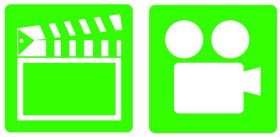
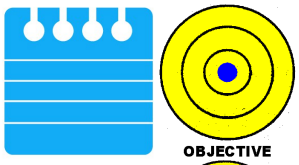
A8 Engine Performance 4th Edition

Chapter 28 Gasoline Direct-Injection Systems

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 the ASE certification test content area "C" (Fuel, Air Induction, and exhaust System Diagnosis). 2. Describe the difference between port fuel-injection and gasoline direct-injection systems. 3. List the various modes of operation of a gasoline direct-injection system. 4. Explain how a gasoline direct-injection system works. 5. Perform a visual inspection of the gasoline direct-injection system and identify the parts.
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	Ch28 Gasoline Direct-Injection Systems
	1. SLIDE 1 CH28 Gasoline Direct-Injection Systems
	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
	2. SLIDE 2 EXPLAIN OBJECTIVE CH28 AEP_LO1 3. SLIDES 3-6 EXPLAIN Direct Fuel Injection
	7. SLIDE 7 EXPLAIN Figure 28-1 gasoline direct-injection system injects fuel under high pressure directly into the combustion chamber
	ANIMATION: GASOLINE DIRECT FUEL INJECT:WWW.MYAUTOMOTIVELAB.COM HTTP://MEDIA.PEARSONCMG.COM/PH/CHET/CHET_MYAUTOMOTIVELAB_2/ANIMATIONS/A16_ANIMATION/CHAPTER59_FIG_59_10/INDEX.HTM
	DIRECT FUEL INJECTION, MECHANICAL
	DISCUSSION: DISCUSS THE OPERATION OF A GASOLINE DIRECT INJECTION SYSTEM. WHAT ARE ADVANTAGES & DISADVANTAGES OF THIS TYPE OF INJECTION SYSTEM? ARE DISADVANTAGES ENOUGH TO LIMIT ITS USE? 8. SLIDES 8-9 EXPLAIN Advantages of Gasoline Direct Injection 10. SLIDES 10-11 EXPLAIN Disadvantages of Gasoline Direct Injection 12. SLIDE 12 EXPLAIN Figure 28-2 engine equipped with a gasoline direct injection (GDI) sometimes requires a NO_X catalyst to meet exhaust emission standards
	DISCUSSION: REVIEW WITH THE STUDENTS WHAT A NOX STORAGE CATALYST IS AND HOW IT FUNCTIONS. WHY IS A NO_X STORAGE CATALYST

ICONS	Ch28 Gasoline Direct-Injection Systems
	**SOMETIMES REQUIRED TO MEET EMISSION STANDARDS? FIGURE 28-2** **SAFETY HIGH-PRESSURE FUEL SYSTEMS ARE VERY DANGEROUS. HIGH PRESSURE FUEL CAN PENETRATE SKIN. IT ALSO CAN SEVERELY INJURY THE EYES OR CAUSE BLINDNESS.**
	13. **SLIDE 13 EXPLAIN** Direct-Injection Fuel Delivery System
	14. **SLIDE 14 EXPLAIN Figure 28-3** typical direct-injection system uses 2 pumps—one low-pressure electric pump in fuel tank and other a high-pressure pump driven by camshaft. The high pressure fuel system operates at a pressure as low as 500 PSI during light load conditions and as high as 2,900 PSI under heavy loads 15. **SLIDE 15 EXPLAIN Figure 28-4** A typical camshaft-driven high-pressure pump used to increase fuel pressure to 2,000 PSI or higher.
	**DISCUSSION: HAVE THE STUDENTS TALK ABOUT THE LOW-PRESSURE SUPPLY PUMP. HOW IS IT SIMILAR TO ANY OTHER FUEL INJECTION SUPPLY PUMP? FIGURE 28-3 & 4**
	16. **SLIDE 16 EXPLAIN Figure 28-5** gasoline direct-injection (GDI) fuel rail and pump assembly with the electric pressure control valve.
	**DISCUSSION: DISCUSS COMMON FUEL RAIL SUPPLY SYSTEM. WHY IS IT NECESSARY TO USE THIS SYSTEM? FIGURE 28-5**
	**DISCUSSION: ASK THE STUDENTS TO DISCUSS THE FUEL RAIL PRESSURE SENSOR USED ON DIRECT-INJECTION SYSTEMS. WHY DO THESE SYSTEMS NEED A PRESSURE SENSOR?**
	2. **SLIDE 2 EXPLAIN OBJECTIVE CH28 AEP_LO2** **REPEAT SLIDES 3-16 FROM AEP_01**
	18. **SLIDES 18-19 EXPLAIN** Gasoline Direct-Injection Fuel Injectors

