Light Vehicle Diesel Engines

Chapter 10 Air Induction and EGR Systems

Opening Your Class

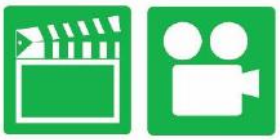
KEY ELEMENT	EXAMPLES
Introduce Content	This Light Vehicle Diesel Engines 1st text provides complete coverage of light duty diesel engine components, operation, and diagnosis. It correlates material to task lists specified by ASE and NATEF and emphasizes a problem-solving approach. Chapter features include Tech Tips, Frequently Asked Questions, and Real World Fixes: www.jameshalderman.com contains Videos, Animations, and Task Sheets for use in the lab and classroom.
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.
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 the chapter learning objectives to the students as listed: 1. Prepare for the ASE Light Vehicle Diesel Engine (A9) ASE certification test content area "E" (Air Induction and Exhaust Systems Diagnosis and Repair). 2. Identify the components of the air induction system. 3. Identify the components of the EGR systems. 4. Describe the function of each of the components in the air induction system. 5. Explain the function of each of the components in the EGR systems. 6. Discuss the diagnosis of drivability concerns related to the air induction and EGR systems.
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: This lesson plan is based on the 1st Edition Chapter Images found on Jim's web site @ www.jameshalderman.com

LINK CHP 10 Chapter Images USE BELOW LINK

http://www.jameshalderman.com/books_a9.html

NOTE: You can use Chapter Images or Power Point files: Though out Power Point Presentations, you will find questions and answers on slides that can be used for discussion.

ICONS	CH10 Air Induction and EGR Systems
	1. SLIDE 1 CH10 AIR INDUCTION AND EGR SYSTEMS
	Check for ADDITIONAL VIDEOS & ANIMATIONS @ http://www.jameshalderman.com/ WEB SITE IS CONSTANTLY UPDATED
	**Light Diesel (111 Links)**
	http://www.jameshalderman.com/books_a9.html Crossword Puzzle (Microsoft Word) (PDF) Word Search Puzzle (Microsoft Word) (PDF)
	**SAFETY** Always be very careful when working on a Diesel engine that is running with air intake removed. Because most diesel ENGINES DO NOT USE a throttle plate, objects can very easily be sucked into engine, causing serious engine damage. MOST OEMs offer intake covers.
	2. SLIDE 2 EXPLAIN FIGURE 10–1 The air filter minder is designed to alert the driver or service technician when the filter element needs to be serviced. The gauge is designed to show the difference between atmospheric pressure and the air pressure in the filter housing under maximum load.
	**DEMONSTRATION:** Show location of air filter minder to the class and demo its operation
	**DISCUSSION:** CHART 10-1 conversion of inches of water to pounds per square inch and inches of mercury
	3. SLIDE 3 EXPLAIN FIGURE 10–2 The air filter housing contains two air inlets. The inlet in the fender is for normal operation and the ram air inlet faces the grille opening.
	DISCUSS FREQUENTLY ASKED QUESTION: Why is Outside Air Used and Under-the-Hood Air Not Used?

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	4. **SLIDE 4 EXPLAIN FIGURE 10–3** The mass air flow sensor provides powertrain control module with data regarding air flow. Exhaust gas recirculation (EGR) strategies are, in part, derived from this sensor. This sensor, along with the boost sensor and temperature sensor are used in the calculation.
	**DEMONSTRATION: Connect a scan tool to a diesel truck and show students how to check operation of MAF sensor**
	**HANDS-ON TASK: have students Connect a scan tool to a diesel truck and check operation of MAF sensor**
	**MAF SENSOR INFO USED FOR EGR OPERATION NOT FUEL INJECTION AMOUNT**
	5. **SLIDE 5 EXPLAIN FIGURE 10–4** The boost pressure sensor, which may be combined with a temperature sensor, is used to calculate the mass of air entering the intake manifold.
	**DEMONSTRATION: Connect a scan tool to a diesel truck and show students how to check BOOST PRESSURE**
	**HANDS-ON TASK: have students Connect a scan tool to a diesel truck and check BOOST PRESSURE**
	6. **SLIDE 6 EXPLAIN FIGURE 10–5** graph depicts the normal voltage to pressure increase graph for a typical boost pressure sensor. 7. **SLIDE 7 EXPLAIN FIGURE 10–6** charge air cooler from a Nissan Titan is an example of the surface area needed to provide sufficient cooling of the air charge after it leaves the turbocharger.
	**DEMONSTRATION: Connect a scan tool to a diesel truck and show students how to check CAC TEMP**

