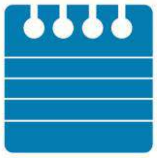
Automotive Technology 5th Edition
Chapter 86 CATALYTIC CONVERTERS
Opening Your Class

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 learning objectives to students as listed below: 1. Explain the purpose and function plus the construction and operation of catalytic converters. 2. Discuss the diagnosis of catalytic converters.
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 the 5th Edition Chapter Images found on Jim's web site @ www.jameshalderman.com

LINK CHP 86: ATE5 Chapter Images

ICONS	Chapter 86 CATALYTIC CONVERTERS
	**1. SLIDE 1 CH86 CATALYTIC CONVERTERS**
	**Check for ADDITIONAL VIDEOS & ANIMATIONS @** **http://www.jameshalderman.com/** **WEB SITE IS CONSTANTLY UPDATED**
	**Videos**
	**Catalytic Converter Operation (View) (Download)** **Catalytic Converter (2004+) (View) (Download)**
	**2. SLIDE 2 EXPLAIN Figure 86-1** Most catalytic converters are located as close to the exhaust manifold as possible, as seen in this display of a Chevrolet Corvette **3. SLIDE 3 EXPLAIN Figure 86-2** typical catalytic converter with a monolithic substrate. **4. SLIDE 4 EXPLAIN Figure 86-3** three-way catalytic converter first separates the NO_x into nitrogen and oxygen and then converts the HC and CO into harmless water (H_2O) and carbon dioxide (CO_2). The nitrogen (N) passes through the converter and exits the tailpipe and enters the atmosphere which is about 78% nitrogen
	**DEMONSTRATION: With a vehicle on lift, show installed catalytic converters & their locations. Point out the reduction catalyst & oxidizing catalyst. FIGURES 86-1 to 4**
	**Because prices of precious metals used in catalytic converters have risen steeply in the past few years, these components have become popular among thieves. Owners of trucks & 4WD vehicles have returned to their parked vehicles to find that thieves have stolen their catalytic converters with battery-powered reciprocating saw. Replacements can run as high as $2,500.**
	**6. SLIDE 6 EXPLAIN Figure 86-5** OBD-II catalytic converter monitor compares signals of upstream and downstream oxygen sensors to determine efficiency.

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	7. **SLIDE 7 EXPLAIN Figure 86-6** waveform of a downstream HO2S sensor from a properly functioning converter shows little, if any, activity 8. **SLIDE 8 EXPLAIN Figure 86-7** highest catalytic converter efficiency occurs when air-fuel mixture 14.7:1
	**DISCUSSION: Have the students discuss how often a PCM tests a catalytic converter. How is catalytic converter monitor classified? When will the monitor check the efficiency of converter? What will happen if the test fails?**
	**DEMONSTRATION: Have the students talk about diagnosing catalytic converters. How are catalytic converters tested?**
	**DEMONSTRATION: Connect a digital storage oscilloscope (DSO) to an Upstream Oxygen Sensor & operate engine at normal operating temperature. Show waveform of an upstream oxygen sensor in operation. FIGURE 86-5**
	9. **SLIDE 9 EXPLAIN Figure 86-8** catalytic converter that rattles when tapped was removed, and substrate, or what was left of it, fell out. This converter has to be replaced and the root cause of why it failed found and corrected.
	**DEMONSTRATION: After showing students a waveform of upstream oxygen sensor, connect DSO to Downstream Oxygen Sensor FIGURE 86-6 to show students difference between sensors. OBD-II uses downstream sensor to check the efficiency of the catalytic converter.**
	FIGURE 86-7
	**DEMONSTRATION: Simulate a plugged or melted converter by installing an expandable plug into a vehicle exhaust pipe. Operate vehicle on dynamometer or on a test drive with vacuum gauge taped to windshield. Show students how vacuum drops as exhaust back pressure increases, causing a substantial drop in engine performance. Remove plug and operate vehicle normally to show proper vacuum readings. FIGURE 86-8**

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	10. **SLIDE 10 EXPLAIN Figure 86-9** A back pressure tool can be made by using an oxygen sensor housing and epoxy or braze to hold the tube to the housing
	**DEMONSTRATION: Install exhaust back pressure gauge in place of an oxygen sensor FIGURE 86-9. Leave oxygen sensor connected while it is removed and operate engine, showing students normal back pressure. Install expandable plug in tailpipe to simulate a plugged converter and have students watch back pressure increase.**
	**ON-VEHICLE NATEF TASK: Perform exhaust system back-pressure test; determine necessary action. Page 268**
	11. **SLIDE 11 EXPLAIN Figure 86-10** This partially melted catalytic converter tested okay at idle but had excessive back pressure at higher engine speeds. 12. **SLIDE 12 EXPLAIN Figure 86-11** The temperature of the outlet should be at least 10% hotter than the temperature of the inlet. If a converter is not working, the inlet temperature will be hotter than the outlet temperature. 13. **SLIDE 13 EXPLAIN FIGURE 86-12** Whenever replacing a catalytic converter with a universal unit, first measure distance between the rear brick & center of the rear oxygen sensor.
	**DISCUSSION: Have the students talk about catalytic converter efficiency tests. How are results of an oxygen level test interpreted?**
	**HANDS-ON TASK: Have students operate an engine at 2,500 RPM until normal operating temperature is achieved, then Measure Inlet & Outlet temperatures of catalytic converter with an infrared thermometer. FIGURE 85-11**
	**ON-VEHICLE NATEF TASK: Inspect and test catalytic converter efficiency. Page 269**

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	**DISCUSSION:** Discuss with the students that an overly rich mixture or any malfunction such as misfire can allow unburned hydrocarbons to enter the catalytic converter. How does this affect the catalytic converter? (Point out that this can cause the converter to melt internally and can even set the vehicle on fire)
	**DEMONSTRATION:** With vehicle on a lift, create a misfire; for example, close electrodes on a spark plug. Operate at 2,500 RPM until the converter begins to overheat and students observe the smell of rotten eggs. Continue operating vehicle for a few more minutes, check converter temperature with infrared thermometer to show students extreme overheat condition. FIGURE 85-11
	Because heat is so critical for converter operation, and underhood space is limited, many OEMS LOCATE catalyst in exhaust manifold.
	14. SLIDES 14-25 OPTIONAL EXPLAIN CATALYTIC CONVERTER OPERATION
	Just because an aftermarket catalytic converter fits a particular vehicle, does not mean it will control emissions on particular vehicle. Many aftermarket catalytic converters are sold at reduced prices because they do not contain amount of precious metals that OEM DID, potentially causing state emissions test failure or MIL to continually illuminate indicating an emissions problem. FIGURE 86-12
	HANDS-ON TASK: Have the students look up catalyst efficiency DTCs for their own vehicles. Students should be able to find conditions that must be met for DTC to set and find OEM troubleshooting procedure to diagnose DTC.

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	**DEMONSTRATION:** Demonstrate catalytic converter operation by testing exhaust emissions with **5-GAS analyzer** before and after converter runs. Remove the upstream oxygen sensor after the engine has warmed up, then operate engine with sensor connected and insert analyzer probe into sensor boss while sampling.
	**DEMONSTRATION:** Perform a **converter snap-throttle test** while sampling exhaust emissions. Have students pay attention to O2 readings to determine converter efficiency.
	**ON-VEHICLE NATEF TASK:** Catalytic Converter Rattle Test. **Page 270**
	**ON-VEHICLE NATEF TASK Catalytic** Converter Performance Test. **Page 271**
	**Crossword Puzzle (Microsoft Word) (PDF)** **Word Search Puzzle (Microsoft Word) (PDF)**