Advanced Engine Performance Diagnosis 6/E

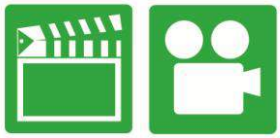
Chapter 6 Gasoline, Alternative Fuels, & Diesel Fuels

Opening Your Class

KEY ELEMENT	EXAMPLES
Introduce Content	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. .
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. 1. Discuss the characteristics of gasoline, refining of gasoline, and volatility of gasoline. 2. Explain air–fuel ratios, normal and abnormal combustion, and octane rating. 3. Discuss gasoline additives, gasoline blending, and testing gasoline for alcohol content. 4. Discuss general gasoline recommendations. 5. Explain alternative fuel vehicles, and discuss the safety procedures when working with alternative fuels. 6. Discuss E85, methanol, and propane fuel. 7. Discuss compressed natural gas, liquefied natural gas, and P-series fuels. 8. Discuss synthetic fuels. 9. Compare diesel fuel, biodiesel, and E-diesel fuel.
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.

NOTE: This lesson plan is based on Advanced Engine Performance Diagnosis 6/E Chapter Images found on Jim's web site @ www.jameshalderman.com

LINK CHP 06: Chapter Images

ICONS	Ch06 Gasoline, Alternative Fuels/Diesel
	1. **SLIDE 1 CH6 Gasoline, Alternative Fuels/Diesel**
	**Check for ADDITIONAL VIDEOS & ANIMATIONS @ http://www.jameshalderman.com/** **WEB SITE REGULARLY UPDATED**
	**At the beginning of this class, you can download the crossword puzzle & Word Search from the links below to familiarize your class with the terms in this chapter & then discuss them** **Crossword Puzzle (Microsoft Word) (PDF)** **Word Search Puzzle (Microsoft Word) (PDF)**
	
	**DISCUSSION: DISCUSS GASOLINE CHEMICAL COMPOSITION. HOW MANY CARBON ATOMS DO HYDROCARBONS IN GASOLINE HAVE?**
	**DISCUSSION: DISCUSS DANGERS OF HYDROCARBONS. IS A HYDROCARBON HARMFUL AS A LIQUID? IS IT HARMFUL AS A GAS? WHAT SAFETY PRECAUTIONS SHOULD BE TAKEN WHEN HANDLING HYDROCARBONS?**
	2. **SLIDE 2 EXPLAIN REFINING & EXPLAIN Figure 6-1** crude oil refining process showing most of the major steps and processes
	**HAVING DIFFERENT GRADES OF GASOLINE, DIFFERENT BLENDS, & VARYING FRESHNESS ON HAND AS YOU DISCUSS GASOLINE WILL OFFER VARIETY OF FUELS TO OBSERVE & TEST.**
	**HANDS-ON TASK: HAVE THE STUDENTS COMPLETE AN MSDS REVIEW OF HYDROCARBONS TO DETERMINE WHETHER THEY UNDERSTAND HAZARDS OF HYDROCARBONS**
	**DISCUSSION: HAVE THE STUDENTS TALK ABOUT DISTILLATION PROCESS. IN ADDITION TO FUEL, WHAT OTHER PRODUCTS ARE PRODUCED THROUGH DISTILLATION PROCESS?**

ICONS	Ch06 Gasoline, Alternative Fuels/Diesel
	**DEMONSTRATION: LOCATE A VIDEO THAT DEMONSTRATES DISTILLATION PROCESS. HAVE STUDENTS WATCH IT & DISCUSS PROCESS. NATIONAL GEOGRAPHIC CHANNEL OR DISCOVERY CHANNEL ARE POSSIBLE VIDEO SOURCES.**
	**DISCUSSION: HAVE THE STUDENTS DISCUSS CRACKING PROCESS. WHAT IS DIFFERENCE BETWEEN THERMAL CRACKING, CATALYTIC CRACKING, & HYDROCRACKING? FIGURE 6-1**
	**3. SLIDE 3 EXPLAIN FIGURE 6–2** A pig is a plug like device that is placed in a pipeline to separate two types or grades of fuel. **4. SLIDE 4 EXPLAIN FIGURE 6-3** 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 6-3**
	**HANDS ON-TASK: CHECK FUEL RVP BASED ON DEMO**
	**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?**
	**5. SLIDE 5 EXPLAIN Figure 6-4** An engine will not run if the air-fuel mixture is either too rich or too lean. **6. SLIDE 6 EXPLAIN Figure 6-5** 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.
	**DISCUSS FREQUENTLY ASKED QUESTION**
	**DISCUSSION: HAVE THE STUDENTS TALK ABOUT HOW AIR-FUEL RATIOS ARE STATED. WHY IS THE RATIO USUALLY MEASURED BY WEIGHT AND NOT VOLUME?**

