













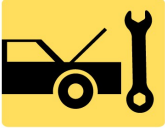







# Automotive Maintenance and Light Repair, 1<sup>ST</sup> Edition











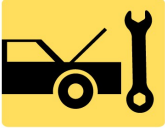
## Chapter 20 Engine Condition Diagnosis












### Opening Your Class

KEY ELEMENT	EXAMPLES
Introduce Content	This course or class covers <b>Automotive Maintenance and Light Repair</b> . 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. <ul style="list-style-type: none"><li>• Prepare for ASE Engine Performance (A8) certification test content area "A" (General Engine Diagnosis).</li><li>• Diagnose typical engine-related complaints.</li><li>• List the visual checks to determine engine condition.</li><li>• Discuss engine noise and its relation to engine condition.</li><li>• Describe how to perform a dry and wet compression test.</li><li>• Explain how to perform a cylinder leakage test.</li><li>• Perform a cylinder balance test, and determine necessary action.</li><li>• Perform an exhaust system back-pressure test, and determine necessary action.</li><li>• Perform engine absolute (vacuum/boost) manifold pressure tests, and determine necessary action.</li></ul>
Establish the Mood or Climate	Provide a <i>WELCOME</i> , 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	Ch20 Engine Condition Diagnosis
  	<p><b>1. SLIDE 1 C20 Engine Condition Diagnosis</b></p> <p><b>2. SLIDES 2-4 EXPLAIN OBJECTIVES</b></p> <p><b>Check for ADDITIONAL VIDEOS &amp; ANIMATIONS @ <a href="http://www.jameshalderman.com/">http://www.jameshalderman.com/</a> WEB SITE REGULARLY UPDATED</b></p>
         <p><b>QUESTION</b></p>    <p><b>QUESTION</b></p>      	<p><b>5. SLIDE 5-6 EXPLAIN</b> Typical-Engine Related Complaints</p> <p><b>7. SLIDE 7 EXPLAIN Figure 20-1</b> Blowby gases coming out of the crankcase vent hose. Excessive amounts of combustion gases flow past the piston rings and into the crankcase.</p> <p><b>8. SLIDE 8 EXPLAIN Figure 20-2</b> 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.</p> <p><b>DISCUSSION: ASK STUDENTS TO DESCRIBE SOME COMMON MECHANICAL-RELATED CUSTOMER COMPLAINTS ABOUT THE ENGINE.</b></p> <p><b>9. SLIDE 9 EXPLAIN CHART 20-1</b></p> <p><b>DISCUSSION: DISCUSS CHART 20-1 &amp; THE CAUSES OF EXHAUST SMOKE. WHAT ARE THE COMMON CAUSES OF BLACK SMOKE?</b></p> <p><b>10. SLIDES 10-11 EXPLAIN</b> Driver Is Your Best Resource</p> <p><b>12. SLIDE 12 EXPLAIN</b> Visual Checks</p> <p><b>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</b></p> <p><b>13. SLIDE 13 EXPLAIN Figure 20-3</b> 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.</p>

ICONS	Ch20 Engine Condition Diagnosis
         <p data-bbox="354 1755 472 1787"><b>QUESTION</b></p>	<p data-bbox="626 258 1406 401">14. <b>SLIDE 14 EXPLAIN</b> Figure 20-4 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.</p> <p data-bbox="626 411 1414 478">15. <b>SLIDE 15 EXPLAIN</b> Figure 20-5 Using a black light to spot leaks after adding dye to the oil.</p> <p data-bbox="586 489 1308 569"><b>DEMONSTRATION: SHOW STUDENTS LOCATION OF CRANKCASE VENT HOSE</b></p> <p data-bbox="586 632 1414 779"><b>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.</b></p> <p data-bbox="586 789 1414 978"><b>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.</b></p> <p data-bbox="586 989 1341 1104"><b>ON-VEHICLE TASK: NATEF TASK INSPECT ENGINE FOR FUEL, OIL, COOLANT AND OTHER LEAKS; DETERMINE NECESSARY ACTION</b></p> <p data-bbox="586 1136 1414 1283"><b>HANDS-ON TASK: USE FOOT POWDER SPRAY TRICK TO CHECK FOR ENGINE OIL LEAKS. REVIEW TECH TIP IN TEXTBOOK BEFORE ATTEMPTING THIS TASK.</b></p> <p data-bbox="626 1293 1341 1325">16. <b>SLIDES 16-17 EXPLAIN</b> Engine Noise Diagnosis</p> <p data-bbox="626 1335 1382 1524">18. <b>SLIDE 18 EXPLAIN</b> Figure 20-6 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.</p> <p data-bbox="626 1535 1154 1566">19. <b>SLIDE 19 EXPLAIN</b> CHART 20-2</p> <p data-bbox="626 1577 1341 1644">20. <b>SLIDE 20 EXPLAIN</b> Figure 20-7 cracked exhaust manifold on a Ford V-8.</p> <p data-bbox="586 1654 1382 1801"><b>DISCUSSION: ASK STUDENTS TO DESCRIBE SOME OF THE POSSIBLE CAUSES OF ENGINE KNOCK. DISCUSS POSSIBLE CAUSES OF LOW OIL PRESSURE.</b></p>

