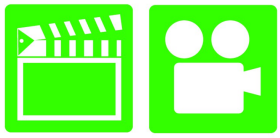
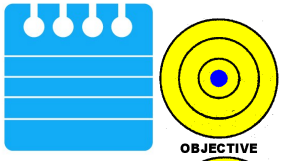
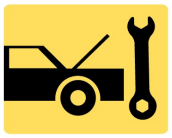
A8 Engine Performance 4th Edition

Chapter 10 Intake and Exhaust Systems

Opening Your Class

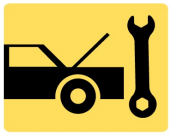
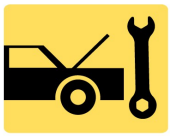
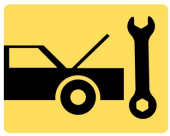
KEY ELEMENT	EXAMPLES
Introduce Content	This course or class covers operation and service of **Automotive Engine Performance.** It correlates material to task lists specified by ASE and NATEF.
Motivate Learners	Explain how the knowledge of how something works translates into the ability to use that knowledge 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 Engine Performance (A8) certified test content area "C" (Air Induction and Exhaust System Diagnosis and repair). 2. Discuss the purpose and function of intake manifolds. 3. Explain the difference between throttle fuel-injection manifolds and port-fuel-injection manifolds. 4. Describe the operation of the exhaust gas recirculation system in the intake manifold. 5. List the materials used in exhaust manifolds and exhaust systems.
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	Ch10 Intake and Exhaust Systems
	**1. SLIDE 1 CH10 Intake and Exhaust Systems**
	**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 CH10 AEP_LO1**
	**3. SLIDE 3 EXPLAIN Figure 10-1** 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. **4. SLIDES 4-5 EXPLAIN** Air Intake Filtration **6. SLIDE 6 EXPLAIN Figure 10-2** Dust and dirt in the air are trapped in the air filter so they do not enter the engine. **7. SLIDES 7 EXPLAIN** Air Intake Filtration **8. SLIDE 8 EXPLAIN Figure 10-3** 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.
	**DISCUSSION: HAVE YOUR STUDENTS DISCUSS THE PROS AND CONS OF NOT USING AN AIR FILTER ON A RACING ENGINE.**
	**DEMONSTRATION: SHOW AIR FILTERS AND POINT OUT THE DIFFERENCES BETWEEN THOSE USED ON A CARBURETED OR THROTTLE USED FOR PORT FUEL INJECTION.**
	**REUSABLE FILTERS THAT ARE COATED WITH AN OIL FILM CAN DAMAGE SOME ENGINE SENSORS AND LEAD TO DIAGNOSTIC TROUBLE CODES (DTC).**

ICONS	Ch10 Intake and Exhaust Systems
	9. **SLIDE 9 EXPLAIN FIGURE 10–4** (a) Note the discovery as the air filter housing was opened during service on a Pontiac Bonneville. The nuts were obviously deposited by squirrels (or some other animal). (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
	10. **SLIDE 10 EXPLAIN Figure 10-5** 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.
	**HANDS-ON TASK: HAVE YOUR STUDENTS APPLY VACUUM TO THE BACK OF A RESTRICTION INDICATOR TO OBSERVE ITS OPERATION.**
	**INSTALLING AN AFTERMARKET AIR INTAKE WITHOUT A RESONANCE TUBE CAN LEAD TO AN INCREASE IN INDUCTION NOISE**
 	**Power Point OBJECTIVE AEP_LO1 & AEP_LO2 USE SAME SLIDES**
 	2. SLIDE 2 EXPLAIN **OBJECTIVE CH10 AEP_LO3**
	3. **SLIDES 3-4 EXPLAIN** Throttle-Body Injection Intake Manifolds 5. **SLIDE 5 EXPLAIN FIGURE 10–6** A throttle-body injection (TBI) unit used on a GM V-6 engine. 6. **SLIDE 6 EXPLAIN Figure 10-7** Heavy fuel droplets separate as they flow around an abrupt bend in an intake manifold
	**DISCUSSION: THROTTLE-BODY INJECTION RELIES ON A MANIFOLD WITH UNEQUAL-LENGTH RUNNERS TO DISTRIBUTE FUEL FROM A CENTRAL LOCATION. HAVE STUDENTS DISCUSS HOW THIS MIGHT AFFECT COLD-ENGINE DRIVABILITY AND FUEL BALANCE BETWEEN CYLINDERS**

