

# Automotive Technology 5<sup>th</sup> Edition

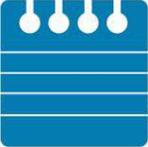
## ATE4 Chapter 66 GASOLINE

### Opening Your Class

KEY ELEMENT	EXAMPLES
<b>Introduce Content</b>	This 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.
<b>Motivate Learners</b>	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.
<b>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.</b>	Explain learning objectives to students as listed below: <ol style="list-style-type: none"> <li>1. Explain the chemical composition of gasoline and the process of refining gasoline.</li> <li>2. Discuss how volatility affects driveability.</li> <li>3. Explain the process of gasoline combustion and the means of avoiding abnormal combustion.</li> <li>4. Discuss the benefits of using gasoline additives, reformulating gasoline, and blending gasoline.</li> <li>5. Discuss safety precautions when working with gasoline.</li> </ol>
<b>Establish the Mood or Climate</b>	Provide a <i>WELCOME</i> , Avoid put downs and bad jokes.
<b>Complete Essentials</b>	Restrooms, breaks, registration, tests, etc.
<b>Clarify and Establish Knowledge Base</b>	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 5<sup>th</sup> Edition Chapter Images found on Jim's web site @ [www.jameshalderman.com](http://www.jameshalderman.com)**

**LINK CHP 66: [ATE5 Chapter Images](#)**

ICONS	Chapter 66 Gasoline
      <p>QUESTION</p>   <p>QUESTION</p>      <p>QUESTION</p>  <p>DEMO</p>	<p><b>1. SLIDE 1 Chapter 66 GASOLINE</b></p> <p>Check for ADDITIONAL VIDEOS &amp; ANIMATIONS @ <a href="http://www.jameshalderman.com/">http://www.jameshalderman.com/</a> WEB SITE IS CONSTANTLY UPDATED</p> <p><b><u>Videos</u></b></p> <p><b><u>DISCUSSION:</u></b> Have the students talk about chemical composition of <b><u>gasoline</u></b>. How many carbon atoms do the hydrocarbons in gasoline have?</p> <p><b><u>DISCUSSION:</u></b> Have the students talk about the dangers of <b><u>hydrocarbons</u></b>. Is a hydrocarbon harmful as a liquid? Is it harmful as a gas? What safety precautions should be taken when handling hydrocarbons?</p> <p><b>2. SLIDE 2 EXPLAIN</b> Figure 66-1 crude oil refining process showing most of the major steps and processes</p> <p><b>Having different grades of gasoline, different blends, and varying freshness on hand as you discuss gasoline will offer students a variety of fuels to observe &amp; test.</b></p> <p><b><u>HANDS-ON TASK:</u></b> Have the students complete an <b><u>MSDS</u></b> review of hydrocarbons to determine whether they understand hazards of hydrocarbons</p> <p><b><u>DISCUSSION:</u></b> Have the students talk about <b><u>Distillation</u></b> process. In addition to fuel, what other products are produced through distillation process?</p> <p><b><u>DEMONSTRATION:</u></b> Locate a <b><u>video</u></b> that <b><u>demonstrates distillation process</u></b>. Have students watch it &amp; discuss process. National Geographic Channel or Discovery Channel are</p>

## ICONS

## Chapter 66 Gasoline



possible video sources. **LRC** may have this video **DISCUSSION:** Have the students discuss cracking process. What is difference between thermal cracking, catalytic cracking, & hydrocracking? **FIGURE 66-1**

3. **SLIDE 3 EXPLAIN Figure 66-2** A gasoline testing kit, including an insulated container where water at 100° F is used to heat a container holding a small sample of gasoline. The reading on the pressure gauge is the Reid vapor pressure (RVP).

**DEMONSTRATION:** Show the students how to test gasoline, emphasizing RVP reading as a classification for usage. **FIGURE 66-2**

**DISCUSSION:** Have students discuss cold start problems that are related to fuel issues. Why is it important for fuel to have a specific **RVP** reading?

