inch (3.2 mm) wide. Be sure to align the blade with the waste side of the cutting line,



00104-15_F19.EPS

Figure 19 Saw kerf.

or the finished piece will be short. When marking for the cut, mark an X on the waste side of the cut mark as a reminder of which side of the mark to cut. The saw kerf is an unavoidable result of sawing any material, so it must be considered for each and every cut.

After the saw has been started and is up to full speed, it is moved forward to start cutting. The lower blade guard will automatically rotate up and under the top guard when the saw is pushed forward. While cutting with the saw, grip the saw handles firmly with two hands, as shown in *Figure 20*.

If the saw cuts off the line, stop, back up very slightly and restart the cut. Do not force the saw. As the cut nears completion, the guide notch on the baseplate will move off the end of the work. At that point, use the blade as a guide. Once the cut has been completed, release the trigger switch. The blade will stop rotating. Make sure the blade has stopped before setting the saw down.

00104-15_F20.EPS

Figure 20 Proper use of a circular saw.

2.1.2 Safety and Maintenance

There are numerous factors to consider in order to use a circular saw safely and effectively. First, always wear the appropriate PPE. Before connecting the saw to its source of power, ensure that the blade is tight and that the blade guard is working correctly. The chosen blade should have a maximum rpm equal to or higher than the speed of the saw. To avoid hitting water lines or electrical wiring, find out what is inside the wall or on the other side of a partition before cutting through a structure.

During operation, keep both hands on the saw grips. Never force the saw through the work. This causes binding and overheating and may cause injury. Never reach underneath the work while operating the saw and never stand directly behind the work. Always stand to one side of it. Use clamps to secure small pieces of material to be cut. Know where the saw's power cord is located at all times. Accidentally cutting through the power cord can cause electrocution.

WARNING!

When using a circular saw, workers should never hold material to be cut with their hands; always use a clamp instead.

The most important maintenance on a circular saw is at the lower blade guard. Sawdust builds up and causes the guard to stick. If the guard sticks and does not move quickly over the blade after it makes a cut, the bare blade may still be turning when the saw is set down and may cause damage. Remove sawdust from the blade guard area. Remember to always disconnect the power source before performing any maintenance.

The Worm-Drive Saw

The worm-drive saw is a heavy-duty type of circular saw. Most circular saws have a direct drive. That is, the blade is mounted on a shaft that is part of the motor. With a worm-drive saw, the motor drives the blade from the rear through two gears. One gear (the worm gear) is cylindrical and threaded like a screw. The worm gear drives a wheel-shaped gear (the worm wheel) that is directly attached to the shaft to which the blade is fastened. This setup delivers much more rotational force (torque), making it easier to cut a double thickness of lumber. The worm-drive saw is almost twice as heavy as a conventional circular saw. This saw should be used only by an experienced craftworker.

00104-15_SA01.EPS

To avoid personal injury and damage to materials, check often to make sure the guard snaps shut quickly and smoothly. To ensure smooth operation of the guard, disconnect the saw from its power source, allow it to cool, and clean foreign material from the track. Be aware of fire hazards when using cleaning liquids such as isopropyl alcohol. Do not lubricate the guard with oil or grease. This could cause sawdust to stick in the mechanism. Always keep blades clean and sharp to reduce friction and kickback. Blades can be cleaned with hot water or mineral spirits. Be careful with mineral spirits; they are very flammable.

2.2.0 Saber and Reciprocating Saws

Two types of saws that are capable of making straight and curved cuts are saber saws and reciprocating saws. Both of these saws have a blade that moves back and forth to enable the cutting action.

2.2.1 Saber Saws

Saber saws, sometimes referred to as jig saws, have very fine blades. This makes the saw an effective tool for doing delicate and intricate work, such as cutting out patterns or irregular shapes from wood or thin, soft metals. They are also some of the best tools for cutting circles.

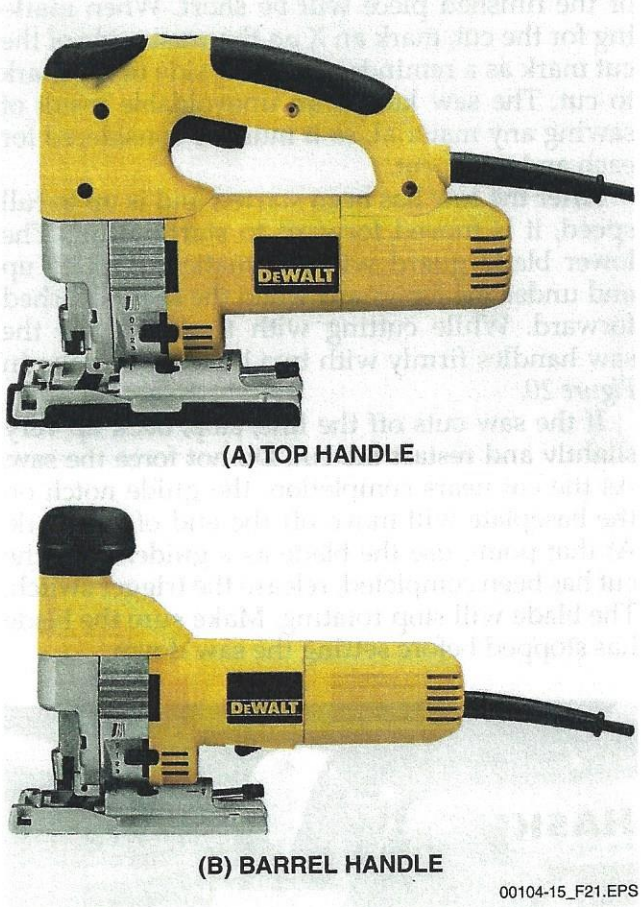
The saber saw (*Figure 21*) is a very useful portable power tool. It can make straight or curved cuts in wood, metal, plastic, wallboard, and other materials. The saber saw cuts with a blade that moves up and down, unlike the spinning circular saw blade. This means that each cutting stroke (upward) is followed by a return stroke (downward), so the saw is cutting only half the time it is in operation. This is called up-cutting or clean-cutting.

An important part of the saber saw is the baseplate (shoeplate or footplate). Its broad surface helps to keep the blade lined up. It keeps the work from vibrating and allows the blade teeth to bite into the material.

Many models are available with tilting baseplates for cutting beveled edges. Models come with a top handle or a barrel handle. Some cordless models are available.

The saber saw has changeable blades that enable it to cut many different materials, from wood and metal to wallboard and ceramic tile. Fine-toothed blades are used for thin materials and smoother cuts. Coarse blades are used for faster cutting in thicker materials and when smooth cuts are not a concern. Blades are rated by the number of teeth per inch or teeth per centimeter.

Most saber saws can be operated at various blade speeds. Types of saber saws include single-speed, two-speed, and variable-speed. The speed of a variable-speed saber saw is controlled by how far the trigger is depressed. The low-speed range is for cutting hard materials, and the high-speed range is for soft materials.



(A) TOP HANDLE

(B) BARREL HANDLE

00104-15_F21.EPS

Figure 21 Saber saws.

CAUTION

Do not lift the blade out of the work while the saw is still running. If the blade is lifted out, the tip of the blade may hit the wood surface, marring the work and possibly breaking the blade.

2.2.2 Reciprocating Saws

A reciprocating saw, regardless of the manufacturer, is often referred to as a SawZall® (a trademark of the Milwaukee Electric Tool Company) in the United States because it was the first saw designed to serve as an electric hacksaw. Both the saber saw and the reciprocating saw can make straight and curved cuts. They are used to cut irregular shapes and holes in plaster, plasterboard, plywood, studs, metal, and most other materials that can be cut with a saw.

Both saws have straight blades that move backward and forward along a straight line as they are guided along the cut. The reciprocating saw (*Figure 22*) is designed for more heavy-duty jobs than the saber saw. It uses longer and tougher blades than a saber saw.

The reciprocating saw is used for jobs that require brute strength. It is an excellent choice for general demolition work. It can saw through walls or ceilings and create openings for windows, plumbing lines, and more.

Like the saber saw, reciprocating saws come in single-speed, two-speed, and variable-speed models. The low-speed setting is best for metal work. The high-speed setting is for sawing wood and other soft materials.

The baseplate (shoeplate or footplate) may have a swiveling action, or it may be fixed. Whatever the design, the baseplate is there to provide a brace or support point for the sawing operation.

2.2.3 How to Use Saber and Reciprocating Saws

Many of the steps involved in the safe and efficient use of saber saws and reciprocating saws are the same. Both saws require the user to wear the appropriate PPE. The material being sawed should be clamped to a pair of sawhorses or secured in a vise to reduce vibration. It is also important to check the blade for dulling or damage and to make sure the proper blade is being used for the material. The material should be measured and marked before any cutting takes place.

When cutting from the edge of a board or panel with a saber saw, be sure the front of the baseplate is resting firmly on the surface of the work before starting the saw. The blade should not be touching the work at this stage. If a cut must be made from the middle of a board, drill a hole at the starting point that is large enough to allow the blade to pass through. Once all the preparations have been made, pull the trigger to start the saw and move the blade gently but firmly into the work. Continue feeding the saw into the work at a reasonable pace without forcing it. Do not force the blade into the work. When the cut is finished, release the trigger and let the blade come to a stop before removing it from the work.

