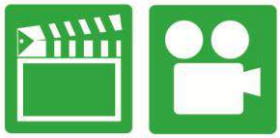
Advanced Engine Performance Diagnosis 6/E

Chapter 28 Vehicle Emission Standards & Testing

Opening Your Class

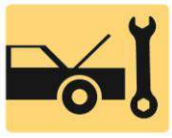
KEY ELEMENT	EXAMPLES
Introduce Content	This course or class covers operation and service of **ADVANCED Automotive Engine Performance Diagnosis 6/E.** It correlates material to task lists specified by ASE and NATEF.
Motivate Learners	Explain how the knowledge of how something works translates into the 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. Discuss the emissions standards for vehicles. 2. Discuss exhaust analysis testing procedures. 3. Identify the reasons for excessive HC, CO, and NOx emissions
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 28: Chapter Images

ICONS	Ch28 Vehicle Emission Standards & Testing
	**1. SLIDE 1 CH28 Vehicle Emission Standards & Testing**
	**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 28-1** underhood decal showing that this Lexus RX-330 meets both national (Tier 2; BIN 5) and California LEV-II (ULEV) regulation standards.
	**DISCUSSION: HAVE THE STUDENTS TALK ABOUT EMISSIONS. WHAT ARE THEIR IMPRESSIONS OF EMISSIONS STANDARDS?**
	**EXPLAIN CHART 28–1** EPA Tier 2—120,000-Mile Tailpipe Emission Limits. NMOG stands for non-methane organic gases which is a measure of all gases except those often created naturally by animals. After January 2007, the highest allowable Bin is 7. Source: Data compiled from the Environmental Protection Agency (EPA). *NOTE: The bin number is determined by the type and weight of the vehicle*
	**EXPLAIN CHART 28–3** Greenhouse Gas Score ***CNG assumes gallon of 121.5 cubic feet.***
	3. SLIDE 3 EXPLAIN Figure 28-2 label on a Toyota Camry hybrid shows the relative smog-producing emissions, but this does not include carbon dioxide (CO_2), which may increase global warming

ICONS	Ch28 Vehicle Emission Standards & Testing
	**DISCUSSION:** DISCUSS FEDERAL EMISSIONS STANDARDS. EXPLAIN THAT **EMISSION CONTROL SYSTEMS (ECS) LABEL** IS UNDER THE HOOD OF EVERY VEHICLE PRODUCED FOR SALE IN THE US & INCLUDES INFORMATION ABOUT EMISSIONS SYSTEMS INSTALLED WHEN IT WAS MANUFACTURED. WHAT DOES HIGHER TIER NUMBER MEAN? **FIGURE 28-1 & 2**
	IF A VEHICLE IS DAMAGED IN A COLLISION, THE ECS LABEL MAY NOT HAVE BEEN REPLACED DURING BODY REPAIRS. IF LABEL IS MISSING, THE VIN MUST BE USED TO DETERMINE YEAR. A REPLACEMENT ECS LABEL CAN BE OBTAINED FROM DEALER USING THE VIN.
	**DISCUSSION:** HAVE THE STUDENTS DISCUSS **3** MAIN **POLLUTANTS** FOR WHICH VEHICLES ARE TESTED. HOW ARE THE MAIN POLLUTANTS PRODUCED? **CHART 28-1 & 2**
	**DISCUSSION:** HAVE THE STUDENTS DISCUSS **HYDROCARBONS, CARBON MONOXIDE, & OXIDES OF NITROGEN**. WHAT ARE ACCEPTABLE LEVELS OF EACH POLLUTANT? WHAT ARE UNITS OF MEASUREMENT FOR PROPERLY TUNED AND RUNNING ENGINE? WHAT IS MEANT BY AIR POLLUTION SCORE (BIN)? **CHARTS 28-1 & 2**
	**DISCUSSION:** BRIEFLY REVIEW AND DISCUSS THE ROLE OF **CATALYTIC CONVERTERS** IN OXIDIZING HYDROGEN AND CARBON WHILE REDUCING OXIDES OF NITROGEN. WHY WOULD A VEHICLE WITH A CATALYTIC CONVERTER THAT IS NOT FUNCTIONING FAIL AN EMISSIONS TEST?
	4. **SLIDE 4 EXPLAIN Figure 28-3** Photo of a sign taken at an emissions test facility. 5. **SLIDE 5 EXPLAIN Figure 28-4** A vehicle being tested during an enhanced emission test
	**DISCUSSION:** DISCUSS DIFFERENCES BETWEEN TESTING VEHICLE'S EMISSIONS AT DIFFERENT IDLE SPEEDS VS. LOAD TEST ON **DYNAMOMETER**. HOW DO EMISSIONS CHANGE

