# Automotive Electrical & Engine Performance 8/E

# Chapter 38 GASOLINE DIRECT INJECTION (GDI)

## Opening Your Class

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| **KEY ELEMENT** | **EXAMPLES** |
| **Introduce Content** | This Automotive Electrical & Engine Performance 8th edition provides complete coverage of automotive areas pertaining vehicle electrical systems and engine performance. 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, and Animations that are listed in this Lesson Plan. This Lesson Plan also references ASEEducation (NATEF) Task Sheets available from Jim’s web site.  |
| **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 learning objectives to students as listed below: 1. Discuss how to troubleshoot a gasoline direct-injection system.
2. Explain how a gasoline direct-injection system works.
3. Describe the differences between port fuel injection and gasoline direct-injection systems.
4. List the various modes of operation of a gasoline direct-injection system.

**This chapter will help you 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: This lesson plan is based on Automotive Electrical & Engine Performance 8th Edition Chapter Images found on Jim’s web site @** [**www.jameshalderman.com**](http://www.jameshalderman.com)

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| ICONS | **Ch38 GASOLINE DIRECT INJECTION (GDI)** |
| --- | --- |
| Explain | 1. SLIDE 1 CH38 GASOLINE DIRECT INJECTION (GDI) |
| AnimationVideo | **Check for ADDITIONAL VIDEOS & ANIMATIONS @** [**http://www.jameshalderman.com/**](http://www.jameshalderman.com/)**WEB SITE IS CONSTANTLY UPDATED** |
| Video | [Videos](http://www.jameshalderman.com/links/book_master/vid/ch79/video_frame.html) |
| InstructorNotesDiscussion | At the beginning of this class, you can download the crossword puzzle & Word Search from Jim’s web site to familiarize your class with terms in this chapter & then discuss them, see below: |
| AssessmentIcon | <http://www.jameshalderman.com/books_a8.html#anchor2> **DOWNLOAD****Crossword Puzzle (Microsoft Word) (PDF)****Word Search Puzzle (Microsoft Word) (PDF** |
| Explain | **2. SLIDE 2 EXPLAIN Figure 38-1** A gasoline direct-injection system injects fuel under high pressure directly into the combustion chamber |
| Animation  | [Direct Fuel Injection, Mechanical (View)](http://jameshalderman.com/links/a8/html5/direct_fl.html) [(Download)](http://jameshalderman.com/links/a8/flash/direct_fl.swf) |
| DiscussionAnswerQuestionIcon | 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 38-1 |
|  | **3. SLIDE 3 EXPLAIN Figure 38-2** engine equipped with a gasoline direct injection (GDI) sometimes requires a NOX catalyst to meet exhaust emission standards |
| DiscussionAnswerQuestionIcon | DISCUSSION: Review with the students what a NOx storage catalyst is and how it functions. Why is a NOx storage catalyst sometimes required to meet emission standards? FIGURE 38-2 |
| **CautionIcon**cross.eps | SAFETY High-pressure fuel systems are very dangerous. High pressure fuel can penetrate skin. It also can severely injury the eyes or cause blindness.  |
| Explain | **4. SLIDE 4 EXPLAIN FIGURE 38–3** 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. |
| Explain | **5. SLIDE 5 EXPLAIN FIGURE 38–4** typical direct-injection system uses 2 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.. |
| DiscussionAnswerQuestionIcon | DISCUSSION: Have the students talk about the low-pressure supply pump. How is it similar to any other fuel injection supply pump? FIGURE 38-3 & 4 |
| Explain | **6. SLIDE 6 EXPLAIN FIGURE 38–5 (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. |
| DiscussionAnswerQuestionIcon | DISCUSSION: discuss Common Fuel Rail Supply System. Why is it necessary to use this system? FIGURE 38-5 |
| DiscussionAnswerQuestionIcon | DISCUSSION: Ask the students to discuss the fuel rail pressure sensor used on direct-injection systems. Why do these systems need a pressure sensor?  |
| DiscussionAnswerQuestionIcon | DISCUSSION: Ask the students to DISCUSS CHART 38–1. Have them compare specifications for port fuel injectors with those for direct fuel injectors |
| Demo | 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.  |
| DiscussionAnswerQuestionIcon | 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?  |
| Explain | **7. SLIDE 7 EXPLAINFIGURE 38–6** gasoline direct-injection (GDI) fuel rail and pump assembly with the electric pressure control valve.**8. SLIDE 8 EXPLAIN FIGURE 38–7** 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 38–8** The side injector combines with the shape of the piston to create a swirl as the piston moves up on the compression stroke**.** |
| Demo | 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).  |
| DiscussionAnswerQuestionIcon | 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? |
| Explain | **10. SLIDE 10 EXPLAIN FIGURE 38–9** piston creates a tumbling force as it moves upward. |
| DiscussionAnswerQuestionIcon | DISCUSSION: discuss Lexus system that combines port injectors with direct injectors. What might be an advantage of this system?  |
| Explain | **11. SLIDE 11 EXPLAIN FIGURE 38–10** 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 38–11** This may become a driveability issue because gasoline direct-injection injector is exposed to combustion carbon and fuel residue.**13. SLIDE 13 EXPLAIN FIGURE 38–12** 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 38–13** Whenever a GDI fuel injector is removed, a new Teflon seal must be installed to ensure a leak-free connection in combustion chamber. |
| DiscussionAnswerQuestionIcon | 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?  |
| DiscussionAnswerQuestionIcon | 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?  |
| Demo | DEMONSTRATION: Show the students’ valve from an engine that has carbon buildup. Explain that this buildup, if severe enough, can restrict airflow. FIGURE 38-10 |
| Repair VehicleASE-Education-Foundation-Horizontal | ASEEDUCATION TASK A1 GASOLINE DIRECT INJECTION Identification: Research service information, such as engine management system operation, vehicle service history, and TSBs |