

# Light Vehicle Diesel Engines

## Chapter 04 Diesel Engine Lubrication 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: <a href="http://www.jameshalderman.com">www.jameshalderman.com</a> 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 on the second SLIDE. <ol style="list-style-type: none"><li>1. Prepare for the Light Vehicle Diesel Engine (A9) ASE certification test content area "D" (Lubrication and Cooling Systems Diagnosis and Repair).</li><li>2. Describe the operation of oil pumps.</li><li>3. Discuss the purpose and function of oil coolers.</li><li>4. Explain the purpose of engine oil and engine oil additives.</li><li>5. Discuss the properties of engine oil.</li><li>6. Discuss SAE and API rating oil ratings.</li><li>7. Discuss the purpose and function of oil filters.</li><li>8. Describe the oil change procedure.</li></ol>
Establish the Mood or Climate	Provide a <b>WELCOME</b> , 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 1<sup>st</sup> Edition Chapter Images found on Jim's web site @ [www.jameshalderman.com](http://www.jameshalderman.com)**

**LINK CHP 04 Chapter Images USE BELOW LINK**

**[http://www.jameshalderman.com/books\\_a9.html](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.**

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### 1. SLIDE 1 CH04 LUBRICATION SYSTEM OPERATION & DIAGNOSIS

### 2. SLIDES 2-3 READ Objectives

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

### Light Diesel (111 Links)

[http://www.jameshalderman.com/books\\_a9.html](http://www.jameshalderman.com/books_a9.html)

**Crossword Puzzle (Microsoft Word) (PDF)**

**Word Search Puzzle (Microsoft Word) (PDF)**

### Show LUBRICATION SYSTEM ANIMATION:

[www.myautomotivelab.com](http://www.myautomotivelab.com)

[http://media.pearsoncmg.com/ph/chet/chet\\_myautomotivelab\\_2/animations/A1\\_Animation/Chapter10\\_Fig\\_10\\_4/index.htm](http://media.pearsoncmg.com/ph/chet/chet_myautomotivelab_2/animations/A1_Animation/Chapter10_Fig_10_4/index.htm)

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[http://media.pearsoncmg.com/ph/chet/chet\\_myautomotivelab\\_2/animations/A1\\_Animation/Chapter10\\_Fig\\_10\\_4/index.htm](http://media.pearsoncmg.com/ph/chet/chet_myautomotivelab_2/animations/A1_Animation/Chapter10_Fig_10_4/index.htm)

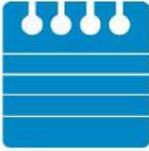
### Oil Flow-World Engine ANIMATION:

<http://www.jameshalderman.com/animations.html#a1>

When performing oil change it is recommended that engine be at operating temperature & that engine be run just before oil is drained. This is done in order to circulate and suspend heavy dirt particles so that they can drain out with oil.

**DISCUSSION:** Discuss with students that today's vehicles USE an engine oil life indicator, located in driver information center. The display shows percentage of engine oil life left or turns on a light alerting driver that the oil should be changed

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With many oil pressure indicator lights, engine oil pressure must be very low (under 10 psi at idle) before warning light is triggered. Engine bearing knock or lifter noise may be evident before light is illuminated.

3. **SLIDE 3 EXPLAIN** Lubrication Principles & **EXPLAIN Figure 4-1** Oil molecules cling to metal surfaces but easily slide against each other.
4. **SLIDE 4 EXPLAIN Figure 4-2** Wedge-shaped oil film developed below a moving block.
5. **SLIDE 5 EXPLAIN** Lubrication Principles & **EXPLAIN Figure 4-3** Wedge-shaped oil film curved around a bearing journal
6. **SLIDE 6 EXPLAIN** Engine Lubrication Systems & **EXPLAIN Figure 4-4** Dash oil pressure gauge may be a good indicator of engine oil pressure. If there is any concern about the oil pressure, always use a mechanical gauge to be sure

