

Automotive Electrical & Engine Performance 8/E












Chapter 42 Emission Control Devices Operation & Diagnosis









Opening Your Class









KEY ELEMENT	EXAMPLES
Introduce Content	This Automotive Electrical & Engine Performance 8th edition provides complete coverage of automotive areas pertaining vehicle electrical systems and engine performance. It correlates material to task lists specified by ASE and ASE Education (NATEF) and emphasizes a problem-solving approach. Chapter features include Tech Tips, Frequently Asked Questions, Case Studies, Videos, and Animations that are listed in this Lesson Plan. This Lesson Plan also references ASE Education (NATEF) Task Sheets available from Jim's web site.
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.	<p>Explain learning objectives to students as listed below:</p> <ol style="list-style-type: none"> 1. Explain exhaust gas recirculation systems. 2. Discuss OBD-II EGR monitoring strategies, diagnosing a defective EGR system, and EGR trouble codes. 3. Discuss crankcase ventilation, PCV system diagnosis, and PCV-related trouble codes. 4. Explain the secondary air-injection system and its diagnosis. 5. Explain the purpose and function of catalytic converters, their diagnosis, and guidelines to replace them. 6. Explain evaporative emission control system, and compare enhanced evaporative control systems and non-enhanced evaporative control systems. 7. Discuss the leak detection pump system and onboard refueling vapor recovery. 8. Discuss diagnosis of EVAP system and state inspection EVAP tests. 9. Describe evaporative system monitors and typical EVAP monitors.
Establish the Mood or Climate	Provide a <i>WELCOME</i> , 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: This lesson plan is based on **Automotive Electrical & Engine Performance 8th Edition** Chapter Images found on Jim's web site @ www.jameshalderman.com

DOWNLOAD Chapter 42 Chapter Images: From
http://www.jameshalderman.com/books_a8.html#anchor2

ICONS	Ch42 Emission Control Devices OP & Diag.
	<p>1. SLIDE 1 CH42 EMISSION CONTROL DEVICES OPERATION & DIAGNOSIS</p>
	<p>Check for ADDITIONAL VIDEOS & ANIMATIONS @ http://www.jameshalderman.com/ WEB SITE IS CONSTANTLY UPDATED</p>
	<p><u>Videos</u> <u>Videos</u> <u>Videos</u></p>
	<p>At the beginning of this class, you can download the crossword puzzle & Word Search from Jim's web site to familiarize your class with terms in this chapter & then discuss them, see below:</p>
	<p><u>HTTP://WWW.JAMESHALDERMAN.COM/BOOKS_A8.HTML#ANCHOR2</u> DOWNLOAD</p>
	<p>CROSSWORD PUZZLE (MICROSOFT WORD) (PDF) WORD SEARCH PUZZLE (MICROSOFT WORD) (PDF)</p>
	<p>2. SLIDE 2 EXPLAIN Figure 42-1 Nitrogen oxides (NO_x) create a red-brown haze that often hangs over major cities</p>
	<p><u>DISCUSSION: DISCUSS HOW EGR SYSTEMS ARE DESIGNED TO RECIRCULATE EXHAUST INTO THE COMBUSTION CHAMBER. WHAT CONDITIONS MUST BE PRESENT TO ALLOW PROPER ENGINE OPERATION WHILE EXHAUST IS RECIRCULATED? FIGURE 42-1</u></p>
	<p>3. SLIDE 3 EXPLAIN Figure 42-2 When the EGR valve opens, the exhaust gases flow through the valve and into passages in the intake manifold</p>
	<p><u>DEMONSTRATION: WHILE APPLYING VACUUM USING A HAND-HELD PUMP, OPEN & CLOSE A STANDARD EGR VALVE SO STUDENTS CAN SEE DIAPHRAGM & VALVE OPERATION. FIGURE 42-2</u></p>
	<p><u>DEMONSTRATION: PASS AROUND VARIOUS EGR VALVES TO THE STUDENTS. POINT OUT POSITIVE</u></p>

ICONS	Ch42 Emission Control Devices OP & Diag.
       	<p>AND NEGATIVE BACKPRESSURE STYLES AND HOW THEY VARY.</p> <p>4. SLIDE 4 EXPLAIN Figure 42-3 vacuum-operated EGR valve. The operation of the valve is controlled by the PCM by pulsing the EGR control solenoid on and off.</p> <p>EGR VALVES CAN BE TESTED FOR LEAKAGE BY INVERTING AND SPRAYING CARBURETOR CLEANER INTO THE PINTLE VALVE. IF THE CARBURETOR CLEANER LEAKS PAST PINTLE, VALVE IS DEFECTIVE.</p> <p>5. SLIDE 5 EXPLAIN Figure 42-4 EGR valve position sensor on top of an EGR valve</p> <p><u>DEMONSTRATION: PASS AROUND BOTH DIGITAL AND LINEAR EGR VALVES FOR THE STUDENTS TO SEE.</u></p> <p><u>DEMONSTRATION: PASS AROUND VARIOUS TYPES OF EGR VALVE POSITION SENSORS FOR THE STUDENTS TO SEE.</u></p> <p><u>EXPLAIN TECH TIP: Find the Root Cause</u> Excessive back pressure, such as that caused by a partially clogged exhaust system, could cause the plastic sensors on EGR valve to melt. Always check for a restricted exhaust whenever replacing a failed EGR valve sensor.</p> <p><u>DISCUSS FREQUENTLY ASKED QUESTION: WHERE IS THE EGR VALVE?</u> Most newer vehicles that are equipped with variable Valve timing (VVT) use valve overlap to keep some exhaust gases in combustion chamber. As a result, most new engines do not use an EGR valve.</p> <p>6. SLIDE 6 EXPLAIN Figure 42-5 Digital EGR valve as used on some older General Motors engines.</p> <p>7. SLIDE 7 EXPLAIN Figure 42-7 GM linear EGR valve.</p> <p>8. SLIDE 8 EXPLAIN FIGURE 42-8 A DPFE sensor and related components.</p>

