**Chapter 13**

**Vehicle Maintenance and Inspection**

**Learning Objectives**

After studying this chapter, you should be able to:

* **13-1** Perform in-vehicle inspection.
* **13-2** Perform fluid inspection.
* **13-3** Perform belt, hose, and air filter/cabin air filter inspection.
* **13-4** Perform under-vehicle inspection.
* **13-5** Perform exterior vehicle inspection.

**Readings and Preparation**

* Review all instructional materials, including the chapter in *Fundamentals of Automotive Technology: Principles and Practice, Third Edition*, and all related presentation support materials.

**Support Materials**

* Lecture PowerPoint presentation
* Demos and exercises
* Review questions

**Pre-Lecture**

* You Are the Automotive Technician
	+ A progressive case study that encourages critical-thinking skills.
	+ Direct students to read the “You Are the Automotive Technician” scenario found at the beginning of each chapter.
	+ Group activity: Direct students to review the discussion questions at the end of the scenario and prepare a response to each question. Facilitate a class discussion centered on the questions.
	+ Homework assignment: Ask students to turn in their comments on the questions.
* Teaching Tip: Explain to students how this material applies to the workplace. Provide an example of a situation to make it relevant and meaningful. How does it fit into the broader picture? Is it building on something they already know? Students need to know that the automotive industry has a variety of jobs for almost every interest. They also need to know the requirements of each type of job. Plus they need to know the most likely paths to pursue to end up with their desired career. Real-world examples of this information will help them engage with the content.

**Lecture**

# **Introduction**

* Regular inspection and maintenance allows for safe and reliable operation of the vehicle.
* The common types of inspection are basic inspection, in-depth inspection, state safety inspection, certified used car inspection, and vehicle prepurchase inspection.
* Most shops use either paper or electronic forms to document the inspection process.
* *Cherry Inspect* (www.drivecherry.com) is an electronic inspection system that can be 40% more efficient than paper inspection forms.
	+ The technician can include notes and pictures as evidence for their decisions.
* Technicians need to be accurate and detailed when performing an inspection and follow the manufacturers’ procedures and specifications.

# **13-1 Perform in-vehicle inspection.**

* Many drivers overlook in-vehicle concerns or ignore them.
	+ When driving a vehicle into the service bay, check the instrument cluster and warning lights and note how the pedals feel and the engine sounds.
	+ If the malfunction indicator lamp (MIL) is illuminated, you will need to check for any diagnostic trouble codes (DTCs) with a scan tool.
* Any changes to the resistance of the brake pedal can indicate a problem; if the pedal is low or hard, do *not* drive the vehicle.
	+ Listen for unusual brake noises like high-pitched scrapes or grinding sounds.
* The service/parking brake holds the vehicle in position when it is parked; check the parking brake during routine inspections.
	+ Apply the brake and observe how far the vehicle travels; going all the way or near its stop means the brake needs further attention.
	+ In below-freezing temperatures, the parking brake cable can freeze in the applied position; it is best not to test the parking brake in this situation.
* Instrument panel warning lamps indicate faults with various systems.
	+ The appropriate warning lamp will be illuminated when a fault is detected.
	+ Observe the lights when starting the vehicle—the MILs often turn on briefly while the warning system checks for any problems, and then turn off.
	+ The on-board diagnostics generation II (OBD-II) does the same; if no DTCs are stored, the light will go off within a few seconds of starting the vehicle.
* **Skill Drill 13-1 Checking Instrument Panel Warning Lamps**
* The OBD-II system tests and analyzes the engine’s systems while the vehicle is being operated and will set and store a DTC if it detects a fault.
	+ During an in-vehicle inspection, retrieve DTCs if any MILs are illuminated to retrieve the code that will help you diagnose any faults.
* **Skill Drill 13-2 Retrieving and Recording DTCs**
* The vehicle’s horn is operated by a relay or by the vehicle body control module (BCM) and is located in the front of the vehicle, behind the grill or bumper.
	+ In cars with two horns, one has a lower pitch than the other.
	+ Check the horn quickly before driving the vehicle into the shop.
* **Skill Drill 13-3 Performing a Horn Check**
* A vehicle’s interior lights include the courtesy lights, dome lights, vanity lights, and map lights.
	+ Use of the key or opening the driver’s door should activate the courtesy and dome lights; dome lights can also be switched on with the door closed.
	+ Vanity lights are usually on the back of a visor and have a switch.
	+ Map lights usually turn on automatically when they are moved into a position in which they can be used.
* **Skill Drill 13-4 Checking the Interior Lights**

