Automotive Fuel and Emissions Control Systems 4/E

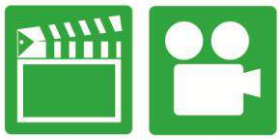
Chapter 10 Engine Condition Diagnosis

Opening Your Class

KEY ELEMENT	EXAMPLES
Introduce Content	This course or class covers operation and service of **Automotive Fuel and Emissions Control Systems.** 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. Discuss typical engine-related complaints and engine smoke diagnosis. 2. Explain the importance of visual checks. 3. Discuss engine noise diagnosis. 4. Describe oil pressure testing. 5. Explain cranking and running compression tests. 6. Describe cylinder leakage test and cylinder power balance test. 7. Describe vacuum testing and discuss the testing of back pressure with a vacuum gauge and a pressure gauge. 8. Explain 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 Fuel & Emission Control 4th Edition Chapter Images found on Jim's web site @ www.jameshalderman.com

LINK CHP 10: Chapter Images

ICONS	Ch10 Engine Condition Diagnosis
         	**1. SLIDE 1 CH10 Engine Condition Diagnosis** **Check for ADDITIONAL VIDEOS & ANIMATIONS @ http://www.jameshalderman.com/** **WEB SITE REGULARLY UPDATED** **Videos** **At the beginning of this class, you can download the crossword puzzle & Word Search from the links below to familiarize your class with the terms in this chapter & then discuss them** **Crossword Puzzle (Microsoft Word) (PDF)** **Word Search Puzzle (Microsoft Word) (PDF)** 2. **SLIDE 2 EXPLAIN Figure 10-1** 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 10-2** 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. **EXPLAIN TECH-TIP** **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** 4. **SLIDE 4 EXPLAIN Figure 10-3** 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.

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        	5. **SLIDE 5 EXPLAIN Figure 10-4** 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 10-5** Using a black light to spot leaks after adding dye to the oil. EXPLAIN **TECH-TIP** **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.** **HANDS-ON TASK: USE FOOT POWDER SPRAY TRICK TO CHECK FOR ENGINE OIL LEAKS** 7. **SLIDE 7 EXPLAIN Figure 10-6** 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 10-7** cracked exhaust manifold on a Ford V-8. EXPLAIN **TECH-TIP** **ON-VEHICLE TASK: NATEF TASK: DIAGNOSE ENGINE NOISES AND VIBRATION; DETERMINE NECESSARY ACTION**

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	9. **SLIDE 9 EXPLAIN Figure 10-8** To measure engine oil pressure, remove the oil pressure sending (sender) unit usually located near the oil filter. Screw the pressure gauge into the oil pressure sending unit hole.
	**DISCUSSION: ASK STUDENTS TO DESCRIBE SOME OF THE POSSIBLE CAUSES OF ENGINE KNOCK. DISCUSS CAUSES OF LOW OIL PRESSURE.**
	**EXPLAIN TECH-TIP**
	10. **SLIDE 10 EXPLAIN Figure 10-9** 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.
	**HANDS-ON TASK: HAVE STUDENTS CONDUCT PAPER TEST OF EXHAUST FLOW TO CHECK FOR ENGINE PROBLEMS.**
	**DEMONSTRATION: SHOW HOW TO USE AN OIL PRESSURE GAUGE TO TEST OIL PRESSURE.**
	**ON-VEHICLE NATEF TASK:** **PERFORM OIL PRESSURE TEST; DETERMINE NECESSARY ACTION**
	**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?**
	11. **SLIDE 11 EXPLAIN FIGURE 10–10** 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
	**EXPLAIN TECH-TIP**

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	12. **SLIDE 12 EXPLAIN Figure 10-11** Use a vacuum or fuel line hose over the spark plug to install it without danger of cross-threading the cylinder head.
	**DEMONSTRATION: SHOW STUDENTS A COMPRESSION GAUGE & HOW IT ATTACHES TO ENGINE.**
	**DEMONSTRATION: SHOW STUDENTS HOSE TRICK FOR INSTALLING SPARK PLUGS**
	13. **SLIDE 13 EXPLAIN** Wet Compression Test & **EXPLAIN Figure 10-12** 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
 	**DISCUSSION: DISCUSS THE REASONS FOR LOSS OF COMPRESSION. ASK STUDENTS TO DESCRIBE HOW TO PERFORM A COMPRESSION TEST**
	**DEMONSTRATION: SHOW STUDENTS HOW TO PERFORM A WET COMPRESSION TEST AND DISCUSS RESULTS.**
	**DEMONSTRATION: SHOW STUDENTS HOW TO PERFORM A RUNNING (DYNAMIC) COMPRESSION TEST.**
	**DISCUSSION: ASK HOW CRANKING, IDLING, & HIGHER RPM COMPARE WITH RESPECT TO COMPRESSION PRESSURE.**
	**ON-VEHICLE NATEF TASK:** **PERFORM CYLINDER COMPRESSION TESTS; DETERMINE NECESSARY ACTION.**
	14. **SLIDE 14 EXPLAIN Figure 10-13** typical handheld cylinder leakage tester. 15. **SLIDE 15 EXPLAIN Figure 10-14** 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

