












Automotive Maintenance and Light Repair, 1ST Edition

Chapter 16 DIESEL ENGINE OPERATION

Opening Your Class

KEY ELEMENT	EXAMPLES
Introduce Content	This course or class covers Automotive Maintenance and Light Repair . 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 the chapter learning objectives to the students. <ul style="list-style-type: none">• Prepare for ASE Engine Performance (A8) certification test content area "C" (Fuel, Air Induction, and Exhaust Systems Diagnosis and Repair).• Explain how a diesel engine operates.• Describe the difference between direct injection (DI) and indirect injection (IDI) diesel engines.• List the parts of the typical diesel engine fuel system.• Explain how glow plugs work.• List the advantages and disadvantages of a diesel engine.
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.

ICONS	Ch16 DIESEL ENGINE OPERATION
     <p>QUESTION</p>       <p>QUESTION</p>	<p>1. SLIDE 1 CH16 DIESEL ENGINE OPERATION</p> <p>2. SLIDES 2-3 EXPLAIN OBJECTIVES</p> <p>Check for ADDITIONAL VIDEOS & ANIMATIONS @ http://www.jameshalderman.com/ WEB SITE REGULARLY UPDATED</p> <p>DISCUSSION: ASK STUDENTS TO DISCUSS ADVANTAGES & DISADVANTAGES OF DIESEL ENGINES AS OPPOSED TO GASOLINE ENGINES. ASK STUDENTS WHY A DIESEL BLOCK HAS TO BE CONSTRUCTED MUCH HEAVIER THAN A GASOLINE ENGINE BLOCK.</p> <p><u>VIDEOS</u> <u>Engine Operation (17 Links)</u></p> <p><u>SAFETY</u> 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.</p> <p>4. SLIDE 4 EXPLAIN Diesel Engines</p> <p>5. SLIDE 5 EXPLAIN FIGURE 16-1 Diesel combustion occurs when fuel is injected into the hot, highly compressed air in the cylinder.</p> <p>DISCUSSION: ASK THE STUDENTS WHY DIESEL ENGINE DOES NOT HAVE SPARK PLUGS. (ANS: DIESEL RELIES ON HEAT OF COMPRESSION TO IGNITE FUEL INSTEAD OF SPARK)</p>

ICONS



QUESTION



Ch16 DIESEL ENGINE OPERATION

6. **SLIDE 6 EXPLAIN FIGURE 16-2** typical injector pump type of automotive diesel fuel-injection system.
7. **SLIDE 7 EXPLAIN FIGURE 16-3** Cummins diesel engine as found in a Dodge pickup truck. A high-pressure pump (up to 30,000 PSI) is used to supply diesel fuel to this common rail, which has tubes running to each injector. Note the thick cylinder walls and heavy-duty construction.

SAFETY DIESEL ENGINE FUEL SYSTEMS OPERATE UNDER EXTREMELY HIGH PRESSURE. SEVERE INJURY CAN RESULT IF CAUTION IS NOT OBSERVED WHEN OPENING FUEL SYSTEM. THE HIGH-PRESSURE FUEL CAN ACTUALLY PENETRATE SKIN.

8. **SLIDE 8 EXPLAIN FIGURE 16-4** Rod/piston assembly from a 5.9 L Cummins diesel engine used in Dodge pickup

ANIMATION: DIESEL ENG OPERATION

WWW.MYAUTOMOTIVELAB.COM

HTTP://MEDIA.PEARSONCMG.COM/PH/CHET/CHET_MYAUTOMOTIVELAB_2/ANIMATIONS/A1_ANIMATION/CHAPTER11_FIG_11_5/INDEX.HTM

ANIMATION: DIESEL 4-STROKE CYCLE

HTTP://WWW.JAMESHALDERMAN.COM/ANIMATIONS.HTML#A1

9. **SLIDE 9 EXPLAIN FIGURE 16-5** indirect injection diesel engine uses a prechamber and a glow plug.

DISCUSSION: ASK THE STUDENTS WHY DIESEL FUEL DOES NOT EVAPORATE AS EASILY AS GASOLINE

SHOW ANIMATION: IDI DIESEL OPERATION

HPCR WWW.MYAUTOMOTIVELAB.COM

HTTP://MEDIA.PEARSONCMG.COM/PH/CHET/CHET_MYAUTOMOTIVELAB_2/ANIMATIONS/A1_ANIMATION/CHAPTER11_FIG_11_10/INDEX.HTM

ICONS

Ch16 DIESEL ENGINE OPERATION



QUESTION



QUESTION



10. **SLIDE 10 EXPLAIN FIGURE 16-6** direct injection diesel engine injects the fuel directly into the combustion chamber. Many designs do not use a glow plug.

