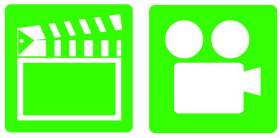
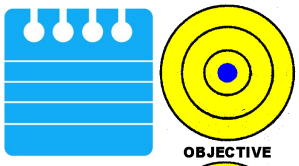
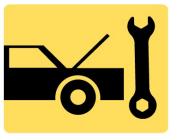
A8 Engine Performance 4th Edition

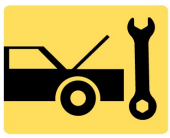
Chapter 31 Vehicle Emission Standards and Testing

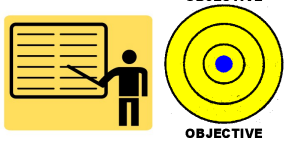
Opening Your Class

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 (A8) certification test content area "D" (Emissions Control Systems diagnosis and Repair) and ASE L1 certification test content area "F" (I/M Failure diagnosis). 2. Discuss emission standards. 3. Identify the reasons why excessive amounts of HC, CO, and NOx exhaust emissions are created. 4. Describe how to baseline a vehicle after an exhaust emission failure. 5. List acceptable levels of HC, CO, Co2, and O2 with and without a catalytic converter. 6. List four possible causes for high readings for HC, CO, and NOx.
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.

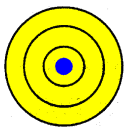
ICONS	Ch31 Vehicle Emission Standards & Testing
	**1. SLIDE 1 CH31 Vehicle Emission Standards and Testing**
	**Check for ADDITIONAL VIDEOS & ANIMATIONS @ http://www.jameshalderman.com/** **WEB SITE REGULARLY UPDATED**
	**POWER POINTS DONE BY INDIVIDUAL LEARNING OBJECTIVES, SO THERE IS POWER POINT FILE FOR EACH LEARNING OBJECTIVE**
	**2. SLIDE 2 EXPLAIN OBJECTIVE CH31 AEP_LO1** **3. SLIDES 3-5 EXPLAIN** Emission Standards in US
	**6. SLIDE 6 EXPLAIN Figure 31-1** 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?**
	**7. SLIDE 7 EXPLAIN** Emission Standards in US **8. SLIDE 8 EXPLAIN FIGURE 31–2** This 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
	**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 1/1/2007, 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***
	**DISCUSSION: DISCUSS FEDERAL EMISSIONS STANDARDS. EXPLAIN THAT EMISSION CONTROL SYSTEMS (ECS) LABEL IS UNDER HOOD OF EVERY VEHICLE IN US & INCLUDES INFORMATION ABOUT EMISSIONS SYSTEMS INSTALLED WHEN IT WAS MANUFACTURED. WHAT DOES HIGHER TIER NUMBER MEAN? FIG 31-1/2**

ICONS	Ch31 Vehicle Emission Standards & Testing
	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 31-1 & 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 30-1 & 2**
	2. SLIDE 2 EXPLAIN **OBJECTIVE CH31 AEP_LO2**
	3. SLIDES 3-6 EXPLAIN **HC Too High**
	7. SLIDES 7-8 EXPLAIN CO Too High
	**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.
	**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.

ICONS	Ch31 Vehicle Emission Standards & Testing
	**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?**
	9. **SLIDES 9-10 EXPLAIN** Measuring Oxygen (O_2) and Carbon Dioxide (CO_2)
	11. **SLIDE 11 EXPLAIN FIGURE 31–8** 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
	**DISCUSSION: 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 31-8**
	**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.**
	12. **SLIDES 12-14 EXPLAIN** Photochemical Smog Formation 15. **SLIDES 15-16 EXPLAIN** Testing for Oxides of Nitrogen
	**DEMONSTRATION: ADVANCE IGNITION TIMING AND/OR DISCONNECT EGR SYSTEM ON A VEHICLE PRIOR TO CONDUCTING AN ASM EMISSIONS TEST. SHOW STUDENTS INCREASE IN NO_X.**
	**HANDS-ON TASK: CORRECT CONDITION THAT CAUSED INCREASE IN NO_X IN VEHICLE USED IN ABOVE DEMO & RETEST VEHICLE TO SEE CHANGES.**
	**DISCUSSION: DISCUSS INCREASE IN NO_X IN PREVIOUS DEMO. WHAT ARE CAUSES?**

ICONS	Ch31 Vehicle Emission Standards & Testing
	2. SLIDE 2 EXPLAIN **OBJECTIVE CH31 AEP_LO3** 3. SLIDES 3-8 EXPLAIN **Exhaust Analysis Testing**
	2. SLIDE 2 EXPLAIN **OBJECTIVE CH31 AEP_LO4**
	3. **SLIDE 3 EXPLAIN Figure 31-3** Photo of a sign taken at an emissions test facility. 4. **SLIDE 4 EXPLAIN Figure 31-4** 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 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 31-3 & 4**
	5. **SLIDE 5 EXPLAIN Figure 31-5** 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.**

ICONS	Ch31 Vehicle Emission Standards & Testing
QUESTION	**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 31-5** 6. **SLIDE 6 EXPLAIN** Exhaust Analysis and Combustion Efficiency 7. **SLIDE 7 EXPLAIN Figure 31-6** A partial stream sampling exhaust probe being used to measure exhaust gases in parts per million (PPM) or percent (%).
DEMO	**DEMONSTRATION: WHILE PERFORMING AN EMISSIONS TEST, DISCONNECT SPARK PLUG WIRE FOR SHORT TIME. SHOW THE STUDENTS THE INCREASE EMISSIONS CAUSED BY MISFIRING CYLINDER. FIGURE 31-6**
DEMO	**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 31-6**
DEMO	**DEMONSTRATION: DEMONSTRATE USING AN INFRARED THERMOMETER WHAT HAPPENS TO TEMPERATURE OF CATALYTIC CONVERTER WHEN MISFIRE OR RICH MIXTURE IS CREATED FIG 31-6**
DEMO	**DEMONSTRATION: BEFORE/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 31-6**
	8. **SLIDE 8 EXPLAIN** Exhaust Analysis and Combustion Efficiency 9. **SLIDE 9 EXPLAIN Figure 31-7** Exhaust emissions are very complex. When air–fuel mixture becomes richer, some exhaust emissions are reduced, while others increase.

ICONS	Ch31 Vehicle Emission Standards & Testing
 QUESTION	**DISCUSSION: DISCUSS THE DIFFERENCES BETWEEN RICH & LEAN EXHAUST. WHAT INDICATES THAT ENGINE IS OPERATING CORRECTLY? FIGURE 31-7**
	**10. SLIDES 10-13 EXPLAIN HC Too High**
	**14. SLIDES 14-15 EXPLAIN CO Too High**
	**16. SLIDES 16-17 EXPLAIN** Measuring Oxygen (O_2) and Carbon Dioxide (CO_2)
	**18. SLIDE 18 EXPLAIN FIGURE 31–8** 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
	**19. SLIDES 19-21 EXPLAIN** Photochemical Smog Formation
  OBJECTIVE	**2. SLIDE 2 EXPLAIN OBJECTIVE CH31 AEP_LO5**
	**3. SLIDES 3-4 EXPLAIN** Testing for Oxides of Nitrogen