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	<p>HANDS-ON TASK: HAVE THE STUDENTS GRADUALLY OPEN AN EGR VALVE WITH A HAND OPERATED VACUUM PUMP. HAVE THEM USE AN OHMMETER TO CHECK VALVE POSITION SENSOR RESISTANCE AT VARIOUS VALVE OPENINGS.</p>
	<p>DISCUSSION: DISCUSS THE DIFFERENCE BETWEEN LINEAR AND DIGITAL EGR VALVES. WHAT IS THE DIFFERENCE?</p>
	<p>DISCUSSION: ASK STUDENTS TO DISCUSS & LIST POSSIBLE SYMPTOMS OF A MALFUNCTIONING EGR SYSTEM. WHAT DRIVEABILITY ISSUES COULD BE CAUSED BY TOO MUCH, OR INCORRECT, EGR FLOW OR TIMING? WHAT PROBLEMS CAN BE CAUSED BY NO, TOO LITTLE, EGR FLOW?</p>
	<p>10. SLIDE 10 EXPLAIN FIGURE 42-9 OBD-II active test. The PCM opens EGR valve and monitors MAP sensor and/or engine speed (RPM) to verify that it meets acceptable values.</p>
	<p>DISCUSSION: HAVE THE STUDENTS DISCUSS MALFUNCTIONING EGR SYSTEMS. WHAT PROBLEMS CAN BE ASSOCIATED WITH CONTROL SIDE OF EGR SYSTEM? WHAT PROBLEMS CAN BE ASSOCIATED WITH FUNCTIONAL SIDE OF THE EGR SYSTEM?</p>
	<p>DISCUSSION: DISCUSS VARIOUS TYPES OF WARNING LIGHTS THAT OEMS USE & SIGNIFICANCE OF THE AMBER COLOR. WHAT IS MIL & WHAT IS ITS COLOR?</p>
	<p>DISCUSSION: DISCUSS OBD II EGR MONITORS, HOW ARE THEY USED IN DIAGNOSIS?</p>
	<p>HANDS-ON TASK: HAVE STUDENTS DISCONNECT EGR VACUUM HOSE ON A CAR AND DRIVE IT UNTIL IT MEETS ENABLING CRITERIA FOR EGR MONITOR TO RUN. CONNECT A SCAN TOOL & RETRIEVE DTC. IF MONITOR RUNS ONLY ONCE, DTC WILL BE STORED AS A PENDING CODE. IF THE MONITOR RUNS TWICE AND FAILS, A MATURED DTC WILL SET, AND THE MIL WILL BE ILLUMINATED.</p>

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	<p><u>DISCUSSION:</u> DISCUSS <u>DETONATION</u>. WHAT IS DETONATION AND HOW IS IT CAUSED? WHAT ARE ITS EFFECTS? WHAT KIND OF MECHANICAL DAMAGE CAN DETONATION CAUSE TO THE ENGINE?</p>
	<p><u>HANDS-ON TASK:</u> HAVE THE STUDENTS LOOK UP <u>OEM PROCEDURES FOR TESTING EGR SYSTEM</u> ON THEIR OWN VEHICLES.</p>
	<p>SPEED-DENSITY FUEL SYSTEM MEASURES INTAKE MAP (VACUUM) CAN BE FOOLED BY STUCK OPEN EGR VALVE. OPEN EGR VALVE ADMITS EXHAUST PRESSURE INTO INTAKE MANIFOLD, WHICH PCM MISINTERPRETS AS AN INCREASE IN LOAD, DRIVING FUEL SYSTEM VERY RICH. ADDITIONAL FUEL WILL KEEP ENGINE RUNNING, ALTHOUGH POORLY DUE TO EXCESS EXHAUST. BLACK SMOKE CAUSED BY THIS OVERLY RICH CONDITION CAN CAUSE TECHNICIAN TO MISTAKENLY LOOK FOR FUEL SYSTEM PROBLEM.</p>
	<p><u>DEMONSTRATION:</u> ON A RUNNING ENGINE, APPLY VACUUM INCREMENTALLY TO THE EGR VALVE USING A HAND-HELD VACUUM PUMP. SHOW EFFECT OF INCREASED VACUUM ON ENGINE OPERATION AS EGR VALVE OPENS UP. APPLY ENOUGH VACUUM TO STALL THE ENGINE.</p>
	<p><u>DEMONSTRATION:</u> ON A VEHICLE WITH EITHER A <u>DIGITAL OR LINEAR EGR VALVE</u>, OPEN THE VALVE INCREMENTALLY WITH A BIDIRECTIONAL <u>SCAN TOOL</u> TO SHOW STUDENTS ITS EFFECTS</p>
	<p>DISCUSS CASE STUDY: <i>BLAZER STORY</i>: THE OWNER OF A CHEVROLET BLAZER EQUIPPED WITH A 4.3-L, V-6 ENGINE COMPLAINED THAT ENGINE WOULD STUMBLE AND HESITATE AT TIMES. EVERYTHING SEEMED TO BE FUNCTIONING CORRECTLY, EXCEPT THAT THE SERVICE TECHNICIAN DISCOVERED WEAK VACUUM GOING TO EGR VALVE AT IDLE. THIS VEHICLE WAS EQUIPPED WITH AN EGR VALVE-CONTROL SOLENOID, CALLED AN ELECTRONIC VACUUM REGULATOR VALVE (EVRV) BY GM. PCM PULSES SOLENOID TO CONTROL VACUUM</p>

