Automotive Technology 6th Edition
Chapter 26 Engine Diagnosis
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 the chapter learning objectives to the students as listed: 1. Discuss typical engine-related complaints and engine smoke diagnosis. 2. Discuss the importance of visual checks. 3. Discuss engine noise diagnosis. 4. Explain oil pressure testing and the purpose of oil pressure warning lamps. 5. Explain compression test, and compare wet compression test and running compression test. 6. Describe cylinder leakage test and cylinder power balance test. 7. Explain the vacuum test and exhaust restriction test. 8. Explain how to test back pressure with a vacuum gauge and a pressure gauge, and how to diagnose head gasket failure. 9. Discuss the operation of dash warning lights.
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 the 6th Edition Chapter Images found on Jim's web site @ www.jameshalderman.com

DOWNLOAD Chapter 26 Chapter Images: From

http://www.jameshalderman.com/automotive_principles.html NOTE: You can use Chapter Images or possibly Power Point files:

ICONS	Chapter 26 Engine Diagnosis
	**1. SLIDE 1 Ch26 ENGINE CONDITION DIAGNOSIS**
	**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**
	**ENGINE DIAGNOSIS** **Videos**
	2. **SLIDE 2 EXPLAIN Figure 26-1** Blowby gases coming out of the crankcase vent hose. Excessive amounts of combustion gases flow past the piston rings and into the crankcase. 3. **SLIDE 3 EXPLAIN Figure 26-2** White steam is usually an indication of a blown (defective) cylinder head gasket that allows engine coolant to flow into the combustion chamber where it is turned to steam.

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	**EXPLAIN TECH TIP: Your Nose Knows: Whenever diagnosing any vehicle, try to use all senses including smell. Some smells and their causes:** • **Gasoline. If exhaust smells like gasoline or unburned fuel, then a fault with ignition system is a likely cause. Unburned fuel due to lean air-fuel mixture, causing a lean misfire is also possible.** • **Sweet smell. A coolant leak often gives off a sweet smell, especially if leaking coolant flows onto hot exhaust.** • **Exhaust smell. Check for an exhaust leak, including a possible cracked exhaust manifold, which can be difficult to find because it often does not make noise.**
	**EXPLAIN TECH TIP: What's Leaking?** **The color of the leaks observed under a vehicle can help determine and correct cause. Some leaks, such as condensate (water) from A/C, are normal, whereas a brake fluid leak is very dangerous. Following are colors of common leaks. Color What's Leaking** • **Sooty black Engine Oil** • **Yellow, green, blue, or orange** • **Antifreeze (coolant)** • **Red Automatic transmission fluid** • **Murky brown Brake or power steering fluid or very neglected antifreeze (coolant)** • **Clear Air-conditioning condensate (water) (normal)**
	**DISCUSSION: Ask students to describe some common mechanical-related customer complaints about the engine.**
	**DISCUSSION: Ask students to consider kinds of questions they should ask customers prior to diagnosing an engine problem. Then discuss visual inspections they should conduct**

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	4. **SLIDE 4 EXPLAIN Figure 26-3** What looks like an oil pan gasket leak can be a rocker cover gasket leak. Always look up and look for the highest place you see oil leaking; that should be repaired first. 5. **SLIDE 5 EXPLAIN Figure 26-4** transmission and flexplate (flywheel) were removed to check the exact location of this oil leak. The rear main seal and/or the oil pan gasket could be the cause of this leak. 6. **SLIDE 6 EXPLAIN Figure 26-5** Using a black light to spot leaks after adding dye to the oil.
	**DEMONSTRATION: Show students location of crankcase vent hose**
	**HANDS-ON TASK: Have students check oil level and condition of an engine. Then have them check the coolant level and condition of an engine.**
	**DISCUSSION: Talk about the different types of leaks that may be observed under a vehicle and how the color of the fluid indicates the type of leak. Discuss consequences of oil leaks.**
	**ON-VEHICLE TASK: NATEF Task Inspect engine for fuel, oil, coolant and other leaks; determine necessary action (P-1)**
	
