

## Lesson A3–7

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# Using Construction Fasteners and Hardware

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**Unit A.** Mechanical Systems and Technology

**Problem Area 3.** Construction Systems

**Lesson 7.** Using Construction Fasteners and Hardware

### **New Mexico Content Standard:**

**Pathway Strand:** Power, Structural and Technical Systems

**Standard:** VII: Develop skills required to use construction/fabrication equipment and tools.

**Benchmark:** VII-A: Use tools in the workplace to demonstrate safe and proper skills with construction/fabrication hand tools.

**Performance Standard:** 3. Demonstrate safe and proper techniques in using hand and power tools in construction/fabrication.

**Student Learning Objectives.** Instruction in this lesson should result in students achieving the following objectives:

1. Discuss the selection and use of nails.
2. Discuss the selection and use of screws.
3. Discuss the selection and use of bolts.
4. Discuss the selection and use of glue.
5. Describe the selection and use of hardware.

**List of Resources.** The following resources may be useful in teaching this lesson:

**Recommended Resources.** One of the following resources should be selected to accompany the lesson:

Burkybile, Carl. *Selecting and Using Fasteners and Hardware*. University of Illinois: Information Technology & Communication Systems (U3051a).

Phipps, Lloyd J., et al. *Introduction to Agricultural Mechanics*, Second Edition. Upper Saddle River, New Jersey: Prentice Hall Interstate, 2004. (Textbook, Chapter 9)

**Other Resources.** The following resources will be useful to students and teachers:

Burke, Stanley R., and T.J. Wakeman. *Modern Agricultural Mechanics*. Danville, Illinois: Interstate Publishers, Inc., 1992. (Textbook, Chapters 12 and 13)

Cooper, Elmer L. *Agricultural Mechanics Fundamentals & Applications*. Albany, New York: Delmar Publishers, 1996. (Textbook, Lab Manual, and Teacher's Manual—Unit 7)

## List of Equipment, Tools, Supplies, and Facilities

Writing surface

Overhead projector

Transparencies from attached masters

Copies of student lab sheets

Samples of nails, screws, bolts, glue, and hardware (locks, hinges, pulls, knobs, etc.)

**Terms.** The following terms are presented in this lesson (shown in bold italics):

Aliphatic yellow wood glue

Box nails

Butt hinge

Carriage bolts

Casein glue

Casing nails

Clearance hole

Common nails

Continuous hinge

Countersunk

Cylinder locks

Drive screw

Fasteners

Finish nails

Gauge number

Hardware

Hasp  
Lag screws  
Machine bolts  
Mastics  
Mortise locks  
One way screw  
Penny  
Pilot hole  
Pot life  
Protein glues  
Resorcinol resin glue  
Rim locks  
Setting time  
Sinkers  
Stove bolts  
Strap hinges  
Synthetic glues  
Tee hinge  
Toenailing  
Urea-formaldehyde glue  
White polyvinyl glue

**Interest Approach.** Use an interest approach that will prepare the students for the lesson. Teachers often develop approaches for their unique class and student situations. A possible approach is included here.

*Ask students if they know what fasteners and hardware are. Ask them to give examples of each. Show samples of fasteners and hardware. Talk about the importance of fasteners and hardware in making projects more functional. Quality construction begins with careful planning and selection of materials. Selection of fasteners and hardware can “make” or “break” a project. **Fasteners**, sometimes called rough hardware, are items used to hold the parts of a project together (nails, screws, bolts, and glue). **Hardware**, sometimes called finish hardware, is metal items used for ornamental as well as functional purposes. Examples include hinges, drawer pulls, knobs, handles, catches, and locks.*

# Summary of Content and Teaching Strategies

**Objective 1:** Discuss the selection and use of nails.

**Anticipated Problem:** How can I select and use nails?

- I. Nails are the most commonly used wood fasteners. Each type of nail has specific uses. The nail size unit is called “**penny**” and is abbreviated with the lower case letter “d”. Nails are sold by the pound, 50 pound box, and 100 pound keg. By choosing the right type and size of nail you will split less wood, make your work stronger, save fingers, and save money.
  - A. **Common nails** are the largest in diameter and have thick heads. They are designed for rough carpentry, like building framing, and are easy to drive without bending.
  - B. **Box nails** are used wherever common nails might split the wood. Box nails bend more easily because of the smaller wire used to form them. The head is thinner and larger in diameter than the head of the common nail. If these nails are cement coated they are called “**sinkers**”. Nail holding power may also be improved by galvanizing, ringing, or threading.
  - C. **Casing nails** are the same weight as box nails, but have a small, conical head. They are used to attach door and window casings and other wood trim.
  - D. **Finish nails** have the thinnest cross section and the smallest head. The head is only slightly larger in diameter than the body of the nail. A slight depression on the top of the head helps keep the nail set from slipping when “setting the nail”.
  - E. To drive a nail, hold it upright firmly between the thumb and first finger, tap the nail with the hammer until it will stand by itself, and then drive the nail with full swings of the hammer using both the wrist and forearm. Use a swinging motion rather than short jabs. Hit the nail squarely each time. Use a hammer size to match the size of the nail to be driven (20 oz. hammer for 16d nails, 12 oz. hammer for small finish nails, etc.). If the nail is likely to bend, lubricate the point with soap, wax, or oil or drill a pilot hole slightly smaller than the diameter of the nail. To avoid splitting never use a nail larger than needed, blunt the point of the nails (turn the nail upside down and hit the point with a hammer), do not drive a series of nails in a straight line parallel to the grain, and never toenail when you can nail straight into the wood. **Toenailing** is driving a nail at an angle into the side of a board rather than driving straight into the wood.