ICONS	Ch06 Gasoline, Alternative Fuels/Diesel
	**DEMONSTRATION:** 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.
	**DISCUSSION:** HAVE THE STUDENTS DISCUSS AIR-FUEL RATIOS. WHAT MAKES AN AIR-FUEL MIXTURE TOO RICH OR TOO LEAN?
	**DISCUSSION:** HAVE THE STUDENTS REFER TO **FIGURE 6–5** AND DISCUSS WHAT HAPPENS TO NO_x, CO, AND HC IN THREE-WAY CATALYTIC CONVERTER. WHY DOES **STOICHIOMETRIC RATIO** WORK BEST TO CONTROL THESE MIXTURES? ANS: **STOICHIOMETRIC** IS CONCERNED WITH, INVOLVING, OR HAVING THE EXACT PROPORTIONS FOR A PARTICULAR CHEMICAL REACTION.
	7. **SLIDE 7 EXPLAIN Figure 6-6** Normal combustion is a smooth, controlled burning of the air-fuel mixture. 8. **SLIDE 8 EXPLAIN Figure 6-7** Detonation is a secondary ignition of the air-fuel mixture. It is also called spark knock or pinging.
	**DEMONSTRATION:** 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: **FIGURE 6-7 DEMO USE OF 5-GAS EXHAUST ANALYZER**
	**HANDS-ON TASK:** HAVE STUDENTS USE A **5-GAS ANALYZER ON VEHICLE**. ASK THEM TO RECORD READINGS AND INTERPRET THEIR FINDINGS.

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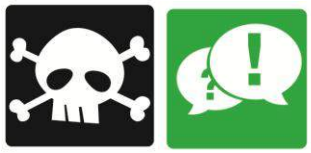
	9. **SLIDE 9 EXPLAIN** Octane Rating & **EXPLAIN Figure 6-8** pump showing regular with a pump octane of 87, plus rated at 89, and premium rated at 93. These ratings can vary with brand as well as in different parts of the country.
	**DISCUSSION:** DISCUSS GRADES OF GASOLINE. IS IT ALWAYS BETTER TO USE 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 6-8
	**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?
	**DISCUSS CHART 6-1, PAGE 79**
	10. **SLIDE 10 EXPLAIN Figure 6-9** posted octane rating in most high-altitude areas shows regular at 85 instead of the usual 87.
	**DISCUSS FREQUENTLY ASKED QUESTION**
	**EXPLAIN TECH-TIP**

ICONS	Ch06 Gasoline, Alternative Fuels/Diesel
	**DISCUSSION: HAVE STUDENTS DISCUSS HIGH-ALTITUDE OCTANE REQUIREMENTS. WHAT HAPPENS TO AIR WHEN ATMOSPHERIC PRESSURE DROPS? HOW DOES LOWERED ATMOSPHERIC PRESSURE AFFECT OCTANE RATING?**
	11. **SLIDE 11 EXPLAIN** Gasoline Additives & **EXPLAIN Figure 6-10** This refueling pump indicates that the gasoline is blended with 10% ethanol (ethyl alcohol) and can be used in any gasoline vehicle.
	**DISCUSSION: HAVE STUDENTS DISCUSS GASOLINE ADDITIVES. WHAT PROBLEMS CAN BE CAUSED BY ADDITIVES?**
	**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 6-10
	12. **SLIDE 12 EXPLAIN Figure 6-11** A container with gasoline containing alcohol. Notice the separation line where the alcohol–water mixture separated from the gasoline and sank to the bottom.
	**DISCUSS FREQUENTLY ASKED QUESTION**
	**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 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?**
	**FUEL BLENDING IN-LINE** **FUEL BLENDING SEQUENTIAL** **FUEL BLENDING SPLASH**

ICONS	Ch06 Gasoline, Alternative Fuels/Diesel
	13. **SLIDE 13 EXPLAIN Figure 6-12** 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 6-13** 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 6-14** Splash blending occurs when ethanol is added to a tanker with gasoline and is mixed as truck travels to retail outlet. **DISCUSS FREQUENTLY ASKED QUESTION**
	**DISCUSSION: HAVE THE STUDENTS TALK ABOUT OXYGENATED FUEL ADDITIVES. UNDER WHAT CONDITIONS CAN ADDITIVES BE USED TO IMPROVE DRIVEABILITY?**
	16. **SLIDE 16 EXPLAIN Figure 6-15** Checking gasoline for alcohol involves using a graduated cylinder and adding water to check if the alcohol absorbs the water. **DISCUSS WARNING**
	
