

# 1

## Tools, Fasteners, and Safety

---

### LEARNING OBJECTIVES

Upon completion and review of this chapter, you should be able to:

- Prepare for ASE assumed knowledge content of the proper use of tools and shop equipment.
- Explain the strength ratings of threaded fasteners.
- Describe how to safely hoist a vehicle.
- Discuss how to safely use hand tools.
- List the personal safety equipment that all service technicians should wear.

---

### KEY TERMS

Barrel  
Bolts  
Bump Cap  
Cap Screws  
Crest  
Grade  
Pitch  
Spindle  
Stud  
Thimble

### THREADED FASTENERS

Most of the threaded fasteners used on vehicles are cap screws. They are called **cap screws** when they are threaded into a casting. Automotive service technicians usually refer to these fasteners as **bolts**, regardless of how they are used. In this chapter, they are called bolts. Sometimes, studs are used for threaded fasteners. A **stud** is a short rod with threads on both ends. Often, a stud will have coarse threads on one end and fine threads on the other end. The end of the stud with coarse threads is screwed into the casting. A nut is used on the opposite end to hold the parts together. See Figure 1-1.

The fastener threads *must* match the threads in the casting or nut. The threads may be measured either in fractions of an inch (called fractional) or in



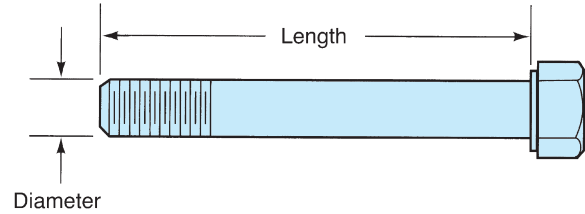
**Figure 1-1.** Typical bolt on the left and stud on the right. Note the different thread pitch on the top and bottom portions of the stud.



**Figure 1-2.** Thread pitch gauge is used to measure the pitch of the thread. This is a 1/2-inch-diameter bolt with 13 threads to the inch (1/2–13).

metric units. The size is measured across the outside of the threads, called the **crest** of the thread.

Fractional threads are either coarse or fine. The coarse threads are called Unified National Coarse (UNC), and the fine threads are called Unified National Fine (UNF). Standard combinations of sizes and number of threads per inch (called **pitch**) are used. Pitch can be measured with a thread pitch gauge as shown in Figure 1-2. Bolts are identified by their diameter and length as measured from below the head, as shown in Figure 1-3.



**Figure 1-3.** Bolt size identification.



**Figure 1-4.** Synthetic wintergreen oil can be used as a penetrating oil to loosen rusted bolts or nuts.

Fractional thread sizes are specified by the diameter in fractions of an inch and the number of threads per inch. Typical UNC thread sizes would be 5/16–18 and 1/2–13. Similar UNF thread sizes would be 5/16–24 and 1/2–20.






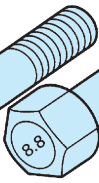
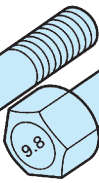

## METRIC BOLTS

The size of a metric bolt is specified by the letter *M* followed by the diameter in millimeters (mm) across the outside (crest) of the threads. Typical metric sizes would be M8 and M12. Fine metric threads are specified by the thread diameter followed by X and the distance between the threads measured in millimeters (M8 × 1.5).

## GRADES OF BOLTS

Bolts are made from many different types of steel, and for this reason some are stronger than others. The strength or classification of a bolt is called the **grade**. The bolt heads are marked to indicate their grade strength. Fractional bolts have lines on the head to indicate the grade, as shown in Figures 1-5 and 1-6.

**Figure 1-5.** Typical bolt (cap screw) grade markings and approximate strength.

				Inch grade
1	5	7	8	
				Metric class
4.6	8.8	9.8	10.9	
60,000	120,000	130,000	150,000	Approximate maximum pound force per square inch

The actual grade of bolts is two more than the number of lines on the bolt head. Metric bolts have a decimal number to indicate the grade. More lines or a higher grade number indicate a stronger bolt. Higher grade bolts usually have threads that are rolled rather than cut, which also makes them stronger. In some cases, nuts and machine screws have similar grade markings.

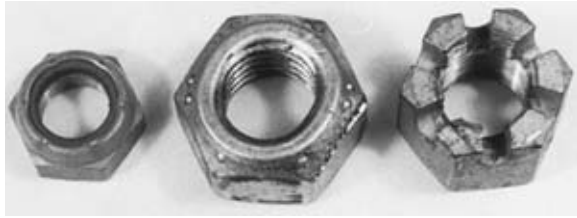
**CAUTION:** Never use hardware store (non-graded) bolts, studs, or nuts on any vehicle steering, suspension, or brake component. Always use the exact size and grade of hardware that is specified and used by the vehicle manufacturer.

## NUTS

Most nuts used on cap screws have the same hex size as the cap screw head. Some inexpensive nuts use a hex size larger than the cap screw head. Metric nuts are often marked with dimples to show their strength. More dimples indicate stronger nuts. Some nuts and cap screws use interference fit threads to keep them from accidentally loosening. This means that the shape of the nut is slightly distorted or that a section of the threads is deformed. Nuts can also be kept from loosening with a nylon washer fastened in the nut or with a nylon patch or strip on the threads. See Figure 1-7.



**Figure 1-6.** Every shop should have an assortment of high-quality bolts and nuts to replace those damaged during vehicle service procedures.



**Figure 1-7.** Types of lock nuts. On the left, a nylon ring; in the center, a distorted shape; and on the right, a castle for use with a cotter key.

**NOTE:** Most of these “locking nuts” are grouped together and are commonly referred to as prevailing torque nuts. This means that the nut will hold its tightness or torque and not loosen with movement or vibration. Most prevailing torque nuts should be replaced whenever removed to ensure that the nut will not loosen during service. Always follow manufacturer’s recommendations. Anaerobic

sealers, such as Loctite, are used on the threads where the nut or cap screw must be both locked and sealed.

## WASHERS

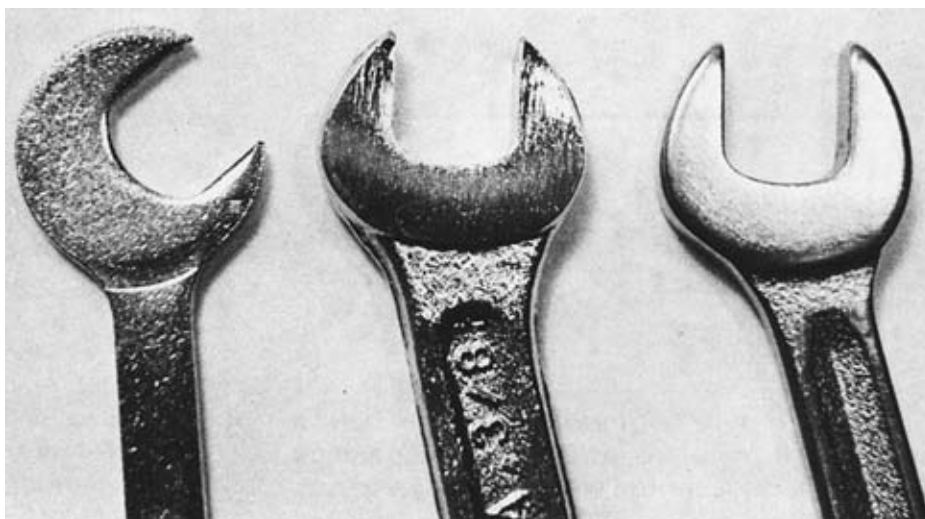
Washers are often used under cap screw heads and under nuts. Plain flat washers are used to provide an even clamping load around the fastener. Lock washers are added to prevent accidental loosening. In some accessories, the washers are locked onto the nut to provide easy assembly.