*Have students read the suggested chapters in the recommended textbooks. Use actual nails, nails charts, and TM: A3–7A, A3–7B, and A3–7C to compare different sizes and types of nails. Practice driving nails including toenailing one board to another.*

**Objective 2:** Discuss the selection and use of screws.

**Anticipated Problem:** How can I select and use wood screws?

- II. Wood screws have some advantages over nails, but they also have disadvantages. Screws hold wood more securely than nails, are easily tightened or removed, and leave a neat appearance. On the other hand, screws are more expensive and require more labor for installation.
- A. Wood screws have straight, cross (Phillips), square, or star shaped screw head slots. The three commonly shaped screw heads are flat, oval, and round. Screws with flat heads may be **countersunk** meaning that the top of the head is flush with the surface of the wood. Oval headed screws are used mainly to fasten hinges or other finish hardware. Round headed screws are utility screws and are used where the fastened piece is too thin to permit countersinking. Wood screws are made of steel, brass, or other metals.
- B. A **drive screw** is a special screw made to be driven with a hammer. It has threads that are far apart and may not have a slot for a screwdriver. A **one-way screw** is designed to be tightened with a standard screwdriver but cannot be turned out with the screwdriver. It is designed to prevent burglary and theft. **Lag screws**, sometimes called lag bolts, are special heavy duty screws made with a square or hex bolt head.
- C. Screws are sized by length in inches and by diameter. The diameter is given as a **gauge number**. To calculate the gauge number subtract  $\frac{1}{16}$  inch from the diameter and multiply the result by 80.
- D. Large wood screws require three holes in order to be inserted and countersunk. When two pieces of wood are joined with screws, the **clearance hole** which is slightly larger than the screw shank is drilled in the first board to allow the shank of the screw to pass without binding. A **pilot hole** slightly smaller than the diameter of the threaded portion of the screw is drilled into the second board. The pilot hole allows easy tightening without danger of splitting the wood. If the screw is to be countersunk, use a countersink bit to drill a beveled hole to match the width of the top of the screw. When the screw is tightened, the top of the head should be even with the wood. Whenever screws are tightened use a standard, Phillips, or square shank screwdriver large enough to fill the screw slot. Using the correct size screwdriver will result in tightening with less effort and fewer damaged screw slots.

*Assign readings in either of the recommended texts. Each of them has good information on the content of this objective. Use wood screw samples and TM: A3-7D, A3-7E, and A3-7F to learn the different types and sizes of screws. Be sure that students know what information is needed to order screws (i.e. steel flat head standard slot 6 gauge 1½ inch wood screw). Practice drilling clearance, pilot, and countersink holes and installing wood screws.*

### **Objective 3:** Discuss the selection and use of bolts.

**Anticipated Problem:** What types of bolts are used to fasten wood?

- III. Bolts are made of steel with either round, square, or hexagonal heads and threaded shanks. The threads may run the full length of the bolt, or they may stop a certain distance from the head, and leave a smooth upper shank. Although bolts are stronger than nails or screws, they are more expensive.
  - A. **Stove bolts** have either flat or round heads that look like wood screws but a threaded shank with a nut like other bolts. To tighten, use a screwdriver on the head and a wrench on the nut. Stove bolts are commonly used with the installation of hinges.
  - B. **Carriage bolts** have a round head with a square shank which pulls into the wood to hold the top of the bolt while a wrench is used to tighten the nut.
  - C. **Machine bolts** have either a square or hexagonal head with a nut shape that matches the head shape. Machine bolts are used with metal and wood. To tighten use a wrench on the bolt head and another on the nut.

*Utilize readings in the suggested texts. Each contains detailed information on this topic. Use sample bolts and TM: A3–7G to show students the different types of bolts. Look for opportunities for students to use all types of bolts.*

### **Objective 4:** Discuss the selection and use of glue.

**Anticipated Problem:** What glues are suitable for fastening wood?

- IV. A properly glued wood joint is stronger than the wood itself. The wood to be glued should be dry, smooth, and free of dirt, oil, and other coatings. Clean dirt, paint, and other coatings from wood with an abrasive such as a scraper, wire brush, or steel wool. Regardless of the type of glue used, a good fit with both pieces of wood in contact at all points is necessary for a strong joint. Glue can be applied with a squeeze bottle, brush, or paint roller. Pressure is applied to the glue joint with clamps, nails, screws, or other fasteners. When the pressure is applied, the glue should ooze out from around the joint. If it does not, you are skimping on glue and may have a weak joint. Exterior glues should be labeled as waterproof. Interior glues will be labeled as water resistant. When in doubt about the future use of your project apply exterior glue.
  - A. The older glues are protein glues. **Protein glues** are made from animal or plant parts or products. **Casein glue** is made from milk protein and is a powder that is mixed with water. It is an interior water resistant glue. **Cellulose cement**, also called “airplane cement” is a quick drying, waterproof glue made from plants. This glue is used most often in building models.
  - B. Newer glues are synthetic glues. **Synthetic glues** are glues made from man-made products. **Resorcinol resin glue** is a waterproof two part liquid and powder mix. The cost and mixing disadvantages are outweighed by the waterproof characteristics for projects

exposed to soaking such as boats and outdoor furniture. Mix only the amount needed just before use, since its “pot life” is only three or four hours. **Pot life** is the time in which an adhesive can be used after mixing. The higher the temperature, the shorter the “pot life” and “setting time”. **Setting time** is the length of time necessary for the glue to harden or cure. **Urea-formaldehyde glue** is a plastic resin one part powder that you mix with water, as per instruction, just before use. It has a high water resistance with a pot life of three to five hours. This plastic resin glue is a popular, easy-to-use glue that hardens quickly when water is added. A close fit with the need for tight clamping and a nine to thirteen hour setting time are disadvantages. **White polyvinyl glue** is an all-around household glue used inside where high moisture resistance is unnecessary. It is a one part ready to use liquid that generally comes in a squeeze bottle. **Aliphatic yellow wood glue** is a one part ready to use liquid that requires less clamping time, sets quicker, and forms a stronger waterproof bond than the white glue. **Mastics** are heavy, pasty type glues or adhesives that are used for fastening drywall, paneling, and flooring. These mastics are generally applied with a notched trowel or a caulking gun.

