Lesson 1: Electricity

Electricity is an extremely important home and farm utility essential to sustaining life as well as livelihood. Humans rely heavily upon electricity in their daily lives. It is important for people to consider factors such as energy conservation and safety in their daily consumption of electricity.

What Is Electricity?

Electricity is a form of energy created by the flow of negatively charged particles in a circuit through a conductor. An electrical conductor is a wire that allows electricity to flow through it. The circuit is the controlled path that the electrons follow. The path flows from where the electricity is generated and goes to where it is used. This process is similar to the natural flow of a river. Rivers must flow from a high point to a lower point of land. Electricity flows from negative charges toward positive charges. The flow of water in a river is referred to as the current, and similarly, the flow of charged particles in electricity is called the current. Finally, the river banks contain the flow of water and determine its direction just as a conductor determines the flow of electricity.

Generating and Transporting Electricity

Electricity is generated by mechanically passing coils of wire through a magnetic field. There are a variety of ways in which the mechanical generators can be driven. Some methods include water power, steam power, wind power, and solar power. Each method is evaluated based upon cost, amount of energy produced, pollution and environmental concerns, and the source of energy available.

Water Power

Water power is used by water that is flowing from a higher point to a lower point. This water flow is used to turn the generator. The action of using water power to generate electricity is called hydroelectric generation. One requirement for using water power to generate electricity is a water source. This may be a river or large stream that has been dammed up. Water power is not a good method to generate electricity in desert areas.

Steam Power

The majority of electricity is generated by steam power. With steam power, water is heated to very high temperatures and creates steam, which turns the wheels in the generator. These steam-powered generators are also called thermal-powered generators. Heat to produce the steam is a requirement for steam-powered generators. This heat is created in a variety of ways.

Fossil fuels, such as coal, oil, and natural gas, can be burned to create heat. One concern with using fossil fuels is that they are an exhaustible resource. When these fuels are used up, they are gone forever. Mining fossil fuels sometimes destroys the land, and burning fossil fuels can add to pollution in the environment if not handled properly.

Nuclear fission can also be used to create steam power. Nuclear fission involves splitting atoms in half like a chef would split a piece of fruit. Atoms are very small and cannot be seen by the naked eye. This process creates a great deal of energy and must be controlled in a specific container called a nuclear reactor. This method creates vast amounts of heat that can be used to produce the steam power necessary to generate electricity. Nuclear energy is an efficient and affordable source that generates almost one-fifth of the electricity used in the United States. Nuclear energy is also considered to be an exhaustible energy source. However, it does not require mining and burning, which is harmful to the environment. Precautions must be taken when using nuclear power and disposing waste products. Splitting atoms can create radioactive waste, which becomes an environmental concern and a health concern.

Another method of creating steam power to generate electricity is called geothermal power. There are several normal breaks in the earth's surface that were created by forces from within the earth. Underneath the breaks are heated rocks. When water is poured over the heated rocks, steam rises up to the surface and can be used to generate electricity. This is an environmentally safe, efficient, and inexhaustible energy resource. However, this method is limited to areas of the country where natural faults, or breaks, in the earth occur.

Steam power can also be created through the burning of solid waste, which is an inexhaustible resource. As with fossil fuels, solid human wastes can be burned to heat water and create steam. With this method, not only is energy being created, human waste materials are being disposed of in a relatively safe and efficient manner.

Wind Power

A third resource for generating electricity is wind power. With this method, air currents turn blades that generate electricity. This source of power is limited in the amount of power that it can generate. It also relies heavily upon consistent currents of air.

Solar Power

Another source for generating electricity is solar power. With solar power, solar cells convert sunlight directly into electricity. This does not require the use of a generator. However, solar power requires vast amounts of sunlight to generate this type of power. Areas where collecting direct sunlight is difficult would be a challenge for solar power.

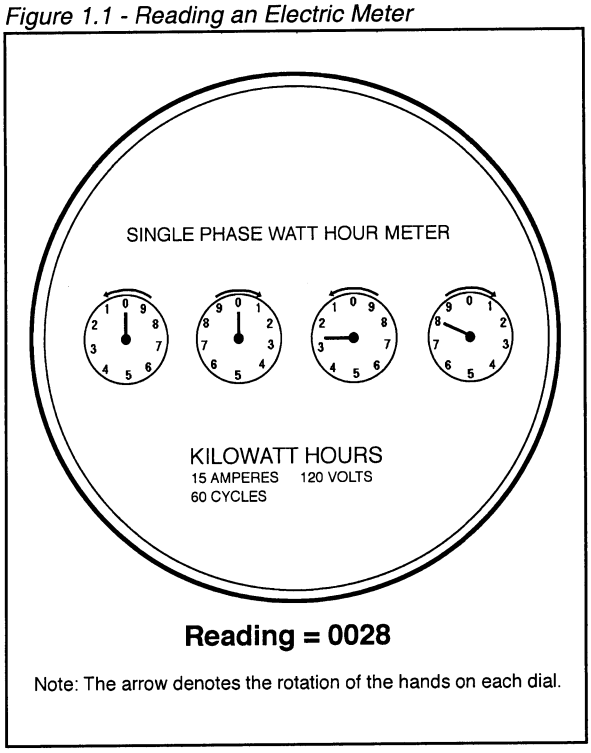
Electricity is transported from the plant where it is generated through a series of power lines to the local electric company. It then moves through an additional series of aboveground or underground power lines to the customer. The types of lines used to move electricity from the power plant to the local electric company are called transmission lines. Transmission lines carry high voltages of electricity. The types of lines used to move electricity from the local electric companies to the home and farm are called distribution lines. Distribution lines can be either overhead or underground.

Measuring Electricity

Once electricity moves from the local plant to the farm or home, it is ready to be used by the customer. Electrical use is measured in units of watt-hours called kilowatt-hours. Each month, electric companies read meters attached to homes and buildings or consult computer readings to determine how much electricity has been used (see Figure 1.1).

The measurement of electricity is similar to measuring the flow of water, as discussed previously. Water flowing through a hose puts out a certain amount of pressure. Voltage is the measure of electrical "pressure" in a circuit. If a person measures the gallons of water flowing through a hose per minute, the quantity, or output, of the flow would be measured. Similarly, amperage is the measure of electrical "flow." Electrical use is computed by multiplying the pressure times the flow (i.e., volts times amps), which yields watts. Electrical use is measured in kilowatts (i.e., 1,000 watts). Kilowatt-hours are the amount of kilowatts of electricity used over time. One kilowatt-hour represents the use of 1,000 watts of electricity over a 1-hour time period.

Figure 1.1 - Reading an Electric Meter



Reading = 0028

Note: The arrow denotes the rotation of the hands on each dial.

Electric companies charge customers for their usage by the kilowatt-hour. It is important for users to be aware of practices to conserve energy, which could decrease their electrical usage and save them money in the long run.

