Automotive Technology 6th Edition
Chapter 79 FUEL PUMPS, LINES, & FILTERS
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.	Explain learning objectives to students as listed below: 1. Explain the role of fuel tanks in the fuel delivery system. 2. Discuss the different types of fuel lines. 3. Explain the different types of electric fuel pumps. 4. Describe how to test and replace fuel filters. 5. Describe how to test and replace fuel pumps. 6. 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

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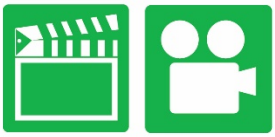
http://www.jameshalderman.com/automotive_principles.html

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

ICONS	Chapter 79 Fuel Pumps, Lines, & Filters
	**1. SLIDE 1 Ch79 FUEL PUMPS, LINES, & FILTERS**
	**Check for ADDITIONAL VIDEOS & ANIMATIONS @ http://www.jameshalderman.com/** **WEB SITE IS CONSTANTLY UPDATED** **http://www.jameshalderman.com/automotive_principles.html** **DOWNLOAD** **Crossword Puzzle (Microsoft Word) (PDF)** **Word Search Puzzle (Microsoft Word) (PDF**
	**Videos**
	**DISCUSSION: Have the students talk about the various components used in fuel delivery system. What is the purpose of fuel delivery systems?**
	**DISCUSSION: Discuss use of baffles in fuel tanks. Ask them if they have ever heard fuel sloshing in a fuel tank.**
	**DEMONSTRATION: Show metal & plastic fuel tanks. Discuss whether there are advantages to using tanks made from either of these materials**
	2. **SLIDE 2 EXPLAIN FIGURE 79–1** fuel system includes many separate parts and components, including fuel tank, fuel pump, and lines, as well as fuel tank pressure sensor used to measure pressure inside fuel tanks, used by evaporative fuel control system. 3. **SLIDE 3 EXPLAIN Figure 79-2** A three-piece filler tube assembly. The main three parts include the upper neck, hose, and lower neck.
	**DISCUSSION: Have the students discuss the mounting position of fuel tanks. What factors are considerations in fuel tank location?**
	4. **SLIDE 4 EXPLAIN Figure 79-3** view of a typical filler tube with the fuel tank removed. Notice the ground strap used to help prevent the buildup of static electricity as the

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	fuel flows into the plastic tank. The check ball looks exactly like a ping-pong ball
	**DISCUSSION:** discuss onboard fueling vapor recovery systems. How is this system different from the recovery system used on gasoline pumps?
	5. **SLIDE 5 EXPLAIN Figure 79-4** Vehicles equipped with onboard refueling vapor recovery usually have a reduced-size fill tube.
	**DEMONSTRATION:** Show a fuel tank filler neck from a vehicle equipped with an onboard refueling vapor recovery system, pointing out the reduced neck size and the vent. **FIGURE 79-4**
	6. **SLIDE 6 EXPLAIN Figure 79-5** fuel pickup tube is part of the fuel sender and pump assembly.
	**DEMONSTRATION:** Show **fuel pump/pickup tube assembly**. Point out the filter sock & fuel return line. **FIGURE 79-5**
	**DEMONSTRATION:** Show the students **charcoal canister storage device** for fuel vapors.
	**DISCUSSION:** Have the students discuss the components of an **evaporative emission control system.** How are fuel vapors vented?
	**HANDS-ON TASK:** Have students locate & identify fuel system components on LAB vehicle. Grade them on accuracy in identifying components and their understanding of the fuel system.
	7. **SLIDE 7 EXPLAIN FIGURE 79–6** Ford uses an inertia switch to turn off the electric fuel pump in case of an accident.
	**DEMONSTRATION:** Show Ford inertia switch used to turn off fuel pump in event of an accident. If Ford vehicle is available, trip switch by tapping on it to show students how it works **FIGURE 79-6**