## BASIC TOOL LIST

Hand tools are used to turn fasteners (bolts, nuts, and screws). The following is a list of hand tools every automotive technician should possess. Specialty tools are not included. See Figures 1-8 through 1-26.

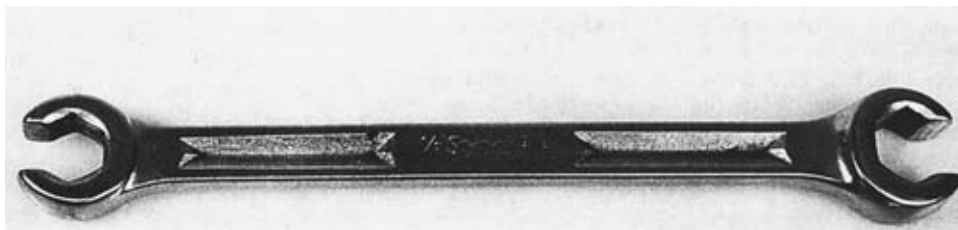


**Figure 1-8.** Combination wrench. The openings are the same size at both ends. Notice the angle of the open end to permit use in close spaces.



**Figure 1-9.** Three different qualities of open-end wrenches. The cheap wrench on the left is made from weaker steel and is thicker and less accurately machined than the standard in the center. The wrench on the right is of professional quality (and price).

Tool chest	3/8-inch hex socket
1/4-inch drive socket set (1/4 in. to 9/16 in. Standard and deep sockets; 6 mm to 15 mm standard and deep sockets)	13 millimeters to 14 millimeters flare nut wrench
1/4-inch drive ratchet	15 millimeters to 17 millimeters flare nut wrench
1/4-inch drive 2-inch extension	5/16-inch to 3/8-inch flare nut wrench
1/4-inch drive 6-inch extension	7/16-inch to 1/2-inch flare nut wrench
1/4-inch drive handle	1/2-inch to 9/16-inch flare nut wrench
3/8-inch drive socket set (3/8 in. to 7/8 in. standard and deep sockets; 10 mm to 19 mm standard and deep sockets)	Diagonal pliers
3/8-inch drive Torx set (T40, T45, T50, and T55)	Needle pliers
3/8-inch drive 13/16-inch plug socket	Adjustable-jaw pliers
3/8-inch drive 5/8-inch plug socket	Locking pliers
3/8-inch drive ratchet	Snap-ring pliers
3/8-inch drive 1 1/2-inch extension	Stripping or crimping pliers
3/8-inch drive 3-inch extension	Ball-peen hammer
3/8-inch drive 6-inch extension	Rubber hammer
3/8-inch drive 18-inch extension	Dead-blow hammer
3/8-inch drive universal	Five-piece standard screwdriver set
3/8-inch drive socket set (1/2 in. to 1 in. standard and deep sockets)	Four-piece Phillips screwdriver set
1/2-inch drive ratchet	#15 Torx screwdriver
1/2-inch drive breaker bar	#20 Torx screwdriver
1/2-inch drive 5-inch extension	Awl
1/2-inch drive 10-inch extension	Mill file
3/8-inch to 1/4-inch adapter	Center punch
1/2-inch to 3/8-inch adapter	Pin punches (assorted sizes)
3/8-inch to 1/2-inch adapter	Chisel
Crowfoot set (frictional inch)	Utility knife
Crowfoot set (metric)	Valve core tool
3/8- through 1-inch combination wrench set	Filter wrench (large filters)
10 millimeters through 19 millimeters combination wrench set	Filter wrench (smaller filters)
1/16-inch through 1/4-inch hex wrench set	Safety glasses
2 millimeters through 12 millimeters hex wrench set	Circuit tester
	Feeler gauge
	Scraper
	Pinch bar
	Sticker knife
	Magnet



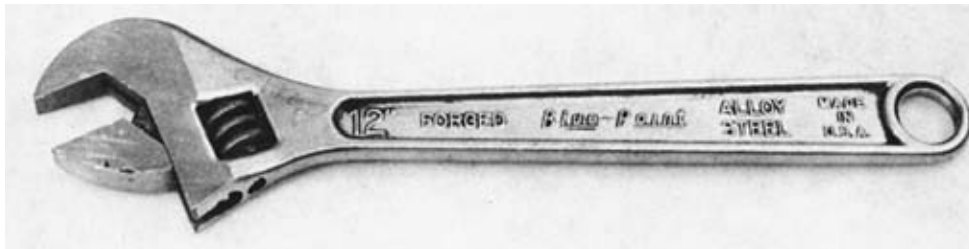
**Figure 1-10.** Flare-nut wrench. Also known as a *line wrench*, *fitting wrench*, or *tube-nut wrench*. This style of wrench is designed to grasp most of the flats of a six-sided (hex) tubing fitting to provide the most grip without damage to the fitting.



**Figure 1-11.** Box-end wrench. Recommended to loosen or tighten a bolt or nut where a socket will not fit. A box-end wrench has a different size at each end and is better to use than an open-end wrench because it touches the bolt or nut around the entire head instead of at just two places.