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	**DEMONSTRATION: SHOW STUDENTS HOW TO PERFORM A CYLINDER LEAKAGE TEST, USING A HANDHELD CYLINDER LEAKAGE TESTER.**
	**ON-VEHICLE NATEF TASK: PERFORM CYLINDER LEAKAGE TESTS; DETERMINE NECESSARY ACTION**
	16. **SLIDE 16 EXPLAIN Figure 10-15** Using vacuum hose & test light to ground 1 cylinder at a time on a distributorless ignition system. Works on all types of ignition systems & provides a method for grounding out 1 cylinder at time without fear of damaging any component. To avoid possible damage to catalytic converter, do not short out cylinder for longer than 5 seconds.
	**DEMONSTRATION: SHOW STUDENTS HOW TO CONDUCT A CYLINDER POWER BALANCE TEST.**
	**DEMONSTRATION: SHOW STUDENTS HOW TO USE A WHISTLE STOP TO FIND TOP DEAD CENTER (TDC) OF COMPRESSION STROKE.**
	**ON-VEHICLE NATEF TASK: PERFORM CYLINDER POWER BALANCE TESTS; DETERMINE NECESSARY ACTION.**
	17. **SLIDE 17 EXPLAIN Figure 10-16** An engine in good mechanical condition should produce 17 to 21 in. Hg of vacuum at idle at sea level. 18. **SLIDE 18 EXPLAIN Figure 10-17** steady but low reading could indicate retarded valve or ignition timing. 19. **SLIDE 19 EXPLAIN Figure 10-18** gauge reading with the needle fluctuating 3 to 9 in. Hg below normal often indicates a vacuum leak in the intake system
	**DISCUSSION: DISCUSS THE VARIOUS TYPES OF MANIFOLD VACUUM TESTS & THEIR PURPOSES.**
	20. **SLIDE 20 EXPLAIN Figure 10-19** leaking head gasket can cause needle to vibrate as it moves through a range from below to above normal. 21. **SLIDE 21 EXPLAIN Figure 10-20** oscillating needle 1-

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	2 in. Hg below normal could indicate an incorrect air-fuel mixture (either too rich or too lean). 22. **SLIDE 22 EXPLAIN Figure 10-21** rapidly vibrating needle at idle that becomes steady as engine speed is increased indicates worn valve guides. 23. **SLIDE 23 EXPLAIN Figure 10-22** needle drops 1-2 in. Hg from normal reading, one of engine valves is burned or not seating 24. **SLIDE 24 EXPLAIN Figure 10-23** Weak valve springs will produce a normal reading at idle, as engine speed increases, needle will fluctuate rapidly between 12-24 in. 25. **SLIDE 25 EXPLAIN Figure 10-24** 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.
	26. **SLIDE 26 EXPLAIN Figure 10-25** 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. 27. **SLIDE 27 EXPLAIN Figure 10-26** needle that drops to near zero when engine is accelerated rapidly and then rises slightly to a reading below normal indicates an exhaust restriction.
	**Vacuum Gauge, Retarded Timing** **Vacuum Gauge, Retarded Valve or Ignition Timing** **Vacuum Gauge, Head Gasket Leak** **Vacuum Gauge, Intake Leak** **Vacuum Gauge, Rich or Lean Fuel Mixture** **Vacuum Gauge, Bad Valve Guide** **Vacuum Gauge, Faulty Valve** **Vacuum Gauge, Weak Valve Springs** **Vacuum Gauge, Advanced Ignition Timing** **Vacuum Gauge Readings**
	**ON-VEHICLE NATEF TASK:** **PERFORM ENGINE VACUUM TESTS; DETERMINE NECESSARY ACTION.**
	28. **SLIDE 28 EXPLAIN Figure 10-27** technician-made adapter used to test exhaust system back pressure.

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	**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.**
	**DISCUSSION: COMPARE AND CONTRAST VARIOUS TYPES OF EXHAUST RESTRICTION TESTS.**
	**29. SLIDE 29 EXPLAIN Figure 10-28** tester that uses a blue liquid to check for exhaust gases in the exhaust, which would indicate a head gasket leak problem
	**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?**
	**EXPLAIN TECH-TIP**
	**30. SLIDES 30-41 EXPLAIN COMPRESSION TEST SLIDE SHOW**