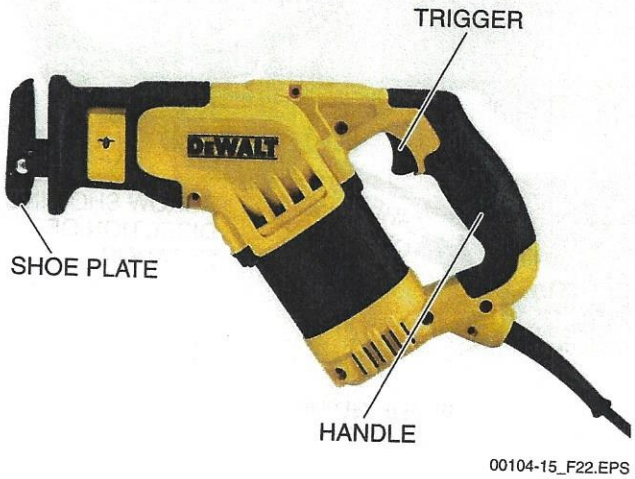
Before cutting material with a reciprocating saw, be sure to set the saw to the desired speed. Use lower speeds for sawing metal; use higher speeds for sawing wood and other soft materials. Grip the saw with both hands (*Figure 23*) and place the baseplate firmly against the workpiece. Once the trigger is squeezed to On, the blade moves back and forth, cutting on the backstroke.

WARNING! You must use both hands to grip the reciprocating saw firmly. Otherwise, the pull created by the blade's grip might jerk the saw out of your grasp.

2.2.4 Safety and Maintenance

As with any power tool, saber saws and reciprocating saws can be dangerous to operate if certain guidelines are not followed. Always wear appropriate PPE. Secure the material being cut to reduce vibration and ensure safety. Before cutting through a wall or partition, find out what is inside the wall or on the other side of the partition. This will prevent the accidental cutting of water lines or electrical wiring.

Make sure that the saw is disconnected from its power source before installing or changing blades or performing any maintenance on the saw.



00104-15_F22.EPS

Figure 22 Reciprocating saw.


00104-15_F23.EPS

Figure 23 Proper use of a reciprocating saw.

When installing a blade in the saw, make sure the blade is in the collar as far as it will go, and tighten the setscrew securely. When replacing a broken blade, look for any pieces of the blade that may be stuck inside the collar. Before using the saw, make sure that the switch is in the Off position before it is plugged into a power source.

Regardless of the type of saw being used, always use a sharp blade and never force the blade through the work. Forcing or leaning into the blade can cause a worker to lose balance, slip or fall forward, and risk being cut by the saw. When cutting metal pieces, use a metal-cutting blade. Lubricate the blade with an agent such as beeswax, to help make tight turns and to reduce the chance of breaking the blade.

Saber and reciprocating blades are available for a wide variety of cutting tasks and materials. To make selection easier, the blades are often labeled for the material or specific use. As a general rule, metal-cutting blades have more teeth per inch, (or per centimeter) than wood-cutting blades. The teeth are also smaller.

When the blade first strikes the surface, it may jump. Keep a steady hand, and the cutting action will eventually allow the blade to enter the workpiece. Plunging the blade into the work with sudden force is a common cause of broken blades. Other causes of broken blades are pushing a saw too fast and mishandling the saw when it is not in use.

2.3.0 Portable Band Saws

The portable band saw (*Figure 24*) can cut pipe, metal, plastics, wood, and irregularly shaped materials. It is especially good for cutting heavy metal, but it will also do fine cutting work. Although it can cut wood, it is used almost exclusively used to cut metal products on the job site.

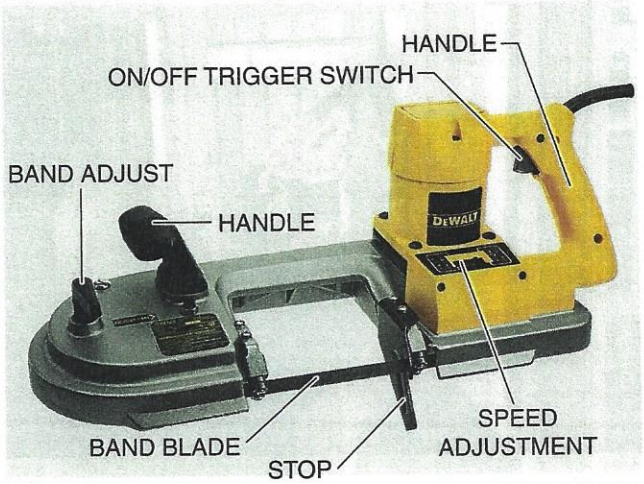


Figure 24 Portable handheld band saw.

The band saw has a one-piece blade that runs in one direction around guides at either end of the saw. The blade is a thin, flat piece of steel. The blade must be of the proper length to fit the revolving pulleys that drive and support the blade. The proper blade length is determined from the manufacturer's documentation. Like most blades, their coarseness is rated in teeth per centimeter or teeth per inch. Thicker materials require coarser blades. If the blade is too coarse for the material, the individual teeth will often begin to break off. *Figure 25* shows how the blade is routed around the pulleys and through the blade guides.

Some band saws have multiple speeds, although most do not. The portable band saw generally cuts best at a low speed. Using a high speed will cause the blade's teeth to rub rather than cut. This can create heat through friction, which will cause the blade to wear out quickly.

WARNING! A portable band saw always cuts in the direction of the user. For that reason, workers must be especially careful to avoid injury when using this type of saw. Always wear appropriate PPE and stay focused on the work.

2.3.1 How to Use a Portable Band Saw

Using a portable band saw safely and efficiently begins with wearing the appropriate PPE. Once prepared, place the stop firmly against the object

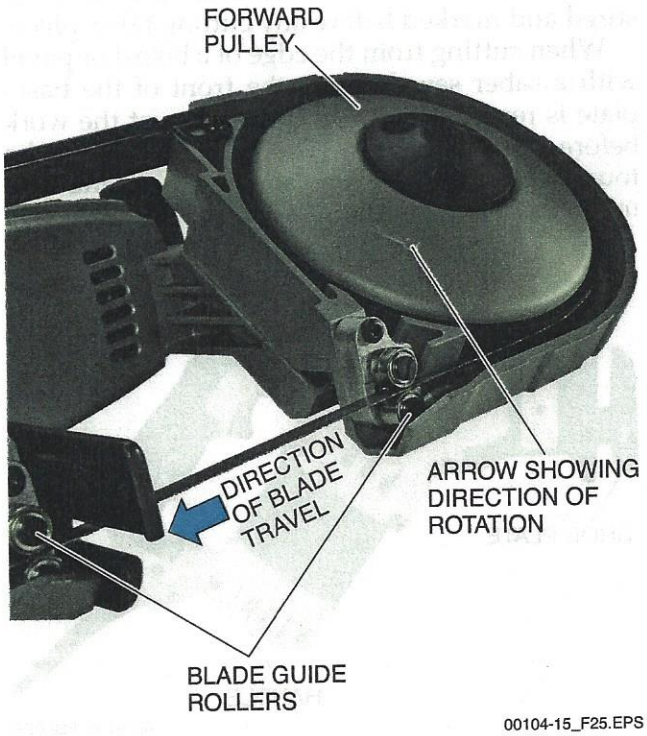


Figure 25 Band saw pulley and blade guide rollers.

to be cut. Note that the direction of blade rotation tends to pull the saw toward the stop. If the stop is not firmly against the workpiece, the saw will jump when started until the stop slams against the material being cut.

Gently pull the trigger. Little or no downward pressure is needed to make a good, clean cut because the weight of the saw provides pressure for cutting.

2.3.2 Safety and Maintenance

There are a few basic guidelines that need to be followed to protect workers and the equipment when a portable band saw is used. First, always wear appropriate PPE. Use only a band saw that has a stop in place. Make sure the saw is disconnected from its power source during any maintenance-related procedure. Before cutting through lines or pipes, always make sure that they do not contain material that could present a hazard; some liquids or gases could be combustible. Keep in mind that the blade of a portable band saw can get stuck or twisted in the work easily. Never force a portable band saw; let the saw do the cutting.

2.4.0 Miter and Cutoff Saws

Miter saws and cutoff saws are similar in that both are used to make straight or miter cuts. Both types of saws can be permanently mounted to be stationary, but portable versions of the saws have the convenience of allowing users to move them from a workshop to a work site.

2.4.1 Power Miter Saws

The power miter saw combines a miter box with a circular saw, allowing it to make straight and miter cuts. There are two types of power miter saws: power miter saws and compound miter saws.

The saw blade of a standard miter saw pivots horizontally from the rear of the table and locks in position to cut angles from 0 to 45 degrees right and left. Stops are pre-set for common angles. The difference between the power miter saw and the compound miter saw (*Figure 26[A]*) is that the blade on the compound miter saw can be tilted vertically, allowing the saw to be used to make a compound cut (combined bevel and miter cut).

Similar to a power miter saw and compound miter saw is the compound-slide miter saw (*Figure 26[B]*). A compound-slide miter saw has a rail in the table that allows the motor and blade assembly to slide forward and backward. This sliding capability enables the tool to cut wider material than a standard miter saw can cut.

(A) COMPOUND MITER SAW

(B) COMPOUND SLIDING MITER SAW

00104-15_F26.EPS

Figure 26 Miter saws.

2.4.2 Abrasive Cutoff Saws

An **abrasive** cutoff saw, also referred to as a chop saw or cutoff saw (*Figure 27*), can be used to make straight cuts or angular cuts through materials such as angle iron, flat bar, and channel. As with miter saws, cutoff saws can be either stationary or portable.

The abrasive blade on a cutoff saw can be between 10 and 18 inches in diameter. Metric blades are commonly 250 mm to 350 mm in diameter. When the saw is in operation, the blade spins at such a high speed that the resulting friction is hot enough to burn through the material. Like all rotating blades and stones, the maximum rpm of the blade must be equal to or greater than that of the saw.

00104-15_F27.EPS

Figure 27 Abrasive cutoff saw.

2.4.3 How to Use Miter and Cutoff Saws

Using a power miter saw and an abrasive cutoff saw safely and efficiently involves many of the same procedures used for other types of power saws. Both types of saws require the user to wear appropriate PPE. It is also important to make sure that the saw is disconnected from its power supply while it is being set up for use. Since miter and cutoff saws have adjustments that can be used to angle and/or tilt the blade, it is important to properly set up the saw according to the cut that is needed. Once the saw has been set up for the proper cut, it can be connected to the power supply and the material can be placed on the saw table and secured.

