Automotive Technology 6th Edition
Chapter 86 Exhaust Gas Recirculation Systems
Opening Your Class

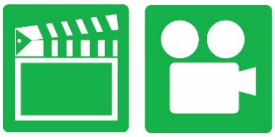
KEY ELEMENT	EXAMPLES
Introduce Content	This Automotive Technology 6th text provides complete coverage of automotive components, operation, design, and troubleshooting. It correlates material to task lists specified by ASE and ASEEducation (NATEF) and emphasizes a problem-solving approach. Chapter features 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 on NEXT SLIDE. 1. Discuss the purpose and function of exhaust gas recirculation (EGR) systems. 2. Explain the strategies to monitor onboard diagnostics generation II (OBD-II) exhaust gas recirculation (EGR) systems. 3. Explain how to diagnose a defective EGR system and interpret EGR -related OBD-II 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 86 Chapter Images: From

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

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

ICONS	Ch86 Exhaust Gas Recirculation Systems
	**1. SLIDE 1 CH86 EXHAUST GAS RECIRCULATION 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**
	**Exhaust Gas Recirculation, EGR (View) (Download)**
	**2. SLIDE 2 EXPLAIN Figure 86-1** Nitrogen oxides (NO_x) create a red-brown haze that often hangs over major cities
 	**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 86-1**
	**3. SLIDE 3 EXPLAIN Figure 86-2** When the EGR valve opens, the exhaust gases flow through the valve and into passages in the intake manifold
	**DEMONSTRATION: While applying vacuum using a hand-held pump, open & close a standard EGR valve so students can see diaphragm & valve operation. FIGURE 86-2**
	**DEMONSTRATION: Pass around various EGR valves to the students. Point out positive and negative FIGURE 86-2 backpressure styles and how they vary.**

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	4. **SLIDE 4 EXPLAIN Figure 86-3** Back pressure in the exhaust system is used to close the control valve, allowing engine vacuum to open the EGR valve. 5. **SLIDE 5 EXPLAIN Figure 86-4** Typical vacuum-operated EGR valve. The operation of the valve is controlled by the PCM by pulsing the EGR control solenoid on and off.
	**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.**
	6. **SLIDE 6 EXPLAIN Figure 86-5** An EGR valve position sensor on top of an EGR valve
	**DEMONSTRATION: Pass around both digital and linear EGR valves for the students to see. FIGURES 86-3, 4, & 5**
	**DEMONSTRATION: Pass around various types of EGR valve position sensors for the students to see. FIGURES 86-3, 4, & 5**
	**EXPLAIN TECH TIP: *Find the Root Cause*** **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.**
	7. **SLIDE 7 EXPLAIN Figure 86-6** Digital EGR valve as used on some older General Motors engines. 8. **SLIDE 8 EXPLAIN Figure 86-7** GM linear EGR valve. 9. **SLIDE 9 EXPLAIN Figure 86-8** EGR valve pintle is pulse-width modulated and a three-wire potentiometer provides pintle-position information back to the PC
	**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.**

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 	**DISCUSSION:** Discuss the difference between linear and Digital EGR valves. What is the difference? FIGURES 86-6, 7, & 8 **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?
	10. **SLIDE 10 EXPLAIN Figure 86-9** typical Ford DPFE sensor and related components. 11. **SLIDE 11 EXPLAIN Figure 86-10** OBD-II active test. The PCM opens the EGR valve and then monitors the MAP sensor and/or engine speed (RPM) to verify that it meets acceptable values
	**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 the 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.
	**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?
	**DISCUSSION:** discuss various types of warning lights that OEMS use & significance of the amber color. What is MIL & what is its color?
	**DISCUSSION:** Discuss OBD II EGR MONITORS, SEE FIGURES 86-9 & 10. How are they used in diagnosis?

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	**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.
	**DISCUSSION:** discuss **detonation**. What is detonation and how is it caused? What are its effects? What kind of mechanical damage can detonation cause to the engine?
	**HANDS-ON TASK:** Have the students look up **OEM procedures for testing EGR system** on their own vehicles.
	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.
	**DEMONSTRATION:** 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.
	**DEMONSTRATION:** On a vehicle with either a **digital or linear EGR valve**, open the valve incrementally with a bidirectional **scan tool** to show students its effects
	**DISCUSS CASE STUDY:** ***Blazer Story:*** **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**

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	vehicle was equipped with an EGR valve-control solenoid, called an electronic vacuum regulator valve (EVRV) by GM. PCM pulses solenoid to control vacuum 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 like a**

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  	**snake in a drainpipe. Some vehicles, such as Hondas, require that plugs be drilled out to gain access to the EGR passages. • SEE FIGURE 86–11.** **11. SLIDE 11 EXPLAIN Figure 86-11** Removing the EGR passage plugs from the intake manifold on a Honda. **ON-VEHICLE ASEEDUCATION TASK E3 3. Diagnose emissions and driveablility 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.**