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THAT REGULATES THE OPERATION OF EGR VALVE. TECHNICIAN CHECKED SERVICE MANUAL FOR DETAILS ON WORKINGS OF THE SYSTEM. TECHNICIAN DISCOVERED THAT VACUUM SHOULD BE PRESENT AT EGR VALVE ONLY WHEN GEAR SELECTOR INDICATES A DRIVE GEAR (DRIVE, LOW, REVERSE). BECAUSE TECHNICIAN DISCOVERED VACUUM AT SOLENOID TO BE LEAKING, SOLENOID WAS OBVIOUSLY DEFECTIVE AND REQUIRED REPLACEMENT.








AFTER REPLACEMENT OF THE SOLENOID (EVRV), HESITATION PROBLEM WAS SOLVED.





SUMMARY:






- **COMPLAINT—CUSTOMER STATED THAT THE ENGINE WOULD STUMBLE AND HESITATE AT TIMES.**
- **CAUSE—ELECTRONIC VACUUM REGULATOR VALVE (EVRV) WAS FOUND TO BE LEAKING.**
- **CORRECTION—ELECTRONIC VACUUM REGULATOR VALVE (EVRV) WAS REPLACED AND THIS RESTORED PROPER ENGINE OPERATION.**

EXPLAIN TECH TIP: *The Snake Trick:* EGR passages on many intake manifolds become clogged with carbon, which reduces the flow of exhaust and amount of exhaust gases in cylinders. This reduction can cause spark knock (detonation) and increased emissions of oxides of nitrogen (NOx) (especially important in areas with enhanced exhaust emissions testing). To quickly and easily remove carbon from exhaust passages, cut an approximately 1-foot (30-cm) length from stranded wire, such as garage door guide wire or an old speedometer cable. Flare end and place end of wire into the passage. Set your drill on reverse and turn it on, and the wire pulls its way through the passage, cleaning carbon as it goes, just



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      	<p>like a snake in a drainpipe. Some vehicles, such as Hondas, require that plugs be drilled out to gain access to the EGR passages. • SEE FIGURE 42-10.</p> <p>11. SLIDE 11 EXPLAIN Figure 42-10 Removing EGR passage plugs from the intake manifold on a Honda.</p> <p>EXPLAIN TECH TIP: Watch Out for Carbon Balls! EGR valves can get stuck partially open by a chunk of carbon, and valve or solenoid tests as defective. When valve (or solenoid) is removed, small chunks or balls of carbon often fall into the exhaust manifold passage. When the replacement valve is installed, the carbon balls can be drawn into the new valve again, causing engine to idle roughly or stall. To help prevent this problem, start engine with EGR valve or solenoid removed. Any balls or chunks of carbon are blown out of passage by the exhaust. Stop engine and install replacement EGR valve or solenoid.</p> <p>ON-VEHICLE ASE EDUCATION TASK E3 3. DIAGNOSE EMISSIONS AND DRIVEABILITY CONCERNS CAUSED BY THE EXHAUST GAS RECIRCULATION (EGR) SYSTEM; INSPECT, TEST, SERVICE AND/OR REPLACE ELECTRICAL/ELECTRONIC SENSORS, CONTROLS, WIRING, TUBING, EXHAUST PASSAGES, VACUUM/PRESSURE CONTROLS, FILTERS, AND HOSES OF EXHAUST GAS RECIRCULATION (EGR) SYSTEMS; DETERMINE NEEDED ACTION.</p> <p>DEMONSTRATION: PASS AROUND VARIOUS PCV VALVES FOR THE STUDENTS TO SEE.</p> <p>STUDENTS SHOULD UNDERSTAND WHERE THE PCV VALVE CAN BE LOCATED ON AN ENGINE</p> <p>Positive Crankcase Ventilation (PCV) (View) (Download)</p> <p>Secondary Air Injection (View) (Download)</p> <p>12. SLIDE 12 EXPLAIN Figure 42-11 PCV valve in a cutaway valve cover, showing the baffles that prevent liquid oil from being drawn into the intake manifold.</p>