11. **SLIDE 11 EXPLAIN FREQUENTLY ASKED QUESTION**

SHOW ANIMATION: DI DIESEL OPERATION **[WWW.MYAUTOMOTIVELAB.COM](http://www.myautomotivelab.com)**

[HTTP://MEDIA.PEARSONCMG.COM/PH/CHET/CHET_MYAUTOMOTIVELAB_2/ANIMATIONS/A0_ANIMATION/CHAPTER19_FIG_19_4/IND_EX.HTM](http://media.pearsoncmg.com/ph/chet/chet_myautomotivelab_2/animations/a0_animation/chapter19_fig_19_4/ind_ex.htm)

12. **SLIDE 12 EXPLAIN** Fuel Tank and Lift Pump

13. **SLIDE 13 EXPLAIN FIGURE 16-7** A fuel temperature sensor is being tested using an ice bath.

14. **SLIDE 14 EXPLAIN** Injection Pump

15. **SLIDE 15 EXPLAIN FIGURE 16-8** A typical distributor-type diesel injection pump showing the pump, lines, and fuel filter.

16. **SLIDE 16 EXPLAIN FIGURE 16-9** A schematic of Stanadyne diesel fuel-injection pump assembly showing all of the related components.

DEMONSTRATION: SHOW TYPICAL FUEL FLOW THROUGH A DISTRIBUTOR TYPE OF FUEL SYSTEM. FIGURE 16-9











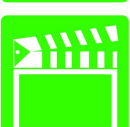

DISCUSSION: ASK THE STUDENTS WHY EACH FUEL LINE OF A DISTRIBUTOR-TYPE INJECTION SYSTEM MUST BE THE SAME LENGTH. (ANSWER: TO ENSURE THAT INJECTOR TIMING IS CORRECT)











17. **SLIDE 17 EXPLAIN FIGURE 16-10** Overview of a computer-controlled **high-pressure common rail** V-8 diesel engine




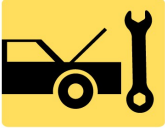



18. **SLIDE 18 EXPLAIN HEUI** System

19. **SLIDE 19 EXPLAIN FIGURE 16-11** HEUI injector from a Ford PowerStroke diesel engine. The O-ring grooves indicate the location of the O-rings that seal the fuel section of injector from coolant and from engine oil.

HANDS-ON TASK: HAVE STUDENTS SEARCH SERVICE INFORMATION FOR BULLETINS RELATING TO OIL CHANGE INTERVALS ON FORD 7.7, 6.0, AND

ICONS	Ch16 DIESEL ENGINE OPERATION
	<p>6.4 LITER DIESEL ENGINES</p> <p>20. SLIDE 20 EXPLAIN Diesel Injector Nozzles</p> <p>21. SLIDE 21 EXPLAIN FIGURE 16-12 Typical computer-controlled diesel engine fuel injectors.</p> <p>22. SLIDE 22 EXPLAIN FIGURE 16-13 A Duramax injector showing all the internal parts.</p>
	<p>DEMONSTRATION: SHOW THE STUDENTS SOME EXAMPLES OF VARIOUS DIESEL INJECTOR NOZZLES.</p> <p>FIGURE 16-13</p>
	<p>HANDS-ON TASK: USING SERVICE INFORMATION, HAVE THE STUDENTS RESEARCH CORRECT PROCEDURE FOR PURGING AIR FROM SPECIFIC VEHICLE EQUIPPED WITH A DIESEL ENGINE.</p>
	<p>23. SLIDE 23 EXPLAIN Glow Plugs</p> <p>24. SLIDE 24 EXPLAIN FIGURE 16-14 A glow plug assortment showing the various types and sizes of glow plugs used. Always use the specified glow plugs</p>
	<p>DEMONSTRATION: SHOW THE STUDENTS SOME EXAMPLES OF GLOW PLUGS AND SHOW THEM HOW TO TEST THEM WITH AN OHMMETER. FIG 16-14</p>
	<p>HANDS-ON TASK: GRADE STUDENTS ON THEIR ABILITY TO TEST GLOW PLUGS AND DETERMINE IF THEY ARE FUNCTIONAL FIGURE 16-14</p>
	<p>25. SLIDE 25 EXPLAIN Diesel Fuel Heaters</p>
	<p>26. SLIDE 26 EXPLAIN Diesel Engine Turbochargers</p>
	<p>27. SLIDE 27 EXPLAIN FIGURE 16-15 Cummins diesel turbocharger is used to increase power and torque</p>
	<p>28. SLIDE 28 EXPLAIN FIGURE 16-16 An air charge cooler is used to cool the compressed air.</p>
	<p>ANIMATION: TURBOCHARGER OPERATION HTTP://WWW.JAMESHALDERMAN.COM/ANIMATIONS.HTML#A1</p>
	<p>ANIMATION: TURBOCHARGER BLOW-OFF VALVE HTTP://WWW.JAMESHALDERMAN.COM/ANIMATIONS.HTML#</p>