	**DEMONSTRATION: SHOW THE STUDENTS HOW TO CHECK FOR ALCOHOL CONTENT IN GAS. REMIND THEM OF SAFETY PRECAUTIONS TO TAKE WHEN TESTING GASOLINE. FIGURE 6-15**
	**ON-VEHICLE NATEF TASK CHECK FUEL FOR CONTAMINANTS AND QUALITY; DETERMINE NECESSARY ACTION.**
	**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?**

ICONS	Ch06 Gasoline, Alternative Fuels/Diesel
	**17. SLIDE 17 EXPLAIN FIGURE 6–16** Many vehicle manufacturers include warning labels to avoid E15 (15% ethanol and 85% gasoline) as well as E85 (85% ethanol and 15% gasoline)..
	**DISCUSS FREQUENTLY ASKED QUESTION**
	**18. SLIDE 18 EXPLAIN Figure 6-17** 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.
	**DEMONSTRATION: DEMONSTRATE A SNIFF TEST ON STALE GASOLINE. TALK ABOUT WHAT GASOLINE STABILIZER IS, WHEN TO USE IT, AND WHERE TO FIND IT.**
	**DISCUSS FREQUENTLY ASKED QUESTION**
	**19. SLIDE 19 EXPLAIN FIGURE 6–18** The ethanol molecule showing two carbon atoms, six hydrogen atoms, and one oxygen atom.
	**DISCUSSION: HAVE STUDENTS DISCUSS KEEPING FUEL LEVEL ABOVE ¼ 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_2 SENSOR READINGS COULD VERIFY CONDITION.**

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	EXPLAIN TECH-TIPS PAGE 84
	**DISCUSSION:** 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? **SLIDE SHOW ON GASOLINE TESTING**
	**DISCUSSION:** HAVE THE STUDENTS DISCUSS ETHANOL AND HOW IT IS PRODUCED. SINCE ETHANOL PRODUCED FOR FUEL IS THE SAME AS THAT FOUND IN ALCOHOLIC DRINKS, CAN DRINK MANUFACTURERS PRODUCE FUEL FOR VEHICLES?
	**DISCUSSION:** HAVE THE STUDENTS TALK ABOUT CELLULOSE BIOMASS? HOW ARE THE GREENHOUSE EFFECTS OF COMBUSTION OF BIOMASS OFFSET?
	20. **SLIDE 20 EXPLAIN Figure 6-19** E85 (85% ethanol and 15% gasoline), has a high octane rating but contains less heat energy compared to gasoline or E10.
	**DISCUSSION:** HAVE STUDENTS TALK ABOUT **E85** AND ITS EFFECTS ON FUEL ECONOMY. IS IT WORTH USING **E85** SINCE YOU HAVE TO PURCHASE MORE **E85** THAN REGULAR GAS FOR THE SAME MILEAGE? WHAT IS PRICE DIFFERENCE BETWEEN REGULAR GAS & **E85**? **FIGURE 6-19**
	EXPLAIN TECH-TIP PAGE 85
	21. **SLIDE 21 EXPLAIN Figure 6-20** location of sensor can vary, depending on make & model of vehicle, but it is always in fuel line between tank & injectors. 22. **SLIDE 22 EXPLAIN Figure 6-21** cutaway view of a typical variable fuel sensor.
	**DEMONSTRATION: SHOW STUDENTS LOCATION OF VARIABLE FUEL SENSOR. REVIEW ITS FUNCTION WITH STUDENTS**
	**DISCUSSION:** DISCUSS FUEL COMPENSATION. COMPARE USE OF **FUEL COMPENSATION SENSOR** AND OXYGEN SENSOR FOR A FLEX-FUEL

