After studying this chapter, you will be able to:

- Explain diesel fuel grades.
- Discuss fuel properties and characteristics.
- Explain the reason for the use of fuel additives.
- Describe the proper procedures for handling and storage of diesel fuel.
- Name the various alternative fuels and their properties.

### Diesel Fuel Grades

While the American Society of Testing Materials (ASTM) has divided diesel fuels into three classifications, only two recommended grades are considered acceptable for use in high-speed trucks and buses in North America. These are the number 1D and number 2D classifications. Grade number 4D, the heaviest diesel fuel, is used in large stationary constant-speed engines or in some marine applications. Number 1 and number 2 fuels are not used in high-speed mobile diesel engines, which are continually accelerating and changing speed. Grade number 3D was discontinued a number of years ago and is obsolete.

The Canadian government has its own fuel specifications recognizing five categories of diesel fuels, with even more restrictive standards set by ASTM. Each individual refiner and supplier attempts to produce diesel fuels that meet as closely as possible with ASTM and American Petroleum Institute (API) standards, as shown in Figure 14-2. Depending on the crude oil source, the diesel fuel end product may be on either the high or low end of the prescribed heat energy scale in Btus per gallon. This is why individual diesel fuels grades may vary slightly from one supplier to another.

Grade 1D is generally the most refined and volatile diesel fuel available. It is a premium fuel used in high rpm engines requiring frequent changes in load and speed. Grade 2D is more widely used in truck fleets due to its greater heat value per gallon, particularly in warm to moderate climates. Although Grade 1D fuel has better properties for cold-weather operation, many fleets still use Grade 2D in the winter. Other cold weather aids include a fuel heater/water separator for easier starting, as well as fuel additive conditioners that can be added directly to the fuel tank.

Like gasoline, diesel fuels are blended on a seasonal and geographical basis to satisfy anticipated temperature conditions. It is usually best and cheapest to burn the heaviest fuel that will work under given circumstances. Heavier grades of diesel can usually produce more energy than light grades, just so long as the increased viscosity does not make the fuel too thick to flow and inject properly.

It is important to remember that the wrong grade of diesel fuel can affect the operation of the engine. If an engine is not developing the proper horsepower, an improper grade of diesel fuel could be the cause. An easy way to confirm this is to use a diesel fuel quality tester such as shown in Figure 14-3.

### Diesel Fuel Properties

In a diesel engine fuel system, the fuel itself performs three functions. It supplies chemical energy to be transformed into mechanical energy, lubricates precision parts in the fuel system components, and cools metal surfaces operating in conditions of friction.

The properties or characteristics of diesel fuel must meet these three if the engine is to perform with reliability.

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**Figure 14-1.** A fractionating column is used to separate crude oil into the various hydrocarbon products. As the vaporized products rise in the tower, they settle onto trays at different levels and are then piped out to other equipment for further refining. (Allis-Chalmers Engine Div.)

**Table 14-1.** General classification chart for diesel fuel. (Detroit Diesel)

<table>
<thead>
<tr>
<th>General Fuel Classification</th>
<th>No. 1 ASTM 1D</th>
<th>No. 2 ASTM 2D</th>
</tr>
</thead>
<tbody>
<tr>
<td>BTU/gal average</td>
<td>137,000</td>
<td>141,800</td>
</tr>
<tr>
<td>Gravity (API)</td>
<td>40.44</td>
<td>39.27</td>
</tr>
<tr>
<td>Flash point, minimum (°F/°C)</td>
<td>100 (38)</td>
<td>125 (52)</td>
</tr>
<tr>
<td>Viscosity, kinematic at 200°F (cSt)</td>
<td>1.3-4.1</td>
<td>1.9-4.1</td>
</tr>
<tr>
<td>Cloud point (°F)</td>
<td>10°F</td>
<td>10°F</td>
</tr>
<tr>
<td>Sulfur content, maximum (w%)</td>
<td>0.5</td>
<td>1.0</td>
</tr>
<tr>
<td>Carbon residue, maximum (w%)</td>
<td>0.15</td>
<td>0.35</td>
</tr>
<tr>
<td>Accelerated stability total insolubles, maximum (mg/100 ml)</td>
<td>1.5</td>
<td>1.5</td>
</tr>
<tr>
<td>Ash, maximum (w%)</td>
<td>0.01</td>
<td>0.02</td>
</tr>
<tr>
<td>Cetane number, minimum</td>
<td>45</td>
<td>40</td>
</tr>
<tr>
<td>Distillation temperature (°F/°C)</td>
<td>350 (177)</td>
<td>375 (191)</td>
</tr>
<tr>
<td>Initial boiling point, typical</td>
<td>385 (196)</td>
<td>430 (221)</td>
</tr>
<tr>
<td>10%, typical</td>
<td>425 (219)</td>
<td>510 (256)</td>
</tr>
<tr>
<td>50%, typical</td>
<td>520 (260) maximum, 825 (929) maximum</td>
<td></td>
</tr>
<tr>
<td>90%</td>
<td>550 (288) maximum, 675 (357) maximum</td>
<td></td>
</tr>
<tr>
<td>Water and sediment, maximum (%)</td>
<td>0.05</td>
<td>0.05</td>
</tr>
</tbody>
</table>

