Automotive Engines
Chapter 22 Engine Diagnosis
Opening Your Class

KEY ELEMENT	EXAMPLES
Introduce Content	This engine systems course or class provides complete coverage of the components, operation, design, and troubleshooting. It correlates material to task lists specified by ASE and NATEF and emphasizes a problem-solving approach. Chapter features include Tech Tips, Frequently Asked Questions, Real World Fixes, Videos, Animations, and NATEF Task Sheet references.
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 on your second SLIDE. 1. Prepare for ASE Engine Performance (A8) certification test content area "A" (General Engine Diagnosis). 2. List the visual checks to determine engine condition. 3. Discuss engine noise and its relation to engine condition. 4. Describe how to perform a dry and a wet compression test. 5. Explain how to perform a cylinder leakage test. 6. Discuss how to measure the amount of timing chain slack. 7. Describe how an oil sample analysis can be used to determine engine condition
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	Chapter 22 Engine Condition Diagnosis
	**1. SLIDE 1 Ch22 ENGINE CONDITION DIAGNOSIS**
	2. SLIDES 2-3 EXPLAIN Objectives & KEY TERMS
	4. SLIDE 4 EXPLAIN Typical-Engine Related Complaints
	**Check for ADDITIONAL VIDEOS & ANIMATIONS @ http://www.jameshalderman.com/**
	WEB SITE IS UPDATED REGULARLY
	**5. SLIDE 5 EXPLAIN** Engine Smoke Diagnosis & **EXPLAIN FIGURE 22-1** Blowby gases coming out of the crankcase vent hose. Excessive amounts of combustion gases flow past the piston rings and into the crankcase.
	6. SLIDE 6 EXPLAIN FIGURE 22-2 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.
	**DISCUSSION: Ask students to describe some common mechanical-related customer complaints about the engine.**
	**7. SLIDE 7 EXPLAIN** Driver Is Your Best Resource
	**8. SLIDE 8 EXPLAIN TECH TIP**
	**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**
	**9. SLIDE 9 EXPLAIN Visual Checks**
	**10. SLIDE 10 EXPLAIN FIGURE 22-3** 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.
	11. SLIDE 11 EXPLAIN FIGURE 22-4 transmission and flexplate (flywheel) were removed to check the exact location of this oil leak. The rear main seal and/or the oil

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	pan gasket could be the cause of this leak. 12. **SLIDE 12** EXPLAIN **FIGURE 22-5** 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.**
	13. **SLIDE 13** EXPLAIN TECH TIP
	14. **SLIDE 14** EXPLAIN TECH TIP
	**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: PAGES 88 & 90**
	**HANDS-ON TASK: Use foot powder spray trick to check for engine oil leaks. Review Tech Tip in textbook before attempting this task.**
	15. **SLIDE 15** EXPLAIN Engine Noise Diagnosis 16. **SLIDE 16** EXPLAIN **FIGURE 22-6** 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. 17. **SLIDE 17** EXPLAIN **FIGURE 22-7** 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.**

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	**Show VIDEO: LISTINING TO ENGINE NOISES 2.5 MINUTES www.myautomotivelab.com** http://media.pearsoncmg.com/ph/chet/chet_mylabs/akamai/template/video640x480.php?title=Listening%20to%20Engine%20Noise&clip=pandc/chet/2012/automotive/Engines/A1T1.mov&caption=chet/chet_mylabs/akamai/2012/automotive/Engines/xml/A1T1.xml
	**Show ASE TASK ENGINE NOISE DIAGNOSIS 3 MINUTES VIDEO: www.myautomotivelab.com** http://media.pearsoncmg.com/ph/chet/chet_mylabs/akamai/template/video640x480.php?title=Listening%20to%20Engine%20Noise&clip=pandc/chet/2012/automotive/Test_Readiness_A1/CA_T4.mov&caption=chet/chet_mylabs/akamai/2012/automotive/Test_Readiness_A1/xml/CA_T4.xml
	**ON-VEHICLE TASK: NON-NATEF Task** **Diagnose engine noises and vibration; determine necessary action.**
	**18. SLIDE 18** EXPLAIN TECH TIP
	**19. SLIDE 19** EXPLAIN Oil Pressure Testing & EXPLAIN **FIGURE 22-8** 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
	**20. SLIDE 20** EXPLAIN TECH TIP
	**21. SLIDE 21** EXPLAIN **OIL PRESSURE WARNING LAMP**
	**22. SLIDE 22** EXPLAIN ENGINE COMPRESSION TEST
	**23. SLIDE 23** EXPLAIN TECH TIP
	**24. SLIDE 24** EXPLAIN TECH TIP **FIGURE 22-9** 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 the exhaust flow to check for engine problems. Be sure they review Tech Tip in textbook before attempting this task.