**DEMONSTRATION: Show students oil filter with decomposed oil and compare it to a new one. Explain why oil and oil filter must be changed at appropriate intervals to prevent dirty, broken down oil from causing serious damage to engine**  
**A major cause of premature engine breakdown is failure to change oil and filter as recommended by OEM. Excessive heat and mechanical stress can cause oil to decompose and thicken.**

**ON-VEHICLE NATEF Task: Inspect, Test, and Replace Oil Temperature and Pressure Switches and Sensors. PAGE 45**

7. **SLIDE 7 EXPLAIN** Oil Pumps & **EXPLAIN Figure 4-5** In an external gear-type oil pump, the oil flows through the pump around the outside of each gear. This is an example of a positive displacement pump, wherein everything entering the pump must leave the pump.

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### External Gear Oil Pump ANIMATION:

<http://www.jameshalderman.com/animations.html#a1>

### Internal-External Gear Pump with Crescent ANIMATION:

<http://www.jameshalderman.com/animations.html#a1>

8. **SLIDE 8 EXPLAIN** Figure 4-6 typical internal/external oil pump mounted in the front cover of the engine that is driven by the crankshaft.
9. **SLIDE 9 EXPLAIN** Figure 4-7 operation of a rotor-type oil pump

**HANDS-ON TASK:** Have a group of students demonstrate to the class how gear type oil pump works and how it differs from a camshaft-driven oil pump.

**HANDS-ON TASK:** Have students inspect a number of worn parts from an engine lubrication system and describe the evidence that indicates wear and how each part got to be way it is.

### Gerotor - Type Oil Pump ANIMATION:

<http://www.jameshalderman.com/animations.html#a1>

10. **SLIDES 10 EXPLAIN** Figure 4-8 Gerotor-type oil pump driven by the crankshaft.
11. **SLIDE 11 EXPLAIN** Figure 4-9 Oil pressure relief valves are spring loaded. The stronger the spring tension, the higher the oil pressure.
12. **SLIDE 12 EXPLAIN** Figure 4-10 Typical engine design that uses both pressure and splash lubrication. Oil travels under pressure through galleries (passages) to reach top of engine. Other parts are lubricated as oil flows back down into oil pan or is splashed onto parts.
13. **SLIDE 13 EXPLAIN** Figure 4-11 (a) visual inspection indicated that this pump cover was worn..
14. **SLIDE 14 EXPLAIN** Figure 4-11 (b) embedded particle of something was found on one of the gears, making this pump worthless except for scrap metal

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15. **SLIDE 15 EXPLAIN FIGURE 4-12** flow of oil in 6.7 liter Power Stroke diesel engine.

### **EXPLAIN FREQUENTLY ASKED QUESTION** **Why Are There Holes on the Underside of Diesel Pistons?**

**ON-VEHICLE NON-NATEF Task: Inspect oil pump gears or rotors, housing, pressure relief devices, & pump drive; perform necessary action.**

16. **SLIDE 16 EXPLAIN FIGURE 4-13 (a)** two holes in the underside of the piston lead to a passage where oil is squirted from nozzles to help cool the top of the piston

17. **SLIDE 17 EXPLAIN FIGURE 4-13 (B)** as the oil flows through the opening underneath the top of the piston, it absorbs heat and the heated oil returns to the oil pan where the oil is cooled by the oil cooler.

18. **SLIDE 18 EXPLAIN Figure 4-14** Oil must be used to lubricate the gears used to drive the camshaft and high-pressure fuel pump on all engines, such as this 6.7 liter Cummins inline six-cylinder diesel engine..

19. **SLIDE 19 EXPLAIN Figure 4-15 (A)** the pickup screen on a Duramax diesel engine is surrounded by many baffles.

20. **SLIDE 20 EXPLAIN Figure 4-15 (B)** the oil pan has a built-in windage tray to help prevent the oil from being aerated during engine operation.