[Fuel Blending In-Line \(View\) \(Download\)](#)

[Fuel Blending Sequential \(View\) \(Download\)](#)

[Fuel Blending Splash \(View\) \(Download\)](#)

[Fuel Mileage, Gas \(View\) \(Download\)](#)

[Fuel Mileage, Hybrid \(View\) \(Download\)](#)

4. **SLIDE 4 EXPLAIN Figure 66-3** A typical distillation curve. Heavier molecules evaporate at higher temperatures and contain more heat energy for power, whereas lighter molecules evaporate easier for starting.
5. **SLIDE 5 EXPLAIN Figure 66-4** An engine will not run if the air-fuel mixture is either too rich or too lean.
6. **SLIDE 6 EXPLAIN Figure 66-5** With a three-way catalytic converter, emission control is most efficient with an air-fuel ratio between 14.65 to 1 and 14.75 to 1.

**HANDS ON-TASK:** [Check fuel RVP BASED ON DEMO](#)

ICONS	Chapter 66 Gasoline
	<p><b>DISCUSSION:</b> Have the students talk about how air-fuel ratios are stated. Why is the ratio usually measured by weight and not volume?</p>
	<p><b>DEMONSTRATION:</b> Show how fuel injector sprays fuel into combustion chamber by creating an external fuel system in which students can view an injector spraying fuel into visible container. For safety reasons, you can perform this demonstration with water instead of fuel, keeping in mind that injectors and pump sustain damage from water after long-term use.</p>
	<p><b>DISCUSSION:</b> Have the students discuss air-fuel ratios. What makes an air-fuel mixture too rich or too lean?</p>
	<p><b>DISCUSSION:</b> Have the students talk about the gasoline combustion process. Will a contaminated atmosphere have an effect on combustion process?</p>
	<p><b>FIGURES 66-3 &amp; 4</b></p>
	<p><b>DISCUSSION:</b> Have the students refer to <b>FIGURE 66-5</b> and discuss what happens to NO<sub>x</sub>, CO, and HC in three-way catalytic converter. Why does <b>stoichiometric ratio</b> work best to control these mixtures? <b>ANS: STOICHIOMETRIC IS concerned with, involving, or having the exact proportions for a particular chemical reaction.</b></p>
	<p>7. <b>SLIDE 7 EXPLAIN Figure 66-6</b> Normal combustion is a smooth, controlled burning of the air-fuel mixture.</p>
	<p>8. <b>SLIDE 8 EXPLAIN Figure 66-7</b> Detonation is a secondary ignition of the air-fuel mixture. It is also called spark knock or pinging.</p>
	<p><b>DEMONSTRATION:</b> Have students listen to a vehicle making knocking sound due to detonation. Ask them to describe what this sounds like to them. This can be done on an older vehicle by advancing timing or disconnecting EGR: <b>FIGURE 66-7</b></p>
	<p><b>HANDS-ON TASK:</b> Have students use a <b>5-gas analyzer on a vehicle</b>. Ask them to record readings and interpret their findings. Grade them on their understanding of by-products of</p>

**ICONS****Chapter 66 Gasoline**

**combustion process and their awareness of what is required to reduce harmful emissions.**

9. **SLIDE 9 EXPLAIN Figure 66-8** A pump showing regular with a pump octane of 87, plus rated at 89, and premium rated at 93. These ratings can vary with brand as well as in different parts of the country.

**DISCUSSION:** Have the students talk about grades of gasoline. Is it always better to use premium gas? Point out the problems of hard start and rough idle using **premium-grade gasoline** during cold weather conditions.

**DISCUSSION:** Have the students talk about injector flow rate. What is the relation of injector flow rate to horsepower?

**DISCUSSION:** Have the students talk about octane rating. How is isooctane used in octane rating? What are the methods used to rate gasoline for antiknock properties? **FIGURE 66-8**

**HANDS-ON TASK:** Have the students locate a **Knock Sensor** on a vehicle. Ask them to review OEM information about sensor. Have students use a **scan tool** to compare it to live data from Sensor. Is knock sensor accurate?

**DISCUSSION:** Have students discuss **high-altitude** octane requirements. What happens to air when atmospheric pressure drops? How does lowered atmospheric pressure affect octane rating?

10. **SLIDE 10 EXPLAIN Figure 66-9** The posted octane rating in most high-altitude areas shows regular at 85 instead of the usual 87.

**DISCUSSION:** Have students discuss gasoline additives. What problems can be caused by additives?

11. **SLIDE 11 EXPLAIN Figure 66-10** This refueling pump indicates that the gasoline is blended with 10% ethanol (ethyl alcohol) and can be used in any gasoline vehicle. E85 contains 85% ethanol and can be used only in vehicles specifically designed to use it.

