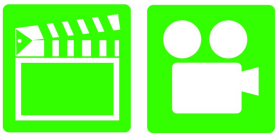
A8 Engine Performance 4th Edition

Chapter 25 WIDE BAND OXYGEN SENSORS

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. Prepare for ASE Engine Performance (A8) certification test content area "E" (Computerized Engine Controls Diagnosis and Repair). 2. Describe the difference between a two-band and a wide band oxygen sensor. 3. Explain the difference between a thimble design and a planar design. 4. Discuss the operation of a wide-band oxygen sensor. 5. List the test procedure for testing a dual cell and a single cell wide-band oxygen sensor.
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	Ch25 WIDE BAND OXYGEN SENSORS
       	1. SLIDE 1 CH25 WIDE BAND OXYGEN SENSORS Check for ADDITIONAL VIDEOS & ANIMATIONS @ http://www.jameshalderman.com/ WEB SITE REGULARLY UPDATED POWER POINTS DONE BY INDIVIDUAL LEARNING OBJECTIVES, SO THERE IS POWER POINT FILE FOR EACH LEARNING OBJECTIVE 2. SLIDE 2 EXPLAIN OBJECTIVE CH25 AEP_LO1 3. SLIDE 3 EXPLAIN TERMINOLOGY 4. SLIDE 4 EXPLAIN Figure 25-1 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 25-1 5. SLIDES 5-6 EXPLAIN NEED FOR Wide-Band Oxygen Sensors 7. SLIDE 7-9 EXPLAIN Dual Cell Planar Wide-Band Sensor Operation 10. SLIDE 10 EXPLAIN FIGURE 25–6 The reference electrodes are shared by the Nernst cell and the pump cell 11. SLIDE 11-12 EXPLAIN Dual Cell Planar Wide-Band Sensor Operation 13. SLIDE 13 EXPLAIN FIGURE 25–7 When the exhaust is rich, PCM applies a negative current into pump cell 14. SLIDE 14 EXPLAIN FIGURE 25–8 When the exhaust is lean, PCM applies a positive current into pump cell

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	2. SLIDE 2 EXPLAIN **OBJECTIVE CH25 AEP_LO2**
	3. **SLIDES 3-6 EXPLAIN** CONVENTIONAL O2S REVIEW 7. **SLIDE 7 EXPLAIN FIGURE 25–5** A planar design Zirconia oxygen sensor places all of the elements together, which allows the sensor to reach operating temperature quickly 8. **SLIDES 8-10 EXPLAIN** Dual Cell Planar Wideband Sensor Operation 11. **SLIDE 11 EXPLAIN FIGURE 25–6** The reference electrodes are shared by the Nernst cell and the pump cell
	**DISCUSSION: HAVE THE STUDENTS DISCUSS THE PLANAR DESIGN OF THE WIDE-BAND OXYGEN SENSOR. WHAT IS THE MAIN ADVANTAGE OF THIS DESIGN? FIGURE 25-5**
	12. **SLIDES 12-13 EXPLAIN** Dual Cell Planar Wideband Sensor Operation 14. **SLIDE 14 EXPLAIN FIGURE 25–7** When the exhaust is rich, PCM applies a negative current into pump cell 15. **SLIDE 15 EXPLAIN FIGURE 25–8** When the exhaust is lean, PCM applies a positive current into pump cell
	2. SLIDE 2 EXPLAIN **OBJECTIVE CH25 AEP_LO3**
	3. **SLIDES 3-5 EXPLAIN** Dual Cell Planar Wideband Sensor Operation 6. **SLIDE 6 EXPLAIN FIGURE 25–6** The reference electrodes are shared by the Nernst cell and the pump cell 7. **SLIDES 7-8 EXPLAIN** Dual Cell Planar Wideband Sensor Operation 9. **SLIDE 9 EXPLAIN FIGURE 25–7** When the exhaust is rich, PCM applies a negative current into pump cell 10. **SLIDE 10 EXPLAIN FIGURE 25–8** When the exhaust is lean, PCM applies a positive current into 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: DISCUSS DUAL CELL, PLANAR-TYPE, WIDE-BAND OXYGEN SENSOR. IN WHAT MAJOR WAY DOES CONSTRUCTION OF THIS SENSOR DIFFER FROM CONVENTIONAL SENSOR?**

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	2. SLIDE 2 EXPLAIN OBJECTIVE CH25 AEP_LO4
	3. SLIDES 3-5 EXPLAIN Dual Cell Diagnosis: Scan Tool Diagnosis 3. SLIDES 6-8 EXPLAIN Digital Multimeter Testing 9. SLIDE 9 EXPLAIN FIGURE 25–9 Testing a dual cell wideband oxygen sensor can be done using a voltmeter or a scope. The meter reading is attached to the Nernst cell and should read stoichiometric (450 mV) at all times. The scope is showing activity to the pump cell with commands from PCM to keep the Nernst cell at 14.7:1 air–fuel ratio.
	**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 16-8**
	**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.
	**DISCUSSION:** ASK STUDENTS TO LOOK AT **CHART 25–1.** WHAT IS NOTICEABLE ABOUT FACTORY AND GENERIC SETTINGS? POINT OUT DIRECT CORRELATION BETWEEN THE VOLTAGE READINGS IN FACTORY & GENERIC SETTINGS. **CHART 25–1.**
	**DISCUSSION:** HAVE THE STUDENTS DISCUSS STEPS FOR **TESTING A WIDE-BAND OXYGEN SENSOR**. WHY IS IT NECESSARY TO CHECK SERVICE INFORMATION FIRST?
	**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 25-9**
	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 25-9

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	10. **SLIDES 10-11 EXPLAIN** Single Cell Wide-Band Oxygen Sensors: Testing with a Milliammeter
	2. SLIDE 2 EXPLAIN **OBJECTIVE CH25 AEP_LO5** 3. **SLIDES 3-5 EXPLAIN** Digital Multimeter Testing
	6. **SLIDE 6 EXPLAIN FIGURE 25–9** Testing a dual cell wideband oxygen sensor can be done using a voltmeter or a scope. The meter reading is attached to the Nernst cell and should read stoichiometric (450 mV) at all times. The scope is showing activity to the pump cell with commands from PCM to keep the Nernst cell at 14.7:1 air–fuel ratio. 7. **SLIDES 7-8 EXPLAIN** Single Cell Wide-Band Oxygen Sensors: Testing with a Milliammeter 9. **SLIDE 9 EXPLAIN FIGURE 25–11** The scan tool can display various voltages 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
	**DISCUSSION: HAVE THE STUDENTS DISCUSS SINGLE CELL WIDEBAND OXYGEN SENSORS. HOW ARE THEY SIMILAR TO OTHER SENSORS?**
	**SAFETY DISCUSS IMPORTANCE OF USING PROPER TERMINALS WHEN TESTING ANY SENSOR, ESPECIALLY WHEN BACK-PROBING CONNECTORS. EXPLAIN THAT PIERCING 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?**
	2. SLIDE 2 EXPLAIN **OBJECTIVE CH25 AEP_LO6** 3. **SLIDES 3-5 EXPLAIN** Wide-Band Oxygen Pattern Failures
	**ON-VEHICLE NATEF TASK INSPECT AND TEST OXYGEN O_2 SENSOR USING GMM)/(DSO); PERFORM NECESSARY ACTION**

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