Automotive Fuel and Emissions Control Systems 4/E

Chapter 8 Intake and Exhaust Systems

Opening Your Class

KEY ELEMENT	EXAMPLES
Introduce Content	This course or class covers operation and service of **Automotive Fuel and Emissions Control Systems.** 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 air intake filtration. 2. Explain throttle-body injection and port fuel-injection intake manifolds. 3. Discuss exhaust gas recirculation passages and exhaust manifolds. 4. Understand the purpose and function of mufflers.
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 Fuel & Emission Control 4th Edition Chapter Images found on Jim's web site @ www.jameshalderman.com

LINK CHP 8: Chapter Images

ICONS	Ch08 Intake and Exhaust Systems
	**1. SLIDE 1 CH08 Intake and Exhaust Systems**
	**Check for ADDITIONAL VIDEOS & ANIMATIONS @ http://www.jameshalderman.com/** **WEB SITE REGULARLY UPDATED**
	**Videos**
	**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)**
	**DISCUSSION: HAVE YOUR STUDENTS DISCUSS THE PROS AND CONS OF NOT USING AN AIR FILTER ON A RACING ENGINE.**
	2. **SLIDE 2 EXPLAIN** Air Intake Filtration & **EXPLAIN FIGURE 8-1** Downward movement of the piston lowers the air pressure inside the combustion chamber. The pressure differential between the atmosphere and the inside of the engine forces air into the engine. 3. **SLIDE 3 EXPLAIN FIGURE 8-2** Dust and dirt in the air are trapped in the air filter so they do not enter the engine. 4. **SLIDE 4 EXPLAIN FIGURE 8-3** Most air filter housings are located on the side of the engine compartment and use flexible rubber hose to direct the airflow into the throttle body of the engine.
	**DEMONSTRATION: SHOW STUDENTS A VARIETY OF AIR FILTERS AND POINT OUT THE DIFFERENCES BETWEEN THOSE USED ON A CARBURETED OR THROTTLE USED FOR PORT FUEL INJECTION.**

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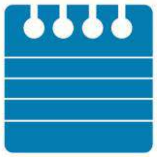        	**REUSABLE FILTERS THAT ARE COATED WITH AN OIL FILM CAN DAMAGE SOME ENGINE SENSORS AND LEAD TO DIAGNOSTIC TROUBLE CODES (DTC).** 5. **SLIDE 5 EXPLAIN FIGURE 8-4** typical air filter restriction indicator used on a GM truck DIESEL engine. The indicator turns red when it detects enough restriction to require a filter replacement. **HANDS-ON TASK: HAVE YOUR STUDENTS APPLY VACUUM TO THE BACK OF A RESTRICTION INDICATOR TO OBSERVE ITS OPERATION.** **EXPLAIN TECH TIP** 6. **SLIDE 6 EXPLAIN FIGURE 8-5 (a)** Note the discovery as the air filter housing was opened during service on a Pontiac. The nuts were obviously deposited by squirrels (or some other animal). 7. **SLIDE 7 EXPLAIN FIGURE 8-5 (b)** Not only was the housing filled with nuts, but also this air filter was extremely dirty, indicating that this vehicle had not been serviced for a long time. **DISCUSS FREQUENTLY ASKED QUESTION** 8. **SLIDE 8 EXPLAIN FREQUENTLY ASKED QUESTION EXPLAIN FIGURE 8-6** A resonance tube, called a Helmholtz resonator, is used on the intake duct between the air filter and the throttle body to reduce air intake noise during engine acceleration. **INSTALLING AN AFTERMARKET AIR INTAKE WITHOUT A RESONANCE TUBE CAN LEAD TO AN INCREASE IN INDUCTION NOISE** 9. **SLIDE 9 EXPLAIN** Throttle-Body Injection Intake Manifolds & **EXPLAIN FIGURE 8-7** throttle-body injection (TBI) unit used on a GM V-6 engine. 10. **SLIDE 10 EXPLAIN FIGURE 8-8** Heavy fuel droplets separate as they flow around an abrupt bend in an intake manifold

