Automotive Engines
Chapter 13 Coolant
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. Describe the various types of antifreeze coolants. 3. Discuss how to store, recycle, and discard used coolant. 4. Discuss how to test 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	CHAPTER 13 COOLANT
	**1. SLIDE 1 CHAPTER 20 COOLANT** **2. SLIDES 2-3 EXPLAIN OBJECTIVES & KEY TERMS**
	**Check for ADDITIONAL VIDEOS & ANIMATIONS @ http://www.jameshalderman.com/** **WEB SITE REGULARLY UPDATED**
	**VIDEOS** **Engine Operation (17 Links)**
	**4. SLIDE 4 EXPLAIN** Coolant Fundamentals & **EXPLAIN FIGURE 13-1** Graph showing the relationship of the freezing point of the coolant to the percentage of antifreeze used in the coolant. **5. SLIDE 5 EXPLAIN** Coolant Fundamentals **6. SLIDE 6 EXPLAIN FIGURE 13-2** Graph showing how the boiling point of the coolant increases as the percentage of antifreeze in the coolant increases. **7. SLIDE 7 EXPLAIN** Coolant Fundamentals
	**8. SLIDE 8 EXPLAIN Types of Coolant** **9. SLIDE 9 EXPLAIN FIGURE 13-3** Havoline was the first company to make and market OAT coolant. General Motors uses the term DEX-COOL
	**DEMONSTRATION: Show students examples of coolant colors. Explain that coolant spills should be cleaned up immediately since they are very slick and can be hazardous.**
	**SAFETY TIP: Never leave open coolant containers where animals can reach them. Animals enjoy sweet taste of coolant & drink it. Coolant can kill pets. Even embittered coolant should not be left around animals. Even though animals may not like taste of this coolant and so may not drink it, they still may lick it and become ill.**
	**DISCUSSION: Discuss how the mixing of types of coolants may harm the system. Discuss with students some examples of manufacturer issues with DEX-COOL. Who was the first OEM to use DEX-COOL?**

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	**10. SLIDE 10 EXPLAIN FIGURE 13-4** Coolant used in Fords that use Mazda engines and in Mazda vehicles. It requires the use of a **PHOAT** coolant which is dark green.
	**11. SLIDE 11 EXPLAIN FREQUENTLY ASKED QUESTION**
	**12. SLIDE 12 EXPLAIN FREQUENTLY ASKED QUESTION**
	**13. SLIDE 13 EXPLAIN FIGURE 13--5** Not all embittered coolant is labeled embittered.
	**14. SLIDE 14 EXPLAIN REAL WORLD FIX**
	**15. SLIDE 15 EXPLAIN FREQUENTLY ASKED QUESTION**
	**16. SLIDES 16-17 EXPLAIN Water**
	**DISCUSSION: Discuss the importance of a proper coolant and water mix, and the problems that arise from incorrect mixtures.**
	**18. SLIDES 18 EXPLAIN** Coolant Freezing/Boiling Temperatures
	**19. SLIDE 19 EXPLAIN FREQUENTLY ASKED QUESTION**
	**DISCUSSION: Discuss with students why the freezing point and the boiling point are not the only things to check when testing coolant. What is the difference between freezing & boiling point?**

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	**20. SLIDES 20 EXPLAIN** Coolant Freezing/Boiling Temperatures
	**21. SLIDES 21-22 EXPLAIN Coolant Testing**
	23. SLIDE 23 EXPLAIN FIGURE 13-6 Galvanic activity is created by two dissimilar metals in contact with a liquid, in this case coolant
	24. SLIDE 24 EXPLAIN FIGURE 13–7 Using a refractometer is an accurate method to check the freezing point of coolant
	25. SLIDE 25 EXPLAIN FIGURE 13–8 meter that measures the actual pH of the coolant can be used for all coolants, unlike many test stripes that cannot be used to test the pH of red or orange coolants
	**DEMONSTRATION: Show students how to test for electrolysis in cooling system.**
	**Coolant colors vary even within OEMS models. Color has no bearing on the service life of the coolant. Most OEMS recommend using distilled water, not tap water, in cooling systems. Distilled water does not have all the chemicals that can harm your cooling system.**
	**26. SLIDE 26 EXPLAIN FIGURE 13–9** Galvanic activity is created by two dissimilar metals in contact with a liquid, in this case coolant.
	**DISCUSSION: Discuss with students why galvanic activity was not a big problem with the older steel engines.**
	**27. SLIDE 27 EXPLAIN FIGURE 13–10** A test strip can be used to determine the pH and percentage of glycol of the coolant. The percentage of glycol determines the freezing and boiling temperatures, as shown on the bottle that contains the test strips
	**28. SLIDE 28 EXPLAIN** Coolant Replacement Issues

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	**Electrolysis in cooling system can create corrosion that destroys components from the inside out**
	**HANDS-ON TASK: Have students use test strips to verify the coolant condition**
	**ON-VEHICLE NATEF TASK Inspect and test coolant; drain and recover coolant; flush and refill cooling system with recommended coolant; bleed air as required PAGE 30**
	**SEARCH INTERNET (2 HOURS OUTSIDE WORK): Have students research the Internet to find out which coolants are organic acid technology types besides DEX-COOL. Have students research which states require embittered coolant other than California and Oregon. Have them share their findings in class.**
	**Talk through SUMMARY and questions**
	**HOMEWORK: complete Ch13 crossword puzzle: http://www.jameshalderman.com/links/book_engine_theory_serv_7/cw/crossword_ch_13.pdf**