

Automotive Technology 6th Edition

Chapter 20 Coolant

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: <ol style="list-style-type: none"> 1. Discuss coolant fundamentals. 2. Compare the different types of coolant. 3. Discuss coolant freezing/boiling temperatures. 4. Discuss coolant testing and coolant replacement issues.
Establish the Mood or Climate	Provide a <i>WELCOME</i> , 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 20 Chapter Images: From

<http://www.jameshalderman.com/>

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

ICONS

CH20 COOLANT



1. SLIDE 1 CHAPTER 20 COOLANT

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

[http://www.jameshalderman.com/
automotive_principles.html](http://www.jameshalderman.com/automotive_principles.html)

DOWNLOAD

Crossword Puzzle (Microsoft Word) (PDF)

Word Search Puzzle (Microsoft Word) (PDF)

COOLANT

<http://www.youtube.com/watch?v=ODwfBDvWxmU>

2. **SLIDE 2 EXPLAIN Figure 20-1** Graph showing the relationship of the freezing point of the coolant to the percentage of antifreeze used in the coolant.
3. **SLIDE 3 EXPLAIN Figure 20-2** Graph showing how the boiling point of the coolant increases as the percentage of antifreeze in the coolant increases
4. **SLIDE 4 EXPLAIN Figure 20-3** Havoline was the first company to make and market OAT coolant. General Motors uses the term DEX-COOL.
5. **SLIDE 5 EXPLAIN Figure 20-4** Coolant used in Fords that use Mazda engines and in Mazda vehicles. It requires the use of a **PHOAT** coolant which is dark green.

ICONS



CH20 COOLANT

DISCUSS FREQUENTLY ASKED QUESTION:

What Is a “G” Coolant?

The “G” coolants come from the trade name **Glysantin** of **BASF** in Europe and **Valvoline (Zerex)** in the United States. The following is a summary of the types listed by G number.

- **G05: different from DEX-COOL in certain amounts of additives**
- **G30 and G34: nonsilicate and phosphate free**
- **G11: blue VW used before 1997**
- **G12: pink/red VW 1997+ (purple VW 2003+)**
- **HOAT formulation**
- **Phosphate free**
- **G48: low silicate and phosphate free**
- **Blue**
- **Nitrates, amines, phosphate (NAP) free**

ICONS



CH20 COOLANT

DISCUSS CASE STUDY:

If 50% Is Good, 100% Must Be Better

A vehicle owner said that the cooling system of his vehicle would never freeze or rust. He used 100% antifreeze (ethylene glycol) instead of a 50/50 mixture with water. However, after the temperature dropped to -20°F (-29°C), the radiator froze and cracked. (Pure antifreeze freezes at about 0°F [-18°C]). After thawing, radiator had to be replaced. The owner was lucky that the engine block did not also crack. For best freeze protection with good heat transfer, use a 50/50 mixture of antifreeze and water. As percentage of antifreeze increases, the boiling temperature increases, and freezing protection increases (up to 70% antifreeze), but the heat transfer performance of mixture decreases.

Summary:

Complaint—coolant froze and cracked the radiator.

Cause—Vehicle owner used 100% antifreeze instead of recommended 50/50 mixture of antifreeze and water.

Correction—radiator was replaced and proper mixture of antifreeze/water was used as the coolant.

ICONS **CH20 COOLANT**



DISCUSS FREQUENTLY ASKED QUESTION:
What Makes Some Water Bad for Coolant?
City water is treated with chloride, which, if the levels are high enough, can cause corrosion problems when used in coolants. Well water may contain iron or other minerals that can affect the coolant and may increase corrosion or cause electrolysis. Due to the fact that the water quality is often unknown and could affect the engine, many OEMS are specifying use of premixed coolant. In premix coolant, the water is usually demineralized and meets the standards for use in coolant.



EXPLAIN TECH TIP:
Always Use **Demineralized or Distilled Water**
All vehicle manufacturers recommend the use of demineralized or distilled water whenever servicing a vehicle with coolant that requires water to be added. This pertains to all coolants, regardless of type (IAT, OAT or HOAT). Most Asian vehicle manufacturers recommend the use of premixed coolants because the quality of the water can be controlled without excessive hardness or chlorine, which can cause corrosion in the cooling system.



