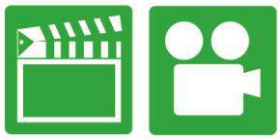
Advanced Engine Performance Diagnosis 6/E

Chapter 20 Wide Band Oxygen Sensors

Opening Your Class

KEY ELEMENT	EXAMPLES
Introduce Content	This 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. 1. Discuss the need for wide-band oxygen sensors compared to a narrow-band O2S. 2. Explain the working of dual-cell planar wideband sensors and their diagnosis. 3. Explain the working of single-cell wide-band oxygen sensors and their diagnosis.
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 Advanced Engine Performance Diagnosis 6/E Chapter Images found on Jim's web site @ www.jameshalderman.com
LINK CHP 20: Chapter Images

ICONS	Ch20 Wide Band Oxygen Sensors
         	**1. SLIDE 1 CH20 Wide Band Oxygen Sensors** **Check for ADDITIONAL VIDEOS & ANIMATIONS @ http://www.jameshalderman.com/** **WEB SITE REGULARLY UPDATED** **Engine Controls (284 Links)** **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 20-1** A conventional Zirconia oxygen sensor can only reset to exhaust mixtures that are richer or leaner than 14.7:1 (lambda 1.00). **DISCUSSION: HAVE THE STUDENTS TALK ABOUT WIDE-BAND OXYGEN SENSORS. WHAT DOES "WIDE-BAND" MEAN?** **DISCUSSION: EXPLAIN TO THE STUDENTS OPERATION OF CONVENTIONAL OXYGEN SENSORS ON A 14.7:1 AIR-FUEL RATIO. IS THIS RATIO ACCURATE ENOUGH? FIGURE 20-1** **DISCUSS FREQUENTLY ASKED QUESTION** **3. SLIDE 3 EXPLAIN FIGURE 20–2** (a) When the exhaust is lean, the output of a Zirconia oxygen sensor is below 450 mV. **4. SLIDE 4 EXPLAIN FIGURE 20–2** (b) When the exhaust is rich, the output of a Zirconia oxygen sensor is above 450 mV.

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	5. **SLIDE 5 EXPLAIN FIGURE 20–3** Most conventional Zirconia oxygen sensors and some wide-band oxygen sensors use the cup-type design. 6. **SLIDE 6 EXPLAIN FIGURE 20–4** A typical heated Zirconia oxygen sensor, showing sensor signal circuit that uses outer (exhaust) electrode as negative & ambient air side electrode as the positive 7. **SLIDE 7 EXPLAIN Figure 20-5** planar design Zirconia oxygen sensor places all of the elements together, which allows the sensor to reach operating temperature quickly.
	**DISCUSSION: HAVE THE STUDENTS DISCUSS THE PLANAR DESIGN OF THE WIDE-BAND OXYGEN SENSOR. WHAT IS THE MAIN ADVANTAGE OF THIS DESIGN? FIGURE 20-5**
	8. **SLIDE 8 EXPLAIN Figure 20-6** reference electrodes are shared by the Nernst cell and the pump cell
	**DISCUSSION: HAVE THE STUDENTS TALK ABOUT ULEV AND SULEV EMISSIONS SYSTEMS. WHY DO THESE EMISSIONS RATINGS REQUIRE MORE PRECISE FUEL MANAGEMENT STRATEGIES?**
	**DISCUSSION: ASK THE STUDENTS TO DISCUSS THE DUAL CELL, PLANAR-TYPE, WIDE-BAND OXYGEN SENSOR. IN WHAT MAJOR WAY DOES CONSTRUCTION OF THIS SENSOR DIFFER FROM THAT OF A CONVENTIONAL SENSOR?**
	9. **SLIDE 9 EXPLAIN Figure 20-7** When exhaust is rich, PCM applies a negative current into the pump cell. 10. **SLIDE 10 EXPLAIN Figure 20-8** When exhaust is lean, PCM applies a positive current into the pump cell.
	**DISCUSSION: ASK THE STUDENTS TO DISCUSS STOICHIOMETRIC READING IN THE EXHAUST AND FACT THAT THE OXYGEN SENSOR CALCULATES THIS AIR-FUEL RATIO AT 14.7:1. FIGURE 20-8**
	**DISCUSSION: ASK THE STUDENTS TO DISCUSS THE NUMBER OF WIRES NEEDED FOR AN OXYGEN SENSOR TO OPERATE. THEY CAN USE WIRING DIAGRAMS OF SINGLE-, THREE-, FOUR-, FIVE-, OR SIX-WIRE SENSORS.**

