

Light Vehicle Diesel Engines 1st Edition

Chapter 03 Diesel Cylinder Heads & Valve Trains

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.	<p>Explain the chapter learning objectives to the students as listed on the second SLIDE.</p> <ol style="list-style-type: none"> 1. Prepare for the Light Vehicle Diesel Engine (A9) ASE certification test content area "B" (Cylinder Head and Valve Train Diagnosis and Repair). 2. Explain the design and construction of cylinder heads. 3. Discuss camshaft design and valve train component operation. 4. Discuss the purpose and function of rocker arms and bridges. 5. Discuss the purpose, function, and operation of hydraulic valve lifters. 6. Describe how to disassemble a cylinder head. 7. Discuss valve-stem-to-guide clearance.
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 1st Edition Chapter Images found on Jim's web site @ www.jameshalderman.com

LINK CHP 03 [Chapter Images](#)

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.

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1. SLIDE 1 CH03 DIESEL CYLINDER HEADS & VALVE TRAINS

2. SLIDES 2-3 EXPLAIN Objectives

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

[Light Diesel \(111 Links\)](#)

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

Crossword Puzzle (Microsoft Word) (PDF)

Word Search Puzzle (Microsoft Word) (PDF)

4. SLIDE 4 EXPLAIN FIGURE 3-1 (A) Aluminum GM Duramax v-8 diesel engine cylinder head

5. SLIDE 5 EXPLAIN FIGURE 3-1(B) Cast iron Cummins 6.7 liter inline six cylinder diesel engine cylinder head.

DEMONSTRATION: Show students a variety Of diesel heads and point out differences. Show major components of cylinder head

Many aluminum cylinder heads have smaller than-normal drain back holes. If an engine has excessive oil consumption, check the drain holes as a possible cause before removing engine.

6. SLIDE 6 EXPLAIN FIGURE 3-3 Identification of the parts of a valve

7. SLIDE 7 EXPLAIN FIGURE 3-4 Typical valve spring and related components. Dual valve springs are used to reduce valve train vibrations and a spring seat is used to protect aluminum heads.

8. SLIDE 8 EXPLAIN FIGURE 3-5 Inertia welded valve stem and head before machining.

9. SLIDE 9 EXPLAIN FIGURE 3-6 Sodium-filled valve uses a hollow stem, which is partially filled with metallic

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sodium (a liquid when hot) to conduct heat away from the head of the valve.

HANDS-ON TASK: Pass around an alloy valve and a Stellite® valve together with magnet and ask the students to identify which valve is the alloy valve and which is the Stellite® valve.

10. **SLIDE 10 EXPLAIN FIGURE 3-7** Integral valve seats are machined directly into the cast-iron cylinder head and are induction hardened to prevent wear.
11. **SLIDE 11 EXPLAIN FIGURE 3-8** Insert valve seats are a separate part that is interference fitted to a counterbore in the cylinder head
12. **SLIDE 12 EXPLAIN FIGURE 3-9** A retainer and two split keepers hold the spring in place on the valve. A separate metal washer is used to prevent the valve spring from wearing into the aluminum cylinder head on aluminum heads. On cast iron heads, the spring seat is a machined area in the head.

HANDS-ON TASK: Give students an intake valve and have them identify its parts

Show ANIMATION: VALVE PARTS

www.myautomotivelab.com

http://media.pearsoncmg.com/ph/chet/chet_myautomotivelab_2/animations/A1_Animation/Chapter_27_Fig_27_1/index.htm

DEMONSTRATION: Show some examples of defective valves such as those that are broken, burnt, and cracked.

DEMONSTRATION: Show differences between exhaust and intake valves

DISCUSSION: Ask why intake valve is larger in diameter than exhaust valve.

DEMONSTRATION: Show cylinder head with four valves per cylinder & cylinder head with two valves per cylinder.

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QUESTION



QUESTION



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DISCUSSION: Ask what benefits are of four valves per cylinder as opposed to only two valves per cylinder.

DEMONSTRATION: Show examples of heads with integral seats and insert seats.

DEMONSTRATION: Show examples of various valves with defects and explain the causes.

HANDS-ON TASK: Have students use service information to determine whether OEM has recommended procedure for removing carbon deposits from valves without removing the cylinder heads from engine.

DISCUSSION: Ask what the best method would be of determining whether a valve is leaking. (Answer: cylinder leakage test)

13. **SLIDE 13 EXPLAIN FIGURE 3–10** All valve springs should be checked for squareness by using a square on a flat surface and rotating the spring while checking.

