Automotive Technology 5th Edition
Chapter 25 TURBOCHARGING & SUPERCHARGING
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 the chapter learning objectives to the students as listed: 1. Discuss airflow requirements and volumetric efficiency of engines. 2. Explain forced induction principles. 3. Discuss superchargers. 4. Discuss turbochargers. 5. Explain boost control and turbocharger failures. 6. Describe the purpose of a nitrous oxide 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: This lesson plan is based on the 6th Edition Chapter Images found on Jim's web site @ www.jameshalderman.com

DOWNLOAD Chapter 25 Chapter Images: From

http://www.jameshalderman.com/automotive_principles.html NOTE: You can use Chapter Images or possibly Power Point files:

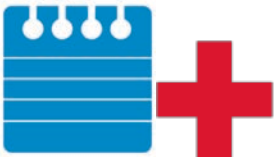
ICONS	CH25 Turbo/Superchargers
	**1. SLIDE 1 CH25 TURBOCHARGER & SUPERCHARGER SYSTEMS**
	**Check for ADDITIONAL VIDEOS & ANIMATIONS @ http://www.jameshalderman.com/** **WEB SITE IS CONSTANTLY UPDATED**
	**http://www.jameshalderman.com/automotive_principles.html** **DOWNLOAD** **Crossword Puzzle (Microsoft Word) (PDF)** **Word Search Puzzle (Microsoft Word) (PDF**
	**TURBOCHRAGERS/SUPERCHARGERS** **Videos**
	2. **SLIDE 2 EXPLAIN Figure 25-1** supercharger on a Ford V-8. 3. **SLIDE 3 EXPLAIN FIGURE 25–2** A turbocharged Ford three-cylinder 1.0 liter Eco Boost engine. 4. **SLIDE 4 EXPLAIN Figure 25-3** more air and fuel that can be packed in a cylinder, the greater the density of the air-fuel charge. 5. **SLIDE 5 EXPLAIN Figure 25-4** Atmospheric pressure decreases with increases in altitude.
	**DISCUSS CHART 25-1: effective compression ratio compared to the boost pressure.**
	**DEMONSTRATION: Demonstrate an engine's change in volumetric efficiency by performing compression test during cranking and at 2500 RPM. Point out to students that the higher cylinder pressure at cranking speeds is due to the increased time for air to flow into cylinder. At slower speeds there is more time for air to leak past rings**

ICONS	CH25 Turbo/Superchargers
	**DISCUSSION:** **Ask students to discuss advantages of using forced induction over increased displacement**
	**ON-VEHICLE TASK: ASEEDUCATION Task:** **Research vehicle information (P-1)**
	
	6. **SLIDE 6 EXPLAIN Figure 25-5** roots-type supercharger uses two lobes to force the air around the outside of the housing and into the intake manifold. 7. **SLIDE 7 EXPLAIN Figure 25-6** bypass actuator opens the bypass valve to control boost pressure 8. **SLIDE 8 EXPLAIN Figure 25-7** Ford supercharger cutaway display showing the roots-type blower and air charge cooler (intercooler). The air charge cooler is used to reduce the temperature of the compressed air before it enters the engine to increase the air charge density.
	**EXPLAIN TECH TIP: Faster Moves More Air** **One of the high-performance measures that can be used to increase horsepower on a supercharged engine is to install a smaller diameter pulley. The smaller the pulley diameter, the faster the supercharger will rotate and the higher the potential boost pressure will be. The change will require a shorter belt, and the extra boost could cause serious engine damage.**
	**A supercharger was optional equipment on 1957 Fords. Some muscle cars used Ram Air scoops to achieve a supercharging effect by capturing high pressure outside air.**
	**Supercharger Bypass (View) (Download**

ICONS	CH25 Turbo/Superchargers
	**DEMONSTRATION:** Show a supercharger to students, pointing out the drive pulley, inlet, outlet, and bypass passage. Care should be taken around the supercharger drive to prevent injury. Clothing or body parts can get caught in belt.
	**DISCUSSION:** Have students discuss why a normal manifold absolute pressure sensor can't be used on a forced induction motor.
	**HANDS-ON TASK:** Have your students check a supercharger's oil level.
	9. **SLIDE 9 EXPLAIN Figure 25-8** A turbocharger uses some of heat energy that would normally be wasted. 10. **SLIDE 10 EXPLAIN Figure 25-9** turbine wheel is turned by the expanding exhaust gases. 11. **SLIDE 11 EXPLAIN Figure 25-10** exhaust drives turbine wheel on left which is connected to impeller wheel on right through a shaft. Bushings that support shaft are lubricated with engine oil under pressure. 12. **SLIDE 12 EXPLAIN Figure 25-11** Engine oil is fed to the center of the turbocharger to lubricate the bushings and returns to the oil pan through a return line.
	**A turbocharged engine can have horsepower of a larger engine but with better gas mileage**
	**DEMONSTRATION: Show your students a turbocharger and point out the turbine, compressor, wastegate, and lubrication passages.**
	**DISCUSSION: Ask your students to compare the power curve of turbochargers to that of superchargers and discuss how this affects vehicle performance.**

