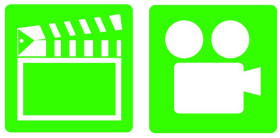
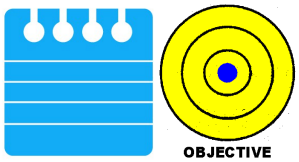
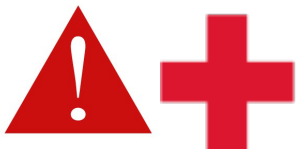
A8 Engine Performance 4th Edition

Chapter 4 Diesel Engine Operation

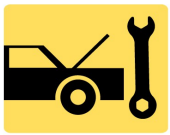
Opening Your Class

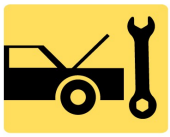
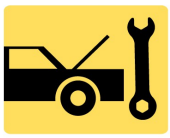
KEY ELEMENT	EXAMPLES
Introduce Content	This course or class covers operation and service of **Automotive Engine Performance.** It correlates material to task lists specified by ASE and NATEF.
Motivate Learners	Explain how the knowledge of how something works translates into the ability to use that knowledge 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. 1. Prepare for ASE Engine Performance (A8) certification test content area "C" (Fuel, Air Induction, and exhaust System 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. List the advantages and disadvantages of a diesel engine. 6. Describe how diesel fuel is rated and tested.
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.

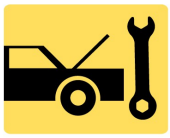
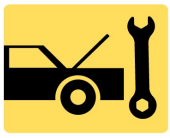
ICONS	Ch04 Diesel Engine Operation
	1. SLIDE 1 CH4 Diesel Engine Operation
	Check for ADDITIONAL VIDEOS & ANIMATIONS @ http://www.jameshalderman.com/ WEB SITE REGULARLY UPDATED
	POWER POINTS DONE BY INDIVIDUAL LEARNING OBJECTIVES, SO THERE IS POWER POINT FILE FOR EACH LEARNING OBJECTIVE
	DISCUSSION: ASK STUDENTS TO DISCUSS ADVANTAGES & DISADVANTAGES OF DIESEL ENGINES AS OPOSED TO GASOLINE ENGINES. ASK STUDENTS WHY A DIESEL BLOCK HAS TO BE CONSTRUCTED MUCH HEAVIER THAN A GASOLINE ENGINE BLOCK.
	VIDEOS Engine Operation (17 Links)
	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 OBJECTIVE CH4 AEP_LO1 3. SLIDE 3 EXPLAIN diesel engines
	4. SLIDE 4 EXPLAIN FIGURE 4-1 Diesel combustion occurs when fuel is injected into the hot, highly compressed air in the cylinder.
	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)

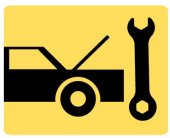
ICONS	Ch04 Diesel Engine Operation
	5. SLIDE 5 EXPLAIN FIGURE 4-2 typical injector pump type of automotive diesel fuel–injection system
	**SAFETY DIESEL ENGINE FUEL SYSTEMS OPERATE UNDER EXTREMELY HIGH PRESSURE. SEVERE INJURY CAN RESULT IF CAUTION IS NOT OBSERVED WHEN OPENING FUEL SYSTEM. HIGH-PRESSURE FUEL CAN ACTUALLY PENETRATE SKIN.**
	**SHOW ANIMATION: DIESEL ENG OP WWW.MYAUTOMOTIVELAB.COM** 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
	6. SLIDE 6 EXPLAIN FIGURE 4–3 An 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
	7. SLIDE 7 EXPLAIN FIGURE 4-4 direct injection diesel engine injects the fuel directly into the combustion chamber. Many designs do not use a glow plug.
	**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

ICONS	Ch04 Diesel Engine Operation
	8. **SLIDE 8 EXPLAIN** DIESEL FUEL IGNITION 9. **SLIDE 9 EXPLAIN** THREE PHASES OF COMBUSTION 10. **SLIDE 10 EXPLAIN FIGURE 4–5** The common rail on a Cummins diesel engine. 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. 11. **SLIDE 11 EXPLAIN FIGURE 4–6** A rod/piston assembly from a 5.9-liter Cummins diesel engine used in a Dodge pickup truck.
 	2. **SLIDE 2 EXPLAIN OBJECTIVE CH4 AEP_LO2** 3. **SLIDES 3-5 EXPLAIN Advantages and Disadvantages to a Diesel Engine**
 	2. **SLIDE 2 EXPLAIN OBJECTIVE CH4 AEP_LO3** **EXPLAIN difference between direct injection (DI) and indirect injection (IDI) diesel engines.**
	3. **SLIDE 3 EXPLAIN FIGURE 4–3** An indirect injection diesel engine uses a prechamber and a glow plug
	4. **SLIDE 4 EXPLAIN FIGURE 4-4** direct injection diesel engine injects the fuel directly into the combustion chamber. Many designs do not use a glow plug. 5. **SLIDE 5 EXPLAIN** Direct and Indirect combustion chambers
 	2. **SLIDE 2 EXPLAIN OBJECTIVE CH4 AEP_LO4**

