

# UNIT 7

## Hand Tools, Fasteners, and Hardware

### Objective

To identify and correctly spell hand tools, hardware, and fasteners that are commonly used in agricultural mechanics.

### Competencies to be developed

After studying this unit, you should be able to:

- Describe how tools are classified.
- Name the major tool categories, according to use.
- Classify and correctly spell hand tools commonly used in agricultural mechanics.
- Identify and correctly spell commonly used screws, nails, and bolts.
- Select screws, nails, and bolts for various uses.
- Identify and correctly spell important items of hardware.

### Materials List

- Hand tools commonly used in agricultural mechanics
- Common types of screws, nails, and bolts
- Items of hardware commonly used in agricultural mechanics

### Terms to Know

- tool
- hand tool
- power tool
- layout tool
- saw
- boring tool
- driving tool
- hammer
- pliers
- wrench
- chisel
- punch
- clamp
- wrecking tool
- digging tool
- fastener
- laminate
- adhesive
- nail
- diameter
- shank
- head
- penny
- galvanized
- screw
- threads

*continued*



**T**he correct use of hand tools is fundamental in agricultural mechanics. Large and efficient power tools are used to do most of the work in society. However, hand tools are used to do the small jobs and to do the work where large machines cannot function.

The use of hand tools is basic and essential for work in design, construction, maintenance, and repair. Hand tools are used by all who construct buildings, install landscape structures, wire computers, or repair tractors. In fact, all people in society use hand tools or pay others to do jobs that require their use. A **tool** is any instrument used in doing work. A **hand tool** generally refers to any tool operated by hand that makes use of muscle power rather than electricity or other power sources (Figure 7-1). This is contrasted with a **power tool**, which is operated by some source of power other than human power. However, note that some people may classify such tools as a power hand drill as a hand tool.

## TOOL CLASSIFICATIONS

There are various methods of classifying tools. Therefore, the student needs to be prepared to recognize tools by their various classifications. Tools may be classified according to who uses them, e.g., carpenters' tools, masons' tools, mechanics' tools, or machinists' tools. Tools from all such trades are used in agriculture. Therefore, classification of tools by use or function is more meaningful to workers in agricultural mechanics.



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**FIGURE 7-1** Hand tools are instruments that use human muscle power to do work.

### Terms to know *(continued)*

- square head
- hex head
- slotted-head screw
- Phillips-head screw
- Allen screw
- drywall screw
- machine bolt
- cap screw
- carriage bolt
- stove bolt
- plow bolt
- nut
- washer
- machine screw
- hardware
- hinge
- butt hinges
- strap hinge
- T hinge
- screw hook and strap hinge
- hasp
- gussets
- flush plate



The following discussion outlines some of the various types of hand tools commonly used in the agricultural mechanics lab. It is essential that you learn the proper name of tools to be able to communicate correctly about tools. One of the common ways to misname a tool is to call it by a brand name. The following outline and images should help you to learn the proper classification and name of a particular tool. For example, locking pliers are sometimes called Vise Grip® pliers because of the popularity of that brand. Many of the specific tools outlined here will be explained in other chapters that deal with their use.

## Layout Tools (L)

A **layout tool** is a tool used to measure or mark wood, metal, or other materials (Figure 7-2). Rules, squares, levels, chalk lines, measuring tapes, and plumb bobs are among some of the tools classified as layout tools. These tools are used to measure and mark materials before cutting or shaping is done. Measuring and marking are done when laying out work so other functions can follow according to plan.

## Saws

A **saw** is a tool used to cut wood or other materials. This permits the user to shape the material (Figure 7-3). There are several different types of saws that are operated by hand, and each has a specific purpose. These purposes can range from the simple sawing of a board using a handsaw to the cutting of dovetail joints using a dovetail saw.

## Boring Tools (B)

A **boring tool** is a tool used to make holes or change the size or shape of holes. Boring tools include bits, drills, reams, and the devices used to turn them (Figure 7-4). In addition to many common hand tools, this group includes a large variety of specialized tool bits for power machines. There is a wide variety of different types and sizes of drill bits. Some are for drilling holes in wood, some for metal, and some for masonry such as concrete.

## Hammers

Another group of tools classified by their use is hammers that are used as **driving tools** (Figure 7-5).

Hammers rely on their weight and speed to provide force to move an object when it is hit. A hammer is used for moving a sliding belt tightener, striking a cold **chisel** to cut a rivet, forcing nails into wood, or driving stakes into the soil. Some examples of hammers are sledges, claw hammers, peen hammers, and non-marring hammers such as rubber mallets.

## Pliers

Very common tools used to grip wood, metal, plastic, and other materials are known as **pliers** (Figure 7-6). Pliers are used to hold material while other tools are used to cut, shape, modify, or turn threaded items like screws. Pliers are also used to grip objects such as bolts or pieces of wire. They may be used to bend or shape such objects as needed. Pliers come in an array of types for different uses. They range from the commonly used slip-joint pliers to locking pliers to wire-crimping pliers.

## Wrenches

A very basic hand tool group is referred to as wrenches. Engine and machinery mechanics as well as people doing everyday household maintenance tasks make frequent use of wrenches. Wrenches are used to turn nuts, bolts, or screws. **Wrenches** may include tools such as boxed-end, open-end, combination, socket, and Allen wrenches (Figure 7-7).

## Chisels and Punches

A category of tools that are usually used by striking them with a hammer is chisels and punches. Chisels are used to cut metal, masonry products, or wood depending on the type of chisel used. **Punches** are used to align holes to insert a pin, to make a dent in metal to start a drill, set a nail below the surface in wood, and many other uses (Figure 7-8).

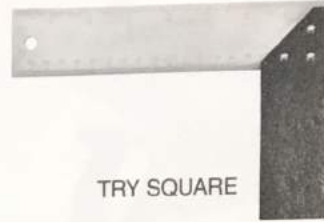
## Screwdrivers

Screwdrivers are found in every toolbox and are basic tools used on a daily basis. There are several different types of screwdrivers. Straight-bit screwdrivers turn traditional slot-headed screws; Phillips screwdrivers turn screws with a cross-shaped opening in the head of the screw. A newer type of screwdriver is called a torx that drives a screw with a star-shaped or groove-shaped head. Nut runners are also included in this category because

SQUARES



COMBINATION SQUARE



TRY SQUARE



QUICK SQUARE



T BEVEL



FRAMING SQUARE

RULES



STEEL RULER



MARKING GAUGE

TAPES AND LINES



CHALK LINE

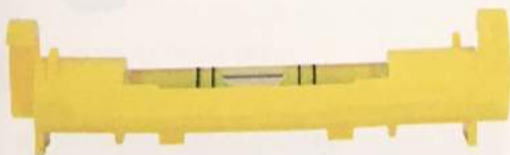


TAPE MEASURE



PLUMB BOB

LEVELS



LINE LEVEL



SPIRIT LEVEL



TORPEDO LEVEL

FIGURE 7-2 Layout tools.



SAWS



BACKSAW



COPING SAW



DRYWALL SAW



HACKSAW



HANSAW



KEYHOLE SAW



DOVETAIL SAW



MINI HACKSAW



FOLDING POCKET SAW



MITER SAW

FIGURE 7-3 Cutting tools.

**CUTTERS**



AVIATION CUTTERS



CARPET KNIFE



RAZOR BLADE SCRAPER



NAIL NIPPERS



SIDE CUTTERS



SNAP-OFF BLADE KNIFE



SPORT UTILITY KNIFE



TIN SNIPS



UTILITY KNIFE



HAWK BILL KNIFE



HOBBY KNIFE

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FIGURE 7-3 (Continued)

**BORING TOOLS**



BRAD-POINT BIT



COUNTERSINK BIT



PLUG CUTTER



FORSTNER BIT



DRILL-BIT EXTENSION



SPADE-BORE BIT



TWIST BIT

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FIGURE 7-4 Boring tools.

