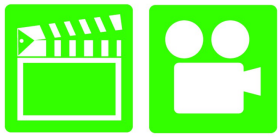
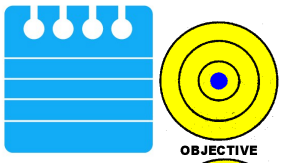
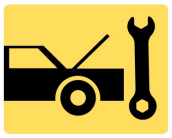
A8 Engine Performance 4th Edition

Chapter 17 Ignition System Diagnosis & Service

Opening Your Class

KEY ELEMENT	EXAMPLES
Introduce Content	This course or class covers operation and service of **Automotive Engine Performance.** 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. Describe the procedure used to check for spark. 2. Inspect and test ignition coils. 3. Inspect and test ignition system pickup sensor or triggering devices. 4. Discuss what to inspect and look for during a visual inspection of the ignition system. 5. Diagnose ignition related problems. 6. Inspect and test ignition secondary circuit wiring and components, to include spark plug service. 7. Check and adjust ignition timing on engines equipped with a distributor. 8. Describe how to test the ignition system using an oscilloscope. **This Chapter will help prepare for ASE Engine performance (A8) certification test content area "B" (ignition System 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.

ICONS	Ch17 Ignition System Diagnosis & Service
	1. SLIDE 1 CH17 Ignition System Diagnosis & Service
	Check for ADDITIONAL VIDEOS & ANIMATIONS @ http://www.jameshalderman.com/ WEB SITE REGULARLY UPDATED
	POWER POINTS DONE BY INDIVIDUAL LEARNING OBJECTIVES, COMPLETE POWER POINT FILE COVERED IN THIS LESSON PLAN
	2. SLIDE 2 EXPLAIN OBJECTIVE CH17 AEP_LO1 3. SLIDES 3 EXPLAIN Checking for Spark
	4. SLIDE 4 EXPLAIN Figure 17-1 spark tester looks like a regular spark plug with an alligator clip attached to the shell. This tester has a specified gap that requires at least 25,000 volts (25 kV) to fire. 5. SLIDE 5 EXPLAIN Figure 17-2 close-up showing the recessed center electrode on a spark tester. It is recessed 3/8 in. into the shell and the spark must then jump another 3/8 in. to the shell for a total gap of 3/4 in.
	6. SLIDES 6-7 EXPLAIN TECH-TIPS Always Use a Spark Tester
	8. SLIDE 8 EXPLAIN CHECKING FOR SPARK REASONS FOR NO-SPARK
	DEMONSTRATION: SHOW HOW TO PROPERLY USE A SPARK TESTER TO CHECK FOR SPARK
	DISCUSSION: DISCUSS SPARK COLOR. HOW CAN SPARK COLOR BE USED TO DETERMINE SPARK QUALITY?
	ON-VEHICLE NATEF TASK MEETS NATEF TASK: SPARK PLUG SPECIFICATIONS: RESEARCH APPLICABLE VEHICLE AND SERVICE INFORMATION, SUCH AS