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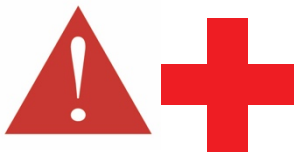
	**Some Ford vehicles, mainly trucks, have fuel pump inertia switch located inside the cab on either the firewall or cowl side panel.**
	**8. SLIDE 8 EXPLAIN FIGURE 79–7** Fuel lines are routed along the frame or body and secured with clips.
	**DEMONSTRATION: Show examples of rigid & flexible fuel lines used on a vehicle. Discuss material, routing, & retention methods used.**
	**DISCUSSION: Have the students discuss different types of fuel lines. What are advantages & disadvantages of different materials?**
	**9. SLIDE 9 EXPLAIN FIGURE 79–8** Some Ford metal line connections use spring-locks and O-rings.
	**SAFETY Explain the dangers involved when working with fuel systems. Some of these systems can operate at pressures of 80 to 100 psi. Any time a fuel line needs to be disconnected, fuel pressure must be released using OEM recommended method.**
	**DISCUSSION: Have the students discuss newer fuel supply systems that do not utilize a return line. What components had to be modified or changed for this system to operate properly?**
	**DISCUSS FREQUENTLY ASKED QUESTION:** ***Just How Much Fuel Is Recirculated?*** **Approximately 80% of the available fuel-pump volume is released to fuel tank through fuel-pressure regulator at idle speed. For example, a passenger vehicle cruising down road at 60 mph gets 30 mpg. With a typical return-style fuel system pumping about 30 gallons per hour from tank, it therefore burns 2 gallons per hour, and returns about 28 gallons per hour to tank!**

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	10. **SLIDE 10 EXPLAIN FIGURE 79–9** Ford spring-lock connectors require a special tool for disassembly. 11. **SLIDE 11 EXPLAIN FIGURE 79–10** Typical quick-connect steps. 12. **SLIDE 12 EXPLAIN FIGURE 79–11** A roller cell-type electric fuel pump.
	**DEMONSTRATION: Show examples of fuel line spring-lock fittings. Show special tools needed to disconnect these fittings.**
	**HANDS-ON TASK: Have students disassemble and reassemble fuel line connections, including spring-lock fittings.**
	13. **SLIDE 13 EXPLAIN FIGURE 79–12** pumping action of an impeller or rotary vane pump.
	**DISCUSS FREQUENTLY ASKED QUESTION: *How Can an Electric Pump Work Inside a Gas Tank and Not Cause a Fire?* Even though fuel fills entire pump, no burnable mixture exists inside pump because there is no air and no danger of commutator brush arcing, igniting fuel.**
	**DEMONSTRATION: Show examples of rotary fuel pumps and discuss how they work. FIGURES 79-12 & 13**
	**DISCUSSION: discuss rotary vane fuel pump shown in Figure 79–12. Will pump be able to pump more fuel if it turns faster?**
	14. **SLIDE 14 EXPLAIN FIGURE 79–13** An exploded view of a gerotor electric fuel pump.
	**DISCUSSION: Ask the students to discuss the gerotor-type pump. What process does this type of pump use to pressurize fuel? FIGURES 79-13**

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	**15. SLIDE 15 EXPLAIN FIGURE 79–14** cutaway view of a typical two-stage turbine electric fuel pump.
	**DISCUSS FREQUENTLY ASKED QUESTION: *Why Are Many Fuel-Pump Modules Spring-Loaded?* Fuel modules that contain the fuel pickup sock, fuel pump, and fuel level sensor are often spring-loaded when fitted to a plastic fuel tank. The plastic material shrinks when cold and expands when hot, so having the fuel module spring-loaded ensures that fuel pickup sock is always the same distance from the bottom of the tank. • SEE FIGURE 79–15.**
	**16. SLIDE 16 EXPLAIN FIGURE 79–15** A typical fuel-pump module assembly, which includes the pickup strainer and fuel pump, as well as the fuel pressure sensor and fuel level sensing unit..
	**DEMONSTRATION: Show example of a modular fuel sender assembly used in modern vehicles. Point out the pump, convoluted tube, & float assembly. FIGURES 79-15**
	**DISCUSSION: Have the students' discuss reason fuel pump modules are spring-loaded. Does fuel tank material make a difference?**
	**DISCUSSION: Have the students talk about electric fuel pump control circuits. Why are relays controlled by the PCM?**
	**17. SLIDE 17 EXPLAIN FIGURE 79–16** schematic showing that an inertia switch is connected in series between the fuel-pump relay and the fuel pump.
	**DISCUSSION: Ask the students to discuss wiring diagram shown in FIGURE 79–16. Could inertia switch be placed anywhere else in circuit and still provide same results?**
	**18. SLIDE 18 EXPLAIN FIGURE 79–17** typical fuel pulsator used mostly with roller vane-type pumps to help even out the pulsation in pressure that can cause noise.