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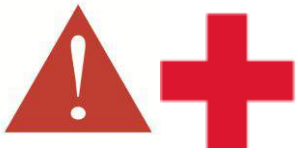
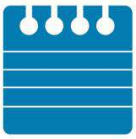
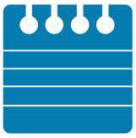
	**SYSTEM. WHY SHOULD A TECHNICIAN AVOID RESETTING FUEL COMPENSATION?** **DISCUSSION: HAVE THE STUDENTS DISCUSS E85 FUEL SYSTEM REQUIREMENTS. WHAT ADDITIONAL HARDWARE IS ON E85 VEHICLES?**
	23. **SLIDE 23 EXPLAIN Figure 6-22** flex-fuel vehicle often has a yellow gas cap, which is labeled E85/gasoline.
	**DISCUSSION: HAVE THE STUDENTS TALK ABOUT ENHANCED FUEL SYSTEM COMPONENTS & MATERIALS USED FOR FLEX-FUEL VEHICLES. CAN ETHANOL DAMAGE COMMON FUEL PUMPS? WHAT WILL HAPPEN TO O-RINGS THAT ARE NOT ALCOHOL-RESISTANT?**
	**DEMONSTRATION: USE A FLEX-FUEL VEHICLE TO SHOW STUDENTS IDENTIFIERS THAT PLACE IT IN E85 CLASS. TALK ABOUT EMISSIONS PRODUCED BY ETHANOL FUELED VEHICLES.**
	**HANDS-ON TASK: HAVE STUDENTS LOCATE VECI ON FLEX-FUEL VEHICLES YOU HAVE IN YOUR SHOP. HAVE STUDENTS SHARE LOCATIONS & INFORMATION FOUND**
	24. **SLIDE 24 EXPLAIN Figure 6-23** vehicle emission control information (VECI) sticker on a flexible fuel vehicle indicating that it can use ethanol from 0 to 85%.
	**DISCUSS FREQUENTLY ASKED QUESTION**
	25. **SLIDE 25 EXPLAIN Figure 6-24** The molecular structure of methanol showing the one carbon atom, four hydrogen atoms, and one oxygen atom. 26. **SLIDE 26 EXPLAIN Figure 6-25** Sign on methanol pump shows that methyl alcohol is a poison and can cause skin irritation and other personal injury. Methanol is used in industry as well as being a fuel.
	**SAFETY REVIEW WITH STUDENTS PPE THAT SHOULD BE USED WHEN HANDLING METHANOL. TALK ABOUT VENTILATION PROCEDURES WHEN**

ICONS	Ch06 Gasoline, Alternative Fuels/Diesel
	WORKING WITH METHANOL VEHICLES, INCLUDING WHERE EXHAUST FANS SHOULD BE PLACED, OPENING DOORS, MONITORING RUNNING VEHICLES, ETC. FIGURE 6-25
	**DISCUSSION: HAVE THE STUDENTS TALK ABOUT METHANOL AND ITS PRODUCTION. WHAT IS BIGGEST SOURCE OF METHANOL IN UNITED STATES? WHAT IS M85?**
	27. **SLIDE 27 EXPLAIN Figure 6-26** Propane fuel storage tank in trunk of Ford taxi.
	**DISCUSSION: HAVE THE STUDENTS TALK ABOUT PROPANE. HOW DOES PROPANE'S USE COMPARE TO THAT OF OTHER FUELS? WHY IS PROPANE LESS ECONOMICAL TO USE THAN OTHER FUELS?** **FIGURE 6-26**
	28. **SLIDE 28 EXPLAIN Figure 6-27** The blue sticker on the rear of this vehicle indicates that it is designed to use compressed natural gas. 29. **SLIDE 29 EXPLAIN Figure 6-28** CNG storage tank from a Honda Civic GX shown with the fixture used to support it while it is being removed or installed in the vehicle. Honda specifies that three technicians be used to remove or install the tank through the rear door of the vehicle due to the size and weight of the tank.
	**DISCUSSION: HAVE STUDENTS TALK ABOUT COMPRESSED NATURAL GAS. WHY IS NATURAL GAS ODORIZED DURING PRODUCTION?**
	**DISCUSS FREQUENTLY ASKED QUESTION**
	30. **SLIDE 30 EXPLAIN Figure 6-29** fuel injectors used on this Honda Civic GX CNG engine are designed to flow gaseous fuel instead of liquid fuel and cannot be interchanged with any other type of injector.
	**DISCUSSION: HAVE THE STUDENTS DISCUSS DIFFERENCES BETWEEN USING GASOLINE AND CNG IN VEHICLES. WHAT DESIGN DIFFERENCES ARE REQUIRED FOR A CNG ENGINE?**