*Have students read the suggested chapters in the recommended resource texts. Show samples of different types of glue and use TM: A3–7H to compare the advantages and disadvantages of each type. Have students design an experiment to compare the ease of use and strength of the synthetic glues shown in the transparency.*

**Objective 5:** Describe the selection and use of hardware.

**Anticipated Problem:** What types of finish hardware should be used with wood?

- V. Metal items used for ornamental as well as functional purposes, such as hinges, drawer pulls, knobs, handles, and catches are classified as “finish hardware”. These items should not be installed until the project has been painted. They come in many different types, styles, and sizes.
  - A. Hinges are sold in pairs and serve as a moveable joint between two pieces of wood. **Butt hinges** have two rectangular leaves usually ranging from one to four inches in length and a connecting pin. **Strap hinges** have two triangular shaped leaves that vary in size from one to twelve inches in length. A **tee hinge** has one butt leaf and one strap leaf. When using a tee hinge, the butt leaf is fastened to the stationary parts, and the strap leaf is fastened to the swinging piece of wood. The **continuous hinge**, also called a piano hinge, is really a long butt hinge. It is often used on desk and piano lids.
  - B. Knobs, pulls, and handles are made in various designs and from many types of materials (wood, glass, wrought iron, aluminum, and bronze). Friction catches, magnetic catches, and hasp/lock combinations are used to keep doors closed. A **hasp** is a hinged piece of hardware with a U-shaped loop that comes through a slot in the other leaf where a padlock is fastened.
  - C. Door locks may be mortise, cylinder, or rim. **Mortise locks** require a deep mortise or pocket cut in edge of the door for the locking mechanism. They are used primarily with

interior doors. **Cylinder locks** require drilling a 1½ to 2 inch hole in the door and a slot cut for the working mechanism. They are used for exterior or interior doors and more dependable than a mortise lock because they remove less wood. **Rim locks** are surface mounted on the inside of a door and are used primarily as night latches or safety locks.

- D. Miscellaneous hardware items include such things as doorsteps, latches, door closures, and window sash locks.

*Assign readings in the recommended texts. Either of them has more detailed information on the content of this objective. Show samples of hardware and use TM: A3–7I and A3–7J to identify the different types of hardware. Discuss situations where each hardware item would be used.*

**Review/Summary.** Use the transparencies and actual fasteners to review the identification of fasteners and hardware. Take a trip to a hardware store to see the assortment available and compare prices. Review the function and importance of each type of fastener and each hardware item. Discuss the advantages and disadvantages of each item.

**Application.** Use the appropriate fasteners and hardware in the construction of various projects. Lay out fasteners and hardware items and use LS: A3–7A as a lab practical test answer sheet. Note to instructors: If you do not have these items in your shop, the accompanying transparencies can be used for the lab activity. Use LS: A3–7B to drive nails, countersink screws, install bolts (stove, carriage, and machine), and attach a butt hinge.

**Evaluation.** Use the written test, the lab practical identification sheet, and the shop exercises in LS: A3–7B.

## Answers to Sample Test:

### Part One: Matching

1 = b, 2 = g, 3 = c, 4 = a, 5 = d, 6 = f, 7 = e

### Part Two: Completion

1. Fasteners
2. Hardware
3. nails, screws, bolts, glue
4. penny, d
5. flat, oval, round  
straight or standard, cross or Phillips, square, star
6. lag bolt
7. gauge
8. stove, Carriage, Machine
9. Pot life, Setting time

**Part Three: Short Answer**

1. Five of the following:
  - a. Hit the nail squarely.
  - b. Lubricate the point with soap, wax, or oil.
  - c. Drill a pilot hole.
  - d. Do not use a nail too large for the job.
  - e. Blunt the point of the nail.
  - f. Never toenail if you can drive straight in.
  - g. Avoid driving a series of nails on a straight line with the grain.
  - h. Avoid driving nails through or close to the knots.
2.
  - a. Clean dirt, paint, and other coatings from wood with an abrasive such as a scraper, wire brush, or steel wool.
  - b. Use sandpaper to sand the wood to make a good fit prior applying the glue.
3. Mortise locks are used for inside doors. Cylinder locks are used for exterior and interior doors. Rim locks are mounted on the inside of an exterior door to serve as a night latch or safety latch.

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# Test

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## Lesson A3–7: Using Construction Fasteners and Hardware

### Part One: Matching

*Instructions.* Match the term with the correct response. Write the letter of the term by the definition.

- |                                    |                           |
|------------------------------------|---------------------------|
| a. aliphatic or “yellow” wood glue | d. resorcinal resin glue  |
| b. white polyvinyl glue            | e. casein glue            |
| c. mastics                         | f. urea-formaldehyde glue |

- \_\_\_\_\_ 1. All-around household glue, where high moisture resistance is unnecessary, usually purchased in a squeeze bottle, and comes as a one part liquid ready to use.
- \_\_\_\_\_ 2. Quick drying waterproof glue also known as “airplane glue”.
- \_\_\_\_\_ 3. Heavy, pasty type glue, usually applied with a notched trowel or caulking gun, and used to apply such things as drywall, paneling, and flooring.
- \_\_\_\_\_ 4. One part liquid that requires less clamping time, sets quicker, and forms a stronger more waterproof bond than polyvinyl glues.
- \_\_\_\_\_ 5. Two part liquid and powder mix that is so waterproof it can be used for gluing boats.
- \_\_\_\_\_ 6. One part powder you mix with water, has high moisture resistance, a pot life of three to five hours, and begins to harden as you add water.
- \_\_\_\_\_ 7. Water resistant glue made from milk protein and comes as a powder you mix with water.

