Automotive Technology 6th Edition
Chapter 85 Evaporative Emission Control Systems
Opening Your Class

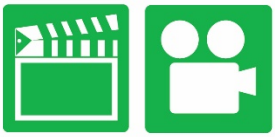
KEY ELEMENT	EXAMPLES
Introduce Content	This Automotive Technology 6th text provides complete coverage of automotive components, operation, design, and troubleshooting. It correlates material to task lists specified by ASE and ASEEducation (NATEF) and emphasizes a problem-solving approach. Chapter features include Tech Tips, Frequently Asked Questions, Case Studies, Videos, Animations, and ASEEducation (NATEF) Task Sheets.
Motivate Learners	Explain how the knowledge of how something works translates into the ability to use that knowledge to figure why the engine does not work correctly and how this saves diagnosis time, which translates into more money.
State the learning objectives for the chapter or course you are about to cover and explain this is what they should be able to do as a result of attending this session or class.	Explain learning objectives to students as listed below: 1. Explain the operation of an evaporative emission control system and compare enhanced and non-enhanced evaporative control (EVAP) systems. 2. Discuss leak detection pump systems and onboard refueling vapor recovery, and explain how to diagnose the EVAP system. 3. Discuss the functions of an evaporative system monitor and interpret the EVAP diagnostic trouble codes
Establish the Mood or Climate	Provide a ***WELCOME,*** Avoid put downs and bad jokes.
Complete Essentials	Restrooms, breaks, registration, tests, etc.
Clarify and Establish Knowledge Base	Do a round robin of the class by going around the room and having each student give their backgrounds, years of experience, family, hobbies, career goals, or anything they want to share.

NOTE: Lesson plan is based on 6th Edition Chapter Images found on Jim's web site @ www.jameshalderman.com

DOWNLOAD Chapter 85 Chapter Images: From

http://www.jameshalderman.com/automotive_principles.html

NOTE: You can use Chapter Images or possibly Power Point files:

ICONS	Ch85 Evaporative Emission Control Systems
	**1. SLIDE 1 CH85 EVAPORATIVE EMISSION CONTROL SYSTEMS**
	**Check for ADDITIONAL VIDEOS & ANIMATIONS @ http://www.jameshalderman.com/** **WEB SITE IS CONSTANTLY UPDATED** **http://www.jameshalderman.com/automotive_principles.html** **DOWNLOAD** **Crossword Puzzle (Microsoft Word) (PDF)** **Word Search Puzzle (Microsoft Word) (PDF**
	**Videos**
	**Evaporative Emission Control System (View) (Download)**
	**DEMONSTRATION: Show students basic evaporative emissions system components. Make sure students can identify components & their functions**
	**2. SLIDE 2 EXPLAIN Figure 85-1** Capless system from a Ford Flex does not use a replaceable cap; instead, it is spring-loaded closed. **3. SLIDE 3 EXPLAIN Figure 85-2** A charcoal canister can be located under the hood or underneath the vehicle. **4. SLIDE 4 EXPLAIN FIGURE 85–3** EVAP system includes all of lines, hoses, and valves, plus charcoal canister.
	**DISCUSS CHART 85-1 Pressure conversions.**
	**DISCUSS FREQUENTLY ASKED QUESTION: When Filling My Fuel Tank, Why Should I Stop When the Pump Clicks Off? Every fuel tank has an upper volume chamber that allows for expansion of fuel when hot. The volume of chamber is between 10% and 20% of volume of**

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   	**tank. For example, if a fuel tank has a capacity of 20 gallons, expansion chamber volume is from 2 to 4 gallons. A hose is attached at top of the chamber and vented to charcoal canister. If extra fuel is forced into this expansion volume, liquid gasoline can be drawn into charcoal canister. This liquid fuel can saturate canister and create an overly rich air-fuel mixture when canister purge valve is opened during normal vehicle operation. This extra-rich air-fuel mixture can cause vehicle to fail an exhaust emissions test, reduce fuel economy, and possibly damage the catalytic converter. To avoid problems, simply add fuel to next dime's worth after the nozzle clicks off. This ensures that the tank is full, yet not overfilled.** **DISCUSS CASE STUDY:** **DISCUSSION: describe main functions of the evaporative system & potential problems. What is system designed to do with fuel vapors (HC)? What are potential problems with system?** **5. SLIDE 5 EXPLAIN Figure 85-4** A typical EVAP system. Note that when the computer turns on the canister purge solenoid valve, manifold vacuum draws any stored vapors from the canister into the engine. Manifold vacuum also is applied to the pressure control valve. When this valve opens, fumes from the fuel tank are drawn into the charcoal canister and eventually into the engine. When the solenoid valve is turned off (or the engine stops and there is no manifold vacuum), pressure control valve is spring-loaded shut to keep vapors inside the fuel tank from escaping to atmosphere. **DEMONSTRATION: Pass around examples of evaporative purge & vent solenoids. Show how to locate purge and vent solenoids on a vehicle using electrical component locator. FIGURE 85-4**