	**HANDS-ON TASK: Use foot powder spray trick to check for engine oil leaks. Review Tech Tip in textbook before attempting this task.**

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	**EXPLAIN TECH TIP: The Foot Powder Spray Trick** **The source of an oil or other fluid leak is often difficult to determine. A quick and easy method that works is the following. First, clean the entire area. This can best be done by using a commercially available degreaser to spray the entire area. Let it soak to loosen all accumulated oil and greasy dirt. Clean off the degreaser with a water hose. Let the area dry. Start the engine, and using spray foot powder or other aerosol powder product, spray the entire area. The leak will turn the white powder dark. The exact location of any leak can be quickly located. NOTE: Most oil leaks appear at the bottom of the engine due to gravity. Look for the highest, most forward location for the source of the leak.**
	7. **SLIDE 7 EXPLAIN Figure 26-6** accessory belt tensioner. Most tensioners have a mark that indicates normal operating location. If the belt has stretched, this indicator mark will be outside of the normal range. Anything wrong with belt or tensioner can cause noise. 8. **SLIDE 8 EXPLAIN Figure 26-7** A cracked exhaust manifold on a Ford V-8.
	**DISCUSSION: Ask students to describe some of the possible causes of engine knock. Discuss possible causes of low oil pressure.**
	**ON-VEHICLE TASK: ASEEDUCATION Task** **Diagnose engine noises and vibration; determine necessary action (P-2)**
Education Foundation	

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	**EXPLAIN TECH TIP: Use a Scan Tool to Check for Misfires: Many factory or factory-level scan tools can display cylinder misfire data. The wise service technician checks for misfire codes and misfire counter information using a scan tool before checking the engine using labor intensive procedures, such as compression testing or cylinder leakage tests. These can be done on just the cylinder or cylinders that the PCM has detected as being at fault. • SEE FIGURE 26–9.**
	**9. SLIDE 9 EXPLAIN FIGURE 26–9** A Tech 2 scan tool display showing a fault with cylinder 3. Once the cylinder has been identified, then more detailed tests can be performed to determine the root cause, which could be an ignition, fuel or mechanical issue**.** **10. SLIDE 10 EXPLAIN FIGURE 26–10** The Ford IDS scan tool has a graph function that allows the technician to view the data on the cylinder contribution test visually, making diagnosis easier. In this example, the cylinders on bank 2 on a Ford V-8 (cylinders 7, 6, 5, and 8) are weak.

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	**EXPLAIN TECH TIP: The Paper Test: A soundly running engine should produce even and steady exhaust at the tailpipe. You can test this with the paper test. Hold a piece of paper or index card (even a dollar bill works) within 1 inch (25 mm) of the tailpipe with the engine running at idle. • SEE FIGURE 26–11. The paper should blow out evenly without "puffing." If the paper is drawn toward the tailpipe at times, exhaust valves in one or more cylinders could be burned. Other reasons why the paper might be sucked toward tailpipe include the following:** **1. The engine could be misfiring because of a lean condition that could occur normally when engine is cold.** **2. Pulsing of paper toward tailpipe could also be caused by a hole in exhaust system. If exhaust escapes through a hole in exhaust system, air could be drawn in during intervals between exhaust puffs from tailpipe to hole in the exhaust, causing the paper to be drawn toward tailpipe.** **1. Ignition fault causing misfire.**
	**11. SLIDE 11 EXPLAIN Figure 26-11** The paper test involves holding a piece of paper near the tailpipe of an idling engine. A good engine should produce even, outward puffs of exhaust. If the paper is sucked in toward the tailpipe, a burned valve is a possibility.
	**EXPLAIN TECH TIP: Engine Noise and Cost** **A light ticking noise often heard at one-half engine speed and associated with valve train noise is a less serious problem than many deep-sounding knocking noises. Generally, the deeper the sound of the engine noise, the more the owner will have to pay for repairs. A light "tick tick tick," though often not cheap, is usually far less expensive than a deep "knock knock knock" from engine.**

