

Automotive Electrical & Engine Performance 8/E

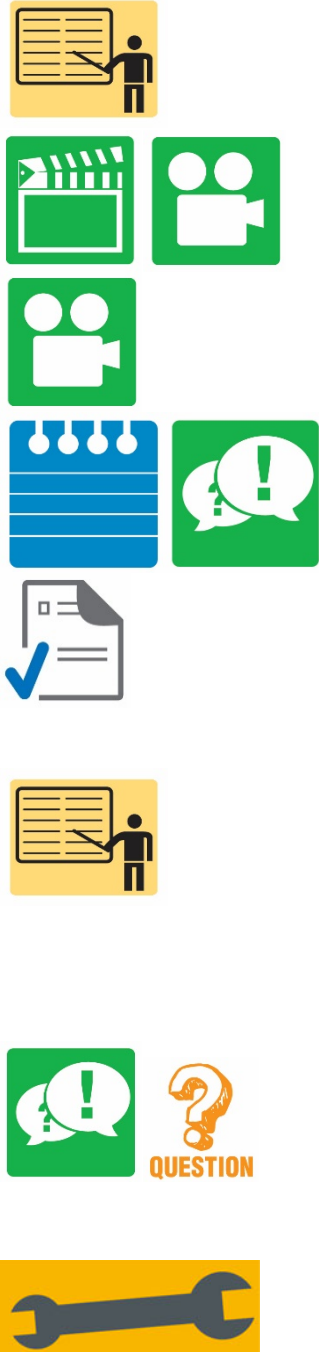
Chapter 44 Scan Tools & Engine Performance Diagnosis







Opening Your Class









KEY ELEMENT	EXAMPLES
Introduce Content	This Automotive Electrical & Engine Performance 8th edition provides complete coverage of automotive areas pertaining vehicle electrical systems and engine performance. It correlates material to task lists specified by ASE and ASEEducation (NATEF) and emphasizes a problem-solving approach. Chapter features include Tech Tips, Frequently Asked Questions, Case Studies, Videos, and Animations that are listed in this Lesson Plan. This Lesson Plan also references ASEEducation (NATEF) Task Sheets available from Jim’s web site.
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 as listed below:</p> <ol style="list-style-type: none"> 1. Discuss the steps of the diagnostic process. 2. Discuss the types of scan tools that are used to assess vehicle components. 3. Explain the troubleshooting procedures to follow if a diagnostic trouble code has been set. 4. Describe the methods for reprogramming (reflashing) a vehicle computer and performing a drive cycle. <p>This chapter will help you prepare for ASE computerized engine controls diagnosis (A8) certification test content area “E.”</p>
Establish the Mood or Climate	Provide a <i>WELCOME</i> , 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 8th Edition Chapter Images found on Jim’s web site @ www.jameshalderman.com

DOWNLOAD Chapter 44 Chapter Images: From http://www.jameshalderman.com/books_a8.html#anchor2

ICONS	Ch44 Scan Tools & Engine Perf. Diagnosis
	<p>1. SLIDE 1 CH44 SCAN TOOLS & ENGINE PERFORMANCE DIAGNOSIS</p> <p>Check for ADDITIONAL VIDEOS & ANIMATIONS @ http://www.jameshalderman.com/ WEB SITE IS CONSTANTLY UPDATED</p> <p><u>Videos</u></p> <p>At the beginning of this class, you can download the crossword puzzle & Word Search from Jim's web site to familiarize your class with terms in this chapter & then discuss them, see below: HTTP://WWW.JAMESHALDERMAN.COM/BOOKS_A8.HTML#ANCHOR2 DOWNLOAD CROSSWORD PUZZLE (MICROSOFT WORD) (PDF) WORD SEARCH PUZZLE (MICROSOFT WORD) (PDF)</p> <p>2. SLIDE 2 EXPLAIN Figure 44-1 A funnel is one way to visualize the diagnostic process. The purpose is to narrow the possible causes of a concern until the root cause is determined and corrected.</p> <p>3. SLIDE 3 EXPLAIN Figure 44-2 Step #1 is to verify the customer concern or problem. If the problem cannot be verified, then the repair cannot be verified</p> <p><u>DISCUSSION: HAVE THE STUDENTS DISCUSS THE EIGHT-STEP DIAGNOSIS PROCEDURE. WHY IS IT IMPORTANT TO BEGIN DIAGNOSIS WITH VERIFICATION OF COMPLAINT? FIGURES 44-1 TO 44-2</u></p> <p><u>EXPLAIN TECH TIP: Original Equipment" Is Not a Four-Letter Word</u> To many service technicians, an original-equipment part is considered to be only marginal and to get the really "good stuff," an aftermarket (renewal market) part has to be purchased. However, many problems can be traced to the use of an aftermarket part that has failed early in its service life. Technicians who work at dealerships usually go immediately to an</p>

