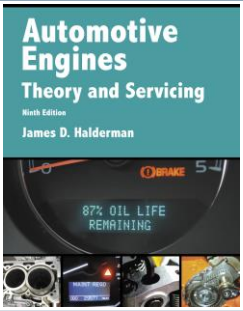
Automotive Engines Theory and Servicing

Ninth Edition



Chapter 13
Coolant

OBJECTIVES

13.1 Discuss coolant fundamentals.

13.2 Compare the different types of coolant.

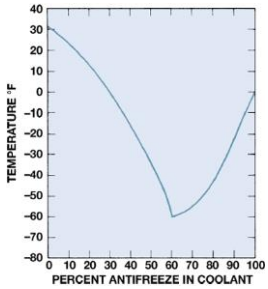
13.3 Discuss coolant freezing/boiling temperatures and water as coolant.

13.4 Discuss coolant testing and coolant replacement issues.

COOLANT FUNDAMENTALS (1 OF 4)

- Coolant is used in the cooling system because it:
  - Transfers heat from the engine to the radiator
  - Protects the engine and the cooling system from rust and corrosion
  - Prevents freezing in cold climates

FIGURE 13–1 Graph showing the relationship of the freezing point of the coolant to the percentage of antifreeze used in the coolant.



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COOLANT FUNDAMENTALS (2 OF 4)

- It should be noted that the freezing point increases as the antifreeze concentration is increased above 60%.
  - The normal mixture is 50% antifreeze and 50% water.

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COOLANT FUNDAMENTALS (3 OF 4)

- Ethylene glycol antifreeze contains:
  - Anticorrosion additives
  - Rust inhibitors
  - Water pump lubricants

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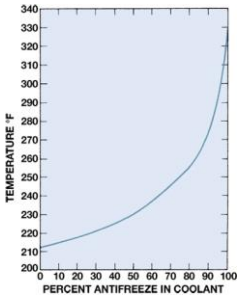
FIGURE 13–2 Graph showing how the boiling point of the coolant increases as the percentage of antifreeze in the coolant increases.



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COOLANT FUNDAMENTALS (4 OF 4)

- All manufacturers recommend the use of ethylene glycol based coolant, which contains:
  - Ethylene glycol (EG): 47%
  - Water: 50%
  - Additives: 3%

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TYPES OF COOLANT

- Inorganic Acid Technology
- Organic Acid Technology
- Hybrid Organic Acid Technology
- Phosphate Hybrid Organic Acid Technology
- Universal Coolant

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FIGURE 13–3 Havoline was the first company to make and market OAT coolant. General Motors uses the term DEX-COOL.

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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.

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WATER (1 OF 2)

- Water is about half of the coolant and is used because of the following qualities.
  - It is inexpensive.
  - It is an efficient heat exchange fluid because of its excellent thermal conductivity.

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WATER (2 OF 2)

- It has good specific heat capacity, meaning it takes more heat energy to increase the temperature, versus one with low specific heat capacity.
- The boiling point is 212°F (100°C) (at sea level).
- The freezing point is 32°F (0°C).

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COOLANT FREEZING/BOILING TEMPERATURES (1 OF 4)

- Freezing Point
  - Pure water
    - 32°F (0°C)
  - Pure antifreeze*
    - 0°F (-18°C)
  - 50/50 mixture
    - - 34°F (-37°C)

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COOLANT FREEZING/BOILING TEMPERATURES (2 OF 4)

  - 70% antifreeze/30% water
    - - 84°F (-64°C)
- Boiling Point at Sea Level
  - Pure water
    - 212°F (100°C)
  - 50/50 mixture
    - 218°F (103°C)

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COOLANT FREEZING/BOILING TEMPERATURES (3 OF 4)

- 70/30 mixture
  - 225°F (107°C)
- Boiling Point with 15 PSI Pressure Cap
  - Pure water
    - 257°F (125°C)
  - 50/50 mixture
    - 265°F (130°C)

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COOLANT FREEZING/BOILING TEMPERATURES (4 OF 4)

- 70/30 mixture
  - 276°F (136°C)

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COOLANT TESTING (1 OF 3)

- Normal coolant tests include:
  - Visual inspection.
    - Coolant should be clean and bright.
  - Freeze/boiling point.
    - A high freezing point or low boiling point indicates dilution (too much water).

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COOLANT TESTING (2 OF 3)

- pH.
  - The wrong pH indicates buffer loss, which is used to help maintain the pH level.
- Coolant voltage.
  - A high voltage indicates the wrong pH or a stray current flow.

- Hydrometer Testing
- Refractometer

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COOLANT TESTING (3 OF 3)

- Ph
- Galvanic Activity
- Electrolysis
- Testing For Galvanic Activity And Electrolysis
- Test Strip Testing

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FIGURE 13–6 Checking the freezing temperature of the coolant using a hydrometer.

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FIGURE 13–7 Using a refractometer is an accurate method to check the freezing point of coolant.

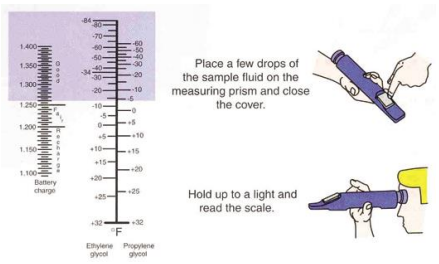

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FIGURE 13–8 A meter that measures the actual pH of the coolant can be used for all coolants, unlike many test strips that cannot be used to test the pH of red or orange coolants.

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FIGURE 13–9 Galvanic activity is created by two dissimilar metals in contact with a liquid, in this case coolant.

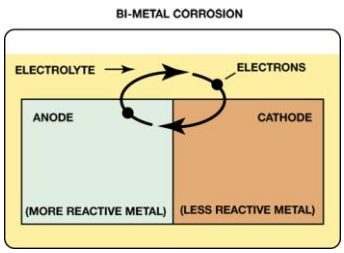

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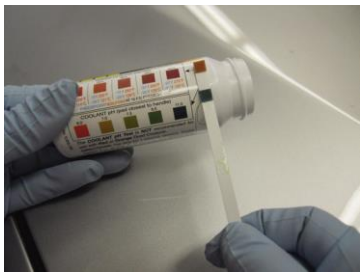
FIGURE 13–10 A test strip can be used to determine the pH and percentage of glycol of the coolant. The percentage of glycol determines the freezing and boiling temperatures, as shown on the bottle that contains the test strips.



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COOLANT REPLACEMENT ISSUES

- Intervals
- Passivation
- Recycling Coolant

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SUMMARY (1 OF 2)

- All coolant is ethylene glycol based. Some aftermarket coolants use propylene glycol.
- Used coolant should be recycled whenever possible.
- The freezing temperature of the coolant can be tested using a hydrometer or refractometer.

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SUMMARY (2 OF 2)

- Proper cooling system maintenance usually calls for replacing the coolant every two years or every 24,000 miles (36,000 km) for IAT coolant.
  - Longer for OAT, HOAT, and PHOAT coolants.

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