Advanced Engine Performance Diagnosis 6/E

Chapter 15 TEMPERATURE 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 purpose and function of engine coolant temperature sensors. 2. Explain the procedure for inspecting and testing engine coolant temperature sensors. 3. Explain the function of intake air temperature sensors and the procedure to test them. 4. Explain transmission fluid, cylinder head, engine fuel, and exhaust gas recirculation temperature sensors
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 15: Chapter Images

ICONS	Ch15 TEMPERATURE SENSORS
	**1. SLIDE 1 CH15 TEMPERATURE SENSORS**
	**Check for ADDITIONAL VIDEOS & ANIMATIONS @ http://www.jameshalderman.com/** **WEB SITE REGULARLY UPDATED**
	**Videos**
	**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 15–1** A typical engine coolant temperature (ECT) sensor. ECT sensors are located near the thermostat housing on most engines. **3. SLIDE 3 EXPLAIN FIGURE 15–2** typical ECT sensor temperature versus voltage curves
	**DEMONSTRATION: SHOW THE STUDENTS HOW TO LOCATE COOLANT TEMPERATURE SENSORS USING AN ELECTRONIC COMPONENT LOCATOR IN THE ONLINE SERVICE INFORMATION: FIGURE 15-1**
	**4. SLIDE 4 EXPLAIN Figure 15-3** A typical two-step ECT circuit showing that when the coolant temperature is low, the PCM applies a 5-volt reference voltage to the ECT sensor through a higher resistance compared to when the temperature is higher. **5. SLIDE 5 EXPLAIN Figure 15-4** transition between steps usually occurs at a temperature that would not interfere with cold engine starts or the cooling fan operation. In this example, the transition occurs when the sensor voltage is about 1 volt and rises to about 3.6 volts

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	**DISCUSSION:** HAVE THE STUDENTS TALK ABOUT SENSORS WITH A **NEGATIVE TEMPERATURE COEFFICIENT (NTC).** HOW IS AN NTC SENSOR DIFFERENT FROM MOST OTHER COMPONENTS?
	**DEMONSTRATION:** SHOW THE STUDENTS HOW TO USE A HYDROMETER AND/OR REFRACTOMETER TO **ANALYZE COOLANT MIXTURE.**
	**DISCUSSION:** DISCUSS DIFFERENCE BETWEEN A HYDROMETER & REFRACTOMETER. WHICH TESTER WOULD THEY PREFER TO USE? WHY?
	**DEMONSTRATION:** SHOW HOW TO PROPERLY **PRESSURE-TEST A COOLING SYSTEM**, TO DETERMINE COOLING SYSTEM CONDITION.
	**DISCUSSION:** DISCUSS **ECT OPERATION**. HOW CAN INCORRECT COOLANT LEVEL, INCORRECT COOLANT MIXTURE, AND/OR INCORRECT PRESSURE CAUSE INACCURATE ECT ?
	6. **SLIDE 6 EXPLAIN Figure 15-5** Measuring **resistance** of the ECT sensor. The resistance measurement can then be compared with specifications
	**ANIMATION: ECT DIAGNOSIS TEST ENGINE COOLANT TEMPERATURE ECT SENSOR**
	7. **SLIDE 7 EXPLAIN Figure 15-6** When the voltage drop reaches approximately 1.20 volts, the PCM turns on a transistor. The transistor connects a 1-kΩ resistor in parallel with the 10-kΩ resistor. Total circuit resistance now drops to around 909 ohms. This function allows the PCM to have full binary control at cold temperatures up to approximately 122° F, and a second full binary control at temperatures greater than 122° F
	8. **SLIDE 8 EXPLAIN Figure 15-7** An ECT sensor being tested using a digital meter set to DC volts and record mode to capture the data shown. A chart showing the voltage decrease of the ECT sensor as the temperature increases from a cold start. The bumps at the bottom of the waveform represent temperature decreases when the thermostat opens and is controlling coolant temperature