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	**HANDS-ON TASK:** Have students conduct paper test of the exhaust flow to check for engine problems. Be sure they review Tech Tip in textbook before attempting this task.
	**DEMONSTRATION:** Show students how to use an oil pressure gauge to test oil pressure.
 	**ON-VEHICLE ASEEDUCATION TASK:** Perform oil pressure test; determine necessary action (P-1)
	**DISCUSSION:** When you are driving your car, oil pressure warning light IS ON. What conditions are indicated? What actions should you take as a driver? Discuss differences between oil light and an oil gauge on dash. Why does oil gauge vary at idle on some vehicles and not on others?
	12. **SLIDE 12 EXPLAIN Figure 26-12** A two-piece compression gauge set. The threaded hose is screwed into the spark plug hole after removing the spark plug. The gauge part is then snapped onto the end of the hose. 13. **SLIDE 13 EXPLAIN Figure 26-13** Use a vacuum or fuel line hose over the spark plug to install it without danger of cross-threading the cylinder head.
	**EXPLAIN TECH TIP:** The Hose Trick: Installing spark plugs can be made easier by using a rubber hose on the end of the spark plug. The hose can be vacuum hose, fuel line, or even an old spark plug wire end. • **SEE FIGURE 26–13.** The hose makes it easy to start the threads of the spark plug into the cylinder head. After starting the threads, continue to thread the spark plug for several turns. Using the hose eliminates the chance of cross threading the plug. This is especially important when installing spark plugs in aluminum cylinder heads.

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DEMO	**DEMONSTRATION: Show students a compression gauge & how it attaches to engine.**
DEMO	**DEMONSTRATION: Show students hose trick for installing spark plugs**
	14. **SLIDE 14 EXPLAIN Figure 26-14** Badly burned exhaust valve. A compression test could have detected a problem, and a cylinder leakage test (leak-down test) could have been used to determine the exact problem
QUESTION	**DISCUSSION: Discuss the reasons for loss of compression. Ask students to describe how to perform a Compression Test**
DEMO	**DEMONSTRATION: Show students how to perform a wet compression test and discuss results.**
DEMO	**DEMONSTRATION: Show students how to perform a running (dynamic) compression test.**
	DISCUSSION: Ask how cranking, idling, & higher RPM compare with respect to compression pressure.
Education Foundation	**ON-VEHICLE ASEEDUCATION TASK: Perform cylinder compression tests; determine necessary action (P-1)**

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	**15. SLIDE 15 EXPLAIN FIGURE 26–15 (a)** A relative compression test using an amp clamp around the starter motor power cable and a Pico scope. (b) The result is a waveform that displays the current needed for each cylinder under compression. This test indicates that all cylinders are requiring the same current to rotate the starter motor which indicates that all cylinders have the same relative compression.
	**16. SLIDE 16EXPLAIN Figure 26-16**typical handheld cylinder leakage tester. **17. SLIDE 17EXPLAIN Figure 26-17** whistle stop used to find top dead center. Remove the spark plug and install the whistle stop, then rotate the engine by hand. When the whistle stops making a sound, the piston is at the top
	**DEMONSTRATION: Show students how to perform a cylinder leakage test, using a handheld cylinder leakage tester.**
 	**ON-VEHICLE ASEEDUCATION TASK: Perform cylinder leakage tests; determine necessary action (P-1)**
	**18. SLIDE 18EXPLAIN Figure 26-18** Using a vacuum hose & test light to ground one cylinder at a time on a distributorless ignition system. This works on all types of ignition systems & provides a method for grounding out 1 cylinder at a time without fear of damaging any component. To avoid possible damage to catalytic converter, do not short out a cylinder for longer than 5 seconds.
	**DEMONSTRATION: Show students how to conduct a cylinder power balance test.**