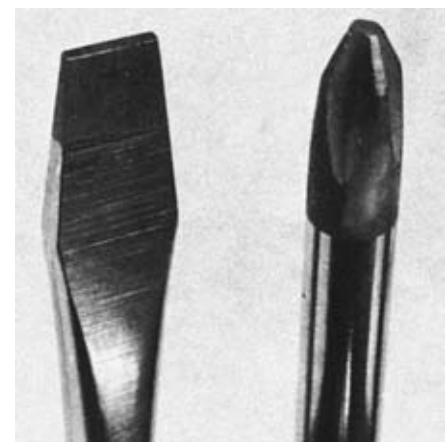


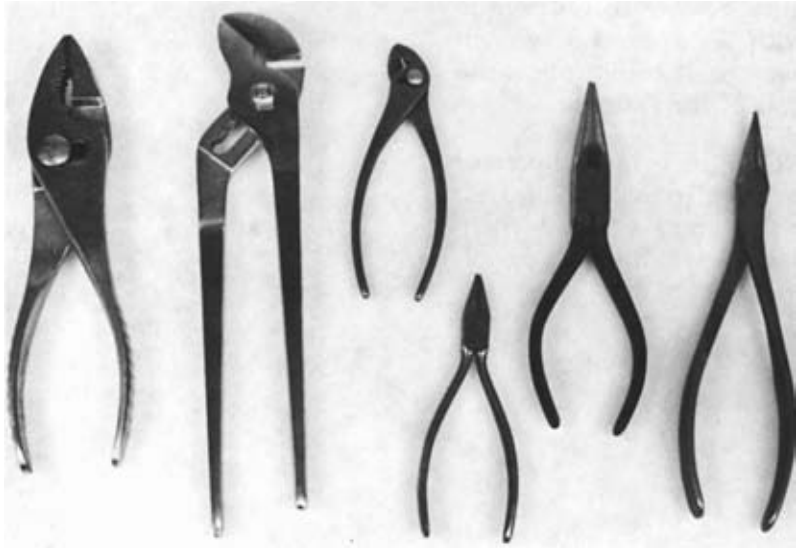
**Figure 1-12.** Open-end wrench. Each end has a different-sized opening and is recommended for general usage. Do not attempt to loosen or tighten bolts or nuts from or to full torque with an open-end wrench because it could round the flats of the fastener.



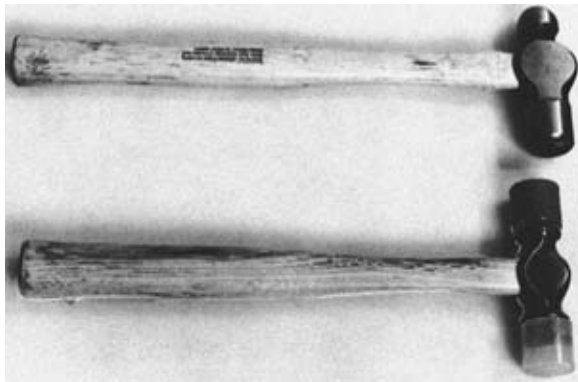
**Figure 1-13.** Adjustable wrench. The size (12 inches) is the *length* of the wrench, not how far the jaws open!

**Figure 1-14.** A flat-blade (or straight-blade) screwdriver (on the left) is specified by the length of the screwdriver and the width of the blade. The width of the blade should match the width of the screw slot of the fastener. A Phillips-head screwdriver (on the right) is specified by the length of the handle and the size of the point at the tip. A #1 is a sharp point, a #2 is most common (as shown), and a #3 Phillips is blunt and is only used for larger sizes of Phillips-head fasteners.

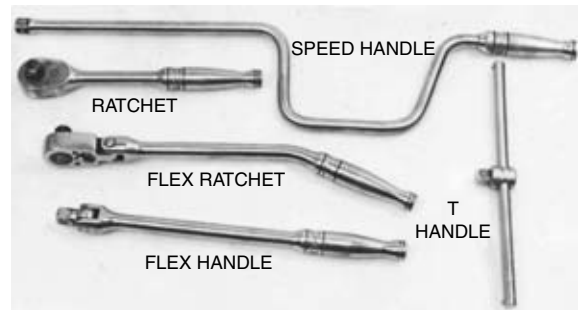




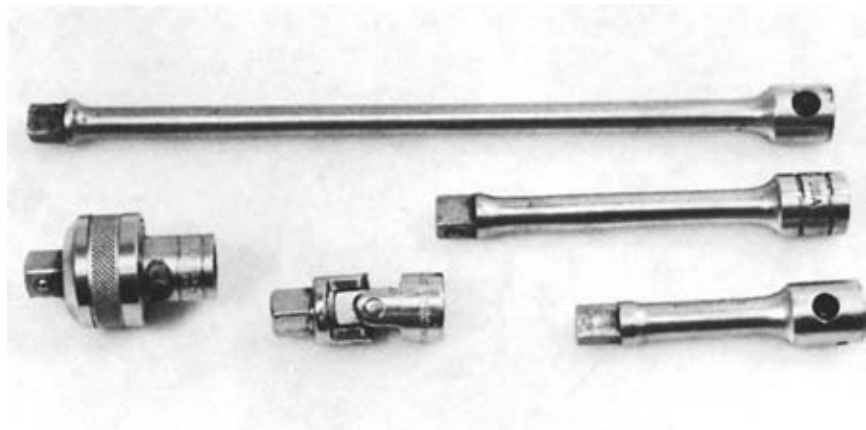
**Figure 1-15.** Assortment of pliers. Slip-joint pliers (far left) are often confused with water pump pliers (second from left).



**Figure 1-16.** A ball-peen hammer (top) is purchased according to weight (usually in ounces) of the head of the hammer. At bottom is a soft-faced (plastic) hammer. Always use a hammer that is softer than the material being driven. Use a block of wood or similar material between a steel hammer and steel or iron engine parts to prevent damage to the engine parts.

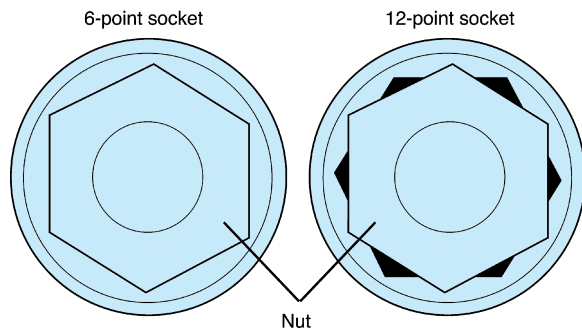
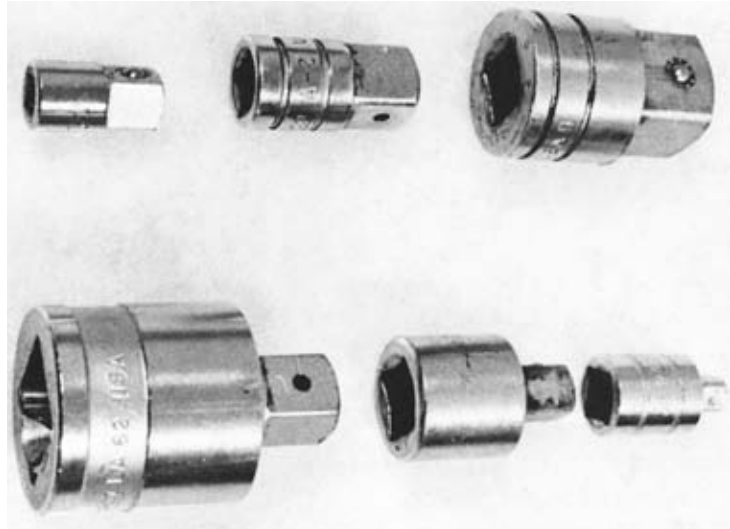