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	<p>aftermarket part that is observed during a visual inspection. It has been their experience that simply replacing the aftermarket part with factory original-equipment (OE) part often solves problem. Original equipment parts are required to pass quality and durability standards and tests at a level not required of aftermarket parts. The technician should be aware that the presence of a new part does not necessarily mean that the part is good.</p> <p>INTERMITTENT PROBLEMS CAN BE DIFFICULT TO DIAGNOSE. IT IS IMPORTANT TO GATHER AS MUCH INFORMATION AS POSSIBLE FOR ACCURATE DIAGNOSIS. FIND OUT TEMPERATURES, SPEEDS, OR OPERATING CONDITIONS WHEN PROBLEMS OCCUR. TRY TO DUPLICATE OPERATING CONDITIONS & CAUSE PROBLEM TO OCCUR.</p>
	<p>4. SLIDE 4 EXPLAIN Figure 44-3 Form that customer should fill out if there is a driveability concern to help the service technician more quickly find the root cause.</p>
	<p><u>DEMONSTRATION:</u> GIVE STUDENTS COPIES OF A DIAGNOSIS WORKSHEET. HAVE STUDENTS COMPLETE WORKSHEET USING PROBLEM THEY MAY BE EXPERIENCING, OR MAY HAVE EXPERIENCED IN PAST WITH THEIR OWN CARS.</p>
	<p><u>FIGURE 44-3</u></p> <p><u>DISCUSSION:</u> HAVE STUDENTS TALK ABOUT INFORMATION FROM CUSTOMER THAT MIGHT BE USEFUL IN DIAGNOSING A CONDITION LIKE AN OBJECTIONABLE NOISE. WHAT SPECIFIC QUESTIONS SHOULD BE ASKED OF CUSTOMER FOR EFFICIENT AND ACCURATE DIAGNOSIS?</p>
	<p><u>DISCUSSION:</u> HAVE THE STUDENTS DISCUSS HOW A ROAD TEST WITH CUSTOMER MIGHT HELP WITH PROBLEM DIAGNOSIS. WHAT ARE EXAMPLES OF CONDITIONS THAT MIGHT HELP</p>
	<p><u>DUPLICATE A CONCERN?</u></p> <p>5. SLIDE 5 EXPLAIN Figure 44-4 This is what was found when removing an air filter from a vehicle that had a lack-of-power concern. Obviously nuts were deposited by squirrels or some other animal, blocking a lot of the airflow into the engine.</p>

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	<p>EXPLAIN TECH TIP: <i>Smoke Machine Testing</i> Vacuum (air) leaks can cause a variety of driveability problems and are often difficult to locate. One good method is to use a machine that generates a stream of smoke. Connecting the outlet of the smoke machine to hose that was removed from the vacuum brake booster allows smoke to enter the intake manifold. Any vacuum leaks are spotted by observing smoke coming out of leak. • SEE FIGURE 44-5.</p>
	<p>6. SLIDE 6 EXPLAIN FIGURE 44-5 Using a bright light makes seeing where the smoke is coming from easier.</p>
 	<p>DEMONSTRATION: SHOW HOW TO TEST AN IGNITION SYSTEM USING AN ADJUSTABLE SPARK TESTER. THESE TESTERS CAN BE ADJUSTED TO REQUIRE VERY HIGH VOLTAGE FROM THE IGNITION SYSTEM. THIS HELPS STUDENTS VISUALIZE AMOUNT OF RESISTANCE INSIDE COMBUSTION CHAMBER. FIGURE 44-6</p>
	<p>7. SLIDE 7 EXPLAIN FIGURE 44-6 A spark tester connected to a spark plug wire or coil output.</p> <p>8. SLIDE 8 EXPLAIN FIGURE 44-7 Step 3 in diagnostic process is to retrieve any stored diagnostic trouble codes</p>
	<p>EXPLAIN TECH TIP: <i>Look at the Freeze-Frame</i> Whenever a DTC is set, a freeze-frame is stored. The freeze-frame includes data showing how the engine was being operated at time code was set. The wise service technician saves freeze-frame information to help determine not only what might have caused the code to set, but also to allow technician to drive vehicle under similar conditions to verify that problem has been corrected.</p>
 	<p>DEMONSTRATION: CREATE A DTC ON A VEHICLE; FOR EXAMPLE, BY DISCONNECTING AN ENGINE COOLANT TEMPERATURE SENSOR. SHOW STUDENTS HOW TO CONNECT SCAN TOOL AND ACCESS DTC. RECONNECT SENSOR & DEMONSTRATE PROCEDURE FOR ERASING DTC. FIGURE 44-7</p>