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   	<p>13. SLIDE 13 EXPLAIN Figure 42-12 Spring force, crankcase pressure, and intake manifold vacuum work together to regulate the flow rate through PCV valve.</p> <p>14. SLIDE 14 EXPLAIN Figure 42-13 Air flows through PCV valve during idle, cruising, and light-load conditions.</p> <p>15. SLIDE 15 EXPLAIN Figure 42-14 Air flows through PCV valve during acceleration and when engine is under a heavy load.</p> <p>16. SLIDE 16 EXPLAIN Figure 42-15 PCV valve operation in event of backfire</p> <p><u>DEMONSTRATION: SHOW HOW TO CHECK VALVE OPERATION BY SHAKING THE VALVE.</u></p> <p><u>HANDS-ON TASK: HAVE THE STUDENTS LOCATE PCV SYSTEM COMPONENTS ON THEIR OWN VEHICLES. ASK THEM TO EXPLAIN HOW AIR FLOWS THROUGH THE SYSTEM.</u></p> <p><u>DISCUSSION: HAVE THE STUDENTS TALK ABOUT WHAT CAN HAPPEN TO A PCV SYSTEM FROM A VEHICLE OWNER WHO <u>NEGLECTS OR EXTENDS NORMAL OIL AND FILTER REPLACEMENTS.</u> WHAT PROBLEMS CAN RESTRICTED AIRFLOW CAUSE?</u></p> <p><u>EXPLAIN TECH TIP: <i>Check for Oil Leaks with the Engine Off</i></u> The owner of an older vehicle equipped with a V-6 engine complained to his technician that he smelled burning oil, but only after shutting off the engine. The technician found that rocker cover gaskets were leaking. But why did owner only notice smell of hot oil when the engine was shut off? Because of PCV system, engine vacuum tends to draw oil away from gasket surfaces. When engine stops, however, engine vacuum disappears, and the oil remaining in the upper regions of the engine tend to flow down and out through any opening. Therefore, a good technician should check an engine for oil leaks, not only with the engine running, but also shortly after shutdown.</p>

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    	<p><u>DEMONSTRATION: SHOW STUDENTS EXAMPLES OF PLUGGED, DIRTY, OR STUCK PCV VALVES</u></p> <p>DISCUSS CASE STUDY: WHISTLING ENGINE An older vehicle was being diagnosed for a whistling sound whenever engine was running, especially at idle. It was finally discovered that breather in valve cover was plugged and caused high vacuum in crankcase. Engine was sucking air from what was likely rear main seal lip, making “whistle” noise. After replacing the breather and PCV, the noise stopped.</p> <p>SUMMARY:</p> <ul style="list-style-type: none"> • Complaint—customer stated that engine made a whistling sound when it was running. • Cause—clogged PCV breather was found to be cause of air being drawn into engine through rear main seal. • Correction— PCV breather and check valve were replaced, which corrected whistling noise concern. <p>17. SLIDE 17 EXPLAIN Figure 42-16 Using a gauge that measures vacuum in units of inches of water to test the vacuum at the dipstick tube, being sure that the PCV system is capable of drawing a vacuum on the crankcase (28 in. H₂O = 1 PSI, or about 2 in. Hg of vacuum)</p> <p>DON'T OVERLOOK MALFUNCTIONING PCV SYSTEM WHEN DIAGNOSING EXCESSIVE OIL LEAKS. PLUGGED PCV SYSTEM CAN CREATE EXCESS PRESSURE IN CRANKCASE DUE TO ACCUMULATION OF COMBUSTION VAPORS. THIS EXCESS PRESSURE CAN FORCE OIL OUT OF CRANKCASE THROUGH ENGINE SEALS & GASKETS.</p> <p><u>HANDS-ON TASK: SHOW THE STUDENTS AN ORIFICE-CONTROLLED CRANKCASE VENTILATION SYSTEM. HAVE THEM LOCATE & LABEL MAIN</u></p>

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COMPONENTS & EXPLAIN AIRFLOW THROUGH THE SYSTEM.

DISCUSS CASE STUDY: *OIL BURNING CHEVROLET VAN:*

An instructor was driving Chevrolet Van to Fairbanks, Alaska, in January. It was pretty cold out, somewhere around -32°f (-36°c). As he pulled into Fairbanks and stopped at a traffic light, he smelled burning oil. When he stopped at hotel he still smelled burning oil. He looked under the van and discovered a large pool of oil. After checking oil and finding very little left, he called a local shop and was told to bring it in. The technician looked over situation and said, “you need to put some cardboard across grill to stop pcv valve from freezing up.” Apparently pcv valve froze, which caused normal blowby gases to force several quarts out dipstick tube. After he installed cardboard, he did not have any further problems.

CAUTION: DO NOT COVER RADIATOR WHEN DRIVING UNLESS UNDER SEVERE COLD CONDITIONS AND CAREFULLY WATCH COOLANT TEMPERATURE TO AVOID OVERHEATING ENGINE.

SUMMARY:

- **Complaint**—vehicle owner experienced oil burning when extremely cold outside.
- **Cause**—PCV valve was frozen causing pressure to build up in crankcase.
- **Correction**—placing some cardboard in front of radiator prevented valve from freezing and allowed crankcase ventilations system to function normally.



DEMONSTRATION: SHOW HOW TO CHECK FOR A SLIGHT VACUUM ON A RUNNING ENGINE BY USING A 3 X 5 INDEX CARD. PINCH VACUUM LINE BETWEEN INTAKE MANIFOLD AND PCV VALVE TO

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ILLUSTRATE PLUGGED OR OBSTRUCTED SYSTEM WITH NO VACUUM.

18. **SLIDE 18 EXPLAIN** Figure 42-17 Most PCV valves used on newer vehicles are secured with fasteners, making it more difficult to disconnect and thereby less likely to increase emissions

DISCUSS FREQUENTLY ASKED QUESTION:
WHAT ARE THE WIRES FOR AT THE PCV VALVE?
FORD USES AN ELECTRIC HEATER TO PREVENT ICE FROM FORMING INSIDE PCV VALVE AND CAUSING BLOCKAGE. WATER IS A BY-PRODUCT OF COMBUSTION, AND RESULTING MOISTURE CAN FREEZE WHEN THE OUTSIDE AIR TEMPERATURE IS LOW. GENERAL MOTORS AND OTHERS CLIP A HEATER HOSE TO PCV HOSE TO PROVIDE THE HEAT NEEDED TO PREVENT AN ICE BLOCKAGE.