When the saw is turned on, make sure the saw blade reaches its maximum speed before starting the cut. Hold the workpiece firmly against the fence when making the cut. Once the cut has been made, turn off the saw immediately. Abrasive cutoff saws produce a significant amount of sparks, much like a grinder.

2.4.4 Safety and Maintenance

Several basic guidelines should be followed when operating a miter saw or a cutoff saw to ensure worker safety and equipment protection. The appropriate PPE must be worn, which can include long sleeves, gloves, safety goggles, and a face mask to protect against dust and sparks. Never wear a watch or jewelry while operating the saw because they can get caught in the machinery. Do not allow other workers to stand nearby while the saw is being operated. It is also a good idea to make sure the work area is clear of flammable materials such as chemicals and rags that could ignite from sparks. Abrasive cutoff saws in particular produce a brilliant stream of sparks.

Do not check or change the blade or perform any sort of maintenance on a miter saw or a cutoff saw unless the saw is disconnected from its power source. Make sure that the blade is in good condition and secure before using the saw. Verify that the rpm rating of the blade meets or exceeds the saw's spindle speed. Check all saw guards to ensure that they are in place and working properly. Never retract a safety guard to view the material being cut while the saw is in use. Also, make sure that the saw is sitting on a firm base and is properly fastened to the base.

The saw must be properly set up for the cuts being made. It should be securely locked at the correct cutting angle. During operation, keep fingers clear of the blade. Never attempt to adjust the saw while it is running. If long material is being cut, have a helper support the end of the material. Once the cut is complete, stop the saw. Never leave a saw unattended until the blade comes to a stop.

Additional Resources

29 *CFR* 1926, *OSHA Construction Industry Regulations*, Latest Edition. Washington, DC: Occupational Safety and Health Administration, US Department of Labor, US Government Printing Office.

All About Power Tools. Ortho Books; Larry Johnson, ed. 2002. Des Moines, IA: Meredith Books.

Power Tool Institute, Inc. 1300 Sumner Avenue Cleveland, OH 44115-2851. **www.powertoolinstitute.com.**

2.0.0 Section Review

1. The proper way to start cutting material with a circular saw is to _____.
   a. rev the saw to full speed and slowly move it forward into the material
   b. hold the lower blade guard up to position the blade on the cut mark
   c. press the blade against the material being cut and set the saw rpm to Low
   d. tilt the front edge of the baseplate upward and push the saw forward

2. A saber saw is an effective tool for _____.
   a. drilling holes in concrete or pavement
   b. making long straight cuts through thick metal
   c. cutting through walls in demolition jobs
   d. doing delicate work on thin materials

3. The blade on a portable band saw _____.
   a. moves up and down through a shoeplate
   b. spins in a circular path on an arbor
   c. runs in one direction around guides
   d. reciprocates in and out from a guard

4. A type of miter saw in which the blade can be pivoted horizontally and vertically is called a _____.
   a. jig saw
   b. compound miter saw
   c. reciprocating saw
   d. sliding abrasive saw

SECTION THREE

3.0.0 GRINDERS AND GRINDER ATTACHMENTS

Objective

Identify and explain how to use various grinders and grinder attachments.

a. Identify and explain how to use various types of grinders.
b. Identify and explain how to use various grinder accessories and attachments.

Performance Task

1. Safely and properly demonstrate the use of the following tool:
   - Portable or bench grinder

Trade Terms

Abrasive: A substance, such as sandpaper, that is used to wear away material.

Grit: A granular, sand-like material used to make sandpaper and similar materials abrasive. Grit is graded according to its texture. The grit number indicates the number of abrasive granules in a standard size (per inch or per cm). The higher the grit number, the more particles in a given area, indicating a finer abrasive material.

Ring test: A method of testing the condition of a grinding wheel. The wheel is mounted on a rod and tapped. A clear ring means the wheel is in good condition; a dull thud means the wheel is in poor condition and should be disposed of.

Grinding tools can power all kinds of **abrasive** wheels, brushes, buffs, drums, bits, saws, and discs. These wheels come in a variety of materials and **grits**. They can drill, cut, smooth, and polish; shape or sand wood or metal; mark steel and glass; and sharpen or engrave. They can even be used on plastics.

WARNING!

Always wear safety goggles and a face shield when working with grinders. Make sure that the work area is free of combustible materials such as rags or flammable liquids and that a fire extinguisher is easily accessible. Clothes should be snug and comfortable and free of cuffs at the wrists and ankles. Wearing excessively loose clothing on the worksite can be extremely dangerous.

3.1.0 Grinders

Grinders are available in various configurations. Common handheld grinders include angle grinders (also called side grinders or right-angle grinders), end grinders, and detail grinders. Stationary grinders, called bench grinders, are permanently mounted on a work table or bench.

Angle grinders are used to grind away hard, heavy materials and to grind surfaces such as pipes, plates, or welds (*Figure 28*). The angle grinder has a rotating grinding disc set at a right angle to the motor shaft.

End grinders are sometimes called horizontal grinders or pencil grinders. These smaller grinders are used to smooth the inside of materials, such as pipe (*Figure 29*). The grinding disc on the end grinder rotates in line with the motor shaft. Grinding is also done with the outside of the grinding disc.

Like end grinders, detail grinders (*Figure 30[A]*) have an arbor that extends from the motor shaft onto which small attachments, called points, can be mounted to smooth and polish intricate metallic work. These attachments, a sample of which is shown in *Figure 30*, are commonly made in shaft sizes ranging from 1/16- to 1/4-inch. The shaft of these points is called the spindle. Metric points typically come in spindle sizes of 3 mm and 6 mm. A tremendous variety of point shapes are available to suit the grinding task.

The primary difference between an end grinder and a detail grinder is power; end grinders offer more power than a detail grinder.

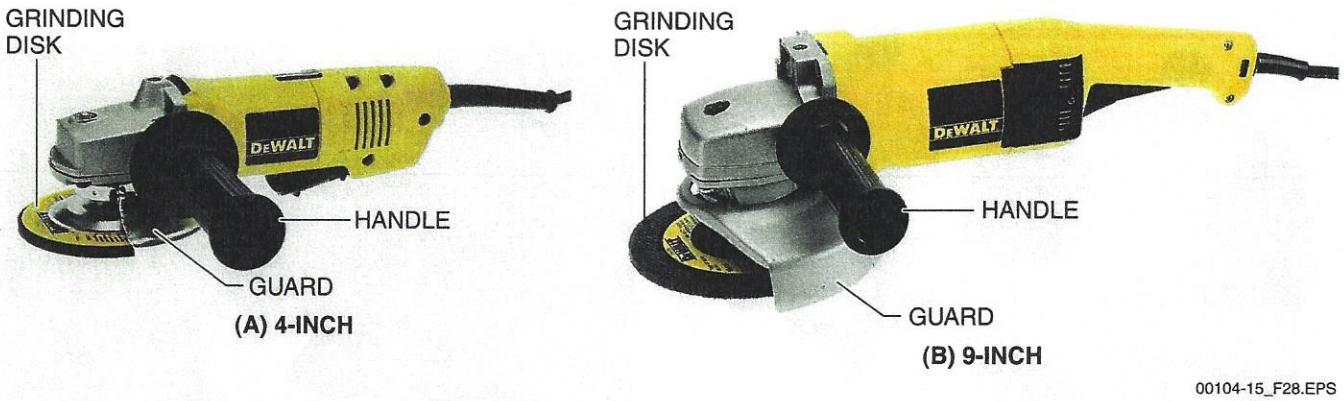


Figure 28 Angle grinders.

Figure 29 End grinder.

Bench grinders (*Figure 31*) are electrically powered stationary grinding machines. They usually have two grinding wheels that are used for grinding, rust removal, and metal buffing. They are also great for renewing worn edges and maintaining the sharp edges of cutting tools. For example, the bench grinder can be used to smooth the mushroomed heads of cold chisels.

Heavy-duty grinder wheels range from 6¾ to 10 inches (150 mm to 250 mm) in diameter. Each wheel's maximum speed is given in rpm. Never use a grinding wheel above its rated maximum speed. Its rated speed must be equal to or faster than the maximum speed of the power tool.

Bench grinders come with an adjustable tool rest. This is the surface on which you position the material you are grinding, such as cold chisel heads. There should be a distance of only ⅛-inch (about 3 mm) between the tool rest and the wheel.

WARNING! Never change the adjustment of tool rests when the grinder is on or when the grinding wheels are spinning. Doing so may damage the work or cause injuries. Disconnect the power source before making any adjustments.

3.1.1 How to Use Grinders

Using handheld portable grinders safely and efficiently requires workers to follow some basic guidelines. Wear appropriate PPE, especially a face shield. If it is not already secured, secure the material in a vise or clamp it to the workbench. To use an angle grinder, place one hand on the handle of the grinder and one on the trigger. To use an end grinder or detail grinder, grip the grinder

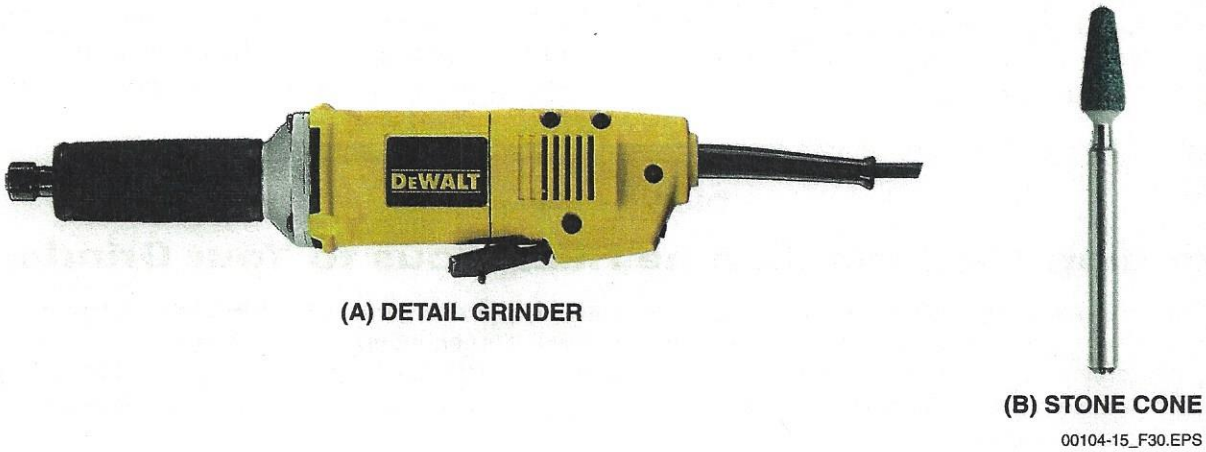


Figure 30 Detail grinder and point.