ICONS

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9. **SLIDE 9 EXPLAIN Figure 44-8** After checking for stored diagnostic trouble codes (DTCs), wise technician checks service information for any technical service bulletins that may relate to vehicle being serviced.

10. **SLIDE 10 EXPLAIN Figure 44-9** Looking carefully at the scan tool data is very helpful in locating the source of a problem.



DEMONSTRATION: PENDING DTC CAN BE SET BY DISCONNECTING AN EMISSION COMPONENT LIKE AN EGR VACUUM HOSE. DRIVE THE VEHICLE TO MEET ENABLING CRITERIA FOR EGR MONITOR. ONCE CONDITIONS HAVE BEEN MET, RECONNECT EGR VACUUM HOSE. SHOW HOW TO ACCESS AND DISPLAY PENDING DTC. FIGURE 44-9



11. **SLIDE 11 EXPLAIN Figure 44-10** Step 8 is very important. Be sure that the customer's concern has been corrected



EXPLAIN TECH TIP: One Test Is Worth 1,000














“Expert” Opinions Whenever any vehicle has an engine performance or driveability concern, certain people always say: “Sounds like it’s a bad injector.” “I’ll bet you it’s a bad computer.” “I had a problem just like yours yesterday and it was a bad EGR valve.” Regardless of the skills and talents of those people, it is still more accurate to perform tests on the vehicle than to rely on feelings or opinions of others who have not even seen vehicle. Even your own opinion should not sway your thinking. Follow a plan, perform tests, and follow test results to the root cause.



















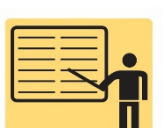


DEMONSTRATION: SHOW HOW TO PERFORM A THOROUGH VISUAL INSPECTION, STARTING WITH BASIC FLUID LEVEL CHECKS. RAISE & SUPPORT VEHICLE, AND CONTINUE WITH A THOROUGH UNDERCAR INSPECTION BY CHECKING ITEMS SUCH AS SUSPENSION, & BRAKE & EXHAUST COMPONENTS AND SYSTEMS.





















HANDS-ON TASK: HAVE THE STUDENTS PERFORM THOROUGH VISUAL INSPECTIONS ON EACH OTHER'S VEHICLES OR LAB VEHICLES.







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 	<p>GRADE THEM ON THEIR ABILITY TO FIND DEFECTS OR PROBLEMS.</p> <p><u>DEMONSTRATION:</u> SHOW THE STUDENTS HOW TO USE A <u>SMOKE MACHINE</u> TO FIND AIR OR VACUUM LEAKS. SIMULATE A VACUUM LEAK BY REMOVING A VACUUM LINE FROM THE INTAKE MANIFOLD.</p>
	<p>SMOKE MACHINES CAN BE USED TO FIND EXHAUST LEAKS. THE TIP OF SMOKE MACHINE CAN BE PUT INSIDE TAILPIPE AND, WHEN EXHAUST SYSTEM FILLS WITH SMOKE, ANY LEAKS WILL BE OBVIOUS.</p>
 	<p><u>DISCUSSION:</u> HAVE THE STUDENTS TALK ABOUT <u>IGNITION VOLTAGE REQUIREMENTS.</u> WHAT CONDITIONS INSIDE COMBUSTION CHAMBER CAN AFFECT IGNITION VOLTAGE REQUIREMENTS?</p>
 	<p><u>DEMONSTRATION:</u> SHOW HOW TO CHECK FUEL PRESSURE BY <u>CONNECTING A FUEL PRESSURE GAUGE</u> TO FUEL RAIL. CAUTION STUDENTS OF THE DANGERS OF FUEL LEAKS WHILE OPERATING THE ENGINE.</p>
	<p><u>HANDS-ON TASK:</u> ASK STUDENTS TO RESEARCH <u>WIRING DIAGRAMS</u> FOR THEIR OWN VEHICLES OR LAB VEHICLES. THEN HAVE THEM SELECT A SPECIFIC FUSE AND LIST HOW MANY INDIVIDUAL CIRCUITS WOULD NOT OPERATE IF THAT FUSE WERE TO OPEN OR BURN.</p>
	<p>12. SLIDE 12 <u>EXPLAIN</u> Figure 44-11 A TECH 2 scan tool is the factory scan tool used on General Motors vehicles.</p>
	<p><u>Scan Tool (View) (Download)</u></p>
	<p>13. SLIDE 13 <u>EXPLAIN</u> Figure 44-12 Some scan tools use pocket PCs which make it very convenient to use.</p>
 	<p><u>DISCUSSION:</u> HAVE THE STUDENTS TALK ABOUT SCAN TOOLS. HOW DO <u>OEM SCAN TOOLS</u> DIFFER FROM GENERIC SCAN TOOLS? WHAT ARE</p>