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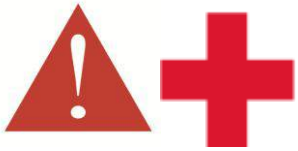
	**EXPLAIN CHART 20–1 A comparison showing what a factory scan tool and a generic OBD-II scan tool might display at various air-fuel ratios.**
	**DISCUSSION: ASK STUDENTS TO LOOK AT CHART 20–1. WHAT IS NOTICEABLE ABOUT FACTORY AND GENERIC SETTINGS? POINT OUT DIRECT CORRELATION BETWEEN THE VOLTAGE READINGS IN FACTORY & GENERIC SETTINGS. CHART 20–1.**
	**DISCUSSION: HAVE THE STUDENTS DISCUSS STEPS FOR TESTING A WIDE-BAND OXYGEN SENSOR. WHY IS IT NECESSARY TO CHECK SERVICE INFORMATION FIRST?**
	**11. SLIDE 11 EXPLAIN Figure 20-9** Testing a dual cell wide-band oxygen sensor can be done using a voltmeter or a scope. The meter reading is attached to Nernst cell and should read stoichiometric (450 mV) at all times. Scope is showing activity to pump cell with commands from PCM to keep Nernst cell at 14.7:1 air-fuel ratio.
	**DEMONSTRATION: IF AVAILABLE, SHOW STUDENTS DATA STREAM READINGS USING FACTORY SCAN TOOL AND GENERIC SCAN TOOL. HAVE THEM OBSERVE DIFFERENCE IN READINGS, IF THEY ARE DIFFERENT. FIGURE 16-9**
	**EXPLAIN WHAT A BREAKOUT BOX IS. ASK THEM TO DECIDE WHETHER A BREAKOUT BOX WOULD BE BENEFICIAL IN TESTING DUAL CELL WIDE-BAND OXYGEN SENSOR SHOWN IN FIGURE 16-9**
	**12. SLIDE 12 EXPLAIN Figure 20-10** single cell wide-band oxygen sensor has four wires with two for heater and two for sensor itself. The voltage applied to sensor is 0.4 V (3.3 − 2.9 = 0.4) across two leads of sensor.
	**DISCUSSION: HAVE THE STUDENTS DISCUSS SINGLE CELL WIDEBAND OXYGEN SENSORS. HOW ARE THEY SIMILAR TO OTHER SENSORS? FIGURE 20-10**
	**SAFETY DISCUSS IMPORTANCE OF USING PROPER TERMINALS WHEN TESTING ANY SENSOR, ESPECIALLY WHEN BACK-PROBING CONNECTORS. EXPLAIN THAT PIERCING**

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	**WIRES THAT WILL BE EXPOSED TO ELEMENTS IS NOT AN ACCEPTED TESTING PROCEDURE.** **DISCUSSION: HAVE THE STUDENTS DISCUSS FACT THAT A WIDE-BAND OXYGEN SENSOR CAN CAUSE AN ENGINE TO OPERATE EXTREMELY LEAN, BUT STILL FAIL TO TRIGGER A DTC. WHY MIGHT UNPLUGGING A SENSOR CAUSE THE ENGINE TO OPERATE CORRECTLY?**
	**13. SLIDE 13 EXPLAIN FIGURE 20–11** The scan tool can display various voltage but will often show 3.3 volts because the PCM is controlling the sensor by applying a low current to the sensor to achieve balance.
	**ON-VEHICLE NATEF TASK INSPECT AND TEST OXYGEN O_2 SENSOR USING GMM)/(DSO); PERPERFORM NECESSARY ACTION**
	**ON-VEHICLE NATEF TASK INSPECT AND TEST WIDE-BAND OXYGEN O_2 SENSOR USING GMM)/(DSO); PERFORM NECESSARY ACTION**