ICONS	Ch10 Intake and Exhaust Systems
	7. **SLIDES 7-8 EXPLAIN** Port Fuel-Injection Intake Manifolds 9. **SLIDE 9 EXPLAIN Figure 10-8** graph shows the effect of sonic tuning of the 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.
	10. **SLIDE 10 EXPLAIN Figure 10-9** 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. 11. **SLIDE 11 EXPLAIN Figure 10-10** air flowing into the engine can be directed through long or short runners for best performance and fuel economy. 12. **SLIDES 12-13 EXPLAIN** Plastic Intake Manifolds 14. **SLIDE 14 EXPLAIN Figure 10-11** Many plastic intake manifolds are constructed using many parts glued together to form complex passages for airflow into engine
	**DEMONSTRATION: SHOW 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 AND CARE MUST BE TAKEN TO FOLLOW CORRECT TIGHTENING SEQUENCE AND TORQUE SPECIFICATIONS. EGR COOLERS ARE FREQUENTLY USED ON DIESEL MOTORS.**
	**SHOW TBI VS. MPI VIDEO: 2 MIN** **WWW.MYAUTOMOTIVELAB.COM** **VIDEO SHOWS THE INSTALLATION OF AN EDELBROCK MPI SYSTEM ON A TBI SYSTEM** HTTP://MEDIA.PEARSONCMG.COM/PH/CHET/CHET_MYLABS/AKAMAI/TEMPLATE/VIDEO640X480.PHP?TITLE=TBI%20VERUS%20MPI&CLIP=PANDC/CHET/2012/AUTOMOTIVE/INSTALLING_EFI_SYSTEM/T12CD1.MOV&CAPTION=CHET/CHET_MYLABS/AKAMAI/2012/AUTOMOTIVE/INSTALLING_EFI_SYSTEM/XML/T12CD1.XML
	**DEMONSTRATION: DEMONSTRATE USE OF PROPANE TO DIAGNOSE AN INTAKE LEAK**

ICONS	Ch10 Intake and Exhaust Systems
      	**MANY "COLD-AIR" INTAKES SOLD THROUGH PERFORMANCE COMPANIES CAN ACTUALLY DRAW IN ENGINE COMPARTMENT HEAT IF THE AIR BOX IS REPLACED WITH AN OPEN FILTER ELEMENT.** 2. SLIDE 2 EXPLAIN **OBJECTIVE CH10 AEP_LO4** 3. **SLIDES 3-4 EXPLAIN** Exhaust Gas Recirculation Passages 5. **SLIDE 5 EXPLAIN FIGURE 10–12** exhaust gas recirculation system is more efficient at controlling NOx emissions if the exhaust gases are cooled. A long metal tube between the exhaust manifold and the intake manifold allows the exhaust gases to cool before entering engine. 6. **SLIDES 6-7 EXPLAIN** Upper and Lower Intake Manifolds 8. **SLIDE 8 EXPLAIN FIGURE 10–13** exhaust gases are pushed out of cylinder by piston on the exhaust stroke. 9. **SLIDE 9 EXPLAIN FIGURE 10–14** This exhaust manifold has a heat shield to help retain the heat and help reduce exhaust emissions. **DISCUSSION: ASK STUDENTS TO DISCUSS ADVANTAGES OF USING STAINLESS STEEL FOR EXHAUST SYSTEMS** 10. **SLIDE 10 EXPLAIN FIGURE 10–15** Many exhaust manifolds are constructed of pressed steel and are free flowing to improve engine performance. 11. **SLIDES 11-12 EXPLAIN** Exhaust Manifold Gaskets 13. **SLIDE 13 EXPLAIN FIGURE 10–16** A crack in an exhaust manifold is often not this visible. A crack in the exhaust manifold upstream of the oxygen sensor can fool the sensor and affect engine operation. 14. **SLIDE 14 EXPLAIN FIGURE 10–17** Typical exhaust manifold gaskets. Note how they are laminated to allow the exhaust manifold to expand and contract due to heating and cooling. 15. **SLIDE 15 EXPLAIN Figure 10-17** 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

ICONS	Ch10 Intake and Exhaust Systems
     	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** 2. **SLIDE 2 EXPLAIN OBJECTIVE CH10 AEP_LO5: REPEATS SLIDES 2-39 FROM AEP_01, 03, & 04:** 40. **SLIDES 40-41 EXPLAIN** Mufflers 42. **SLIDE 42 EXPLAIN FIGURE 10–19** Exhaust gases expand and cool as they travel through the passages in the muffler. 43. **SLIDE 43 EXPLAIN Figure 10-20** hole in the muffler allows condensed water to escape. 44. **SLIDE 44 EXPLAIN Figure 10-21** high-performance aftermarket air filter often can increase airflow into the engine for more power.