Fuses and Circuit Breakers

When electricity is transported to individual homes through distribution lines, the electrical power (i.e., voltage) has been reduced so it can be used safely in the home. However, electrical equipment must be installed to protect circuits from being overloaded from surges in electricity. Circuits are the paths of electrical flow within homes and

buildings. Fuses and circuit breakers are two methods of current protection.

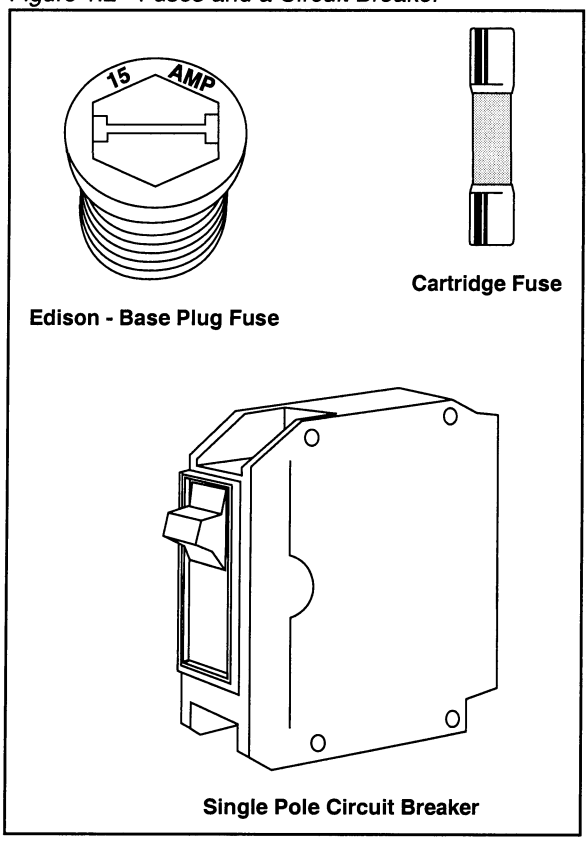
A fuse is a short piece of metal that will melt at a predetermined number of amps. Thus, if the amount of electricity flowing through a fused circuit is too high, the fuse will melt and stop the flow of electricity. Fuses can either be cartridge types, which are bullet-shaped objects designed to fit within brackets in the electrical panel, or they can be plugs that screw into or out of the electrical panel. Fuses are disposable devices that are removed and replaced when blown.

Circuits that are not properly fused may become overloaded and cause a fire from the overheated wire and/or burning insulation. Overloading occurs when too much electricity flows through the circuit. If there is an overload or electrical short problem in a circuit, the fuse will blow. This stops the flow of current to that specific area before it overheats the system. A new fuse must be installed before service can be restored to the circuit. Without safety devices to disrupt the flow of current, the continued flow of electricity could heat up the wire to the point of causing a fire. Oversized fuses should never be used to replace a blown fuse. To do so would override the safety factors provided by a fuse of the proper size. A blown fuse should always be replaced with a new one of the same size. Replacing fuses with ones of larger amperage would allow too much electricity to flow, causing the wires to melt and possibly create a fire.

A circuit breaker works in a similar fashion to a fuse. If the circuit overloads, the circuit breaker will trip. This means that the switch on the circuit breaker will trip to the "off" position. This stops the flow of current into the circuit. Repairing the circuit requires the circuit breaker to be reset by switching the toggle to the "on" position. If the circuit breaker continues to trip, it is a sign that there is an electrical problem in the line. Thus, before resetting the circuit, the home or business owner should determine the cause of the problem in the circuit and have the circuit repaired by a trained professional.

The difference between a fuse and a circuit breaker is that the circuit breaker must only be reset, whereas a fuse must be replaced each time it is blown. Occasionally a circuit breaker may wear out and have to be replaced with one of the same size.

Figure 1.2 - Fuses and a Circuit Breaker



Hot, Neutral, and Ground Wires

Electricity travels from its source to your electrical tools and appliances through a series of wires. The first type of electrical wire is the hot wire. Hot wires are the positive wires that conduct the electrical power to the appliance or tool. They are usually coated with red or black plastic. The next type of wire found in an electrical system is the neutral wire. Neutral wires help to complete the electrical circuit by carrying the electrical current from the appliance or tool back to its source. Neutral wires are usually coated with gray or white plastic. The final type of wire is the ground wire. Ground wires, usually coated in green plastic, serve as a connection from the electrical appliance or tool to the earth. If electricity travels outside its normal path, ground wires help to provide an alternate path for this electricity back to its source.

Types of Lightbulbs

There are several types of lightbulbs used in the home and around the farm. There are a variety of choices regarding types of indoor and outdoor

lighting. It is important to keep energy efficiency and safety in mind when choosing the right bulb for a particular job.

Incandescent lightbulbs are the most common type of lighting. Incandescent lighting works by electric current traveling through the filament in the bulb. The current heats up a filament wire inside the bulb and produces light. The light produced is a softer light used indoors.

Fluorescent lightbulbs are coated on the inside with a material that glows when the gases trapped inside the tube are charged with an electric current. Fluorescent lighting is efficient, inexpensive, and produces little heat. Used indoors and in greenhouses, they can produce large amounts of light for plants to grow without putting out heat that may damage the plants.

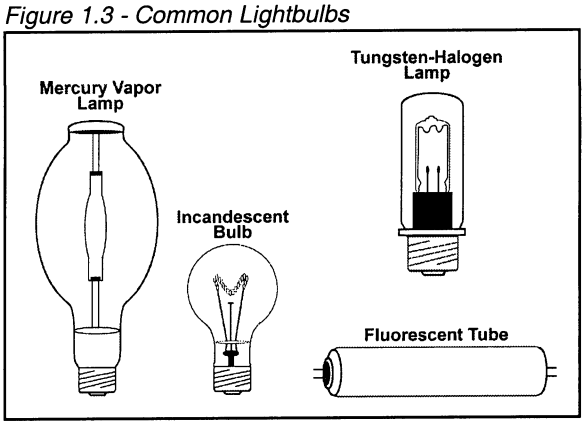
Halogen lighting involves heating halogen gases. These gases glow when charged with an electric current. Halogen lights produce large amounts of light; however, they tend to become very hot and must be monitored carefully for fires. Halogen lamps are recommended for outdoor use due to the immense output of heat that may cause fire hazards inside a building.

Mercury vapor lights have a two-lightbulb configuration. The inner bulb is made of quartz and is called the arc tube. This tube contains sodium with a mixture of argon and neon gas. The light produced is greenish-blue. These lamps last for a long period of time; however, they may take several minutes to heat up and reach full brightness. Mercury vapor lamps are used primarily outdoors to light the outside of homes and other buildings.

Metal halide lights contain compounds of metal and halogen with a basic two-bulb design. They produce a more naturally colored light. They have a long life and a high output of light, making them excellent sources for outdoor lighting. Metal halide lights would be poor indoor lights but are commonly used in shops. They put out a high quantity of light with a harsh glow that would be too bright and unpleasant to the eye indoors.

