Automotive Technology 6th Edition
Chapter 23 Lubrication System Operation & Diagnosis
Opening Your Class

KEY ELEMENT	EXAMPLES
Introduce Content	This Automotive Technology 6th text provides complete coverage of automotive components, operation, design, and troubleshooting. It correlates material to task lists specified by ASE and ASEEducation (NATEF) and emphasizes a problem-solving approach. Chapter features include Tech Tips, Frequently Asked Questions, Case Studies, Videos, Animations, and ASEEducation (NATEF) Task Sheets.
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: 1. Explain the lubrication principles and discuss engine lubrication systems. 2. Describe the purpose and function of oil pumps. 3. Discuss the purpose and function of oil passages. 4. Discuss oil pans, oil coolers, and the dry sump system.
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 6th Edition Chapter Images found on Jim's web site @ www.jameshalderman.com

DOWNLOAD Chapter 23 Chapter Images: From

http://www.jameshalderman.com/automotive_principles.html NOTE: You can use Chapter Images or possibly Power Point files:

ICONS	CH23 Lubrication System
	**1. SLIDE 1 CH23 LUBRICATION SYSTEM OPERATION & DIAGNOSIS**
	**Check for ADDITIONAL VIDEOS & ANIMATIONS @ http://www.jameshalderman.com/** **WEB SITE IS CONSTANTLY UPDATED**
	**http://www.jameshalderman.com/automotive_principles.html** **DOWNLOAD** **Crossword Puzzle (Microsoft Word) (PDF)** **Word Search Puzzle (Microsoft Word) (PDF**
	**LUBRICATION SYSTEM** **Videos**
	**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 triggered. Engine bearing knock or lifter noise may be evident before light is illuminated.**

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	2. **SLIDE 2 EXPLAIN Figure 23-1** Oil molecules cling to metal surfaces but easily slide against each other. 3. **SLIDE 3 EXPLAIN Figure 23-2** Wedge-shaped oil film developed below a moving block. 4. **SLIDE 4 EXPLAIN Figure 23-3** Wedge-shaped oil film curved around a bearing journal.
	5. **SLIDE 5 EXPLAIN Figure 23-4** 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 ASEEDUCATION Task: Inspect, Test, and Replace Oil Temperature and Pressure Switches and Sensors. (P-2):**
Education Foundation	
	6. **SLIDE 6 EXPLAIN Figure 23-5** oil pump driven by the camshaft. 7. **SLIDE 7 EXPLAIN Figure 23-6** 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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	8. **SLIDE 8 EXPLAIN Figure 23-7** typical internal/external oil pump mounted in the front cover of the engine that is driven by the crankshaft. 9. **SLIDE 9 EXPLAIN Figure 23-8** 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.**
	External Gear Oil Pump (View) (Download) Gerotor Pump - Slow (View) (Download) Gerotor - Type Oil Pump (View) (Download) Internal-External Gear Pump with Crescent (View) (Download) Rotor Oil Pump (View) (Download) Vane Phaser (View) (Download)
	**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.**
	10. **SLIDES 10 EXPLAIN Figure 23-9** Gerotor-type oil pump driven by the crankshaft. 11. **SLIDE 11 EXPLAIN FIGURE 23–10** Oil pressure relief valves are spring loaded. The stronger the spring tension, the higher the oil pressure.
	12. **SLIDE 12 EXPLAIN Figure 23-11** 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.

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	**DISCUSS FREQUENTLY ASKED QUESTION: Is a High-Pressure or High-Volume Oil Pump Needed? No. Engine parts need pressure after the oil reaches parts that are to be lubricated. The oil film between the parts is developed and maintained by hydrodynamic lubrication. Excessive oil pressure requires more Horsepower and provides no better lubrication than the minimum effective pressure. A high-volume pump is physically larger and pumps more oil with each revolution. A high-volume pump is used mostly in race engines where the main and rod bearing clearances are much greater than normal, and, therefore, would need a great volume of oil to make up for the oil leaking from the wide clearances.** 13. **SLIDE 13 EXPLAIN Figure 23-12 (a)** visual inspection indicated that this pump cover was worn. **23-12 (b)** embedded particle of something was found on one of the gears, making this pump worthless except for scrap metal.  14. **SLIDE 14 EXPLAIN Figure 23-13 (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. **23-13 (b)** If debris gets into oil pump, drive or distributor shaft can twist and/or break. When this occurs, engine will lose all oil pressure.  **ON-VEHICLE ASEEDUCATION Task: Inspect oil pump gears or rotors, housing, pressure relief devices, & pump drive; perform needed action.** Education Foundation

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	15. **SLIDE 15 EXPLAIN Figure 23-14** 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. 16. **SLIDE 16 EXPLAIN Figure 23-15** 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.
	**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. Today many dealers will perform an oil analysis to determine if the proper oil was used in an engine if the engine fails.**
	**EXPLAIN TECH TIP:** **New Hemi Engine Oiling System:** **Chrysler Hemi V-8 engine uses a unique oiling system because the valve lifters are fed oil from the top of the cylinder heads and through the pushrods. While it is normal to have oil flowing through hollow pushrods, it is unique that in the Hemi V-8 the oil flows backward from normal and from the head down the hollow pushrods to the lifters. Be sure to use the specified viscosity of oil, as this is critical for proper lubrication of the valve lifters.**

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 	**ON-VEHICLE ASEEDUCATION Task:** Research applicable vehicle & service information, vehicle service history, service precautions, & TSBs.(P-1)
	**DISCUSS FREQUENTLY ASKED QUESTION: Why Is It Called a Windage Tray?** A windage tray **FIGURE 23-16** is a plate or baffle installed under the crankshaft and is used to help prevent aeration of the oil. Where does the wind come from? Pistons push air down into the crankcase as they move from top dead center to bottom dead center. The pistons also draw air oil upward when moving from bottom dead center to TDC. At high engine speeds, this causes a great deal of airflow, which can easily aerate the oil. Therefore, a windage tray is used to help prevent this movement of air (wind) from affecting the oil in the pan. Try the following: • Take an oil pan and add a few quarts (liters) of oil. • Then take an electric hair dryer and use it to blow air into the oil pan. Oil will be thrown everywhere, which helps illustrate why windage trays are used in all newer engines.
	19. **SLIDE 19 EXPLAIN Figure 23-16** typical oil pan with a built-in windage tray used to keep oil from being churned up by the rotating crankshaft.

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	**DEMONSTRATION:** Show students an oil pan with a built-in windage tray. Have students discuss the benefits of this configuration.
	Cylinder Wall Lubrication (View) (Download) Dry Sump Oil System (View) (Download) Vane Phaser (View) (Download)
	21. **SLIDE 21 EXPLAIN Figure 23-18** dry sump system as used in a Chevrolet Corvette. 22. **SLIDE 22 EXPLAIN Figure 23-19** Oil is cooled by the flow of coolant through the oil filter adapter.
 	**ON-VEHICLE ASEEDUCATION Task:** Inspect Auxiliary Oil Coolers; Determine Needed 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.
	**SEARCH INTERNET:** 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.