Before service begins, be sure to cover the seats, floor, and steering wheel with protective coverings.

An exhaust system hose should be connected to the tailpipe(s) whenever the engine is being run indoors.
TECH TIP: Do No Harm

As stated in the Hippocratic oath, a doctor agrees first to do no harm to the patient during treatment. Service technicians should also try to do no harm to the vehicle while it is being serviced.

Always ask, "Am I going to do any harm if I do this?" before you do it.

Figure 17-3 Installing a wiper blade insert into a wiper arm.

Figure 17-4 (a) The windshield wiper fluid reservoir cap is usually labeled with a symbol showing a windshield wiper.
Figure 17-4 (b) Use only the recommended washer fluid. Never use antifreeze in the windshield washer reservoir.

Figure 17-5 A cabin filter can be accessed either through the glove compartment or under the hood on most vehicles.

WARNING: Windshield washer fluid usually contains methanol, a poisonous chemical that can cause blindness if ingested.
Figure 17-6 (a)  A typical dirty air filter.

Figure 17-6 (b)  Always check the inlet passage leading to the air filter for debris that can reduce airflow to the engine.

Figure 17-7  A master cylinder with a transparent reservoir. The brake fluid level should be between the MAX and the MIN levels as marked on the reservoir.
Figure 17-8  DOT 3 brake fluid. Always use fluid from a sealed container because brake fluid absorbs moisture from the air.

Figure 17-9  Brake fluid test strips are a convenient and easy-to-use method to determine if the brake fluid needs to be replaced.

FREQUENTLY ASKED QUESTION:
What Is Used in the Clutch Master Cylinder?

Vehicles equipped with a manual transmission often use a hydraulically operated clutch. This type of clutch operation uses a master cylinder and a slave cylinder near the clutch assembly. When the driver depresses the clutch pedal, the hydraulic pressure created in the master cylinder is transferred to the slave cylinder which moves and actuates the clutch. Most hydraulic clutches use DOT 3 brake fluid. Check to see that the level is between the maximum and the minimum levels as shown by lines on the reservoir. If low, check for a leak in the system as it is not normal for brake fluid level to decrease over time.
Figure 17-10  A typical oil level indicator (dipstick).

Figure 17-11  The oil level should be between the MAX and the MIN marks when the vehicle is on level ground and the oil has had time to drain into the oil pan.

FREQUENTLY ASKED QUESTION

Can I Switch from Synthetic Oil to Regular Oil?

Yes. All oil is miscible, meaning that it can be readily mixed. Therefore, synthetic oil can be used one time and then regular mineral oil used the next time. Most important, however, is that the oil be changed at intervals that are never longer than specified by the vehicle manufacturer.
### Chart 17-1

The difference between normal and severe use as specified by many vehicle manufacturers:

<table>
<thead>
<tr>
<th>Normal Use</th>
<th>Severe Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Most trips over 10 miles (16 km).</td>
<td>Most trips under 10 miles (16 km).</td>
</tr>
<tr>
<td>Operating at a low RPM, when the vehicle is new or under 50,000 miles (80,000 km).</td>
<td>Operating at a high RPM, when the vehicle is over 50,000 miles (80,000 km).</td>
</tr>
<tr>
<td>Most trips do not include idle or stop-and-go driving.</td>
<td>Most trips do include idle or stop-and-go driving.</td>
</tr>
<tr>
<td>No drastic changes in atmospheric conditions.</td>
<td>No excessive heat or cold.</td>
</tr>
<tr>
<td>The air charge-injected refrigerant is not being used.</td>
<td>The air charge-injected refrigerant is being used.</td>
</tr>
<tr>
<td>Normal operation.</td>
<td>Normal operation.</td>
</tr>
</tbody>
</table>

### FREQUENTLY ASKED QUESTION:

**How Does an Oil Life Monitor Work?**

While some vehicle manufacturers, such as Mercedes, use a sensor to measure oil temperature and acidity, most vehicle oil change monitors function three ways:

1. **Vehicle mileage.** This is the most commonly used vehicle service monitoring system. When a certain number of miles has occurred since it was reset, the control (usually the powertrain control module (PCM)) will turn on a dash light that states maintenance is required.

2. **Oil life computer program.** A computer program called an algorithm, or a series of mathematical calculations, is used to determine the life of the engine oil. For example, when the oil change warning light is reset, the oil life is reset to 100%. Then the PCM tracks the number of engine starts, the outside temperature, when the engine was started (based on intake air temperature (IAT) sensor input), and the number of miles traveled. Because long drives are easier on engine oil than short stop-and-go driving, the PCM deducts miles faster during this condition.