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	**DEMONSTRATION: Show students how to use an oil pressure gauge to test oil pressure.**
	**ON-VEHICLE NATEF TASK: Perform oil pressure test; determine necessary action PAGE 101**
	**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?**
	**25. SLIDE 25** EXPLAIN Compression Test & EXPLAIN **FIGURE 22-10** 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.
	**26. SLIDE 26** EXPLAIN TECH TIP
	**27. SLIDE 27** EXPLAIN TECH TIP **FIGURE 22-11** 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**
	**28. SLIDE 28** EXPLAIN Wet Compression Test & EXPLAIN **FIGURE 22-12** 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
	**29. SLIDE 29** EXPLAIN Running (Dynamic) Compression Test

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	**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 NON-NATEF TASK: Perform cylinder compression tests; determine necessary action.**
	**30. SLIDE 30 EXPLAIN** Cylinder Leakage Test **31. SLIDE 31 EXPLAIN FIGURE 22-13** typical handheld cylinder leakage tester. **32. SLIDE 32 EXPLAIN FIGURE 22-14** whistle stop used to find top dead center. Remove 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 NON-NATEF TASK: Perform cylinder leakage tests; determine necessary action**
	**Show VIDEO: Power Balance, Compression Test: 6.5 Minutes** **www.myautomotivelab.com** http://media.pearsoncmg.com/ph/chet/chet_mylabs/akamai/template/video640x480.php?title=Performing,%20Power%20Balance,%20Compression,&clip=pandc/chet/2012/automotive/Engine_Performance/Performing_Power_Balance.mov&caption=chet/chet_mylabs/akamai/2012/automotive/Engine_Performance/xml/Performing_Power_Balance.xml
	**33. SLIDE 33 EXPLAIN Cylinder Power Balance Test**

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	**34. SLIDE 34** EXPLAIN Power Balance Test Procedure & EXPLAIN **FIGURE 22-15** 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 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.**
	**DEMONSTRATION: Show students how to use a whistle stop to find top dead center (TDC) of compression stroke.**
	**ON-VEHICLE NON-NATEF TASK: Perform cylinder power balance tests; determine necessary action**
	**35. SLIDE 35** EXPLAIN Vacuum Tests & EXPLAIN **FIGURE 22-16** engine in good mechanical condition should produce 17 to 21 in. Hg of vacuum at idle at sea level. **36. SLIDE 36** EXPLAIN **FIGURE 22-17** steady but low reading could indicate retarded valve or ignition timing.
	**DISCUSSION: Discuss the various types of manifold vacuum tests & their purposes.**
	**37. SLIDE 37** EXPLAIN **FIGURE 22--18** A gauge reading with the needle fluctuating 3 to 9 in. Hg below normal often indicates a vacuum leak in the intake system. & EXPLAIN **FIGURE 22--19** A leaking head gasket can cause the needle to vibrate as it moves through a range from below to above normal. **38. SLIDE 38** EXPLAIN **FIGURE 22--20** oscillating needle 1 or 2 in. Hg below normal could indicate an incorrect air-fuel mixture (either too rich or too lean) & EXPLAIN **FIGURE 22--21** rapidly vibrating needle at idle that becomes steady as engine speed is increased indicates worn valve guides.

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	**39. SLIDE 39 EXPLAIN FIGURE 22-22** needle drops 1 or 2 in. Hg from normal reading, one of engine valves is burned or not seating properly & **EXPLAIN FIGURE 22-23** Weak valve springs will produce a normal reading at idle, as engine speed increases, needle will fluctuate rapidly between 12-24 in **40. SLIDE 40 EXPLAIN FIGURE 22-24** 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 & **EXPLAIN FIGURE 22-25** 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. **41. SLIDE 41 EXPLAIN FIGURE 22-26** 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.
	**ON-VEHICLE NON-NATEF TASK: Perform engine vacuum tests; determine necessary action**
	**42. SLIDE 42 EXPLAIN** Exhaust Restriction Test
	**43. SLIDE 43 EXPLAIN** Testing Back Pressure with a Vacuum Gauge **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** **www.myautomotivelab.com** http://media.pearsoncmg.com/ph/chet/chet_mylabs/akamai/template/video640x480.php?title=Checking%20Exhaust%20Back%20Pressure&clip=pandc/chet/2012/automotive/Advanced_Drivability/L1T2.mov&caption=chet/chet_mylabs/akamai/2012/automotive/OBD2_GM/xml/L1T2.xml
	**44. SLIDE 44 EXPLAIN** Testing Back Pressure with a Pressure Gauge **45. SLIDE 45 EXPLAIN FIGURE 22-27** technician-made adapter used to test exhaust system back pressure.

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	**DISCUSSION: Compare and contrast various types of exhaust restriction tests.**
	**46. SLIDE 46 EXPLAIN** Diagnosing Head Gasket Failure & **EXPLAIN FIGURE 22-28** 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?**
	**47. SLIDE 47 EXPLAIN** Dash Warning Lights
	**48. SLIDE 48 EXPLAIN TECH TIP**
	**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.**
	**Talk through SUMMARY and questions**
	**HOMEWORK: complete Ch22 crossword puzzle: http://www.jameshalderman.com/links/book_engine_theory_serv_7/cw/crossword_ch_22.pdf**