

Automotive Technology 5th Edition

Chapter 24 Intake & Exhaust Systems

Opening Your Class

| KEY ELEMENT | EXAMPLES |
|--|--|
| Introduce Content | This Automotive Technology 5th text provides complete coverage of automotive 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 the chapter learning objectives to the students as listed: <ol style="list-style-type: none"> 1. Explain air intake filtration. 2. Discuss the throttle-body injection intake manifolds and port fuel-injection intake manifolds. 3. Discuss exhaust gas recirculation passages and exhaust manifolds. 4. Describe the purpose and function of mufflers. |
| Establish the Mood or Climate | Provide a <i>WELCOME</i> , 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 24: [ATE5 Chapter Images](#)

ICONS



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1. SLIDE 1 CH24 INTAKE & EXHAUST SYSTEMS

Check for **ADDITIONAL VIDEOS & ANIMATIONS**
@ <http://www.jameshalderman.com/>
WEB SITE IS CONSTANTLY UPDATED

INTAKE & SYSTEM

Videos

2. **SLIDE 2 EXPLAIN Figure 24-1** 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 24-2** Dust and dirt in the air are trapped in the air filter so they do not enter the engine.
4. **SLIDE 4 EXPLAIN Figure 24-3** 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 students a variety of 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).

5. **SLIDE 5 EXPLAIN Figure 24-4** 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.

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HANDS-ON TASK: Have your students apply vacuum to the back of a restriction indicator to observe its operation.

6. **SLIDE 6 EXPLAIN Figure 24-5 (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 24-5 (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.
8. **SLIDE 8 EXPLAIN Figure 24-6** 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.

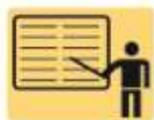
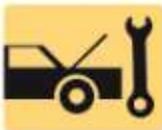
Installing an aftermarket air intake without a resonance tube can lead to an increase in induction noise

9. **SLIDE 9 EXPLAIN Figure 24-7** throttle-body injection (TBI) unit used on a GM V-6 engine.
10. **SLIDE 10 EXPLAIN Figure 24-8** 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

11. **SLIDE 11 EXPLAIN Figure 24-9** 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.
12. **SLIDE 12 EXPLAIN Figure 24-10** 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 24-11** air flowing into the engine can be directed through long or short runners for best performance and fuel economy.
14. **SLIDE 14 EXPLAIN Figure 24-12** Many plastic intake

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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 and 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 [PAGE 62](#)

DEMONSTRATION: Demonstrate use of propane to diagnose an intake leak

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.

- 15. SLIDE 15 EXPLAIN FIGURE 24-13** A typical long exhaust gas line used to cool the exhaust gases before being recirculated back into the intake manifold
- 16. SLIDE 16 EXPLAIN Figure 24-14** exhaust gases are pushed out of cylinder by piston on exhaust stroke.
- 17. SLIDE 17 EXPLAIN Figure 24-15** This exhaust manifold (red area) is equipped with a heat shield to help retain heat and reduce exhaust emissions.
- 18. SLIDE 18 EXPLAIN Figure 24-16** 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

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19. **SLIDE 19 EXPLAIN** Figure 24-17 crack in an exhaust manifold is often not visible because a heat shield usually covers the area.
20. **SLIDE 20 EXPLAIN** Figure 24-18 Typical exhaust manifold gaskets. Note how they are laminated to allow the exhaust manifold to expand and contract due to heating and cooling.
21. **SLIDE 21 EXPLAIN** Figure 24-19 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
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22. **SLIDE 22 EXPLAIN** Figure 24-20 Exhaust gases expand and cool as they travel through passages in the muffler.
23. **SLIDE 23 EXPLAIN** Figure 24-21 hole in the muffler allows condensed water to escape.
24. **SLIDE 24 EXPLAIN** Figure 24-22 high-performance aftermarket air filter often can increase airflow into the engine for more power.

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.

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HOMEWORK

[Crossword Puzzle \(Microsoft Word\) \(PDF\)](#)

[WORD SEARCH PUZZLE \(MICROSOFT WORD\) \(PDF\)](#)

Crossword