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	**DISCUSSION:** Have the students discuss the **pulsators and accumulators** used in fuel supply system. Why do some experts advise removal of the pulsators in the fuel tank? **FIGURE 79–17**
	**19. SLIDE 19 EXPLAIN FIGURE 79–18** Inline fuel filters are usually attached to the fuel line with screw clamps or threaded connections. The fuel filter must be installed in the proper direction or a restricted fuel flow can result.
	**EXPLAIN TECH TIP:** ***Use a Headlight to Test for Power and Ground*** **When replacing a fuel pump, always check for proper power and ground. If supply voltage is low due to resistance in circuit or the ground connection is poor, lower available voltage to the pump results in lower pump output and could also reduce the life of the pump. While a voltage drop test can be preformed, a quick and easy test is to use a headlight connected to circuit. If headlight is bright, then both power side and ground side of the pump circuit are normal. If headlight is dim, then more testing is needed to find the source of the resistance in the circuit(s) • SEE FIGURE 79–19.**
	**20. SLIDE 20 EXPLAIN FIGURE 79–19** A dim headlight indicates excessive resistance in fuel pump circuit..
	Fuel Filters (View) (Download) Low Side Driver Control (View) (Download) Output Driver Control (View) (Download)
	**DEMONSTRATION:** Show **location of fuel filters** on vehicles in the shop. Are all filters located in common areas? **FIGURE 79–18**
	**DEMONSTRATION:** Show examples of fuel filters. Show some filters from the carbureted era, as well as modern high pressure filters used in fuel-injected vehicles. Point out that a vehicle with a returnless-type fuel system will most likely have fuel filter inside fuel tank. **FIGURE 79–19**

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QUESTION	**DISCUSSION:** Have the students discuss need to filter fuel before it goes through any fuel metering device, such as a carburetor or fuel injector. What do fuel filters remove? **FIGURE 79–19 & 20** **ON-VEHICLE ASEEDUCATION TASK:** Replace fuel **filters**.
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QUESTION	**DISCUSSION:** Have the students discuss **fuel pump test procedures**. What drivability problems would warrant a fuel pump test?
DEMO	**DEMONSTRATION:** Show how to jar a stalled fuel pump into operation by striking the fuel tank. Why should a rubber mallet be used for this procedure? Then, show students how to listen for fuel pump operation by removing fuel cap and inserting a funnel into filler neck. **FIGURE 79–20**
	EXPLAIN TECH TIP: ***The Ear Test:*** No, this is not a test of your hearing, but rather using your ear to check that electric fuel pump is operating. Electric fuel pump inside fuel tank is often difficult to hear running, especially in a noisy shop environment. A commonly used trick to better hear pump is to use a funnel in fuel filter neck. • **SEE FIGURE 79–20.**
	21. **SLIDE 21 EXPLAIN FIGURE 79–20** (a) A funnel helps in hearing if the electric fuel pump inside gas tank is working. (b) If the pump is not running, check the wiring and current flow before going through process of dropping the fuel tank to remove pump. 22. **SLIDE 22 EXPLAIN Figure 79-21** Schrader valve on this General Motors 3800 V-6 is located next to the fuel-pressure regulator. 23. **SLIDE 23 EXPLAIN Figure 79-22** fuel system should hold pressure if the system is leak free
	EXPLAIN TECH TIP: ***Rubber Mallet Trick*** Often a no-start condition is due to an inoperative electric fuel pump. A common trick is to tap on the bottom of the fuel tank with a rubber mallet in an attempt to jar the pump motor enough to work. Instead of

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	**pushing a vehicle into shop, simply tap on the fuel tank and attempt to start engine. This is not a repair, but rather a confirmation that fuel pump does indeed require replacement.** **DISCUSSION: Discuss Pressure-Testing Fuel Pump. If pressure is correct at idle, will it also be correct under load? DISCUSS rest pressure test. What could happen if pressure leaks down rapidly? Discuss dynamic pressure test. If pressure doesn't change when throttle is cycled, what problems might exist?**
	**24. SLIDE 24 EXPLAIN FIGURE 79–23** If vacuum hose is removed from the fuel pressure regulator when the engine is running, the fuel pressure should increase. If it does not increase, then the fuel pump is not capable of supplying adequate pressure or the fuel-pressure regulator is defective. If gasoline is visible in the vacuum hose, regulator is leaking and should be replaced.
	**Presence of fuel in vacuum line to regulator can mean only one thing—diaphragm is leaking. This can cause multiple drivability problems and DTCS: FIGURE 79–24 & 25**
	**HANDS-ON TASK: Give students a list of Vehicles. Have them use reference materials to locate fuel pressure specifications & test procedure for each vehicle.**
	**EXPLAIN TECH TIP: *Fuel-Pressure Stethoscope Test.* When fuel pump is energized & engine is not running, fuel should be heard flowing back to fuel tank at outlet of pressure regulator. • SEE FIGURE 79–24. If fuel is heard flowing through return line, fuel-pump pressure is higher than regulator pressure. If no sound of fuel is heard, either fuel pump or fuel pressure regulator is at fault.**
	**25. SLIDE 25 EXPLAIN FIGURE 79–24** Fuel should be heard returning to fuel tank at the fuel return line if the fuel pump and fuel-pressure regulator are functioning correctly.

