Figure 9-1  A forged wrench after it has been forged but before the flashing, extra material around the wrench, has been removed.

Figure 9-2  A typical open-end wrench. The size is different on each end and notice that the head is angled 15 degrees at each end.
A typical box-end wrench is able to grip the bolt or nut at points completely around the fastener. Each end is a different size.

The end of a box-end wrench is angled 15 degrees to allow clearance for nearby objects or other fasteners.

A combination wrench has an open end at one end and a box end at the other with the same size at each end.
Figure 9-6  An adjustable wrench. Adjustable wrenches are sized by the overall length of the wrench and not by how far the jaws open. Common sizes of adjustable wrenches include 8, 10, and 12 in.

Figure 9-7  The end of a typical line wrench, which shows that it is capable of grasping most of the head of the fitting.

Figure 9-8  A typical ratchet used to rotate a socket. A ratchet makes a rattling noise when it is being rotated in the opposite direction from loosening or tightening. A knob or lever on the ratchet allows the user to switch directions.
Figure 9-9 A typical flex handle used to rotate a socket, also called a breaker bar because it usually has a longer handle than a ratchet and, therefore, can be used to apply more torque to a fastener than a ratchet.

Figure 9-10 The most commonly used socket drive sizes include 1/4 in., 3/8 in., and 1/2 in.

Figure 9-11 A 6-point socket fits the head of the bolt or nut on all sides. A 12-point socket can fit all the head of a bolt or nut if a lot of force is applied.
Figure 9-12 A crowfoot socket is designed to reach fasteners using a ratchet or breaker bar with an extension.

Figure 9-13 Using a torque wrench to tighten rod nuts on an engine.

Figure 9-14 A beam-type torque wrench that displays the torque reading on the face of the dial. The beam deflection is read on the beam deflects, which is in proportion to the amount of torque applied to the fasteners.
TECH TIP: Right to Tighten
It is sometimes confusing which way to rotate a wrench or screwdriver, especially when the head of the fastener is pointing away from you. To help visualize while looking at the fastener, say “righty tighty, lefty loosey.”

TECH TIP: Check Torque Wrench Calibration Regularly
Torque wrenches should be checked regularly. For example, Honda has a torque wrench calibration setup at each of their training centers. It is expected that a torque wrench be checked for accuracy before every use. Most experts recommend that torque wrenches be checked and adjusted as needed at least every year and more often if possible. \( \text{SEE FIGURE 9–15.} \)
Figure 9-16  Deep sockets allow access to the nut that has a stud plus other locations needing great depth, such as spark plugs.

FREQUENTLY ASKED QUESTION

Is It Lb-ft or Ft-lb of Torque?
The unit for torque is expressed as a force times the distance (leverage) from the object. Therefore, the official unit for torque is lb-ft (pound-feet) or newton-meters (a force times a distance). However, it is commonly expressed in ft-lb and even some torque wrenches are labeled with this unit.

TECH TIP: Double-Check the Specifications

Misreading torque specifications is easy to do but can have serious damaging results. Specifications for fasteners are commonly expressed in-lb. Many smaller fasteners are tightened to specifications expressed in lb-in. 1 lb-ft = 12 lb-in.

Therefore, if a fastener were to be accidentally tightened to 24 lb-ft instead of 24 lb-in., the actual torque applied to the fastener will be 288 lb-in. instead of the specified 24 lb-in. This extra torque will likely break the fastener, but it could also warp or distort the part being tightened. Always double-check the torque specifications.
TECH TIP: Use Socket Adapters with Caution

Socket adapters are available and can be used for different drive size sockets on a ratchet. Combinations include:
- 1/4 in. drive—3/8 in. sockets
- 3/8 in. drive—1/4 in. sockets
- 3/8 in. drive—1/2 in. sockets
- 1/2 in. drive—3/8 in. sockets

Using a larger drive ratchet or breaker bar on a smaller size socket can cause the application of too much force to the socket, which could crack or shatter. Using a smaller size drive tool on a larger socket will usually not cause any harm, but would greatly reduce the amount of torque that can be applied to the bolt or nut.