ICONS	Ch17 Ignition System Diagnosis & Service
	**ENGINE MANAGEMENT SYSTEM OPERATION, VEHICLE SERVICE HISTORY, SERVICE PRECAUTIONS, AND TSBS** 9. SLIDE 9 EXPLAIN **OBJECTIVE CH17 AEP_LO2** 10. SLIDES 10 EXPLAIN Ignition Coil Testing 11. SLIDE 11 EXPLAIN **Figure 17-3** Checking an ignition coil using a multimeter set to read ohms
	**HANDS-ON TASK: HAVE THE STUDENTS TEST IGNITION COILS, USING OHMMETER TO DETERMINE COIL CONDITION**
	**PERFORM CAREFUL VISUAL INSPECTION OF COIL HOUSING. INSPECTION WILL HELP TO LOCATE BURN MARKS OR CRACKS THAT INDICATE A FAULTY COIL.**
	**ON-VEHICLE NATEF TASK: IGNITION COIL TESTING INSPECT AND TEST IGNITION PRIMARY AND SECONDARY CIRCUIT WIRING AND SOLID STATE COMPONENTS; TEST IGNITION COIL (S); PERFORM NECESSARY ACTION.**
	**SAFETY HAVE STUDENTS REVIEW HAZARDS OF WORKING WITH ELECTRICAL COMPONENTS. EXPLAIN TO REDUCE CHANCES OF BEING SHOCKED, THEY SHOULD NOT HOLD/TOUCH A SPARK TESTER WHILE CHECKING FOR SPARK**
	**DISCUSSION: HAVE THE STUDENTS DISCUSS WHAT RESULTS FROM LOW/NO VOLTAGE TO PRIMARY SIDE OF COIL. HOW DOES LOWER-THAN-NORMAL VOLTAGE IN THE PRIMARY CIRCUIT AFFECT SECONDARY CIRCUIT?**
	**DISCUSSION: HAVE STUDENTS TALK ABOUT RELATIONSHIP BETWEEN TEMPERATURE & RESISTANCE. HOW DOES TEMPERATURE AFFECT RESISTANCE OF SENSORS AND COILS?**
	12. SLIDE 12 **OBJECTIVE CH17 AEP_LO3** 13. SLIDE 13 EXPLAIN IGNITION SENSOR TESTING

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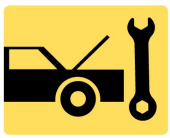
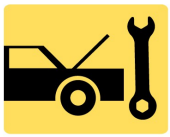
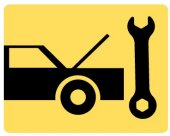
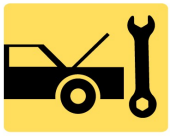
	14. **SLIDE 14 EXPLAIN FIGURE 17–4** Measuring the resistance of an HEI pickup coil using a digital multimeter set to the ohms position. The reading on the face of the meter is 0.796 kΩ or 796 ohms in the middle of the 500- to 1,500-ohm specifications. 15. **SLIDE 15 EXPLAIN FIGURE 17–5** AC voltage is produced by a magnetic sensor. Most sensors should produce at least 0.1 volt AC while engine is cranking and can exceed 100 volts with engine running if pickup wheel has many teeth. If pickup wheel has only a few teeth, you may need to switch meter to read DC volts and watch display for a jump in voltage as teeth pass magnetic sensor.
	**DEMONSTRATION: USE A DSO TO SHOW DIFFERENT WAVEFORMS GENERATED BY PICKUP COIL, HALL-EFFECT, AND OPTICAL SENSORS**
	**HANDS-ON TASK: HAVE THE STUDENTS TEST A MAGNETIC SENSOR (PICKUP COIL) USING AN OHMMETER TO DETERMINE ELECTRICAL INTEGRITY OF SENSOR**
	**DISCUSSION: HAVE STUDENTS TALK ABOUT CHANGES IN FREQUENCY. HOW DOES AMPLITUDE OF AN AC SIGNAL CHANGE WITH CHANGES IN FREQUENCY?**
	**HANDS-ON TASK: HAVE STUDENTS LOCATE AND INSPECT CKP & CMP IGNITION SENSORS TO DETERMINE TYPES OF SENSORS. CHECK THEM USING A SCAN TOOL**
	16. **SLIDE 16 EXPLAIN Figure 17-6** (a) connection required to test a Hall effect sensor. (b) A typical waveform from a Hall-effect sensor
	17. **SLIDE 17 EXPLAIN FIGURE 17–7** (a) low-resolution signal has same number of pulses as engine has cylinders. (b) dual trace pattern showing both low-resolution & high-resolution signals that usually represent 1 degree of rotation
	18. **SLIDE 18 EXPLAIN TECH-TIP Bad Wire? Replace the Coil! SEE FIGURE 17-8**

