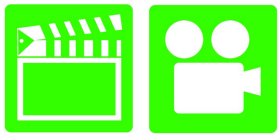
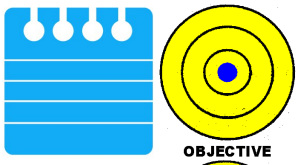
A8 Engine Performance 4th Edition

Chapter 27 Fuel-Injection Components and 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. Describe how a port fuel-injection system works. 3. Discuss the purpose and function of the fuel-pressure regulator. 4. List the types of fuel-injection systems.
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	Ch27 Fuel-Injection Components & OP
	1. SLIDE 1 C27 Fuel-Injection Components and 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
	2. SLIDE 2 EXPLAIN OBJECTIVE CH27 AEP_LO1 3. SLIDE 3 EXPLAIN Electronic Fuel-Injection Operation
	4. SLIDE 4 EXPLAIN Figure 27-1 Typical port fuel-injection system, indicating the location of various components. Notice that the fuel-pressure regulator is located on the fuel return side of the system. The computer does not control fuel pressure. But does control the operation of the electric fuel pump (on most systems) and the pulsing on and off of injectors
	DISCUSSION: HAVE THE STUDENTS DISCUSS HOW THE PCM CONTROLS FUEL INJECTION SYSTEM. WHAT ARE SOME COMMON COMPONENTS OF AN ELECTRONIC FUEL-INJECTION SYSTEM? FIGURE 27-1
	DISCUSSION: HAVE THE STUDENTS DISCUSS THE TWO TYPES OF ELECTRONIC FUEL-INJECTION SYSTEMS. WHICH TYPE IS MORE EFFICIENT? DISCUSS DIAGRAM FIGURE 27–1. WHY IS THE PRESSURE REGULATOR POSITIONED AFTER THE INJECTORS?
	5. SLIDES 5-8 EXPLAIN Electronic Fuel-Injection Operation 9. SLIDE 9 EXPLAIN Figure 27-2 dual-nozzle TBI unit on a Chevrolet 4.3-L V-6 engine. The fuel is squirted above the throttle plate where the fuel mixes with air before entering the intake manifold.

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	10. SLIDE 10 EXPLAIN Figure 27-3 typical port fuel-injection system squirts fuel into the low pressure (vacuum) of the intake manifold, about 2 to 3 in. (70 to 100 mm) from the intake valve
DEMO	**DEMONSTRATION: SHOW EXAMPLES OF FUEL INJECTORS. SHOW THEM INJECTORS FOR A PORT-INJECTION SYSTEM AND THROTTLE-BODY INJECTION. DISCUSS SIMILARITY OF INJECTORS. FIGURES 27-1 TO 27-7**
	2. SLIDE 2 EXPLAIN OBJECTIVE CH27 AEP_LO2 3. SLIDES 3-4 EXPLAIN Fuel-Pressure Regulator
	5. SLIDE 5 EXPLAIN Figure 27-9 A typical port fuel-injected system showing a vacuum-controlled fuel-pressure regulator. 6. SLIDE 6 EXPLAIN Figure 27-10 typical fuel-pressure regulator that has a spring that exerts 46 pounds of force against fuel. If 20 inches of vacuum are applied above the spring, the vacuum reduces the force exerted by the spring on the fuel, allowing the fuel to return to the tank at a lower pressure.
DEMO	**DEMONSTRATION: SHOW EXAMPLES OF FUEL PRESSURE REGULATORS FOR THROTTLE-BODY AND PORT FUEL INJECTION. POINT OUT VACUUM HOSE FITTING ON THE PORT FUEL INJECTION REGULATOR. FIGURES 27-9 &10**
	**DISCUSSION: HAVE THE STUDENTS DISCUSS THE DIFFERENCES BETWEEN FUEL-PRESSURE REGULATORS AND VACUUM BIASED FUEL-PRESSURE REGULATORS. WHY IS A SECONDARY CONTROL SOURCE (VACUUM) USED WITH PORT INJECTION? FIGURES 27-9 & 10**
	7. SLIDE 7 EXPLAIN FIGURE 27–11 A lack of fuel flow could be due to a restricted fuel-pressure regulator. Notice the fine screen filter. If this filter were to become clogged, higher than normal fuel pressure would occur.
DEMO	**DEMONSTRATION: EXPLAIN HOW A LEAKING DIAPHRAGM CAN ALLOW FUEL TO ENTER ENGINE & CAUSE RICH CONDITION. SHOW HOW TO REMOVE VACUUM LID TO CHECK FOR FUEL**