HANDS-ON TASK: HAVE STUDENTS PERFORM THE **SNAP-BACK TEST** ON A PCV VALVE ON A RUNNING ENGINE BY PLACING THEIR FINGER OVER VALVE INLET. STUDENTS SHOULD LISTEN & FEEL FOR CLICK WHEN THEY REMOVE THEIR FINGER INDICATING THE VALVE IS FUNCTIONING PROPERLY.

DISCUSSION: HAVE THE STUDENTS TALK ABOUT WHY **OBD-II SYSTEM** CHECKS OR MONITORS **PCV SYSTEM**. HOW DO CRANKCASE EMISSIONS AFFECT ATMOSPHERE? WHAT DOES PCV SYSTEM DO TO PREVENT POLLUTION?

HANDS-ON TASK: HAVE THE STUDENTS RESEARCH A **PCV SYSTEM FAILURE DTC**. STUDENTS SHOULD BE ABLE TO DETERMINE CONDITIONS THAT CAUSED DTC & OEM TROUBLESHOOTING PROCEDURE FOR DTC.

ON-VEHICLE ASE EDUCATION TASK: **DIAGNOSE OIL LEAKS, EMISSIONS, AND DRIVEABILITY CONCERNS CAUSED BY THE POSITIVE CRANKCASE VENTILATION (PCV) SYSTEM; DETERMINE NECESSARY ACTION.**

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ON-VEHICLE ASE EDUCATION TASK: INSPECT, TEST AND SERVICE POSITIVE CRANKCASE VENTILATION (PCV) FILTER/BREATHING CAP, VALVE, TUBES, ORIFICES, AND HOSES; PERFORM NECESSARY ACTION.

19. **SLIDE 19 EXPLAIN** Figure 42-18 typical belt-driven AIR pump. Air enters through revolving fins behind the drive pulley. The fins act as an air filter because dirt is heavier than air, and therefore the dirt is deflected off of the fins at the same time air is being drawn into the pump









DEMONSTRATION: SHOW THE STUDENTS VARIOUS TYPES OF AIR INJECTION PUMPS. MOST BELT-DRIVEN PUMPS CAN BE EASILY DISASSEMBLED TO SHOW THEIR INTERNAL COMPONENTS.

HANDS-ON TASK: USE ELECTRONIC SERVICE INFORMATION COMPONENT LOCATOR TO LOCATE SECONDARY AIR-INJECTION COMPONENTS ON THEIR OWN CARS. THEY SHOULD BE ABLE TO IDENTIFY COMPONENTS AND EXPLAIN THEIR OPERATION AND PURPOSES.

20. **SLIDE 20 EXPLAIN** Figure 42-19 external air manifold and exhaust check valve on a restored muscle car engine.
21. **SLIDE 21 EXPLAIN** Figure 42-20 (a) When engine is cold and before the oxygen sensor is hot enough to achieve closed loop, the airflow from the air pump is directed to the exhaust manifold(s) through the one-way check valves, which keep the exhaust gases from entering the switching solenoids and the pump itself

DEMONSTRATION: SHOW VARIOUS AIR DISTRIBUTION MANIFOLDS & EXHAUST CHECK VALVES. DEMONSTRATE CHECK VALVE OPERATION BY ATTEMPTING TO BLOW AIR THROUGH EACH SIDE. IF VALVE IS GOOD, AIR SHOULD PASS THROUGH ONLY ONE SIDE.

22. **SLIDE 22 EXPLAIN** FIGURE 42-20 (a) When engine is cold and before oxygen sensor is hot enough to achieve closed loop, the airflow from air pump is directed to the exhaust manifold(s) through one-way check valves, which keep the exhaust gases from entering switching solenoids

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	<p>and the pump itself. (b) When engine achieves closed loop, the air is directed to the catalytic converter.</p> <p>23. SLIDE 23 EXPLAIN Figure 42-21 typical electric motor-driven SAI pump. This unit is on a Chevrolet Corvette and only works when the engine is cold</p> <p>DISCUSSION: HAVE THE STUDENTS TALK ABOUT THE VARIOUS <u>CONDITIONS THAT REQUIRE AIR INJECTION</u> & AREAS THAT WILL RECEIVE AIR INJECTION. UNDER WHAT CONDITIONS DOES THE SAI SYSTEM OPERATE, AND WHERE DOES IT INJECT AIR?</p>
	<p>DEMONSTRATION: CREATE A <u>SAI SYSTEM FAILURE ON OBD-II VEHICLE</u>. THIS CAN BE DONE EASILY BY DISCONNECTING AN ELECTRIC PUMP OR AIR HOSE. OPERATE THE VEHICLE UNDER CONDITIONS NECESSARY TO SET DTC.</p>
	<p>HANDS-ON TASK: HAVE STUDENTS RETRIEVE THE DTC AND LIST CONDITIONS NECESSARY FOR THE CODE TO SET</p>
	<p>DISCUSSION: HAVE STUDENTS DISCUSS ENABLING CRITERIA REQUIRED FOR <u>OBD-II SYSTEM</u> TO TEST AIR INJECTION SYSTEMS AND VARIOUS SAI SYSTEMS & RESULTING VARIATIONS IN CRITERIA. WHAT ENABLING CRITERIA ARE NECESSARY FOR THE OBD-II SYSTEM TO TEST THE SAI SYSTEM?</p>
 <p></p>	<p>ON-VEHICLE ASE EDUCATION TASK E1: DIAGNOSE OIL LEAKS, EMISSIONS, AND DRIVEABILITY CONCERNS CAUSED BY THE POSITIVE CRANKCASE VENTILATION (PCV) SYSTEM; DETERMINE NEEDED ACTION..</p>
 <p></p>	<p>ON-VEHICLE ASE EDUCATION TASK E2: INSPECT, TEST, SERVICE, AND/OR REPLACE POSITIVE CRANKCASE VENTILATION (PCV) FILTER/BREATHER, VALVE, TUBES, ORIFICES, AND HOSES; PERFORM NEEDED ACTION</p>