ICONS	Ch17 Ignition System Diagnosis & Service
	19. SLIDE 19 EXPLAIN FIGURE 17–8 track inside ignition coil is not a short, but a low-resistance path or hole that has been burned through from secondary wiring to steel core.
	20. SLIDE 20 EXPLAIN TECH-TIP CONTINUED: Bad Wire? Replace the Coil!
	**DEMONSTRATION: SHOW HOW TO PREPARE A DSO (DIGITAL STORAGE OSCILLOSCOPE) TO OBTAIN PRIMARY CIRCUIT PATTERNS.**
	**ON-VEHICLE NATEF TASK SCOPE TESTING: INSPECT AND TEST IGNITION PRIMARY AND SECONDARY CIRCUIT WIRING AND SOLID STATE COMPONENTS; TEST IGNITION COIL (S); PERFORM NECESSARY ACTION**
	**DISCUSSION: HAVE THE STUDENTS TALK ABOUT ANALYSIS OF WAVEFORMS. WHAT SHOULD YOU LOOK FOR WHEN ANALYZING WAVEFORMS TO DETERMINE IGNITION COIL CONDITION?**
	**DISCUSSION: DISCUSS DIFFERENCE BETWEEN ANALOG & DIGITAL SIGNALS. DOES SCOPE TESTING USE AN ANALOG OR A DIGITAL SIGNAL?**
	**DISCUSSION: HAVE THE STUDENTS DISCUSS THE DIFFERENCE BETWEEN THE TERMS SHORTED AND OPEN. HOW DO THESE TERMS RELATE TO COILS?**
	**DEMONSTRATION: SHOW STUDENTS HOW TO USE SCAN TOOL ON A LAB VEHICLE TO OBTAIN ENGINE RPM.**
	21. SLIDE 21 OBJECTIVE CH17 AEP_LO4
	22. SLIDES 22-23 EXPLAIN VISUAL INSPECTIONS
	24. SLIDE 24 EXPLAIN TECH-TIP The Magnetic Pickup Tool Test, SEE FIGURE 17-9, NEXT
	25. SLIDE 25 EXPLAIN FIGURE 17–9 If the coil is working, the end of the magnetic pickup tool will move with the changes in the magnetic field around the coil

ICONS	Ch17 Ignition System Diagnosis & Service
	26. SLIDE 26 OBJECTIVE CH17 AEP_LO5 27. SLIDE 27 EXPLAIN STEPS ON PAGE 287 OF TEXT TO CHECK FOR POOR PERFORMANCE 28. SLIDE 28 EXPLAIN Figure 17-10 Using vacuum hose & test light to ground one cylinder at a time on distributorless ignition system. This works on all types of ignition systems & provides method for grounding out one cylinder at a time without fear of damaging any component. To avoid damage to catalytic converter, do not short out cylinder for longer than 5 seconds. 29. SLIDE 29 EXPLAIN PROCESS OF DIAGNOSING A NO-START CONCERN, SEE PAGE 288 OF TEXT
	**DISCUSSION:** HAVE THE STUDENTS DISCUSS WHAT CAN CAUSE NO-START CONDITION. HOW DO YOU SYSTEMATICALLY TEST IGNITION SYSTEM COMPONENTS & CIRCUITRY TO DETERMINE CAUSE OF NO-SPARK CONDITION?
	30. SLIDE 30 EXPLAIN DISTRIBUTOR INDEXING 31. SLIDE 31 EXPLAIN FIGURE 17–11 relationship between crankshaft position (CKP) sensor & camshaft position (CMP) sensor is affected by wear in timing gear and/or chain
	**DISCUSSION:** HAVE THE STUDENTS DISCUSS HOW FIRING ORDER CAN BE USED TO FIND COMPANION CYLINDERS. WHERE CAN FIRING ORDER BE FOUND?
	**HANDS-ON TASK:** PROVIDE THE STUDENTS WITH A VEHICLE THAT HAS INCORRECT FIRING ORDER. HAVE THEM USE SPECIFICATIONS TO INSPECT AND CORRECT FIRING ORDER
	**DISCUSSION:** DISCUSS DISTRIBUTOR INDEXING. HOW DOES INCORRECT DISTRIBUTOR INDEXING AFFECT OPERATION? FIGURE 17-11
	**VIDEO: 3 MIN DISTRIBUTOR R&RWWW.MYAUTOMOTIVELAB.COM** HTTP://MEDIA.PEARSONCMG.COM/PH/CHET/CHET_MYLABS/AKAMAI/TEMPLATE/VIDEO640X480.PHP?TITLE=DISTRIBUTOR%20REMOVAL%20AND%20INSTALATION&CLIP=PANDC/CHET/2012/AUTOMOTIVE/INSTALLING_EFI_SYSTEM/T12CD3.MOV&CAPTION=CHET/CHET_MYLABS/AKAMAI/2012/AUTOMOTIVE/INSTALLING_EFI_SYSTEM/XML/T12CD3.XML

