

Introduction to Automotive Service

Chapter 15 Diesel Engine Operation

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 the chapter learning objectives to the students. <ol style="list-style-type: none">1. Prepare for ASE Engine Performance (A8) certification test content area "C" (Fuel, Air Induction, and Exhaust Systems Diagnosis and Repair).2. Explain how a diesel engine works.3. Describe the difference between direct injection (DI) and indirect injection (IDI) diesel engines.4. List the parts of the typical diesel engine fuel system.5. Explain how glow plugs work.6. List the advantages and disadvantages of a diesel engine.
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.

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      	<p>1. SLIDE 1 Ch15 DIESEL ENGINE OPERATION</p> <p><u>DISCUSSION:</u> 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>Check for ADDITIONAL VIDEOS & ANIMATIONS @ http://www.jameshalderman.com/ WEB SITE REGULARLY UPDATED</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>2. SLIDE 2 EXPLAIN Diesel Engines</p> <p>3. SLIDE 3 EXPLAIN FIGURE 15-1 Diesel combustion occurs when fuel is injected into the hot, highly compressed air in the cylinder.</p> <p><u>DISCUSSION:</u> 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>

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4. **SLIDE 4 EXPLAIN FIGURE 15-2** typical injector pump type of automotive diesel fuel–injection system.
5. **SLIDE 5 EXPLAIN FIGURE 15-3** 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.



6. **SLIDE 6 EXPLAIN FIGURE 15-4** Rod/piston assembly from a 5.9 liter Cummins diesel engine used in a Dodge pickup truck.



Show 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)

http://media.pearsoncmg.com/ph/chet/chet_myautomotivelab_2/animations/A1_Animation/Chapter11_Fig_11_5/index.htm



Show ANIMATION: Diesel 4-Stroke Cycle
<http://www.jameshalderman.com/animations.html#a1>



7. **SLIDE 7 EXPLAIN FIGURE 15-5** indirect injection diesel engine uses a prechamber and a glow plug.

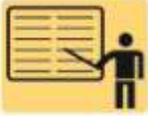


DISCUSSION: Ask the students why diesel fuel does not evaporate as easily as gasoline



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)

http://media.pearsoncmg.com/ph/chet/chet_myautomotivelab_2/animations/A1_Animation/Chapter11_Fig_11_10/index.htm

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	<p>8. SLIDE 8 EXPLAIN FIGURE 15-6 direct injection diesel engine injects the fuel directly into the combustion chamber. Many designs do not use a glow plug.</p>
 QUESTION	<p>9. SLIDE 9 EXPLAIN FREQUENTLY ASKED QUESTION</p>
	<p>Show ANIMATION: DI DIESEL OPERATION www.myautomotivelab.com http://media.pearsoncmg.com/ph/chet/chet_myautomotivelab_2/animations/A0_Animation/Chapter19_Fig_19_4/index.htm</p>
	<p>10. SLIDE 10 EXPLAIN Fuel Tank and Lift Pump</p> <p>11. SLIDE 11 EXPLAIN FIGURE 15-7 A fuel temperature sensor is being tested using an ice bath.</p>
	<p>12. SLIDE 12 EXPLAIN Injection Pump</p> <p>13. SLIDE 13 EXPLAIN FIGURE 15-8 A typical distributor-type diesel injection pump showing the pump, lines, and fuel filter.</p> <p>14. SLIDE 14 EXPLAIN FIGURE 15-9 A schematic of Stanadyne diesel fuel-injection pump assembly showing all of the related components.</p>
	<p><u>DEMONSTRATION:</u> Show typical fuel flow through a distributor type of fuel system. FIGURE 15-9</p>
	<p><u>DISCUSSION:</u> 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)</p>
	<p>15. SLIDE 15 EXPLAIN FIGURE 15-10 Overview of a computer-controlled high-pressure common rail V-8 diesel engine</p> <p>16. SLIDE 16 EXPLAIN Heui System</p>

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17. **SLIDE 17 EXPLAIN FIGURE 15-11** 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 the students search service information for bulletins relating to oil change intervals on Ford 7.7, 6.0, and 6.4 liter diesel engines

18. **SLIDE 18 EXPLAIN** Diesel Injector Nozzles

19. **SLIDE 19 EXPLAIN FIGURE 15-12** Typical computer-controlled diesel engine fuel injectors.

20. **SLIDE 20 EXPLAIN FIGURE 15-13** A Duramax injector showing all the internal parts.

DEMONSTRATION: Show the students some examples of various diesel injector nozzles.

FIGURE 15-13

HANDS-ON TASK: Using service information, have the students research correct procedure for purging air from specific vehicle equipped with a diesel engine.

21. **SLIDE 21 EXPLAIN** Glow Plugs

22. **SLIDE 22 EXPLAIN FIGURE 15-14** A glow plug assortment showing the various types and sizes of glow plugs used. Always use the specified glow plugs

DEMONSTRATION: Show the students some examples of glow plugs and show them how to test them with an ohmmeter. **FIGURE 15-14**

HANDS-ON TASK: Grade the students on their ability to test glow plugs and determine if they are functional **FIGURE 15-14**

23. **SLIDE 23 EXPLAIN** Diesel Fuel Heaters

24. **SLIDE 24 EXPLAIN** Diesel Engine Turbochargers

25. **SLIDE 25 EXPLAIN FIGURE 15-15** Cummins diesel turbocharger is used to increase the power and torque of

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the engine.

26. **SLIDE 26 EXPLAIN FIGURE 15-16** An air charge cooler is used to cool the compressed air.

ANIMATION: Turbocharger Operation
<http://www.jameshalderman.com/animations.html#a1>

ANIMATION: Turbocharger Blow-Off Valve
<http://www.jameshalderman.com/animations.html#a1>

ANIMATION: Turbocharger Wastegate
<http://www.jameshalderman.com/animations.html#a1>

DEMONSTRATION: Given a diesel engine equipped with an EGR system, point out the various components that make up the EGR system.

27. **SLIDE 27 EXPLAIN** Diesel Exhaust Emission Control Systems
28. **SLIDE 28 EXPLAIN FIGURE 15-17** Aftertreatment of diesel exhaust is handled by the DOC and DPF
29. **SLIDE 28 EXPLAIN FIGURE 15-18** The soot is trapped in the passages of the DPF. The exhaust has to flow through the sides of the trap and exit

DISCUSSION: Ask the students how recirculating hot exhaust gases helps cool the combustion.

29. **SLIDE 28 EXPLAIN FIGURE 15-19** 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)

DEMONSTRATION: On a newer vehicle equipped with a DOC and a DPF, point out the components on the vehicle.

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	<p><u>SAFETY</u> Usually regeneration of particulate filter occurs when vehicle is driven. At times a vehicle may require regeneration in the shop. Make sure that the vehicle is parked outside away from any other vehicles before starting regeneration process.</p>
	<p><u>HANDS-ON TASK:</u> Using service information, have the students look up what symptoms would result from excessive exhaust back pressure.</p>
	<p>30. SLIDE 30 <u>EXPLAIN</u> Figure 15-20 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><u>DEMONSTRATION:</u> Using a scan tool on vehicle equipped with a particulate filter, show students scan tool data that relates to particulate filter regeneration</p>
	<p><u>DEMONSTRATION:</u> 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) <u>FIGURE 15-20</u></p>
	<p><u>HANDS-ON TASK:</u> 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>31. SLIDE 31 <u>EXPLAIN</u> Diesel Emission Control Systems</p>
	<p><u>Homework:</u> complete Ch15 crossword puzzle: http://www.jameshalderman.com/links/book_intro/cw/crossword_ch_15.pdf</p>