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ON-VEHICLE ASE EDUCATION TASK E4

DIAGNOSE EMISSIONS AND DRIVEABILITY CONCERNS CAUSED BY THE SECONDARY AIR INJECTION SYSTEM; INSPECT, TEST, REPAIR, AND/OR REPLACE ELECTRICAL/ELECTRONICALLY-OPERATED COMPONENTS AND CIRCUITS OF SECONDARY AIR INJECTION SYSTEMS; DETERMINE NEEDED ACTION.

[Catalytic Converter Operation \(View\) \(Download\)](#)













[Catalytic Converter \(2004+\) \(View\) \(Download\)](#)






24. **SLIDE 24 EXPLAIN** Figure 42-22 Most catalytic converters are located as close to the exhaust manifold as possible, as seen in this display of a Chevrolet Corvette
25. **SLIDE 25 EXPLAIN** FIGURE 42-23 base material, called the substrate, is used to support the wash coat, which is a porous material that is used to hold the catalyst materials.
26. **SLIDE 26 EXPLAIN** Figure 42-24 three-way catalytic converter first separates the NO_x into nitrogen and oxygen and then converts the HC and CO into harmless water (H_2O) and carbon dioxide (CO_2). The nitrogen (N) passes through the converter and exits the tailpipe and enters the atmosphere which is about 78% nitrogen







DEMONSTRATION: WITH A VEHICLE ON LIFT, SHOW INSTALLED CATALYTIC CONVERTERS & THEIR LOCATIONS. POINT OUT THE REDUCTION CATALYST & OXIDIZING CATALYST.

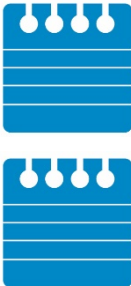





BECAUSE PRICES OF PRECIOUS METALS USED IN CATALYTIC CONVERTERS HAVE RISEN STEEPLY IN PRICE, THESE COMPONENTS HAVE BECOME POPULAR AMONG THIEVES. OWNERS OF TRUCKS & 4WD VEHICLES HAVE RETURNED TO THEIR PARKED VEHICLES TO FIND STOLEN CATALYTIC CONVERTERS WITH BATTERY-POWERED RECIPROCATING SAW. REPLACEMENTS CAN RUN AS HIGH AS \$2,500.

27. **SLIDE 27 EXPLAIN** Figure 42-25 OBD-II catalytic converter monitor compares signals of upstream and downstream oxygen sensors to determine efficiency.

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  <p>QUESTION</p>	<p>DISCUSSION: HAVE THE STUDENTS DISCUSS HOW OFTEN A <u>PCM TESTS A CATALYTIC CONVERTER</u>. HOW IS CATALYTIC CONVERTER MONITOR CLASSIFIED? WHEN WILL THE MONITOR CHECK THE EFFICIENCY OF CONVERTER? WHAT WILL HAPPEN IF THE TEST FAILS?</p>
	<p>DEMONSTRATION: HAVE THE STUDENTS TALK ABOUT DIAGNOSING CATALYTIC CONVERTERS. <u>HOW ARE CATALYTIC CONVERTERS TESTED?</u></p>
 	<p>DEMONSTRATION: <u>CONNECT A DIGITAL STORAGE OSCILLOSCOPE (DSO) TO AN UPSTREAM OXYGEN SENSOR</u> & OPERATE ENGINE AT NORMAL OPERATING TEMPERATURE. SHOW <u>WAVEFORM</u> OF AN <u>UPSTREAM OXYGEN SENSOR</u> IN OPERATION.</p>
 	<p>DEMONSTRATION: AFTER SHOWING STUDENTS A WAVEFORM OF UPSTREAM OXYGEN SENSOR, CONNECT DSO TO <u>DOWNSTREAM OXYGEN SENSOR</u> TO SHOW STUDENTS DIFFERENCE BETWEEN SENSORS. OBD-II USES DOWNSTREAM SENSOR TO CHECK THE EFFICIENCY OF THE CATALYTIC CONVERTER.</p>
 	<p>DEMONSTRATION: SIMULATE A PLUGGED OR MELTED CONVERTER BY INSTALLING AN <u>EXPANDABLE PLUG</u> INTO A VEHICLE EXHAUST PIPE. OPERATE VEHICLE ON DYNAMOMETER OR ON A TEST DRIVE WITH VACUUM GAUGE TAPED TO WINDSHIELD. SHOW STUDENTS HOW VACUUM DROPS AS EXHAUST BACK PRESSURE INCREASES, CAUSING A SUBSTANTIAL DROP IN ENGINE PERFORMANCE. REMOVE PLUG AND OPERATE VEHICLE NORMALLY TO SHOW PROPER VACUUM READINGS.</p>
	<p>28. SLIDE 28 EXPLAIN Figure 42-26 A back pressure tool can be made by using an oxygen sensor housing and epoxy or braze to hold the tube to the housing</p>
 	<p>DEMONSTRATION: <u>INSTALL EXHAUST BACK PRESSURE GAUGE</u> IN PLACE OF AN OXYGEN SENSOR. LEAVE OXYGEN SENSOR CONNECTED</p>