ICONS	Ch17 Ignition System Diagnosis & Service
	32. SLIDE 32 **OBJECTIVE CH17 AEP_LO6** 33. **SLIDE 33 EXPLAIN Figure 17–12** When checking a **coil-on-plug (COP) assembly**, check that primary and secondary wiring looks normal and that the coil is not discolored from arcing or corrosion.
	34. **SLIDE 34 EXPLAIN FIGURE 17–13** When checking a waste spark-type ignition system, check that secondary wires are attached to the correct coil terminal and that the wiring is correctly routed to help avoid cross-fire. 35. **SLIDE 35 EXPLAIN FIGURE 17–14** Corroded terminals on a waste-spark coil can cause misfire diagnostic trouble codes to be set. 36. **SLIDE 36 EXPLAIN Figure 17-15** This spark plug boot on **COP IGNITION** overhead camshaft engine has been arcing to valve cover causing a misfire
	**DISCUSSION: DISCUSS TERM TRACKING.** **WHAT IS TRACKING? WHAT TYPES OF PROBLEMS DOES IT CAUSE? HOW CAN IT BE FOUND?**
	**DEMONSTRATION: SHOW THE STUDENTS HOW TO PERFORM A ROTOR AIR GAP TEST TO CHECK DISTRIBUTOR CAP AND ROTOR CONDITION.**
	37. **SLIDE 37 EXPLAIN FIGURE 17-16** Measuring the resistance of a spark plug wire with a multimeter set to the ohms position. The reading of 16.03 kΩ (16.03 ohms) is okay because the wire is about 2 ft long. Maximum allowable resistance for a spark plug wire this long would be 20 kΩ (20,000 ohms).
	**HANDS-ON TASK: HAVE STUDENTS USE OHMMETER TO TEST SPARK PLUG WIRES FOR CONTINUITY AND COMPARE COLLECTED VALUES TO SPECIFICATIONS TO DETERMINE CONDITION**
	**DISCUSSION: HAVE STUDENTS DISCUSS SPARK PLUG HEAT RANGE & HOW IT AFFECTS ENGINE OPERATION AND EMISSIONS. IS IT EVER ACCEPTABLE OR BENEFICIAL TO VARY FROM OEM RECOMMENDATIONS?**
	**DISCUSSION: DISCUSS PURPOSE OF "SUPPRESSION" WIRES. HOW DO THEY WORK?**

