

# Automotive Technology 6<sup>th</sup> Edition

## Chapter 70 DIESEL & BIODIESEL FUELS

### Opening Your Class

KEY ELEMENT	EXAMPLES
<b>Introduce Content</b>	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.
<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 diesel fuel specifications.</li> <li>2. List the advantages and disadvantages of biodiesel.</li> <li>3. Discuss API gravity.</li> <li>4. Explain E-diesel specifications.</li> </ol>
<b>Establish the Mood or Climate</b>	Provide a <i><b>WELCOME</b></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: Lesson plan is based on 6<sup>th</sup> Edition Chapter Images found on Jim's web site @ [www.jameshalderman.com](http://www.jameshalderman.com)**

**DOWNLOAD Chapter 70 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:**

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QUESTION



QUESTION



QUESTION



## Chapter 70 Diesel & Bio-Diesel

### 1. SLIDE 1 Chapter 70 DIESEL AND BIODIESEL FUELS

Check for **ADDITIONAL VIDEOS & ANIMATIONS**  
@ <http://www.jameshalderman.com/>  
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Crossword Puzzle (Microsoft Word) (PDF)

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#### Videos

**DISCUSSION:** Have the students talk about features & requirements of diesel fuel. Review what ambient temperature is. What is meant by diesel fuel's "pour point"?

**DISCUSSION:** Discuss cloud point. How does cloud point affect filters? How do diesel fuel suppliers accommodate pour point and cloud point?

**DISCUSSION:** Talk about Cetane # for diesel fuel. Review why octane rating for diesel is lower than the octane rating for gas. Does combustion pressure affect diesel fuel's Cetane number?

**HANDS-ON TASK:** Have students explain what a Cetane rating means & what effects if any it has on drivability.

Cetane # is a measure of ignition quality of fuel relative to a reference fuel mixture composed of Cetane and alpha-methylnaphthalene, the %, by volume, of Cetane in mixture being Cetane #. CCI stands for Calculated Cetane Index. High Cetane numbers indicate good ignition quality resulting in a Short Delay Period and low Cetane numbers indicate poor ignition

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quality that results in Long Delay Period. Low Cetane numbers can cause a LONG IGNITION DELAY, which can cause a hard starting with white smoke & misfiring. Cetane # for diesel fuels is not to be interpreted in the same manner as the octane number for gasoline. Octane # requirement depends on the full-load performance, while the Cetane # depends on the requirements for good ignition at light loads and low temperatures

2. SLIDE 2 **EXPLAIN** Figure 70-1 (a) Regular diesel fuel on the left has a clear or greenish tint, whereas fuel for off-road use is tinted red for identification.
3. SLIDE 3 **EXPLAIN** Figure 70-1 (b) A fuel pump in a farming area that clearly states the red diesel fuel is for off-road use only.

**DEMONSTRATION: Obtain regular diesel and off-road diesel to show to the students. Have them visually note difference in the two fuels.**

### **FIGURE 68-1**

**DISCUSSION: discuss grades of diesel fuel. In which applications is Grade #1 used? Why? In which applications is Grade #2 used? Why?**

4. SLIDE 4 **EXPLAIN** Figure 70-2 Testing API viscosity of a diesel fuel sample using a hydrometer.

**DISCUSS FREQUENTLY ASKED QUESTION:**  
***How Can You Tell If Gasoline Has Been Added to the Diesel Fuel by Mistake? If gasoline has been accidentally added to diesel fuel and is burned in a diesel engine, the result can be very damaging to engine. The gasoline can ignite faster than diesel fuel, which tends to increase the temperature of combustion. This high temperature can harm injectors and glow plugs, as well as pistons, head gaskets, and other major diesel engine components. If***

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DEMO



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contaminated fuel is suspected, first smell the fuel at the filler neck. If the fuel smells like gasoline, then tank should be drained and refilled with diesel fuel. If smell test does not indicate a gasoline smell (or any rancid smell), then test a sample for proper API gravity.

**NOTE:** Diesel fuel designed for on-road use should be green in color. Red diesel fuel (high sulfur) should only be found in off-road or farm equipment.

**DEMONSTRATION:** Use a hydrometer to show the students how to test API gravity of diesel fuel: FIGURE 70-2

**HANDS-ON TASK: FIGURE 70-2** Have students sample diesel fuel and take an API gravity reading. Have them use Chart 70-1 to find weight density & pounds per gallon of fuel that they are sampling.

**SAFETY** Review with students the safety precautions that should be taken when working With and testing, diesel fuel.

5. SLIDE 5 **EXPLAIN** FIGURE 70-3 Many diesel fuel additives increase the Cetane rating, which results in improved fuel economy..