14. **SLIDE 14 EXPLAIN FIGURE 3–11** one popular type of valve spring tester used to measure compressed force of valve springs. Specifications usually include (1) free height (height without being compressed), (2) pressure at installed height with valve closed, and (3) pressure with valve open to height specified












Show VIDEO: CHECKING VALVE SPRING PRESSURE: 1.3 Minutes

www.myautomotivelab.com

http://media.pearsoncmg.com/ph/chet/chet_mymlabs/akamai/template/video640x480.php?title=Checking%20Valve%20Springs&clip=pandc/chet/2012/automotive/Engines/A1T3.mov&caption=chet/chet_mymlabs/akamai/2012/automotive/Engines/xml/A1T3.xml

DEMONSTRATION: Show students how to test valve spring tension and height using a valve spring tester.

HANDS-ON TASK: Have the students check various valve springs for squareness and determine whether they meet specifications.

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	ON-VEHICLE NON-NATEF TASK: Inspect valve springs for squareness and free height; determine necessary action.
	HANDS-ON TASK: With valve springs and a valve spring tester, have students test springs for tension & height and determine whether they meet specifications.
	Show VIDEO: <u>VALVE SPRING INSTALLED HEIGHT: 1.13 Minutes</u> <u>www.myautomotivelab.com</u> <small>http://media.pearsoncmg.com/ph/chet/chet_mylibs/akamai/template/video640x480.php?title=Checking%20Valve%20Spring%20Install%20Height&clip=pandc/chet/2012/automotive/Engines/A1T6.mov&caption=chet/chet_mylibs/akamai/2012/automotive/Engines/xml/A1T6.xml</small>
	<u>DEMONSTRATION:</u> Show the students how to correctly measure installed valve spring height.
	HANDS-ON TASK: Have the students measure installed valve stem height and determine whether it meets specifications.
	15. SLIDE 15 EXPLAIN FIGURE 3–12 Coolant passages on a Duramax diesel engine block.
	<u>DEMONSTRATION:</u> Show coolant passages in the cylinder head.
	<u>DEMONSTRATION:</u> Show oil flow and return passages in the cylinder head.
	NOTE: Many aluminum cylinder heads have smaller than-normal drain back holes. If an engine has excessive oil consumption, check the drain holes as a possible cause before removing engine.
 	<u>ON-VEHICLE NATEF TASK</u> Research CAMSHAFT SPECS

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16. **SLIDE 16 EXPLAIN FIGURE 3–13** Cummins 6.7 liter inline six-cylinder diesel camshaft is driven by a gear from the crankshaft.



17. **SLIDE 17 EXPLAIN FIGURE 3–14** Fiat-Chrysler 3.0 liter V-6 diesel engine that has double overhead camshafts. Exhaust camshaft is driven by a chain from crankshaft and intake camshaft is driven by a gear off exhaust camshaft.

17. **SLIDE 17 EXPLAIN FIGURE 3–15** Hardened steel lobes are a press-fit onto the hollow steel tube to create a composite camshaft that is both light weight and flexible as well.



DEMONSTRATION: Show camshaft and point out intake and exhaust lobes



DISCUSSION: Advantages DOHC as opposed to cam-in-block design.



DEMONSTRATION: Show examples of DIFFERENT DIESEL camshafts.



Camshaft & Flat Lifter (View) (Download)

Camshaft & Roller Lifter (View) (Download)



NOTE: Rockwell is a type of hardness test, and represents scale used. Higher number is, harder surface. Abbreviation Rc60, indicates Rockwell hardness of 60 as measured on “c” scale



18. **SLIDE 18 EXPLAIN FIGURE 3–16** Lobe lift is amount cam lobe lifts lifter. **Blue** circle called base circle.



DEMONSTRATION: Show examples of hydraulic lash adjusters.

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DISCUSSION: Ask the students to define valve overlap.

HANDS-ON TASK: Have students use service information to look up valve overlap on a particular engine.

DISCUSSION: Ask why some dual overhead cam engines may have a different camshaft profile for each of the intake valves and exhaust valves. (Answer: This creates an engine that is able to produce a high torque over a broader engine speed range.)

19. SLIDE 19 EXPLAIN FIGURE 3–17 1.5:1 ratio rocker arm means that dimension A is 1.5 times length of dimension B. Therefore, if pushrod is moved up 0.4 inch by camshaft lobe, the valve will be pushed down (opened) 0.4 inch \times 1.5, or 0.6 inch.