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	**DEMONSTRATION:** Show students how to use a whistle stop to find top dead center (TDC) of compression stroke.
	**ON-VEHICLE ASEEDUCATION TASK:** Perform cylinder power balance tests; determine necessary action (P-2)
	
	19. **SLIDE 19 EXPLAIN Figure 26-19** An engine in good mechanical condition should produce 17 to 21 in. Hg of vacuum at idle at sea level. 20. **SLIDE 20 EXPLAIN Figure 26-20** steady but low reading could indicate retarded valve or ignition timing.
	**DISCUSSION:** Discuss the various types of manifold **vacuum tests** & their purposes.
	21. **SLIDE 21 EXPLAIN Figure 26-21** A gauge reading with the needle fluctuating 3 to 9 in. Hg below normal often indicates a vacuum leak in the intake system. 22. **SLIDE 22 EXPLAIN Figure 26-22** A leaking head gasket can cause the needle to vibrate as it moves through a range from below to above normal. 23. **SLIDE 23 EXPLAIN Figure 26-23** oscillating needle 1 or 2 in. Hg below normal could indicate an incorrect air-fuel mixture (either too rich or too lean). 24. **SLIDE 24 EXPLAIN Figure 26-24** rapidly vibrating needle at idle that becomes steady as engine speed is increased indicates worn valve guides. 25. **SLIDE 25 EXPLAIN Figure 26-25** needle drops 1 or 2 in. Hg from normal reading, one of engine valves is burned or not seating properly. 26. **SLIDE 26 EXPLAIN Figure 26-26** Weak valve springs will produce a normal reading at idle, as engine speed increases, needle will fluctuate rapidly between 12-24 in

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	27. **SLIDE 27 EXPLAIN Figure 26-27** steady needle reading that drops 2 or 3 in. Hg when the engine speed is increased slightly above idle indicates that the ignition timing is retarded. 28. **SLIDE 28 EXPLAIN Figure 26-28** A steady needle reading that rises 2 or 3 in. Hg when the engine speed is increased slightly above idle indicates that the ignition timing is advanced. 29. **SLIDE 29 EXPLAIN Figure 26-29** needle that drops to near zero when the engine is accelerated rapidly and then rises slightly to a reading below normal indicates an exhaust restriction.
 Education Foundation	**ON-VEHICLE ASEEDUCATION TASK:** **Perform engine vacuum tests; determine necessary action (P-1)**
	**DEMONSTRATION: Show students how to test back pressure by using a vacuum gauge**
	**A pressure gauge adapter can be fashioned from a short section of brake line.**
	**Show CHECKING EXHAUST BACKPRESSURE VIDEO: 2 MINUTES: CH26**
	28. **SLIDE 28 EXPLAIN Figure 26-27** technician-made adapter used to test exhaust system back pressure.
	**DISCUSSION: Compare and contrast various types of exhaust restriction tests.**

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	**30. SLIDE 30 EXPLAIN Figure 26-30** tester that uses a blue liquid to check for exhaust gases in the exhaust, which would indicate a head gasket leak problem. **31. SLIDES 31-42 COMPRESSION TEST SHOW**
	**DISCUSSION: Ask students how they would diagnose a head gasket failure. Compare various diagnostic techniques described in textbook: using an exhaust gas analyzer, using a chemical tester, determining if there are bubbles in the coolant, & observing for excessive exhaust steam.**
	**DISCUSSION: As you are driving, coolant temperature light becomes illuminated (or coolant gauge reads high). What actions should you take?**
	**SEARCH INTERNET: Have students use Internet to research cost and features of 3 types of diagnostic tools covered in the chapter. Ask students to compare various tools based on features and costs. As a class, have them develop list of tools they would recommend for purchase if they were setting up a shop.**