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	**DEMONSTRATION:** SHOW HOW TO USE AN OHMMETER FIGURE 15-5 TO TEST ENGINE COOLANT TEMPERATURE SENSORS. SHOW HOW TO USE A VOLTMETER TO CHECK FOR PROPER ECT CIRCUIT OPERATION. FIGURE 15-6 & 7
	**DISCUSSION:** HAVE THE STUDENTS DISCUSS HOW EXCESSIVE RESISTANCE IN ECT CIRCUIT WOULD AFFECT THE COMPUTER CONTROL SYSTEM. WHAT EFFECT WOULD EXCESSIVE RESISTANCE HAVE ON ENGINE OPERATION, FUEL ECONOMY, AND EMISSIONS?
	**DEMONSTRATION:** SHOW THE STUDENTS HOW TO USE A SCAN TOOL TO RETRIEVE ECT CIRCUIT VOLTAGE AND COOLANT TEMPERATURE.
	SOME OLDER TOYOTAS WILL DISPLAY A FIXED VALUE OF 176 ON SCAN TOOL IF THERE IS AN ECT CIRCUIT MALFUNCTION.
	**DISCUSSION:** HAVE THE STUDENTS DISCUSS THE SIGNIFICANCE OF FIXED ECT READINGS. WHAT IS INDICATED BY A – 40° F READING ON SCAN TOOL? WHAT IS INDICATED BY A 248°F READING?
	9. **SLIDE 9 EXPLAIN Figure 15-8** IAT sensor on this GM 3800 V-6 engine is in the air passage duct between the air cleaner housing and the throttle body.
	**DISCUSSION:** HAVE THE STUDENTS DISCUSS IAT OPERATION. WHAT IMPACT DOES IAT SENSOR HAVE ON AIR-FUEL MIXTURE? FIGURE 15-8
	**HANDS-ON TASK:** HAVE THE STUDENTS LOCATE AN IAT SENSOR ON A VEHICLE AND PERFORM A VISUAL INSPECTION. FIGURE 15-8
	EXPLAIN TECH-TIPS
	**DEMONSTRATION:** REMOVE IAT SENSOR. HOOK UP OHMMETER TO SHOW HOW RESISTANCE CHANGES WHEN YOU HOLD SENSOR IN YOUR HAND.

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	**DISCUSSION:** HAVE THE STUDENTS DISCUSS HOW A SHORT-TO GROUND IN THE 5 V REFERENCE WIRE WOULD AFFECT IAT OPERATION. WHAT WOULD BE THE EFFECT ON AIR-FUEL MIXTURE AND EMISSIONS?
	**HANDS-ON TASK:** HAVE THE STUDENTS USE A SCAN TOOL TO RETRIEVE ECT & IAT CIRCUIT VOLTAGE AND TEMPERATURE. HOW CAN THIS DATA BE USED TO DIAGNOSE MALFUNCTIONS?
	DISCUSS FREQUENTLY ASKED QUESTION
	10. SLIDE 10 EXPLAIN FIGURE 15–9 A typical temperature sensor circuit
	**DISCUSSION:** DISCUSS THE DIFFERENT TYPES OF TEMPERATURE SENSORS USED ON VEHICLES. ASK THEM TO TALK ABOUT DIFFERENT TYPES OF CONDITIONS SENSORS ARE EXPOSED TO. HOW DOES THIS AFFECT DESIGN OF SENSORS?
	**DISCUSSION:** HAVE THE STUDENTS DISCUSS TEMPERATURE SENSOR DIAGNOSTIC TROUBLE CODES. WHY WILL MOST COMPUTER CONTROL SYSTEMS SET A DTC FOR TEMPERATURE SENSOR CIRCUIT ONLY OPEN OR GROUNDED?
	**ON-VEHICLE NATEF TASK** INSPECT AND TEST **TEMPERATURE SENSOR** USING GMM OR DSO; PERFORM NECESSARY ACTION