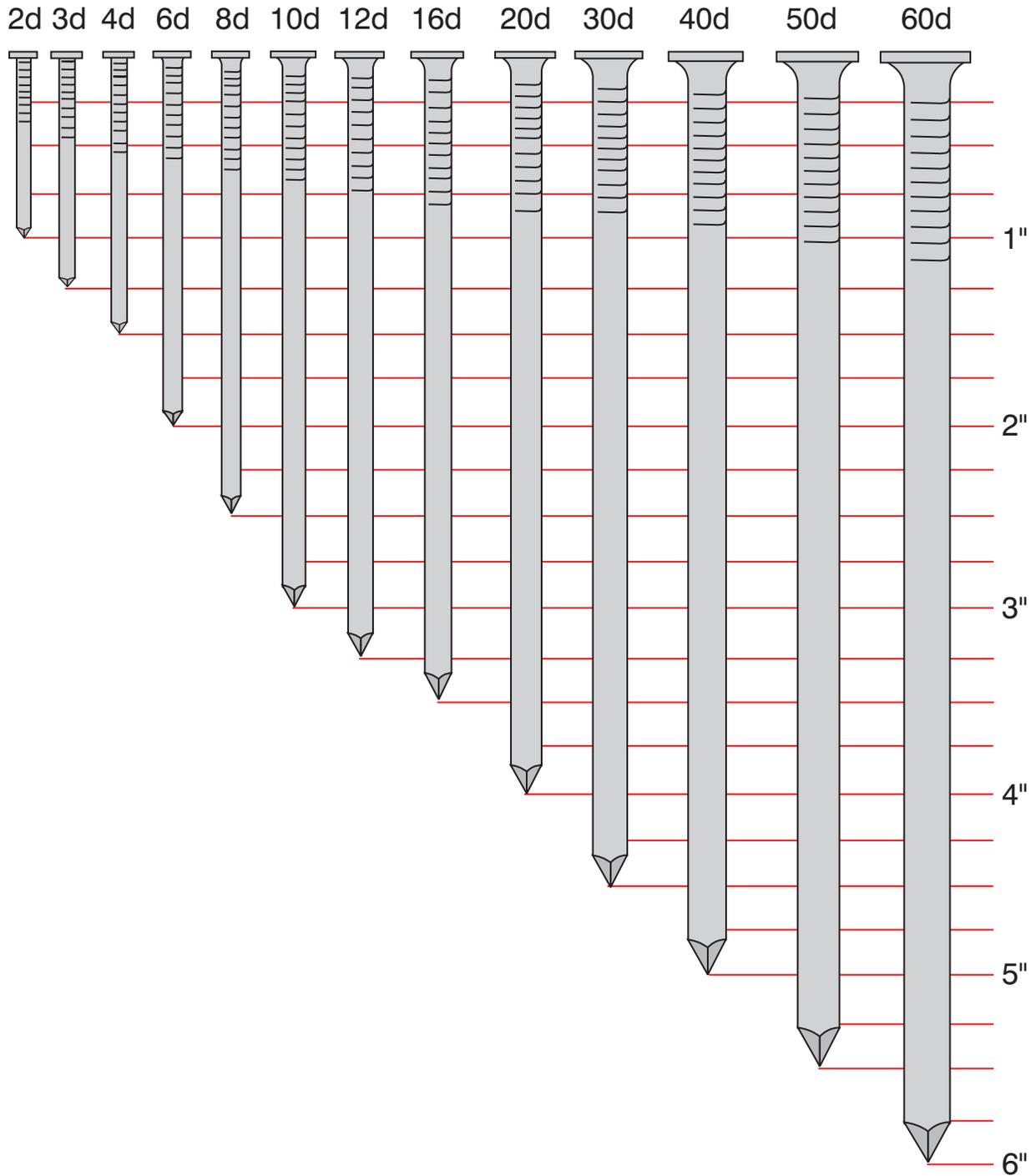
### Part Two: Completion

*Instructions.* Provide the word or words to complete the following statements.

1. \_\_\_\_\_, sometimes called rough hardware, are used to hold a project together.
2. \_\_\_\_\_, sometimes called finish hardware, includes hinges, catches, pulls, handles, and locks.
3. The common types of fasteners for wood are: \_\_\_\_\_, \_\_\_\_\_, \_\_\_\_\_, and \_\_\_\_\_.

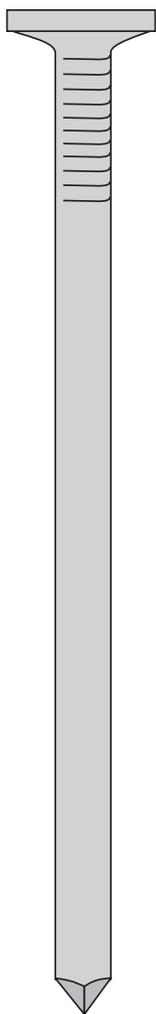
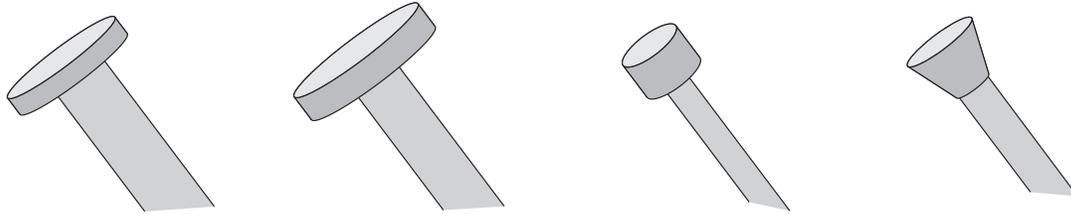