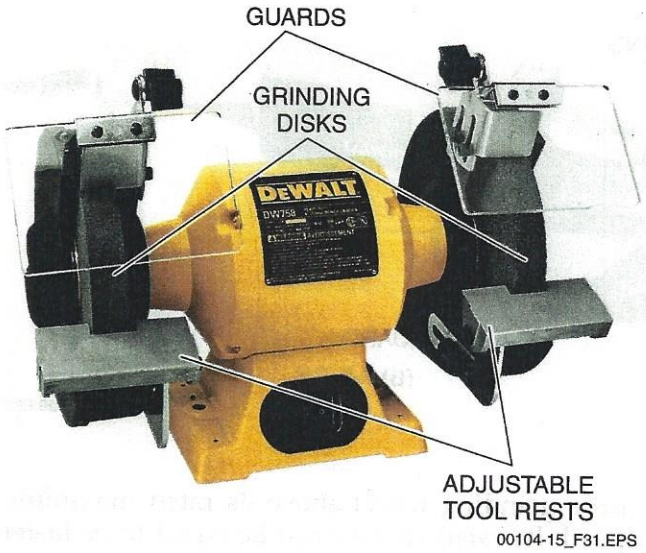
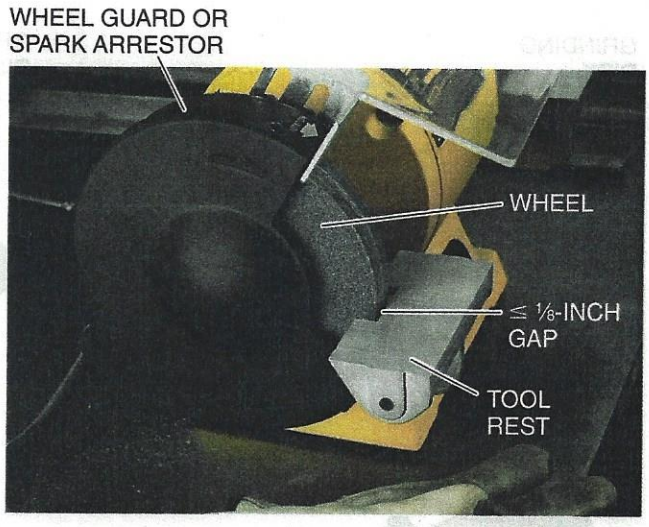


Figure 31 Bench grinder.

handle at the shaft end with one hand and cradle the opposite (motor) end of the tool in your other hand. Always allow the grinder to reach its maximum speed before beginning. Do not force the tool and overload the motor. If too much pressure is being applied, there will be a significant reduction in the grinder's rpm. Before laying the grinder down, be sure that the wheel has stopped rotating completely. Finish the work by removing any loose material with a wire brush.

When a bench grinder is used, it is necessary to wear the appropriate PPE. A face shield is essential. Always use the adjustable tool rest as a support when grinding or beveling metal pieces. There should be a maximum gap of ⅛-inch (≈3 mm) between the tool rest and the wheel and ¼-inch (≈6 mm) between the wheel guard (also called a spark arrestor) and wheel. Make sure the bench grinder is firmly secured to a stable surface. The grinding wheel should be allowed to reach its full speed before grinding begins. Keep the metal cool as it is being ground. If the metal gets too hot, it can destroy the temper (hardness) of the material. Always work on the face of the wheel and not on the side. *Figure 32* shows the proper way to use a bench grinder.



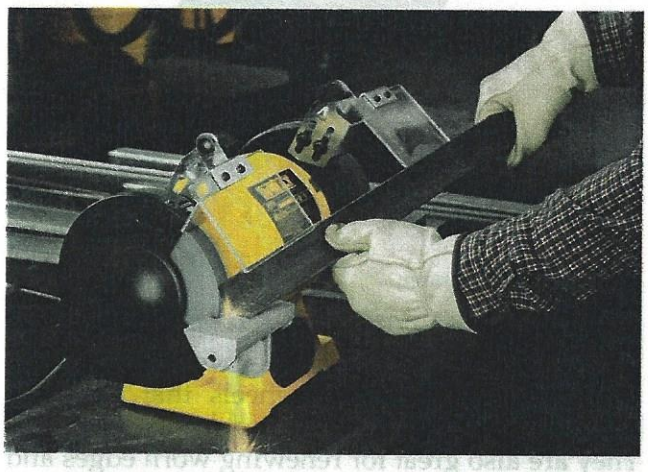


Figure 32 Proper use of a bench grinder.

3.1.2 Safety and Maintenance

Guidelines related to safety and maintenance for grinders are very similar to those that apply to other power tools. Always wear appropriate PPE, including a face shield as well as proper eye protection. Never wear loose clothing or

Did You Know?

Grinding Tungsten Can be Hazardous to Your Grinder

Workers who use power tools are almost certain to encounter objects that contain tungsten. Tungsten is an extremely hard and brittle metal with a very high melting point. It is commonly mixed with carbon to create tungsten carbide—a material that is used to make cutting tools, drill bits, and similar products. Attempting to grind tungsten with conventional grinding discs and wheels is a bad idea. The most likely outcome of such an attempt is a damaged and/or weakened grinding wheel.

jewelry that can get caught in the grinder wheels. Wear gloves and keep your hands away from the grinding wheels. When working near walkways or other workers, or when flammable materials are nearby, use standing screens to keep sparks from flying into their path.

Before using a grinder, make sure all guards are in place. Never use an angle grinder, end grinder, or detail grinder unless it is equipped with the manufacturer-provided guard that surrounds the grinding wheel. Choose a grinding disc that is appropriate for the type of work being done. Make sure that the disc is properly sized for the grinder and rated for the correct rpm. Only the proper grinding discs and wheels should be stocked and used. Each time a new wheel is installed, check the maximum rpm markings to ensure it is equal to or greater than the maximum speed of the grinder.

Wire wheels are popular accessories for grinders. Be aware that individual wires can separate from the wheel while it is in use. These wire whiskers are very sharp and are propelled from the wheel at a high rate of speed. Using the proper PPE at all times and placing protective screens in the correct places will protect the operator and others from this hazard.

Before starting the grinder, make sure the grinding disc is properly secured and in good condition. To avoid being pulled off balance, establish firm footing and maintain a firm grip on the grinder. Always hold the grinder with both hands. Let the grinder come up to full speed before grinding. Direct the sparks and debris (*Figure 33*) away from people and any flammable materials. When grinding on a platform, use a flame-retardant blanket to catch falling sparks. After shutting off the power, do not leave the tool until the grinding disc has come to a complete stop. Always disconnect the power source before you do maintenance.

WARNING!

Grinding discs can instantaneously disintegrate if used when they are cracked. Inspect the disc for cracks before using the grinder.

Some specific guidelines apply to bench grinders. As with a handheld grinder, grinding metal on a bench grinder creates sparks, so keep the area around the grinder clean. Always adjust the tool rests so they are within ⅛-inch (≈3 mm) of the wheel. This reduces the chance of getting the work wedged between the rest and the wheel. Never use a grinding wheel above its rated maximum speed. After finishing a job with the bench grinder, shut it off. Always make sure the bench grinder is disconnected from its power source before changing grinding wheels or performing any type of maintenance.

00104-15_F33.EPS

Figure 33 Be aware of sparks created by grinders.

Before mounting a grinding wheel onto a bench grinder, first check the wheel for chipped edges and cracks. Then perform a **ring test**. Slide the wheel onto a rod that fits through the wheel hole. Then tap the wheel gently on the side with a piece of wood. The wheel will ring clearly if it is in good condition. A dull thud may mean that there is a crack that isn't visible. Dispose of the wheel if this happens.

WARNING!

Never grind soft metals or wood on a grinding wheel. The material will wedge itself between the grit, creating stresses that may cause the wheel to shatter.

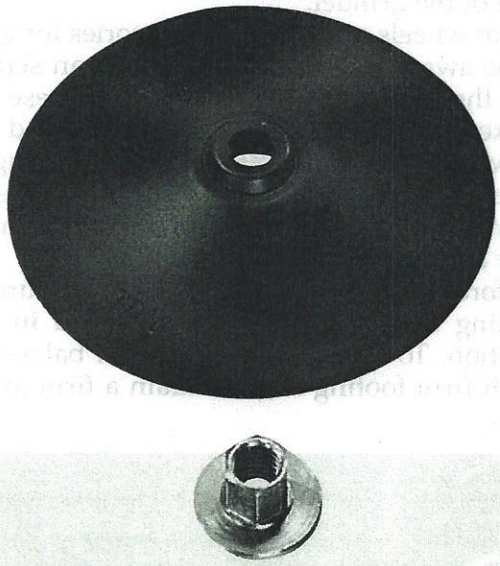
3.2.0 Grinder Attachments and Accessories

Grinders are versatile pieces of equipment. While the primary uses of a typical grinder are to grind, cut, sand, and polish materials, numerous attachments and accessories can be used to extend a grinder's capability.