# **13-2 Perform fluid inspection.**

* Underhood inspection should be performed at the manufacturer’s recommended intervals and prior to a long driving trip.
	+ A thorough check of the underhood systems for low fluid level or torn belt can prevent many future problems.
* All vehicle fluids must be at the right level; use the manufacturer’s recommended type and amount.
	+ Nearly all the fluids in a vehicle get old and wear out, so replacement is necessary; the one exception is some automatic transmission/transaxle fluids.
	+ Different fluids show age differently.
* Low engine oil causes the oil pump to starve for oil, and too high results in the crankshaft churning the oil to foam; both cause a lack of lubrication that can result in damage throughout the engine.
	+ Check the level periodically using a dipstick when the vehicle is on a level surface with the engine off.
	+ Dipsticks typically have *full* and *add* marks or *min* and *max*, which differ depending on the vehicle.
	+ The difference between the add and full marks is usually 1 quart (0.9 L) but can reach 2 quarts (1.9 L).
	+ Pull the dipstick out and read it horizontally; check both sides; the lower level is usually the more accurate reading.
* To determine if it is time for an oil change, check the vehicle’s oil-life monitoring (OLM) system, which will indicate the remaining percentage of oil life.
	+ If a vehicle does not have an OLM, check the service information for the recommended mileage or time interval between changes.
* Even if the engine oil needs to be changed check the oil level with a dipstick.
	+ A low reading could mean there is a leak or that the engine is using oil; both situations require further investigation.
	+ Refer to Chapters 18 and 19 for more information on engine lubrication.
* Coolant level is critical to the transfer of excessive heat from the engine to the radiator.
	+ Check coolant level whenever you check engine oil.
	+ Some vehicles have a tank marked with hot and cold so you can check the coolant without removing the cap.
	+ Other vehicles have a transparent overflow tank so you can look at the fluid temperature levels.
	+ Older vehicles may require removing the radiator cap and confirming the coolant level is about 1.5″ (38.1 mm) below the filler neck.
* The coolant’s freeze point also needs to be checked.
	+ Insufficient antifreeze can lead to the coolant freezing, expanding, and cracking cooling system components.
	+ The freeze protection level can be measured with an antifreeze hydrometer or a refractometer.
* Most climates require a 50/50 mix of antifreeze and water.
	+ This can be converted to a ratio or percentage form—6 quarts (5.7 L) of distilled water and 6 quarts (5.7 L) of antifreeze would be a 1:1 ratio.
	+ In percentage form, this is 50% distilled water and 50% antifreeze.
* **Skill Drill 13-5 Using a Hydrometer to Measure the Freeze Protection Level of Antifreeze**
* **Skill Drill 13-6 Using a Refractometer to Measure the Freeze Protection Level of Coolant**
* The brake fluid should also be checked whenever the oil level is checked.
	+ The hygroscopic and hydraulic braking systems depend on it.
	+ Hygroscopic brake fluid absorbs water from atmosphere; it should be changed every two to four years.
	+ The condition is checked with a brake fluid tester or brake fluid test strips.
	+ Check the brake master cylinder reservoir or a separate fluid reservoir for the proper fluid level.
* Check power steering fluid in the fluid reservoir or separate container.
	+ The engine should be idling and the fluid should be hot.
	+ Check the level with a dipstick connected to the filler cap.
	+ Check the appearance; dark fluid color usually means it needs to be changed.
* If a vehicle’sautomatic transmission/transaxle fluid is too low, there can be slipping and shift timing faults; too high churns and aerates the fluid.
* The automatic transmission fluid is usually checked with a dipstick located under the hood, near the front of the transmission.
	+ Check with the engine running, transmission fully warmed, and the vehicle in PARK or NEUTRAL.
* **Skill Drill 13-7 Checking Automatic Transmission Fluid Using a Dipstick**
* Always use the specified type of transmission fluid when adding more.
	+ Use a funnel to add the fluid through the dipstick tube; add in small amounts.
* For vehicles that do not have dipsticks, follow the vehicle’s service information.
	+ Some vehicles have a fill plug (or level plug), on the side of the transmission.
* Some diesel-powered vehicles used diesel exhaust fluid (DEF), which helps reduce nitrogen oxides in the exhaust.
	+ DEF is consumed over time and thus must be replenished periodically.
	+ The filler cap is often located under the hood and is usually blue.
* Windshield washer fluid is important for the safety of the driver.
	+ The reservoir is usually under the hood; there may also be a separate rear reservoir for the rear window somewhere in the rear hatch or trunk.
	+ The fluid should be checked at each vehicle service.
* **Skill Drill 13-8 Checking and Refilling Windshield Washer Fluid**