ICONS	Ch42 Emission Control Devices OP & Diag.
  	<p>WHILE IT IS REMOVED AND OPERATE ENGINE, SHOWING STUDENTS NORMAL BACK PRESSURE. INSTALL EXPANDABLE PLUG IN TAILPIPE TO SIMULATE A PLUGGED CONVERTER AND HAVE STUDENTS WATCH BACK PRESSURE INCREASE.</p> <p><u>ON-VEHICLE ASE EDUCATION TASK: PERFORM EXHAUST SYSTEM BACK-PRESSURE TEST; DETERMINE NECESSARY ACTION.</u></p> <p>29. SLIDE 29 EXPLAIN Figure 42-27 The temperature of the outlet should be at least 10% hotter than the temperature of the inlet. If a converter is not working, the inlet temperature will be hotter than the outlet temperature.</p> <p><u>EXPLAIN TECH TIP: Aftermarket Catalytic Converters</u> Some replacement aftermarket (nonfactory) catalytic converters do not contain the same amount of cerium as original part. Cerium is the element that is used in catalytic converters to store oxygen. As a result of the lack of cerium, the correlation between the oxygen storage and conversion efficiency may be affected enough to set a false diagnostic trouble code (P0422).</p> <p>NOTE: If an aftermarket converter is being installed, be sure that distance between rear of catalyst block is the same distance from rear oxygen sensor as factory converter to be ensured of proper operation. Always follow instructions that come with the replacement converter. • SEE FIGURE 42-28.</p>
 	<p>30. SLIDE 30 EXPLAIN FIGURE 42-28 Whenever replacing a catalytic converter with a universal unit, first measure distance between the rear brick & center of the rear oxygen sensor.</p> <p><u>EXPLAIN TECH TIP: Catalytic Converters Are Murdered</u> Catalytic converters start a chemical reaction, but do not enter into chemical reaction. Therefore, catalytic converters neither wear out nor die of old age. If a catalytic converter is found to be defective (nonfunctioning or clogged), look for the root cause. Remember this: “Catalytic converters do not commit suicide—they’re murdered.” Items that should be checked when a defective catalytic</p>

ICONS	Ch42 Emission Control Devices OP & Diag.
	<p>converter is discovered include all components of ignition and fuel systems. Excessive unburned fuel can cause the catalytic converter to overheat and fail. The oxygen sensor must be working and fluctuating from 0.5 to 5 Hz (times per second) to provide the necessary air fuel mixture variations for maximum catalytic converter efficiency.</p> <p><u>DISCUSSION:</u> HAVE THE STUDENTS TALK ABOUT CATALYTIC CONVERTER EFFICIENCY TESTS. HOW ARE RESULTS OF AN OXYGEN LEVEL TEST INTERPRETED?</p>
	<p><u>HANDS-ON TASK:</u> HAVE STUDENTS OPERATE AN ENGINE AT 2,500 RPM UNTIL NORMAL OPERATING TEMPERATURE IS ACHIEVED, THEN <u>MEASURE INLET & OUTLET TEMPERATURES</u> OF CATALYTIC CONVERTER</p>
	<p>WITH AN INFRARED THERMOMETER.</p> <p><u>ON-VEHICLE ASE EDUCATION TASK:</u> INSPECT AND TEST <u>CATALYTIC CONVERTER</u> EFFICIENCY.</p>
	
	<p><u>DISCUSSION:</u> DISCUSS WITH THE STUDENTS THAT AN <u>OVERLY RICH MIXTURE OR ANY MALFUNCTION SUCH AS MISFIRE</u> CAN ALLOW UNBURNED HYDROCARBONS TO ENTER THE CATALYTIC CONVERTER. HOW DOES THIS AFFECT THE CATALYTIC CONVERTER? (POINT OUT THAT THIS CAN CAUSE THE CONVERTER TO MELT INTERNALLY AND CAN EVEN</p>
	<p>SET THE VEHICLE ON FIRE)</p> <p><u>DEMONSTRATION:</u> WITH VEHICLE ON A LIFT, CREATE A MISFIRE; FOR EXAMPLE, CLOSE ELECTRODES ON A SPARK PLUG. OPERATE AT 2,500 RPM UNTIL THE CONVERTER BEGINS TO OVERHEAT AND STUDENTS OBSERVE THE SMELL OF ROTTEN EGGS. CONTINUE OPERATING VEHICLE FOR A FEW MORE MINUTES, CHECK CONVERTER TEMPERATURE WITH INFRARED THERMOMETER TO SHOW STUDENTS EXTREME OVERHEAT CONDITION.</p>