Accessories such as guards and shields (*Figure 34*) can be added to a portable grinder to provide additional protection when special grinding discs are used. For example, there are specialized guards for use with diamond discs, flap discs, and cup brushes. Side handles can be added to some grinders to improve stability and grip during use. There are also shields available to help protect against dust. Some dust shields are even equipped with a vacuum hose outlet so that dust can be vacuumed away when the grinder is in use.

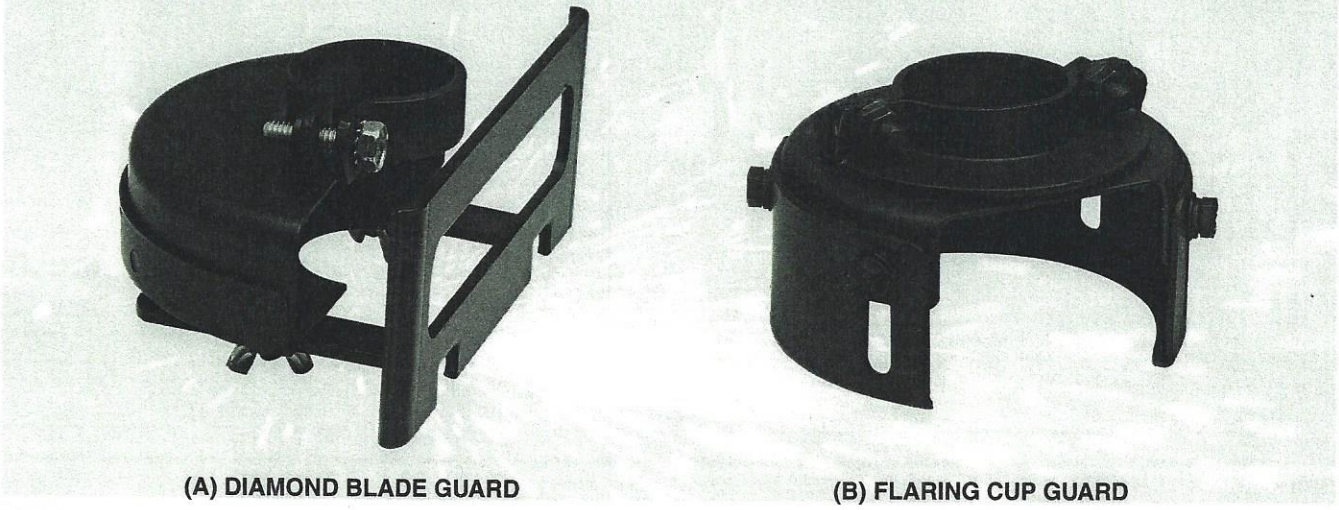
Adapters and backing pads (*Figure 35*) can be installed on a grinder's arbor so that different types of sanding discs, wheels, and buffing pads can be used. The backing pad provides a stable surface for flexible discs to rest against.

There is an almost endless variety of grinder attachments available, and most of them are available in various sizes. Some of the more common accessories are shown in *Figure 36*. They include wire brushes, cup brushes and stones, flap discs, cutting wheels, and polishing and buffing wheels. Some grinders can also be equipped with a cutoff wheel. These are best described as smaller, thinner versions of the blade used on an abrasive saw. Because of their tendency to break or fly apart when too much stress is applied, many companies require workers to have specific permission and documentation before they can be used.



00104-15_F35.EPS

Figure 35 Backing pad and adapter nut.



(A) DIAMOND BLADE GUARD

(B) FLARING CUP GUARD

00104-15_F34.EPS

Figure 34 Grinder accessories.

(A) KNOTTED CUP BRUSH

(B) CUP STONE

(C) CUTOFF WHEEL

(D) WOOL BUFFING PAD

00104-15_F36.EPS

Figure 36 Grinder attachments.

Wire brushes and cup brushes are good for removing rust, scale, and file marks from metal surfaces. Flap discs are used for similar jobs, but they tend to last longer than fiber discs. Cutting discs are designed for cutting through material. Cloth buffing wheels enable a grinder to be used for polishing and buffing metal surfaces. Coring bits are sometimes used for cutting holes in stone or composite materials, such as those used for countertops.

Special bits can be used on some grinders to remove rough edges and burrs from the inside and outside of pipes and other objects. These rotary bits are commonly called burr bits (*Figure 37*). As with other grinder accessories, burr bits are available in various shapes and sizes to fit almost any need. Workers should be aware that using a grinder with a burr bit requires steady hands. These bits operate at high rpm and can catch on burrs and cause the grinder to shift around quite a bit. They can also heat up the material being smoothed and possibly damage it. It is best to work in short bursts to avoid overheating the bit and the material.

No matter what type of attachment is used on a grinder, workers must always make sure that it is designed to fit the grinder and rated for the proper rpm. Always follow the attachment and accessory manufacturer's guidelines for use.

00104-15_F37.EPS

Figure 37 Burr bit assortment.

Additional Resources

29 *CFR* 1926, *OSHA Construction Industry Regulations*, Latest Edition. Washington, DC: Occupational Safety and Health Administration, US Department of Labor, US Government Printing Office.

All About Power Tools. Ortho Books; Larry Johnson, ed. 2002. Des Moines, IA: Meredith Books.

Power Tool Institute, Inc. 1300 Sumner Avenue Cleveland, OH 44115-2851. **www.powertoolinstitute.com**.

3.0.0 Section Review

1. A stationary grinder that has two wheels for grinding, removing rust, and buffing metal is a(n) _____.
   a. angle grinder
   b. tandem grinder
   c. bench grinder
   d. end grinder

2. Special rotary bits that can be used on some grinders to remove rough edges from the inside and outside of pipes and other objects are commonly called _____.
   a. burr bits
   b. backing pads
   c. coring bits
   d. buffing wheels

SECTION FOUR

4.0.0 MISCELLANEOUS POWER TOOLS

Objective

Identify and explain how to use miscellaneous power tools.

a. Identify and explain how to use pneumatic and powder-actuated fastening tools.
b. Identify and explain how to use pavement breakers.
c. Identify and explain the uses of hydraulic jacks.

Performance Task

1. Safely and properly demonstrate the use of the following tool(s):
   - Pneumatic nail gun
   - Pavement breaker

Power tools are used for many different applications on a typical construction site. In addition to drilling, cutting, and grinding, some of the more common applications include fastening, demolition, and jacking. This section covers the following power tools:

- Pneumatically powered nailers (nail guns)
- Powder-actuated fastening systems
- Pneumatic impact wrenches
- Pavement breakers
- Hydraulic jacks

4.1.0 Pneumatic and Powder-Actuated Fastening Tools

Pneumatically powered nailers (*Figure 38*), or nail guns, are common on construction jobs. They greatly speed up the installation of materials such as wallboard, molding, framing members, and shingles.

Nail guns are driven by compressed air traveling through air lines connected to an air compressor. Nailers are designed for specific purposes, such as roofing, framing, siding, flooring, sheathing, trim, and finishing. Nailers use specific types of nails depending on the material to be fastened. The nails come in coils and in strips and are loaded into the nail gun.

00104-15_F38.EPS

Figure 38 Pneumatic nailer.

WARNING!

Never exceed the maximum specified operating pressure of a pneumatic nailer. Doing so will damage the pneumatic nailer and cause injury.

Pneumatic nailers are designed to fire when the trigger is pressed and the tool is pressed against the material being fastened. An important safety feature of all pneumatic nailers is that they will not fire unless pressed against the material.

The use of powder-actuated anchor or fastening systems has been increasing rapidly in recent years. They are used for anchoring static loads to steel and concrete beams, walls, and so forth.

A powder-actuated tool is a low-velocity fastening system powered by gunpowder cartridges, or loads. The tools are used to drive steel pins or threaded steel studs directly into masonry and steel (*Figure 39*). They eliminate the need for compressed air to operate the tool.

WARNING!

Operators of powder-actuated tools must be trained and certified by the manufacturer of the tool being used.

Avoid firing a powder-actuated tool into easily penetrated materials. The fastener may pass through the material and become a flying missile on the other side.

If a powder load fails to fire, wait ten seconds, remove it from the installation tool, and then dispose of it in a bucket of water or oil.

Figure 39 Powder-actuated fastening system.

4.1.1 How to Use Power Fastening Tools

The safe and efficient use of power fastening tools depends on careful preparation, following some common sense guidelines, and being familiar with the tool. Before using any pneumatically powered nailer, always read the manufacturer's instructions. Also, wear the appropriate PPE, including gloves, safety goggles, hearing protection, and a hard hat.

Inspect the nailer for damage and loose connections before operation. Select the proper type of nail for the job and make sure the nails being used match the nailer. Then, load the nails into the nailer.

Verify that the air hose is properly connected to the nailer. Check the air compressor and adjust the pressure to the recommended amount. Most nailers operate at pressures of 70 to 120 pounds per square inch (psi) (≈480 to 830 kPa). Test the nailing ability using a piece of scrap material. If the nail penetration is not correct, follow the manufacturer's instructions for adjusting the air pressure for the particular gun.

When nailing wall materials, locate and mark the wall studs before nailing. Otherwise, it will be difficult to determine when a nail penetrates the wallboard but misses the stud. Hold the nailer firmly against the material to be fastened, then press the trigger (*Figure 40*).

Once the job is finished, turn off the air supply and disconnect the air hose from the nailer. Never leave the nailer connected and unattended.

WARNING!

A nail gun is not a toy. Playing with a nail gun can cause serious injury. Nails can easily pierce a hand, leg, or eye. Never point a nail gun at anyone or carry one with your finger on the trigger. Use the nail gun only as directed.