**Figure 1-17.** Typical drive handles for sockets.

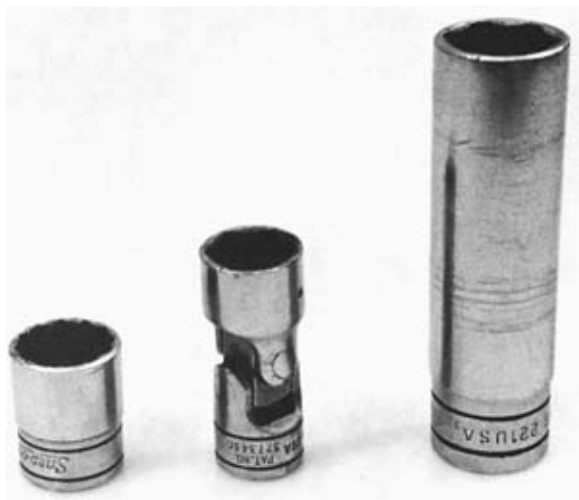


**Figure 1-18.** Various socket extensions. The universal joint (U-joint) in the center (bottom) is useful for gaining access in tight areas.

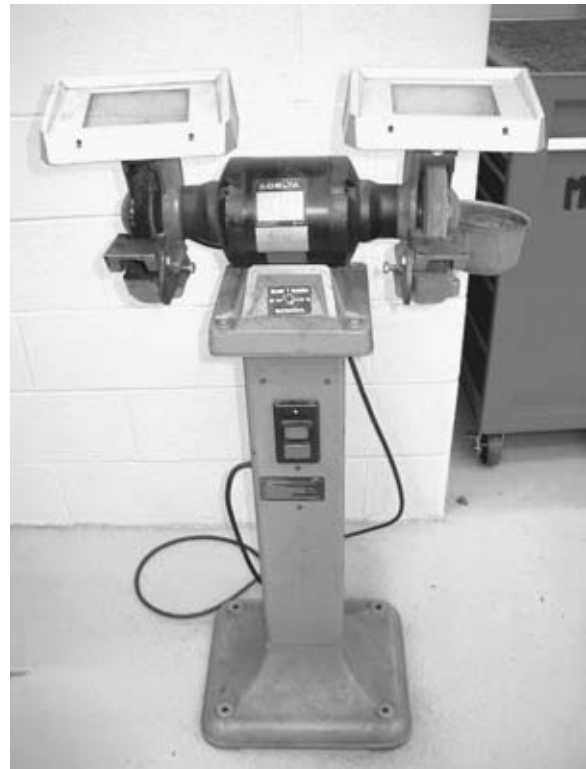
**Figure 1-19.** Socket drive adapters. These adapters permit the use of a 3/8-inch drive ratchet with 1/2-inch drive sockets, or other combinations as the various adapters permit. Adapters should *not* be used where a larger tool used with excessive force could break or damage a smaller-sized socket.



**Figure 1-20.** A 6-point socket fits the head of the bolt or nut on all sides. A 12-point socket can round off the head of a bolt or nut if a lot of force is applied.

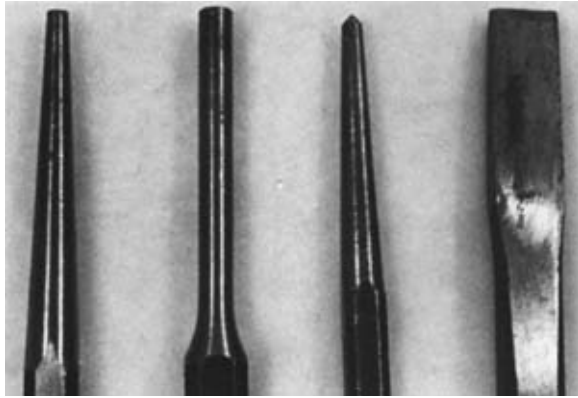


**Figure 1-21.** Standard 12-point short socket (left), universal joint socket (center), and deep-well socket (right). Both the universal and deep well are 6-point sockets.



**Figure 1-22.** Pedestal grinder with shields. This type of grinder should be bolted to the floor. A face shield should also be worn whenever using a grinder or wire wheel.

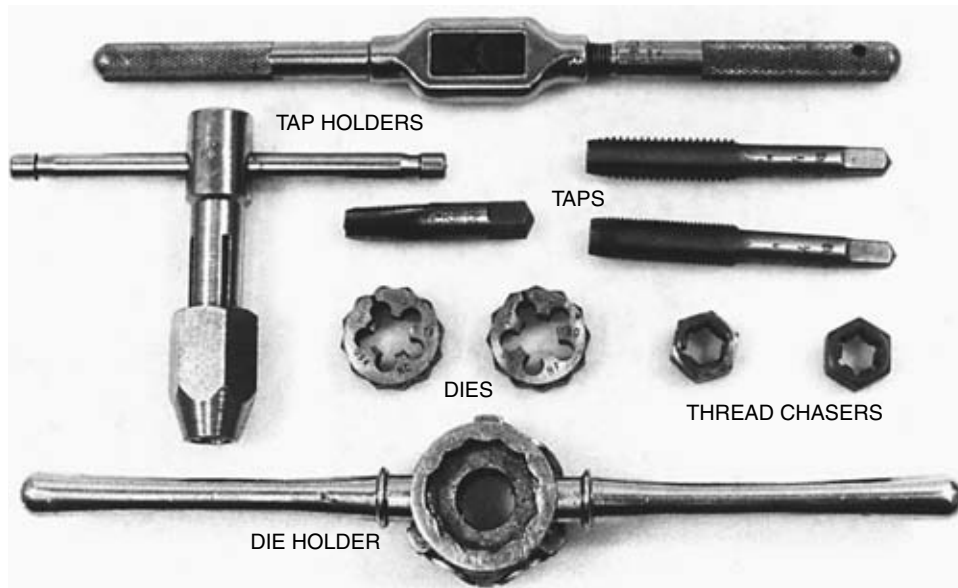




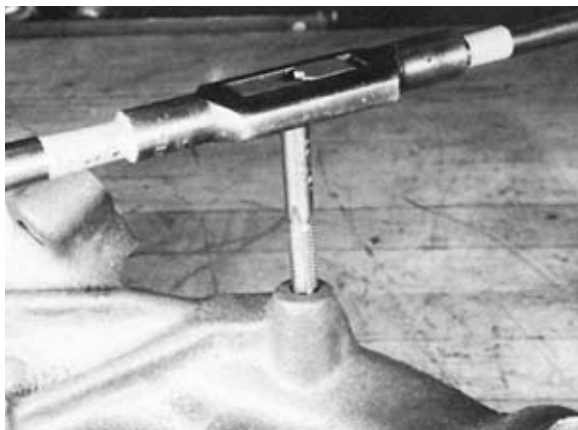
**Figure 1-23.** Various punches on the left and a chisel on the right.