Sodium lights are composed of an arc tube made of aluminum oxide containing a solid mixture of sodium and mercury. These lamps produce an orange-white light and have a long life and very high light output. They are also an excellent source for outdoor lighting. As with metal halide lights, sodium lights would be too bright for indoor use.

Figure 1.3 - Common Lightbulbs



Hazards Associated with the Use of Electricity

There are two primary hazards associated with electricity. These are the dangers of electric shock and fire. Following safety precautions is important when working with electricity. The following are important electrical safety tips:

- Stay clear of electric power equipment. This means do not tamper with, touch, or climb on utility poles, transmission towers, electrical meters, etc.
- Never touch any outdoor wires.
- Do not fly kites or other toys near electrical transmission wires.
- Be alert for damaged electrical cords or plugs.
- Keep electrical appliances away from water and never work with electricity near wet or damp areas.
- Stay away from metal fences that are electrified.
- When a fuse blows or a breaker trips, always locate the source of the problem before replacing fuses. Then once determined, replace fuses with new ones of the exact amperage. Higher amp fuses in a circuit will cause overheating and fire.
- Determine the exact wattage of lightbulbs that lamps and lighting sources require. Higher wattage bulbs may cause overheating and fire.
- Be sure to follow all installation instructions and electrical codes when installing electricity or electrical equipment. The main power source should be turned off.

- Do not use extension cords as permanent fixtures in a poorly wired room. Overused cords can become worn or overloaded, causing shock or fire.

Summary

Electricity, or the flow of charged particles, can be generated, controlled, and channeled to serve the needs of people. Many different sources from water to nuclear to solar are utilized to generate electricity. Three different types of wires, hot, neutral and ground wires, can be found in electrical circuits. Guards referred to as fuses and circuit breakers monitor electricity channeled in the form of circuits. Lightbulbs convert electricity into light. Electricity should always be taken seriously for its awesome power and positive impact on human lives. However, safety is of number one importance to ensure that this great power source does not damage property or human lives by fire or electrical shock.

Lesson 2: Common Measurements and Their Uses

One important skill in the study of agricultural mechanics is the ability to take correct measurements and to convert one unit of measurement to another.

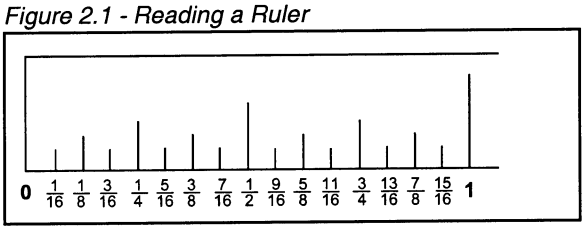
There are two common systems of measurement. The English system of measurement is the most commonly used in the United States. This system includes units such as inches, feet, and miles. The agricultural mechanics student will use this system the most often in course work. The metric system is used widely around the world and its practices are becoming more prevalent in the United States, namely in the automotive industry. This system includes measurements such as centimeters, meters, and kilometers. Objects can be measured in a number of ways including linear, area, volume, and weight.

Linear Measurements

Linear measurement involves measuring distances in straight lines. Common English linear measurements include inches, feet, yards, rods, miles, and knots. A standard ruler is 12 inches (1 foot) long. An inch is typically divided into sections for more accurate measurements: half, quarters, eighths, and sixteenths. Refer to Figure 2.1.

When reading a ruler or tape to accurately measure inches, remember to always read from left to right. The fractions of an inch should always be converted to simplest form. For example, 8/16 of an inch is read as 1/2 of an inch.

Figure 2.1 - Reading a Ruler



Additional linear measurements are feet, yards, rods, miles, and knots. There are 3 feet in 1 yard; 16.5 feet in a rod; 5,280 feet in a mile; and 6,080 feet in a knot.

Inches and feet can be used to measure distances such as the length of a piece of paneling or the length of a flower bed. Yards and rods measure longer distances such as lengths of rows in a field. Miles typically cover road distances, and knots are distances measured by ships in the oceans.

Common metric linear measurements include millimeters, centimeters, meters, and kilometers. One advantage to using metric measurements is that they are easy to convert and calculate. For instance, there are 1,000 millimeters in a meter, 100 centimeters in a meter, and 1,000 meters in a kilometer. Metric measurements are used to measure distances similar to those in the English system. However, the metric system is not commonly used in the United States; it is prevalent in European countries.

Area Measurements

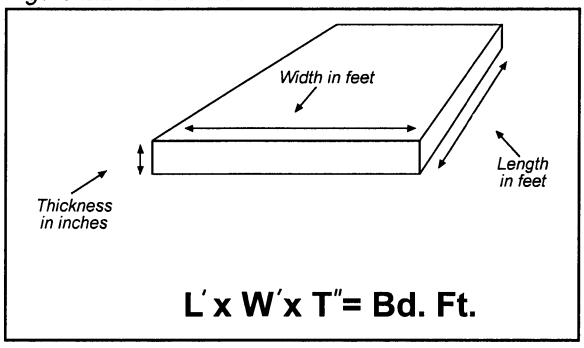
In many instances, objects cannot be measured simply by a straight-line method. The length and width of an object must be calculated to measure the surface area of an object. Measuring area involves multiplying the length by the width of an object. This can also be written as A=LxW. Common area measurements include square feet and square yards. A square foot is calculated by multiplying the length of an object in feet by the width of the object in feet. A square yard is calculated by multiplying the length of an object in yards by the width of an object in yards. There are 9 square feet in 1 square yard.

Volume Calculation

Another method of measuring objects involves calculating the volume. The volume of an object is the length of an object times its width times its thickness. This can also be written as LxWxT. Common volume measurements include cubic feet, cubic yards, and board feet. A cubic foot is calculated by multiplying the length of an object in feet by the width in feet by the thickness in feet. Similarly, a cubic yard is calculated by multiplying the length of an object in yards by the width in yards by the thickness in yards. There are 27 cubic feet in 1 cubic yard.

One common way of calculating the volume of wood used in a project involves calculating the board feet. This is similar to cubic feet; however, the thickness is normally calculated in inches. The way to measure the board feet in a piece of wood is to multiply the width in feet by the length in feet by the thickness in inches. Refer to Figure 2.2. It is important for the builder to use this measurement correctly so not to confuse it with cubic feet.

Figure 2.2 - Board Feet



Weight Measurements

Another way to measure an object is to calculate the object's weight. Weight is also described as the mass of an object. Common English units of weight include ounces, pounds, and tons. There are 16 ounces in 1 pound. Common metric units of weight include milligrams, grams, and kilograms. There are 1,000 grams in 1 kilogram.

Weight measurements are used for food products, such as sugar, flour, raw meat, and margarine. Weights are also used for shipping items through the postal service and express delivery systems.