Using a powder-actuated fastening tool requires special training and certification. Never try to operate a powder-actuated tool without the proper training. Training and certification to use a powder-actuated tool is typically provided by the manufacturer through an on-site class or similar arrangement.

Figure 40 Proper use of a nailer.

Power Screwdrivers

Power screwdrivers use a power source (this model uses a battery) to speed production in a variety of applications, such as drywall installation, floor sheathing and underlayment, decking, fencing, and cement board installation. A chain of screws feeds automatically into the firing chamber. Most models incorporate a back-out feature to drive out screws as well as a guide that keeps the screw feed aligned and tangle-free. This tool can accept Phillips or square slot screws and weighs an average of six pounds.

00104-15_SA02.EPS

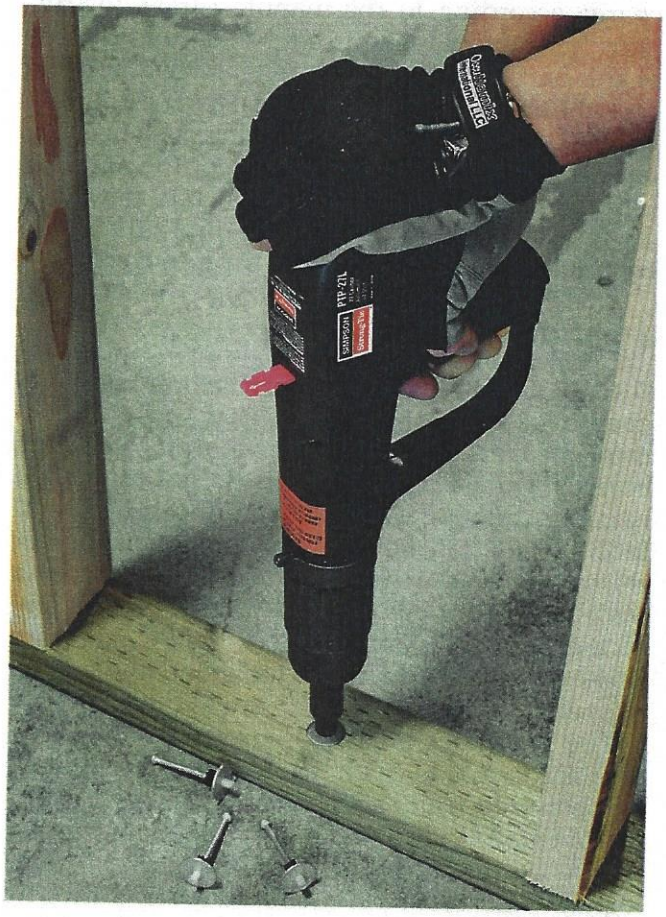
To use a powder-actuated tool, start by wearing the appropriate PPE, including safety goggles, ear protection, gloves, and a hard hat. The pin or stud to be fired is fed into the piston and then the gunpowder cartridge (booster or charge) is placed. The tool is positioned in front of the item to be fastened and pressed firmly against the mounting surface (*Figure 41*). This pressure releases the safety lock, and the trigger fires the charge.

4.1.2 Safety and Maintenance

There are numerous safety and maintenance guidelines associated with pneumatic and powder-actuated fastening tools. Both types of tools require workers to wear appropriate PPE, including ear protection, safety goggles, and a hard hat. It is also important to read and understand the manufacturer's manual for the tool being used.

When using a pneumatic nailer, workers should avoid pointing the nail gun at their own body or towards anyone else. The correct nail gun and nail size and type must be selected for the job. Keep the nailer oiled according to the manufacturer's instructions. Add a few drops to the air inlet before each use, according to the manufacturer's recommendations.

Never load a pneumatic nailer with the compressor hose attached. If the nailer is not firing, disconnect the air hose before attempting any repairs. Remember that there is a chance that air pressure is trapped within the tool if an internal



00104-15_F41.EPS

Figure 41 Using a powder-actuated fastening tool.

failure occurs, although it is unlikely. Check for pipes, electrical wiring, vents, and other materials behind wallboard before nailing. During operation, keep all body parts and co-workers away from the nail path to avoid serious injury. Nails can go through paneling or wallboard and strike someone on the other side if you miss the wood surface behind it. Never leave the nailer connected to the compressor hose when it is not in use.

Powder-actuated fastening tools have several guidelines that apply to them specifically. The most important rule is that workers should never use a powder-actuated tool unless they have been properly trained and certified on the specific model being used. Manufacturer representatives often visit the job site to conduct their training and certification program for a group of workers. The manufacturer's instruction manual also lists safety precautions that must be followed.

Be sure to select the proper size pin for the job and never load the tool until it is time to complete the firing. When loading the driver, put the pin in before loading the charge. Use the correct booster charge according to the manufacturer's instructions for the tool being used. Never hold the end of the barrel against any part of your body or cock the tool against your hand. Never place your hands behind the material being fastened. Do not fire the tool close to the edge of the material, especially concrete. Pieces of concrete may chip off and strike someone, or the projectile could continue past the concrete and strike a co-worker.

4.2.0 Pavement Breakers

Several large-scale demolition tools are frequently used in construction. They include pavement breakers, clay spades, rock drills, and core borers (*Figure 42*). These tools do not rotate like hammer drills; they reciprocate (move back and forth). They can be powered pneumatically or electrically. The name *jackhammer* comes from a trade name, but has come to refer to almost any of the handheld impact tools. While there are slight differences in these tools and their uses, this section will focus on pavement breakers.

The pavement breaker is used for large-scale demolition work, such as tearing down brick and concrete walls and breaking up concrete or pavement. A typical pneumatic pavement breaker weighs between 50 and 90 pounds (≈22 to 40 kilograms). On most pavement breakers, a throttle is located on the T-handle. When the throttle is pushed, compressed air operates a piston inside the tool. The piston drives the steel cutting shank into the material being broken up with a hammering action. Attachments, such as spades or chisels, can be used on the pavement breaker for different applications.

4.2.1 How to Set Up and Use a Pavement Breaker

To operate a pavement breaker safely and efficiently, start by wearing the appropriate PPE. Prior to connecting the tool to its air supply, make sure that the air pressure is shut off at the main air outlet. Then, hold the coupler at the end of the air supply line, slide the ring back, and slip the coupler on the connector, or nipple, that is attached to the air drill. Verify that the connection is good. (A good coupling cannot be taken apart without first sliding the ring back.) Add a whip check to prevent the hoses from whiplashing if the connector comes uncoupled. Once a good connection has been established, turn on the air supply valve. The pavement breaker is now ready to use.

4.2.2 Safety and Maintenance

Besides always following the tool manufacturer's guidelines for operating a pavement breaker, there are a few other important rules. Always wear the appropriate PPE. This includes gloves, a hard hat, eye protection, appropriate boots, and because some of these tools make a lot of noise, hearing protection (earplugs). Also, know what is under the material being broken up. There could be water, gas, electricity, sewer, and telephone lines below the surface. Always follow the applicable methods to find out what is there and where it is before breaking the pavement.

4.3.0 Hydraulic Jacks

Hydraulic tools are used when an application calls for extreme force to be applied in a controlled manner. These tools do not operate at high speed, but great care should be used when operating them. The forces generated by hydraulic tools can easily damage equipment or cause personal injury if the manufacturer's procedures are not strictly followed.

Hydraulic jacks are portable devices used for a wide variety of purposes. They can be used to move or lift heavy equipment and other heavy material, to position heavy loads precisely, and to straighten or bend frames. Hydraulic jacks have two basic parts: a pump and a cylinder (sometimes called a ram). There are various types of hydraulic jacks including those with internal pumps and those that use a lever-operated pump.

