Automotive Technology 6th Edition
Chapter 87 Positive Crankcase Ventilation & Secondary Air-Injection Systems
Opening Your Class

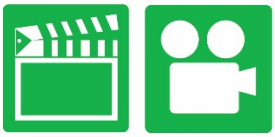
KEY ELEMENT	EXAMPLES
Introduce Content	This Automotive Technology 6th text provides complete coverage of automotive components, operation, design, and troubleshooting. It correlates material to task lists specified by ASE and ASEEducation (NATEF) and emphasizes a problem-solving approach. Chapter features include Tech Tips, Frequently Asked Questions, Case Studies, Videos, Animations, and ASEEducation (NATEF) Task Sheets.
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. Describe the purpose and function of the positive crankcase ventilation (PCV) system. 2 Explain the purpose and function of the secondary air-injection (SAI) system and how to diagnose faults in the system
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: Lesson plan is based on 6th Edition Chapter Images found on Jim's web site @ www.jameshalderman.com

DOWNLOAD Chapter 87 Chapter Images: From

http://www.jameshalderman.com/automotive_principles.html

NOTE: You can use Chapter Images or possibly Power Point files:

ICONS	Ch87 PCV & SAI Systems
	**1. SLIDE 1 CH85 POSITIVE CRANKCASE VENTILATION & SECONDARY AIR-INJECTION SYSTEMS**
	**Check for ADDITIONAL VIDEOS & ANIMATIONS @ http://www.jameshalderman.com/** **WEB SITE IS CONSTANTLY UPDATED** **http://www.jameshalderman.com/automotive_principles.html** **DOWNLOAD** **Crossword Puzzle (Microsoft Word) (PDF)** **Word Search Puzzle (Microsoft Word) (PDF**
	**Videos**
	
	**DEMONSTRATION: Pass around various PCV valves for the students to see. Students should understand where the PCV valve can be located on an engine**
	**Positive Crankcase Ventilation (PCV) (View) (Download)** **Secondary Air Injection (View) (Download)**
	**2. SLIDE 2 EXPLAIN Figure 87-1** A PCV valve in a cutaway valve cover, showing the baffles that prevent liquid oil from being drawn into the intake manifold. **3. SLIDE 3 EXPLAIN Figure 87-2** Spring force, crankcase pressure, and intake manifold vacuum work together to regulate the flow rate through the PCV valve. **4. SLIDE 4 EXPLAIN Figure 87-3** Air flows through the PCV valve during idle, cruising, and light-load conditions. **5. SLIDE 5 EXPLAIN Figure 87-4** Air flows through the PCV valve during acceleration and when the engine is under a heavy load. **6. SLIDE 6 EXPLAIN Figure 87-5** PCV valve operation in the event of a backfire
	**DEMONSTRATION: Show how to check valve operation by shaking the valve. FIG 87-1 to 5**

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	**HANDS-ON TASK:** Have the students locate PCV system components on their own vehicles. Ask them to explain how air flows through the system.
	**DISCUSSION:** Have the students talk about what can happen to a PCV system from a vehicle owner who neglects or extends normal oil and filter replacements. What problems can restricted Airflow cause?
	**DEMONSTRATION:** Show students examples of plugged, dirty, or stuck PCV valves
	**DISCUSS CASE STUDY: Whistling Engine** An older vehicle was being diagnosed for a whistling sound whenever engine was running, especially at idle. It was finally discovered that breather in valve cover was plugged and caused high vacuum in crankcase. Engine was sucking air from what was likely rear main seal lip, making "whistle" noise. After replacing the breather and PCV, the noise stopped. **Summary:** • Complaint—customer stated that engine made a whistling sound when it was running. • Cause—clogged PCV breather was found to be cause of air being drawn into engine through rear main seal. • Correction—PCV breather and check valve were replaced, which corrected whistling noise concern.
	**EXPLAIN TECH TIP:** ***Check for Oil Leaks with the Engine Off*** The owner of an older vehicle equipped with a V-6 engine complained to his technician that he smelled burning oil, but only after shutting off the engine. The technician found that rocker cover gaskets were leaking. But why did owner only notice smell of hot oil when the engine was shut

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	off? Because of PCV system, engine vacuum tends to draw oil away from gasket surfaces. When engine stops, however, engine vacuum disappears, and the oil remaining in the upper regions of the engine tend to flow down and out through any opening. Therefore, a good technician should check an engine for oil leaks, not only with the engine running, but also shortly after shutdown.
	7. **SLIDE 7 EXPLAIN Figure 85-6** Using a gauge that measures vacuum in units of inches of water to test the vacuum at the dipstick tube, being sure that the PCV system is capable of drawing a vacuum on the crankcase (28 in. H_2O = 1 PSI, or about 2 in. Hg of vacuum)
	**Don't overlook malfunctioning PCV system when diagnosing excessive oil leaks. Plugged PCV system can create excess pressure in crankcase due to accumulation of combustion vapors. This excess pressure can force oil out of crankcase through engine seals & gaskets. FIGURE 87-6**
	**HANDS-ON TASK: Show the students an orifice-controlled crankcase ventilation system. Have them LOCATE & LABEL main components & explain airflow through the system.**
	**DEMONSTRATION: Show how to check for a slight vacuum on a running engine by using a 3 x 5 index card. Pinch vacuum line between intake manifold and PCV valve to illustrate plugged or obstructed system with no vacuum.**
	8. **SLIDE 8 EXPLAIN Figure 87-7** Most PCV valves used on newer vehicles are secured with fasteners, making it more difficult to disconnect and thereby less likely to increase emissions
	**DISCUSS FREQUENTLY ASKED QUESTION:** ***What Are the Wires for at the PCV Valve?*** **Ford uses an electric heater to prevent ice from forming inside PCV valve and causing blockage. Water is a by-product of combustion, and resulting moisture can freeze when the outside air temperature is low. General Motors and others clip a heater hose**