ICONS	Ch06 Gasoline, Alternative Fuels/Diesel
	31. **SLIDE 31 EXPLAIN Figure 6-30** This CNG pump is capable of supplying compressed natural gas at either 3,000 PSI or 3,600 PSI. Price per gallon is higher for the higher pressure.
	EXPLAIN CHART 6-2 ON PAGE 90
	**DISCUSSION: HAVE THE STUDENTS DISCUSS CNG FUEL SYSTEMS. WHAT IS IMPORTANCE OF HAVING LOCK-OFF VALVES IN CNG VEHICLES?**
	**DISCUSSION: DISCUSS REFUELING OF CNG VEHICLES. WHY IS IT IMPORTANT TO FILL A CNG VEHICLE'S TANK SLOWLY?**
	**DISCUSSION: HAVE THE STUDENTS TALK ABOUT LIQUEFIED NATURAL GAS. WHAT ARE PRACTICALITIES OF USING LNG IN VEHICLES?**
	**DISCUSSION: HAVE THE STUDENTS TALK ABOUT TRI-FUEL VEHICLES. WHICH FUELS ARE TRI-FUEL VEHICLES CAPABLE OF USING?**
	**DISCUSS CHART 6-3 P-SERIES FUEL VARIES IN COMPOSITION, DEPENDING ON THE OCTANE RATING AND TEMPERATURE.**
	**DISCUSSION: USE CHART 6-3 TO REVIEW ADVANTAGES & DISADVANTAGES OF ALTERNATIVE FUELS. WHICH HAVE FOSSIL FUEL SOURCES?**
	32. **SLIDE 32 EXPLAIN Figure 6-31** Fischer-Tropsch processing plant is able to produce a variety of fuels from coal
	**DISCUSS FREQUENTLY ASKED QUESTION**
	**DISCUSSION: DISCUSS FISCHER-TROPSCH METHOD. WHAT IS BIGGEST DRAWBACK TO FISCHER-TROPSCH FUELS? FIGURE 67-15**
	67. **SLIDES 67-68 EXPLAIN** Safety Procedures When Working With Alternative Fuels

ICONS	Ch06 Gasoline, Alternative Fuels/Diesel
 	**EXPLAIN WARNING**
 	**DISCUSSION: DISCUSS FUTURE OF SYNTHETIC FUELS. HOW IS RISING COST OF CRUDE OIL AFFECTING THE COST EFFECTIVENESS OF ALTERNATIVE METHODS OF PRODUCING FUELS?**
	33. **SLIDE 33 EXPLAIN Figure 6-32 (a)** Regular **diesel fuel** on left has a clear or greenish tint, whereas fuel for off-road use is tinted red for identification. 34. **SLIDE 34 EXPLAIN Figure 6-32 (b)** fuel pump in a farming area that clearly states the red diesel fuel is for off-road use only.
	**DEMONSTRATION: OBTAIN REGULAR DIESEL & OFF-ROAD DIESEL TO SHOW VISUALLY THE DIFFERENCE IN TWO FUELS. FIGURE 6-32**
 	**DISCUSSION: HAVE THE STUDENTS TALK ABOUT GRADES OF DIESEL FUEL. IN WHICH APPLICATIONS IS GRADE #1 USED? WHY? IN WHICH APPLICATIONS IS GRADE #2 USED? WHY?**
 	**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.**

ICONS	Ch06 Gasoline, Alternative Fuels/Diesel
	**CETANE # 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 QUALITY THAT RESULTS IN LONG DELAY PERIOD. LOW CETANE NUMBERS CAN CAUSE A LONG IGNITON 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**
	
	35. **SLIDE 35 EXPLAIN Figure 6-33** Testing API viscosity of a diesel fuel sample using a hydrometer.
	**DEMONSTRATION: USE A HYDROMETER TO SHOW THE STUDENTS HOW TO TEST API GRAVITY OF DIESEL FUEL: FIGURE 6-33**
	**HANDS-ON TASK: FIGURE 6-33 HAVE STUDENTS SAMPLE DIESEL FUEL AND TAKE AN API GRAVITY READING. HAVE THEM FIND WEIGHT DENSITY & POUNDS PER GALLON OF FUEL THAT THEY ARE SAMPLING.**
	**DISCUSS FREQUENTLY ASKED QUESTION**
	**DEMONSTRATION: SHOW LOCATION OF FUEL HEATER & FUEL FILTER ON A DIESEL VEHICLE**

ICONS	Ch06 Gasoline, Alternative Fuels/Diesel
	**36. SLIDE 36 EXPLAIN** Biodiesel & **Figure 6-34** pump decal indicating that the biodiesel fuel is ultra-low-sulfur diesel (ULSD) and must be used in **2007** and newer diesel vehicles.
	**DISCUSS FREQUENTLY ASKED QUESTION**
	**DISCUSSION: HAVE THE STUDENTS TALK ABOUT WHY SULFUR DIOXIDE IS HARMFUL TO ENVIRONMENT. WHAT IS DIFFERENCE IN APPEARANCE OF ULSD?**
	**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?**
	**EXPLAIN E-Diesel Fuel**
	**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?**
	**DISCUSS FREQUENTLY ASKED QUESTION**
	**EXPLAIN CHART 10-4** **37. SLIDES 37-42 TESTING FUEL SLIDE SHOW**