# **13-3 Perform belt, hose, and air filter/cabin air filter inspection.**

* Engine drive belts operate engine accessories like the water pump and alternator; if any belts break or come off, the engine will quickly overheat.
* Always check the service information for belt replacement intervals.
	+ Some manufacturers recommend replacement at about five years.
	+ New belt technology includes *stretchy belts*, which can have a life of up to 150,000 miles (241,402 km).
* V-belts sit inside a V-shaped groove in the pulley and wedge in its sides.
* Serpentine-type belts have grooves running lengthwise that are the exact reverse of the grooves in the pulley’s outer diameter.
	+ Most vehicles with serpentine belts also recommend replacing the tensioner along with the belt.
* Visually inspect driver belts whenever you are under the hood.
	+ Check for cracks, oil soaking, glazing, tears, and bottoming out.
* A vehicle usually has two large radiator hoses (an upper hose and lower hose) and smaller heater hoses.
	+ When inspecting hoses, the engine should be cool.
	+ Touch the hoses to feel for consistent firmness; they should be neither too hard nor too soft.
	+ If the engine is hot, the firmness can be misleading; check for bulging in the hoses.
* Air filters protect engines from dust, grit, etc.
	+ Refer to the vehicle’s service information for the filter’s location.
	+ Check the air cleaner housing and ductwork for cracks or holes.
	+ Remove the filter and hold it up to a light; if no light comes through, it is clogged and needs to be replaced.
* **Skill Drill 13-9 Inspecting and Changing an Air Filter**
* Many vehicles now have cabin air filters as part of the HVAC system.
	+ These should be checked with every service and replaced according to the manufacturer’s recommended interval.
	+ Remove the filter and perform the light test as described with the engine air filter.