**Figure 1-24.** Using a die to cut threads on a rod.



**Figure 1-25.** Dies are used to make threads on the outside of round stock. Taps are used to make threads inside holes. A thread chaser is used to clean threads without removing metal.



**Figure 1-26.** Starting a tap in a drilled hole. The hole diameter should be matched exactly to the tap size for proper thread clearance. The proper drill size to use is called the **tap drill** size.

## TOOL SETS AND ACCESSORIES

A beginning service technician may wish to start with a small set of tools before spending a lot of money on an expensive, extensive tool box. See Figures 1-27 through 1-29.



(a)

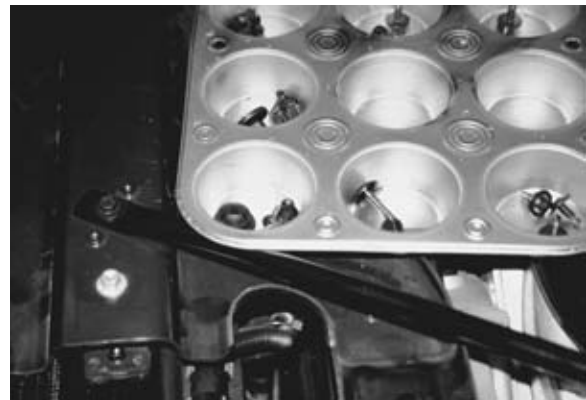


(b)

**Figure 1-27.** (a) A beginning technician can start with some simple basic hand tools. (b) An experienced, serious technician often spends several thousand dollars a year for tools such as those found in this large (and expensive) tool box.

## BRAND NAME VERSUS PROPER TERM

Technicians often use slang or brand names of tools rather than the proper term. This results in some confusion for new technicians. Some examples are given in the following table.



**Figure 1-28.** An inexpensive muffin tin can be used to keep small parts separated.



**Figure 1-29.** A good fluorescent trouble light is essential. A fluorescent light operates cooler than an incandescent light and does not pose a fire hazard as when gasoline is accidentally dropped on an unprotected incandescent bulb used in some trouble lights.

Brand Name	Proper Term	Slang Name
Crescent wrench	Adjustable wrench	Monkey wrench
Vise Grips	Locking pliers	
Channel Locks	Water pump pliers or multigroove adjustable pliers	Pump pliers
	Diagonal cutting pliers	Dikes or side cuts

## SAFETY TIPS FOR USING HAND TOOLS

The following safety tips should be kept in mind whenever you are working with hand tools.

- Always *pull* a wrench toward you for best control and safety. Never push a wrench.
- Keep wrenches and all hand tools clean to help prevent rust and for a better, firmer grip.
- Always use a 6-point socket or a box-end wrench to break loose a tight bolt or nut.
- Use a box-end wrench for torque and an open-end wrench for speed.
- Never use a pipe extension or other type of “cheater bar” on a wrench or ratchet handle. If more force is required, use a larger tool or use penetrating oil and/or heat on the frozen fastener. (If heat is used on a bolt or nut to remove it, always replace it with a new part.)
- Always use the proper tool for the job. If a specialized tool is required, use the proper tool and do not try to use another tool improperly.
- Never expose any tool to excessive heat. High temperatures can reduce the strength (“draw the temper”) of metal tools.
- Never use a hammer on any wrench or socket handle unless you are using a special “staking face” wrench designed to be used with a hammer.
- Replace any tools that are damaged or worn.

## MEASURING TOOLS

The purpose of any repair is to restore the engine or vehicle to factory specification tolerance. Every repair procedure involves measuring. The service technician must measure twice.

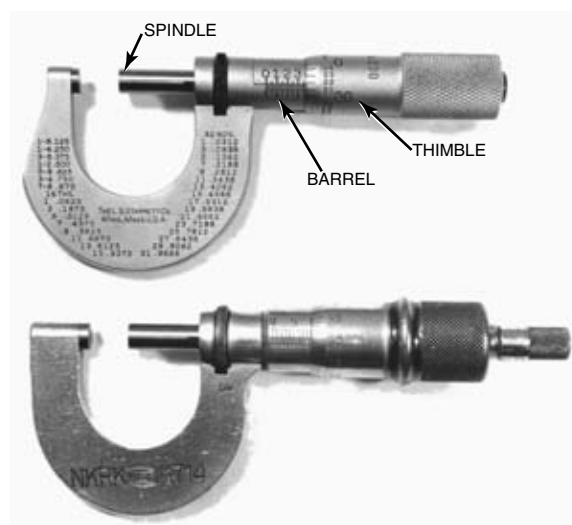
- The original engine or vehicle components must be measured to see if correction is necessary to restore the component or part to factory specifications.
- The replacement parts and finished machined areas must be measured to ensure proper dimension before the engine or component is assembled or replaced on the vehicle.

## Micrometer

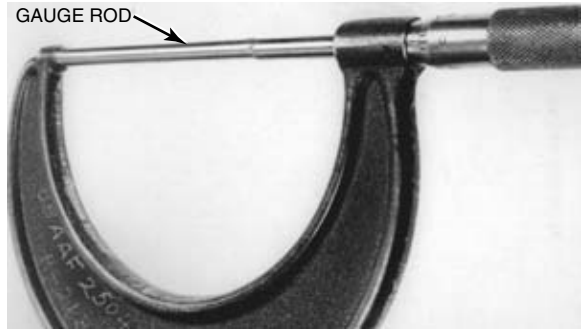
A micrometer is the most used measuring instrument in engine service and repair. See Figure 1-30. The **thimble** rotates over the **barrel** on a screw that has 40 threads per inch. Every revolution of the thimble moves the **spindle** 0.025 inch. The thimble is graduated into 25 equally spaced lines; therefore, each line represents 0.001 inch. Every micrometer should be checked for calibration on a regular basis. See Figure 1-31. Figure 1-32 shows examples of micrometer readings.