TECH TIP: Avoid Using “Cheater Bars”

Whenever a fastener is difficult to remove, some technicians will insert the handle of a ratchet or a breaker bar into a length of steel pipe. The extra length of the pipe allows the technician to exert more torque than can be applied using the drive handle alone. However, the extra torque can easily overload the socket and ratchet, causing them to break or shatter, which could cause personal injury.

Figure 9-17  A flat-tip (straight blade) screwdriver. The width of the blade should match the width of the slot in the fastener being loosen or tightened.
Figure 9-18 Two stubby screwdrivers are used to access screws that have limited space above. A straight blade is on top and a #2 Phillips screwdriver is on the bottom.

Figure 9-19 An offset screwdriver is used to install or remove fasteners that do not have enough space above to use a conventional screwdriver.

Figure 9-20 An impact screwdriver is used to remove slotted or Phillips head fasteners that cannot be broken loose using a standard screwdriver.
FREQUENTLY ASKED QUESTION

What Are Torx and Robertson Screwdrivers?

A Torx is a six-pointed star-shaped tip that was developed by Camcar (formerly Textron) to offer greater loosening and tightening torque than is possible with a straight (flat tip) or Phillips screwdriver. Torx is commonly used in the automotive field for fastening of many components.

P. L. Robertson invented the Robertson screw and screwdriver in 1908, which uses a square-shaped tip with a slight taper. The Robertson screwdriver uses color-coded handles because different size screws require different tip sizes. Robertson screws are commonly used in Canada and in the recreational vehicle (RV) industry in the United States.

Figure 9-21 A typical ball-peen hammer.

Figure 9-22 A rubber mallet used to deliver a force to an object without harming the surface.
Figure 9-23  A dead-blow hammer that was left outside in freezing weather. The plastic covering that protected it from cold temperatures, which destroyed the hammer. The lead shot is encased in the metal housing and then sealed.

Figure 9-24  Typical slip-joint pliers, which are also common household pliers. The slip joint allows the jaws to be opened to two different settings.

Figure 9-25  Multigroove adjustable pliers are known by many names, including the trade name Channel Locks.
Figure 9-26  A linesman’s pliers are very useful because they can help perform many automotive service jobs.

Figure 9-27  Diagonal-cut pliers are another common tool that has many names.

Figure 9-28  Needle-nose pliers are used where there is limited access to a wire or pin that needs to be installed or removed.
Figure 9-29  Locking pliers are best known by their trade name Vise-Grip®.

**TECH TIP: 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.

<table>
<thead>
<tr>
<th>Brand Name</th>
<th>Proper Term</th>
<th>Slang Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crescent wrench</td>
<td>Adjustable wrench</td>
<td>Monkey wrench</td>
</tr>
<tr>
<td>Vise Grip</td>
<td>Locking pliers</td>
<td>Pump pliers</td>
</tr>
<tr>
<td>Channel Locks</td>
<td>Water pump pliers or multi-groove adjustable pliers</td>
<td>Dikes or side cuts</td>
</tr>
<tr>
<td>Lyric</td>
<td>Diagonal cutting pliers</td>
<td></td>
</tr>
</tbody>
</table>

**TECH TIP: Use Chalk**
Often soft metal particles can become stuck in a file, especially when using it to file aluminum or other soft metals. Rub some chalk into the file before using it to prevent this from happening.
Figure 9-30 Snap-ring pliers are also called lock-ring pliers and are designed to remove internal and external snap rings (lock rings).

Figure 9-31 Files come in many different shapes and sizes. Never use a file without a handle.

Figure 9-32 Tin snips are used to cut thin sheets of metal or carpet.
Figure 9-33  A utility knife uses replaceable blades and is used to cut carpet and other materials.

Figure 9-34  A punch used to drive pins from assembled components. This type of punch is also called a pin punch.

Figure 9-35  Warning stamped in the side of a punch warning that goggles should be worn when using this tool. Always follow safety warnings.
Figure 9-36. Use a grinder or a file to remove the mushroom material on the end of a punch or chisel.