# **13-4 Perform under-vehicle inspection.**

* Under-vehicle inspections are important for spotting any problems with major systems.
	+ With the vehicle on a hoist, it is relatively easy to observe obvious problems such as tire issues, leaks, worn parts, and structural damage.
* Tires should be inspected for pressure, wear patterns, cuts, and tread depth.
	+ The air pressure should be checked every three months or at every oil change.
	+ Normal pressure varies by vehicle, so check the tire placard, and never overinflate the tires.
	+ Measure the tread depth of each tire in at last three places to ensure even wear in tread.
	+ Inspect the tire visually for any damage, and feel the tire for any bulges, being careful of any exposed steel cords.
* Tires usually have a useful life of 6 to 10 years.
	+ Check the DOT tire date code on the tire’s sidewall to determine its age.
	+ The first two digits represent the week it was manufactured and the last two digits represent the year it was manufactured.
* Refer to Chapter 41 for more information on tires.
* Technicians should also perform a preventative check on the manual transmission/transaxle/transfer case fluid.
	+ The fill plug is usually located under the vehicle, on the side of the transmission/transaxle.
	+ Remove the plug. If fluid comes out, the level is fine.
	+ If no fluid comes out, feel for the fluid level with your finger. Anything above 0.25″ (6 mm) from the bottom is fine, but anything lower requires adding fluid.
	+ Add the manufacturer’s recommended fluid until the fluid is even with the bottom of the fill hole.
* **Skill Drill 13-10 Checking the Fluid Level of a Manual Transmission/Transaxle**
* Checking and adjusting the differential/transfer case fluid level is similar in process to checking the transmission fluid, with some differences.
	+ Refer to the service information to verify the specifics of the vehicle.
	+ Differentials and transfer cases often do not have a drain plug, so specific bolts or covers may need to be removed.
* **Skill Drill 13-11 Checking and Adjusting the Differential Fluid Level**
* To be able to spot any fluid leaks, it is important to (a) clean the shop floor before driving a vehicle in and (b) become familiar with the characteristics of different fluids
	+ Brake fluid is slippery and has an acidic smell; it is clear or light amber for DOT 3 and DOT 4, but purple for DOT 5.
	+ Automatic transmission fluid is normally red, but may be clear or amber; it is slippery, oily, and has an oily smell.
	+ Power steering fluid is red if it uses automatic transmission fluid and clear if it uses power steering fluid.
	+ Coolant is normally green, orange, or yellow (but GM uses red); it is slippery and has a sweet, syrupy smell.
	+ Engine oil can be clear, brown, or black; it is very slippery, thick, and has an oily smell.
	+ Gear oil is light brown, very slippery, and has an oily smell.
	+ Gasoline is clear, evaporates easily, and is known for its distinct odor.
	+ Diesel is dirty clear, thin, and has an oily smell.
* Fluid leaks are best checked with the vehicle on a lift with the engine OFF.
	+ Use a flashlight to look for drips/wet spots, checking the top of the wet spot to locate the source of the leak.
	+ Remember that some leaks may send fluids onto other components.
	+ If no leaks are found, start the engine, wait a few minutes, and inspect again, keeping away from any hot or moving parts.
	+ If this does not work, shut down the engine and check again; some leaks happen a few minutes after the engine shuts down.
* **Skill Drill 13-12 Locating and Identifying Fluid Leaks**
* The steering system is best inspected with the vehicle on a lift.
	+ Perform a visual inspection for any wear or damage.
	+ Wiggle each wheel while someone else feels the steering joints for any play.
* The suspension system needs to be checked for any worn or torn parts; any tears or displacements in the dust boots; any leaks in the shock absorbers; any cracks or bulging in the brake hoses; any kinks or rust in the brake lines; and any excessive play in the wheel bearings.
* The drive axles and driveshafts need to be checked for any worn out joints; bent or damaged axles; cracked, torn, or leaking dust boots or CV joints; excessive movement, dents, or bends in the driveshaft; leaks around the differential; and any problems with the rear shock absorbers, leaf springs, brake hoses, and lines.
* When inspecting the engine, look for torn or cracked motor mounts, coolant hoses, and belts.
* When inspecting the transmission, look for torn or cracked mounts; faults or looseness in the clutch mechanism; and shift linkage.
* When inspecting the exhaust system, look for signs of leaks, corrosion, or deteriorations; check the condition of heat shields; and check the exhaust pipe’s integrity by squeezing it with arc joint pliers.
	+ If the exhaust pipe is squishy, it needs to be replaced.
* The parking brake should be checked for rusted, frozen, broken, or crushed cables.
* Fuel tank inspection should include checking the filler tube and hose; the vent and fuel delivery lines; the straps; and the protective shields.
	+ If you smell gasoline when inspecting the fuel tank, that means there is a leak that needs to be located.
* **Skill Drill 13-13 Performing an Under-Vehicle Inspection**

