

Light Vehicle Diesel Engines

Chapter 09 TURBOCHARGER SYSTEMS

Opening Your Class

| KEY ELEMENT | EXAMPLES |
|---|--|
| Introduce Content | This Light Vehicle Diesel Engines 1st text provides complete coverage of light duty diesel engine components, operation, and diagnosis. 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, and Real World Fixes: www.jameshalderman.com contains Videos, Animations, and Task Sheets for use in the lab and classroom. |
| 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. Prepare for the Light Vehicle Diesel Engine (A9) ASE certification test content area • “E” (Air Induction and Exhaust Systems Diagnosis and Repair). 2. Discuss airflow requirements and volumetric efficiency of engines. 3. Explain forced induction principles. 4. Discuss turbochargers. 5. Explain boost control |
| 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 1st Edition Chapter Images found on Jim’s web site @ www.jameshalderman.com

LINK CHP 06_Chapter Images: USE BELOW LINK

http://www.jameshalderman.com/books_a9.html

NOTE: You can use Chapter Images or Power Point files: Though out Power Point Presentations, you will find questions and answers on slides that can be used for discussion

ICONS



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1. SLIDE 1 CH09 TURBOCHARGER SYSTEMS

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

Light Diesel (111 Links)

http://www.jameshalderman.com/books_a9.html

Crossword Puzzle (Microsoft Word) (PDF)

Word Search Puzzle (Microsoft Word) (PDF)

SAFETY Always be very careful when working on a Diesel engine that is running with air intake removed. Because most diesel ENGINES DO NOT USE a throttle plate, objects can very easily be sucked into engine, causing serious engine damage. MOST OEMs offer intake covers.

2. **SLIDE 2 EXPLAIN FIGURE 9-1** turbocharger on a Cummins inline six-cylinder diesel engine. Engine oil is fed to the center of the turbocharger to lubricate the bushings and returns to the oil pan through a return line.

3. **SLIDE 3 EXPLAIN FIGURE 9-2** more air that can be packed in a cylinder, greater density of air and the greater efficiency of engine

4. **SLIDE 4 EXPLAIN FIGURE 9-3** Atmospheric pressure decreases with increases in altitude.

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

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ON-VEHICLE TASK: NATEF Task: Research vehicle information

5. **SLIDE 5 EXPLAIN FIGURE 9–4** turbine wheel is turned by the expanding exhaust gases.
6. **SLIDE 6 EXPLAIN FIGURE 9–5** 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.
7. **SLIDE 7 EXPLAIN FIGURE 9–6** Engine oil is fed to the center of the turbocharger to lubricate the bushings and returns to the oil pan through a return line.

DISCUSS CHART 9-1

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.

HANDS-ON TASK: Give students an exploded view diagram of a turbocharger and have them use service information to label all components.

8. **SLIDE 8 EXPLAIN FIGURE 9–7** wastegate is a hinged door usually with 2 exits for exhaust to flow through bypassing turbine blade of turbocharger.

DISCUSS CHART 9-1

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[Turbocharger Operation \(View\) \(Download\)](#)

[Turbocharger Wastegate \(View\) \(Download\)](#)

HANDS-ON TASK: Have students measure boost at various RPM ranges using a pressure gauge or scan tool

HANDS-ON TASK: Have students find turbocharger endplay specifications in ON-LINE service information.

9. **SLIDE 9 EXPLAIN FIGURE 9-8** Variable vane turbocharger allows the boost to be controlled without the need of a wastegate.
10. **SLIDE 10 EXPLAIN FIGURE 9-9 (A)** variable vane turbocharger from a Duramax diesel engine, showing vanes in the extended position. This position creates a higher velocity exhaust stream being applied to the turbine blades when engine speed is low.
11. **SLIDE 11 EXPLAIN FIGURE 9-9 (B)** This shows position of 3 variable vanes at higher engine speed where greater volume of exhaust gases applied to turbine blades

[Variable Vane Turbocharger \(View\) \(Download\)](#)

12. **SLIDE 12 EXPLAIN FIGURE 9-10** The vane position sensor is an input signal to the PCM to provide feedback data for control of turbocharger boost levels.
13. **SLIDE 13 EXPLAIN FIGURE 9-11** The low-pressure turbocharger compresses the air and sends the air through the extension tube and the crossover tube prior to entering the high-pressure turbocharger.
14. **SLIDE 14 EXPLAIN FIGURE 9-12** 6.4-Liter power stroke diesel engine air management system, showing a low-pressure and a high-pressure turbocharger, plus the sensors and arrows showing the airflow.
15. **SLIDE 15 EXPLAIN FIGURE 9-13** air charge cooler is used to cool the compressed air.
16. **SLIDE 16 EXPLAIN FIGURE 9-14** A turbocharger with damaged impeller blades. Small black plastic pieces

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were found around area indicating that air filter housing had been damaged when owner replaced air filter. Pieces from broken housing causes damage to turbocharger.

ON-VEHICLE TASK: Task: Test operation of turbocharger/supercharger systems; determine necessary action