ICONS	Ch28 Vehicle Emission Standards & Testing
	AS VEHICLE LOAD INCREASES? DISCUSS TERM LOADED-MODE TESTING. STUDENTS SHOULD UNDERSTAND THAT LOADED MODE TESTING REQUIRES VEHICLE TO BE ON A DYNAMOMETER. HOW DOES DYNAMOMETER SIMULATE REAL-WORLD DRIVING CONDITIONS IN A TESTING ENVIRONMENT? FIGURES 28-3 & 4
	18. **SLIDE 18 EXPLAIN Figure 28-5** Trace showing Inspection/Maintenance 240 test. Test duplicates an urban test loop around Los Angeles, California. First "hump" in curve represents vehicle being accelerated to about 20 mph, then driving up a small hill to about 30 mph and coming to a stop at 94 seconds. Then, the vehicle accelerates while climbing a hill and speeding up to about 50 mph during this second phase of the test
	**DISCUSSION: HAVE STUDENTS DISCUSS ABBREVIATIONS HC, CO, AND NO_x AND WHAT THESE COMPOUNDS ARE. HOW ARE HC, CO & NOX FORMED IN THE COMBUSTION CHAMBER?**
	**DEMONSTRATION: USING 5-GAS EXHAUST ANALYZER, MEASURE HC, CO, AND NOX EMISSIONS ON A VEHICLE SIMULATING A TWO-SPEED IDLE TEST. USE THE SAME VEHICLE AND MEASURE AGAIN, PERFORMING AN ASM TEST TO SHOW STUDENTS DIFFERENCE IN EMISSIONS.**
	**DISCUSSION: HAVE THE STUDENTS DISCUSS HOW AND WHY EMISSIONS SUCH AS NO_x INCREASE DURING ASM TEST COMPARED TO TSI TESTS. WHY DOES NO_x INCREASE AS A RESULT OF A LOADED ENGINE? FIGURE 28-5**
	7. **SLIDE 7 EXPLAIN Figure 28-6** A partial stream sampling exhaust probe being used to measure exhaust gases in parts per million (PPM) or percent (%).
	**DEMONSTRATION: WHILE PERFORMING AN EMISSIONS TEST, DISCONNECT SPARK PLUG WIRE FOR SHORT TIME. SHOW THE STUDENTS THE INCREASE EMISSIONS CAUSED BY MISFIRING CYLINDER. FIGURE 28-6**