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	<p>ADVANTAGES & DISADVANTAGES OF BOTH TYPES OF TOOLS? FIGURES 44-11 & 12</p> <p><u>DEMONSTRATION: CONNECT BOTH OEM & GENERIC SCAN TOOLS TO A VEHICLE AND ALLOW STUDENTS TO SEE INFORMATION AVAILABLE WITH EACH TOOL. DEMONSTRATE BIDIRECTIONAL CAPABILITIES BY INCREASING OR DECREASING IDLE SPEEDS, FOR EXAMPLE. FIGURES 44-11 & 12</u></p>
	<p><u>DEMONSTRATION: DISCONNECT CRITICAL SENSORS, LIKE CRANK SENSOR AND AIRFLOW SENSOR, ON A RUNNING ENGINE TO DEMONSTRATE ENGINE STALLING. RESTART ENGINE & DISCONNECT SENSORS SUCH AS AN OXYGEN SENSOR AND COOLANT TEMPERATURE SENSOR TO DEMONSTRATE ENGINE OPERATION WITHOUT THIS DATA.</u></p>
	<p><u>HANDS-ON TASK: HAVE THE STUDENTS CONNECT AN OEM SCAN TOOL TO A RUNNING VEHICLE AND RECORD ALL DATASTREAM PARAMETERS AVAILABLE.</u></p>
	<p><u>DISCUSSION: HAVE THE STUDENTS DISCUSS DATA PARAMETERS. WHAT DATA PARAMETERS ARE NECESSARY FOR ENGINE OPERATION? WHAT DATA PARAMETERS ARE CONSIDERED FUEL TRIM SENSORS OR MONITORS FOR EMISSIONS SYSTEMS?</u></p>
	<p><u>ON-VEHICLE ASE EDUCATION TASK B2 ACCESS AND USE SERVICE INFORMATION TO PERFORM STEP-BY-STEP (TROUBLESHOOTING) DIAGNOSIS.</u></p>
 ASE Education Foundation	<p><u>ON-VEHICLE ASE EDUCATION TASK B5 DIAGNOSE THE CAUSES OF EMISSIONS OR DRIVEABILITY CONCERNS WITH STORED OR ACTIVE DIAGNOSTIC TROUBLE CODES (DTC); OBTAIN, GRAPH, AND INTERPRET SCAN TOOL DATA.</u></p>
  ASE Education Foundation	

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 	<p><u>ON-VEHICLE ASE EDUCATION TASK B8:</u> DIAGNOSE DRIVEABILITY AND EMISSIONS PROBLEMS RESULTING FROM MALFUNCTIONS OF INTERRELATED SYSTEMS (CRUISE CONTROL, SECURITY ALARMS, SUSPENSION CONTROLS, TRACTION CONTROLS, HVAC, AUTOMATIC TRANSMISSIONS, NON-OEM INSTALLED ACCESSORIES, OR SIMILAR SYSTEMS); DETERMINE NEEDED ACTION.</p>
 	<p><u>ON-VEHICLE ASE EDUCATION TASK:</u> RETRIEVE AND RECORD STORED OBD II DIAGNOSTIC TROUBLE CODES; CLEAR CODES.</p>
 	<p><u>ON-VEHICLE ASE EDUCATION TASK B3:</u> PERFORM ACTIVE TESTS OF ACTUATORS USING A SCAN TOOL; DETERMINE NEEDED ACTION.</p>
 	<p><u>ON-VEHICLE ASE EDUCATION TASK B7:</u> INSPECT AND TEST COMPUTERIZED ENGINE CONTROL SYSTEM SENSORS, POWERTRAIN/ENGINE CONTROL MODULE (PCM/ECM), ACTUATORS, AND CIRCUITS USING A GRAPHING MULTIMETER (GMM)/DIGITAL STORAGE OSCILLOSCOPE (DSO); PERFORM NEEDED ACTION.</p>
	<p>14. SLIDE 14 EXPLAIN Figure 44-13 To retrieve flash codes from an OBD-I General Motors vehicle, without a scan tool, connect terminals A and B with the ignition on—engine off. The M terminal is used to retrieve data from the sensors to a scan tool.</p>
 	<p><u>DEMONSTRATION: USING AN OLDER GM OBD-I VEHICLE, SET A DTC, FOR EXAMPLE, BY DISCONNECTING A COOLANT TEMPERATURE SENSOR. SHOW HOW TO RETRIEVE THE DTC THROUGH <u>FLASHING CHECK ENGINE LIGHT.</u> FIGURE 44-13</u></p>

