FIGURE 1.1 The vehicle identification number (VIN) is visible through the base of the windshield and on a decal inside the driver's door.

FIGURE 1.2 The vehicle emissions control information (VECI) sticker is placed under the hood.
FIGURE 1.3 A typical calibration code sticker on the case of a controller. The information on the sticker is often required when ordering parts or a replacement controller.

FIGURE 1.4 Casting numbers on major components can be either cast or stamped.

FIGURE 1.5 Electronic service information is available from aftermarket sources, such as All-Data and Mitchell-on-Demand, as well as on websites hosted by vehicle manufacturers.
FIGURE 1.6 Technical service bulletins (TSBs) are issued by vehicle manufacturers when a fault occurs that affects many vehicles with the same problem. The TSB then provides the fix for the problem including any parts needed and detailed instructions.

FIGURE 1.7 The dimensions of a typical bolt showing where sizes are measured.

FIGURE 1.8 Thread pitch gauge used to measure the pitch of the thread. This bolt has 13 threads to the inch.
**FIGURE 1.9** Bolts and screws have many different heads. The head determines what tool is needed.

**FIGURE 1.10** The metric system specifies fasteners by diameter, length, and pitch.

**FIGURE 1.11** Stronger threads are created by cold rolling a heat-treated bolt blank instead of cutting the threads using a die.
**FIGURE 1.12** Metric bolt (cap screw) grade markings and approximate tensile strength.

<table>
<thead>
<tr>
<th>METRIC CLASS</th>
<th>4.6</th>
<th>8.8</th>
<th>9.8</th>
<th>10.9</th>
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<tr>
<td></td>
<td>60,000</td>
<td>120,000</td>
<td>130,000</td>
<td>150,000</td>
</tr>
<tr>
<td>APPROXIMATE MAXIMUM POUND FORCE PER SQUARE INCH</td>
<td></td>
<td></td>
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</tbody>
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SAE Bolt Designations: Head Marking_01.

SAE Bolt Designations: Head Marking_02.
FIGURE 1.13 Nuts come in a variety of styles, including locking (prevailing torque) types, such as the distorted thread and nylon insert type.

FIGURE 1.14 Washers come in a variety of styles, including flat and star (serrated), and are often used to help prevent a fastener from loosening.
FIGURE 1.15 A wrench after it has been forged but before the flashing (extra material around the wrench) has been removed.

FIGURE 1.16 A typical open-end wrench. Note the size difference on each end and that the head is angled 15 degrees at the end.

FIGURE 1.17 The end of a box-end wrench is angled 15 degrees to allow clearance for nearby objects or other fasteners.
FIGURE 1.18 A combination wrench has an open end at one end and a box end at the other end.

FIGURE 1.19 An adjustable wrench. Adjustable wrenches are sized by the overall length of the wrench, not by how far the jaws open. Common sizes of adjustable wrenches include 8, 10, and 12 inch.

FIGURE 1.20 The end of a typical line wrench, which shows that it is capable of grasping most of the head of the fitting.
A typical ratchet used to rotate a socket. A ratchet makes a ratcheting noise when it is being rotated in the opposite direction from loosening or tightening.

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.

The most commonly used socket drive sizes include 1/4, 3/8, and 1/2 inch drives.
FIGURE 1.24 A 6-point socket fits the head of a bolt or nut on all sides. A 12-point socket can round off the head of a bolt or nut if great force is applied.

FIGURE 1.25 Allows access to the nut that has a stud plus other locations needing great depth, such as spark plugs.

FIGURE 1.26 Using a torque wrench to tighten connecting rod nuts on an engine.
FIGURE 1.27 A beam-type torque wrench that displays the torque reading on the face of the dial. The beam display is read as the beam deflects, which is in proportion to the amount of torque applied to the fastener.

FIGURE 1.28 Torque wrench calibration checker.

FIGURE 1.29 A flat-tip (straight-blade) screwdriver. The width of the blade should match the width of the slot in the fastener being loosened or tightened.
FIGURE 1.30 Two stubby screwdrivers 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 1.31 An offset screwdriver is used to install or remove fasteners that do not have enough space above to use a conventional screwdriver.

FIGURE 1.32 An impact screwdriver used to remove slotted or Phillips head fasteners that cannot be broken loose using a standard screwdriver.
FIGURE 1.33 A typical ball-peen hammer.