# **13-5 Perform exterior vehicle inspection.**

* Exterior vehicle inspections should be performed whenever a vehicle is in the shop.
	+ Work in a systematic manner and use an inspection sheet to avoid missing anything.
* **Skill Drill 13-14 Performing a Visual Inspection of the Vehicle’s Exterior**
* Shock absorbers are often tested when tires show unusual wear (they appear cupped).
	+ Shock absorber problems could result in a stiff or uneven ride.
	+ If the vehicle has adjustable shock absorbers, check that both sides are the same.
	+ Both modern and conventional shock absorbers are tested with a bounce test.
	+ Visually inspect the mounting points and look for any leaks.
* **Skill Drill 13-15 Checking Shock Absorbers**
* Exterior lights should be checked periodically for burnout.
	+ This includes headlights, taillights, turn signals, side markers, brake lights, license plate lights, and backing lights.
	+ On some vehicles, there are cornering lights, driving lights, or fog lights.
	+ Be sure to check all rear light bulbs.
* **Skill Drill 13-16 Checking the Exterior Lights**
* Wiper blades usually need to be replaced yearly; possibly more if the car is typically parked outdoors.
	+ Never operate the wipers when dry, and never bend the arms.
	+ To avoid a broken windshield during replacement, never let the arm slip. Place a folded fender cover on the windshield to protect it.
* **Skill Drill 13-17 Checking and Replacing the Windshield Wiper Blades**
* Also inspect the state of the windshield when checking wiper blades.
	+ Any scratches or pits can be fixed with polish.
	+ Small chips or cracks might be fixable with resin.
	+ Larger issues or unfixable small ones mean replacement is necessary.
* **Skill Drill 13-18 Inspecting the Windshield**

**Post-Lecture**

This section contains various student-centered end-of-chapter activities designed as enhancements to the instructor’s presentation. As time permits, these activities may be presented in class. They are also designed to be used as homework activities.

1. Direct students to read and individually answer the question sets located in the Wrap-Up section at the end of each chapter. Allow approximately 10–20 minutes for this part of the activity.
2. Facilitate a class review and discussion of the answers, allowing students to correct responses, as needed. Use the answers noted in the Answer Key to assist in building this review.
3. You may wish to ask students to complete this activity on their own and turn in their answers on a separate piece of paper.

**Review Questions**

This question set is designed to assist students in understanding the chapter content by asking knowledge-based comprehension questions.

1. Most shops use inspection forms when inspecting vehicles because:
2. they slow the technician down.
3. **they ensure a thorough and efficient inspection.**
4. they don’t have computers at the workstations.
5. they are required by insurance to complete them.
6. If the malfunction indicator lamp (MIL) is illuminated while the vehicle is being operated:
7. shut off the engine immediately.
8. try revving the engine to see if the lamp goes off.
9. **retrieve any diagnostic trouble codes (DTCs) with a scan tool.**
10. step on the brake pedal firmly for at least 10 seconds.
11. When checking engine oil, it is important that the engine level be:
12. **between the minimum and maximum lines.**
13. higher than the maximum line.
14. at least 0.25″ (6 mm) below the minimum line.
15. not touching the bottom of the dipstick.
16. What is the main reason that brake fluid needs to be changed periodically?
17. The boiling point becomes too high.
18. It becomes too thin (viscosity).
19. **It absorbs water (hygroscopic).**
20. It ruins the brake lining.
21. When checking a serpentine belt for bottoming out:
22. use a straight edge across the belt ridges and measure the depth of the grooves.
23. twist the belt 90 degrees and see if cracks appear in the ridges.
24. measure the width of the belt to see if it has stretched too far.
25. **use a small tool that should sit higher than the ridges in the belt.**
26. A good way to test the integrity of exhaust pipes is to:
27. heat it up with a propane torch.
28. **squeeze the pipe with arc joint pliers.**
29. use a pry bar to see if the pipe will bend.
30. fill it with water and see if any leaks out.
31. How should you inspect an air filter to see if it needs to be replaced?
32. Wash it in the sink and see how water flows through it.
33. Use an air nozzle to blow air through it.
34. **See if you can see light through it easily.**
35. Air filters cannot be inspected; just replace them.
36. All the following systems should be checked as part of an under-vehicle inspection EXCEPT:
37. the steering system.
38. the suspension system.
39. the exhaust system.
40. **the electrical system.**
41. All the following statements are true EXCEPT:
42. the wiper blades should be flexible and not torn.
43. the wiper blades should be checked as part of an exterior inspection.
44. **while checking, operate the wipers when they are dry.**
45. never bend the arms to make better contact with the windshield.
46. Which of these is normally reddish in color?
47. Engine oil
48. Brake fluid
49. **Automatic transmission fluid**
50. Gear lube