Summary

Measurements are used daily in everyone's life. It is important to understand common linear measurements, area measurements, volume measurements, and weight measurements.

Lesson 3: Common Tools and Their Uses

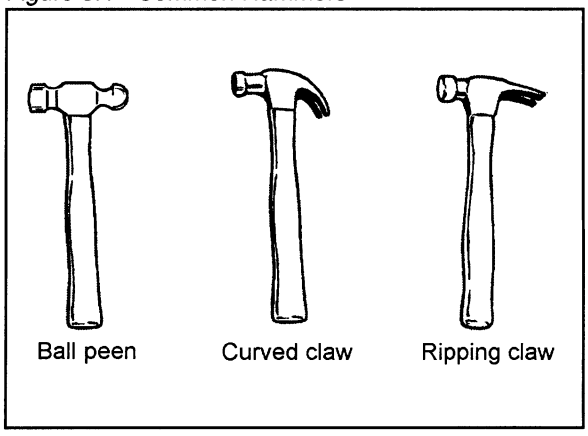
There are many types of tools. Each tool is designed for a specific job. Tools should be used only for their intended purposes. Using tools for other purposes than for what they were intended may cause personal injury or damage the tool.

Common Hand Tools and Their Uses

Identifying and correctly using hand tools are important in agricultural mechanics. A hand tool is any tool operated by the hand to do work. Hand tools can be used to perform small jobs around the home and farm where it is inappropriate to use large power tools. They can also be used to perform nearly any type of operation, only at a reduced power than power tools. There are a large number of hand tools used to serve a number of purposes.

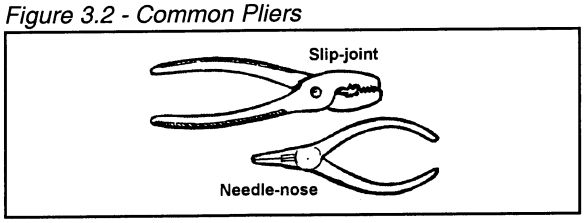
An important basic hand tool is the hammer. Hammers are considered driving tools because they are used to drive nails. They can also be used to drive other tools or objects. Various types of hammers include the ball peen hammer, which is ball-shaped on one end and flat on the other end. The curved claw hammer can be used to remove nails or to pry objects. The ripping claw hammer has a straighter claw end.

Figure 3.1 - Common Hammers



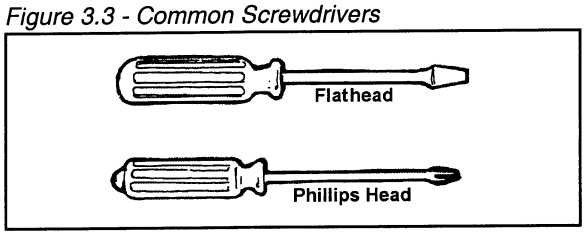
Pliers are used to grip and turn objects. Needle-nosed pliers have a long slender point that is ideal for gripping objects in narrow openings or for gripping wire and other small objects. Slip-joint pliers are used to grip or twist larger objects and have an adjustable bolt that opens up to grip larger objects.

Figure 3.2 - Common Pliers



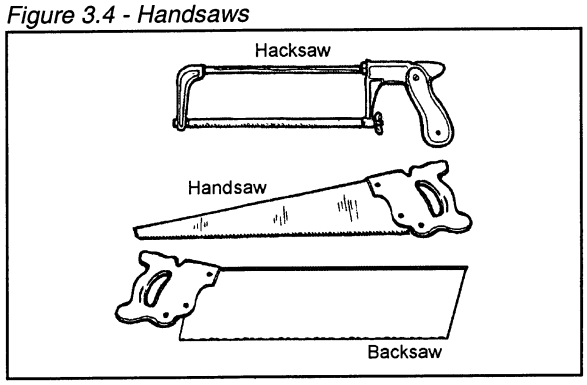
Screwdrivers are an important hand tool used to turn bolts or screws. Two common types of screwdrivers include the Phillips head screwdriver and the flat-head screwdriver. These screwdrivers differ in the shape of their turning ends. The Phillips has a round and slotted tip. The flat-head has a tapered, flat, and straight tip.

Figure 3.3 - Common Screwdrivers



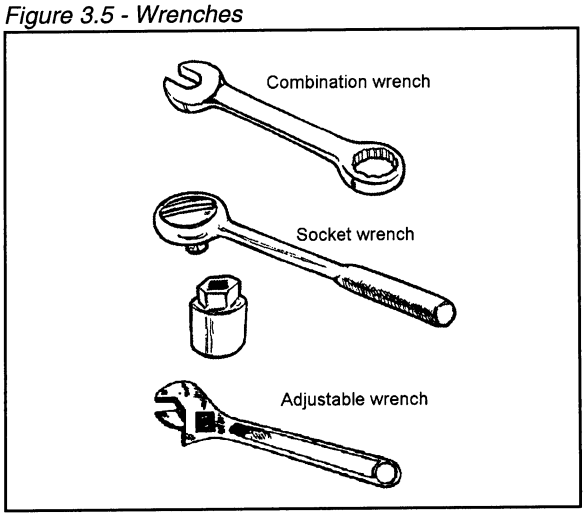
Handsaws are used to cut wood, metal, or plastic materials. They are classified by the cut made or the type of material to be cut. A hacksaw is used mainly to cut metal. The common handsaw is used mostly for common cuts in wood materials. The backsaw is used to make very precise cuts. It has very fine teeth and a straight metal back. It is used often in combination with a special device called a miter box, which correctly measures the angle of the cut.

Figure 3.4 - Handsaws



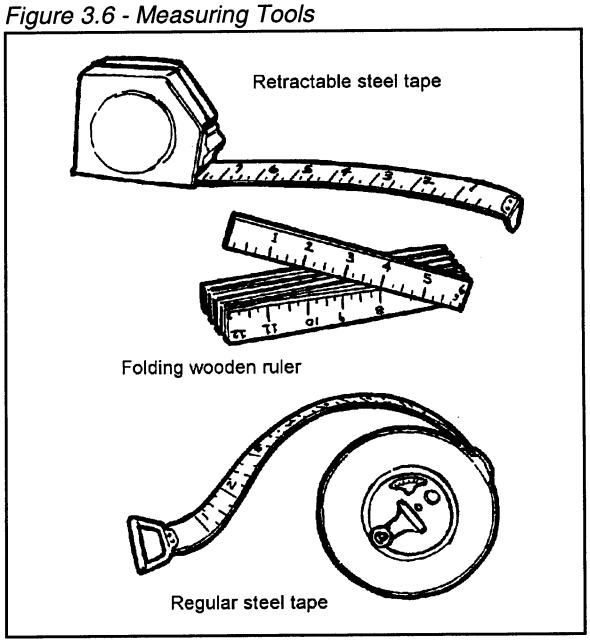
Wrenches are used to tighten and loosen bolts and nuts. Combination wrenches are normally open at one end and circular at the other end. Socket wrenches are used in combination with sockets of various sizes to fit directly over the nut to be adjusted. Adjustable wrenches are equipped with a screw that will adjust the wrench to various sizes depending upon the object.