FIGURE 1.34 A rubber mallet used to deliver a force to an object without harming the surface.

FIGURE 1.35 A dead-blow hammer that was left outside in freezing weather. The plastic covering was damaged, which destroyed this hammer. The lead shot is encased in the metal housing and then covered.
FIGURE 1.36 Typical slip-joint pliers are common household pliers. The slip joint allows the jaws to be opened to two different settings.

SLIP JOINT

SMALLER

LARGER

FIGURE 1.37 Multigroove adjustable pliers are known by many names, including the trade name Channel Locks®.

MULTIPLE GROOVES FOR JAW WIDTH ADJUSTMENT

FIGURE 1.38 Linesman’s pliers are very useful because they can help perform many automotive service jobs.

FLAT GRIP

PIPE GRIP

SIDE CUTTERS

JOINT CUTTERS

GRIPS SMALL OBJECTS

CUTS SOFT WIRE
FIGURE 1.39 Diagonal pliers are another common tool that has many names.

FIGURE 1.40 Needle-nose pliers are used where there is limited access to a wire or pin that needs to be installed or removed.

FIGURE 1.41 Locking pliers are best known by the trade name Vise-Grip®.
FIGURE 1.42 Snap-ring pliers are also called lock-ring pliers, and they are designed to remove internal and external snap rings (lock rings).

FIGURE 1.43 Files come in many different shapes and sizes. Never use a file without a handle.

FIGURE 1.44 Tin snips are used to cut thin sheets of metal or carpet.
FIGURE 1.45 A utility knife uses replaceable blades and can cut carpet and other materials.

![Utility Knife Image]

FIGURE 1.46 A punch is used to drive pins from assembled components. This type of punch is also called a pin punch.

![Punch Image]

FIGURE 1.47 Warning stamped on the side of a punch that goggles should be worn when using this tool. Always follow safety warnings.

![Warning Image]
FIGURE 1.48 Use a grinder or a file to remove the mushroom material on the end of a punch or chisel.

![Diagram showing the correct (CHAMFER) and incorrect (MUSHROOM) use of tools.]

FIGURE 1.49 A typical hacksaw that is used to cut metal. If cutting sheet metal or thin objects, then use a blade with more teeth.

![Diagram of a hacksaw with a replaceable blade.]

FIGURE 1.50 A typical beginning technician tool set that includes the basic tools to get started.
FIGURE 1.51 A typical large tool box, showing just one of many drawers.

FIGURE 1.52 A typical 12 volt test light.

FIGURE 1.53 Electric and butane-powered soldering guns used to make electrical repairs. Soldering guns are sold by the wattage rating: The higher the wattage, the greater the amount of heat created.
FIGURE 1.54 A fluorescent trouble light operates cooler and is safer to use in the shop because it is protected against accidental breakage where gasoline or other flammable liquids would happen to come in contact with the light.

FIGURE 1.55 A typical 1/2 inch drive air impact wrench. The direction of rotation can be changed to loosen or tighten a fastener.

FIGURE 1.56 A typical battery-powered 3/8 inch drive impact wrench.
FIGURE 1.57 A black impact socket. Always use an impact-type socket whenever using an impact wrench to avoid the possibility of shattering the socket, which could cause personal injury.

FIGURE 1.58 An air ratchet is a very useful tool that allows fast removal and installation of fasteners, especially in areas that are difficult to reach or do not have room enough to move a hand ratchet or wrench.

FIGURE 1.59 This typical die grinder surface preparation kit includes the air-operated die grinder and a variety of sanding disks for smoothing surfaces or removing rust.
FIGURE 1.60 A typical pedestal grinder with a wire wheel on the left side and a stone wheel on the right side. Even though this machine is equipped with guards, safety glasses or a face shield should always be worn whenever using a grinder or wire wheel.

FIGURE 1.61 Safety glasses should be worn at all times when working on or around any vehicle or servicing any components.

FIGURE 1.62 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 1.63 One version of a bump cap is a molded plastic insert worn inside a regular cloth cap.

FIGURE 1.64 Protective gloves are available in several sizes and materials.

FIGURE 1.65 Remove all jewelry before performing service work on any vehicle.
FIGURE 1.66 Always connect an exhaust hose to the tailpipe of a vehicle to be run inside a building.