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	**HANDS-ON TASK: have students Connect a scan tool to a diesel truck and check CAC TEMP**
	**DISCUSSION: DIAGNOSIS OF A DIESEL INTAKE AIR SYSTEM**
	8. **SLIDE 8 EXPLAIN FIGURE 10–7** charge air cooler is sealed with test adapters and then pressurized with regulated shop air. The liquid soap and water solution will bubble in area of leak and identify reason for low boost condition. 9. **SLIDE 9 EXPLAIN FIGURE 10–8** The wear on cylinder wall is a result of an incorrectly installed air filter element that allowed unfiltered air into induction system. The foreign material in intake air scored the cylinder walls when it was drawn into the cylinder in a boost condition.
	10. **SLIDE 10 EXPLAIN FIGURE 10–9** The intake heater grid is used to warm intake air and increase pre-ignition temperatures. The heater may continue to be cycled to decrease the amount of time needed to warm the engine.
	**DISCUSS REAL WORLD FIX Case of Erratic Electrical Symptoms (1 of 2)**
	**DISCUSS REAL WORLD FIX Case of Erratic Electrical Symptoms (2 of 2)**
	11. **SLIDE 11 EXPLAIN FIGURE 10–10** glow plug is controlled by the powertrain control module. The glow plug on-time is based on inputs from ECT, BARO, and battery voltage. On-time varies from 1 to 180 seconds. Amperage through glow plug varies with design.
	**DEMONSTRATION: PASS AROUD SEVERAL TYPES OF GLOW PLUGS**

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	12. **SLIDE 12 EXPLAIN FIGURE 10–11** glow plug control module example is from a Nissan Titan equipped with a 5.0 liter Cummins engine. Module controls glow plugs based on messages received from powertrain control module on the high speed CAN Bus network 13. **SLIDE 13 EXPLAIN FIGURE 10–12** Wait-To-Start Light is controlled by PCM & illuminated during the time the glow plugs are heating.
	**DEMONSTRATION: SHOW THE OPERATION OF A WAIT LIGHT**
	**HANDS-ON TASK: :STUDENTS OPERATE A WAIT LIGHT**
	14. **SLIDE 14 EXPLAIN FIGURE 10–13** measuring diaphragm in pressure sensing glow plug is designed to provide feedback on cylinder pressure. Feedback allows the powertrain control module to adjust fuel quantity and timing in an effort to reduce tailpipe emissions.
	15. **SLIDE 15 EXPLAIN FIGURE 10–**14 ohmmeter shows a resistance of 0.9 ohms which is normal for most glow plugs that usually have a specification of 0.6 to 6.0 ohms. Check service information for the exact resistance specification for vehicle being tested.
	**DEMONSTRATION: SHOW HOW TO TEST A GLOW PLUG WITH OHMMETER & HOW TO USE SCAN TOOL TO TEST SYSTEM OPERATION**
	**HANDS-ON TASK: :STUDENTS DOWNLOAD WRING DIAGRAM FOR GLOW PLUG SYSTEM FOR A LAB VEHICLE & TRACE CIRCUIT**
	**HANDS-ON TASK: :STUDENTS TEST GLOW PLUG WITH OHMMETER & USE SCAN TOOL TO TEST SYSTEM OPERATION**
	22. **SLIDE 22 EXPLAIN FIGURE 10–15 EGR** valve meters flow of non-combustible exhaust gases into intake manifold. Exhaust gases displace combustible air in intake air stream & reduce combustion pressures and

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	temperatures, effectively lowering NOx levels in exhaust. 23. **SLIDE 23 EXPLAIN FIGURE 10–16** EGR cooler lowers exhaust gas temperatures, allowing it to absorb more combustion chamber heat. 24. **SLIDE 24 EXPLAIN FIGURE 10–17** electronic throttle valve is used to increase flow of exhaust gases in intake manifold. Position of throttle valve creates a pressure difference in intake manifold draws more exhaust gas into cylinders.
	**DEMONSTRATION: SHOW STUDENT HOW TO USE SCAN TOOL TO CHECK EGR OPERATION**
	25. **SLIDE 25 EXPLAIN FIGURE 10–18 ECM** provides sensor with 5 volt feed and ground. The change in exhaust gas temperature affects resistance of sensor. The resulting change in monitored voltage is used as part of the EGR flow calculation. 26. **SLIDE 26 EXPLAIN FIGURE 10–19** EGR valve is electrically functional; however, passages through valve are almost completely closed due to carbon buildup.
	**HANDS-ON TASK: Have students look up EGR SYSTEM OPERATION & DOWNLOAD WIRING DIAGRAM**
	**DISCUSS REAL WORLD FIX Case of the Failed EGR system 1 OF 2 SLIDES**
	**DISCUSS REAL WORLD FIX Case of the Failed EGR system 2 OF 2 SLIDES**
	**DISCUSS REAL WORLD FIX Case of Duramax EGR Low Flow 1 OF 2 SLIDES**
	**DISCUSS REAL WORLD FIX Case of Duramax EGR Low Flow 2 OF 2 SLIDES**

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	**27. SLIDE 27 EXPLAIN FIGURE 10–19** EGR valve is electrically functional; however, passages through valve are almost completely closed due to carbon buildup. **28. SLIDE 28 EXPLAIN FIGURE 10–20** EGR cooler passages are restricted due to a heavy carbon buildup. The buildup was beyond the normal level that could be cleaned and the unit was replaced. **EXPLAIN TECH TIP The "Simple Green" Treatment** **29. SLIDE 29 EXPLAIN FIGURE 10–21** right side of this exhaust part was soaked in Simple Green. Prior to soaking, areas inside looked like the left side