ICONS	Ch28 Gasoline Direct-Injection Systems
	**DISCUSSION: DISCUSS CHART 28–1. HAVE THEM COMPARE SPECS FOR PORT FUEL INJECTORS WITH THOSE FOR DIRECT FUEL INJECTORS**
	2. SLIDE 2 EXPLAIN **OBJECTIVE CH28 AEP_LO3** 3. SLIDES 3-4 EXPLAIN Modes of Operation
	**DEMONSTRATION: SHOW EXAMPLE OF A GASOLINE DIRECT FUEL-INJECTION INJECTOR, IF AVAILABLE. A LOCAL DEALER MAY LET YOU BORROW A DIRECT FUEL INJECTION INJECTOR TO SHOW TO CLASS.**
	**DISCUSSION: ASK THE STUDENTS TO DISCUSS THE DIFFERENT MODES OF OPERATION OF DIRECT FUEL-INJECTION SYSTEMS. DO THEY SEE ANY ADVANTAGES TO THESE DIFFERENT MODES OF OPERATION?**
	5. SLIDES 5-6 EXPLAIN Piston Top Designs 7. SLIDE 7 EXPLAIN **Figure 28-6** In this design, the fuel injector is at the top of the cylinder and sprays fuel into the cavity of the piston. 8. SLIDE 8 EXPLAIN **Figure 28-7** The side injector combines with the shape of the piston to create a swirl as the piston moves up on the compression stroke. 9. SLIDE 9 EXPLAIN **Figure 28-8** The piston creates a tumbling force as the piston moves upward.
	**DEMONSTRATION: SHOW PISTON FROM A PORT FUEL INJECTED ENGINE. SHOW THEM PISTON FROM A DIRECT FUEL-INJECTED ENGINE, IF AVAILABLE, EXPLAIN DIFFERENCE(S)**
	**DISCUSSION: DISCUSS PISTON TOP DESIGNS USED IN DIRECT FUEL-INJECTION ENGINES. HOW MIGHT A DESIGN FOR DIRECT FUEL-INJECTION ENGINE BE DIFFERENT FROM THAT OF A PORT-INJECTED ENGINE? FIGURES 28-6, 7, 8**
	10. SLIDES 10-11 EXPLAIN Lexus Port- and Direct-Injection Systems 12. SLIDE 12 EXPLAIN **Figure 28-9** Notice that there are conditions when port fuel-injector located in intake manifold, and gasoline direct injector, located in cylinder

ICONS	Ch28 Gasoline Direct-Injection Systems
	both operate to provide the proper air–fuel mixture. 13. **SLIDES 13-14 EXPLAIN** Lexus Port- and Direct-Injection Systems
	**DISCUSSION: ASK STUDENTS TO DISCUSS LEXUS SYSTEM THAT COMBINES PORT INJECTORS WITH DIRECT INJECTORS. WHAT MIGHT BE AN ADVANTAGE OF THIS SYSTEM? FIGURE 28-9**
	**DISCUSSION: ASK THE STUDENTS TO DISCUSS THE ENGINE START SYSTEM USED BY MITSUBISHI. HOW WOULD THEY ADAPT TO DRIVING A VEHICLE EQUIPPED WITH THIS TYPE OF SYSTEM?**
	**DISCUSSION: ASK STUDENTS TO DISCUSS SERVICE PROCEDURES FOR GASOLINE DIRECT-INJECTION SYSTEMS. WHY DO DIRECT-INJECTION ENGINES ACCUMULATE CARBON BUILDUP, ESPECIALLY IF THEY ARE MORE FUEL EFFICIENT?**
	**DEMONSTRATION: SHOW VALVE FROM AN ENGINE THAT HAS CARBON BUILDUP. EXPLAIN THAT THIS BUILDUP, IF SEVERE ENOUGH, CAN RESTRICT AIRFLOW. FIGURE 28-10**
	**ON-VEHICLE NATEF TASK: GASOLINE DIRECT INJECTION IDENTIFICATION: RESEARCH SERVICE INFORMATION, SUCH AS ENGINE MANAGEMENT SYSTEM OPERATION, VEHICLE SERVICE HISTORY, AND TSBS**