Figure 3.5 - Wrenches



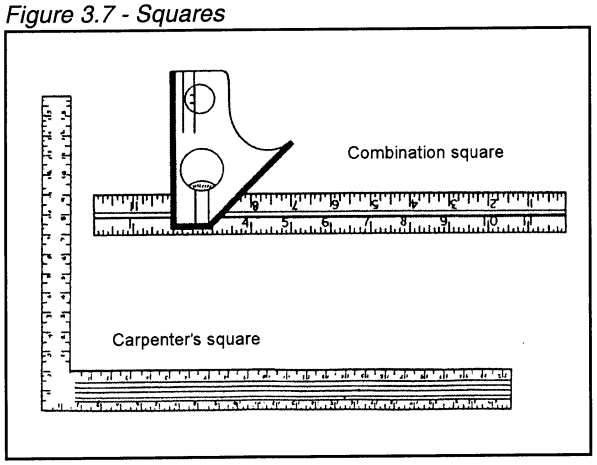
Measuring tools are used to determine the dimensions of specific areas. The retractable steel tape will wind itself up after being used. Regular steel tape must be manually wrapped after usage. The folding wooden rule is a long wooden ruler that folds into a form that is much easier to store.

Figure 3.6 - Measuring Tools



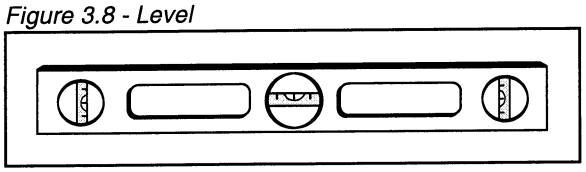
Squares are used as layout tools. They form 90° square corners on objects. A combination square includes a sliding ruler and an angle device that assist the user in measuring and cutting angles. A carpenter's square is normally utilized to make square corners only.

Figure 3.7 - Squares



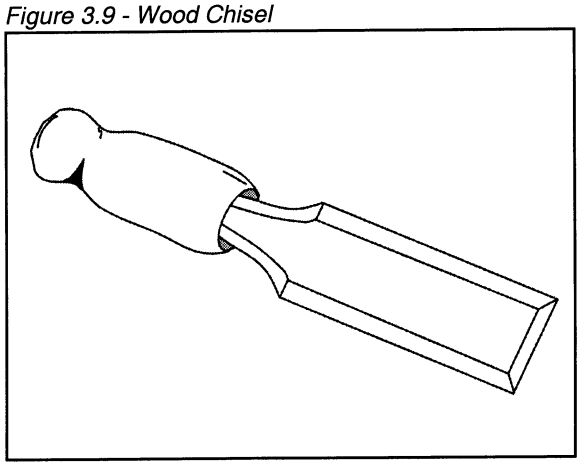
An additional type of layout tool is the level. Common levels use a system of air bubbles to determine the straightness, or level, of an object or line. An air bubble is positioned in the middle section to indicate that a point is level.

Figure 3.8 - Level



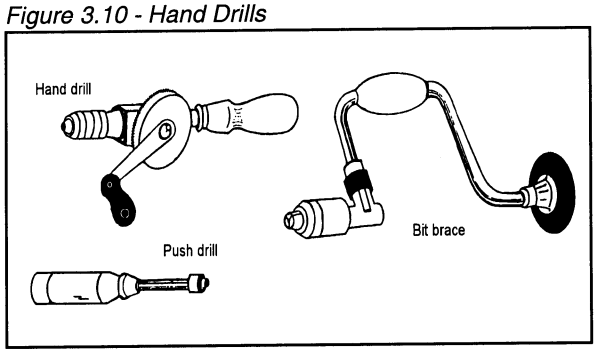
Wood chisels are cutting tools with a sharpened blade used to cut, shave, or carve wood. They are used where shaving or chipping processes are necessary that might not work well with larger power tools.

Figure 3.9 - Wood Chisel



Hand drills are tools used to drill holes in surfaces where it may not be possible or appropriate to use a power drill. The push drill is a smaller type of hand drill that is operated by a pushing motion. The bit brace is used where more force is necessary. The operator must physically hold and turn the bit brace.

Figure 3.10 - Hand Drills

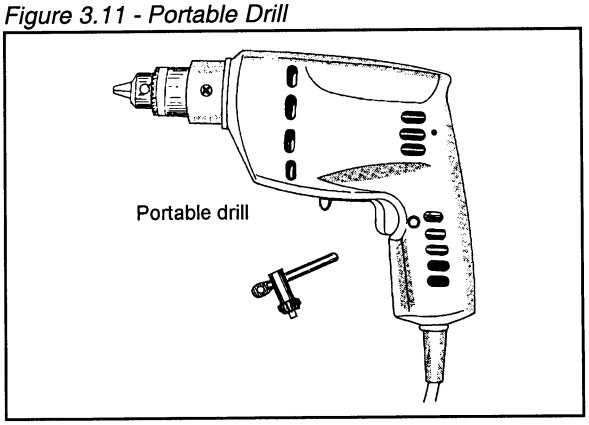


Common Power Tools and Their Uses

Power tools are operated by some source of power other than human power such as batteries, electric, or hydraulic power. They are faster, more efficient, and much more powerful than hand tools of the same nature. Power tools can either be portable or stationary, which means they are either easily transported from job to job or must remain in one place.

Portable drills are a lightweight type of drill that can be taken nearly anywhere. They are typically powered by electricity or batteries. As with a hand drill, a portable drill is used to drive screws or to drill holes in objects.

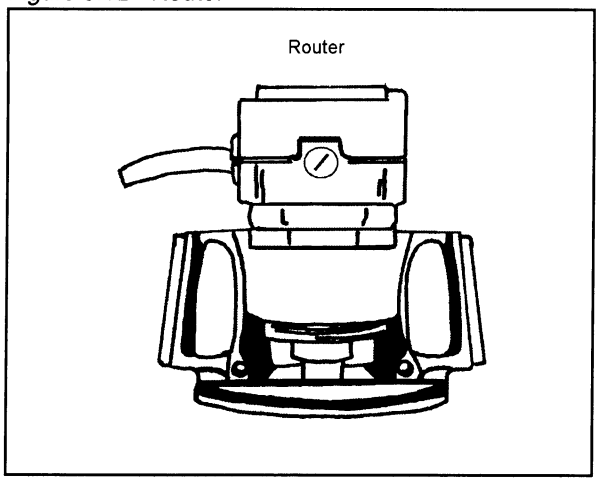
Figure 3.11 - Portable Drill



The router can either be a stationary or a portable power tool. It is used to create a groove or a cut in wood. Routers can be used for creating special