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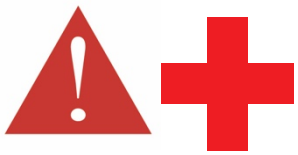
	**HANDS-ON TASK: STUDENTS** Cut open a used evaporative canister to show the students what activated charcoal granules look like.
	**SAFETY** Remind the students of **extreme fire hazard** of working around & servicing evaporative emission system on a vehicle. **Fuel vapors are extremely explosive.**
	**DISCUSSION:** Have the students talk about **fuel evaporation rates.** What factors (e.g., alcohol content, temperature, atmospheric pressure, etc.) influence fuel evaporation rates?
	**DEMONSTRATION:** Show how to use an **alcohol test kit** to obtain a sample of fuel from a vehicle & test for alcohol content.
	6. **SLIDE 6 EXPLAIN Figure 85-5** enhanced EVAP system is able to perform system & leak diagnosis.
	**DEMONSTRATION:** Show the students how to use a vehicle underhood ECS label & wiring diagram and/or vacuum diagram to determine whether the vehicle has an enhanced or non-enhanced system. **FIGURES 85-4 & 5**
	**HANDS-ON TASK:** Ask the students to identify and locate purge solenoid & evaporative canisters on their own cars using OEM service information.
	**Students can easily remember rest position of both purge & vent solenoids (normally closed & normally open, respectively) by using analogy of a home's front & back doors. Front door is usually closed, whereas back door is frequently left open.**
	**Explain to the students how vent solenoids can be tested using jumper wires and a 12 V source to allow system testing. Remember, the vent solenoid is normally open and**

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	should be energized for only short periods (5 minutes or less) to prevent damage.
	7. **SLIDE 7 EXPLAIN Figure 85-6** leak detection pump (LDP) used on some Chrysler and other vehicles to pressurize (slightly) the fuel system to check for leaks
	**DEMONSTRATION: Pass around various leak detection pumps. Show location of the pump on vehicle. FIGURE 85-6**
	**DISCUSSION: Have the students talk about leak detection pump systems. What other possible methods might manufacturers use to leak test an evaporative system without using a pump?**
	**EXPLAIN TECH TIP: *Problems after Refueling?* Check the Purge Valve: Purge valve is normally closed and open only when PCM is commanding system to purge. If purge solenoid becomes stuck in open position, gasoline fumes are allowed to flow directly from gas tank to intake manifold. When refueling, this results in a lot of fumes being forced into intake manifold and, as a result, causes a hard-to-start condition after refueling. This also results in a rich exhaust, and likely black exhaust, when first starting the engine after refueling. While purge solenoid is usually located under the hood of most vehicles and is less subject to rust and corrosion, as with vent valve, it can still fail.**
	**DEMONSTRATION: Using small drill bits for automatic transmission service, drill two .020" & 0.040" holes in a small aluminum plate. Have students observe drilled plate so they can visualize size of leak that an enhanced system must detect.**
	**53. SLIDE 53 ONBOARD REFUELING VAPOR RECOVERY**
	8. **SLIDE 8 EXPLAIN Figure 85-7** restricted fuel fill pipe shown on vehicle with the interior removed
	9. **SLIDE 9 EXPLAIN Figure 85-8** Some vehicles will display a message if an evaporative control system leak is detected that could be the result of a loose gas cap.

