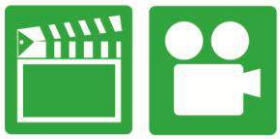
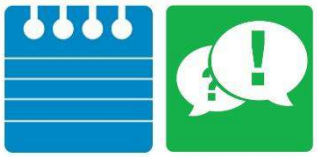
Automotive Electrical & Engine Performance 7/E

Chapter 28 TEMPERATURE SENSORS

Opening Your Class

KEY ELEMENT	EXAMPLES
Introduce Content	**This course or class covers Automotive Electrical & 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 purpose and function of engine coolant temperature sensors. 2. Describe how to inspect and test temperature sensors. 3. Diagnose emissions and drivability problems resulting from malfunctions in the intake air temperature control systems. 4. Discuss how automatic fluid temperature sensor valves can affect transmission operation. This chapter will help you prepare for Engine Repair (A8) ASE certification test content area "E" (Computerized Engine Controls 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.

NOTE: This lesson plan is based on Automotive Electrical & Engine Performance 7/E Chapter Images found on Jim's web site @ www.jameshalderman.com
LINK CHP 28: Chapter Images

ICONS	Ch28 TEMPERATURE SENSORS
	**1. SLIDE 1 CH28 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 28–1** A typical engine coolant temperature (ECT) sensor. ECT sensors are located near the thermostat housing on most engines. **3. SLIDE 3 EXPLAIN FIGURE 28–2** A typical ECT sensor temperature versus voltage curve
	**DEMONSTRATION: SHOW THE STUDENTS HOW TO LOCATE COOLANT TEMPERATURE SENSORS USING AN ELECTRONIC COMPONENT LOCATOR IN THE ONLINE SERVICE INFORMATION: FIGURE 28-1**
	**4. SLIDE 4 EXPLAIN Figure 28-3** 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 28-4** 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: HAVE THE STUDENTS DISCUSS THE DIFFERENCE BETWEEN A HYDROMETER & REFRACTOMETER. WHICH TESTER WOULD THEY PREFER TO USE? WHY?**
	**DEMONSTRATION: SHOW STUDENTS HOW TO PROPERLY PRESSURE-TEST A COOLING SYSTEM, TO DETERMINE COOLING SYSTEM CONDITION.**
	**EXPLAIN** Testing Engine Coolant Temperature Sensor
	**DISCUSSION: HAVE THE STUDENTS TALK ABOUT ECT OPERATION. HOW CAN INCORRECT COOLANT LEVEL, INCORRECT COOLANT MIXTURE, AND/OR INCORRECT SYSTEM PRESSURE CAUSE INACCURATE ECT OPERATION?**
	6. **SLIDE 6 EXPLAIN Figure 28-5** Measuring **resistance** of the ECT sensor. The resistance measurement can then be compared with specifications
	**ANIMATION: TEST ENGINE COOLANT TEMPERATURE ECT SENSOR**
	7. **SLIDE 7 EXPLAIN Figure 28-6** When the voltage drop reaches approximately 1.20 volts, the PCM turns on a transistor. The transistor connects a 1-k Ω resistor in parallel with the 10-k Ω 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

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	8. **SLIDE 8 EXPLAIN Figure 28-7** 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
	**DEMONSTRATION: SHOW HOW TO USE AN OHMMETER FIGURE 28-5 TO TEST ENGINE COOLANT TEMPERATURE SENSORS. SHOW HOW TO USE A VOLTMETER TO CHECK FOR PROPER ECT CIRCUIT OPERATION. FIGURE 28-6 & 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 28-8** 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 28-8**
	**HANDS-ON TASK: HAVE THE STUDENTS LOCATE AN IAT SENSOR ON A VEHICLE AND PERFORM A VISUAL INSPECTION. FIGURE 28-8**

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	**EXPLAIN TECH-TIPS**
	**EXPLAIN** TESTING Intake Air Temperature Sensor
	**DEMONSTRATION: REMOVE AN IAT SENSOR FROM A VEHICLE. HOOK UP AN OHMMETER TO SHOW HOW RESISTANCE CHANGES WHEN YOU HOLD SENSOR IN YOUR HAND. DISCUSS HOW BODY HEAT MAY LEAD TO INCORRECT DIAGNOSIS OF SENSOR CONDITION.**
	**DISCUSSION: DISCUSS HOW A SHORT-TO GROUND IN 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?**
	**EXPLAIN** Transmission Fluid Temperature Sensor
	**DISCUSS FREQUENTLY ASKED QUESTION**
	**10. SLIDE 10 EXPLAIN FIGURE 28–9 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?**

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	ON-VEHICLE NATEF TASK INSPECT AND TEST TEMPERATURE SENSOR USING GMM OR DSO; PERFORM NECESSARY ACTION