HAMMERS



BALL-PEEN HAMMER



BLACKSMITH'S HAMMER



CURVED CLAW HAMMER



DEAD-BLOW HAMMER



RUBBER HAMMER



SHINGLING HATCHET



SLEDGEHAMMER



STRAIGHT CLAW HAMMER



MASON'S HAMMER



DRILLING HAMMER



TACK HAMMER

FIGURE 7-5 Hammers.



## PLIERS



DIAGONAL OR SIDE-CUTTING PLIERS



LINEMAN'S PLIERS



NAIL NIPPERS



WELDING PLIERS



LONG NOSE OR NEEDLENOSE PLIERS



GROOVE-JOINT PLIERS



LOCKING PLIERS



SLIP-JOINT PLIERS



WIRE-CRIMPING PLIERS

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FIGURE 7-6 Pliers.

of their close resemblance to and similar function of a screwdriver. These turn small bolts or nuts (Figure 7-9).

## Clamps

**Clamps** are used to draw and hold objects together. As you can imagine, they have a very wide range of uses and come in many different sizes, shapes, and types to fit different needs. Vises are also included in this group (Figure 7-10).

## Wrecking Tools

Some tools are designed for taking apart materials such as walls and other structures that are to be demolished.

**Wrecking tools** are used as pry bars to pry apart boards that are **nailed** together. Obviously, the larger the boards the larger the wrecking tool that is needed. Most of these tools can also be used to remove nails (Figure 7-11).

## Digging Tools (D)

Many people working in agriculture use a group of tools known as digging tools (designated by the capital letter **D**). A **digging tool** is any device used to turn up, loosen, or remove earth (Figure 7-12). Digging tools include shovels, mattocks, hoes, rakes, posthole diggers, and garden trowels.



### WRENCHES



ADAPTER



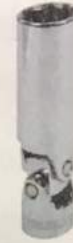
DEEP-WELL SOCKETS



SOCKET U JOINT



SOCKET SET



SWIVEL HEAD SOCKET



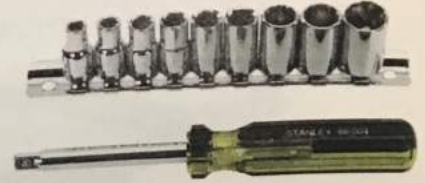
SOCKETS



ADJUSTABLE WRENCH



ALLEN WRENCHES



NUT-RUNNER SOCKETS



COMBINATION WRENCHES



OPEN-END WRENCHES



FLEX-HEAD RATCHET WRENCHES



FLEX-HEAD RATCHET



PULL HANDLE



RATCHET



IMPACT SOCKETS



SCREWDRIVER SOCKETS



ALLEN SOCKETS



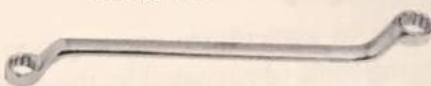
SOCKET EXTENSIONS



RATCHETING BOX WRENCHES



RATCHETING COMBINATION WRENCHES



BOX END WRENCH



T BAR



TORQUE WRENCH



SPEED HANDLE



SOCKET DRIVER



SPARK PLUG SOCKETS

FIGURE 7.7 Wrenches.

CHISELS AND PUNCHES



COLD CHISEL



CENTER PUNCH



FLOORING CHISEL



MASON'S CHISEL



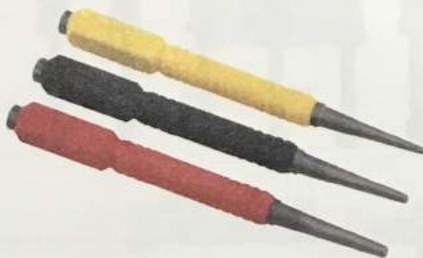
PRICK PUNCH



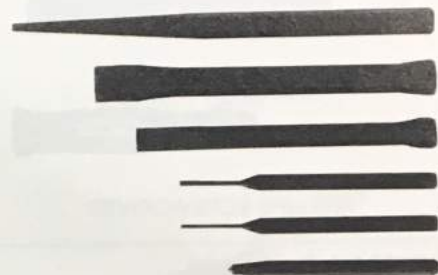
DRIFT PUNCH



WOOD CHISELS



NAIL SETS



CHISELS AND PUNCHES



PIN PUNCH



BRICK SET



SCRAPER

FIGURE 7-8 Chisels and punches.

**FASTENERS**

A **fastener** is any device used to hold two or more pieces of material together or in place. The carpenter creates a building out of individual pieces by using fasteners such as nails. By using fasteners such as bolts and nuts, the manufacturer assembles a machine from many parts. Fasteners are used to hang pictures and laminate panels. **Laminate** means to fasten two or more flat pieces together with an adhesive. An **adhesive** is a sticky substance such as glue. The most common fasteners used in agricultural

mechanics are nails, screws, bolts, nuts, washers, and machine screws.

**Nails**

A **nail** is a fastener that is driven into the material it holds. There are many types of nails classified generally by their use or form (Figure 7-13). When buying nails, the purchaser must know the use for the nail, the desired length, and the desired thickness or diameter. **Diameter** refers to the distance





FIGURE 7-9 Screwdrivers.

across the center of a round circle or object. The **shank** is the long stem part of a nail or screw; the **head** is the enlarged part on top. Probably the most familiar nail is the common nail. It has a fairly thick shank and medium-sized head. Nails that are flat and tapered are called cut nails. These are cut from steel and used for wood flooring, or they may be hardened and used as fasteners in masonry materials.

**Nail Lengths.** The unit of measure used to designate the length of most nails is the **penny** (Figure 7-14). The symbol for penny is the lower-case letter d. The term penny was originally used to indicate the number of English pennies needed to purchase 100 nails of a given size. The lengths of common nails, box nails, finishing nails, cut nails, and spikes are designated by penny. The size ranges for these nails are:

- common nail—2d to 60d
- box nail—2d to 40d
- finishing nail—2d to 20d
- cut nail—2d to 20d
- spike—16d to 12 inches

**Uses for Nails.** Nails vary in thickness of shank and diameter of head according to their use. If the material being held is soft, a large-headed nail is needed. Otherwise, the material will pull over the head of the nail. If the material being held is heavy, a thick, strong shank is required. Following are some important types of nails and their uses:

- common nail—used for general construction; nailing sheeting, shiplap, and board fencing
- cut nail—used for nailing tongue-and-groove flooring; if hardened, used for nailing in masonry materials
- box nail—used for light household construction; nailing siding on buildings; nailing into the end grain of boards
- finishing nail—used for interior finishing of buildings; trim, cabinet, and furniture work, when countersinking is needed
- shingle nail—used for nailing wood and shingles
- roofing nail—used for nailing rolled roofing and composition shingles
- plasterboard nail—used to attach plasterboard to studs in buildings
- hinge nail—used to fasten hinges on doors and cabinets

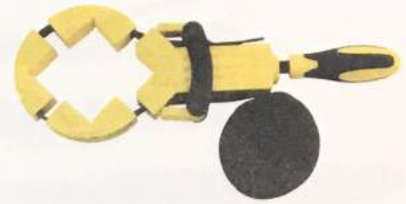
## CLAMPS



PIPE CLAMP



BAR CLAMP



BAND CLAMP



BENCH CLAMPS



BENCH VISE



DRILL-PRESS VISE



C CLAMP



SPRING CLAMP



CORNER CLAMP



MULTI-ANGLE VISE



TRIGGER CLAMP

FIGURE 7-10 Clamps.