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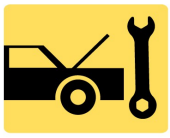
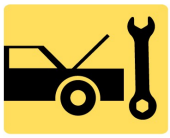
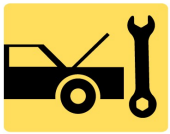
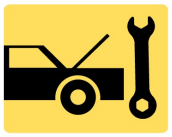
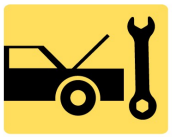
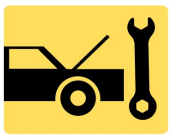
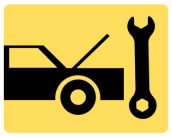
	38. SLIDE 38 EXPLAIN **TECH-TIP Spark Plug Wire Pliers Are a Good Investment, SEE FIG 17-17**
	39. SLIDE 39 EXPLAIN FIGURE 17-17 Spark plug wire boot pliers are a handy addition to any tool box
	40. SLIDE 40 EXPLAIN **TECH-TIP Route the Wires Right!, SEE FIG 17-18**
	41. SLIDE 41 EXPLAIN FIGURE 17–18 Always take time to install spark plug wires back into original holding brackets (wiring combs).
	**HANDS-ON TASK: REMOVE SPARK PLUG WIRES TO INSPECT FOR EVIDENCE OF SPARK LEAKAGE. MAKE SURE WIRES ARE REINSTALLED CORRECTLY, FOLLOWING PROPER ROUTING & USE OF WIRE SEPARATORS. CHECK FOR CORROSION**
	42. SLIDE 42 EXPLAIN FIGURE 17-19 When removing spark plugs, it is wise to arrange them so that they can be compared and any problem can be identified with a particular cylinder.
	**INSTALLING SPARK PLUGS WITH THE WRONG REACH INTO AN ENGINE MAY CAUSE SEVERE ENGINE DAMAGE.**
	**DISCUSSION: DISCUSS IMPORTANCE OF KEEPING SPARK PLUGS IN CORRECT ORDER DURING REMOVAL. HOW CAN SPARK PLUGS HELP TO DIAGNOSE ENGINE OPERATING CONDITION?**
	**DISCUSSION: DISCUSS STEPS FOR REPLACING SPARK PLUGS. WHY SHOULD THE ENGINE BE COOL BEFORE REMOVING SPARK PLUGS?**
	43. SLIDE 43 EXPLAIN FIGURE 17-20 spark plug thread chaser is a low-cost tool that hopefully will not be used often, but is necessary in order to clean threads before installing new spark plugs
	44. SLIDE 44 EXPLAIN FIGURE 17–21 Since 1991, GM engines have been equipped with slightly (1/8 inch or 3 mm) longer spark plugs. This requires that a longer spark plug socket should be used to prevent possibility of cracking a spark plug during installation. Longer socket is shown next to a normal 5/8 inch spark plug socket

ICONS	Ch17 Ignition System Diagnosis & Service
	**VIDEO: 2 MIN SPARK PLUGS & WIRES (CH70) WWW.MYAUTOMOTIVELAB.COM** HTTP://MEDIA.PEARSONCMG.COM/PH/CHET/CHET_MYLABS/AKAMAI/TEMPLATE/VIDEO640X480.PHP?TITLE=SPARK%20PLUG%20AND%20WIRES&CLIP=PANDC/CHET/2012/AUTOMOTIVE/AUTO_SHOP_SAFETY/CLIP17SPARKPLUGS1.MOV&CAPTION=CHET/CHET_MYLABS/AKAMAI/2012/AUTOMOTIVE/AUTO_SHOP_SAFETY/XML/CLIP17SPARKPLUGS1.XML
	**HANDS-ON TASK: HAVE THE STUDENTS GAP A SET OF SPARK PLUGS USING PROPER TOOLS.**
	**DISCUSSION: HAVE THE STUDENTS TALK ABOUT OIL-FOULED SPARK PLUGS AND FUEL- OR CARBON-FOULED SPARK PLUGS. WILL CHANGING FOULED SPARK PLUGS PROVIDE A LONG-TERM CURE FOR DRIVABILITY COMPLAINTS?**
	45. **SLIDE 45 EXPLAIN Figure 17-22** normally worn spark plug that uses a tapered platinum-tipped center electrode. 46. **SLIDE 46 EXPLAIN Figure 17-23** Spark plug removed from an engine after 500-mile race. Note clipped side (ground) electrode. Electrode design and narrow (0.025 in.) gap are used to ensure that a spark occurs during extremely high engine speed operation. 47. **SLIDE 47 EXPLAIN Figure 17-24** spark plug from engine that had a blown head gasket. White deposits could be from additives in coolant. 48. **SLIDE 48 EXPLAIN Figure 17-25** platinum tipped spark plug that is fuel soaked indicating a fault with fuel system or ignition system causing spark plug to not fire.
	**DISCUSSION: DISCUSS WHY SOME SPARK PLUGS USE MULTIPLE GROUND ELECTRODES. HOW DO MULTIPLE GROUND ELECTRODES AFFECT OPERATION AND SERVICE LIFE?**
	**DISCUSSION: DISCUSS THE DIFFERENCE BETWEEN BTDC & ATDC. HOW WOULD CHANGES IN IGNITION TIMING AFFECT ENGINE OPERATION?**
	49. **SLIDE 49 EXPLAIN TECH-TIP Use Original Equipment Manufacturer's Spark Plugs**
	50. **SLIDE 50 EXPLAIN FIGURE 17–26** water spray bottle is excellent diagnostic tool to help find an intermittent engine misfire caused by break in secondary ignition circuit