Figure 9-37. A stud remover uses an offset serrated wheel to grasp the stud so it will be rotated when a ratchet or breaker bar is used to rotate the assembly.

Figure 9-38. A nut splitter is used to split a nut that cannot be removed. After the nut has been split, a chisel is then used to remove the nut.
Figure 9-39 A set of bolt extractors, commonly called easy outs.

**TECH TIP: The Wax Trick**

Many times rusted fasteners can be removed by using heat to expand the metal and break the rust bond between the fastener and the nut or casting. Many technicians heat the fastener using a torch and then apply paraffin wax or a candle to the heated fastener.  

*SEE FIGURE 9–40.* The wax will melt and as the part cools, will draw the liquid wax down between the threads. After allowing the part to cool, attempt to remove the fastener. It will often be removed without any trouble.

Figure 9-40 Removing plugs or bolts is easier if the plug is first heated to cherry red color, using a torch, and then applying wax. During cooling, the wax flows in between the threads, making it easier to remove.
FREQUENTLY ASKED QUESTION

I Broke Off an Easy Out—Now What?
An extractor (easy out) is hardened steel and removing this and the broken bolt is now a job for a professional machine shop. The part, which could be as large as an engine block, needs to be removed from the vehicle and taken to a machine shop that is equipped to handle this type of job. One method involves using an electrical discharge machine (EDM). An EDM uses a high amperage electrical current to produce thousands of arcs between the electrode and the broken tool. The part is submerged in a non-conducting liquid and each tiny spark vaporizes a small piece of the broken tool.

TECH TIP

Hide Those from the Boss
An apprentice technician started working for a dealership and put his top tool box on a workbench. Another technician observed that, along with a complete set of good-quality tools, the box contained several adjustable wrenches. The more experienced technician said, “Hide those from the boss.” If any adjustable wrench is used on a bolt or nut, the movable jaw often moves or loosens and starts to round the head of the fastener. If the head of the bolt or nut becomes rounded, it becomes that much more difficult to remove.
Figure 9-42 A typical beginning technician tool set that includes the basic tools to get started.

Figure 9-43 A typical large tool box, showing just one of many drawers.

TECH TIP: Need to Borrow a Tool More than Twice? Buy It!
Most service technicians agree that it is okay for a beginning technician to borrow a tool occasionally. However, if a tool has to be borrowed more than twice, then be sure to purchase it as soon as possible. Also, whenever a tool is borrowed, be sure that you clean the tool and let the technician you borrowed the tool from know that you are returning the tool. These actions will help in any future dealings with other technicians.
TECH TIP: The Valve Grinding Compound Trick

Apply a small amount of valve grinding compound to a Phillips or Torx screw or bolt head. The gritty valve grinding compound “grips” the screwdriver or tool bit and prevents the tool from slipping up and out of the screw head. Valve grinding compound is available in a tube from most automotive parts stores.

Figure 9-44: A seal puller being used to remove a seal from a rear axle.

Figure 9-45: A seal driver or installer is usually plastic and is designed to seat the seal.
Figure 9-46 A typical 12 volt test light.

Figure 9-47 An electric soldering gun used to make electrical repairs. Soldering guns are sold by their wattage rating. The higher the wattage, the greater amount of heat created. Most solder guns used for automotive electrical work usually fall within the 60 to 160 watt range.

TECH TIP: It Just Takes a Second
Whenever removing any automotive component, it is wise to screw the bolts back into the holes a couple of threads by hand. This ensures that the right bolt will be used in its original location when the component or part is put back on the vehicle. Often, the same diameter of fastener is used on a component, but the length of the bolt may vary. Spending just a couple of seconds to put the bolts and nuts back where they belong when the part is removed can save a lot of time when the part is being reinstalled. Besides making certain that the right fastener is being installed in the right place, this method helps prevent bolts and nuts from getting lost or kicked away. How much time have you wasted looking for that lost bolt or nut?
TECH TIP

Use a Binder Clip

A binder clip (size 1 1/4 in. wide) is used by wise technicians to help keep fender covers in place. See Figure 9-48. Binder clips are found at office supply stores.

Figure 9-48 A binder clip being used to keep a fender cover from falling.