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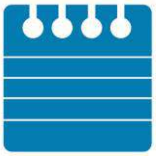
	**DISCUSSION: THROTTLE-BODY INJECTION RELIES ON MANIFOLD WITH UNEQUAL-LENGTH RUNNERS TO DISTRIBUTE FUEL FROM A CENTRAL LOCATION. DISCUSS HOW THIS MIGHT AFFECT COLD-ENGINE DRIVABILITY**
	**EXPLAIN TECH TIP**
	11. **SLIDE 11 EXPLAIN** Port Fuel-Injection Intake Manifolds & **EXPLAIN FIGURE 8-9** graph shows effect of sonic tuning of intake manifold runners. The longer runners increase the torque peak and move it to a lower RPM. The 600 mm intake runner is about 24 in. long.
	12. **SLIDE 12 EXPLAIN FIGURE 8-10** Airflow through the large diameter upper intake manifold is distributed to smaller diameter individual runners in the lower manifold in this two-piece manifold design.
	13. **SLIDE 13 EXPLAIN FIGURE 8-11** air flowing into the engine can be directed through long or short runners for best performance and fuel economy.
	14. **SLIDE 14 EXPLAIN PLASTIC MANIFOLDS & FIGURE 8-12** Many plastic intake manifolds are constructed using many parts glued together to form complex passages for airflow into the engine.
	**DEMONSTRATION: SHOW STUDENTS EXAMPLES OF CAST IRON, ALUMINUM, AND PLASTIC INTAKE MANIFOLDS. BE SURE TO POINT OUT DIFFERENCES BETWEEN TBI & PORT FUEL-INJECTION MANIFOLDS.**
	**DISCUSSION: ASK STUDENTS TO DISCUSS HOW SMOOTH FINISH OF A PLASTIC MANIFOLD CAN HELP ENGINE PERFORMANCE.**
	**PLASTIC MANIFOLDS ARE FRAGILE & CARE MUST BE TAKEN TO FOLLOW CORRECT TIGHTENING SEQUENCE AND TORQUE SPECIFICATIONS. EGR COOLERS ARE FREQUENTLY USED ON DIESEL MOTORS.**
	**ON-VEHICLE TASK: REPLACE INTAKE MANIFOLD GASKET**

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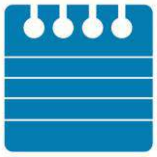
	**DEMONSTRATION: DEMONSTRATE USE OF PROPANE TO DIAGNOSE AN INTAKE LEAK**
	**"COLD-AIR" INTAKES SOLD THROUGH PERFORMANCE COMPANIES CAN ACTUALLY DRAW IN ENGINE COMPARTMENT HEAT IF AIR BOX IS REPLACED WITH AN OPEN FILTER ELEMENT.**
	15. **SLIDE 15 EXPLAIN EXHAUST GAS RECIRCULATION PASSAGES & FIGURE 8–13** typical long exhaust gas line used to cool exhaust gases before being recirculated back into intake manifold. 16. **SLIDE 16 EXPLAIN UPPER AND LOWER INTAKE MANIFOLDS & FIGURE 8-14** exhaust gases are pushed out of cylinder by piston on exhaust stroke.
	17. **SLIDE 17 EXPLAIN FIGURE 8–15** This exhaust manifold (red area) is equipped with a heat shield to help retain heat and reduce exhaust emissions 18. **SLIDE 18 EXPLAIN FIGURE 8-16** Many exhaust manifolds are constructed of steel tubing and are free flowing to improve engine performance.
	**DISCUSSION: ASK STUDENTS TO DISCUSS ADVANTAGES OF USING STAINLESS STEEL FOR EXHAUST SYSTEMS**
	**DISCUSS FREQUENTLY ASKED QUESTION**
	19. **SLIDE 19 EXPLAIN FREQUENTLY ASKED QUESTION FIGURE 8–17** A crack in an exhaust manifold is often not visible because a heat shield usually covers the area. A crack in the exhaust manifold upstream of the oxygen sensor can fool the sensor and affect engine operation 20. **SLIDE 20 EXPLAIN FIGURE 8-18** Typical exhaust manifold gaskets. Note how they are laminated to allow the exhaust manifold to expand and contract due to heating and cooling.

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	**EXPLAIN TECH TIP**
	**21. SLIDE 21 EXPLAIN FIGURE 8-19** exhaust manifold spreader tool is absolutely necessary when reinstalling exhaust manifolds. When they are removed from the engine, the manifolds tend to warp slightly even though the engine is allowed to cool before being removed. The spreader tool allows the technician to line up the bolt holes without harming the manifold
	**HANDS-ON TASK: HAVE STUDENTS REMOVE AND INSTALL AN EXHAUST MANIFOLD.**
	**DEMONSTRATION: SHOW STUDENTS CORRECT USE OF AN EXHAUST MANIFOLD SPREADER**
	**HANDS-ON TASK: HAVE STUDENTS PRACTICE USING A MANIFOLD SPREADER, NOTING CHANGE IN PORT POSITION WITH A VERNIER CALIPER.**
	**ON-VEHICLE TASK: EXHAUST SYSTEM INSPECTION**
	**22. SLIDE 22 EXPLAIN** Mufflers & **EXPLAIN FIGURE 8-20** Exhaust gases expand and cool as they travel through passages in the muffler.
	**EXPLAIN TECH TIP**
	**23. SLIDE 23 EXPLAIN FIGURE 20-21** hole in the muffler allows condensed water to escape.
	**EXPLAIN TECH TIP**
	**24. SLIDE 24 EXPLAIN FIGURE 8-22** high-performance aftermarket air filter often can increase airflow into the engine for more power**.**

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	**HOMEWORK: SEARCH INTERNET:** **HAVE STUDENTS RESEARCH THE USE OF TUNED INTAKES FOR RACING USE. STUDENTS SHOULD PICK A SPECIFIC APPLICATION AND PRESENT THEIR FINDINGS TO THE CLASS.**