Introduction to Automotive Service

Chapter 16 Engine Lubrication and Cooling Systems

Opening Your Class

KEY ELEMENT	EXAMPLES
Introduce Content	This course or class serves as an introduction to the world of automotive service. It correlates material to task lists specified by ASE and NATEF.
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. 1. Prepare for ASE Engine Repair (A1) certification test content area "D" (Lubrication and Cooling Systems Diagnosis and Repair). 2. Describe how the oil pump and engine lubrication work. 3. Discuss how oil lubricates the internal engine parts 4. Describe how the cooling system works. 5. List the types of coolant.
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.

ICONS	Ch16 Engine Lubrication & Cooling Systems
	1. SLIDE 1 CH16 ENGINE LUBRICATION & COOLING SYSTEMS 2. SLIDE 2 EXPLAIN LUBRICATION
	Check for ADDITIONAL VIDEOS & ANIMATIONS @ http://www.jameshalderman.com/ WEB SITE IS CONSTANTLY UPDATED
	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 @ idle) before warning light is triggered. Engine bearing knock or lifter noise may be evident before light is illuminated.
	3. SLIDE 3 EXPLAIN FIGURE 16-1 Oil molecules cling to metal surfaces but easily slide against each other. 4. SLIDE 4 EXPLAIN FIGURE 16-2 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

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	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: (A1D12) Inspect, Test, and Replace Oil Temperature and Pressure Switches and Sensors. (P-2): Page 60**
	5. **SLIDE 5 EXPLAIN FIGURE 16-3** 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. 6. **SLIDE 6 EXPLAIN** LUBRICATION
	**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
	**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.**
	**Gerotor - Type Oil Pump ANIMATION:** http://www.jameshalderman.com/animations.html#a1

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	**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.
	**ON-VEHICLE NATEF Task: (A1D2)** Inspect oil pump gears or rotors, housing, pressure relief devices, & pump drive; perform necessary action (P-2) Page 58
	7. **SLIDE 7** EXPLAIN **FIGURE 16-4** 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**.**
	8. **SLIDE 8** EXPLAIN **Oil Passages** 9. **SLIDE 9** EXPLAIN **FIGURE 16-5** 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. 10. **SLIDE 10** EXPLAIN **FIGURE 16-6** Oil is sent to the rocker arms on this Chevrolet V-8 engine through the hollow pushrods. The oil returns to the oil pan through the oil drain back holes in the 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.**
	**ON-VEHICLE NATEF Task: (A1A3)** Research applicable vehicle & service information, vehicle service history, service precautions, & TSBs. (P-1) Page 57

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	**11. SLIDE 11 EXPLAIN Oil Pans**
	**12. SLIDE 12 EXPLAIN FIGURE 16-7** typical oil pan with a built-in windage tray used to keep oil from being churned up by the rotating crankshaft.
	**DEMONSTRATION: Show students an oil pan with a built-in windage tray. Have students discuss the benefits of this configuration.**
	**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
	**13. SLIDE 13 EXPLAIN** Oil Coolers **14. SLIDE 14 EXPLAIN FIGURE 16-8** Oil is cooled by the flow of coolant through the oil filter adapter.
	**ON-VEHICLE NATEF Task: (A1D11) Inspect Auxiliary Oil Coolers; Determine Necessary Action (P-3)**
	**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.**

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	**15. SLIDES 15 EXPLAIN** Cooling System **16. SLIDE 16 EXPLAIN FIGURE 16-9** Typical combustion and exhaust temperatures.
	**DISCUSSION: Have students discuss heat generated in an engine. Ask: "If one-third of the heat is removed through the cooling system, and one-third is removed through the exhaust system, what is the other one-third used for?" (Answer: Pushing pistons down.)**
	**Engines that do not reach proper operating temperature may leave water in oil, which can cause engine failures, such as bearing failure.**
	**DISCUSSION: Discuss with students how improper coolant temperature can harm fuel economy. Why does temperature affect fuel economy? (ANS: Changes fuel vaporization rate)**
	**Water Pump Operation ANIMATION:** **http://www.jameshalderman.com/animations.html#a1**
	**VIDEOS** **Lubrication and Cooling System (70 Links)**
	**Thermostat Operation ANIMATION:** **http://www.jameshalderman.com/animations.html#a1**
	**17. SLIDE 17 EXPLAIN 16-10** engine cooling system includes the water jackets (passages) in the engine, plus the water pump and radiator. Hoses are used to move the coolant to and from the radiator and to and from the heater core inside the vehicle. The thermostat is used to control coolant temperature