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	to PCV hose to provide the heat needed to prevent an ice blockage.
	**HANDS-ON TASK: Have students perform the SNAP-BACK TEST on a PCV valve on a running engine by placing their finger over valve inlet. Students should listen & feel for click when they remove their finger indicating the valve is functioning properly.**
	**DISCUSSION: Have the students talk about why OBD-II system checks or monitors PCV system. How do crankcase emissions affect atmosphere? What does PCV system do to prevent pollution?**
	**HANDS-ON TASK: Have the students research a PCV system failure DTC. Students should be able to determine conditions that caused DTC & OEM troubleshooting procedure for DTC.**
 	**ON-VEHICLE ASEEDUCATION TASK: Diagnose oil leaks, emissions, and driveability concerns caused by the positive crankcase ventilation (PCV) system; determine necessary action.**
 	**ON-VEHICLE ASEEDUCATION TASK: Inspect, test and service positive crankcase ventilation (PCV) filter/breather cap, valve, tubes, orifices, and hoses; perform necessary action.**
	**9. SLIDE 9 EXPLAIN Figure 87-8** typical belt-driven AIR pump. Air enters through revolving fins behind the drive pulley. The fins act as an air filter because dirt is heavier than air, and therefore the dirt is deflected off of the fins at the same time air is being drawn into the pump
	**DEMONSTRATION: Show the students various types of air injection pumps. Most belt-driven pumps can be easily disassembled to show their internal components. FIGURE 87-8**
	**HANDS-ON TASK: use electronic service information COMPONENT LOCATOR to locate secondary air-injection components on their own cars. They should be able to identify components and explain their operation and purposes.**

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	**10. SLIDE 10 EXPLAIN Figure 87-9** external air manifold and exhaust check valve on a restored muscle car engine. **11. SLIDE 11 EXPLAIN Figure 87-10 (a)** When engine is cold and before the oxygen sensor is hot enough to achieve closed loop, the airflow from the air pump is directed to the exhaust manifold(s) through the one-way check valves, which keep the exhaust gases from entering the switching solenoids and the pump itself
	**DEMONSTRATION: Show various air distribution manifolds & exhaust check valves. Demonstrate check valve operation by attempting to blow air through each side. If valve is good, air should pass through only one side. FIGURES 87-9 & 10**
	**12. SLIDE 12 EXPLAIN FIGURE 87–10** (a) When engine is cold and before oxygen sensor is hot enough to achieve closed loop, the airflow from air pump is directed to the exhaust manifold(s) through one-way check valves, which keep the exhaust gases from entering switching solenoids and the pump itself. (b) When engine achieves closed loop, the air is directed to the catalytic converter. **13. SLIDE 23 EXPLAIN Figure 87-11** A typical electric motor–driven SAI pump. This unit is on a Chevrolet Corvette and only works when the engine is cold
	**DISCUSSION: Have the students talk about the various conditions that require air injection & areas that will receive air injection. Under what conditions does the SAI system operate, and where does it inject air?**
	**DEMONSTRATION: Create a SAI system failure on OBD-II vehicle. This can be done easily by disconnecting an electric pump or air hose. Operate the vehicle under conditions necessary to set DTC. FIGURE 87-11**
	**HANDS-ON TASK: Have students retrieve the DTC and list conditions necessary for the code to set DEMONSTRATED ABOVE FIGURE 87-11**
	**DISCUSS CHART 87-1**

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	**DISCUSSION:** Have students discuss enabling criteria required for **OBD-II system** to test air injection systems and various SAI systems & resulting variations in criteria. What enabling criteria are necessary for the OBD-II system to test the SAI system?
 	**ON-VEHICLE ASEEDUCATION TASK E1:** Diagnose oil leaks, emissions, and driveablility concerns caused by the positive crankcase ventilation (PCV) system; determine needed action..
 	**ON-VEHICLE ASEEDUCATION TASK E2:** Inspect, test, service, and/or replace positive crankcase ventilation (PCV) filter/breather, valve, tubes, orifices, and hoses; perform needed action
 	**ON-VEHICLE ASEEDUCATION TASK E4** Diagnose emissions and driveablility concerns caused by the secondary air injection system; inspect, test, repair, and/or replace electrical/electronically-operated components and circuits of secondary air injection systems; determine needed action.