ICONS	Ch42 Emission Control Devices OP & Diag.
	<p>BECAUSE HEAT IS SO CRITICAL FOR CONVERTER OPERATION, AND UNDERHOOD SPACE IS LIMITED, MANY OEMS LOCATE CATALYST IN EXHAUST MANIFOLD.</p> <p>JUST BECAUSE AN AFTERMARKET CATALYTIC CONVERTER FITS A PARTICULAR VEHICLE, DOES NOT MEAN IT WILL CONTROL EMISSIONS ON PARTICULAR VEHICLE. MANY AFTERMARKET CATALYTIC CONVERTERS ARE SOLD AT REDUCED PRICES BECAUSE THEY DO NOT CONTAIN AMOUNT OF PRECIOUS METALS THAT OEM DID, POTENTIALLY CAUSING STATE EMISSIONS TEST FAILURE OR MIL TO CONTINUALLY ILLUMINATE INDICATING AN EMISSIONS PROBLEM.</p>
	<p>HANDS-ON TASK: HAVE THE STUDENTS LOOK UP <u>CATALYST EFFICIENCY DTCS</u> FOR THEIR OWN VEHICLES. STUDENTS SHOULD BE ABLE TO FIND CONDITIONS THAT MUST BE MET FOR <u>DTC</u> TO SET AND FIND OEM TROUBLESHOOTING PROCEDURE TO DIAGNOSE <u>DTC</u>.</p>
	<p>DEMONSTRATION: DEMONSTRATE CATALYTIC CONVERTER OPERATION BY TESTING EXHAUST EMISSIONS WITH <u>5-GAS ANALYZER</u> BEFORE AND AFTER CONVERTER RUNS. REMOVE THE UPSTREAM OXYGEN SENSOR AFTER THE ENGINE HAS WARMED UP, THEN OPERATE ENGINE WITH SENSOR CONNECTED AND INSERT ANALYZER PROBE INTO SENSOR BOSS WHILE SAMPLING.</p>
	<p>DEMONSTRATION: PERFORM A <u>CONVERTER SNAP-THROTTLE TEST</u> WHILE SAMPLING EXHAUST EMISSIONS. HAVE STUDENTS PAY ATTENTION TO O2 READINGS TO DETERMINE CONVERTER EFFICIENCY.</p>
	<p>ON-VEHICLE ASE EDUCATION TASK E6: DIAGNOSE EMISSION AND DRIVEABILITY CONCERNS CAUSED BY CATALYTIC CONVERTER SYSTEM; DETERMINE NEEDED ACTION.</p>
	



[EVAPORATIVE EMISSION CONTROL SYSTEM \(VIEW\) \(DOWNLOAD\)](#)

[DEMONSTRATION: SHOW STUDENTS BASIC EVAPORATIVE EMISSIONS SYSTEM COMPONENTS. MAKE SURE STUDENTS CAN IDENTIFY COMPONENTS & THEIR FUNCTIONS](#)

31. SLIDE 31 **EXPLAIN** FIGURE 42–29 capless system from a Ford Flex does not use a replaceable cap; instead, it has a spring-loaded closure.
32. SLIDE 32 **EXPLAIN** Figure 42-30 A charcoal canister can be located under the hood or underneath the vehicle.
33. SLIDE 33 **EXPLAIN** FIGURE 42–31 evaporative emission control system includes all of the lines, hoses, and valves, plus the charcoal canister.

DISCUSS FREQUENTLY ASKED QUESTION: WHEN FILLING MY FUEL TANK, WHY SHOULD I STOP WHEN THE PUMP CLICKS OFF? EVERY FUEL TANK HAS UPPER VOLUME CHAMBER THAT ALLOWS FOR EXPANSION OF FUEL WHEN HOT. THE VOLUME OF CHAMBER IS BETWEEN 10% AND 20% OF VOLUME OF 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.

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?

34. SLIDE 34 **EXPLAIN** FIGURE 42-32 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.

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.

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.

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 SHOULD BE ENERGIZED FOR ONLY SHORT PERIODS (5 MINUTES OR LESS) TO PREVENT DAMAGE.

35. SLIDE 35 **EXPLAIN** Figure 42-33 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.

36. **SLIDE 36 EXPLAIN** Figure 42-34 restricted fuel fill pipe shown on vehicle with the interior removed

37. **SLIDE 37 EXPLAIN** Figure 42-35 Some vehicles will display a message if an evaporative control system leak is detected that could be the result of a loose gas cap.

38. **SLIDE 38 EXPLAIN** Figure 42-36 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

39. **SLIDE 39 EXPLAIN** Figure 42-37 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.

ON-VEHICLE ASE EDUCATION TASK E5: DIAGNOSE EMISSIONS AND DRIVEABILITY CONCERNS CAUSED BY THE EVAPORATIVE EMISSIONS CONTROL SYSTEM; DETERMINE NECESSARY ACTION

ON-VEHICLE ASE EDUCATION TASK: INTERPRET DIAGNOSTIC TROUBLE CODES (DTCS) AND SCAN TOOL DATA RELATED TO THE EMISSIONS CONTROL SYSTEMS; DETERMINE NECESSARY ACTION.

- 40. SLIDE 40 **EXPLAIN** FIGURE 42–38 An emission tester that uses nitrogen to pressurize the fuel system.
- 41. SLIDE 41 **EXPLAIN** FIGURE 42-39 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)

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: POINT OUT THAT THESE SENSORS, ABLE TO SENSE VERY SMALL PRESSURE CHANGES, ARE MUCH MORE SENSITIVE THAN TRADITIONAL PRESSURE SENSORS.

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.



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 42-40.

42. SLIDE 42 **EXPLAIN FIGURE 42-40** This Toyota cap warns that the check engine light will come on if not tightened until one click

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. 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 42-41.

43. SLIDE 43 **EXPLAIN FIGURE 42-41** 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?