ICONS	Ch20 Engine Condition Diagnosis
 	<p><b>SHOW VIDEO: <u>LISTENING TO ENGINE NOISES</u> 2.5 MINUTES</b>  <b><u>WWW.MYAUTOMOTIVELAB.COM</u></b>  <b>ENGINE NOISE DIAGNOSIS 3 MIN</b>  <b><u>WWW.MYAUTOMOTIVELAB.COM</u></b>  <small>HTTP://MEDIA.PEARSONCMG.COM/PH/CHET/CHET_MYLABS/AKAMAI/TEMPLATE/VIDEO640X480.PHP?TITLE=LISTENING%20TO%20ENGINE%20NOISE&amp;CLIP=PANDC/CHET/2012/AUTOMOTIVE/TEST_READINESS_A1/CA_T4.MOV&amp;CAPTION=C HET/CHET_MYLABS/AKAMAI/2012/AUTOMOTIVE/TEST_READINESS_A1/XML/CA_T4.XML</small></p>
  	<p><b>ON-VEHICLE TASK: NATEF TASK DIAGNOSE ENGINE NOISES AND VIBRATION; DETERMINE NECESSARY ACTION</b></p> <p>21. SLIDES 21-22 EXPLAIN Oil Pressure Testing</p> <p>23. SLIDE 23 EXPLAIN Figure 20-8 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.</p> <p>24. SLIDES 24-25 EXPLAIN Oil Pressure Warning Lamp</p>
	<p><b>DEMONSTRATION: SHOW HOW TO USE AN OIL PRESSURE GAUGE TO TEST OIL PRESSURE.</b></p>
   <p><b>QUESTION</b></p>	<p><b>ON-VEHICLE NATEF TASK: PERFORM OIL PRESSURE TEST; DETERMINE NECESSARY ACTION</b></p> <p><b>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?</b></p>
	<p>26. SLIDE 26 EXPLAIN Figure 20-9 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.</p>
	<p><b>HANDS-ON TASK: HAVE STUDENTS CONDUCT PAPER TEST OF EXHAUST FLOW TO CHECK FOR ENGINE PROBLEMS.</b></p>

ICONS	Ch20 Engine Condition Diagnosis
                   	<p>27. <b>SLIDES 27-28 EXPLAIN</b> Compression Test</p> <p>29. <b>SLIDE 29 EXPLAIN</b> Figure 26-10 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.</p> <p>30. <b>SLIDE 30 EXPLAIN</b> Figure 26-11 Use a vacuum or fuel line hose over the spark plug to install it without danger of cross-threading the cylinder head.</p> <p><b><u>DEMONSTRATION: SHOW STUDENTS A COMPRESSION GAUGE &amp; HOW IT ATTACHES TO ENGINE.</u></b></p> <p><b><u>DEMONSTRATION: SHOW STUDENTS HOSE TRICK FOR INSTALLING SPARK PLUGS</u></b></p> <p>31. <b>SLIDE 31 EXPLAIN</b> Figure 20-12 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</p> <p>32. <b>SLIDE 32 EXPLAIN</b> Running (Dynamic) Compression Test</p> <p><b><u>DISCUSSION: DISCUSS THE REASONS FOR LOSS OF COMPRESSION. ASK STUDENTS TO DESCRIBE HOW TO PERFORM A COMPRESSION TEST</u></b></p> <p><b><u>DEMONSTRATION: SHOW STUDENTS HOW TO PERFORM A WET COMPRESSION TEST AND DISCUSS RESULTS.</u></b></p> <p><b><u>DEMONSTRATION: SHOW STUDENTS HOW TO PERFORM A RUNNING (DYNAMIC) COMPRESSION TEST.</u></b></p> <p><b><u>DISCUSSION: ASK HOW CRANKING, IDLING, &amp; HIGHER RPM COMPARE WITH RESPECT TO COMPRESSION PRESSURE.</u></b></p> <p><b><u>ON-VEHICLE NATEF TASK: PERFORM CYLINDER COMPRESSION TESTS; DETERMINE NECESSARY ACTION</u></b></p>

## ICONS

## Ch20 Engine Condition Diagnosis



33. SLIDES 33-34 EXPLAIN Cylinder Leakage Test

35. SLIDE 35 EXPLAIN Figure 20-13 typical handheld cylinder leakage tester.

36. SLIDE 36 EXPLAIN Figure 20-14 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

**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**

**POWER BALANCE, COMPRESSION TEST: 6  
MIN [WWW.MYAUTOMOTIVELAB.COM](http://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](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)







37. SLIDES 37-38 EXPLAIN Cylinder Power Balance Test

39. SLIDES 39-40 EXPLAIN Power Balance Test Procedure

41. SLIDE 41 EXPLAIN Figure 20-15 Using 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 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 cylinder for longer than 5 secs