# NAIL SIZES AND LENGTHS

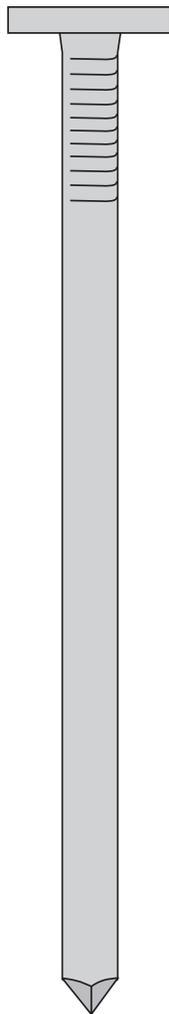


(Courtesy, Interstate Publishers, Inc.)

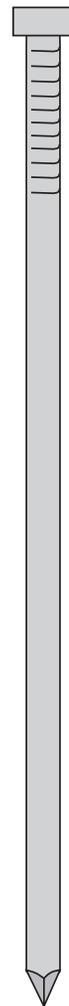
# TYPES OF NAILS



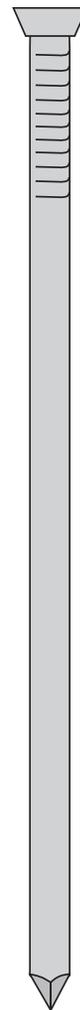
**Common  
Nails**



**Box  
Nails**



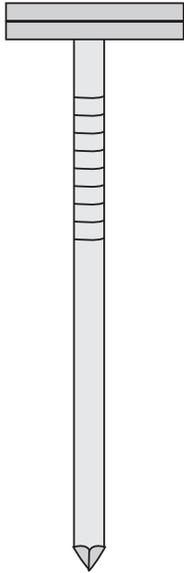
**Finishing  
Nails**



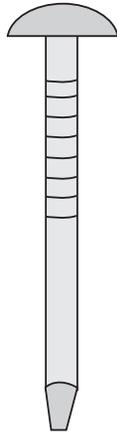
**Casing  
Nails**

*(Courtesy, Interstate Publishers, Inc.)*

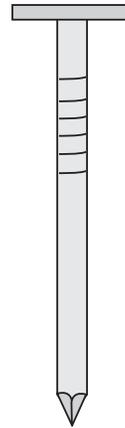
# SPECIALIZED NAILS



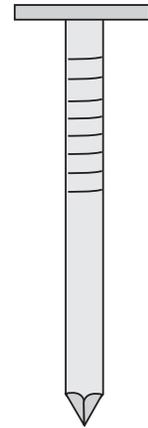
Lead Head



Hinge



Plaster Board



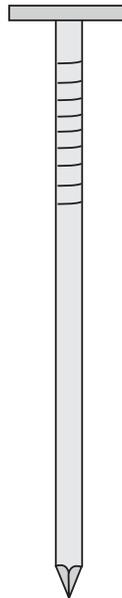
Roofing



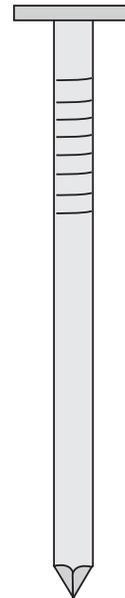
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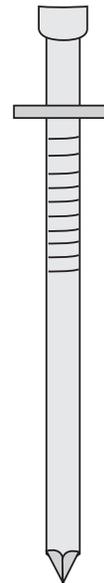
Finishing



Box



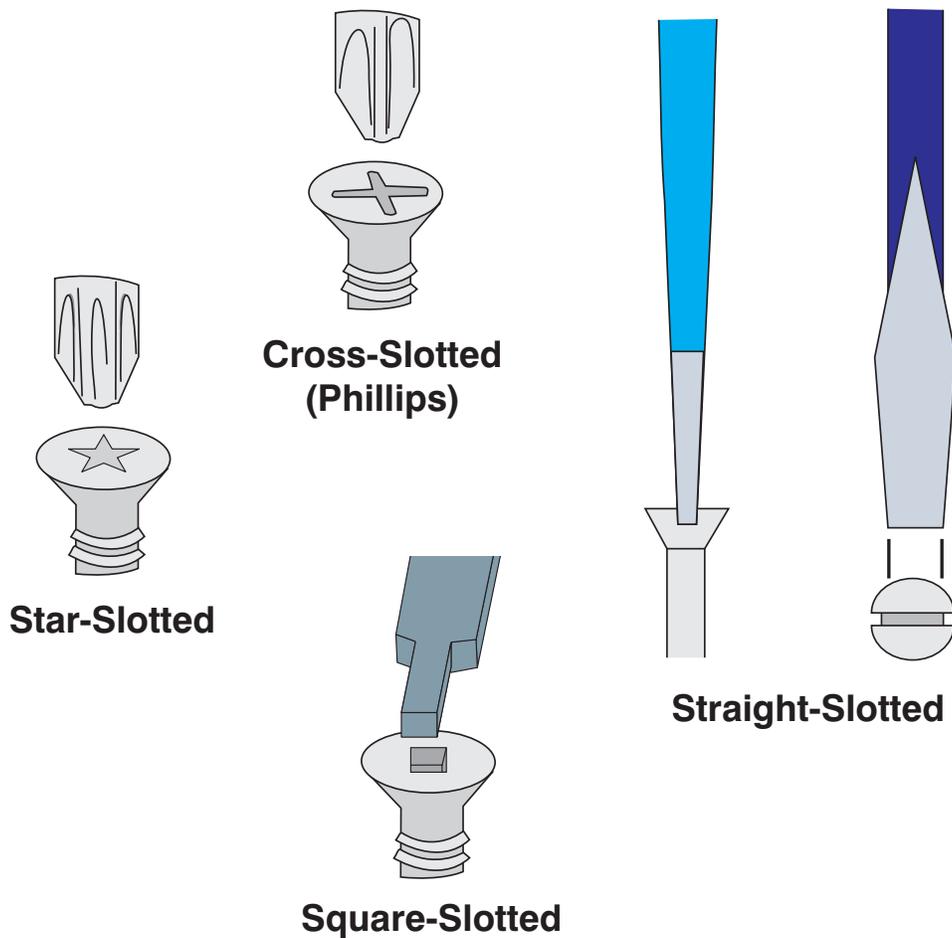
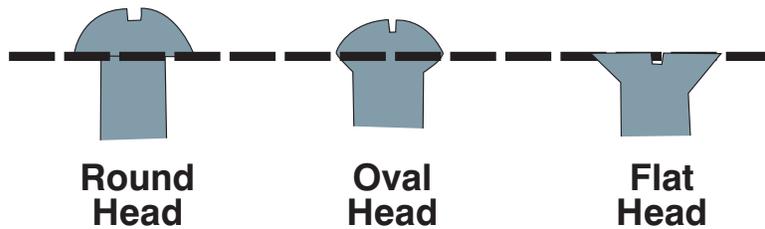
Common



