

Automotive Technology 6th Edition

Chapter 81 GASOLINE DIRECT-INJECTION SYSTEMS

Opening Your Class

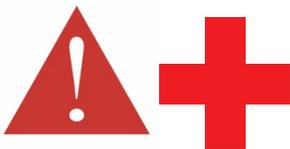
KEY ELEMENT	EXAMPLES
Introduce Content	This Automotive Technology 6th text provides complete coverage of automotive components, operation, design, and troubleshooting. It correlates material to task lists specified by ASE and ASEEducation (NATEF) and emphasizes a problem-solving approach. Chapter features include Tech Tips, Frequently Asked Questions, Case Studies, Videos, Animations, and ASEEducation (NATEF) Task Sheets.
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.	<p>Explain learning objectives to students as listed below:</p> <ol style="list-style-type: none"> 1. List the advantages and disadvantages of direct fuel injection. 2. Explain how a gasoline direct-injection system works. 3. List the various modes of operation of a gasoline direct-injection system. 4. Describe common piston top designs. 5. Describe the differences between port fuel-injection and gasoline direct-injection systems. 6. Discuss how to troubleshoot a gasoline direct-injection system. 7. This chapter will help prepare for Engine Repair (A8) ASE certification test content area "C" (Fuel, Air Induction, and Exhaust Systems Diagnosis and Repair).
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: Lesson plan is based on 6th Edition Chapter Images found on Jim's web site @ www.jameshalderman.com

DOWNLOAD Chapter 81 Chapter Images: From http://www.jameshalderman.com/automotive_principles.html

NOTE: You can use Chapter Images or possibly Power Point files:

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CH81 GASOLINE DIRECT-INJECTION SYSTEMS

1. SLIDE 1 CH81 GASOLINE DIRECT-INJECTION SYSTEMS

2. SLIDE 2 **EXPLAIN** Figure 81-1 A gasoline direct-injection system injects fuel under high pressure directly into the combustion chamber

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Crossword Puzzle (Microsoft Word) (PDF)

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Videos

[Direct Fuel Injection, Mechanical \(View\) \(Download\)](#)

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 81-1](#)

3. SLIDE 3 **EXPLAIN** Figure 81-2 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 [NO_x storage catalyst](#) is and how it functions. Why is a NO_x storage catalyst sometimes required to meet emission standards? [FIGURE 81-2](#)

SAFETY High-pressure fuel systems are very dangerous. [High pressure fuel can penetrate skin](#). It also can severely injure the eyes or cause blindness.

4. SLIDE 4 **EXPLAIN** FIGURE 81-3 GDI system uses a low-pressure pump in the gas tank similar to other types of fuel-injection systems. The PCM controls pressure of the high-pressure pump using sensor inputs.

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5. **SLIDE 5 EXPLAIN** FIGURE 81–4 A typical direct-injection system uses two pumps—one low-pressure electric pump in the fuel tank and other a high-pressure pump driven by the 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..

DISCUSSION: Have the students talk about the low-pressure supply pump. How is it similar to any other fuel injection supply pump? **FIGURE 81-3 & 4**

6. **SLIDE 6 EXPLAIN** FIGURE 81–5 (a) A typical camshaft-driven high-pressure pump used to increase fuel pressure to 2,000 PSI or higher. (b) The high pressure pump assembly removed from the engine. Many GDI engines use a roller where the high-pressure pump rides against the cam lobes to help reduce friction and wear.

DISCUSSION: Have the students discuss Common Fuel Rail Supply System. Why is it necessary to use this system? **FIGURE 81-5**

DISCUSSION: Ask the students to discuss the fuel rail pressure sensor used on direct-injection systems. Why do these systems need a pressure sensor?

DISCUSSION: Ask the students to **DISCUSS** CHART 81–1. 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 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 81–6 gasoline direct-injection (GDI) fuel rail and pump assembly with the electric pressure control valve.

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8. **SLIDE 8 EXPLAIN FIGURE 81-7** In this design, the fuel injector is at the top of cylinder and sprays fuel into the cavity of the piston.
9. **SLIDE 9 EXPLAIN FIGURE 81-8** The side injector combines with the shape of the piston to create a swirl as the piston moves up on the compression stroke.

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).

DISCUSSION: Ask the students to 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?

10. **SLIDE 10 EXPLAIN FIGURE 81-9** piston creates a tumbling force as it moves upward.

DISCUSSION: discuss Lexus system that combines port injectors with direct injectors. What might be an advantage of this system?

11. **SLIDE 11 EXPLAIN FIGURE 81-10** 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.
12. **SLIDE 12 EXPLAIN FIGURE 81-11** This may become a driveability issue because gasoline direct-injection injector is exposed to combustion carbon and fuel residue.
13. **SLIDE 13 EXPLAIN FIGURE 81-12** The high-pressure lines use a ball and socket connection. The ball end deforms when the line is tightened and must be replaced with a new part whenever it is removed.
14. **SLIDE 14 EXPLAIN FIGURE 81-13** Whenever a GDI fuel injector is removed, a new Teflon seal must be installed to ensure a leak-free connection in combustion chamber.

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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 the students' **valve** from an engine that has carbon buildup. Explain that this buildup, if severe enough, can restrict airflow. **FIGURE 81-10**

ON-VEHICLE ASE EDUCATION TASK **GASOLINE DIRECT INJECTION**

Identification: Research service information, such as engine management system operation, vehicle service history, and TSBs. **(P-1)**

