Automotive Engines

Chapter 16 Lubrication System Operation & Diagnosis

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 Repair (A1) certification test content area "D" (Lubrication and Cooling Systems Diagnosis and Repair). 2. Explain hydrodynamic lubrication. 3. Describe how the oil pump and engine lubrication work. 4. Discuss how oil flows to the valve train components. 5. Explain how to inspect an oil pump for wear.
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.

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	**1. SLIDE 1 CH16 LUBRICATION SYSTEM OPERATION & DIAGNOSIS** **2. SLIDES 2-3 READ** Objectives & KEY TERMS **4. SLIDES 4 Introduction** **Check for ADDITIONAL VIDEOS & ANIMATIONS @ http://www.jameshalderman.com/** **WEB SITE REGULARLY UPDATED**
	**VIDEOS** **Engine Operation (17 Links)**
	**Show LUBRICATION SYSTEM ANIMATION: www.myautomotivelab.com** http://media.pearsoncmg.com/ph/chet/chet_myautomotivelab_2/animations/A1_Animation/Chapter10_Fig_10_4/index.htm
	**Show LUBRICATION SYSTEM ANIMATION: www.myautomotivelab.com** 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**
	**With many oil pressure indicator lights, engine oil pressure must be very low (under 10 psi at idle) before warning light is**

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	triggered. Engine bearing knock or lifter noise may be evident before light is illuminated.
	5. **SLIDE 5** EXPLAIN Lubrication Principles & EXPLAIN **Figure 16-1** Oil molecules cling to metal surfaces but easily slide against each other. 6. **SLIDE 6** EXPLAIN **Figure 16-2** Wedge-shaped oil film developed below a moving block. 7. **SLIDE 7** EXPLAIN Lubrication Principles & EXPLAIN **Figure 16-3** Wedge-shaped oil film curved around a bearing journal
	8. **SLIDE 8** EXPLAIN Engine Lubrication Systems & EXPLAIN **Figure 16-4** 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**
	9. **SLIDE 9** EXPLAIN Oil Pumps 10. **SLIDE 10** EXPLAIN **Figure 16-5** oil pump driven by the camshaft. 11. **SLIDE 11** EXPLAIN Oil Pumps & EXPLAIN **Figure 16-6** 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** 12. **SLIDE 12 EXPLAIN Figure 16-7** typical internal/external oil pump mounted in the front cover of the engine that is driven by the crankshaft. 13. **SLIDE 13 EXPLAIN Figure 16-8** 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** 14. **SLIDES 14 EXPLAIN Figure 16-9** Gerotor-type oil pump driven by the crankshaft. 15. **SLIDE 15 EXPLAIN** Oil Pumps 16. **SLIDE 16 EXPLAIN Figure 16-10** Oil pressure relief valves are spring loaded. The stronger the spring tension, the higher the oil pressure. 17. **SLIDE 17 EXPLAIN Figure 16-11** 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. 18. **SLIDE 18 EXPLAIN Figure 16-12 (a)** visual inspection indicated that this pump cover was worn.. **(b)** embedded particle of something was found on one of the gears, making this pump worthless except for scrap metal

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	**19. SLIDE 19 EXPLAIN Figure 16-13 (a)** oil pump is the only part in an engine that gets unfiltered engine oil. The oil is drawn up from the bottom of the oil pan and is pressurized before flowing to the oil filter. **(b)** If debris gets into an oil pump, the drive or distributor shaft can twist and/or break. When this occurs, the engine will lose all oil pressure. **20. SLIDE 20 EXPLAIN FREQUENTLY ASKED QUESTION**
	**ON-VEHICLE NON-NATEF Task: Inspect oil pump gears or rotors, housing, pressure relief devices, & pump drive; perform necessary action.**
	**21. SLIDE 21 EXPLAIN** Oil Passages **22. SLIDE 22 EXPLAIN Figure 16-14** An intermediate shaft drives the oil pump on this overhead camshaft engine. Note the main gallery and other drilled passages in the block and cylinder head. **23. SLIDE 23 EXPLAIN Figure 16-15** Oil is sent to rocker arms on this Chevrolet V-8 engine through hollow pushrods. Oil returns to oil pan through oil drainback holes in cylinder head.
	**24. SLIDE 24 EXPLAIN TECH TIP**
	**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.**
	**ON-VEHICLE NATEF Task: Research applicable vehicle & service information, vehicle service history, service precautions, & TSBs PAGE 16 & 20**

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	**25. SLIDE 25 EXPLAIN Oil Pans & EXPLAIN Figure 16-16** A typical oil pan with a built-in windage tray used to keep oil from being churned up by the rotating crankshaft
	**26. SLIDE 26 EXPLAIN FREQUENTLY ASKED QUESTION**
	**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://media.pearsoncmg.com/ph/chet/chet_myautomotivelab_2/animations/A1_Animation/Chapter16_Fig_16_14/index.htm
	**27. SLIDE 27 EXPLAIN Dry Sump System & EXPLAIN Figure 16-17** dry sump system as used in a Chevrolet Corvette.
	**ENGINE LUBRICATION WET SUMP ANIMATION: www.myautomotivelab.com** http://media.pearsoncmg.com/ph/chet/chet_myautomotivelab_2/animations/A1_Animation/Chapter16_Fig_16_14/index.htm
	**ENGINE LUBRICATION DRY SUMP ANIMATION: www.myautomotivelab.com** http://media.pearsoncmg.com/ph/chet/chet_myautomotivelab_2/animations/A1_Animation/Chapter16_Fig_16_17/index.htm
	**Dry Sump Oil System ANIMATION:** http://www.jameshalderman.com/animations.html#a1
	**VIDEOS** Lubrication and Cooling System (70 Links)
	**28. SLIDE 28 EXPLAIN Oil Coolers**
	29. SLIDE 29 EXPLAIN Figure 16-18 Oil is cooled by the flow of coolant through the oil filter adapter.
	**30. SLIDE 30 EXPLAIN FREQUENTLY ASKED QUESTION**

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	**ON-VEHICLE NATEF Task:** Inspect, Test, and Replace Oil Temperature and Pressure Switches and Sensors. PAGE 45
	**ON-VEHICLE NATEF Task:** Perform oil pressure tests; determine necessary action PAGE 100
	**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.
	**SEARCH INTERNET:** Have students research American Petroleum Institute (API) and find all engine oil ratings. The first letter should start with "S", which stands for spark ignition (gasoline) 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.
	**Talk through SUMMARY and questions**
	**HOMEWORK:** complete Ch16 crossword puzzle: http://www.jameshalderman.com/links/book_engine_theory_serv_7/cw/crossword_ch_16.pdf