## Telescopic Gauge

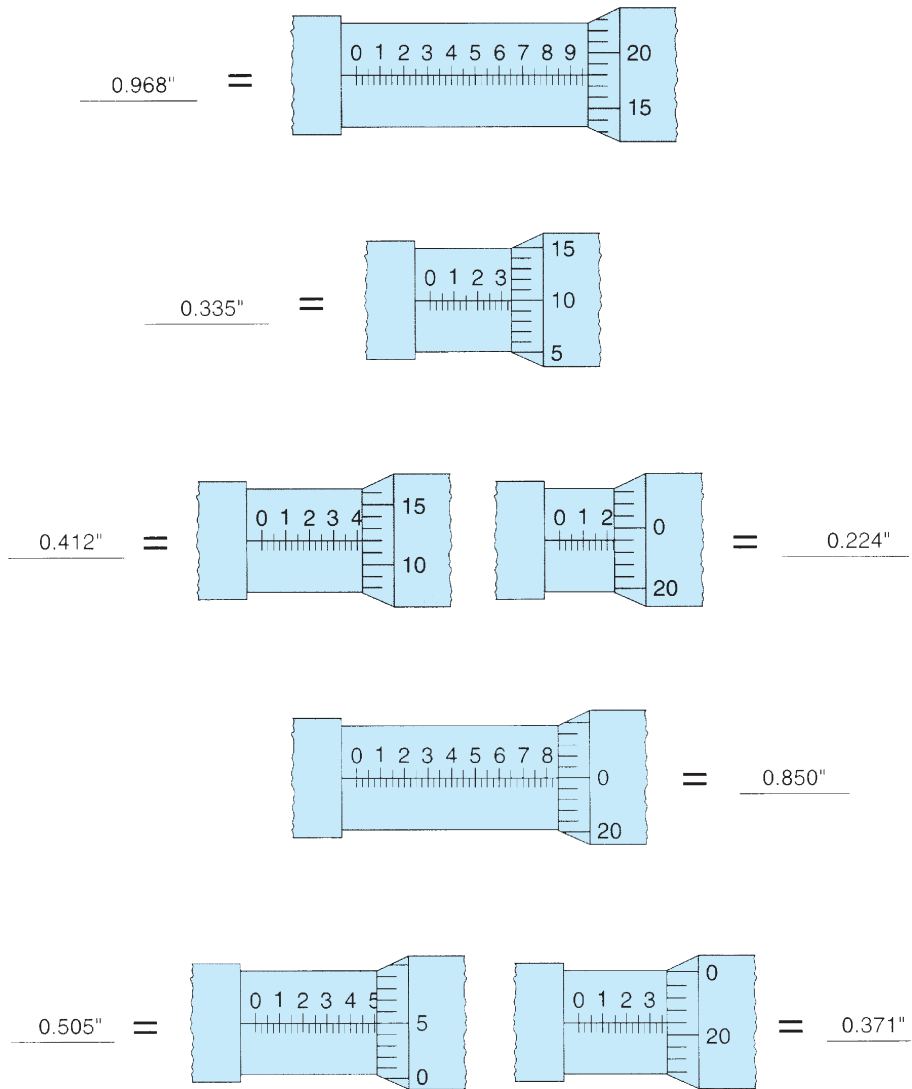
A telescopic gauge is used with a micrometer to measure the inside diameter of a hole or bore.



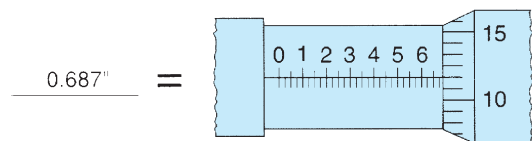
**Figure 1-30.** Typical micrometers used for dimensional inspection.



**Figure 1-31.** All micrometers should be checked and calibrated as needed using a gauge rod.



**Figure 1-32.** Sample micrometer readings. Each larger line on the barrel between the numbers represents 0.025". The number on the thimble is then added to the number showing and the number of lines times 0.025".



## Vernier Dial Caliper

A vernier dial caliper can be used to measure rotor thickness and caliper piston diameter as well as the length of a bolt or other component. See Figure 1-33.

## Dial Indicator

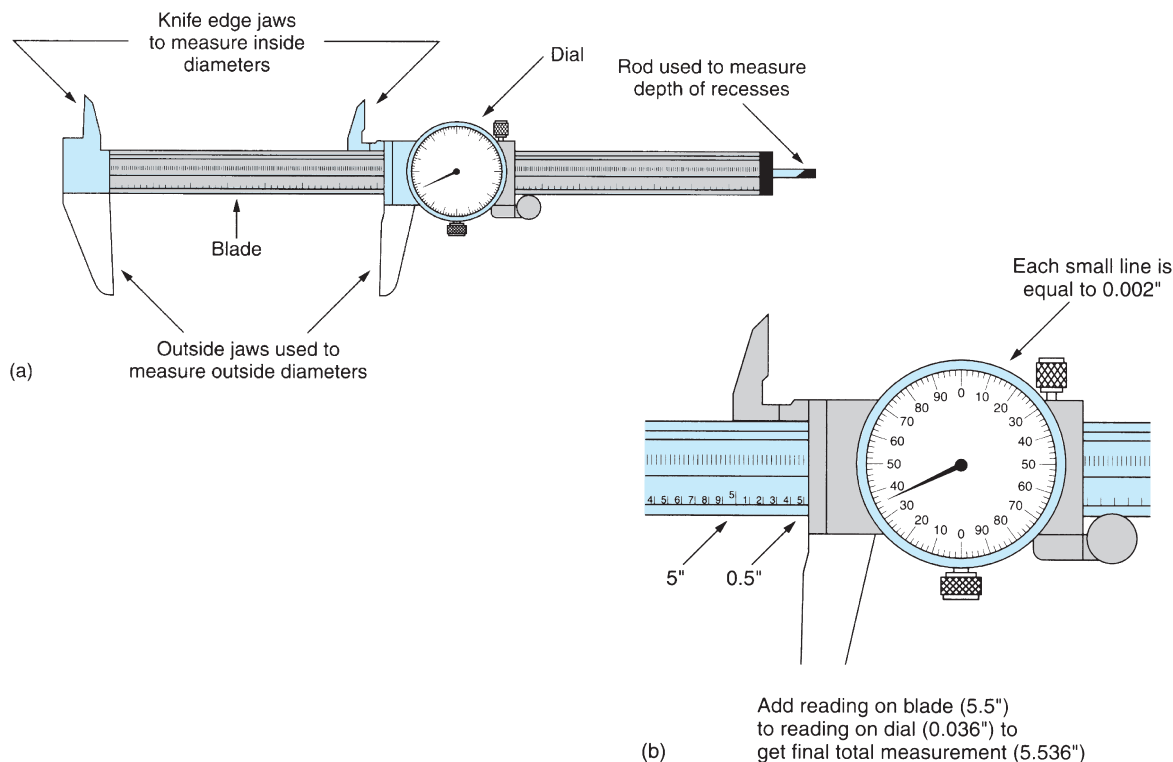
A dial indicator is used to measure movement such as rotor runout or gear lash/clearance.

## SAFETY TIPS FOR TECHNICIANS

Safety is not just a buzzword on a poster in the work area. Safe work habits can reduce accidents and injuries, ease the workload, and keep employees pain free. Suggested safety tips include the following.

- Wear safety glasses at all times while servicing any vehicle. See Figure 1-34.