3. **Oil condition sensor.** This sensor measures the dielectric properties of the oil, which change when exposed to water, soot, ash, and glycol in the oil. A computer program takes the information from the sensor about the changes of the dielectric property of the oil to determine when to light the change oil lamp.

### Figure 17-12

Visually check the level and color of coolant in the coolant recovery or surge tank.
FREQUENTLY ASKED QUESTION

What Is the Magnuson-Moss Act?
The Magnuson-Moss Act, passed into law in 1975, allows the use of non–original equipment replacement parts during the service or repair of a vehicle without losing the factory warranty. This means that any oil filter, spark plug, or other service part can be used unless the vehicle manufacturer furnishes these parts for free during the warranty period.

The vehicle manufacturer cannot deny paying a warranty claim for a fault unless the replacement part is proved to be the cause of the condition needed to be covered by the warranty. Therefore, it is up to the business owner, service manager, or technician to determine if the replacement part is of good quality. While this is very difficult or impossible, unless defects are obviously visible, the best solution is to use the original equipment manufacturer (OEM) parts or service parts from a well-known company.

WARNING:
Remove the pressure cap only on a cold engine as the coolant will boil when pressure is released. This occurs because the coolant temperature is above the boiling point but it does not boil due to the pressure. When the pressure is released, all of the hot coolant immediately boils and expands outward from the opening where the cap was installed. The resulting geyser of boiling hot coolant can cause severe burns or even death.

WARNING:
The coolant level should only be checked when the engine is cool. Removing the pressure cap from a hot engine will release the cooling system pressure when the coolant temperature is above its atmospheric boiling temperature. When the cap is removed, the pressure will instantly drop to atmospheric pressure level, causing the coolant to boil immediately. Vapors from the boiling liquid will blow coolant from the system. Coolant will be lost, and a person may be injured or burned by the high-temperature coolant that is blown out of the filler opening.
Figure 17-13 (a) A refractometer is used to measure the freezing point of coolant. A drop of coolant is placed on a viewing screen, the lid is closed, and then held up to the light to view the reading on the scale.

Figure 17-13 (b) The use of test strips is a convenient and cost-effective method to check coolant condition and freezing temperature.

Figure 17-14 Used coolant should be stored in a leak-proof container until it can be recycled or disposed of according to local, state, or federal laws.ograph the draining barrel is placed inside another container to catch any coolant that may spew out of the inside container.
Figure 17-15  Using a hand-operated pressure tester. Do not exceed the pressure rating of the radiator cap when pressurizing the system. This vehicle had a leaking upper radiator that only leaked when the system was pressurized.

Figure 17-16  Hose clamps come in a variety of shapes and designs.

TECH TIP: The Cut-and-Peel Trick
It is often difficult to remove a radiator or heater hose from the fittings on the radiator or heater core. To avoid possible damage to expensive radiator or heater cores, do not pull or twist the hose to remove it. Simply use a utility knife and slit the hose lengthwise and then use your finger to peel the hose off of the radiator or heater core. Although this procedure will not work if the hose is to be reused, it is a real time saver when it comes to replacing old hoses. Sometimes using an angled pick that is dull at the end will do a good job breaking the hose free.
Figure 17-17: A typical automatic transmission dipstick.

Figure 17-18: Most vehicles use a combination filler cap and level indicator (dipstick) that shows the level of power steering fluid in the reservoir.

TECH TIP: The Paper Towel Test

New ATF will penetrate a paper towel better than used oxidized ATF. To compare old fluid with new, place three drops of new fluid on a paper towel and three drops of used ATF on the paper towel about 3 inches from the first sample. Wait for 30 minutes. The new ATF will have expanded (penetrated through the paper towel) much farther than the old, oxidized fluid. This test can be used to convince a customer that the ATF should be changed according to the vehicle manufacturer's recommended interval even though, to the naked eye, the fluid looks okay.
A special tool is useful when installing a new accessory drive belt. The long-handled wrench fits in a hole of the belt tensioner.

A typical worn serpentine accessory drive belt. Newer belts made from ethylene propylene diene monomer (EPDM) do not crack like older belts that were made from nitrile rubber.

A belt tension gauge displays the belt tension in pounds of force.
Figure 17-22. A spring-loaded accessory drive belt tensioner.

