Introduction to Automotive Service
Chapter 32 Emission Control Devices
Opening Your Class

KEY ELEMENT	EXAMPLES
Introduce Content	This course or class serves as an introduction to the world of automotive service. It correlates material to task lists specified by ASE and NATEF.
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. 1. Prepare for the ASE Engine Performance (A8) certification test content area "D" (Emission Control Systems). 2. Describe the purpose and function of the exhaust gas recirculation (EGR) system. 3. Describe the purpose and function of the PCV system. 4. Describe the purpose and function of the Secondary Air Injection (SAI) system. 5. Describe the purpose and function of the catalytic converter. 6. Describe the purpose and function of the evaporative emission control system.
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.

ICONS	Ch32 Emission Control Devices
	**1. SLIDE 1 CH32 EMISSION CONTROL DEVICES**
	**Check for ADDITIONAL VIDEOS & ANIMATIONS @ http://www.jameshalderman.com/ WEB SITE IS UPDATED REGULARLY**
	**DEMONSTRATION: Show students basic emissions system components. Make sure students can identify components & their functions**
	**2. SLIDE 2 EXPLAIN** Smog **3. SLIDE 3 EXPLAIN FIGURE 32-1** Nitrogen oxides (NOx) create a red-brown haze that often hangs over major cities
	**DISCUSSION: Have the students discuss 3 main pollutants for which vehicles are tested. How are the main pollutants produced?**
	**DISCUSSION: Have the students discuss hydrocarbons, carbon monoxide, & oxides of Nitrogen. What are acceptable levels of each pollutant? What are units of measurement for properly tuned and running engine? What is meant by air pollution score (BIN)?**
	**4. SLIDE 4 EXPLAIN EGR** **5. SLIDE 5 EXPLAIN FIGURE 32-2** Typical vacuum-operated EGR valve. The operation of the valve is controlled by the PCM by pulsing the EGR control solenoid on and off **6. SLIDE 6 EXPLAIN FIGURE 32-3** GM electronic EGR valve
	**Exhaust Gas Recirculation, EGR** **Show ANIMATION** **http://www.jameshalderman.com/**

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	**DISCUSSION:** Have the students talk about 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?
	**DEMONSTRATION:** While applying vacuum using a hand-held pump, open & close a standard EGR valve so students can see diaphragm & valve operation.
	**DEMONSTRATION:** Pass around various EGR valves to the students. Point out positive and negative backpressure styles and how they vary.
	**DEMONSTRATION:** Pass around both digital and linear EGR valves for the students to see.
	7. **SLIDE 7** EXPLAIN OBD II MONITORING
	**DISCUSSION:** Have students talk about purpose of onboard diagnostic systems. How did computer control systems function prior to OBD-I? Have the students discuss OBD-I. What were some of shortcomings/problems of OBD-I?
	**HANDS-ON TASK:** Have the students locate the diagnostic link connector (DLC) on several OBD-I vehicles using component locators. Ask students to compare various locations to standardized locations on an OBD-II vehicle
	8. **SLIDE 8** EXPLAIN **Positive Crankcase Ventilation** 9. **SLIDE 9** EXPLAIN **FIGURE 32-4** PCV valve and hose on a Ford 5.0-liter V-8. Many are hard to see as they are hidden from view under plastic covers 10. **SLIDE 10** EXPLAIN **FIGURE 32-5** Spring force, crankcase pressure, and intake manifold vacuum work together to regulate the flow rate through the PCV valve