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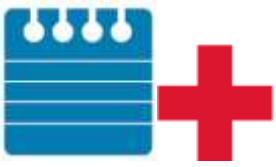
	**DISCUSSION:** Have students discuss possible reasons that older engines were less likely to have engine failure from overheating. (The reason is that heavy steel blocks and heads displaced heat better and were able to take higher temperatures without damage due to amount of metal.)
	**DEMONSTRATION:** Show students a bypass hose and where it is located on different engines.
	**DISCUSSION:** Discuss with students why the bypass hose is so important. Why is it important? (ANS: Allows for rapid engine warm up)
	**ON-VEHICLE NATEF Task: (A1A3)** Research applicable vehicle and service information, vehicle service history, service precautions, and technical service bulletins (P-1), P.47
	**DEMONSTRATION:** Show students different styles of radiators.
	**DISCUSSION:** Discuss importance of heat transfer. What are 3 forms of heat transfer from Physics Class? (ANS: Conductance, Convection, & Radiation. Radiators despite their name, generally transfer bulk of their heat via convection, not by thermal radiation. Convection is transfer of heat from one place to another by movement of fluids. Convection is usually the dominant form of heat transfer in liquids and gases)
	**SAFETY TIP:** Always remove a pressure cap slowly using rags or heavy gloves for protection. A hot cooling system can spray coolant or steam under pressure. Even a cold system may have pressure that can spray coolant into eyes or damage paint.

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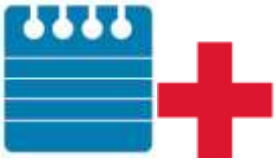
	**DEMONSTRATION:** Demonstrate how a pressure cap vents at the pressure listed.
	**RADIATOR PRESSURE CAP ANIMATION: www.myautomotivelab.com** http://media.pearsoncmg.com/ph/chet/chet_myautomotivelab_2/animations/A1_Animation/Chapter14_Fig_14_14/index.htm
	**Pressure Cap Operation ANIMATION:** http://www.jameshalderman.com/animations.html#a1
	**CLUTCH FAN & HOSES VIDEO: 1.5 MINUTES www.myautomotivelab.com** http://media.pearsoncmg.com/ph/chet/chet_mylabs/akamai/template/video640x480.php?title=Clutch%20Fan%20and%20Hoses&clip=pandc/chet/2012/automotive/Auto_Parts_Specialist/Exp5.mov&caption=chet/chet_mylabs/akamai/2012/automotive/Auto_Parts_Specialist/xml/Exp5.xml
	**SAFETY: Electrical cooling fans can come on unexpectedly. Always keep hands and objects clear of them. Spring-type fans should spin freely on a cold engine.**
	**DEMONSTRATION:** Show students examples of heater cores and their locations.
	**Coolant on the passenger floor or a mist out of the vents may be caused by a leaking heater core.**
	**Some vehicles, especially hybrids, use a form of electrical heater core**
	18. **SLIDES 18-19 EXPLAIN COOLANT** 20. **SLIDE 20 EXPLAIN Types of Coolant** 21. **SLIDE 21 EXPLAIN FIGURE 16-11** Havoline was the first company to make and market OAT coolants. General Motors uses the term “DEX-COOL.” 22. **SLIDE 22 EXPLAIN FIGURE 16-12** Coolant used in Fords that use Mazda engines and in Mazda vehicles. It requires the use of an HOAT coolant, which is dark

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	green and is premixed 55% antifreeze and 45% water in this example 23. **SLIDE 23 EXPLAIN Types of Coolant** 24. **SLIDE 24 EXPLAIN FIGURE 16-13** Not all embittered coolants are labeled "embittered." Many states now require that all coolants sold in the state be embittered **Homework: complete Ch16 crossword puzzle: http://www.jameshalderman.com/links/book_intro/cw/crossword_ch_16.pdf**