**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.**

ICONS	Ch20 Engine Condition Diagnosis
     	<p data-bbox="586 247 1273 380"><b>ON-VEHICLE NATEF TASK: PERFORM CYLINDER POWER BALANCE TESTS; DETERMINE NECESSARY ACTION</b></p> <p data-bbox="623 401 1414 737"> <b>42. SLIDES 42-46 EXPLAIN</b> Vacuum Tests  <b>47. SLIDE 47 EXPLAIN</b> Figure 20-16 An engine in good mechanical condition should produce 17 to 21 in. Hg of vacuum at idle at sea level.  <b>48. SLIDE 48 EXPLAIN</b> Figure 20-17 steady but low reading could indicate retarded valve or ignition timing. <b>&amp; EXPLAIN</b> Figure 20-18 A gauge reading with the needle fluctuating 3 to 9 in. Hg below normal often indicates a vacuum leak in the intake system. </p> <p data-bbox="586 747 1382 1272"> <u><b>Vacuum Gauge, Retarded Timing</b></u>  <u><b>Vacuum Gauge, Retarded Valve or Ignition Timing</b></u>  <u><b>Vacuum Gauge, Head Gasket Leak</b></u>  <u><b>Vacuum Gauge, Intake Leak</b></u>  <u><b>Vacuum Gauge, Rich or Lean Fuel Mixture</b></u>  <u><b>Vacuum Gauge, Bad Valve Guide</b></u>  <u><b>Vacuum Gauge, Faulty Valve</b></u>  <u><b>Vacuum Gauge, Weak Valve Springs</b></u>  <u><b>Vacuum Gauge, Advanced Ignition Timing</b></u>  <u><b>Vacuum Gauge Readings</b></u>  <b>DISCUSSION: DISCUSS VARIOUS TYPES OF MANIFOLD <u>VACUUM TESTS</u> &amp; THEIR PURPOSES.</b> </p> <p data-bbox="623 1339 1414 1778"> <b>49. SLIDE 49 EXPLAIN</b> Figure 20-19 A leaking head gasket can cause the needle to vibrate as it moves through a range from below to above normal &amp; <b>EXPLAIN</b> Figure 20-20 oscillating needle 1 or 2 in. Hg below normal could indicate an incorrect air-fuel mixture (either too rich or too lean)  <b>50. SLIDE 50 EXPLAIN</b> Figure 20-21 rapidly vibrating needle at idle becomes steady as engine speed is increased indicates worn valve guides &amp; <b>EXPLAIN</b> Figure 20-22 needle drops 1-2 in. Hg from normal reading, one of engine valves is burned or not seating properly </p>

## ICONS

## Ch20 Engine Condition Diagnosis



51. **SLIDE 51 EXPLAIN** Figure 20-23 Weak valve springs will produce a normal reading at idle, as engine speed increases, needle will fluctuate rapidly between 12-24 in. & **EXPLAIN** Figure 20-24 steady needle reading that drops 2 or 3 in. Hg when engine speed is increased slightly above idle indicates ignition timing is retarded.

52. **SLIDE 52 EXPLAIN** Figure 20-25 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 & **EXPLAIN** Figure 20-26 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 NATEF TASK: PERFORM ENGINE VACUUM TESTS; DETERMINE NECESSARY ACTION**



**DISCUSSION: ASK STUDENTS TO DESCRIBE IN THEIR OWN WORDS THE SIGNIFICANCE OF EACH OF FIGURES FROM 20-17 TO 20-26**



53. **SLIDE 53 EXPLAIN** Exhaust Restriction Test

54. **SLIDE 54 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.**



**CHECKING EXHAUST BACKPRESSURE VIDEO: [WWW.MYAUTOMOTIVELAB.COM](http://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](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)



55. **SLIDE 55 EXPLAIN** Testing Back Pressure with a Pressure Gauge

56. **SLIDE 56 EXPLAIN** Figure 20-27 technician-made adapter used to test exhaust system back pressure.



ICONS	Ch20 Engine Condition Diagnosis
	<p><b>DISCUSSION: COMPARE AND CONTRAST VARIOUS TYPES OF EXHAUST RESTRICTION TESTS.</b></p>
	<p>57. SLIDE 57 EXPLAIN Diagnosing Head Gasket Failure</p> <p>58. SLIDE 58 EXPLAIN Figure 20-28 tester that uses a blue liquid to check for exhaust gases in the exhaust, which would indicate a head gasket leak problem.</p>
  <p>QUESTION</p>	<p><b>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, &amp; OBSERVING FOR EXCESSIVE EXHAUST STEAM.</b></p>
  <p>QUESTION</p>	<p><b>DISCUSSION: AS YOU ARE DRIVING, COOLANT TEMPERATURE LIGHT BECOMES ILLUMINATED (OR COOLANT GAUGE READS HIGH). WHAT ACTIONS SHOULD YOU TAKE?</b></p>
	<p>59. SLIDE 59 EXPLAIN Dash Warning Lights</p> <p>60. SLIDES 60-71 EXPLAIN COMPRESSION TEST</p>
	<p><b>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.</b></p>