- duplex nail—used for construction of forms for concrete work and for nailing insulators on wooden posts for electric fencing
- wire staple—used in wire fence construction
- lead-head nail—used for nailing galvanized steel roofing and siding

**Improved Nails.** Changes in nail forms have come about with the development of new types of building materials. Some new materials require special fastening devices. For instance, soft insulating boards should be nailed with special nails having large, square heads.



### WRECKING TOOLS



FIGURE 7-11 Wrecking tools.

### DIGGING TOOLS



FIGURE 7-12 Digging tools.

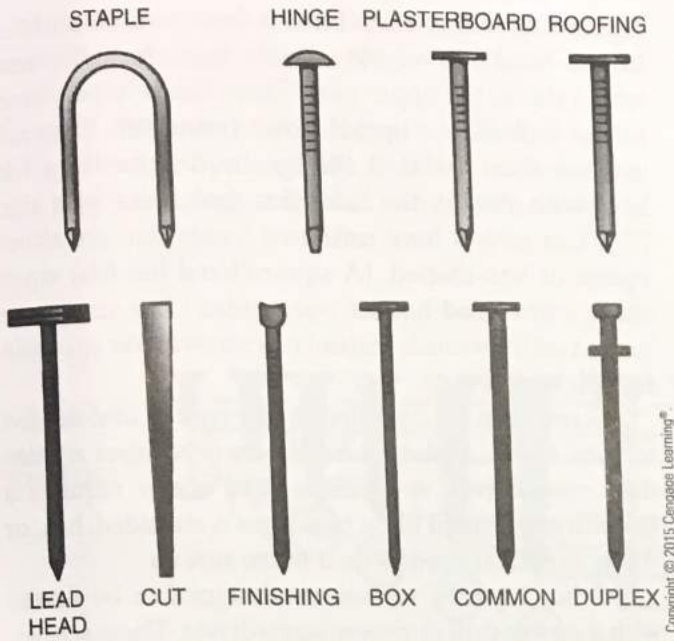


FIGURE 7-13 Types of nails.

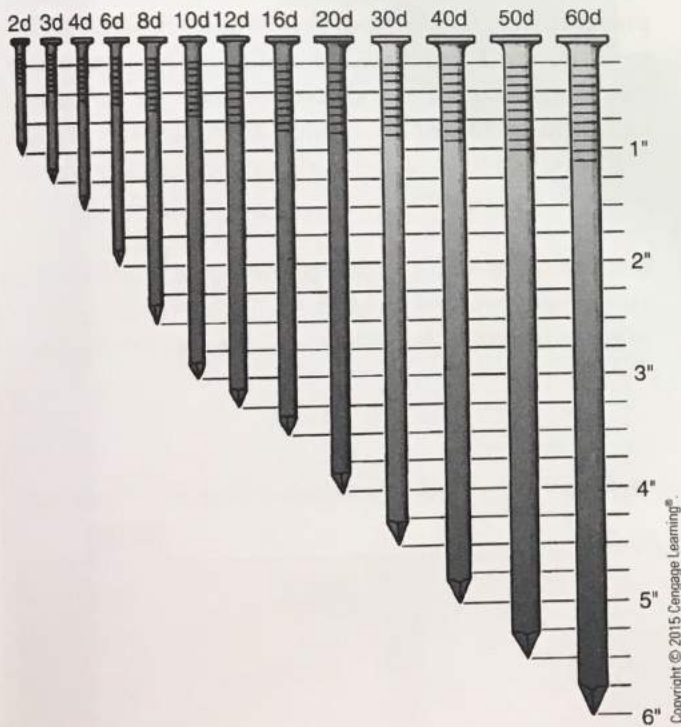


FIGURE 7-14 Length of nails.

Improved nails, sometimes referred to as thread nails, are basically the same as regular nails. They differ in that a portion of the nail shank is threaded with annular or helical threads (Figure 7-15). The indentations in the threads along the nail shank provide

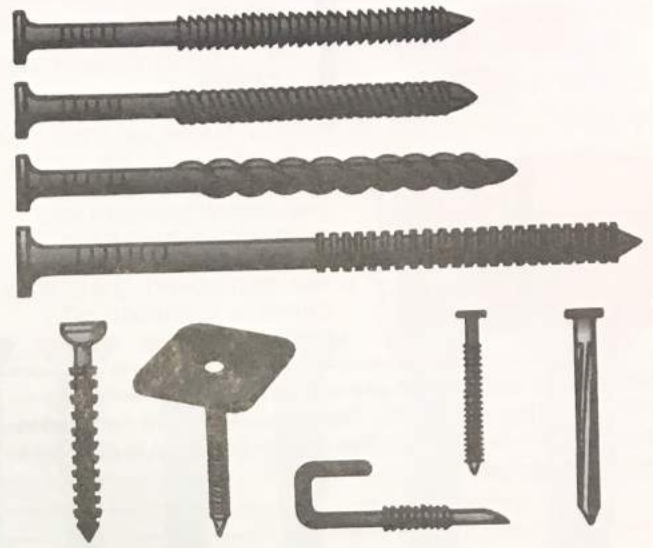


FIGURE 7-15 Improved nails have threaded shanks, which give them more holding power than regular nails.

grooves into which the wood fibers can expand. Thus, both friction and shear resistance make it very difficult to remove the nail. Nails that must be driven into very hard substances are heat treated to make them hard.

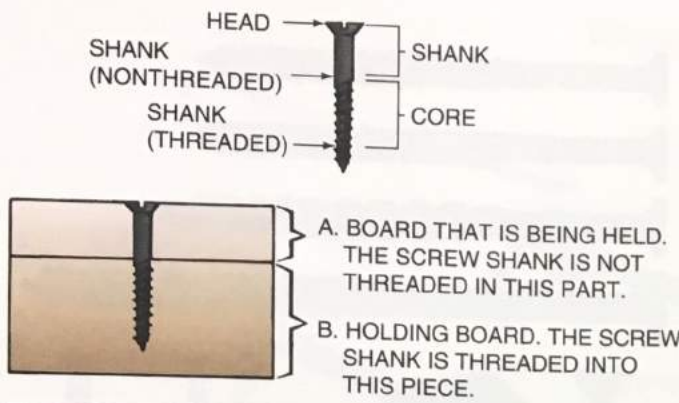
Nails are generally made of steel or aluminum. Steel nails will rust and must be galvanized if exposed to moisture. **Galvanized** means coated with zinc. Steel nails can be coated with a varnishlike cement to make them hold wood together more securely. Nails used with aluminum should be made of aluminum. This is necessary since steel nails will rust and galvanized nails will react with and destroy the aluminum that they touch.

## Screws

A **screw** is a fastener with threads that bite into the material it fastens. The term **threads** refers to grooves of even shape and taper that wrap continuously around a shank or hole. Screws are made for use in wood, sheet metal, plastic, and any material solid enough to hold them. Screws generally cut threads into the material to which they hold (Figure 7-16).

**Classifications of Screws.** Screws can be classified according to the material they hold. Wood screws have threads designed to bite into wood fibers, which draw the screw into the wood when turned. Sheet metal screws have threads that are wide enough to





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**FIGURE 7-16** Screws hold and resist pulling out by threading into the holding material (B). The screw must not be threaded in the material being held (A). This permits material A to draw tight against material B.

permit the thin metal to fit between the ridges of the threads. Cap screws are designed to thread into thick metal that has matching threads cut into the metal. Lag screws, also called lag bolts, have very coarse threads designed for use in structural timber or lead-wall anchors.