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.

ICONS



CH20 COOLANT

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?

ICONS



CH20 COOLANT

DISCUSS FREQUENTLY ASKED QUESTION:

What Is “Pet Friendly” Antifreeze?

Conventional ethylene glycol antifreeze used by all vehicle manufacturers is attractive to pets and animals because it has a sweet taste. Ethylene glycol is fatal to any animal if swallowed, so any spill should be cleaned up quickly. There are two types of coolant that are safer for use around pets than the conventional type.

- **Propylene glycol (PG).** This type of antifreeze is less attractive to pets and animals because it is not as sweet, but it is still harmful if swallowed. This type of coolant, including the Sierra brand, should not be mixed with any other ethylene glycol-based coolant.

CAUTION: Some vehicle manufacturers do not recommend the use of propylene glycol coolant. Check the recommendation in the owner manual or service information before using it in a vehicle.

- **Embittered coolant.** This coolant has a small amount of a substance that makes it taste bitter and, therefore, not appealing to animals. The embittering agent used in ethylene glycol (EG) antifreeze is usually denatonium benzoate, added at the rate of 30 (parts per million) PPM. Oregon and California require all coolant sold in these states since 2004 to be embittered. • **SEE FIGURE 20-5.**

ICONS	CH20 COOLANT
-------	--------------



6. SLIDE 6 **EXPLAIN** Figure 20-5 Not all embittered coolant is labeled embittered.



DISCUSSION: Discuss the importance of a proper coolant and water mix, and the problems that arise from incorrect mixtures.



DISCUSS FREQUENTLY ASKED QUESTION:
Why Is Most Coolant 50/50 with Water?
According to the freezing point, it appears that the lowest freezing point of coolant is achieved when 70% antifreeze is used with 30% water. While the freezing temperature is lower, the high concentrate of antifreeze reduces the heat transferability of the coolant. So, most OEMS specify a 50/50 mixture of antifreeze and water to achieve the best balance between freeze protection and heat conductivity.



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?

7. SLIDE 7 **EXPLAIN** FIGURE 20-6 Checking the freezing temperature of the coolant using a hydrometer.

8. SLIDE 8 **EXPLAIN** FIGURE 20-7 Using refractometer is an accurate method to check freezing point of coolant

9. SLIDE 9 **EXPLAIN** FIGURE 20-8 meter that measures actual pH of coolant can be used for all coolants, unlike many test strips that cannot be used to test pH of red or orange coolants

10. SLIDE 10 **EXPLAIN** Figure 20-9 Galvanic activity is created by two dissimilar metals in contact with a liquid, in this case coolant.

ICONS	CH20 COOLANT
	<p><u>DISCUSSION:</u> Discuss with students why galvanic activity was not a big problem with the older steel engines.</p>
	<p><u>DEMONSTRATION:</u> Show students how to test for electrolysis in cooling system.</p>
	<p>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.</p>
	<p>Electrolysis in cooling system can create corrosion that destroys components from the inside out</p>
	<p><u>EXPLAIN TECH TIP:</u> Ignore the Wind Chill Factor</p>
	<p>The wind chill factor is a temperature that combines actual temperature and the wind speed to determine overall heat loss effect on open skin. Because it is heat loss factor for open skin, the wind chill temperature is not to be considered when determining antifreeze protection levels. Although moving air makes it feel colder, the actual temperature is not changed by the wind, and the engine coolant will not be affected by the wind chill. If you are not convinced, try placing a thermometer in a room and wait until a stable reading is obtained. Now turn on a fan and have the air blow across the thermometer. The temperature will not change.</p>
	<p><u>HANDS-ON TASK:</u> Have students use test strips to verify the coolant condition</p>

ICONS	CH20 COOLANT
   ASE Education Foundation	<p><u>SEARCH INTERNET</u> 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.</p> <p><u>ON-VEHICLE ASE EDUCATION TASK</u> Test and Replace Coolant Coolant Flush</p>