Figure 17-23. The specified tire inflation pressure is printed on a placard on the driver’s door or doorpost. This information may also be located in the glove compartment, the owner’s manual, and in service information.

**TECH TIP:** The Water Spray Trick

Lower-than-normal alternator output could be the result of a loose or slipping drive belt. All belts (V and serpentine multigroove) use an interference angle between the angle of the Vs of the belt and the angle of the Vs on the pulley. Over time this interference angle is worn off the edges of the Vs of the belt. As a result, the belt may start to slip and make a squealing sound even if tensioned properly.

A fast method to determine if the noise is from the belt is to spray water from a squirt bottle at the belt with the engine running. If the noise stops, the belt is the cause of the noise. The water quickly evaporates; therefore, water simply finds the problem, it does not provide a short-term fix.
Figure 17-24 An electronic tire pressure gauge is usually more accurate than a mechanical pencil type and more likely to provide consistent pressure readings. Do not allow air to escape when testing or the reading will not be accurate.

Figure 17-25 The method most often recommended is the modified X method. Using this method, each tire eventually is used at each of the four wheel locations. An easy way to remember the sequence, whether front-wheel drive or rear-wheel drive, is: 'Three wheels straight, cross the fourth wheel.'

TECH TIP: Two Quick Checks

If the vehicle is hoisted on a frame-contact lift, perform two quick checks:
1. Spin each tire to check that the brakes are not dragging. You should be able to turn all four wheels by hand if the parking brake is off and the transmission is in neutral.
2. When spinning the tire, look over the top of the tire to check if it is round. An improperly mounted tire or a tire that is out-of-round due to a fault in the tire can be detected by watching for the outside of the tire to move up and down as it is being rotated.
Figure 17-26 (a) A torque absorbing adaptor commonly called a “torque stick” is being used to tighten lug nuts. The adapter should not be held during the tightening process because the cold effect the torque will have and could cause personal injury or the torque will decrease.

Figure 17-26 (b) A color-coded assortment of torque sticks.

TECH TIP: Check for Wheel Lock Key

Many vehicles have wheel locks that require a special key to remove. The wise technician should always ask the customer or service writer about wheel locks before pulling the vehicle into the shop or before the vehicle is hoisted.
REAL WORLD FIX: Waiting for the Second Click Story

A student service technician was observed applying a lot of force to a click-type torque wrench attached to a wheel lug nut. When the instructor asked what he was doing, the student replied that he was turning the lug nut tighter until he heard a second click from the torque wrench.

As he was explaining this to the instructor, the student explained that he had heard a second click during the demonstration. The instructor realized that the student had heard a click when the proper torque was achieved, plus another click when the force on the torque wrench was released.

No harm occurred to the vehicle because all of the lug nuts were reinstalled and properly torqued. The instructor learned that a more complete explanation for the use of click-type torque wrenches was needed.

Figure 17-28
Most vehicle manufacturers recommend the use of grease meeting the NLGI #2 classification for wheel bearings and LB for chassis lubrication. Many greases have both designations and therefore can be used for either application.
**TECH TIP: Watch Out for Vents that Look Like Grease Fittings**

Watch for what looks like a grease (Zerk) fitting but is somewhat smaller, as this may be a vent such as found on a late-model Dodge Caravan on the ball joints. If the grease gun does not fit on it, do not be tempted to remove and replace with a grease fitting.

---

**Figure 17-29** This differential assembly has been leaking fluid. The root cause should be determined and the unit filled to the proper level using the specified lubricant, to help prevent early failure and an expensive repair later.

---

**TECH TIP: Check the Fill Plug Before Draining a Transmission**

Experienced technicians have learned that it is wise to check that the fill plug can be removed before draining the manual transmission or transfer case through the drain plug. If the fill plug cannot be removed, then the fluid should not be drained until the problem is resolved. Once the fluid has been drained, there is no option but to do whatever it takes to get the fill plug open. This process is often difficult and may result in having to replace the entire assembly. **SEE FIGURE 17-30.**
Figure 17-30 Always ensure that the fill plug can be accessed and removed before draining the fluid from a manual transmission.

Figure 17-31 A broken coil spring was found during an under-vehicle inspection. The owner was not aware of a problem and it did not make any noise, but the vehicle stability was affected.

Figure 17-32 This corroded muffler was found during a visual inspection, but was not detected by the driver because it was relatively quiet.