Duplex

*(Courtesy, Interstate Publishers, Inc.)*

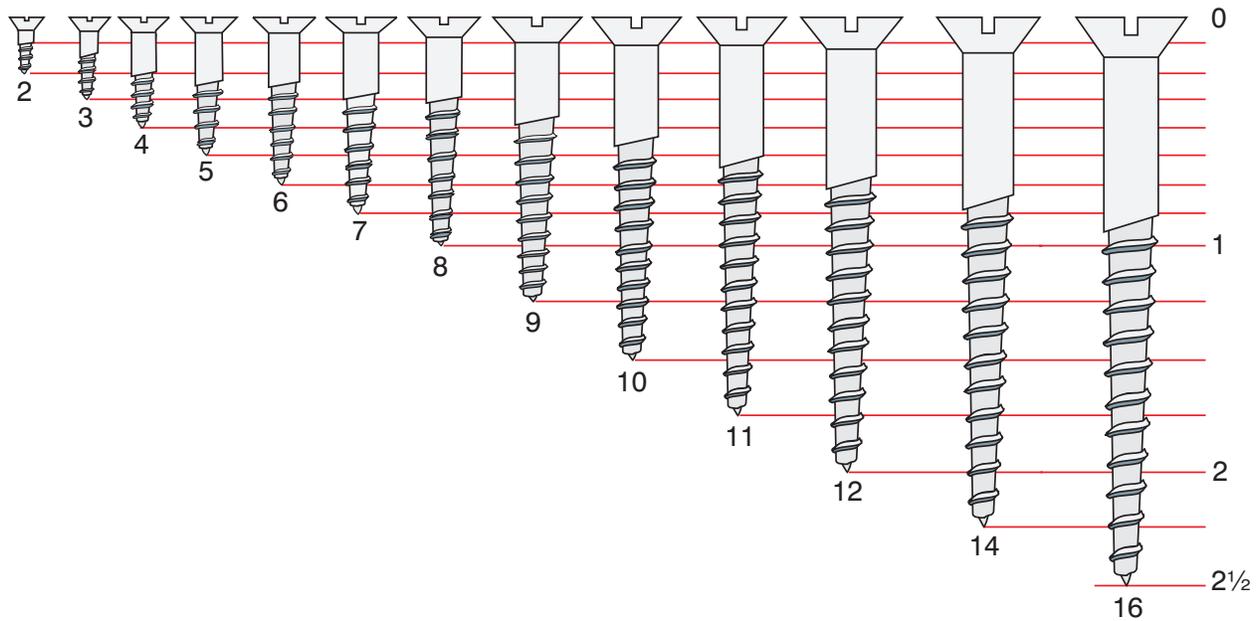
# TYPES OF SCREW HEADS AND SCREW SLOTS



*(Courtesy, Interstate Publishers, Inc.)*

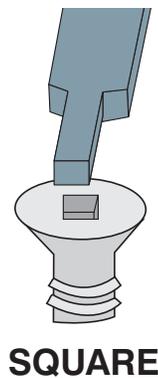
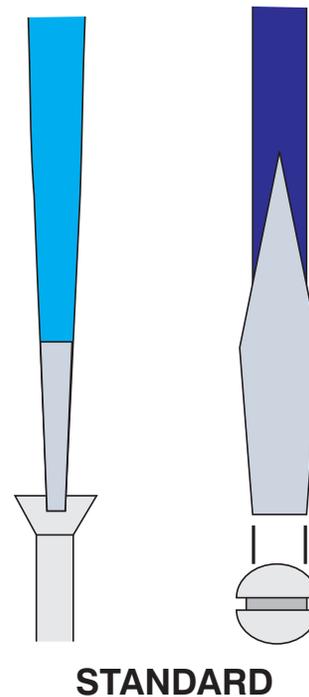
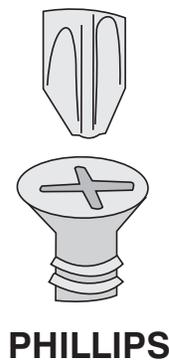
TM: A3-7E

# ACTUAL SIZE OF COMMON WOOD SCREWS



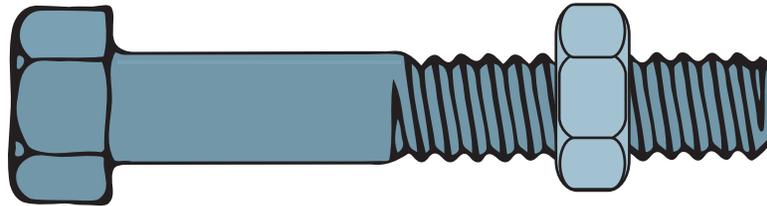
(Courtesy, Interstate Publishers, Inc.)

