

Chapter 30 Ignition System

Opening Your Class

KEY ELEMENT	EXAMPLES
Introduce Content	This course or class serves as an introduction to the world of automotive service. 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.	<p>Explain learning objectives to students.</p> <ol style="list-style-type: none"> 1. Prepare for ASE Engine Performance (A8) certification test content area "B" (Ignition System Diagnosis and Repair). 2. Explain how ignition coils create 40,000 volts. 3. Discuss crankshaft position sensor and pickup coil operation. 4. Describe the operation of waste-spark and coil-on-plug ignition systems.
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.

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1. SLIDE 1 CH30 IGNITION SYSTEM
2. SLIDE 2 **EXPLAIN** Ignition System



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DEMONSTRATION: Show a **point-type distributor**. Review its major components & **SHOW HOW TO SET AIR GAP**. Show major components of a distributor ignition system.



3. SLIDE 3 **EXPLAIN** FIGURE 30-1 A high-voltage pulse is sent to the spark plug to ignite the air-fuel mixture in the cylinder



4. SLIDE 4 **EXPLAIN** Distributor Ignition
5. SLIDE 5 **EXPLAIN** FIGURE 30-2 primary ignition system is used to trigger and therefore create the secondary (high-voltage) spark from ignition coil. Some ignition coils are electrically connected, called married (top figure) whereas others use separated primary and secondary windings, called divorced (lower figure).



DISCUSSION: Have the students talk about the **primary & secondary ignition circuits**. How do the 2 circuits function independently and how do they interact? **FIGURE 30-2**



DISCUSSION: Have the students talk about **ignition coil operation**. What process does an ignition use to produce a high-voltage spark from an ignition coil?



DISCUSSION: Have the students discuss the construction of an ignition coil. What is at the core of an ignition coil? What is the purpose of core?



HANDS-ON TASK: Have students **disassemble old coils**. Have them identify internal components and point out electrical connections. **OPTION:** students draw or describe the primary and secondary circuits.

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Show ANIMATION: IGNITION OPERATION

www.myautomotivelab.com

http://media.pearsoncmg.com/ph/chet/chet_myautomotivelab_2/animations/A16_Animation/Chapter56_Fig_56_4/index.htm

DEMONSTRATION: Review with students how to use a hand-held oscilloscope (GMM), including setup and interpreting waveform patterns. Then show them how to check pickup on an electronic ignition system using an oscilloscope: DEMO SNAP-ON MODUS HERE

DISCUSSION: Using an ignition system wiring diagram, have the students locate triggering device. How does this triggering device work?

Show ANIMATION: SIGNAL GENERATION FORM PERMANENT MAGNET (Ch69)

www.myautomotivelab.com

http://media.pearsoncmg.com/ph/chet/chet_myautomotivelab_2/animations/A1_Animation/Chapter18_Fig_18_7/index.htm

Show VIDEO: 5 MINUTES RANDOM MISFIRE DETECTION (Ch70)

www.myautomotivelab.com

http://media.pearsoncmg.com/ph/chet/chet_mylabs/akamai/template/video640x480.php?title=Case%20Study%203%20Random%20Misfire%20Detected&clip=pandc/chet/2012/automotive/OBD2_Ford/ST15_CS3.mov&caption=chet/chet_mylabs/akamai/2012/automotive/OBD2_Ford/xml/ST15_CS3.xml

Show VIDEO: 8 MINUTES DTC P0300 MISFIRE DIAGNOSIS (Ch70)

www.myautomotivelab.com

http://media.pearsoncmg.com/ph/chet/chet_mylabs/akamai/template/video640x480.php?title=Case%20Study%201%20Diagnosing%20%20Engine%20Misfire%20P0300&clip=pandc/chet/2012/automotive/OBD2_GM/CS1.mov&caption=chet/chet_mylabs/akamai/2012/automotive/OBD2_GM/xml/CS1.xml

Show VIDEO: 6 MINUTES SINGLE CYLINDER MISFIRE DIAGNOSIS

www.myautomotivelab.com

http://media.pearsoncmg.com/ph/chet/chet_mylabs/akamai/template/video640x480.php?title=Case%20Study%203%20Single%20Cylinder%20Misfire&clip=pandc/chet/2012/automotive/OBD2_Chrysler_Corp/ST16CS3.mov&caption=chet/chet_mylabs/akamai/2012/automotive/OBD2_Chrysler_Corp/xml/ST16CS3.xml

DEMONSTRATION: Show how to replace Crankshaft (CKP)/camshaft position sensors (CMP) & make adjustments using a gauging tool. Show how to monitor

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crankshaft/camshaft position sensors using scan tool

DEMONSTRATION: Review importance of **camshaft & crankshaft timing.** Use opened timing cover to emphasize timing markings and what is happening to piston & and valve positions

6. **SLIDE 6 EXPLAIN** FIGURE 30-3 firing order is cast or stamped on the intake manifold on most engines that have a distributor ignition.