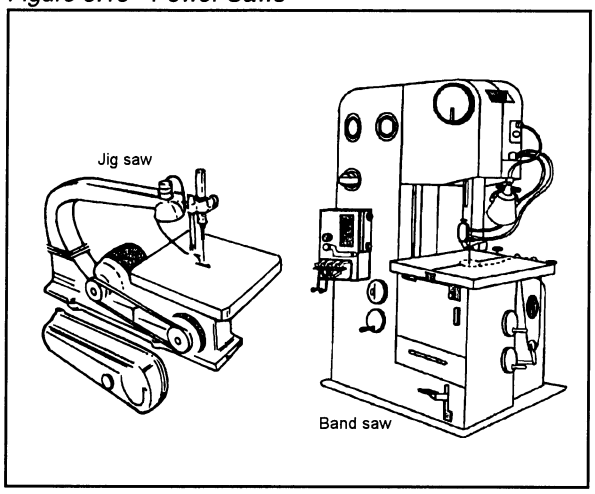
joints (to join pieces of wood together) or to create decorative grooves in wood.

Figure 3.12 - Router



The jig saw (or scroll saw) is a small stationary or portable power tool used primarily to cut curved lines in wood. It is not recommended for straight cuts. The band saw, however, is a large stationary power tool. It can be used to cut a variety of materials including wood and metal. The band saw can cut straight or curved lines.

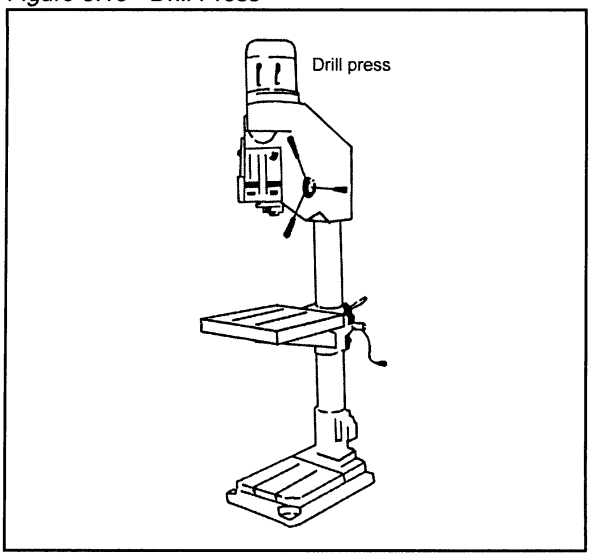
Figure 3.13 - Power Saws



A drill press is a larger stationary power tool. It is used to cut or drill holes in metal, wood, and other materials. It is preferred over the portable drill when many precision cuts are necessary or when cutting larger holes.

Power tools can make jobs faster and more efficient. Often they are necessary for jobs requiring more power than the human hand can provide. It is essential for the safety of the operator and for the long life of the tool that proper instruction is provided before operating any power tool.

Figure 3.13 - Drill Press



Summary

Hand and power tools were developed to make the performance of tasks faster, easier, and more efficient. A good working knowledge of hand and power tools and their proper uses will assist in completing tasks at a faster rate.

Lesson 4: Personal Safety Practices

Safety when working with tools is critical. This lesson addresses various practices that will help ensure personal well-being of those working with tools in a variety of settings.

Eye Protection

When working in an agricultural mechanics shop, in the home, or on the farm, one of the most important safety tasks is to properly protect the eyes. Proper eye protection includes safety glasses or safety goggles. Safety glasses and goggles protect the eyes from debris from the front. They should have side shields to protect the eyes from debris that could enter from the side. Safety glasses are a requirement when working with hand tools, power tools, or when standing near others who are using tools.

Proper Clothing

Proper clothing is another safety item necessary when working around the farm, home, or shop area. Clothing must fit well and be free from tears. Loose, baggy, or frayed clothing is a safety hazard because it can become entangled in the moving parts of a machine or easily catch fire. Protective clothing such as coveralls, shop aprons, or shop coats are highly recommended to protect clothing from damage such as staining or tearing. Protective clothing should be fire resistant.

If hair is long, hair restraints must be worn to keep hair out of the way of machines that have moving parts. Long hair can easily become entangled in a machine or catch fire. Protective head covering is recommended to protect the head from fire or injury when tearing out walls or performing any demolition work.

Leather shoes with steel toes and high tops are recommended to protect feet from injury that can occur from falling or dropped objects. Leather shoes are more resistant to fire. Face masks should be worn when working around fumes or dust, such as when spraying chemicals, painting, or sanding.

Cleanliness

A messy shop is a hazard in the home or on the farm for a number of reasons. Tools strewn about on the floor and work benches are obstacles. Persons working in the home or farm shop could stumble and fall over tools that have been left on the floor. Tools need to be returned to their proper areas to avoid the risk of becoming damaged and creating a safety hazard for the next operator.

Debris strewn about the shop is also a fire hazard. Waste materials must be cleaned and disposed of in a proper manner to avoid fires. A home or shop fire can be especially devastating due to the risk of burning the shop as well as the entire house. A clean shop is an efficient and safe area in which to work.

Hand Tool Safety

There are many factors to consider when maintaining safe operation of hand tools. The first is to be sure that the eyes and clothing are properly protected before entering the shop area. Next, the operator must be certain of using the correct tool for the job. Each tool has its own specific purpose, and using a hand tool for the wrong purpose makes it an unsafe tool.

Next, the operator should inspect the hand tool to be certain that the tool is not damaged in any way. Dull or damaged tools are also a safety hazard. The operator should then be careful to operate the tool carefully and in the proper manner for its intended use. It is important for a person to obtain instruction in the safe and proper use of each tool.

When finished using a hand tool, it should be inspected to ensure that it is clean and undamaged. The tool should then be returned to its proper storage area to keep the shop clean and free from debris and safety hazards. Although hand tools may seem simpler and much safer than power tools, they can still cause injury to persons working in the shop if not used safely and correctly.

Power Tool Safety

Power tools are fast-moving, powerful machines most often operated by an electrical power source. This makes them extremely dangerous if used improperly. It is extremely important for the operator of a power tool to master the safety rules associated with the power tool.

Before using any power tool, obtain permission to use it. At school, obtain permission from the instructor if the tool is to be used in a school laboratory. If the tool is to be used at home or on the farm, obtain permission from an adult in charge of the tool. Be sure that eyes and clothing are properly protected before entering the home, farm, or school shop.

Next, the operator must inspect the tool to be sure that the blade or cutter is clean and sharp, the power cord and switch are in good condition, and all guards are in place. Dull tools damage the tool or may cause injury to the operator. Frayed cords can cause electric shock, and faulty guards fail to protect the operator from turning blades and other moving parts. Each power tool has its own unique set of operating and safety instructions. The operator should use a power tool only after reading the safety manual and mastering the safety rules for the particular tool.