**ASE Technician A/Technician B-Style Questions**

This question set is designed to assist students in gaining a further understanding of and familiarity with ASE Technician A/Technician B questions.

1. Technician A says that very wet fluid on struts or shocks is typically normal. Technician B says that shock absorbers can be tested without a bounce test. Who is correct?
2. Technician A
3. **Technician B**
4. Both Technician A and Technician B
5. Neither Technician A nor Technician B
6. Technician A says that improper handling of a windshield wiper can lead to a broken windshield. Technician B says that when testing wipers, if they wipe cleanly, replace them anyway. Who is correct?
7. **Technician A**
8. Technician B
9. Both Technician A and Technician B
10. Neither Technician A nor Technician B
11. Two technicians are discussing steering system inspection. Technician A says to wiggle the front tires side to side while feeling for play in the joints. Technician B says that there may be excessive wear marks on the parts, indicating excessive movement. Who is correct?
12. Technician A
13. Technician B
14. **Both Technician A and Technician B**
15. Neither Technician A nor Technician B
16. Technician A says that when the engine is started, the amber antilock brake system (ABS) warning lamp should come on, stay on for a few seconds, and then go off, indicating a successfully completed preliminary self-check. Technician B says that if a fault is detected in the system, the warning lamp will blink five times. Who is correct?
17. **Technician A**
18. Technician B
19. Both Technician A and Technician B
20. Neither Technician A nor Technician B
21. Technician A says that coolant freeze protection can be measured with a hydrometer. Technician B says that coolant freeze protection can be measured with a refractometer. Who is correct?
22. Technician A
23. Technician B
24. **Both Technician A and Technician B**
25. Neither Technician A nor Technician B
26. Technician A says that operating the brake pedal can indicate a hydraulic brake problem. Technician B says that high-pitched scraping noises could indicate a worn brake lining. Who is correct?
27. Technician A
28. Technician B
29. **Both Technician A and Technician B**
30. Neither Technician A nor Technician B
31. Technician A says that the date code of the tire can be found on the tire sidewall. Technician B says that the vehicle’s recommended tire pressure can be found on the tire sidewall. Who is correct?
32. **Technician A**
33. Technician B
34. Both Technician A and Technician B
35. Neither Technician A nor Technician B
36. Technician A says that the air cabin filter can be inspected similar to an engine air filter. Technician B says that the cabin air filter should be changed about every four to five years. Who is correct?
37. **Technician A**
38. Technician B
39. Both Technician A and Technician B
40. Neither Technician A nor Technician B
41. Technician A says that stretch-fit belts use a spring-loaded tensioner to keep them tight. Technician B says that a bottomed-out belt can be fixed by tightening it. Who is correct?
42. Technician A
43. Technician B
44. Both Technician A and Technician B
45. **Neither Technician A nor Technician B**
46. Technician A says that diesel exhaust fluid helps control oxides of nitrogen. Technician B says that diesel exhaust fluid should be replenished during oil changes. Who is correct?
47. Technician A
48. Technician B
49. **Both Technician A and Technician B**
50. Neither Technician A nor Technician B

**Assignments**

* Review all materials from this chapter and be prepared for a chapter quiz to be administered (date to be determined by instructor).
* Direct students to read the next chapter in *Fundamentals of Automotive Technology: Principles and Practice, Third Edition*, as listed on your syllabus to prepare for the next class session.