HANDS-ON TASK: Have students identify **Proper Firing Order** for a selected vehicle in the shop. Then have them verify the spark plug wire routing. Grade them on their understanding of where to find the firing order and location of the spark plug wires. **FIGURE 30-3**

7. **SLIDE 7 EXPLAIN** FIGURE 30-4 Ford V-6 engine that uses a waste-spark-type ignition system. Note that each of the three coils has two spark plug wires. Both the cylinders fire at the same time

Waste Spark Ignition System

Show **ANIMATION: WASTE SPARK**

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www.myautomotivelab.com

http://media.pearsoncmg.com/ph/chet/chet_myautomotivelab_2/animations/A16_Animation/Chapter56_Fig_56_21/index.htm

DEMONSTRATION: DEMO WASTE-SPARK IGNITION SYSTEM OPERATION: FIGURE 69-13

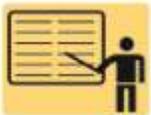
DISCUSSION: Have the students talk about **WASTE-SPARK IGNITION SYSTEMS.** Review reverse polarity that is occurring in a DIS. What is the path of the current?

DISCUSSION: Have the students review the purpose of a **crankshaft sensor (CKP).** Why is there adjustment on some engines?

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DEMO



DEMO

DEMO



DEMONSTRATION: Using ignition oscilloscope, show students typical connecting procedure for obtaining ignition patterns.

You should not check for spark by pulling plug wire on running engine. In addition to risking personal injury, you could damage or shorten electronic ignition components life. Method of checking for cylinder firing was used on older systems.

Show **ANIMATION: COIL-ON-PLUG OPERATION (Ch69)**

www.myautomotivelab.com

http://media.pearsoncmg.com/ph/chet/chet_myautomotivelab_2/animations/A1_Animation/Chapter_18_Fig_18_16_b/index.htm

8. SLIDE 8 **EXPLAIN** Coil-On-Plug Ignition

9. SLIDE 9 **EXPLAIN** Figure 30-5 overhead camshaft engine equipped with variable valve timing on both the intake and exhaust camshafts and the coil-on-plug ignition.

10. SLIDE 10 **EXPLAIN** FIGURE 30-6 This General Motors V-8 engine is equipped with a coil-near-plug ignition. Each cylinder has a coil and uses a short spark plug wire from the coil to the spark .

DISCUSSION: What does the coil-on-plug (COP) ignition system eliminate?

DEMONSTRATION: Show the students COP ignition systems with 2 & 3 primary wires and explain the differences.

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HANDS-ON TASK: Have students draw wiring diagrams of 2 & 3 wire COP primary ignition systems. Grade them on accuracy

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11. **SLIDE 11 EXPLAIN** Testing for Spark
12. **SLIDE 12 EXPLAIN FIGURE 30-7** 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
13. **SLIDE 13 EXPLAIN Figure 30-8** A 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

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 (A8-A-3)
Spark Plug Specifications: Research applicable vehicle and service information, such as engine management system operation, vehicle service history, service precautions, and TSBs. (P-1)

14. **SLIDE 14 EXPLAIN** Spark Plug Wire Inspection
15. **SLIDE 15 EXPLAIN FIGURE 30-9** Spark plug wires carry high-voltage pulses from the ignition coil or distributor to the spark plugs. Always take the time to install spark plug wires back into the original holding brackets (wiring combs)
16. **SLIDE 16 EXPLAIN Figure 30-10** Spark plug wire boot pliers are a handy addition to any tool box
17. **SLIDE 17 EXPLAIN FIGURE 30-11** This spark plug boot on an overhead camshaft engine has been arcing to the valve cover causing a misfire to occur
18. **SLIDE 18 EXPLAIN FIGURE 30-12** Measuring resistance of a spark plug wire with a multimeter set to the ohms position. The reading of 16.03 k Ω (16,030 ohms) is okay because the wire is about 2-ft long. Maximum allowable resistance for a spark plug wire this long would be 20 k Ω (20,000 ohms)

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HANDS-ON TASK: Have students use ohmmeter to test spark plug wires for continuity and compare collected values to specifications to determine condition.



19. SLIDE 19 **EXPLAIN** Spark Plugs

20. SLIDE 20 **EXPLAIN** Figure 30-13 Parts of spark plug.

21. SLIDE 21 **EXPLAIN** Spark Plugs



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?



Be sure to check the reach of any new spark plugs being installed. Installing spark plugs with the wrong reach into an engine may cause severe engine damage.



22. SLIDE 22 **EXPLAIN** Figure 30-14 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.



DISCUSSION: discuss importance of keeping spark plugs in correct order during removal. How can the spark plugs help to diagnose engine operating condition? **FIGURE 30-14**



23. SLIDE 23 **EXPLAIN** Figure 30-15 spark plug thread chaser is a low-cost tool that hopefully will not be used often, but is necessary in order to clean the threads before installing new spark plugs



DISCUSSION: Have the students talk about the steps for replacing spark plugs. Why should the engine be allowed to cool before removing spark plugs?



23. SLIDE 23 **EXPLAIN** Spark Plug Service

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ON-VEHICLE NATEF TASK (A8-A-3) Research applicable vehicle and service information, such as **Ignition System Identification (P-1) Pg 225**

Homework: complete Ch30 crossword puzzle:
http://www.jameshalderman.com/links/book_intro/cw/crossword_ch_30.pdf