Screws can be classified according to the metal they are made from or the finish used. Steel screws may be coated with a blued, galvanized, cadmium, nickel, chromium, or brass finish. Solid brass screws are rust-proof and are used where severe moisture problems destroy coated or plated screws.

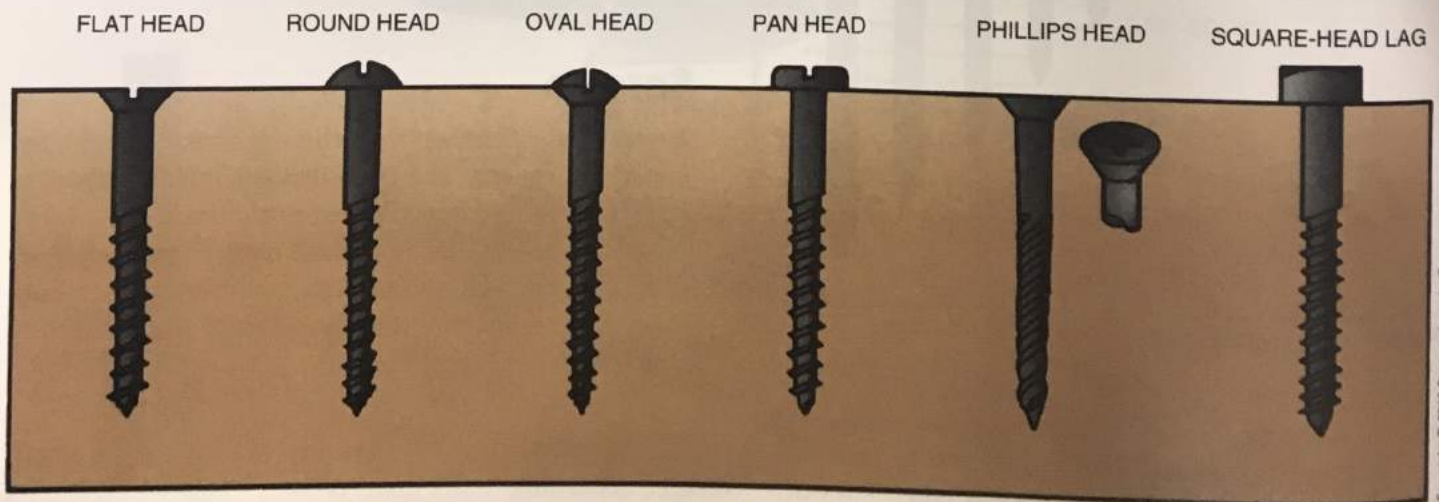
Screws can be classified by the shape of their heads (Figure 7-17). Flat-head screws have tapered heads designed to fit into a hole countersunk in the material.

The result is a screw head that is flush with the surface. Round-head screws have heads that are half-round with a slot in the upper part. These heads or pan-head screws look like an upside-down frying pan. They are used on sheet metal. A Phillips-head screw has a flat head with slots in the head that look like a plus sign (+). Lag screws have unslotted heads that are either square or hex-shaped. (A **square head** has four equal sides; a **hex head** has six equal sides.) Lag screws are turned with a wrench instead of a screwdriver to obtain more leverage.

Screws can be classified by the type of tool needed to turn them. A **slotted-head screw** requires a standard screwdriver. A **Phillips-head screw** requires a screwdriver shaped like a plus sign. A six-sided, hex, or Allen wrench is used to turn **Allen screws**.

Other types of screws are designed to be driven with a power drill or power screwdriver. These screws, which must be harder to withstand the force needed to turn them, usually have a Phillips head, but they might have a square-shaped notch in the head for accepting a square drive bit. A common type of screw designed for power drivers is called a deck screw. Deck screws come in lengths of 1 to 3½ inches and have the same diameter size as regular wood screws. They are galvanized and are used to install outdoor decking. They are also used in a variety of woodworking applications where a power driver is used.

**Size of Screws.** The size of the screw is specified by the diameter and length of shank. Diameter is expressed by gauge numbers that run from 2 through 24. Numbers



**FIGURE 7-17** Screws can be classified by the shape of their heads.

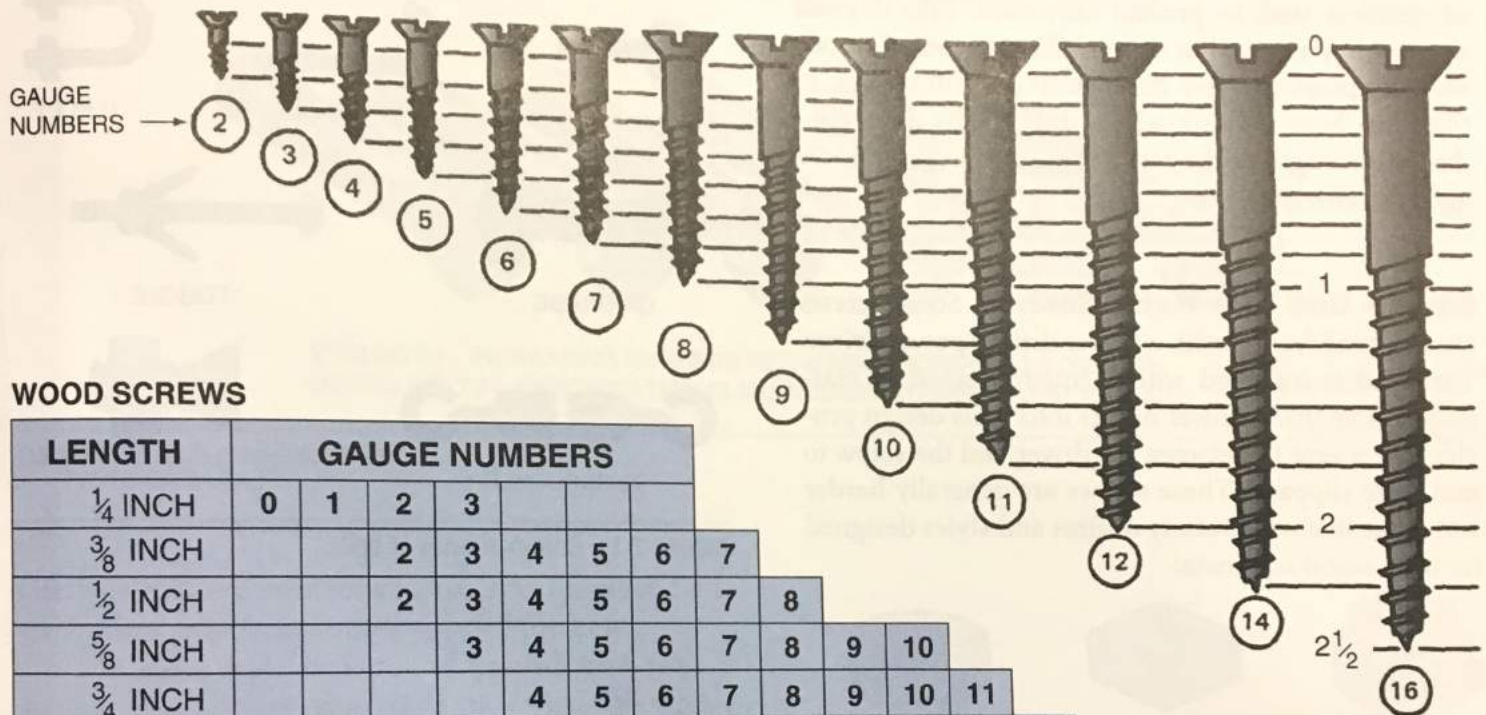
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6, 8, and 10 are common sizes. Common lengths range from ¼ inch through 4 inches (Figure 7-18).