- Watch your toes—always keep your toes protected with steel-toed safety shoes. See Figure 1-35. If safety shoes are not available, then leather-topped shoes offer more protection than canvas or cloth.
- Wear gloves to protect your hands from rough or sharp surfaces. Thin rubber gloves are recommended when working around automotive liquids such as engine oil, antifreeze, transmission fluid, or any other liquids that may be hazardous.
- Service technicians working under a vehicle should wear a **bump cap** to protect the head against under-vehicle objects and the pads of the lift. See Figure 1-36.
- Remove jewelry that may get caught on something or act as a conductor to an exposed electrical circuit. See Figure 1-37.
- Take care of your hands. Keep your hands clean by washing with soap and hot water at least 110°F (43°C).
- Avoid loose or dangling clothing.
- Ear protection should be worn if the sound around you requires that you raise your



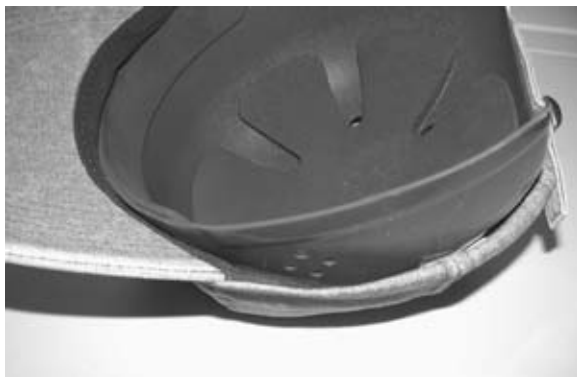
**Figure 1-33.** (a) A typical vernier dial caliper. This is a very useful measuring tool for automotive engine work because it is capable of measuring inside and outside measurements. (b) To read a vernier dial caliper, simply add the reading on the blade to the reading on the dial.



**Figure 1-34.** Safety glasses should be worn at all times when working on or around any vehicle or servicing any component.



**Figure 1-35.** Steel-toed shoes are a worthwhile investment to help prevent foot injury due to falling objects. Even these well-worn shoes can protect the feet of this service technician.



**Figure 1-36.** One version of a bump cap is this padded plastic insert that is worn inside a regular cloth cap.



**Figure 1-37.** Remove all jewelry before performing service work on any vehicle.

voice (sound level higher than 90 dB). (A typical lawnmower produces noise at a level of about 110 dB. This means that everyone who uses a lawnmower or other lawn or garden equipment should wear ear protection.)

- When lifting any object, get a secure grip with solid footing. Keep the load close to your body to minimize the strain. Lift with your legs and arms, not your back.
- Do not twist your body when carrying a load. Instead, pivot your feet to help prevent strain on the spine.
- Ask for help when moving or lifting heavy objects.
- Push a heavy object rather than pull it. (This is opposite to the way you should work with tools—never push a wrench! If you do and a bolt or nut loosens, your entire weight is used to propel your hand(s) forward. This usually results in cuts, bruises, or other painful injury.)
- Always connect an exhaust hose to the tailpipe of any running vehicle to help pre-



**Figure 1-38.** Always connect an exhaust hose to the tailpipe of the engine of a vehicle to be run inside a building.

vent the build-up of carbon monoxide inside a closed garage space. See Figure 1-38.

- When standing, keep objects, parts, and tools with which you are working between chest height and waist height. If seated, work at tasks that are at elbow height.
- Always be sure the hood is securely held open. See Figure 1-39.

**WARNING:** Always dispose of oily shop cloths in an enclosed container to prevent a fire. See Figure 1-40. Whenever oily cloths are thrown together on the floor or workbench, a chemical reaction can occur which can ignite the cloth even without an open flame. This process of ignition without an open flame is called **spontaneous combustion**.

## SAFETY IN LIFTING (HOISTING) A VEHICLE

Many chassis and underbody service procedures require that the vehicle be hoisted or lifted off the ground. The simplest methods involve the use of



(a)



(b)

**Figure 1-39.** (a) A crude but effective method is to use locking pliers on the chrome-plated shaft of a hood strut. Locking pliers should only be used on defective struts because the jaws of the pliers can damage the strut shaft. (b) A commercially available hood clamp. This tool uses a bright orange tag to help remind the technician to remove the clamp before attempting to close the hood. The hood could be bent if force is used to close the hood with the clamp in place.

drive-on ramps or a floor jack and safety (jack) stands, whereas in-ground or surface-mounted lifts provide greater access.

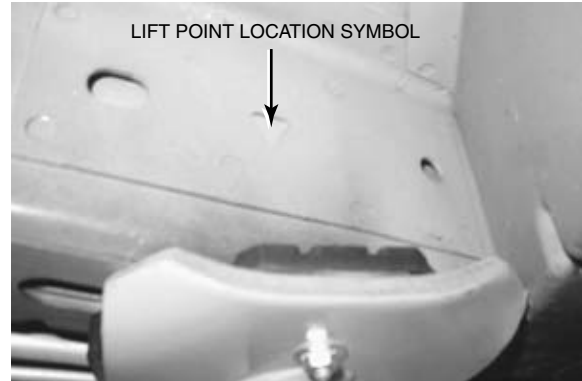


**Figure 1-40.** All oily shop cloths should be stored in a metal container equipped with a lid to help prevent spontaneous combustion.

**Setting the pads is a critical part of this procedure.** All automobile and light-truck service manuals include recommended locations to be used when hoisting (lifting) a vehicle. Newer vehicles have a triangle decal on the driver's door indicating the recommended lift points. The recommended standards for the lift points and lifting procedures are found in SAE Standard JRP-2184. See Figure 1-41. These recommendations typically include the following points.

1. The vehicle should be centered on the lift or hoist so as not to overload one side or put too much force either forward or rearward. See Figure 1-42.
2. The pads of the lift should be spread as far apart as possible to provide a stable platform.
3. Each pad should be placed under a portion of the vehicle that is strong and capable of supporting the weight of the vehicle.
  - a. Pinch welds at the bottom edge of the body are generally considered to be strong.

**CAUTION:** Even though pinch weld seams are the recommended location for hoisting many vehicles with unitized bodies (unit-body), care should be taken not to place the pad(s) too far forward or rearward. Incorrect placement of the vehicle on the lift could cause the vehicle to be imbalanced, and the vehicle could fall. This is exactly what happened to the vehicle in Figure 1-43.



**Figure 1-41.** Most newer vehicles have a triangle symbol indicating the recommended hoisting lift points.

- b. Boxed areas of the body are the best places to position the pads on a vehicle without a frame. Be careful to note whether the arms of the lift might come into contact with other parts of the vehicle before the pad touches the intended location. Commonly damaged areas include the following.
  1. Rocker panel moldings
  2. Exhaust system (including catalytic converter)
  3. Tires or body panels (see Figures 1-44 through 1-46)
4. The vehicle should be raised about a foot (30 centimeters [cm]) off the floor, then stopped and shaken to check for stability. If the vehicle seems to be stable when checked at a short distance from the floor continue raising the vehicle and continue to view the vehicle until it has reached the desired height.

**CAUTION:** Do not look away from the vehicle while it is being raised (or lowered) on a hoist. Often one side or one end of the hoist can stop or fail, resulting in the vehicle being slanted enough to slip or fall, creating physical damage not only to the vehicle and/or hoist but also to the technician or others who may be nearby.