Before turning a tool to the "on" position, inform others in the shop that the power tool will be turned on. This will give them time to clear

themselves from the safety zone around the tool. Before making any adjustments to the tool, the operator should make sure the switch is off and the tool is unplugged. After using a power tool, it should be properly cleaned and stored in the appropriate location.

Summary

Safety in the shop, home, or on the farm is not a matter to be taken lightly. Mastering safety procedures helps tool and machine operators ensure their own safety as well as the safety of others in the area. Some important general safety procedures involve wearing safety glasses or safety goggles at all times when operating any type of tool or equipment; wearing proper clothing for the home shop, farm shop, or classroom laboratory; and keeping work areas clean and clear of tools and debris. Hand tools should always be inspected before use and stored in the proper area after use. Power tools should always be operated according to proper safety instructions for the particular machine, with careful attention to safety guards, and should never be operated without permission from an instructor, a parent, or the owner of the tool. Safe and proper operating procedures help to maintain the condition of the tools and shop equipment.

Lesson 5: Safety and Maintenance Procedures for Lawn and Garden Equipment

Lawn and garden tools, whether operated manually or electrically, must be handled safely and used appropriately. In this lesson, the features of hand lawn and garden tools and of power lawn equipment are described.

Common Lawn and Garden Hand Tools

Hand lawn and garden tools are tools that are held in the hand and operated by manual labor. Common hand tools used to work on lawns or in the garden are pictured in Figure 5.1.

It is important to remember that each tool has a specific use and should not be used for any other purpose. Tools should be cleaned, inspected for damage, and placed in the proper storage area after each use.

Common Power Lawn Equipment

Power lawn equipment is operated either by a two- or four-stroke gas engine or an electrical source. Power equipment makes the operator's job faster and more efficient. Types of power equipment used in lawn work are illustrated in Figure 5.2.

The operator should read all instruction and safety manuals before attempting to use any power lawn equipment and follow proper maintenance procedures.

Differences Between Two- and Four-Stroke Engines

There are several differences between two- and four-stroke engines in power lawn equipment. Large riding mowers contain a four-stroke engine, whereas most small trimmers and blowers have two-stroke engines. Each engine has advantages and disadvantages that make it the suitable choice for the intended job.

The major difference between two- and four-stroke engines is the type of fuel used in each. The two-stroke engine requires an oil-fuel mixture directly in the fuel chamber. The four-stroke engine strictly requires fuel in the fuel tank and oil in the oil reservoir. Never place the wrong type of fuel in a particular engine; severe damage can result to the engine. See Table 5.1 for a comparison between two- and four-stroke engines.

Safety Guidelines for Using Hand Lawn Equipment

Safety is extremely important when working with any type of lawn tool. It is important to know the tools well and use only the appropriate tool for the job. Misuse of tools can cause injury and damage to the tool.

The operator should be careful to avoid baggy, loose-fitting clothing. Loose clothing can become caught in tools and cause injury. To avoid damage to the eyes, always wear safety glasses when using any tool and particularly when sharpening tools. Wear gloves to protect the hands from cuts and blisters.

Inspect the tool to ensure that it is sharp and in good working condition before use. Clean the tools and replace them in the proper area after using each tool. To avoid injuring anyone, be