# MATCHING THE SCREWDRIVER SIZE TO THE SLOT

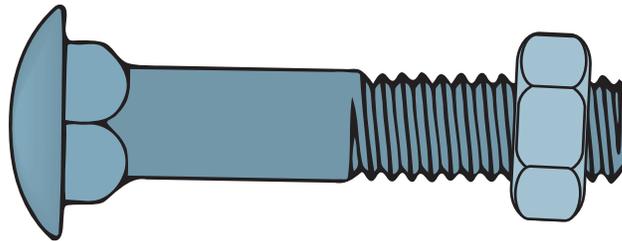


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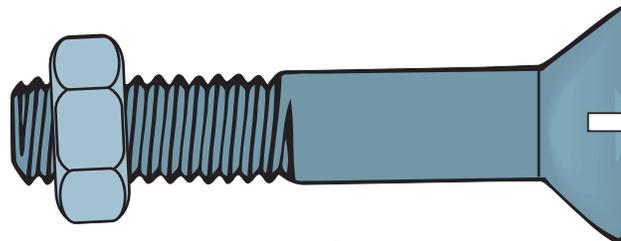
# TYPES OF BOLTS



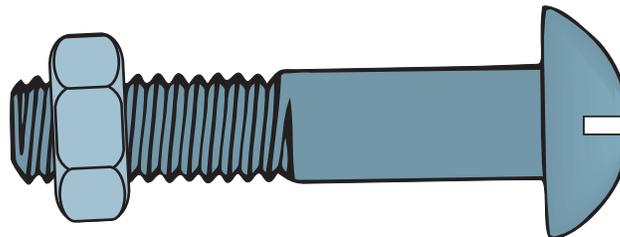
**Common or Machine Bolt**



**Carriage Bolt      Nut**



**Flat Head Stove Bolt**



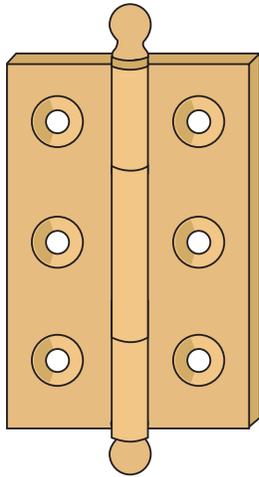
**Round Head Stove Bolt**

*(Courtesy, Interstate Publishers, Inc.)*

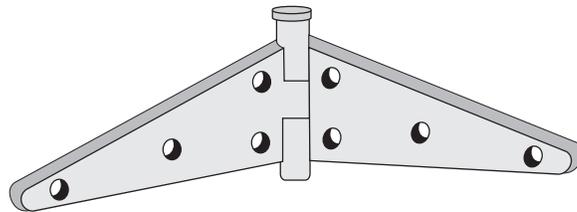
# COMPARING SYNTHETIC RESIN GLUES

Type	How to Prepare	Advantages	Disadvantages
Resorcinol Resin	2 parts liquid and powder mixed as needed	very strong, very waterproof	requires mixing, expensive, dark-colored glue line
Urea Formaldehyde	1 part powder mixed with water just before use	easy to mix, very strong, colorless glue line	requires tight joints and long clamping time
Polyvinyl White Glue	1 part ready-to-use liquid, usually in a squeeze bottle	interior glue, ready-to-use, colorless glue line	will not hold in high moisture or high heat situations
Aliphatic Yellow Glues	1 part ready-to-use liquid, usually in a squeeze bottle	easy to use, dries clear, can be sanded	not suitable for high moisture or high heat situations