**Drywall Screws.** The **drywall screw** has a flat Phillips head, with a very thin shank. It is made from very hard and tough steel that can be driven with a

power driver or drill. Screws can be purchased with black or galvanized finish and flat or pan heads and have threads that run the entire length of the screw. They are commonly used to install drywall but are also used as wood screws in many woodworking projects. They can be driven with power tools without



**WOOD SCREWS**

LENGTH	GAUGE NUMBERS																					
	0	1	2	3																		
¼ INCH	0	1	2	3																		
⅜ INCH			2	3	4	5	6	7														
½ INCH			2	3	4	5	6	7	8													
⅝ INCH				3	4	5	6	7	8	9	10											
¾ INCH					4	5	6	7	8	9	10	11										
7/8 INCH							6	7	8	9	10	11	12									
1 INCH								6	7	8	9	10	11	12	14							
1¼ INCH									7	8	9	10	11	12	14	16						
1½ INCH										6	7	8	9	10	11	12	14	16	18			
1¾ INCH											8	9	10	11	12	14	16	18	20			
2 INCH												8	9	10	11	12	14	16	18	20		
2¼ INCH													9	10	11	12	14	16	18	20		
2½ INCH																12	14	16	18	20		
2¾ INCH																	14	16	18	20		
3 INCH																		16	18	20		
3½ INCH																			18	20	24	
4 INCH																				18	20	24

When you buy screws specify (1) length, (2) gauge number, (3) type of head (flat, round, or oval), (4) material (steel, brass, bronze, etc.), and (5) finish (bright, steel blued, cadmium, nickel, or chromium-plated).

**FIGURE 7-18** A screw's gauge number refers to the diameter of its head, while a screw's length is expressed in inches. Wood screws can be purchased in various combinations of length and gauge number. Drywall and deck screws can also be purchased in a variety of lengths and diameters.



making drilled holes as needed with standard screws (Figure 7-18)

**Deck Screws.** Outdoor decks are generally installed using long flat-head screws called deck screws. These screws are hardened and made with a Phillips head so they can be driven using a power drill or power driver. They can be galvanized, specially coated, or made of stainless steel to prevent corrosion. Like drywall screws, they are used in many different types of woodworking projects. They differ from drywall screws, in that they have a shank where the threads do not go the entire length of the screw. This allows wood to be tightly drawn together.

**Square and Torx Head Screws.** Some screws are designed for use with a power drill or power driver. The head is indented with a square-shaped or star-shaped hole that a power bit fits into. This design provides for a sure fit between the driver and the screw to minimize slippage. These screws are generally harder and come in a wide variety of sizes and styles designed for both wood and metal.

## Bolts

A bolt is a fastener with a threaded nut (Figure 7-19). Types of bolts that are often used in agricultural mechanics include machine bolts, carriage bolts, stove bolts, plow bolts, and special bolts.

The threads on bolts come in two types—coarse and fine. They are designated UNC for coarse and UNF for fine. The U stands for “unified,” and N stands for “national.” A  $\frac{3}{8}$ -inch-diameter thread designated as  $\frac{3}{8} \times 24$  means that the bolt has 24 threads per inch and is a fine thread. A bolt  $\frac{3}{8} \times 16$  would have 16 threads per inch and would be a coarse thread. Most automotive engine bolts are fine-threaded. Both types come in standard and metric sizes.

Bolts are generally straight, with round, square, or hex heads. However, some are bent, modified, or shaped for special uses. These include the eye bolt, hook or J bolt, U bolt, turnbuckle, and plow bolt. A lag screw, when used with an expansion plug in a masonry wall, is known as an expansion bolt. A toggle is a collapsible winged nut that opens when inserted into a hollow wall. A toggle with bolt is called a toggle bolt.

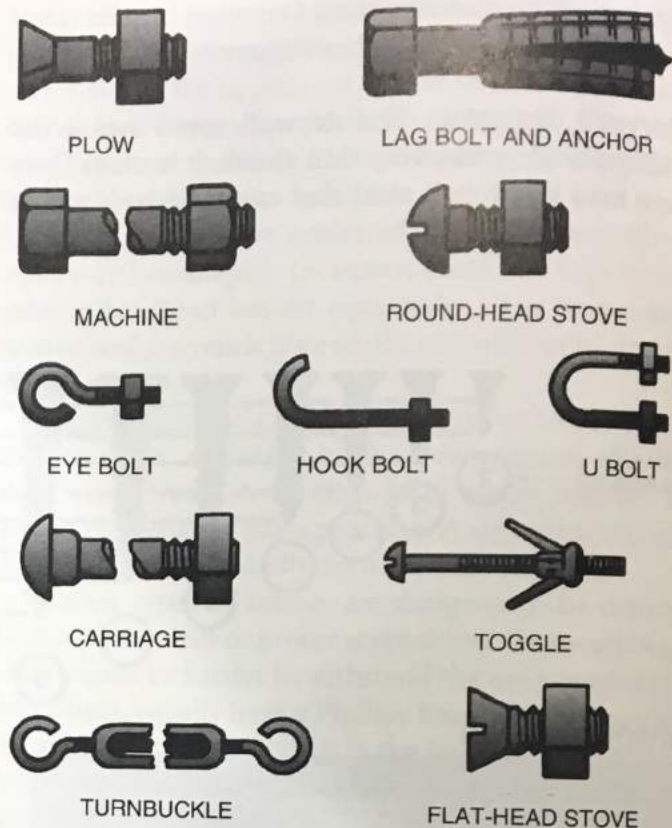


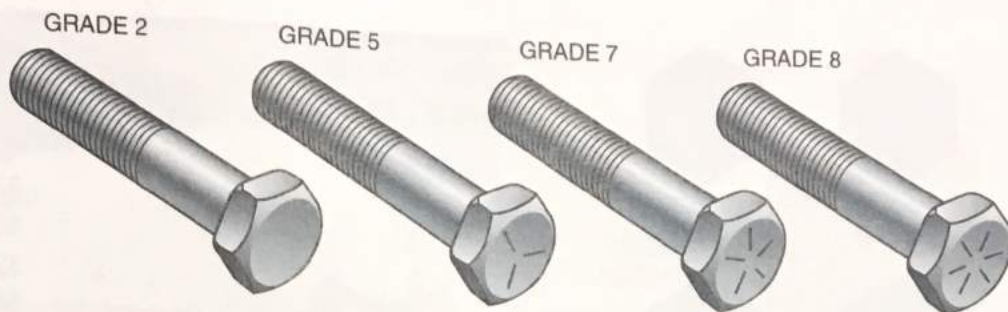
FIGURE 7-19 Common types of bolts.

The **machine bolt** is a fastener with a square head or hex head with threads on just the last 1 inch (or more) of the shank. Machine bolts are used extensively in engines and other machines. Special hardened machine bolts with extra strength and toughness have heads marked with short lines that point from the shoulders toward the center of the head (Figure 7-20). Three lines designate a very tough bolt, and six lines designate a very, very tough bolt. The tougher the bolt, the more expensive it is to manufacture.