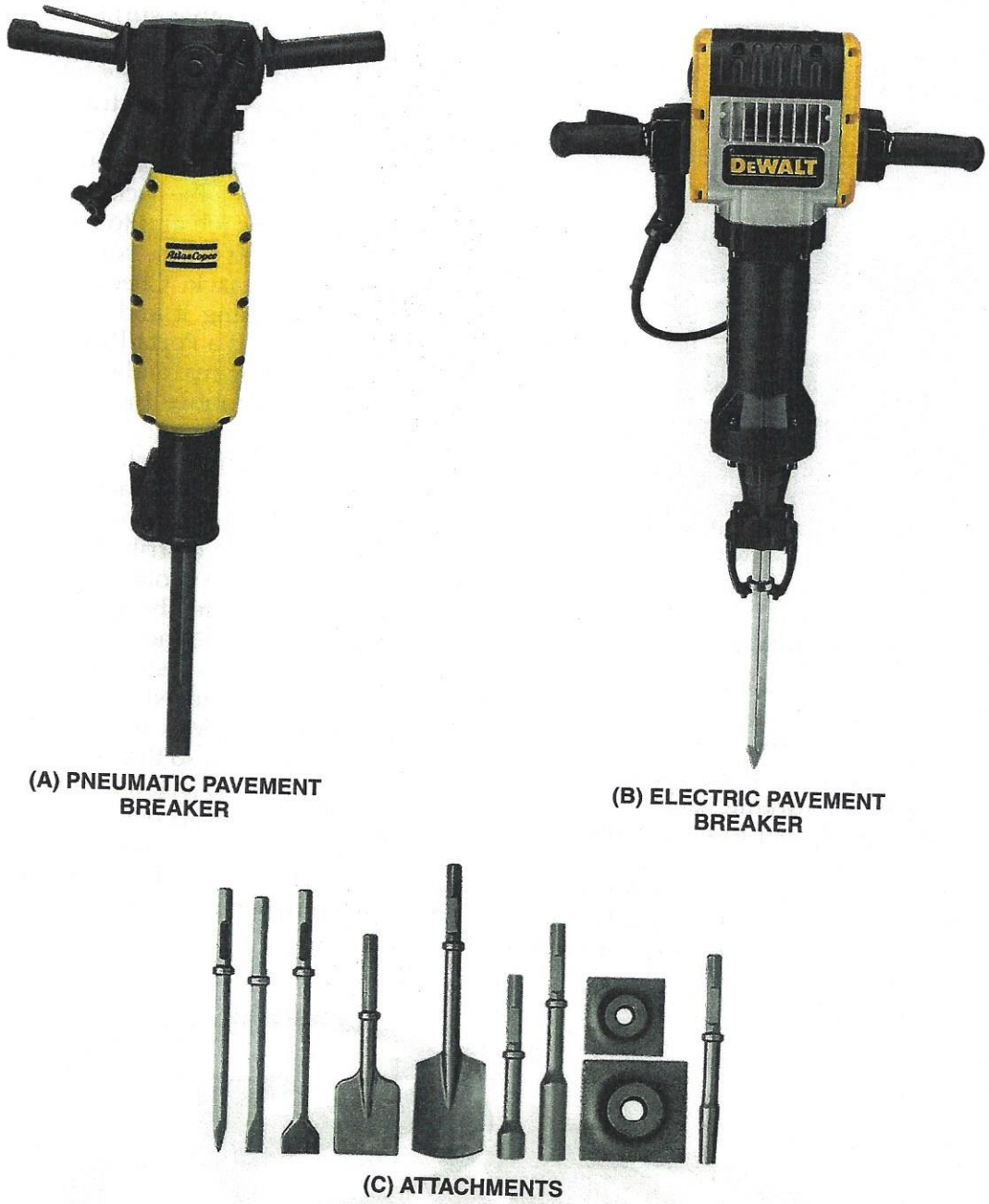


Figure 42 Typical demolition tools and attachments.

The latter type is often referred to as a Porta-Power®, the name of one common brand.

A hydraulic jack with an internal pump is a general-purpose jack that is available in many different capacities (*Figure 43*). The pump inside the jack applies pressure to the hydraulic fluid when the handle is pumped. The pressure on the hydraulic fluid applies pressure to the cylinder, which lifts or moves the load.

A lever-operated pump kit (*Figure 44*) includes a length of hydraulic hose and a cylinder, which are joined by the high-pressure hydraulic hose. Lever-operated pumps are available in different capacities. Cylinders are available in many sizes; they are rated by the weight (in tons or metric tonnes) they can lift and the distance they can move it. This distance is called stroke and is measured in inches or millimeters. Hydraulic cylinders can lift more than 500 tons (≈454 metric tonnes). Strokes range from ¼-inch (≈6 mm) to more than 48 inches (≈122 cm). Different cylinder sizes and ratings are used for different jobs. Lever-operated pumps are especially useful for horizontal jacking.

00104-15_F43.EPS

Figure 43 Portable hydraulic jack.

4.3.1 Safety and Maintenance

Using hydraulic jacks safely and effectively requires an awareness of the area surrounding the load, the load itself, and the jack. As with other power tools, always wear the appropriate PPE when working with hydraulic jacks. Check the area prior to jacking a load to ensure that other workers are safely out of the way and that the load will clear all obstacles. Also, make sure the base of the jack can be placed on a solid, even, and level surface. Never place the base of the jack on bare soil or any other surface that could compact or shift under the load. If there is a possibility that the load could move while jacking, make sure it is chocked and restrained. Never jack metal against metal. Instead, use wood softeners as a buffer between metal surfaces.

Carefully inspect the jack to make sure it is appropriate for the job and to check for any signs of damage or fluid leaks. Never exceed the lifting capacity of a jack. Check the fluid level in the jack before using it and watch for any fluid leaks during use. If a Porta-Power® is being used, make sure that the hydraulic hose is not twisted or kinked. Do not move the pump if the hose is under pressure.

Properly position the jack so that it is on a level and secure surface. The jack should be placed under the load so that the load is centered and the weight is uniformly distributed. Stay clear of the object being lifted to avoid injury if the load slips off the jack. Operate the jack according to the manufacturer's guidelines. Do not use an extension bar, or cheater, or step on the pump handle to gain more leverage. Never leave a jack under a load as a support. Block the load up as you progress through the lift, so that it will only fall a very short distance if the jack fails. Once at the proper height, add blocking as needed so the load is supported while the jack is removed. To reduce tripping hazards, remove the jack handle any time the jack is not being pumped.

00104-15_F44.EPS

Figure 44 Lever-operated hydraulic pump kit.

Additional Resources

29 *CFR* 1926, *OSHA Construction Industry Regulations*, Latest Edition. Washington, DC: Occupational Safety and Health Administration, US Department of Labor, US Government Printing Office.

All About Power Tools. Ortho Books; Larry Johnson, ed. 2002. Des Moines, IA: Meredith Books.

Power Tool Institute, Inc. 1300 Sumner Avenue Cleveland, OH 44115-2851. **www.powertoolinstitute.com**.

4.0.0 Section Review

1. Pneumatic nailers are designed to fire when the trigger is pressed and the tool is _____.
   a. filled with a charge of compressed air
   b. pressurized with hydraulic fluid
   c. connected to its battery pack
   d. pressed against the material being fastened

2. The cutting shank on a pavement breaker is able to demolish concrete or pavement by _____.
   a. drilling
   b. reciprocating
   c. rotating
   d. expanding

3. When using a portable hydraulic jack, be sure to _____.
   a. avoid twisting or kinking the air lines
   b. leave the jack under the load as a support
   c. use an extension bar on the pump handle
   d. place the base of the jack on a solid, level surface

SUMMARY

Power tools are a necessity in the construction industry, and it is important to understand how they work and what they do. A worker might not use all of the tools covered in this module, but more than likely they will encounter other craft workers on construction sites who will be using them. All workers will be safer if everyone is familiar with the tools being used on the job site.

Power tool maintenance is another subject that workers need to learn and appreciate. The better a tool is maintained, the better it will function. Well-maintained tools operate safer and last longer, which protects workers and saves time and money.

As workers focus on a chosen field within the construction industry, they will learn to use the power tools for that specialized area. Although some of these specific tools might not be covered in this module, the basic safety and usage concepts are always applicable. Always read the manufacturer's manual for any new power tool being used. Never use a tool without the proper training for that tool. Following the basic use and safety guidelines explained in this module, properly maintaining the tools, and becoming educated about any new equipment beforehand will help ensure safe and efficient work habits and promote career advancement.

Review Questions

1. Pneumatic tools get their power from _____.
   a. air pressure
   b. fluid pressure
   c. hand pumps
   d. AC power sources

2. The most common use of the power drill is to _____.
   a. cut wood, metal, and plastic
   b. drive nails into wood, metal, and plastic
   c. make holes in wood, metal, and plastic
   d. carve letters in wood, metal, and plastic

3. A masonry bit is able to drill into concrete and similar material because it has a _____.
   a. countersink shank
   b. ceramic core
   c. whip check
   d. carbide tip

4. An example of an electric power drill that is designed to be used in tight spaces is a(n) _____.
   a. electromagnetic drill
   b. right-angle drill
   c. hammer drill
   d. keyless chuck drill

5. The electromagnetic drill is a _____.
   a. handheld drill used on wood
   b. cordless drill used on masonry and tile
   c. portable drill used on thick metal
   d. pneumatic drill that has a pounding action

6. Hammer drills are designed to drill into _____.
   a. wood, metal, and plastic
   b. concrete, brick, and tile
   c. drywall, fiberglass, and wood
   d. roofing shingles, plastic, and wood

7. A pneumatic impact wrench requires the use of _____.
   a. impact sockets that are designed for the applicable tool
   b. an adapter so that handheld sockets will fit
   c. shear pins between the wrench and the socket
   d. a trigger lock to prevent accidental starting

8. When cutting with a circular saw, grip the saw handles _____.
   a. and pull the saw toward you
   b. firmly with one hand
   c. and engage the trigger lock
   d. firmly with two hands

9. The high speed setting on a reciprocating saw is used for _____.
   a. cutting through drywall
   b. metal work
   c. sawing wood and other soft materials
   d. grinding surfaces

10. When using a saber saw, avoid vibration by _____.
    a. using a low-speed setting
    b. using a clamp or vise to hold the work
    c. setting a heavy object on the workpiece
    d. holding the workpiece down with your free hand

11. Before using a reciprocating saw to cut through a wall or partition, always _____.
    a. find out what is on the other side
    b. remove the lower blade guard
    c. increase the revolutions per minute
    d. lubricate the guard with oil or grease

12. Use only a band saw that has a _____.
    a. breastplate with a broad surface
    b. battery pack
    c. thick, three-piece blade
    d. stop

13. A sliding compound miter saw has a rail that allows the blade to slide forward and backward, which enables the saw to _____.
    a. use much thinner blades than a standard miter saw
    b. cut wider material than a standard miter saw
    c. produce much less dust than a standard miter saw
    d. cut harder material than a standard miter saw

14. The blade of an abrasive cutoff saw spins at such a high speed that _____.
    a. it can only be used for straight cuts
    b. the abrasive particles will melt into some metals
    c. the resulting friction is hot enough to burn through the material
    d. it can never be more than eight inches in diameter

15. The end grinder is used to _____.
    a. polish intricate work
    b. grind surfaces
    c. smooth the work before painting
    d. smooth the inside of materials, such as pipe

16. A detail grinder smoothes and polishes intricate metallic work by using attachments called _____.
    a. points
    b. rollers
    c. pins
    d. studs

17. Powder-actuated fastening systems are used to _____.
    a. penetrate drywall
    b. anchor static loads to steel beams
    c. hammer nails into metal
    d. remove nails

18. Before you begin setting up a pavement breaker for use, make sure that the air pressure is _____.
    a. shut off at the main air outlet
    b. turned on only halfway
    c. turned on full
    d. shut off at the coupler

19. Porta-Power® cylinders are rated by how much weight they can lift and by _____.
    a. their torque
    b. the amount of electromagnetic material they have
    c. the distance they can move the weight
    d. how much they weigh

20. Hydraulic jacks are used when the application calls for _____.
    a. operation at high speed
    b. extreme force to be applied
    c. quiet operation
    d. manually assisted lifting

Trade Terms Quiz

Fill in the blank with the correct term that you learned from your study of this module.

