Advanced Engine Performance Diagnosis 6/E

Chapter 24 Gasoline Direct Injection (GDI)

Opening Your Class

KEY ELEMENT	EXAMPLES
Introduce Content	This course or class covers operation and service of **ADVANCED Automotive Engine Performance Diagnosis 6/E.** 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. Explain the operation of a direct-injection fuel delivery system. 2. Understand a gasoline direct-injection fuel injector, the modes of operation. 3. Describe the port- and direct-injection systems used in Lexus vehicles. 4. Describe how to diagnose a gasoline direct injection 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 Advanced Engine Performance Diagnosis 6/E Chapter Images found on Jim's web site @ www.jameshalderman.com
LINK CHP 24: Chapter Images

ICONS	Ch24 Gasoline Direct Injection
	**1. SLIDE 1 CH24 Gasoline Direct Injection**
	**Check for ADDITIONAL VIDEOS & ANIMATIONS @ http://www.jameshalderman.com/** **WEB SITE REGULARLY UPDATED** **Engine Controls (284 Links)**
	**At the beginning of this class, you can download the crossword puzzle & Word Search from the links below to familiarize your class with the terms in this chapter & then discuss them** **Crossword Puzzle (Microsoft Word) (PDF)** **Word Search Puzzle (Microsoft Word) (PDF)**
	
	**2. SLIDE 2 EXPLAIN Figure 24-1** A gasoline direct-injection system injects fuel under high pressure directly into the combustion chamber **DIRECT FUEL INJECTION, MECHANICAL**
	
	**DISCUSSION: HAVE THE STUDENTS 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? FIGURE 24-1**
	3. SLIDE 3 EXPLAIN Figure 24-2 engine equipped with a gasoline direct injection (GDI) sometimes requires a NO_X catalyst to meet exhaust emission standards
	**DISCUSSION: DISCUSS NOX STORAGE CATALYST IS AND HOW IT FUNCTIONS. WHY IS A NO_X STORAGE CATALYST SOMETIMES REQUIRED TO MEET EMISSION STANDARDS? FIGURE 24-2**

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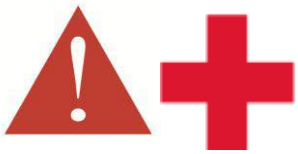	**SAFETY HIGH-PRESSURE FUEL SYSTEMS ARE VERY DANGEROUS. HIGH PRESSURE FUEL CAN PENETRATE SKIN. IT ALSO CAN SEVERELY INJURY THE EYES OR CAUSE BLINDNESS.**
	4. **SLIDE 4 EXPLAIN Figure 24-3** typical direct-injection system uses 2 pumps—one low-pressure electric pump in fuel tank and other a high-pressure 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
	5. **SLIDE 5 EXPLAIN Figure 24-4** 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 24-3 & 4**
	6. **SLIDE 6 EXPLAIN Figure 20-5** 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 24-5**
	**DISCUSSION: ASK THE STUDENTS TO DISCUSS THE FUEL RAIL PRESSURE SENSOR USED ON DIRECT-INJECTION SYSTEMS. WHY DO THESE SYSTEMS NEED A PRESSURE SENSOR?**
	**EXPLAIN CHART 24–1** A comparison chart showing the major differences between a port fuel-injection system and a gasoline direct-injection system
	**DISCUSSION: ASK THE STUDENTS TO DISCUSS CHART 24–1. HAVE THEM COMPARE SPECIFICATIONS FOR PORT FUEL INJECTORS WITH THOSE FOR DIRECT FUEL INJECTORS**
	**DEMONSTRATION: SHOW EXAMPLE OF A GASOLINE DIRECT FUEL-INJECTION INJECTOR, IF AVAILABLE. A LOCAL DEALER MAY LET YOU BORROW A DIRECT FUEL INJECTION**

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	**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?**
	7. **SLIDE 7 EXPLAIN Figure 24-6** 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 24-7** 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 24-8** The piston creates a tumbling force as the piston moves upward.
	**DEMONSTRATION: SHOW STUDENTS A PISTON FROM A PORT FUEL INJECTED ENGINE. SHOW THEM PISTON FROM A DIRECT FUEL-INJECTED ENGINE, IF AVAILABLE, AND EXPLAIN THE DIFFERENCE(S).** **FIGURES 24-6, 7, 8**
	**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 24-6, 7, 8**
	10. **SLIDE 10 EXPLAIN Figure 24-9** Notice that there are conditions when the port fuel-injector located in the intake manifold, and the gasoline direct injector, located in the cylinder both operate to provide the proper air–fuel mixture.
	**DISCUSSION: ASK STUDENTS TO DISCUSS LEXUS SYSTEM THAT COMBINES PORT INJECTORS WITH DIRECT INJECTORS. WHAT MIGHT BE AN ADVANTAGE OF THIS SYSTEM? FIGURE 24-9**
	11. **SLIDE 11 EXPLAIN Figure 24-10** There may become a driveability issue because the gasoline direct-injection injector is exposed to combustion carbon and fuel residue

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	**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 24-10**
	**ON-VEHICLE NATEF TASK: GASOLINE DIRECT INJECTION IDENTIFICATION:** RESEARCH SERVICE INFORMATION, SUCH AS ENGINE MANAGEMENT SYSTEM OPERATION, VEHICLE SERVICE HISTORY, AND TSBS