ICONS	Ch17 Ignition System Diagnosis & Service
	51. SLIDE 51 EXPLAIN TECH-TIP Two-Finger Trick
	**ON-VEHICLE NATEF TASK: SPARK PLUG INSPECTION: INSPECT AND TEST SPARK PLUGS**
	**ON-VEHICLE NATEF TASK INSPECT, TEST, AND/OR REPLACE IGNITION CONTROL MODULE, POWERTRAIN/ENGINE CONTROL MODULE; REPROGRAM AS NECESSARY**
	**ON-VEHICLE NATEF TASK INSPECT AND TEST CRANKSHAFT AND CAMSHAFT POSITION SENSOR(S); PERFORM NECESSARY ACTION**
	52. SLIDE 52 OBJECTIVE CH17 AEP_LO7 53. SLIDE 53 EXPLAIN IGNITION TIMING AAA& **Figure 17–27** Typical timing marks. The numbers of the degrees are on the stationary plate and the notch is on harmonic balancer..
	54. SLIDE 54 EXPLAIN TECH-TIP "Turn the Key" Test
	55. SLIDE 55 EXPLAIN FIGURE 17–28 Cylinder 1 & timing mark location guide 56. SLIDE 56 EXPLAIN FIGURE 17–29 (a) Typical SPOUT connector as used on many Ford engines equipped with distributor ignition (DI). (b) connector must be opened (disconnected) to check and/or adjust the ignition timing. On DIS/EDIS systems, the connector is called SPOUT/SAW (spark output/spark angle word)
	**DEMONSTRATION: SHOW HOW TO USE A TIMING LIGHT TO CHECK AND/OR ADJUST IGNITION TIMING. DEMONSTRATE FOR STUDENTS HOW TO DETERMINE WHETHER TIMING IS ADJUSTABLE**
	**HANDS-ON TASK: RETRIEVE TIMING SPECIFICATIONS FROM VECI LABEL OR SERVICE INFORMATION. FOLLOW PROCEDURE TO CHECK & ADJUST IGNITION TIMING**