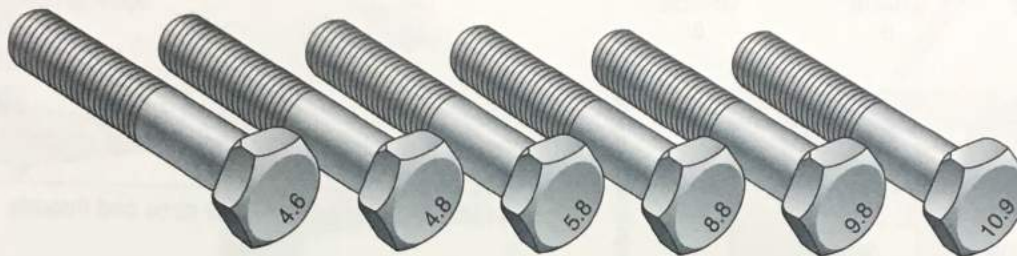
The **cap screw** looks like a machine bolt with the following exceptions. A cap screw usually is threaded over its entire length, generally is 2 inches or shorter in length, and may have a special head, such as one requiring an Allen wrench. It threads into an object rather than a nut.

The **carriage bolt** is a fastener with a round head over square shoulders and is used with wood. The shoulders are drawn down into the wood to prevent the bolt from turning. The round, low profile of the head makes it almost flush with the surface of the wood.





CUSTOMARY (INCH) BOLTS – IDENTIFICATION MARKS CORRESPOND TO BOLT STRENGTH – INCREASING NUMBERS REPRESENT INCREASING STRENGTH



STRENGTH – INCREASING NUMBERS REPRESENT INCREASING STRENGTH. METRIC BOLTS – IDENTIFICATION CLASS NUMBERS CORRESPOND TO BOLT

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FIGURE 7-20 Bolt grade markings.

Carriage bolts are used for construction of wagon bodies, feeders, doors, and other wooden projects.

The **stove bolt** is a round-headed bolt with a straight screwdriver slot. It is threaded the entire length. When purchased, stove bolts generally come with square nuts. They are generally available in sizes up to  $\frac{3}{8}$  inch diameter and up to 6 inches in length.

The **plow bolt** has a square tapered head. When placed in a hole designed for a plow bolt, the head is flush with the surface. The plow bolt is used to hold shares and other parts in place on tillage implements.

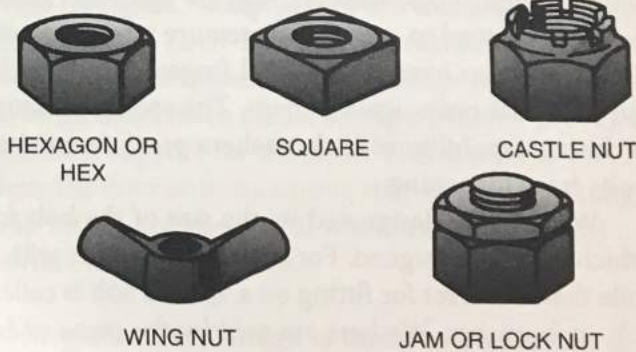


FIGURE 7-21 Types of nuts.

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## Nuts

A **nut** is a device with a threaded hole (Figure 7-21). Nuts are the movable part of bolts that are used to fasten two items together. Nuts may be square (with four sides) or hexagonal (with six sides). Hexagonal is also simply referred to as hex. Wing nuts have winged extensions for tightening with the fingers.

Special nuts are available with slots on one side to permit the use of cotter pins or keys to lock the nut in place. Another technique used to lock a nut in place is to tighten a second nut against the first. The second

nut is then referred to as a lock nut. Some nuts are said to be self-locking. These have special design features that make them difficult to turn on or off a bolt. Like bolts, nuts are also graded according to their strength (Figure 7-22).

## Washers

A **washer** is a flat device with a hole in the center and is used as part of a fastener (Figure 7-23). Flat washers are used to prevent bolt heads or nuts from



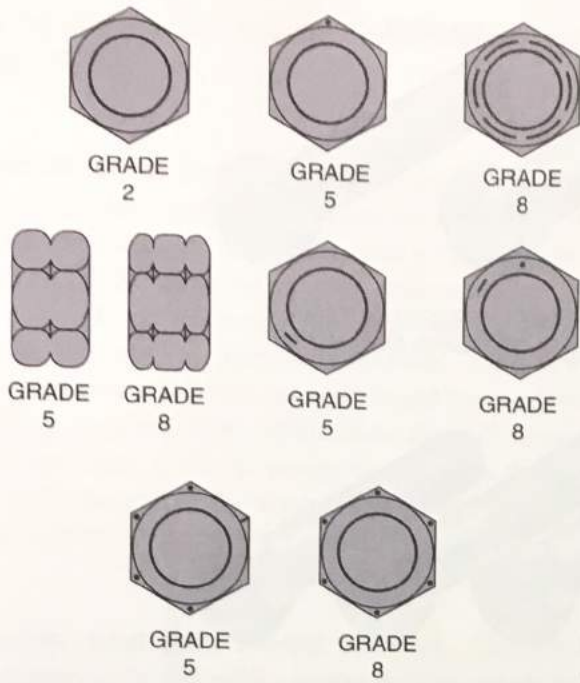


FIGURE 7-22 Nut grade markings.

penetrating material. Special lock washers are used to prevent nuts or bolts from loosening due to vibration and use. Lock washers may be split and made with spring steel to exert back pressure when pressed. They may also have spring steel fingers that bite the surfaces that press against them. The spring pressure or biting capability of lock washers prevents nuts or bolts from loosening.

Washers are designated by the size of the bolt for which they are designed. For instance, a washer with a hole that is correct for fitting on a  $\frac{3}{8}$ -inch bolt is called a  $\frac{3}{8}$ -inch washer. Washers are sold by the piece or by the pound.

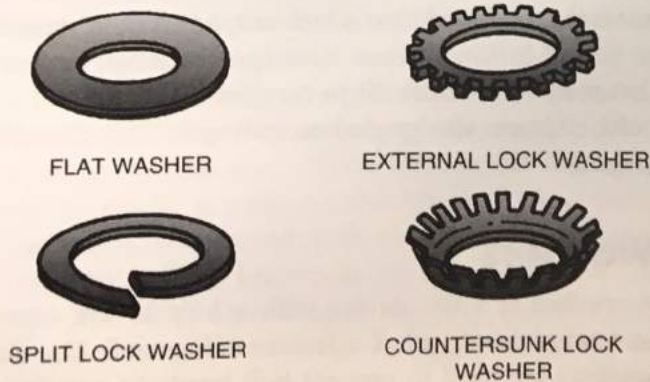


FIGURE 7-23 Types of washers.

DIAMETER NUMBER	THREADS PER INCH
4	40
6	32
6	40
8	32
8	36
10	24
10	32
12	24
12	28
$\frac{1}{4}$ *	20
$\frac{1}{4}$	28

\*Same as  $\frac{1}{4}$ -inch stove bolt or cap screw with standard threads

FIGURE 7-24 Machine screw sizes and threads.

## Machine Screws

A **machine screw** is a small bolt with a hex nut. Machine screws range in size from very tiny up to less than  $\frac{1}{4}$  inch in diameter, and up to several inches in length. The diameter of machine screws is expressed by a number (Figure 7-24). The most common machine screws range from number 4 (very small) to number 12 (nearly  $\frac{1}{4}$  inch in diameter).

Threads on machine screws are designated by the number per inch. Finer threads have more threads per inch than coarse threads and are less likely to vibrate loose. On the other hand, coarse threads permit greater ease of starting and greater speed in applying a nut.

When buying machine screws, the diameter by number, the threads per inch, and the length must be specified. For example, a 4-40  $\times$   $\frac{1}{2}$  machine screw is one with a number 4 diameter, 40 threads per inch, and  $\frac{1}{2}$  inch long.