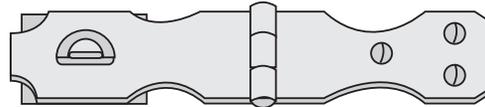
# COMMON TYPES OF HINGES



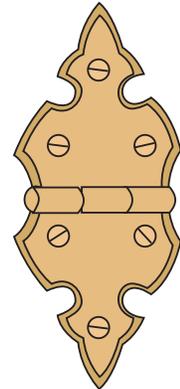
Butt Hinge



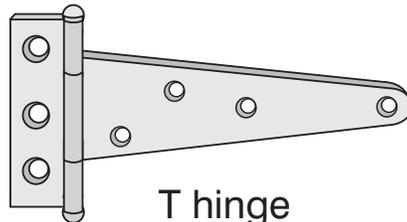
Strap Hinge



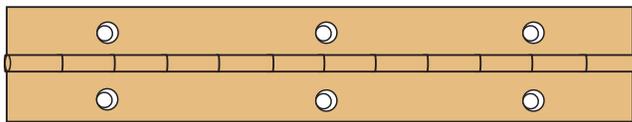
Hasp Hinge



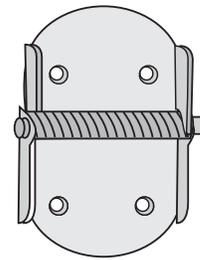
Surface Hinge



T hinge



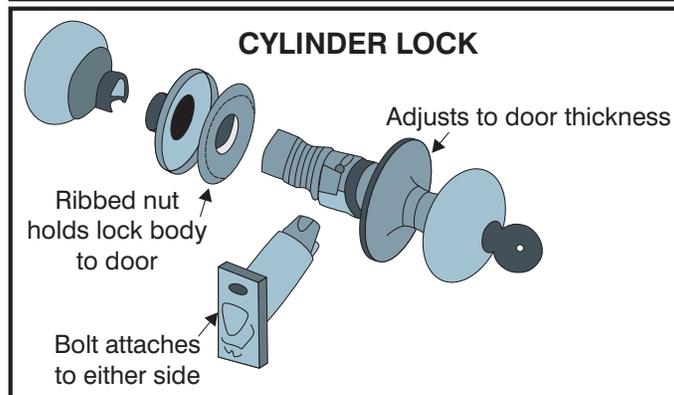
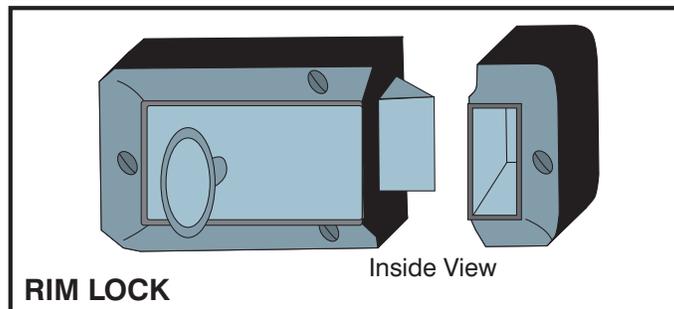
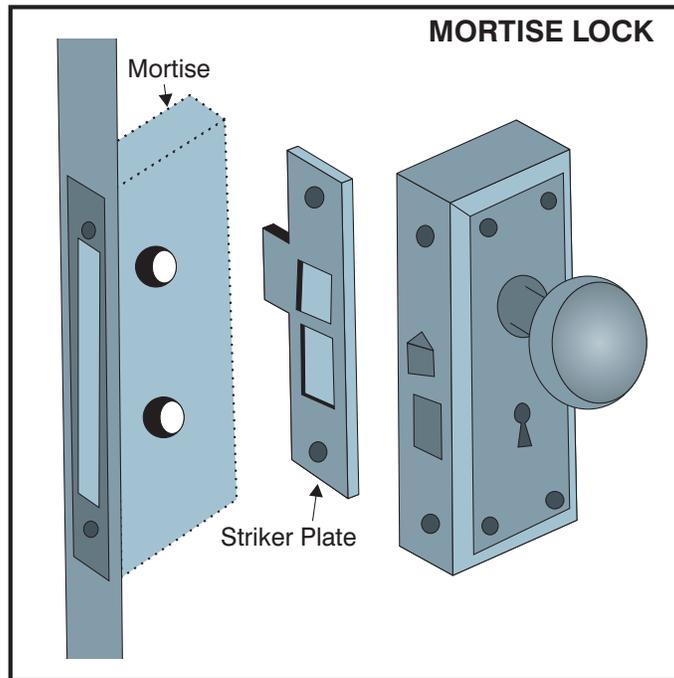
Continuous (Piano) Hinge



Spring Hinge

*(Courtesy, Interstate Publishers, Inc.)*

# TYPES OF DOOR LOCKS



(Courtesy, Interstate Publishers, Inc.)

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# Lab Sheet

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**Directions:** Your teacher has laid out samples of many of the items listed below. Match the item to the correct name.

- \_\_\_\_\_ 1. Box nail
- \_\_\_\_\_ 2. Butt hinge
- \_\_\_\_\_ 3. Casing nail
- \_\_\_\_\_ 4. Common nail
- \_\_\_\_\_ 5. Concrete nail
- \_\_\_\_\_ 6. Continuous hinge
- \_\_\_\_\_ 7. Cylinder lock
- \_\_\_\_\_ 8. Drive screw
- \_\_\_\_\_ 9. Finish nail
- \_\_\_\_\_ 10. Flat head wood screw
- \_\_\_\_\_ 11. Friction catch
- \_\_\_\_\_ 12. Hasp
- \_\_\_\_\_ 13. Lag screw
- \_\_\_\_\_ 14. Magnetic catch
- \_\_\_\_\_ 15. Mortise lock
- \_\_\_\_\_ 16. One way screw
- \_\_\_\_\_ 17. Oval head wood screw
- \_\_\_\_\_ 18. Rim lock
- \_\_\_\_\_ 19. Ring shank nail
- \_\_\_\_\_ 20. Roofing nail
- \_\_\_\_\_ 21. Round head wood screw
- \_\_\_\_\_ 22. Scaffold or form nail
- \_\_\_\_\_ 23. Staple
- \_\_\_\_\_ 24. Strap hinge
- \_\_\_\_\_ 25. Tack
- \_\_\_\_\_ 26. Tee hinge

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# Lab Sheet

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## Using Fasteners and Hardware

- \_\_\_\_\_ 1. Drive a 16d nail in rough oak lumber with the instructor watching. Hit the nail squarely. Use a swinging motion rather than jabbing at the nail. Drive the nail in but avoid that one extra hit that leaves a hammer print in the wood.
- \_\_\_\_\_ 2. Drill a pilot hole through the first and second piece of wood, drill a clearance hole in the top board, use a countersink bit to drill a countersink hole to match the head of the screw you plan to use, countersink a flat head wood screw.
- \_\_\_\_\_ 3. Install a round headed stove bolt. Start by drilling a hole in the two boards to match the size of the bolt. Insert and tighten the bolt.
- \_\_\_\_\_ 4. Drill a hole, install a carriage bolt, and tighten the bolt.
- \_\_\_\_\_ 5. Drill another hole, install a machine bolt, and tighten the bolt.
- \_\_\_\_\_ 6. Attach a butt hinge to two scrap pieces of lumber.