ICONS	Ch17 Ignition System Diagnosis & Service
	**DISCUSSION: DISCUSS HOW INITIAL TIMING CHANGES WITH ENGINE WEAR. CAN CHANGES BE MADE TO COMPENSATE FOR WEAR? HOW?**
	**HANDS-ON TASK: HAVE STUDENTS HOOK UP A SCAN TOOL TO SEE HOW IGNITION TIMING CHANGES AS ENGINE SPEED & LOAD CHANGE**
	57. SLIDE 57 **OBJECTIVE CH17 AEP_LO8** 58. **SLIDES 58-59 EXPLAIN** Ignition Scope Testing
	60. **SLIDE 60 EXPLAIN FIGURE 17-30** Typical engine analyzer hookup that includes a scope display. (1) Coil wire on top of distributor cap if integral type of coil; (2) number 1 spark plug connection; (3) negative side of ignition coil; (4) ground (negative) connection of battery. 61. **SLIDE 61 EXPLAIN FIGURE 17-31** Clip-on adapters used with ignition system that uses integral ignition coil.
	**DEMONSTRATION: SHOW HOW TO PROPERLY HOOK UP IGNITION OSCILLOSCOPE TO CHECK SECONDARY IGNITION PATTERNS. DISCUSS HOW VOLTAGE/TIME DIVISIONS CAN BE CHANGED ON MANY SCOPES. FIG 17-30 & 31**
	**HANDS-ON TASK: PROVIDE THE STUDENTS WITH IGNITION COIL PRIMARY WAVEFORMS. IDENTIFY KEY PARTS OF WAVEFORM THAT CAN BE ANALYZED TO DETERMINE CONDITION.**
	**ANIMATION: SECONDARY IGNITION SCOPE PATTERN WWW.MYAUTOMOTIVELAB.COM** HTTP://MEDIA.PEARSONCMG.COM/PH/CHET/CHET_MYAUTOMOTIVELAB_2/ANIMATIONS/A16_ANIMATION/CHAPTER57_FIG_57_32/INDEX.HTM
	**DISCUSSION: DISCUSS HOW SCOPE CONNECTION POINTS DIFFER BETWEEN DISTRIBUTOR, WASTE-SPARK, COP SYSTEMS. ARE ANY SPECIAL ADAPTERS NEEDED? ARE THERE ANY DIFFICULTIES YOU MAY FACE WHEN TESTING DIFFERENT TYPES OF SYSTEMS?**
	62. **SLIDE 62 EXPLAIN FIGURE 17-32** Typical secondary ignition oscilloscope pattern. 63. **SLIDE 63 EXPLAIN FIGURE 17-33** single cylinder is shown at the top and a 4-cylinder engine at the bottom

ICONS	Ch17 Ignition System Diagnosis & Service
	64. **SLIDE 64 EXPLAIN FIGURE 17-34** Drawing shows what is occurring electrically at each part of scope pattern
	**DISCUSSION: HAVE THE STUDENTS DISCUSS THE DIFFERENT PARTS OF A TYPICAL SECONDARY IGNITION PATTERN. WHAT DOES EACH SECTION REPRESENT?**
	65. **SLIDE 65 EXPLAIN FIGURE 17-35** Typical secondary ignition pattern. Note the lack of firing lines on the superimposed pattern.
	66. **SLIDE 66 EXPLAIN FIGURE 17-36** Raster is the best scope position to view the spark lines of all the cylinders to check for differences. Most scopes display cylinder 1 at the bottom. The other cylinders are positioned by firing order above cylinder 1.
	**DISCUSSION: HAVE THE STUDENTS DISCUSS HOW FIRING LINE ANALYSIS CAN BE USED TO DETERMINE SECONDARY IGNIGNITION SYSTEM COMPONENT CONDITION. WHAT ARE COMMON CAUSES OF ABNORMALLY HIGH OR LOW FIRING LINE VOLTAGE? FIGURES 17-32 TO 17-36**
	**DEMONSTRATION: SHOW DIFFERENT IGNITION SYSTEM PATTERNS (PARADE, RASTER, SUPERIMPOSED) AND HOW THEY CAN BE USED TO DIAGNOSE SECONDARY SYSTEM CONDITION**
	67. **SLIDE 67 EXPLAIN FIGURE 17–37** Display is the only position to view the firing lines of all cylinders. Cylinder 1 is displayed on the left (except for its firing line, which is shown on the right). The cylinders are displayed from left to right by firing order.
	**DISCUSSION: DISCUSS HOW THE DISPLAY OR PARADE PATTERN CAN BE USED TO DIAGNOSE SECONDARY IGNITION SYSTEM ABNORMALITIES. HOW DOES A LEAN MIXTURE COMPARE TO RICH MIXTURE? FIGURES 17-36 & 17-37**
	**ON-VEHICLE NATEF TASK POSITION SENSOR WAVEFORM TESTING INSPECT AND TEST CRANKSHAFT (CKP) & CAMSHAFT (CMP) POSITION SENSOR (S); PERFORM ACTION**