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	<p>HANDS-ON TASK: HAVE THE STUDENTS RESEARCH THE DTC FROM ABOVE DEMONSTRATION USING OEM SERVICE INFORMATION. THE STUDENTS SHOULD UNDERSTAND THE CONDITIONS THAT WERE MET FOR THE DTC TO SET. THEN HAVE STUDENTS USE OEM SERVICE INFORMATION TO FIND PREFERRED METHOD TO ERASE DTC.</p>
	<p>EXPLAIN TECH TIP: <i>Quick and Easy Chrysler Code Retrieval</i> Most Chrysler-made vehicles (Dodge, Ram, and Chrysler) can display diagnostic trouble code on dash by turning ignition switch on and then off and then on 3 times with last time being on. This makes it easy for anyone to see if there are any stored trouble codes without having to use a scan tool. This works on vehicles built after 1996, too. • SEE FIGURE 44-14.</p>
	<p>15. SLIDE 15 EXPLAIN FIGURE 44-14 DTCs from Chrysler & Dodge vehicles can be retrieved by turning ignition switch to on/then off 3 times.</p>
	<p>DEMONSTRATION: CREATE A DTC IN OBD-I FORD VEHICLE, AND DEMONSTRATE KEY ON-ENGINE OFF (KOEO) CODE RETRIEVAL USING A JUMPER WIRE & TEST LIGHT. HAVE STUDENTS COUNT FLASHES OF TEST LIGHT TO RETRIEVE DTC. FIGURES 44-14 & 15</p>
	<p>EXPLAIN TECH TIP: <i>Do Not Lie to a Scan Tool!</i> Because computer calibration may vary from year to year, using incorrect year for vehicle while using a scan tool can cause data retrieved to be incorrect or inaccurate.</p>
	<p>DEMONSTRATION: WHILE PERFORMING KOER TEST ON FORD OBD-I VEHICLE, DEMONSTRATE DYNAMIC RESPONSE CHECK, WHEN PROMPTED. FIGURES 44-14 & 15</p>
	<p>HANDS-ON TASK: HAVE THE STUDENTS LOCATE THE DIAGNOSTIC LINK CONNECTOR (DLC) ON THEIR OWN VEHICLES USING COMPONENT LOCATOR. HAVE THEM RETRIEVE DTCS USING A</p>