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	2. SLIDE 2 EXPLAIN OBJECTIVE CH27 AEP_LO3 3. SLIDES 3-6 EXPLAIN Speed-Density Fuel-Injection Systems
	**DISCUSSION: DISCUSS SPEED-DENSITY FUEL-INJECTION SYSTEMS. ASK THEM TO DISCUSS IMPORTANCE OF COOLANT & AMBIENT AIR TEMPERATURE ON THESE SYSTEMS.** 7. SLIDES 7-8 EXPLAIN Mass Airflow Fuel-Injection Systems
	**DISCUSSION: HAVE THE STUDENTS TALK ABOUT THE MASS AIRFLOW FUEL-INJECTION SYSTEM & HOW IT WORKS. HOW IS IT DIFFERENT FROM SPEED-DENSITY SYSTEM?**
	9. SLIDES 9-10 EXPLAIN Throttle-Body Injection
	11. SLIDE 11 EXPLAIN Figure 27-4 tension of spring in the fuel-pressure regulator determines the operating pressure on a throttle-body fuel-injection unit 12. SLIDES 12-13 EXPLAIN Port-Fuel Injection 14. SLIDE 14 EXPLAIN Figure 27-5 injectors receive fuel & supported by fuel rail 15. SLIDE 15 EXPLAIN Figure 27-6 Cross-section of a typical port fuel-injection nozzle assembly. These injectors are serviced as an assembly only; no part replacement or service is possible except for replacement of external O-ring seals
	**DEMONSTRATION: SHOW 2 VEHICLES, ONE WITH PORT FUEL INJECTION & OTHER WITH TBI. ASK STUDENTS TO EXPLAIN DIFFERENCES BETWEEN THE 2 SYSTEMS.**
	16. SLIDE 16 EXPLAIN Figure 27-7 Port fuel injectors spray atomized fuel into the intake manifold about 3 inches (75 mm) from the intake valve 17. SLIDE 17 EXPLAIN PORT FUEL INJECTION 18. SLIDE 18 EXPLAIN Figure 27-8 port fuel-injected engine that is equipped with long, tuned intake manifold runners

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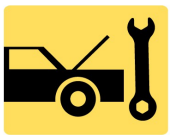
	**DISCUSSION:** HAVE THE STUDENTS TALK ABOUT THE **FIRING ORDER** OF A SEQUENTIAL FUEL INJECTION SYSTEM. CAN FUEL INJECTOR FIRING TIME BE ADJUSTED LIKE IGNITION TIMING?
	**DEMONSTRATION:** SHOW **INTAKE MANIFOLDS** ON PORT FUEL-INJECTED VEHICLES. ALLOW THEM TO SEE LENGTHS OF THE RUNNERS. POINT OUT THAT ALL RUNNERS CAN BE THE SAME LENGTH AND CAN BE TUNED FOR OPTIMUM PERFORMANCE.
	4-CYLINDER ENGINES ARE GOOD EXAMPLES FOR AN INTAKE MANIFOLD DEMONSTRATION. THESE VEHICLES USUALLY HAVE MANIFOLD RUNNERS THAT ARE EASIER TO VIEW.
	**DISCUSSION:** HAVE THE STUDENTS TALK ABOUT THE **SENSORS THAT AFFECT FUEL PULSE WIDTH**. WHAT CAN HAPPEN IF A SENSOR GIVES A FALSE READING?
	**DEMONSTRATION:** SHOW THE STUDENTS A CAR WITH **SEQUENTIAL FUEL INJECTION**. POINT OUT DIFFERENCE IN THE **COLOR OF WIRES** TO INJECTORS.
	**DISCUSSION:** HAVE THE STUDENTS DISCUSS THE GROUPED DOUBLE-FIRE, SIMULTANEOUS DOUBLE-FIRE, & SEQUENTIAL INJECTION FIRING CHARACTERISTICS. WHICH ONE IS THE MOST EFFICIENT?
	**DEMONSTRATION:** SHOW THE STUDENTS HOW TO USE A **STETHOSCOPE** TO LISTEN FOR NOISES.
	**HANDS-ON TASK:** HAVE THEM USE **STETHOSCOPE** TO LISTEN TO FUEL INJECTORS ON RUNNING ENGINE.
	**DISCUSSION:** HAVE STUDENTS DISCUSS **FUEL INJECTORS DESIGN**. DO INJECTORS THAT HAVE DISTINCTIVE SPRAY PATTERNS HAVE TO BE INSTALLED IN A SPECIFIC WAY? WHY ARE DEPOSIT-RESISTANT FUEL INJECTORS USED IN SOME APPLICATIONS?

ICONS	Ch27 Fuel-Injection Components & OP
	**DEMONSTRATION: WHILE MONITORING DATA ON A SCAN TOOL, START ENGINE & ALLOW STUDENTS TO SEE STEPS OR PERCENTAGE OF IDLE AIR CONTROL PERFORMED BY PCM. SHOW EXAMPLES OF IDLE AIR CONTROL VALVES OR STEPPER MOTORS USED ON FUEL-INJECTED ENGINES.**