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	**Positive Crankcase Ventilation (PCV)** **Show ANIMATION** **http://www.jameshalderman.com/**
	**DEMONSTRATION: Pass around various PCV valves for the students to see. Students should understand where the PCV valve can be located on an engine**
	**DEMONSTRATION: Show the students how to check valve operation by shaking the valve**
	**HANDS-ON TASK: Have the students locate PCV system components on their own vehicles. Ask them to explain how air flows through the system.**
	11. **SLIDE 11** EXPLAIN **Secondary Air Injection** 12. **SLIDE 12** EXPLAIN **FIGURE 32-6** typical belt-driven AIR pump. Air enters through the 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 same time air is being drawn into the pump. 13. **SLIDE 13** EXPLAIN **Secondary Air Injection** 14. **SLIDE 14** EXPLAIN **FIGURE 32-7** external air manifold and exhaust check valve on a restored muscle car engine 15. **SLIDE 15** EXPLAIN **FIGURE 32-8** typical electric motor–driven SAI pump. This unit is on a Chevrolet Corvette and only works when the engine is cold
	**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: Have the students use electronic service information COMPONENT LOCATOR to locate the secondary air-injection components on their own cars. Students should be able to identify components and explain their operation and purposes.**

ICONS	Ch32 Emission Control Devices
	**Show ANIMATION: CATALYTIC CONVERTER OPERATION: www.myautomotivelab.com** http://media.pearsoncmg.com/ph/chet/chet_myautomotivelab_2/animations/A16_Animation/Chapter62_Fig_62_22/index.htm
	**Catalytic Converter (2004+)** **Show ANIMATION** **http://www.jameshalderman.com/**
	16. **SLIDE 16 EXPLAIN Catalytic Converters** 17. **SLIDE 17 EXPLAIN FIGURE 32-9** Most catalytic converters are located as close to the exhaust manifold as possible, as seen in this display of a Chevrolet Corvette. 18. **SLIDE 18 EXPLAIN FIGURE 32-10** three-way catalytic converter first separates the NOx into nitrogen and oxygen and then converts HC and CO into harmless water (H2O) and carbon dioxide (CO2). The nitrogen (N) passes through the converter, exits the tailpipe, and enters the atmosphere, which is about 78% nitrogen
	**DEMONSTRATION: With 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 the past few years, these components have become popular among thieves. Owners of trucks & 4WD vehicles have returned to their parked vehicles to find that thieves have stolen their catalytic converters with battery-powered reciprocating saw. Replacements can run as high as $2,500.**
	**DISCUSSION: Have the students discuss how often a PCM tests a catalytic converter. How is catalytic converter monitor classified? When will the monitor check the efficiency of converter? What will happen if the test fails?**
	**DEMONSTRATION: Have the students talk about diagnosing catalytic converters. How are catalytic converters tested?**

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	**DEMONSTRATION: Connect a digital storage oscilloscope (DSO) to an Upstream Oxygen Sensor & operate engine at normal operating temperature. Show waveform of an upstream oxygen sensor in operation**
	**Evaporative Emission Control System** **Show ANIMATION** **http://www.jameshalderman.com/**
	19. **SLIDE 19** EXPLAIN Evaporative Emission Control System 20. **SLIDE 20** EXPLAIN **Figure 32-11** charcoal canister can be located under the hood or underneath the vehicle. EVAP system includes all of the lines, hoses, and valves, plus the charcoal canister.
	**DISCUSSION: Have the students list and describe main functions of the evaporative system & potential problems. What is the system designed to do with fuel vapors (hydrocarbons)? What are potential problems with the system?**
	**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?**

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	**DEMONSTRATION: Show how to use an alcohol test kit to obtain a sample of fuel from a vehicle & test for alcohol content.**
	21. **SLIDE 21 EXPLAIN Figure 32-12** enhanced EVAP system is able to perform system and leak detection diagnosis. 22. **SLIDE 22 EXPLAIN** Evaporative Emission Control System 22. **SLIDE 22 EXPLAIN FIGURE 32-13** Some vehicles will display a message if an evaporative control system leak is detected that could be the result of a loose gas cap
	**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.**
	**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**
	**ON-VEHICLE NATEF TASK (A8-E-11) Inspect and test components and hoses of evaporative emissions control system; perform necessary action. (P-1) Page 258**
	**Homework: complete Ch32 crossword puzzle: http://www.jameshalderman.com/links/book_intro/cw/crossword_ch_32.pdf**