ICONS	Ch16 DIESEL ENGINE OPERATION
     <p>QUESTION</p>     	<p>A1 <u>ANIMATION: TURBOCHARGER WASTEGATE</u> HTTP://WWW.JAMESHALDERMAN.COM/ANIMATIONS.HTML#A1</p> <p>A1 DEMONSTRATION: GIVEN A DIESEL ENGINE EQUIPPED WITH AN EGR SYSTEM, POINT OUT VARIOUS COMPONENTS THAT MAKE UP EGR SYS.</p> <p>29. SLIDE 29 EXPLAIN Diesel Exhaust Emission Control Systems</p> <p>30. SLIDE 30 EXPLAIN FIGURE 16-17 Aftertreatment of diesel exhaust is handled by the DOC and DPF</p> <p>31. SLIDE 31 EXPLAIN FIGURE 16-18 The soot is trapped in the passages of the DPF. The exhaust has to flow through the sides of the trap and exit</p> <p>DISCUSSION: ASK THE STUDENTS HOW RECIRCULATING HOT EXHAUST GASES HELPS COOL THE COMBUSTION.</p> <p>32. SLIDE 32 EXPLAIN FIGURE 16-19 Diesel exhaust fluid costs \$3 to \$4 a gallon and is housed in a separate container that holds from 5 to 10 gallons, or enough to last until the next scheduled oil change in most diesel vehicles that use SCR (Selective catalytic reduction)</p> <p>DEMONSTRATION: ON A NEWER VEHICLE EQUIPPED WITH A DOC AND A DPF, POINT OUT THE COMPONENTS ON THE VEHICLE.</p> <p>SAFETY USUALLY REGENERATION OF PARTICULATE FILTER OCCURS WHEN DRIVEN. AT TIMES VEHICLE MAY REQUIRE REGEN IN THE SHOP. MAKE SURE THAT VEHICLE IS PARKED OUTSIDE AWAY FROM ANY OTHER VEHICLES BEFORE STARTING REGENERATION PROCESS.</p> <p>HANDS-ON TASK: USING SERVICE INFORMATION, HAVE THE STUDENTS LOOK UP WHAT SYMPTOMS WOULD RESULT FROM EXCESSIVE EXHAUST BACK PRESSURE.</p>

ICONS	Ch16 DIESEL ENGINE OPERATION
	<p>33. SLIDE 33 EXPLAIN Figure 16-20 Urea (diesel exhaust fluid) injection is used to reduce NOx exhaust emissions. It is injected after the diesel oxidation catalyst (DOC) and before the diesel particulate filter (DPF) on this 6.7 liter Ford diesel engine.</p>
	
	
	<p>DEMONSTRATION: USING A SCAN TOOL ON VEHICLE EQUIPPED WITH A PARTICULATE FILTER, SHOW STUDENTS SCAN TOOL DATA THAT RELATES TO PARTICULATE FILTER REGENERATION</p>
	<p>DEMONSTRATION: IF YOU HAVE ACCESS TO A VEHICLE WITH UREA INJECTION, SHOW STUDENTS THE COMPONENTS THAT COMPRISE THE UREA INJECTION SYSTEM. (INTRODUCED IN 2010 MODEL YEAR GM DURAMAX ENGINE) FIG 16-20</p>
	<p>HANDS-ON TASK: HAVE THE STUDENTS SEARCH FOR SOURCES AND PRICES OF DIESEL UREA</p>
	<p>SOME STATES DO RANDOM SMOKE TESTS ON HEAVY DUTY DIESELS AS PART OF THEIR CLEAN AIR PROGRAM. IF THE VEHICLES FAIL THIS SMOKE TEST THERE CAN BE HEAVY FINES, OR VEHICLE MAY BE REQUIRED TO BE PARKED UNTIL REPAIRED.</p>
	<p>34. SLIDE 34 EXPLAIN Diesel Emission Control Systems</p>
	<p>HOMEWORK: COMPLETE CH16 CROSSWORD PUZZLE: HTTP://WWW.JAMESHALDERMAN.COM</p>