FIGURE 1.67 A binder clip keeps a fender cover from falling off.

FIGURE 1.68 Covering the interior as soon as the vehicle comes in for service helps improve customer satisfaction.
FIGURE 1.69 All oily shop cloths should be stored in a metal container equipped with a lid to help prevent spontaneous combustion.

FIGURE 1.70 Most newer vehicles have a triangle symbol indicating the recommended hoisting lift location.

FIGURE 1.71A Tall safety stands can be used to provide additional support for the vehicle while on the hoist.
FIGURE 1.71B A block of wood should be used to avoid the possibility of doing damage to components supported by the stand.

FIGURE 1.72 This training vehicle fell from the hoist because the pads were not set correctly. No one was hurt, but the vehicle was damaged.

FIGURE 1.73A An assortment of hoist pad adaptors that are often needed to safely hoist many pickup trucks, vans, and sport utility vehicles (SUVs).
FIGURE 1.73B 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.

FIGURE 1.74A The pad arm is just contacting the rocker panel of the vehicle.

FIGURE 1.74B The pad arm has dented the rocker panel on this vehicle because the pad was set too far inward underneath the vehicle.
FIGURE 1.75A A typical 3 ton (6,000 lb) capacity hydraulic jack.

FIGURE 1.75B Whenever a vehicle is raised off the ground, a safety stand should be placed under the frame, axle, or body to support the weight of the vehicle.

FIGURE 1.76 Drive-on ramps are dangerous to use. The wheels on the ground level must be chocked (blocked) to prevent accidental movement down the ramp.
FIGURE 1.77 Jumper cable usage guide. Follow the same connections if using a portable jump box.

FIGURE 1.78 The air pressure going to the nozzle should be reduced to 30 psi or less to help prevent personal injury.

FIGURE 1.79 A typical fire extinguisher designed to be used on class A, B, or C fires.
FIGURE 1.80 A CO₂ fire extinguisher being used on a fire set in an open drum during a demonstration at a fire training center.

FIGURE 1.81 A treated wool blanket is kept in an easy-to-open, wall-mounted holder and should be placed in a central location in the shop.

FIGURE 1.82 A first aid box should be centrally located in the shop and kept stocked with the recommended supplies.
FIGURE 1.83 A typical eye wash station. A thorough flushing of the eyes with water is the first and often the best treatment in the event of eye contamination.

FIGURE 1.84 A warning label on a Honda hybrid warns that a person can be killed due to the high-voltage circuits under the cover.

FIGURE 1.85 The high-voltage disconnect switch is in the trunk area on a Toyota Prius. High-voltage lineman's gloves should be worn when removing this plug.
FIGURE 1.86 The high-voltage shut-off switch on a Ford Escape hybrid. The switch is located under the carpet at the rear of the vehicle.

FIGURE 1.87 The shut-off switch on a GM parallel hybrid truck is green because this system uses 42 volts instead of higher, and possible fatal, voltages used in other hybrid vehicles.

The first step in hoisting a vehicle is to properly align the vehicle in the center of the stall.
Most vehicles will be correctly positioned when the left front tire is centered on the tire pad.

The arms can be moved in and out and most pads can be rotated to allow for many different types of vehicle construction.

Most lifts are equipped with short pad extensions that are often necessary to use to allow the pad to contact the frame of a vehicle without causing the arm of the lift to hit and damage parts of the body.
Tall pad extensions can also be used to gain access to the frame of a vehicle. This position is needed to safely hoist many pickup trucks, vans, and sport utility vehicles.

An additional extension may be necessary to hoist a truck or van equipped with running boards to give the necessary clearance.

Position the pads under the vehicle at the recommended locations.
After being sure all pads are correctly positioned, use the electromechanical controls to raise the vehicle.

With the vehicle raised one foot (30 cm) off the ground, push down on the vehicle to check if it is stable on the pads. If the vehicle rocks, lower it and reset the pads. The vehicle can be raised to any desired working level. Be sure the safety is engaged before working on or under the vehicle.

If raising a vehicle without a frame, place the flat pads under the pinch weld seam to spread the load. If additional clearance is necessary, the pads can be raised as shown.
When the service work is completed, the hoist should be raised slightly and the safety released before using the hydraulic lever to lower the vehicle.

After lowering the vehicle, be sure all arms of the lift are moved out of the way before driving the vehicle out of the work stall.