**HINT:** Most hoists can be safely placed at any desired height. For ease while working, the area in which you are working should be at chest level. When working on brakes or suspension components, it is not necessary to work on them down near the floor or over your head. Raise the hoist so that the components are at chest level.





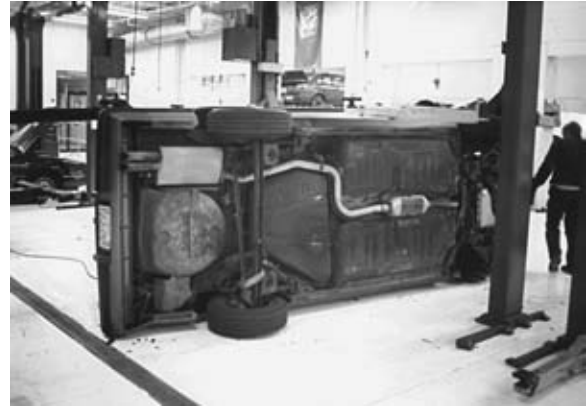
(a)



(b)

**Figure 1-42.** (a) Tall safety stands can be used to provide additional support for a vehicle while on a hoist. (b) A block of wood should be used to avoid the possibility of doing damage to components supported by the stand.

- Before lowering the hoist, the safety latch(es) must be released and the direction of the controls reversed. The speed downward is often adjusted to be as slow as possible for additional safety.



**Figure 1-43.** This vehicle fell from the hoist because the pads were not set correctly. No one was hurt, but the vehicle was a total loss.



**Figure 1-44.** The safety arm clip should be engaged to prevent the possibility that the hoist support arms can move.

## ELECTRICAL CORD SAFETY

Use correctly grounded three-prong sockets and extension cords to operate power tools. Some tools use only two-prong plugs. Make sure these are double insulated. When not in use, keep electrical cords off the floor to prevent tripping over them. Tape the cords down if they are placed in high foot traffic areas.



(a)



(b)

**Figure 1-45.** (a) An assortment of hoist pad adapters that are often necessary to use to safely hoist many pickup trucks, vans, and sport utility vehicles. (b) A view from underneath a Chevrolet pickup truck showing how the pad extensions are used to attach the hoist lifting pad to contact the frame.



(a)



(b)

**Figure 1-46.** (a) In this photo the pad arm is just contacting the rocker panel of the vehicle. (b) This photo shows what can occur if the technician places the pad too far inward underneath the vehicle. The arm of the hoist has dented in the rocker panel.

## FIRE EXTINGUISHERS

There are four classes of fire extinguishers. Each class should be used on specific fires only.

- **Class A**—is designed for use on general combustibles, such as cloth, paper, and wood.
- **Class B**—is designed for use on flammable liquids and greases, including gasoline, oil, thinners, and solvents.
- **Class C**—is used only on electrical fires.
- **Class D**—is effective only on combustible metals such as powdered aluminum, sodium, or magnesium.

The class rating is clearly marked on the side of every fire extinguisher. Many extinguishers are good for multiple types of fires. See Figure 1-47.

When using a fire extinguisher, remember the word “PASS.”

P = Pull the safety pin.

A = Aim the nozzle of the extinguisher at the base of the fire.

S = Squeeze the lever to actuate the extinguisher.

S = Sweep the nozzle from side-to-side.

See Figure 1-48.

**WARNING: Improper use of an air nozzle can cause blindness or deafness. Compressed air must be reduced to less than 30 psi (206 kPa). If an air nozzle is used to dry and clean parts, make sure the air stream is directed away from anyone else in the immediate area. Coil and store air hoses when they are not in use.**

### Types of Fire Extinguishers

Types of fire extinguishers include the following.

- **Water**—A water fire extinguisher is usually in a pressurized container and is good to use on Class A fires by reducing the temperature to the point where a fire cannot be sustained.
- **Carbon Dioxide (CO<sub>2</sub>)**—A carbon dioxide fire extinguisher is good for almost any type of fire, especially Class B or Class C materials. A CO<sub>2</sub> fire extinguisher works by



**Figure 1-47.** A typical fire extinguisher designed to be used on type A, B, or C fires.



**Figure 1-48.** A CO<sub>2</sub> fire extinguisher being used on a fire set in an open steel drum during a demonstration at a fire department training center.

moving the oxygen from the fire and the cold CO<sub>2</sub> also helps reduce the temperature of the fire.

- **Dry Chemical (yellow)**—A dry chemical fire extinguisher is good for Class A, B, or C fires by coating the flammable materials, which eliminates the oxygen from the fire. A dry chemical fire extinguisher tends to be very corrosive and will cause damage to electronic devices.

## SUMMARY

- Bolts, studs, and nuts are commonly used as fasteners in the chassis. The sizes for fractional and metric threads are different and

are not interchangeable. The grade is the rating of the strength of a fastener.

- Whenever a vehicle is raised above the ground, it must be supported at a substantial section of the body or frame.

## Review Questions

- List three precautions that must be taken whenever hoisting (lifting) a vehicle.
- Describe how to determine the grade of a fastener, including how the markings differ between customary and metric bolts.
- List four items that are personal safety equipment.
- List the types of fire extinguishers and their usage.
- Two technicians are discussing the hoisting of a vehicle. Technician A says to put the pads of a lift under a notch at the pinch weld seams of a unit-body vehicle. Technician B says to place the pads on the four corners of the frame of a full-frame vehicle. Which technician is correct?
  - Technician A only
  - Technician B only
  - Both Technicians A and B
  - Neither Technician A nor B
- The correct location for the pads when hoisting or jacking the vehicle can often be found in the \_\_\_\_\_.
  - Service manual
  - Shop manual
  - Owner's manual
  - All of the above
- For the best working position, the work should be \_\_\_\_\_.
  - At neck or head level
  - At knee or ankle level
  - Overhead by about 1 foot
  - At chest or elbow level
- When working with hand tools, always \_\_\_\_\_.
  - Push the wrench—don't pull toward you
  - Pull a wrench—don't push a wrench
- A high-strength bolt is identified by \_\_\_\_\_.
  - A UNC symbol
  - Lines on the head
  - Strength letter codes
  - The coarse threads
- A fastener that uses threads on both ends is called a \_\_\_\_\_.
  - Cap screw
  - Stud
  - Machine screw
  - Crest fastener
- The proper term for Channel Locks is \_\_\_\_\_.
  - Vise Grips
  - Crescent wrench
  - Locking pliers
  - Multigroove adjustable pliers
- The proper term for Vise Grips is \_\_\_\_\_.
  - Locking pliers
  - Slip-joint pliers
  - Side cuts
  - Multigroove adjustable pliers
- What is *not* considered to be personal safety equipment?
  - Air impact wrench
  - Safety glasses
  - Rubber gloves
  - Hearing protection
- Which tool listed is a brand name?
  - Locking pliers
  - Monkey wrench
  - Side cutters
  - Vise Grips