ICONS	Ch04 Diesel Engine Operation
	3. **SLIDE 3 EXPLAIN** Fuel Tank and Lift Pump 4. **SLIDE 4 EXPLAIN FIGURE 4-7** fuel temperature sensor is being tested using an ice bath. 5. **SLIDES 5-6 EXPLAIN** Injection Pump 7. **SLIDE 7 EXPLAIN FIGURE 4-8** typical distributor-type diesel injection pump showing pump, lines, & filter. 8. **SLIDES 8-9 EXPLAIN** Injection Pump 10. **SLIDE 10 EXPLAIN FIGURE 4-9** 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 4-9**
	**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)**
	11. **SLIDE 11 EXPLAIN** HPCR 12. **SLIDE 12 EXPLAIN FIGURE 4-10** Overview of a computer-controlled high-pressure common rail V-8 diesel engine 13. **SLIDE 13 EXPLAIN** Heui System 14. **SLIDE 14 EXPLAIN FIGURE 11-11** 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: STUDENTS SEARCH SERVICE INFORMATION FOR BULLETINS RELATING TO OIL CHANGE INTERVALS ON FORD 7.7, 6.0, AND 6.4 LITER DIESEL ENGINES**
	15. **SLIDES 15-16 EXPLAIN** Diesel Injector Nozzles 17. **SLIDE 17 EXPLAIN FIGURE 4-12** Typical computer-controlled diesel engine fuel injectors.
	**DEMONSTRATION: SHOW THE STUDENTS SOME EXAMPLES OF VARIOUS DIESEL INJECTOR NOZZLES**

ICONS	Ch04 Diesel Engine Operation
	**HANDS-ON TASK: USING SERVICE INFORMATION, HAVE THE STUDENTS RESEARCH CORRECT PROCEDURE FOR PURGING AIR FROM SPECIFIC VEHICLE EQUIPPED WITH A DIESEL ENGINE.**
	2. SLIDE 2 EXPLAIN **OBJECTIVE CH4 AEP_LO5 Explain how glow plugs work**
	3. SLIDES 3-5 EXPLAIN Glow Plug Resistance Balance Test
	**DEMONSTRATION: SHOW HOW TO PERFORM A CYLINDER BALANCE TEST ON VEHICLE THAT IS EQUIPPED WITH GLOW PLUGS.**
	**HANDS-ON TASK: HAVE THE STUDENTS PERFORM A GLOW PLUG RESISTANCE TEST**
	6. SLIDE 6 EXPLAIN FIGURE 4–22 A typical pop tester used to check the spray pattern of a diesel engine injector.
	2. SLIDE 2 EXPLAIN **OBJECTIVE CH4 AEP_LO6 EXPLAIN how diesel fuel is rated and tested**
	3. SLIDES 3-5 EXPLAIN Diesel Emission Testing
	6. SLIDE 6 EXPLAIN FIGURE 4–23 The letters on the side of this injector on a Cummins 6.7 liter diesel indicate the calibration number for the injector
	**DISCUSSION: WHY DOES A DIESEL NOT GENERATE ENOUGH VACUUM TO OPERATE VACUUM-CONTROLLED DEVICES: (ANS: TO GENERATE VACUUM, YOU NEED A RESTRICTION TO INCOMING AIR SUCH AS A THROTTLE PLATE. SINCE MOST DIESELS DO NOT HAVE THROTTLE PLATE, THERE IS NO RESTRICTION TO INCOMING AIR & VERY LITTLE VACUUM IS CREATED NOR IS THERE A WAY TO RETAIN VACUUM)**

ICONS	Ch04 Diesel Engine Operation
	**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 VARIOUS COMPONENTS THAT MAKE UP EGR SYSTEM.**
 	**DISCUSSION: ASK THE STUDENTS HOW RECIRCULATING HOT EXHAUST GASES HELPS COOL THE COMBUSTION.**
	**DEMONSTRATION: ON A NEWER VEHICLE EQUIPPED WITH A DOC AND A DPF, POINT OUT THE COMPONENTS ON THE VEHICLE.**
	**HANDS-ON TASK: USING SERVICE INFORMATION, HAVE THE STUDENTS LOOK UP WHAT SYMPTOMS WOULD RESULT FROM EXCESSIVE EXHAUST BACK PRESSURE.**
	**DEMONSTRATION: USING A SCAN TOOL ON VEHICLE EQUIPPED WITH A PARTICULATE FILTER, SHOW STUDENTS SCAN TOOL DATA THAT RELATES TO PARTICULATE FILTER REGENERATION**
	**DEMONSTRATION: USING A SCAN TOOL ON VEHICLE EQUIPPED WITH A PARTICULATE FILTER, SHOW STUDENTS SCAN TOOL DATA THAT RELATES TO PARTICULATE FILTER REGENERATION**
	**HANDS-ON TASK: HAVE THE STUDENTS SEARCH FOR SOURCES AND PRICES OF DIESEL UREA**
	**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**

ICONS	Ch04 Diesel Engine Operation
	VEHICLE MAY BE REQUIRED TO BE PARKED UNTIL REPAIRED. **DEMONSTRATION:** SHOW THE STUDENTS HOW TO PERFORM DIESEL ENGINE COMPRESSION TEST
	**HANDS-ON TASK:** HAVE THE STUDENTS PERFORM A COMPRESSION TEST ON A DIESEL ENGINE.
	**DISCUSSION:** ASK THE STUDENTS WHY A DIESEL ENGINE REQUIRES SUCH A HIGH FUEL PRESSURE.