ICONS	Ch28 Vehicle Emission Standards & Testing
	**DEMONSTRATION:** DISCONNECT FUEL PRESSURE REGULATOR VACUUM HOSE OR ECT SENSOR TO SHOW HOW CARBON MONOXIDE (CO) READINGS CAN BE INCREASED DURING AN EMISSIONS TEST. **FIGURE 28-6**
	**DEMONSTRATION:** DEMONSTRATE USING AN INFRARED THERMOMETER WHAT HAPPENS TO THE TEMPERATURE OF CATALYTIC CONVERTER WHEN A MISFIRE OR RICH MIXTURE IS CREATED. **FIGURE 28-6**
	**DEMONSTRATION: BEFORE- AND AFTER CONVERTER EMISSION READINGS** CAN BE OBTAINED BY REMOVING OXYGEN SENSOR AND INSERTING 5-GAS ANALYZER PROBE INTO THE SENSOR BOSS. LEAVE SENSOR CONNECTED WHILE OPERATING THE ENGINE AND QUICKLY RECORD READINGS. REMOVE ANALYZER AND INSERT IT INTO THE TAILPIPE AFTER CONVERTER TO ILLUSTRATE OPERATION OF CATALYTIC CONVERTER. **FIGURE 28-6**
	8. **SLIDE 8 EXPLAIN Figure 28-7** Exhaust emissions are very complex. When air–fuel mixture becomes richer, some exhaust emissions are reduced, while others increase.
	**DISCUSSION:** DISCUSS THE DIFFERENCES BETWEEN **RICH & LEAN EXHAUST**. WHAT INDICATES THAT ENGINE IS OPERATING CORRECTLY? **FIGURE 28-7**
	**DISCUSS FREQUENTLY ASKED QUESTION**
	**HANDS-ON TASK: PREPARE A VEHICLE TO FAIL AN EMISSIONS TEST.** FOR EXAMPLE, CLOSE ELECTRODES ON A SPARK PLUG. HAVE STUDENTS OPERATE THE VEHICLE FOR AN ASM EMISSIONS TEST. ASK THE STUDENTS TO EXPLAIN THE FAILURE AND LIST CAUSES FOR THE HIGH EMISSIONS. GRADE THEM ON THEIR ABILITY TO IDENTIFY IGNITION PROBLEMS AS CAUSE OF HIGH HYDROCARBONS.

ICONS	Ch28 Vehicle Emission Standards & Testing
	**DEMONSTRATION: SIMULATE A LEAN CONDITION WHILE ANALYZING A VEHICLE'S EMISSIONS BY DISCONNECTING ONE OR TWO INJECTORS. SHOW DROP IN CARBON MONOXIDE AND INCREASE IN OXYGEN.**
	**DISCUSSION: HAVE THE STUDENTS TALK ABOUT THE EMISSION READINGS OF THE VEHICLE IN PREVIOUS DEMO. WHY IS INCREASE IN OXYGEN & CORRESPONDING DECREASE IN CARBON MONOXIDE A RESULT OF LEAN CONDITION?**
	**DISCUSSION: HAVE THE STUDENTS DISCUSS HOW AN EXHAUST LEAK CAN CAUSE A FALSE LEAN CONDITION. HOW ARE LOW PRESSURE PULSES IN EXHAUST SYSTEM CAUSED BY THE 4-STROKE CYCLE DRAWING OUTSIDE AIR PAST THE OXYGEN SENSOR? FIGURE 28-8**
	**ON-VEHICLE NATEF TASK: PREPARE 4 OR 5 GAS ANALYZER; INSPECT AND PREPARE VEHICLE FOR TEST, AND OBTAIN EXHAUST READINGS; INTERPRET READINGS, AND DETERMINE NECESSARY ACTION.**
	**EXPLAIN TECH-TIPS** **9. SLIDE 9 EXPLAIN FIGURE 28–8** A hole in the exhaust system can cause outside air (containing oxygen) to be drawn into the exhaust system. This extra oxygen can be confusing to a service technician because the extra O2 in the exhaust stream could be misinterpreted as a too-lean air–fuel mixture
	**31. SLIDE 31 EXPLAIN TECH-TIP**
	**DEMONSTRATION: ADVANCE IGNITION TIMING AND/OR DISCONNECT EGR SYSTEM ON A VEHICLE PRIOR TO CONDUCTING AN ASM EMISSIONS TEST. SHOW STUDENTS INCREASE IN NOX.**
	**DISCUSSION: DISCUSS INCREASE IN NOX IN PREVIOUS DEMONSTRATION. WHAT ARE THE POTENTIAL CAUSES?**

ICONS	Ch28 Vehicle Emission Standards & Testing
  	**HANDS-ON TASK:** HAVE STUDENTS **CORRECT THE CONDITION** THAT CAUSED INCREASE IN NO_x IN VEHICLE USED IN **DEMONSTRATION** & RETEST VEHICLE TO SEE CHANGES. EXPLAIN TECH-TIP **DISCUSS REAL WORLD FIX**