## HARDWARE

The term **hardware** is used in agricultural mechanics for special fasteners. These include hinges, brackets, plates, and miscellaneous metal objects. Hardware is used to support doors, lock windows, secure sideboards on trucks, and anchor roofs. Whenever two objects need to be connected, hardware is generally used. Hardware, as the term suggests, is hard because it is usually made from steel or brass.



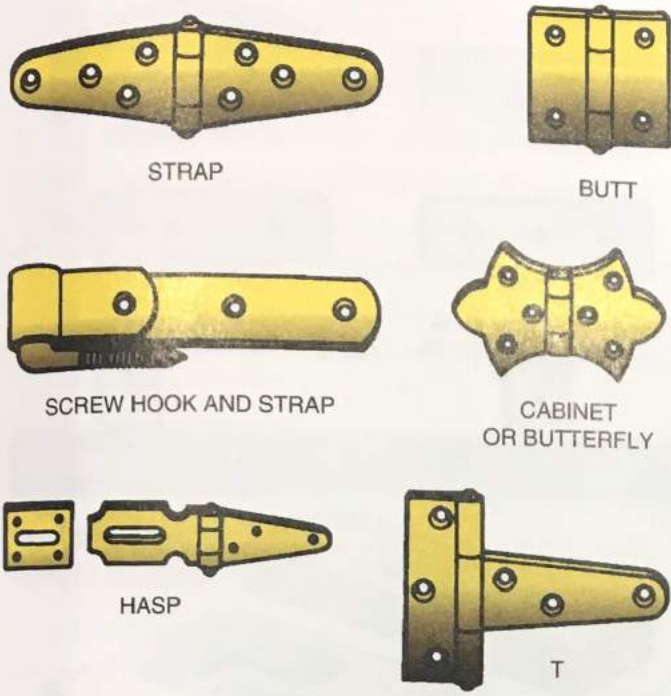


FIGURE 7-25 Types of hinges.

## Hinges

A **hinge** is an object that pivots and permits a door or other object to swing back and forth or up and down. Small hinges used on cabinets and furniture are referred to as cabinet hinges. Hinges are classified according to their type and size. Some common types of hinges are butt hinges, strap hinges, T hinges, screw hook and strap hinges, and hasps (Figure 7-25). All hinges consist of two parts plus a pin. The parts are fastened to the stationary object and the moving object. The pin is then inserted to permit movement between the parts (Figure 7-26).

**Butt Hinges.** Butt hinges are used to mount doors in a butted position. This means the door and the strip it is mounted on are flush and form a smooth surface. Butt hinges are fairly short in length as compared to their height or the length of their pins. Butt hinges may be mounted on the surface or may be mounted in a concealed position between the door and its mounting strip. If the hinges are concealed or out of sight, they must be set in the material and have countersunk screw holes with flat-head screws.

Some surface-mounted butt hinges are designed to be attractive. An example is the butterfly hinge. It is so named because it is shaped like a butterfly in flight.

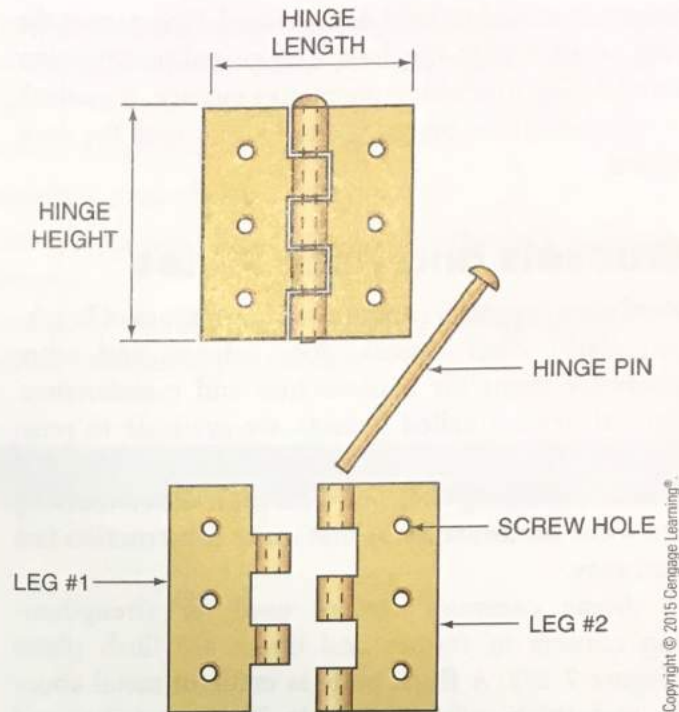


FIGURE 7-26 A hinge consists of three parts: two legs and a pin. The hinge pin interlocks leg 1 with leg 2. Hinges with removable pins may be purchased for use on doors intended for occasional removal. Many hinge pins, however, are not removable.

**Strap Hinges.** Strap hinges are much longer than they are high. Their long, thin, straplike appearance gives them their name. The strap hinge is used where the hinge must reach across a long surface; it provides additional support for the door. This feature is useful where the door or its mounting strip is not very strong. Strap hinges are also useful where excessive weight or pressure is used on a door.

**T Hinges.** The T hinge is made by combining the features of the butt hinge and the strap hinge. One leg of the hinge is short and high, like a butt hinge. The other leg is narrow and long, like a strap hinge. The T hinge is useful where the mounting strip for a door is thin but strong, and the door is flimsy and needs extra hinge support.

**Screw Hook and Strap Hinges.** The screw hook and strap hinge is also called a gate hinge. Two special screw hooks are screwed into a post or door-jamb. The two straps are then mounted in the correct positions on the door. The door with hinge straps mounted is set or hung on the screw hooks. This completes the installation.

**Hasps.** The hasp is not really a hinge but is constructed like one and is sometimes classified with

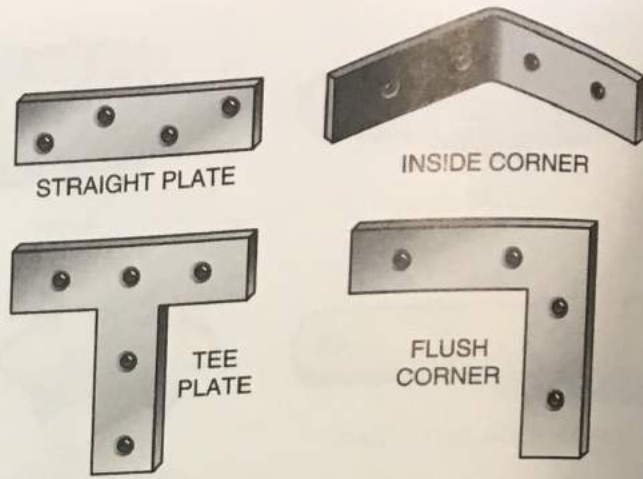


hinges. It is used to hold doors closed. One part of the hasp is attached to the door. The hinged part fits over a metal loop attached to the mating surface. A padlock or other device is placed in the loop to hold the door closed.

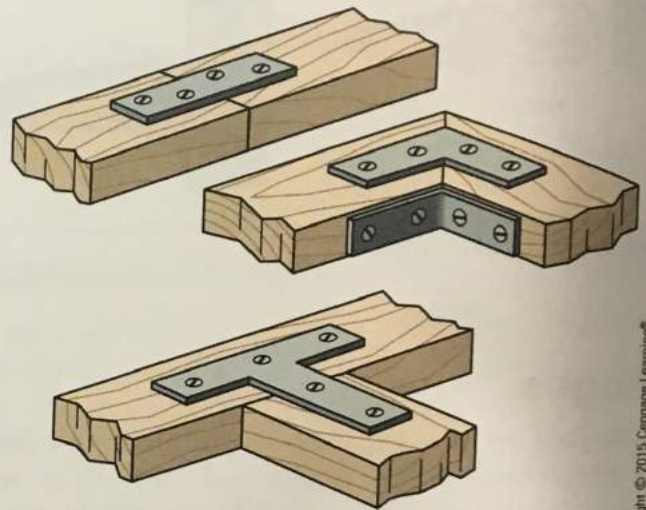
## Brackets and Flush Plates

Hardware suppliers can provide many types of brackets, plates, door closers, door catches, and other hardware items for construction and maintenance. Special devices called **gussets** are available to reinforce joints in wood and metal. Wall brackets and special mounting channels with prefinished shelving are some hardware items that make construction fast and easy.