12. **SLIDE 12 EXPLAIN Figure 66-11** A container with

**ICONS****Chapter 66 Gasoline****DEMO****DEMO**

gasoline containing alcohol. Notice the separation line where the alcohol–water mixture separated from the gasoline and sank to the bottom.

**DEMONSTRATION:** Place some gas and water in a clear container for viewing. Have students talk about phase separation. Discuss what happens when an engine combusts a little water. What will happen to cylinder temperature if this happens?

**DISCUSSION:** Have the students talk about adding ethanol to base gasoline. Why are there different methods for adding additives to create an **E10** fuel mixture? **FIGURE 66-10**

**DISCUSSION:** Have students talk about reformulated gasoline. Will reformulated gas work well in cold weather conditions? Have students discuss changes made to reformulate gasoline. What has been result in areas where reformulated gas is being used?

13. **SLIDE 13 EXPLAIN Figure 66-12** In-line blending is the most accurate method for blending ethanol with gasoline because computers are used to calculate the correct ratio.
14. **SLIDE 14 EXPLAIN Figure 66-13** Sequential blending uses a computer to calculate correct ratio as well as the prescribed order in which the products are loaded.
15. **SLIDE 15 EXPLAIN Figure 66-14** Splash blending occurs when ethanol is added to a tanker with gasoline and is mixed as truck travels to retail outlet.

**DISCUSSION:** Have the students talk about oxygenated fuel additives. Under what conditions can additives be used to improve driveability?

16. **SLIDE 16 EXPLAIN Figure 66-15** Checking gasoline for alcohol involves using a graduated cylinder and adding water to check if the alcohol absorbs the water.
17. **SLIDE 17 EXPLAIN FIGURE 66-16** Many vehicle manufacturers include warning Labels to avoid E15 (15% ethanol and 85% gasoline) as well as E85 (85% ethanol and 15% gasoline).

**DEMONSTRATION:** Show the students how to check for alcohol content in gas. Remind them of safety precautions to take when testing gasoline.

## ICONS

## Chapter 66 Gasoline



### **FIGURE 66-15**

**ON-VEHICLE NATEF TASK** Check fuel for contaminants and quality; determine necessary action. **\_Page 221**

**DISCUSSION:** Remind students of importance of testing fuel for alcohol & water. How can *not* testing fuel for alcohol and water affect repair of driveability problems associated with fuel mixture?

**18. SLIDE 18 EXPLAIN Figure 66-17** Many gasoline service stations have signs posted warning customers to place plastic fuel containers on the ground while filling. If placed in a trunk or pickup truck bed equipped with a plastic liner, static electricity could build up during fueling and discharge from the container to the metal nozzle, creating a spark and possible explosion. Some service stations have warning signs not to use cell phones while fueling to help avoid the possibility of an accidental spark creating a fire hazard.

**19. SLIDES 19-24 EXPLAIN OPTIONAL TESTING FOR ALCOHOL CONTENT IN GASOLINE**

**DEMONSTRATION:** Demonstrate a sniff test on stale gasoline. Talk about what gasoline stabilizer is, when to use it, and where to find it.

**DISCUSSION:** Have students discuss keeping the fuel level above 1/4 tank. Why should fuel level be kept above that level?

When a rich mixture is detected & fuel gauge reads full, remind the students to check charcoal canister outlet to the engine. Verify to see whether liquid gas is being sucked into the engine. Temporary blockage of line and repeated checking of O<sub>2</sub> sensor readings could verify condition.

**SAFETY** Discuss importance of having a fire extinguisher available when working with fuel, and of wearing PPE including safety glasses, a respirator, and gloves.

ICONS	Chapter 66 Gasoline
  <p data-bbox="350 363 456 390">QUESTION</p> 	<p data-bbox="586 260 1409 373"><b><u>DISCUSSION:</u></b> Have the students talk about using a fuel composition tester to test for alcohol content in gasoline. What is the first step to using tester?</p> <p data-bbox="586 380 1284 415"><b><u>SLIDE SHOW ON GASOLINE TESTING</u></b></p> <p data-bbox="586 422 1365 464"><a href="#"><u>Crossword Puzzle (Microsoft Word) (PDF)</u></a></p> <p data-bbox="586 470 1409 506"><a href="#"><u>Word Search Puzzle (Microsoft Word) (PDF)</u></a></p>