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	26. **SLIDE 26 EXPLAIN FIGURE 79–25** fuel-pressure reading does not confirm that there is enough fuel volume for the engine to operate correctly..
	27. **SLIDE 27 EXPLAIN FIGURE 79–26** fuel system tester connected in series in fuel system so all of fuel used flows through the meter, which displays rate of flow and the fuel pressure.
	**EXPLAIN TECH TIP:** ***Remove the Bed to Save Time?*** **The electric fuel pump is easier to replace on many General Motors pickup trucks if bed is removed. Access to top of fuel tank, where access hole is located, for removal of fuel tank sender unit and pump is restricted by the bottom of the pickup truck bed. It takes several people (usually other technicians in shop) to lift the truck bed from frame after removing only a few fasteners. • SEE FIGURE 79–27.**
	28. **SLIDE 28 EXPLAIN FIGURE 79-27** Removing the bed from a pickup truck makes gaining access to the fuel pump a lot easier
	**DEMONSTRATION: Demonstrate quick & easy fuel pump volume test. Is this test 100% accurate?**
	**EXPLAIN TECH TIP:** ***Quick and Easy Fuel Volume*** **Test: Testing for pump volume involves using a specialized tester or a fuel-pressure gauge equipped with a hose to allow fuel to be drawn from system into a container with volume markings to allow for a volume measurement. This test can be hazardous because of expanding gasoline. An alternative test involves connecting a fuel-pressure gauge to system with steps: STEP 1 Start engine and observe fuel-pressure gauge. The reading should be within factory specifications (typically between 35 and 45 PSI). STEP 2 Remove hose from the fuel-pressure regulator. Pressure should increase if system uses a demand-type regulator. STEP 3 Rapidly accelerate engine while watching fuel-pressure gauge. If fuel volume is okay, fuel**

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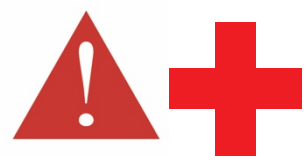
	**pressure should not drop more than 2 PSI. If the fuel pressure drops more than 2 PSI, replace fuel filter and retest.** **STEP 4 After replacing fuel filter, accelerate engine and observe the pressure gauge, if pressure drops more than 2 PSI, replace the fuel pump.** **DISCUSS CASE STUDY: *Case of Stalling Chevrolet Suburban* The owner of a Chevrolet Suburban with 187,000 miles complains that it has died several times when driving on highway. Before it died, driver felt as if vehicle was rumbling and had a jerky feeling. Then the truck lost power and stalled. After truck was allowed to sit on shoulder of road for a few minutes, it started and ran normally.** **The service technician checked fuel pump for proper current draw and, while it was within specification, technician thought that symptoms were perfect for a fuel pump failure because it was intermittent. Using a DSO on feed line to the pump at fuel pump relay, showed a pattern that indicated worn brushes. The fuel pump was replaced and owner reported back that intermittent stalling had not occurred since repair.** **Summary:** • **Complaint—owner complained that truck would intermittently stall when driving on highway.** • **Cause—worn fuel pump was the root cause of intermittent stalling.** • **Correction—fuel pump was replaced, which solved stalling problem.**
	**SAFETY EXTREME CAUTION advised when working around any component of the fuel system, especially when the engine is hot.**

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	**DISCUSSION:** discuss whether removing bed from a pick-up truck might make it easier to replace a fuel pump. If tank was completely full of fuel, would this procedure help?
 	**ON-VEHICLE ASEEDUCATION TASK:** Inspect and test **fuel pumps & pump control** systems for pressure, regulation, and volume; perform necessary action.
	**DEMONSTRATION:** Explain how a **current draw test** can indicate a worn fuel pump. Use fuel pump current draw table to show that a pump can draw more or less current than specifications. Show students how to perform the **Fuel Pump Current Draw Test**.
 	**ON-VEHICLE ASEEDUCATION TASK:** Fuel Pump Current Draw Test.
 	**ON-VEHICLE ASEEDUCATION TASK:** Perform active tests of **actuators** using a **scan tool**; determine necessary action.