ICONS	Ch17 Ignition System Diagnosis & Service
	**VIDEO: 2 MIN CRANKSHAFT LEARN WWW.MYAUTOMOTIVELAB.COM** HTTP://MEDIA.PEARSONCMG.COM/PH/CHET/CHET_MYLABS/AKAMAI/TEMPLATE/VIDEO640X480.PHP?TITLE=CRANKSHAFT%20LEARN%20PROCEDURE&CLIP=PANDC/CHET/2012/AUTOMOTIVE/OBD2_GM/VC1.MOV&CAPTION=CHET/CHET_MYLABS/AKAMAI/2012/AUTOMOTIVE/OBD2_GM/XML/VC1.XML
	68. SLIDES 68-69 EXPLAIN **REAL-WORLD FIX: Technician's Toughie**
	70. SLIDE 70 EXPLAIN CHART 17–2 71. SLIDE 71 EXPLAIN **Figure 17-38** downward-sloping spark line usually indicates high secondary ignition system resistance or an excessively rich air-fuel mixture.
	**HANDS-ON TASK: HAVE THE STUDENTS HOOK UP A SECONDARY IGNITION SCOPE AND USE DIFFERENT PATTERNS TO DETERMINE SECONDARY IGNITION SYSTEM CONDITION.**
	**DISCUSSION: HAVE THE STUDENTS TALK ABOUT THE IMPORTANCE OF DWELL & FACTORS THAT AFFECT IT. HOW DOES DWELL DIFFER BETWEEN DISTRIBUTOR IGNITION, WASTE-SPARK, AND COIL-ON-PLUG SYSTEMS?**
	72. SLIDE 72 EXPLAIN **Figure 17-39** upward-sloping spark line usually indicates a mechanical engine problem or a lean air-fuel mixture.
	**DISCUSSION: HAVE THE STUDENTS DISCUSS HOW FIRING VOLTAGE AFFECTS SPARK DURATION. HOW IS REQUIRED VOLTAGE AFFECTED BY A LEAN CYLINDER?**
	73. SLIDE 73 EXPLAIN **Figure 17-40** relationship between height of firing line and length of spark line can be illustrated using a rope. Because energy cannot be destroyed, stored energy in an ignition coil must dissipate totally, regardless of engine operating conditions
	**HANDS-ON TASK: HAVE THE STUDENTS USE OSCILLOSCOPE TO PERFORM AN ACCELERATION CHECK TO DETERMINE SECONDARY IGNITION SYSTEM CONDITION.**
	**ON-VEHICLE NATEF TASK DIAGNOSE ELECTRONIC IGNITION-RELATED PROBLEMS; DETERMINE NECESSARY ACTION**

ICONS	Ch17 Ignition System Diagnosis & Service
	**ON-VEHICLE NATEF TASK USING SCAN TOOL DIAGNOSE ELECTRONIC IGNITION-RELATED PROBLEMS; DETERMINE NECESSARY ACTION**
	**ON-VEHICLE NATEF TASK: IGNITION INSPECTION & TESTING: INSPECT AND TEST IGNITION PRIMARY AND SECONDARY CIRCUIT WIRING; PERFORM NECESSARY ACTION.**
	74. **SLIDE 74 EXPLAIN** Scope-Testing Waste-Spark System
	75. **SLIDE 75 EXPLAIN Figure 17-41** dual trace scope pattern showing both the power and the waste spark from the same coil (cylinders 1 and 6). Note that the firing line is higher on the cylinder that is under compression (power); otherwise, both patterns are almost identical
	76. **SLIDE 76 EXPLAIN Scope Testing a COP System**
	77. **SLIDE 77 EXPLAIN Figure 17-42** secondary waveform of a Ford 4.6 liter V-8, showing three sparks occurring at idle speed.
	78. **SLIDE 78 EXPLAIN** Ignition System Symptom Guide
	**DISCUSSION: HAVE THE STUDENTS TALK ABOUT SCOPE-TESTING A WASTE-SPARK SYSTEM. WHY IS THE FIRING VOLTAGE MEASURED ACROSS THE WASTE CYLINDER LOWER THAN THE VOLTAGE MEASURED ACROSS POWER CYLINDER?**