### DISCUSS FREQUENTLY ASKED QUESTION:

***What Are Diesel Fuel Additives?*** There are several types and many brands of additives that are designed to be added to diesel fuel.

These types of additives include:

1. **Winter Conditioners**—Winter conditioners are designed to reduce the Cold Filter Plugging Point (CFPP). CFPP is the lowest temperature at which a specified volume of diesel type of fuel can pass through a standardized filtration device in a specified time when cooled under certain conditions.

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- 2. Multi-functional Conditioners**—Many multifunctional additives increase the Cetane rating of the fuel and helps keep injectors clean. By raising the Cetane rating of diesel fuel, engine power and fuel economy is improved. This type of additive is designed to be used year-round.
- 3. Microbicide**—Microbes can grow in diesel fuel at the junction between the water and the diesel. Water is heavier than diesel fuel and is near the bottom of the tank. Water in the fuel can be caused by condensation of moist air in the tank and during transport and storage. A microbicide is designed to kill microorganisms, including bacteria and fungi. Always follow the vehicle OEMS recommended service procedures and, for best results, always use additives from a known brand, and use according to the instructions on the product label. • See Figure 70-3.

**DEMO**



### **DEMONSTRATION: Show location of fuel heater & fuel filter on a diesel vehicle: FIGURE 70-3**

- 6. SLIDE 6 EXPLAIN Figure 70-4** A pump decal indicating that the biodiesel fuel is ultra-low-sulfur diesel (ULSD) and must be used in 2007 and newer diesel vehicles.

### **DISCUSSION: Have the students talk about why sulfur dioxide is harmful to environment. What is difference in appearance of ULSD? FIGURE 70-4**

### **DISCUSS FREQUENTLY ASKED QUESTION: / Thought Biodiesel Was Vegetable Oil?**

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**Biodiesel is vegetable oil with the glycerin component removed by means of reacting vegetable oil with a catalyst. Resulting hydrocarbon esters are 16 to 18 carbon atoms in length, almost identical to petroleum diesel fuel atoms. This allows use of biodiesel fuel in a diesel engine with no modifications needed. Biodiesel-powered vehicles do not need a second fuel tank, whereas vegetable-oil-powered vehicles do. *3 main types of fuel used in diesel engines.* These are:**

- **Petroleum diesel, a fossil hydrocarbon with a carbon chain length of about 16 carbon atoms.**
- **Biodiesel, a hydrocarbon with a carbon chain length of 16 to 18 carbon atoms.**
- **Vegetable oil is a triglyceride with a glycerin component joining three hydrocarbon chains of 16 to 18 carbon atoms each, called straight vegetable oil (SVO). Other terms used when describing vegetable oil include:**
  - **Pure plant oil (PPO)—a term most often used in Europe to describe SVO**
  - **Waste vegetable oil (WVO)—this oil could include animal or fish oils from cooking**
  - **Used cooking oil (UCO)—a term used when the oil may or may not be pure vegetable oil**

**Vegetable oil is not liquid enough at common ambient temperatures for use in a diesel engine fuel delivery system designed for lower-viscosity petroleum diesel fuel. Vegetable oil needs to be heated to obtain a similar viscosity to biodiesel and petroleum diesel. This means that a heat source needs to be provided before the fuel can be used in a diesel**

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engine. This is achieved by starting on petroleum diesel or biodiesel fuel until the engine heat can be used to sufficiently warm a tank containing the vegetable oil. It also requires purging the fuel system of vegetable oil with petroleum diesel or biodiesel fuel prior to stopping the engine to avoid the vegetable oil thickening and solidifying in the fuel system away from the heated tank. The use of vegetable oil in its natural state does, however, eliminate need to remove glycerin component. Many vehicle and diesel engine fuel system suppliers permit the use of biodiesel fuel that is certified as meeting testing standards. None permit the use of vegetable oil in its natural state.



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**DISCUSSION:** Have the students talk about **biodiesel blends**. Can **B20** be used in unmodified diesel engines? Since biodiesel costs more than regular diesel, what are its benefits?

**DISCUSSION:** Have students talk about biodiesel in relation to vegetable oil. What is difference between biodiesel powered vehicles & **vegetable-oil-powered** vehicles? Also discuss **E-diesel fuel**. What is a typical blend level for E-diesel?

**DISCUSSION:** Have the students talk about the **Cetane rating of E-diesel**. In what applications is E-diesel currently used?

### **ON-VEHICLE ASE EDUCATION TASK** **Biodiesel Fuel**

Meets **ASE EDUCATION** Task: Not specified by **ASE EDUCATION**