Rocker Arm Ratio (View)
(Download)

DISCUSSION: Ask the students to explain the difference between a free-wheeling engine design & interference engine design. The FIAT/CHRYSLER V6 is an Interference design/Oversquare design.

19. SLIDE 19 EXPLAIN FIGURE 3–18 Bridges are used in many light diesel engines so that one rocker arm can operate 2 valves, which simplify valve train when 4 valves per cylinder heads used in a cam-in-block engine.

DEMONSTRATION: On DURAMAX with adjustable valves show students how to adjust valve lash.

HANDS-ON TASK: On DURAMAX with adjustable valves have students adjust valve lash to meet specifications.

20. SLIDE 20 EXPLAIN FIGURE 3–19 Overhead valve engines are also known as pushrod engines because of the long pushrod that extends from the lifter to the rocker arm

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DEMO



DEMONSTRATION: Show how to check for bent pushrods by rolling them across a flat surface.

ON-VEHICLE TASK Inspect pushrods, rocker arms, rocker arm pivots and shafts for wear, bending, cracks, looseness, and blocked oil passages; determine necessary action (P-2)

21. **SLIDE 21 EXPLAIN FIGURE 3–20(A)** Duramax diesel engine anti-rotation clip used to keep roller lifter from turning in its bore so that roller will always be rotating along lobes of cam. Duramax uses non-hydraulic roller lifters

22. **SLIDE 22 EXPLAIN FIGURE 3–20(B)** A lifter from a Duramax that shows the large size compared to a lifter from a typical gasoline-powered engine.

DEMONSTRATION: On an engine with roller lifters, show the proper installation of the roller lifter and retaining guides.

23. **SLIDE 23 EXPLAIN FIGURE 3–21** exploded view of hydraulic roller lifter

DEMO



DEMONSTRATION: Show disassembled hydraulic lifter

DEMO

DEMO

DEMONSTRATION: Show examples of solid and hydraulic lifters.



When installing new lifters, immerse them in clean oil and pump them up manually to eliminate the air from the lifter.



ON-VEHICLE TASK Inspect valve lifters; determine necessary action

DEMO

DEMONSTRATION: show correct procedure for disassembling cylinder head for service

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24. **SLIDE 24 EXPLAIN FIGURE 3–22** Cylinder heads should be checked in five planes for warpage, distortion, bend, and twist.

DEMONSTRATION: Show how to use straightedge & feeler gauge to check cylinder head for flatness.

HANDS-ON TASK: Have the students use a cylinder head, feeler gauge, and straightedge to check a cylinder head for warpage.

ON-VEHICLE TASK Clean & visually inspect a cylinder head for cracks; check gasket surface areas for warpage and surface finish; check passage condition

25. **SLIDE 25 EXPLAIN FIGURE 3–23** All aluminum cylinder heads use valve guide inserts.

26. **SLIDE 26 EXPLAIN FIGURE 3–24** small-hole gauge and a micrometer are being used to measure the valve guide. The guide should be measured in three places: at the top, middle, and bottom.






27. **SLIDE 27 EXPLAIN FIGURE 3–25** Diameter of valve stem is being measured using a micrometer. Difference between inside diameter of valve guide and diameter of valve stem is valve guide-to-stem clearance.

28. **SLIDE 28 EXPLAIN FIGURE 3-26** Measuring valve guide clearance

DEMONSTRATION: Show the students examples of cylinder heads with integral and pressed-in valve guides

DEMONSTRATION: Show the students how to measure valve guide clearance using a small hole gauge & micrometer & a dial indicator

ON-VEHICLE TASK Inspect valve guides for wear, check valve stem-to-guide clearance; determine necessary action

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	<p>HANDS-ON TASK: Have the students use service information to locate the valve guide clearance for a variety of engines.</p>
	<p>OPTIONAL DEMONSTRATION: Show the students how to replace a valve guide insert using the proper tools and following OEM recommendations.</p>
	<p>OPTIONAL HANDS-ON TASK: Have the students replace the valve guide on a cylinder head with replaceable valve guide using the proper tools and equipment & meeting OEM specifications.</p>
	<p>OPTIONAL DEMONSTRATION: Show the students the proper procedure to install a valve guide insert.</p>
	<p>HANDS-ON TASK: On a cylinder head and with proper tools, have the students install valve guide insert, meeting OEM specifications</p>