**DISCUSSION: Discuss common locations of oil galleries in an engine block and how oil flows through hollow push rods to the rocker arms.**

**HANDS-ON TASK: Have students inspect a number of worn parts from an engine lubrication system and describe the evidence that indicates wear and how each part got to be the way it is. Check with OEM before using oil additives. Some OEMS will void the engine warranty if unapproved additives are found in oil.**

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**ON-VEHICLE Task:** Research applicable vehicle & service information, vehicle service history, service precautions, & TSBs

21. **SLIDE 21 EXPLAIN FIGURE 16–18** Oil is cooled by the flow of coolant through the oil filter adaptor

**DEMONSTRATION:** Show students an oil pan with a built-in windage tray. Have students discuss the benefits of this configuration.

Show **ENGINE LUBRICATION WET SUMP ANIMATION:**

[www.myautomotivelab.com](http://www.myautomotivelab.com)

[http://media.pearsoncmg.com/ph/chet/chet\\_myautomotivelab\\_2/animations/A1\\_Animation/Chapter16\\_Fig\\_16\\_14/index.htm](http://media.pearsoncmg.com/ph/chet/chet_myautomotivelab_2/animations/A1_Animation/Chapter16_Fig_16_14/index.htm)

22. **SLIDE 22 EXPLAIN FIGURE 4–17** Container of SAE 15W-40 engine oil that may be suitable for use in many light diesel engines.

**ON-VEHICLE Task:** Inspect, Test, and Replace Oil Temperature and Pressure Switches and Sensors.

**ON-VEHICLE Task:** Perform oil pressure tests; determine necessary action

**DEMONSTRATION:** Show students oil cooler. Talk about the possible applications of oil coolers. Indicate that some oil coolers use engine coolant to transfer heat from oil to engine cooling system

**HANDS-ON TASK:** Have a group of students disassemble an engine oil cooler. Have a second group of students reassemble oil cooler.

23. **SLIDE 23 EXPLAIN FIGURE 4–18** viscosity index (VI) improver is a polymer and feels like finely ground foam rubber. When dissolved in the oil, it expands when hot to keep the oil from thinning.

24. **SLIDE 24 EXPLAIN Figure 4–19** rubber diaphragm acts as an antidrainback valve to keep oil in filter when engine is stopped and oil pressure drops to zero.

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**SEARCH INTERNET:** Have students research American Petroleum Institute (API) and find all engine oil ratings. The first letter should start with "C", which stands for COMPRESSION ignition (DIESEL) engine. Also have them research the International Lubricant Standardization and Approval Committee (ILSAC) and find international lubricant standards. Ask students to report their findings to the class.

25. **SLIDE 25 EXPLAIN Figure 4-20** A cutaway of typical spin-on oil filter. Engine oil enters filter through small holes around center of filter & flows through pleated paper filtering media & out large hole in center of filter. Center metal cylinder with holes is designed to keep paper filter from collapsing under pressure. Bypass valve can be built into center on oil filter or is part of oil filter housing and located in engine.

26. **SLIDE 26 EXPLAIN Figure 4-21** typical filter crusher. The hydraulic ram forces out most of oil from filter. The oil is trapped underneath crusher and is recycled

26. **SLIDE 26 EXPLAIN Figure 4-22** Many vehicle manufacturers can display percentage of oil life remaining, whereas others simply turn on a warning lamp when it has been determined that an oil change is required.

**HANDS-ON TASK:** Have a group of students reset the oil minder lamp using the vehicle system and a scan tool

### EXPLAIN FREQUENTLY ASKED QUESTION What is the Relationship Between Miles Driven and Engine Hours? FIGURE 23 A&B

27. **SLIDE 27 EXPLAIN FIGURE 4-23 (a)** number of miles shown on this two year old Ford F-250 with a Power stroke 6.7 liter diesel engine.

28. **SLIDE 28 EXPLAIN FIGURE 4-23 (b)** The number of hours with the engine running at idle (481 hours) is equal to about 12,000 miles, so the total is equal to about 26,000 miles instead of what the odometer reads (14,726).

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**HANDS-ON TASK:** Have a group of students do an oil change on a diesel equipped truck