1. Activating the _____ will make the trigger stay in the operating mode even when it is released.
2. _____ reverses its direction at regularly recurring intervals; this type of current is delivered through wall plugs.
3. A(n) _____ saw's straight blades move backward and forward along a straight line.
4. A circular saw blade is attached to the _____ of the saw.
5. Masonry bits and nail-cutter saw blades have a(n) _____ tip.
6. A(n) _____ is a substance, such as sandpaper, that is used to wear away material.
7. A(n) _____ is used to open and close the chuck on a power drill.
8. _____ is the value used to report the rotational speed of a motor or shaft.
9. A(n) _____ is used to set the head of a screw at or below the surface of the material.
10. _____ flows in one direction, from the negative to the positive terminal of the source, such as a battery.
11. Use a(n) _____ to bore holes in wood and other materials.
12. A sand-like material used to make a surface rough, graded by its size, is called _____.
13. The _____ of the drill holds the drill bit.
14. To prevent an electrical shock, do not operate electric power tools without proper _____.
15. If a flat-bottomed hole is needed in a piece of lumber, use a _____.
16. A _____ is used to bore holes in brick, block, and similar materials.
17. A _____ is created by a saw blade as it cuts through the material.
18. Perform a(n) _____ to check the condition of a grinding wheel.
19. The _____ is the smooth part of a drill bit that fits into the chuck.
20. A(n) _____ protects people from electric shock and protects equipment from damage by interrupting the flow of electricity if an electrical fault occurs.

Trade Terms

Abrasive
Alternating current (AC)
Arbor
Auger bit
Carbide
Chuck
Chuck key
Countersink
Direct current (DC)
Forstner bit
Grit
Ground fault circuit interrupter (GFCI)
Ground fault protection
Kerf
Masonry bit
Reciprocating
Revolutions per minute (rpm)
Ring test
Shank
Trigger lock

Fernando Sanchez

TIC—The Industrial Company
Craft Training Instructor

How did you choose a career in the construction industry?
Honestly, by referral through family. My brother Israel recommended me to TIC. I immediately adapted to it and it grew on me. Helping build something provides a great sense of accomplishment that I really enjoy.

Who inspired you to enter the industry?
My brother Israel and my dad Fernando Sr. They inspired me and helped me get into the industry.

What types of training have you been through?
I have completed a wide variety of training programs, including:

- Real estate school (obtained a license)
- Mortgage training for real estate purchasing
- How to Be an Effective Leader training/seminar
- OSHA 10 hour
- First Aid and CPR
- NCCER *Core*
- NCCER *Pipefitting* Levels 1 through 4 (obtained Certified Plus credential)
- NCCER Master Trainer
- *Welding* Levels 1 and 2 (obtained Structural Pipe Certifications)
- TIC – QA/QC Levels 1 and 2
- TIC – Field Management 1 and 2
- TIC – Bull Rigging Class
- E-learn SkillSoft Training

How important is education and training in construction?
Education and training is extremely important, because an individual needs to be trained in all facets of construction to become professional in their craft.

How important are NCCER credentials to your career?
NCCER is a nationally accredited source of quality craft training and their credentials need to be on the record of all construction workers around the country.

How has training/construction impacted your life?
It has given me the opportunity to grow with my company and experience new and innovative things in the construction industry. Most importantly, it has given me the opportunity to build on my personal skills and allowed me to transfer my knowledge and experience to others in the field. Teaching others is a true passion of mine.

I've also had the opportunity to provide a better way of life for my family, to put my kids through college, and to give them things I never had.

What kinds of work have you done in your career?
I have done a little bit of everything in my career, such as:

- Residential construction
- Environmental services
- Pharmacy technician
- Mortgage loans
- Real estate
- Electrical line clearance (professional tree trimmer)
- Public relations (arborist)
- Restaurant (general manager)
- Industrial construction

Tell us about your present job.
I'm currently in charge of the Pipe Department at the Steamboat Springs TIC training center. I am a craft instructor and my job is to teach our current employed pipe helpers and pipefitters to reach their ultimate goal of becoming journey-level workers and supervisors in their craft.

What do you enjoy most about your job?
The thing I enjoy most about my job is having the ability to teach someone new things and transfer knowledge so that they can become successful in their own careers. I love to teach and train and I truly enjoy seeing others become great.

What factors have contributed most to your success?
Having loving parents has contributed in a big way. They raised me and taught me that being a simple person can take you a long way. My dad showed me the power of friendship and kindness. My mom always told me that if I try my best, anything is possible.

Working for a great company like TIC has also been a major factor. They offer the opportunity to evolve and reach a career goal with their training and support.

I've also have had several mentors in my career, including Paul La Borde, my pipe instructor. Greg Jones and Mike Burris, past foremen of mine, also deserve a place on that list. Above all through, the support of my beautiful wife Gaby has taken me a long way.

Would you suggest construction as a career to others? Why?
Yes. This is a fast-growing field and we need more people in construction. The opportunities are endless, and working for a company like TIC that provides training for their employees opens up opportunities to make a great career out of construction.

What advice would you give to those new to the field?
Knowledge is power; the more you learn, the more you can contribute. Above all, stay safe and keep others safe as well.

Interesting career-related fact or accomplishment:
To me, it is a blessing that I am doing what I love to do for a living. I have been coaching and teaching since the age of 12 and I always knew that's what I wanted to do with my life. Having been at the right place at the right time, I am now living my dream. I can honestly say I do not feel as if I work a day in my life because I love what I do.

How do you define craftsmanship?
Having the ability to perform a particular occupation or trade at your fullest potential, and taking pride in your work.

Trade Terms Introduced in This Module

Abrasive: A substance, such as sandpaper, that is used to wear away material.

Alternating current (AC): The common power supplied to most all wired devices, where the current reverse its direction may times per second. AC power is the type of power generated and distributed throughout settled areas.

Arbor: The end of a circular saw shaft where the blade is mounted.

Auger bit: A drill bit with a spiral cutting edge for boring holes in wood and other materials.

Carbide: A very hard material made of carbon and one or more heavy metals. Commonly used in one type of saw blade.

Chuck: A clamping device that holds an attachment; for example, the chuck of the drill holds the drill bit.

Chuck key: A small, T-shaped steel piece used to open and close the chuck on power drills.

Countersink: A bit or drill used to set the head of a screw at or below the surface of the material.

Direct current (DC): An electric power supply where the current flows in one direction only. DC power is supplied by batteries and by transformer-rectifiers that change AC power to DC.

Forstner bit: A bit designed for use in wood or similar soft material. The design allows it to drill a flat-bottom blind hole in material.

Grit: A granular, sand-like material used to make sandpaper and similar materials abrasive. Grit is graded according to its texture. The grit number indicates the number of abrasive granules in a standard size (per inch or per cm). The higher the grit number, the more particles in a given area, indicating a finer abrasive material.

Ground fault circuit interrupter (GFCI): A circuit breaker designed to protect people from electric shock and to protect equipment from damage by interrupting the flow of electricity if a circuit fault occurs.

Ground fault protection: Protection against short circuits; a safety device cuts power off as soon as it senses any imbalance between incoming and outgoing current.

Kerf: The channel created by a saw blade passing through the material, which is equal to the width of the blade teeth.

Masonry bit: A drill bit with a carbide tip designed to penetrate materials such as stone, brick, or concrete.

Reciprocating: Moving backward and forward on a straight line.

Revolutions per minute (rpm): The rotational speed of a motor or shaft, based on the number of times it rotates each minute.

Ring test: A method of testing the condition of a grinding wheel. The wheel is mounted on a rod and tapped. A clear ring means the wheel is in good condition; a dull thud means the wheel is in poor condition and should be disposed of.

Shank: The smooth part of a drill bit that fits into the chuck.

Trigger lock: A small lever, switch, or part that can be used to activate a locking catch or spring to hold a power tool trigger in the operating mode without finger pressure.

Additional Resources

This module presents thorough resources for task training. The following resource material is suggested for further study.

29 *CFR* 1926, *OSHA Construction Industry Regulations*, Latest Edition. Washington, DC: Occupational Safety and Health Administration, US Department of Labor, US Government Printing Office.

All About Power Tools. Ortho Books; Larry Johnston, ed. 2002. Des Moines, IA: Meredith Books.

Power Tool Institute, Inc. 1300 Sumner Avenue Cleveland, OH 44115-2851. **www.powertoolinstitute.com**.

Figure Credits

DeWALT Industrial Tool Co., Module Opener, Figures 1, 2A, 2E, 3, 5, 11, 17, 21, 22, 23, 24, 26B, 28, 30A, 31, 32, 34, 35, 42B

Courtesy of Milwaukee Electric Tool Corporation, Figures 2B, 2C, 4, 6 (photo), 25, 27, 29, 36, 42C

Courtesy of Irwin Tools, Figures 2D, 18

Cianbro Corporation, Figures 7, 8, 9, 19

Image courtesy of RIDGID®

RIDGID® is the registered trademark of RIDGID, Inc., Figures 10, 38, SA02

Courtesy of Atlas Copco, Figures 13, 14, 33, 37, 42A

C. R. Laurence Co., Inc., Figure 15

Robert Bosch Tool Corporation, SA01

Makita USA, Inc., Figure 26A

Courtesy of Dremel, Figure 30B

Zachary McNaughton, River Valley Technical Center, Figure 40

Simpson Strong-Tie Company Inc., Figure 39A, 41

Walter Meier Manufacturing Americas, Figure 43

Torin Jacks, Inc., Figure 44