Figure 5.1 - Common Lawn and Garden Hand Tools

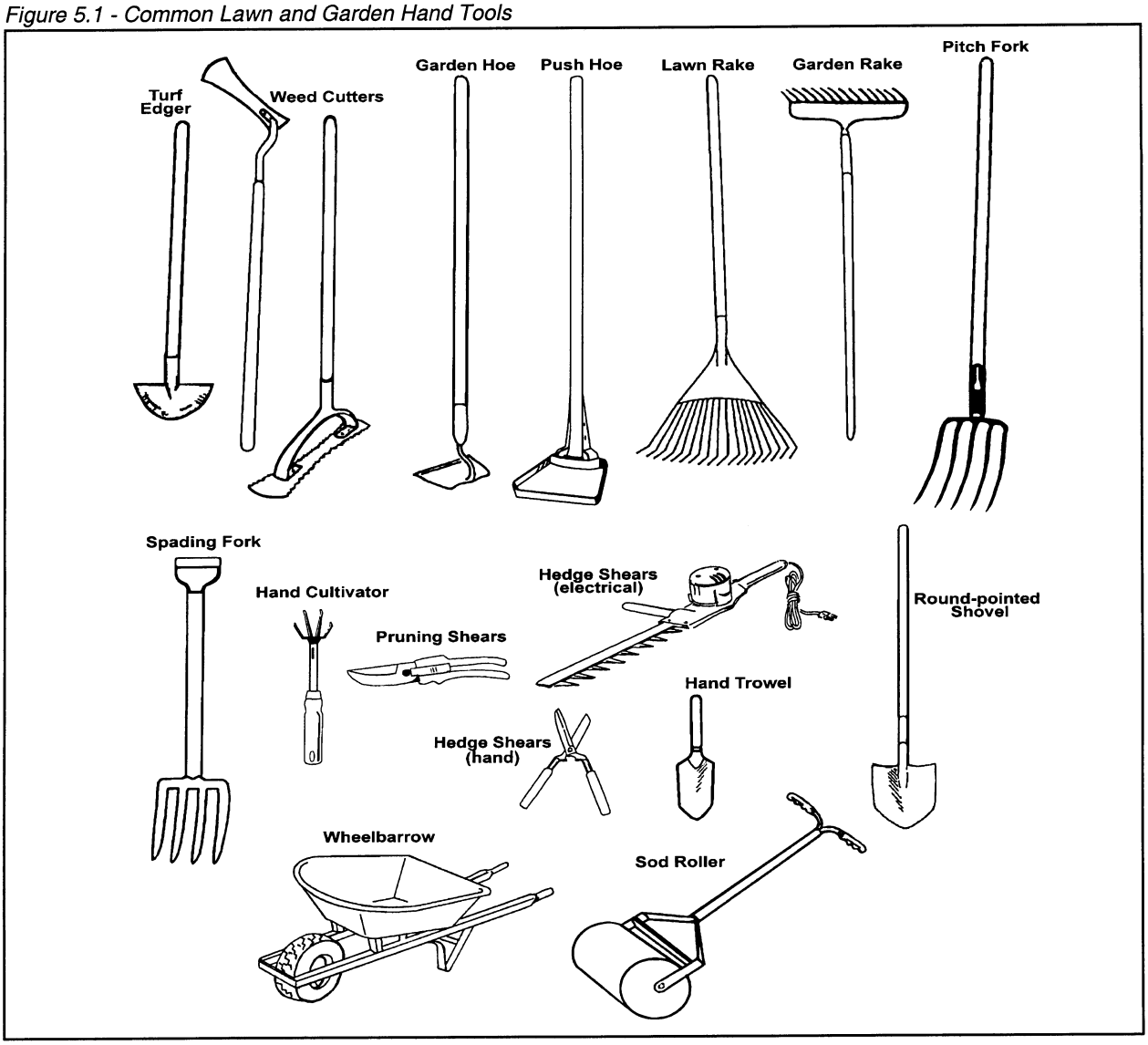


Figure 5.2 - Common Power Lawn Equipment

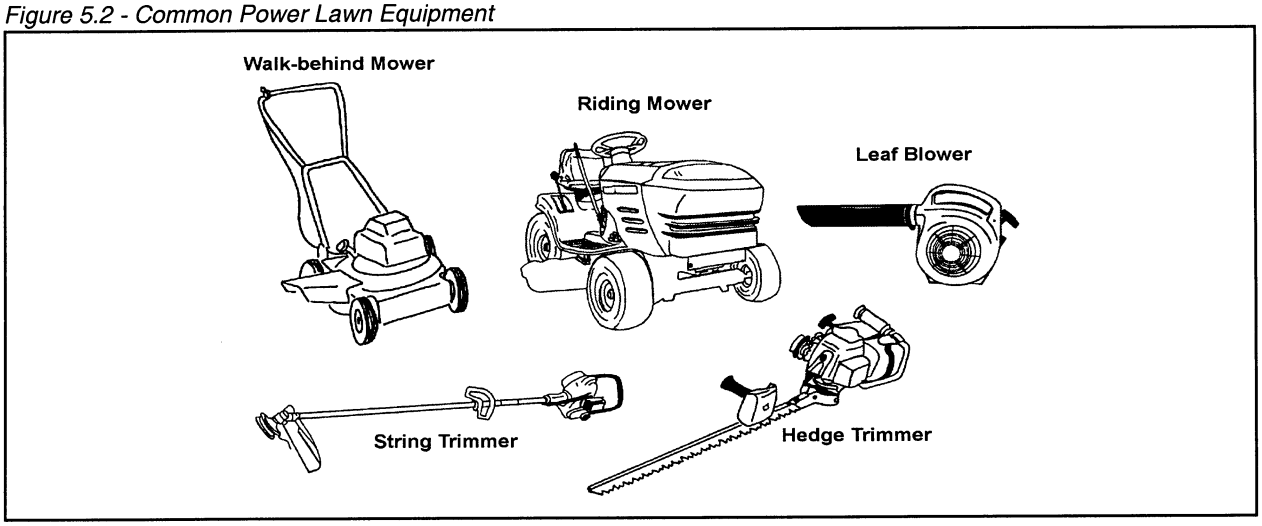


Table 5.1 - Two-Stroke vs. Four-Stroke Engines

	Four-Cycle Engine (equal hp) One Cylinder	**Two-Cycle Engine (equal hp) One Cylinder**
Number of moving parts	Nine	Three
Running	Cooler running	Hotter running
Overall	Larger	Smaller
Engine	Heavier construction	Lighter in weight
Fuel and Oil	No mixture required	Must be premixed
Fuel Consumption	Fewer gallons per hour	More gallons per hour
Oil consumption	Oil recirculates and stays in engine	Oil is burned with fuel
Sound	Generally quiet	Louder in operation
Operation	Smoother	More erratic
Acceleration	Slower	Very quick
General Maintenance	Greater	Less
Initial Cost	Greater	Less
Versatility of Operation	Limited slope operation (receives less lubrication when tilted)	Lubrication not affected at any angle of operation

conscious of others' locations before swinging sharp tools.

Safety Guidelines for Power Lawn Equipment

Power lawn equipment can be a dangerous tool to the operator as well as others nearby if used in an unsafe manner. The operator should master safety guidelines for each tool to ensure the safety of all involved. Carefully read the instructions and operating procedures in the owner's manual before attempting to operate any power lawn tool. Each tool has its own unique safety feature that should be mastered by the operator.

As with the use of other tools, the operator should avoid wearing loose or baggy clothing, because it can become entangled in moving parts of the equipment. Safety goggles should also be worn to protect the eyes. The equipment should be inspected before use to be sure blades are sharp and in good working condition. Dull or damaged tools are dangerous to the operator, do a poor job of cutting, and can cause damage to the equipment itself.

Before turning on a power tool, alert others so that they are aware that a power tool is in use. When mowing or cutting, keep hands and feet away from all moving parts. Remove debris and large movable objects from areas where mowers and trimmers will be operated to ensure that the operator or others around will not be hit by flying objects.

Never smoke or attempt to refill the fuel tank while the equipment is running. Fuel can easily ignite and burn the operator. Keep all safety shields in their proper places. Safety guards generally protect against blades or objects flying from the blades. Use caution when mowing on slopes to avoid falling or overturning equipment.

Only mow grass when it is dry. Cut grass to a height of 1 1/2 to 3 inches depending upon time of year and type of grass.

Maintenance Procedures for Hand Lawn Equipment

Hand tools should be properly maintained to ensure the safety and long life of the tool. Hand tools should be cleaned and inspected for any damage after each use. First, inspect wooden handles to be certain they are in good condition. Restore rough, dry, and splintered wooden handles by first sanding them, rubbing them with

linseed oil, and then rubbing the handles again with a soft cloth.

Metal parts must be maintained against rust. Prevent rusting by keeping all metal surfaces dry. If a surface becomes rusty, first clean the area to remove all dirt and debris. Then wire brush metal surfaces to remove the accumulated rust. Finally, shine the area with a light oil to remove existing rust.

Blades on tools should be kept sharp at all times. A dull blade is dangerous and does a poor job. Blades can be sharpened with files, various types of stones, and grinders. Different blades require different angles of sharpening. Oversharpening reduces the life of the tool, and uneven sharpening throws off the balance of the tool.

Maintenance Procedures for Power Lawn Equipment

Air cleaners and filters should be kept clean to ensure the longevity of the tool. Check air cleaners and filters every 25 hours of operation or sooner when working in extremely dusty conditions. The oil should be checked in four-stroke engines before each use and changed every 25 hours of use.

It is important to understand that four-stroke engines have separate reservoirs for the fuel and the oil and that one should never be mixed within another. However, two-stroke engines require a fuel-oil mixture in the fuel chamber. Always use the correct fuel-oil mixture in a two-stroke engine. This is determined by reading the owner's manual of the tool.

Check spark plugs frequently and clean them by scraping off the dirt, soaking in a solvent, and drying them. Change the spark plugs after 100 hours of use.

It is important to follow proper procedures when storing power tools for long periods of time to ensure that they run well when they are needed. The fuel tank should be drained, the oil and filters should be changed, the exterior and the chains should be cleaned and lubricated, and the belts should be loosened.

Summary

As a homeowner, it is very important to identify and know the proper use, maintenance, and safety procedures for lawn and garden equipment. Appropriate practices will help ensure the safety of the operator, the ease of operation, and the longevity of the tool.

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