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 	<p>SCAN TOOL OR ON OLDER VEHICLES, THE FLASH CODE RETRIEVAL PROCEDURE AND OEM SERVICE INFORMATION. FIGURE 44-16</p> <p>DEMONSTRATION: CREATE A DTC ON AN OBD-I VEHICLE BY DISCONNECTING A SENSOR, SUCH AS THE ENGINE COOLANT TEMPERATURE SENSOR. CREATE OPPOSITE DTC BY SHORTING THE CONNECTOR TERMINALS WITH A JUMPER WIRE.</p>
	<p>HANDS-ON TASK: BASED ON ABOVE DEMO, HAVE STUDENTS RETRIEVE THE DTCS AND HAVE THE STUDENTS RESEARCH THE DTC CODE DEFINITIONS.</p>
	<p>16. SLIDE 16 EXPLAIN Figure 44-15 data link connector (DLC) can be located in various locations.</p> <p>17. SLIDE 17 EXPLAIN Figure 44-16 A typical OBD-II data link connector (DLC). The location varies with make and model and may even be covered. Check service information for the exact location if needed.</p>
 	<p>DEMONSTRATION: CREATE A DTC IN OBD-I FORD VEHICLE, AND DEMONSTRATE KEY ON-ENGINE OFF (KOEO) CODE RETRIEVAL USING A JUMPER WIRE & TEST LIGHT. HAVE STUDENTS COUNT FLASHES OF TEST LIGHT TO RETRIEVE DTC. FIGURES 44-14 & 15</p>
 	<p>DEMONSTRATION: WHILE PERFORMING KOER TEST ON FORD OBD-I VEHICLE, DEMONSTRATE DYNAMIC RESPONSE CHECK, WHEN PROMPTED. FIGURES 44-14 & 15</p>
	<p>HANDS-ON TASK: HAVE THE STUDENTS LOCATE THE DIAGNOSTIC LINK CONNECTOR (DLC) ON THEIR OWN VEHICLES USING COMPONENT LOCATOR. HAVE THEM RETRIEVE DTCS USING A SCAN TOOL OR ON OLDER VEHICLES, THE FLASH CODE RETRIEVAL PROCEDURE AND OEM SERVICE INFORMATION. FIGURE 44-16</p>
 	<p>DEMONSTRATION: CREATE A DTC ON AN OBD-I VEHICLE BY DISCONNECTING A SENSOR, SUCH AS THE ENGINE COOLANT TEMPERATURE SENSOR. CREATE OPPOSITE DTC BY SHORTING THE CONNECTOR TERMINALS WITH A JUMPER WIRE.</p>

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	<p>HANDS-ON TASK: BASED ON ABOVE DEMO, HAVE STUDENTS RETRIEVE THE DTCS AND HAVE THE STUDENTS RESEARCH THE DTC CODE DEFINITIONS.</p>
	<p>18. SLIDE 18 EXPLAIN FIGURE 44-17 The first step in the reprogramming procedure is to determine the current software installed using a scan tool. Not all scan tools can be used. In most cases using the factory scan tool is needed for reprogramming unless the scan tool is equipped to handle reprogramming</p>
	<p>DEMONSTRATION: CREATE A DTC ON AN OBD-I VEHICLE BY DISCONNECTING A SENSOR, SUCH AS THE ENGINE COOLANT TEMPERATURE SENSOR. CREATE OPPOSITE DTC BY SHORTING THE CONNECTOR TERMINALS WITH A JUMPER WIRE.</p>
	<p>HANDS-ON TASK: BASED ON ABOVE DEMO, HAVE STUDENTS RETRIEVE THE DTCS AND HAVE THE STUDENTS RESEARCH DTC CODE DEFINITIONS.</p>
	<p>19. SLIDE 19 EXPLAIN FIGURE 44-18 Follow the on-screen instructions</p> <p>20. SLIDE 20 EXPLAIN FIGURE 44-19 An Internet connection is usually needed to perform updates although some vehicle manufacturers use CDs which are updated regularly at a cost to the shop</p> <p>21. SLIDE 21 EXPLAIN FIGURE 44-20 battery charger that does not introduce any alternating current (AC) when charging the battery is extremely important when programming a PCM.</p> <p>22. SLIDE 22 EXPLAIN FIGURE 44-21 Connecting cables and a computer to perform off-board programming.</p> <p>23. SLIDE 23 EXPLAIN FIGURE 44-22 J2534 pass-through reprogramming system does not need a scan tool to reflash the PCM on most 2004 and newer vehicles.</p> <p>24. SLIDE 24 EXPLAIN FIGURE 44-23 A typical J2534 universal reprogrammer that uses the J2534 standards.</p>
	<p>EXPLAIN TECH TIPS Brake Pedal Trick If vehicle manufacturer recommends that battery power be disconnected, first disconnect negative battery cable and then depress brake pedal.</p>

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  	<p>Because brake lights are connected to battery power, depressing brake pedal causes all of capacitors in electrical system and computer(s) to discharge through brake lights.</p> <p>EXPLAIN TECH TIP: <i>Drive the Light Out</i> If working on a vehicle that is subject to state emissions testing, it is best to not clear codes. When DTCs are cleared, all of the monitors have to be rerun, and this can be a time-consuming job. Instead of clearing code, simply drive vehicle until PCM clears code. This likely takes less time compared to trying to drive vehicle under varying conditions to run all of monitors.</p> <p><u>DEMONSTRATION:</u> DEMO J2534 REPROGRAMMING</p> <p><u>HANDS-ON TASK:</u> BASED ON ABOVE DEMO, HAVE STUDENTS REPROGRAM A PCM</p>