ICONS	CH25 Turbo/Superchargers
	**HANDS-ON TASK:** **Give students an exploded view diagram of a turbocharger and have them use service information to label all components.**
	13. **SLIDE 13 EXPLAIN Figure 25-12** unit on top of this Subaru that looks like a radiator is the intercooler, which cools the air after it has been compressed by the turbocharger. 14. **SLIDE 14 EXPLAIN Figure 25-13** wastegate is used on many turbocharged engines to control maximum boost pressure. The wastegate is controlled by a computer-controlled valve.
	**EXPLAIN TECH TIP: Boost Is the Result of Restriction: The boost pressure of a turbocharger (or supercharger) is commonly measured in pounds per square inch. If a cylinder head is restricted because of small valves and ports, the turbocharger will quickly provide boost. Boost results when the air being forced into the cylinder heads cannot flow into the cylinders fast enough and "piles up" in intake manifold, increasing boost pressure. If engine had large valves and ports, the turbocharger could provide a much greater amount of air into engine at same boost pressure as an identical engine with smaller valves and ports. SO, by increasing size of valves, a turbocharged or supercharged engine will be capable of producing much greater power.**
	**Turbocharger Operation (View) (Download)** **Turbocharger Wastegate (View) (Download** **Variable Vane Turbocharger (View) (Download)**
	**HANDS-ON TASK: Have students measure boost at various RPM ranges using a pressure gauge or a scan tool**

ICONS	CH25 Turbo/Superchargers
	**15. SLIDE 15 EXPLAIN Figure 25-14** blow-off valve is used in some turbocharged systems to relieve boost pressure during deceleration.
	**EXPLAIN TECH TIP: If One Is Good, Two Are Better** **A turbocharger uses the exhaust from the engine to spin a turbine, which is connected to an impeller inside a turbocharger. This impeller then forces air into the engine under pressure, higher than is normally achieved without a turbocharger. The more air that can be forced into an engine, the greater the power potential. A V-type engine has two exhaust manifolds and so two small turbochargers can be used to help force greater quantities of air into an engine, as shown in • FIGURE 25–15.**
	**16. SLIDE 16 EXPLAIN Figure 25-15** dual turbocharger system installed on a small block Chevrolet V-8 engine.
	**Relief valves also prevent compressor surging that can hurt performance and damage turbocharger.**
	**DISCUSSION: Ask your students to discuss why they might use a BOV when a CBV is much less obtrusive**
	**ON-VEHICLE TASK: ASEEDUCATION Task: Test operation of turbocharger/ supercharger systems; determine needed action**
Education Foundation	
	**HANDS-ON TASK: Have students find turbocharger endplay specifications in ON-LINE service information.**

ICONS	CH25 Turbo/Superchargers
	17. **SLIDE 17 EXPLAIN Figure 25-16** Nitrous bottles have to be mounted at an angle to ensure that the pickup tube is in the liquid N_2O
	**DISCUSSION: Ask your students to discuss the advantages and disadvantages of using nitrous oxide instead of supercharger OR turbocharger**
	**SAFETY NOTE: Deliberate inhalation of nitrous oxide can have serious health consequences by depriving brain of oxygen.**
	**EXPLAIN TECH TIP: Increase Bottle Pressure** **To increase the pressure of the nitrous oxide in a bottle, an electrical warming blanket can be used, as seen in • FIGURE 25–17. The higher the temperature, the higher the pressure, and the greater the amount of N2O flow when energized.**
	17. **SLIDE 17 EXPLAIN FIGURE 25–17** An electrical heating mat is installed on the bottle of nitrous oxide to increase the pressure of the gas inside.
	**DISCUSS CAHRT 25-2 Temperature/pressure relation for nitrous oxide: The higher the temperature, the higher the pressure.**
	**SEARCH INTERNET: Have students research Internet to find the effect of elevation on volumetric efficiency. Ask students to report their findings to the class.**