Light Vehicle Diesel Engines

Chapter 15 Exhaust and Aftertreatment Systems

Opening Your Class

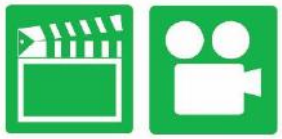
KEY ELEMENT	EXAMPLES
Introduce Content	This Light Vehicle Diesel Engines 1st text provides complete coverage of light duty diesel engine components, operation, and diagnosis. It correlates material to task lists specified by ASE and NATEF and emphasizes a problem-solving approach. Chapter features include 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. Identify the components of the exhaust and aftertreatment systems. 2. Describe the function of each aftertreatment system. 3. Explain the differences between active and passive regeneration. 4. Explain how temperature sensors are used to monitor component operation. 5. Describe the function of the diesel exhaust fluid (DEF) in the selective catalyst reduction (SCR) 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.

NOTE: This lesson plan is based on the 1st Edition Chapter Images found on Jim's web site @ www.jameshalderman.com

LINK CHP 15 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	CH15 EXHAUST/AFTERTREATMENT SYSTEMS
       	**1. SLIDE 1 CH15 EXHAUST & AFTERTREATMENT 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.** **DISCUSS FREQUENTLY ASKED QUESTION:** **DISCUSSION: CHART** **2. SLIDE 2 EXPLAIN FIGURE 15–1** emission chart shows the mandated reductions in tailpipe emissions, how they have driven changes in way diesel engines operate, and how exhaust aftertreatment is configured

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	3. **SLIDE 3 EXPLAIN FIGURE 15–2** Relative size of particulate matter to a human hair
	4. **SLIDE 4 EXPLAIN 15–3 FIGURE 15**–3 emissions certification label identifies how the vehicle is certified**.**
	**DEMONSTRATION: HOW TO LOCATE EMISSIONS CERTIFICATION LABEL & DEFINE TERMS ON THE LABEL**
	**HANDS-ON TASK: :STUDENTS LOCATE EMISSIONS CERTIFICATION LABEL & DEFINE TERMS ON THE LABEL**
	5. **SLIDE 5 EXPLAIN 15–4** exhaust downpipe is constructed to retain heat to help the aftertreatment work as designed
	**EXHAUST SYSTEM COMPONENTS AND EXHAUST AIR STREAM CAN BE HOT ENOUGH TO CAUSE DAMAGE OR PERSONAL INJURY. DO NOT PARK OR OPERATE VEHICLE IN AREAS WHERE EXHAUST MIGHT COME IN CONTACT WITH ANYTHING THAT CAN BURN. USE EXTREME CAUTION WHEN WORKING AROUND THESE COMPONENTS**
	6. **SLIDE 6 EXPLAIN FIGURE 15–4** exhaust downpipe is constructed to retain heat to help the aftertreatment work as designed. 7. **SLIDE 7 EXPLAIN FIGURE 15–5** exhaust backpressure regulator (EBPR) allows engine to warm to operating conditions more quickly**.** 8. **SLIDE 8 EXPLAIN FIGURE 15–6** design of tailpipe allows for cooling of exhaust during regeneration event.
	9. **SLIDE 9 EXPLAIN FIGURE 15–7 diesel oxidation catalyst (DOC) r**educes hydrocarbons (HC) and carbon monoxide (CO) through oxidation. The heat generated from process is used to reduce particulate matter.
	**DEMONSTRATION: HOW TO CHECK**

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	**HANDS-ON TASK: :STUDENTS CHECK**
	10. **SLIDE 10 EXPLAIN IGURE 15–8** NOx Adsorber catalyst holds NOx emissions during lean conditions and oxidizes them when operating conditions are rich.
	11. **SLIDE 11 EXPLAIN FIGURE 15–9** SCR catalyst reduces level of NOx emissions when diesel exhaust fluid (DEF) is injected onto its substrate. 12. **SLIDE 12 EXPLAIN FIGURE 15–10** Diesel exhaust fluid (DEF) is available in consumer-friendly containers or in bulk
	**DEMONSTRATION: HOW TO CHECK DEF LEVEL**
	**HANDS-ON TASK:HAVE STUDENTS CHECK DEF LEVEL**
	13. **SLIDE 13 EXPLAIN FIGURE 15–11** refractometer is used to measure quality of diesel exhaust fluid (DEF**).**
	**Diesel Exhaust Fluid (View) (Download)**
	**DEMONSTRATION: HOW TO CHECK DEF WITH refractometer**
	**HANDS-ON TASK:HAVE STUDENTS CHECK DEF WITH refractometer**
	14. **SLIDE 14 EXPLAIN FIGURE 15–12** reductant dosing module contains DEF injector, diffuser, and mixer.
	**Diesel Air & Exhaust (View) (Download)** **Diesel Particulate Filter (View) (Download)** **Diesel Turbocharger & Intercooler (View)(Download)**

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	15. **SLIDE 15 EXPLAIN FIGURE 15–13** DPF monolith is responsible for capturing particulate matter and holding it until a regeneration event occurs. DPF pictured failed due to internal fracture.
	16. **SLIDE 16 EXPLAIN FIGURE 15–14** DPF warning lamp used to warn driver vehicle needs to be driven in manner that regeneration event can occur.
	**DEMONSTRATION: HOW TO A SCAN TOOL REGENERATION**
	**HANDS-ON TASK:HAVE STUDENTS DO SCAN TOOL REGENERATION**
	17. **SLIDE 17 EXPLAIN FIGURE 15–15** sequence of drawings shows steps of a regeneration event. SENSOR SHOWN IN FIGURE
	18. **SLIDE 18 EXPLAIN FIGURE 15–16** feedback from the differential pressure sensor is used by the powertrain control module to determine when a regeneration event is needed
	19. **SLIDE 19 EXPLAIN FIGURE 15–17** Temperature sensors are used by PCM to monitor function of various components in aftertreatment system.
	20. **SLIDE 20 EXPLAIN FIGURE 15–18** NOx sensor is used to measure NOx emissions in aftertreatment system.