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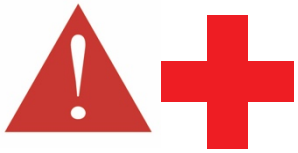
	10. **SLIDE 10 EXPLAIN Figure 85-9** To test for a leak, this tester was set to the 0.020-inch hole and turned on. The ball rose in the scale on the left, and the red arrow was moved to that location. If when testing the system for leaks the ball rises higher than the arrow, then the leak is larger than 0.02 inch. If the ball does not rise to the level of the arrow, the leak is smaller than 0.020 inch 11. **SLIDE 11 EXPLAIN Figure 85-10** unit is applying smoke to the fuel tank through an adapter, and the leak was easily found to be the gas cap seal
	**DEMONSTRATION:** **Show how to leak-check an evaporative system using a smoke machine. Create a small leak by disconnecting a vacuum or vapor hose to show smoke diagnosis. FIGURES 85-8, 9, & 10**
	12. **SLIDE 12 EXPLAIN Figure 85-11** emission tester that uses nitrogen to pressurize the fuel system.
	**SAFETY Remind students that it is imperative to use an inert gas such as nitrogen FIGURE 85-11 to prevent possible explosions when pressure-checking evaporative emission system for leaks. Using compressed air could produce a flammable mixture of fuel vapors and oxygen.**
 	**ON-VEHICLE ASEEDUCATION TASK E5: Diagnose emissions and driveability concerns caused by the evaporative emissions control system; determine necessary action**
 	**ON-VEHICLE ASEEDUCATION TASK: Interpret diagnostic trouble codes (DTCs) and scan tool data related to the emissions control systems; determine necessary action.**
	13. **SLIDE 13 EXPLAIN Figure 85-12** The fuel tank pressure sensor (black unit with three wires) looks like a MAP sensor and is usually located on top of the fuel pump module (white unit)

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	**DISCUSSION:** Have the students discuss the role that fuel stability as well as engine-operating conditions play before **OBD II evaporative monitor** will run. Ask students to list or explain enabling criteria for the evaporative monitor to run.
	**DEMONSTRATION:** Show students fuel tank units with **Fuel Tank Pressure (FTP) Sensors: FIGURE 85-12.** Point out that these sensors, able to sense very small pressure changes, are much more sensitive than traditional pressure sensors.
	14. **SLIDE 14 EXPLAIN Figure 85-13** tank car was cleaned using steam, and then both bottom drain and top vent were closed. The next day, the tank had collapsed because of air pressure difference when inside cooled. The higher outside air pressure caused tank to collapse.
	**HANDS-ON TASK:** Have the students look up an **EVAP DTC** for a particular vehicle using **electronic service information.** What conditions must be met to cause **PCM** to set **DTC**? Have students describe OEM troubleshooting process for diagnosing **DTC**. **FIGURE 85-14**
	**EXPLAIN TECH TIP:** ***Always Tighten the Cap Correctly:*** **Many DTCs are set because the gas cap has not been properly installed. To be sure that a screw-type gas cap is properly sealed, tighten it until you hear three clicks. The clicking is a ratchet device, and the clicking does not harm cap. Therefore, if a P0440 or similar DTC is set, check the cap. • SEE FIGURE 85–14.**
	15. **SLIDE 15 EXPLAIN Figure 85-14** This Toyota cap warns that the check engine light will come on if not tightened until one click
	16. **SLIDE 16 EXPLAIN Figure 85-15** To easily check the fuel tank pressure sensor, remove the cap, and the sensor should read about 1.7 volts
	**Most OEMS will not run EVAP monitor until vehicle reaches normal operating temperature from a cold start and is operating at a steady cruise speed of 35–55 mph. Vehicles used for in-town use only may never run this monitor.**

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	**PCM on a vehicle that uses engine-off natural vacuum for evaporative system testing must stay "on," operating long after vehicle owner has shut off ignition, in order to satisfactorily test evaporative system integrity. Don't overlook this capability when diagnosing a parasitic battery drain.**
	**EXPLAIN TECH TIP:** ***Keep Fuel Tank Properly Filled*** **Most evaporative system monitors do not run unless fuel level is between 15% and 85%. In other words, if a driver always runs with close to an empty tank or always tries to keep tank full, EVAP monitor may not run. • SEE FIGURE 85–16.**
	**17. SLIDE 17 EXPLAIN FIGURE 85–16** fuel level must be above 15% and below 85% before the EVAP monitor runs on most vehicles.
	**DISCUSSION: Have the students discuss how a hybrid vehicle's evaporative emission system should differ from that of a traditional vehicle. Will hybrid vehicle operate longer with fuel in tank? What must the hybrid's system be capable of doing for longer periods of time?**