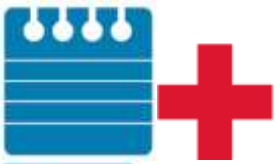
Automotive Engines
Chapter 21 TURBOCHARGING & SUPERCHARGING
Opening Your Class

KEY ELEMENT	EXAMPLES
Introduce Content	This engine systems course or class provides complete coverage of the 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 on the second SLIDE. 1. Prepare for ASE Engine Performance (A8) certification test content area "C" (Fuel, Air Induction, and Exhaust Systems Diagnosis and Repair). 2. Explain the difference between a turbocharger and a supercharger. 3. Describe how the boost levels are controlled. 4. Discuss maintenance procedures for turbochargers and superchargers.
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	Chapter 21 Turbo/Superchargers
	**1. SLIDE 1 CH21 TURBOCHARGER & SUPERCHARGER SYSTEMS** **2. SLIDES 2-3 EXPLAIN Objectives & KEY TERMS**
	**Check for ADDITIONAL VIDEOS & ANIMATIONS @ http://www.jameshalderman.com/** **WEB SITE IS UPDATED REGULARLY**
	**4. SLIDES 4-6 EXPLAIN Introduction SLIDES** **7. SLIDE 11 EXPLAIN FIGURE 21-1** supercharger on a Ford V-8 & **EXPLAIN FIGURE 21-2** turbocharger on a Toyota engine.
	**8. SLIDES 8 EXPLAIN** Forced Induction Principles & **EXPLAIN FIGURE 21-3** more air and fuel that can be packed in a cylinder, the greater the density of the air-fuel charge. **9. SLIDES 9 EXPLAIN** Forced Induction Principles & **EXPLAIN FIGURE 21-4** Atmospheric pressure decreases with increases in altitude. **10. SLIDE 10 EXPLAIN Chart 21-1** 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**
	**DISCUSSION: Ask students to discuss advantages of using forced induction over increased displacement**
	**ON-VEHICLE TASK: NATEF Task: (A1A2)** **Research vehicle information on turbochargers or superchargers PAGES 16 & 20**
	**11. SLIDES 11-12 EXPLAIN SUPERCHARGERS** **13. SLIDE 13 EXPLAIN FIGURE 21-5** roots-type supercharger uses two lobes to force the air around the outside of the housing and into the intake manifold.

ICONS	Chapter 21 Turbo/Superchargers
	14. **SLIDE 14** EXPLAIN **FIGURE 21-6** bypass actuator opens the bypass valve to control boost pressure 15. **SLIDE 15** EXPLAIN **FIGURE 21-7** 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.
	16. **SLIDE 16** EXPLAIN TECH TIP
	**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.**
	**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.**
	17. **SLIDE 17** EXPLAIN **Turbochargers** 18. **SLIDE 18** EXPLAIN **FIGURE 21-8** A turbocharger uses some of heat energy that would normally be wasted. & EXPLAIN **FIGURE 21-9** turbine wheel is turned by the expanding exhaust gases. 19. **SLIDE 19** EXPLAIN **FIGURE 21-10** 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. EXPLAIN **FIGURE 21-11** 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**

ICONS	Chapter 21 Turbo/Superchargers
	**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.**
	**HANDS-ON TASK: Give students an exploded view diagram of a turbocharger and have them use service information to label all components.**
	**20. SLIDE 20 EXPLAIN Boost Control** **21. SLIDE 21 EXPLAIN FIGURE 21-12 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.** **22. SLIDE 22 EXPLAIN FIGURE 21-13 wastegate is used on many turbocharged engines to control maximum boost pressure. The wastegate is controlled by a computer-controlled valve**.
	**HANDS-ON TASK: Have students measure boost at various RPM ranges using a pressure gauge or a scan tool**
	**23. SLIDE 23 EXPLAIN FIGURE 21-14** A blow-off valve is used in some turbocharged systems to relieve boost pressure during deceleration
	**24. SLIDE 24 EXPLAIN TECH TIP**
	**25. SLIDE 25 EXPLAIN FIGURE 21-15** A 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**

ICONS	Chapter 21 Turbo/Superchargers
          	**ON-VEHICLE TASK: NATEF Task: Test operation of turbocharger/supercharger systems; determine necessary action (P-3)** **HANDS-ON TASK: Have students find turbocharger endplay specifications in ON-LINE service information.** 26. **SLIDE 26 EXPLAIN Turbocharger Failures** 27. **SLIDES 27-28 EXPLAIN Nitrous Oxide** 29. **SLIDE 29 EXPLAIN Chart 25-2 Temperature/pressure relation for nitrous oxide: The higher the temperature, the higher the pressure.** 30. **SLIDE 30 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** 31. **SLIDE 31 EXPLAIN TECH TIP** 32. **SLIDE 32 EXPLAIN TECH TIP FIGURE 21–17** An electrical heating mat is installed on the bottle of nitrous oxide to increase the pressure of the gas inside **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.** **SEARCH INTERNET: Have students research Internet to find the effect of elevation on volumetric efficiency. Ask students to report their findings to the class.** **Talk through SUMMARY and questions** **HOMEWORK: complete Ch21 crossword puzzle: http://www.jameshalderman.com/links/book_engine_theory_serv_7/cw/crossword_ch_21.pdf**