Some common devices used for strengthening corners of frames and doors are flush plates (Figure 7-27). A **flush plate** is made of metal about  $\frac{1}{16}$  inch thick and  $\frac{1}{2}$  inch wide. They are drilled and have countersunk holes to receive flat-head screws. Flush plates are available as straight, tee, inside, or flush corners.



EXAMPLES OF FLUSH PLATES



TYPICAL APPLICATIONS OF FLUSH PLATES

**FIGURE 7-27** Flush plates are used to strengthen corners of frames and doors.

## SUMMARY

The beginning point for developing most agricultural mechanics skills is learning the proper tools and hardware. The most basic of tools are those powered by humans rather than by electricity or another power source. Learning the names and uses of these tools is the first step toward achieving the skill level needed to carry out projects. Likewise, learning the basic types of hardware and fasteners is also essential.

## Student Activities

1. Define the Terms to Know in this unit.
2. Study individual tools provided by the instructor and classify them according to their use.
3. Prepare a bulletin board or computer document with captions showing the major classes of tools: layout, cutting, boring, driving, holding, turning, digging, and other. Cut pictures of tools from old issues of magazines and catalogs or copy and paste from the Internet, and place them under their caption on the bulletin board.

4. Examine the tool storage area in your agricultural mechanics department. On a sheet of paper, list all tools that you see. Place a letter after each tool to indicate its classification as follows: L = Layout; C = Cutting; B = Boring; Dr = Driving; H = Holding; T = Turning; D = Digging; and O = Other.
5. Make up a board with samples of various types of nails attached; properly label the nails.
6. Make up a board with samples of screws and bolts attached; properly label them.
7. Visit a hardware store and examine various nails, screws, bolts, and other fasteners. Ask the store manager for manufacturers' charts or tables that describe fasteners.
8. Ask your instructor if there are some activities you can do to improve the arrangement and storage of nails, screws, bolts, and other fasteners in the agricultural mechanics department.

## Relevant Web Sites

The Home Depot  
[www.homedepot.com](http://www.homedepot.com)

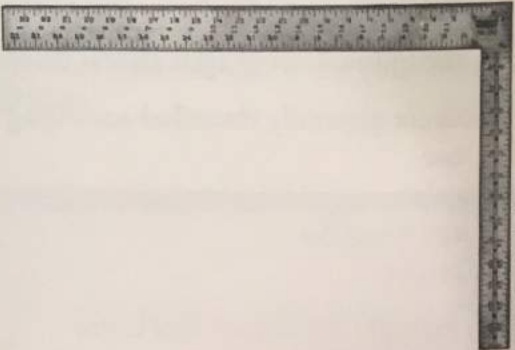
New Tool News  
[www.newtoolnews.com](http://www.newtoolnews.com)


## Self-Evaluation

A. **Multiple Choice.** Select the best answer.

1. The use of hand tools is
  - a. for those who cannot afford power tools
  - b. for a limited number of highly specialized jobs
  - c. primarily for engine and machinery mechanics
  - d. the foundation of agricultural mechanics
2. Tools are generally classified according to
  - a. use
  - b. color
  - c. construction
  - d. origin
3. An example of a layout tool is/are
  - a. claw hammer
  - b. outside calipers
  - c. handsaw
  - d. plug cutter
4. Saws are classified as
  - a. kerf tools
  - b. push tools
  - c. flexing tools
  - d. cutting tools
5. Taps and dies are classified as
  - a. holding tools
  - b. digging tools
  - c. cutting tools
  - d. turning tools
6. Wrenches are classified as
  - a. turning tools
  - b. digging tools
  - c. other tools
  - d. cutting tools
7. The lowercase letter *d* is used to designate sizes of
  - a. lumber
  - b. screws
  - c. nails
  - d. bolts
8. Which is not the name of a type of nail?
  - a. lumber
  - b. plasterboard
  - c. roofing
  - d. duplex
9. The term *improved* means a nail
  - a. is made of copper
  - b. is easy to remove
  - c. has a thick shank
  - d. holds better
10. Screws are classified
  - a. according to the material they hold
  - b. by the metal from which they are made or the finish used
  - c. by the shape of their heads
  - d. by all of these



11. The number of a screw refers to its
    - a. diameter
    - b. length
    - c. head type
    - d. use
  12. The difference between a bolt and a screw is
    - a. a bolt has threads
    - b. a bolt has a nut
    - c. a screw has a slotted head
    - d. a screw is suitable for use in wood
  13. A bolt used in wood that has a round head over square shoulders is
    - a. a stove bolt
    - b. a machine bolt
    - c. a carriage bolt
    - d. none of these
  14. How many sides are there on a hexagon nut?
    - a. four
    - b. six
    - c. eight
    - d. twelve
  15. A 4-40  $\times$   $\frac{1}{2}$  machine screw
    - a. has 4 threads per inch
    - b. has 40 threads per inch
    - c. is 4 inches long
    - d. comes four to the package
  16. Which is not a type of hinge?
    - a. butt
    - b. strap
    - c. T
    - d. N
  17. The hinge that contains a feature from each of the two other hinges is the
    - a. butt hinge
    - b. strap hinge
    - c. T hinge
    - d. N hinge
  18. The best hinge to use if it is not to be seen is the
    - a. butt hinge
    - b. strap hinge
    - c. T hinge
    - d. N hinge
  19. The best hinge for a very large and extra-heavy door or gate is the
    - a. butt hinge
    - b. T hinge
    - c. N hinge
    - d. screw hook and strap hinge
  20. Corners of frames and doors may be strengthened by using a
    - a. hasp
    - b. butt hinge
    - c. flush plate
    - d. hook and eye bolt
- B. Brief Answer.** Briefly answer the following questions.
1. What is a hand tool?
  2. Name and correctly spell six layout tools.
  3. Name and correctly spell six cutting tools.
  4. Name and correctly spell six boring tools.
  5. Name and correctly spell six driving tools.
  6. Name and correctly spell six holding tools.
  7. Name and correctly spell six turning tools.
  8. Name and correctly spell six digging tools.
- C. Identification.** Name, correctly spell, and classify each of the following tools.
1. 

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  2. 

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3.



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4.



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5.



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6.



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7.



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8.



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9.



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**D. Identification.** Name, correctly spell, and classify each of the following fasteners.

1.



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2.



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3.



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4.



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5.



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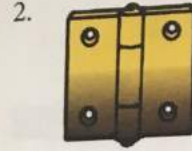


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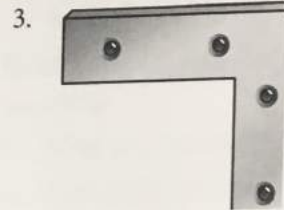
E. Identification. Name, correctly spell, and classify each of the following items of hardware.



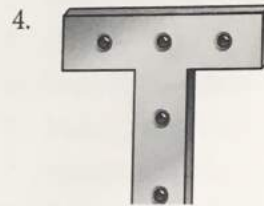
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