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**Figure 14-2.** General classification chart for diesel fuel. (Detroit Diesel)
Fuel processors, as well as engine manufacturers, run laboratory tests to evaluate fuel in diesel engines. These measured properties give a good indication of the way the fuel will perform; however, there is no real substitute for an actual engine test. The major diesel fuel properties affecting engine performance are:

- **Heat value**
- **Specific gravity**
- **Flash point**
- **Volatility**
- **Cetane number rating**
- **Pour point**
- **Cloud point**
- **Viscosity**
- **Carbon residue**
- **Sulfur content**
- **Fungus and bacterial contaminants**
- **Oxidation and water**

### Heat Value

The heat value of a fuel is a general indication of how much heat energy is supplied to an engine and how well the engine converts this heat into work. The heat value can be found by testing with a calorimeter. This test, a pre-measured amount of fuel is burned and the amount of heat emitted is calculated. The SI unit for heat is measured in joules (J) or more commonly in British thermal units (BTU) per gallon of diesel fuel.

### Specific Gravity

The specific gravity of a fuel is the ratio of the fuel density to the density of water. It is measured using a hydrometer. Specific gravity affects the fuel's spray penetration as it is injected into the combustion chamber. Because water is the standard, it has a specific gravity of one. Since oil floats on water, a diesel fuel's specific gravity is always less than one. Diesel fuel's specific gravity ranges from 0.98 to 0.84. Specific gravity is also a factor in measuring the heat value of the fuel. In general, heavier fuels usually have a greater heat value per gallon (BTU) than lighter fuels. Thus, specific gravity is a good indicator of the amount of heat (BTU) available in a given amount of fuel.

### Viscosity

Viscosity or 'stiffness' is the property of a diesel fuel that affects the speed at which its molecules move through other fuel. A typical diesel fuel quality tester is shown in Figure 14-3. Viscosity is measured in centistokes (cSt) or Saybolt Universal seconds (SSU).

### Cetane Number Rating

Cetane number is a measure of the fuel's ignition quality. The cetane number rating of a fuel is determined by comparing it with pure cetane, which is a fuel that ignites easily. The cetane number range spans from 0 to 100, with 100 being the highest ignition quality. In general, the higher a fuel's cetane rating, the lower the emissions. Currently, a 40 cetane or above rating is standard for all on-highway diesel engines. In some areas, 50 cetane or above rating is required for off-highway diesel engines. The cetane number is used to predict the ability of the fuel to ignite. The cetane rating of a fuel is determined by comparing it with pure cetane, which is a fuel with a very high cetane rating. The cetane number range spans from 0 to 100, with 100 being the highest ignition quality. In general, the higher a fuel's cetane rating, the lower the emissions. Currently, a 40 cetane or above rating is standard for all on-highway diesel engines. In some areas, 50 cetane or above rating is required for off-highway diesel engines. The cetane number is used to predict the ability of the fuel to ignite. The cetane rating of a fuel is determined by comparing it with pure cetane, which is a fuel with a very high cetane rating. The cetane number range spans from 0 to 100, with 100 being the highest ignition quality. In general, the higher a fuel's cetane rating, the lower the emissions. Currently, a 40 cetane or above rating is standard for all on-highway diesel engines. In some areas, 50 cetane or above rating is required for off-highway diesel engines. The cetane number is used to predict the ability of the fuel to ignite. The cetane rating of a fuel is determined by comparing it with pure cetane, which is a fuel with a very high cetane rating. The cetane number range spans from 0 to 100, with 100 being the highest ignition quality.
viscous than grade 2D, which is the fuel used at normal operating temperatures. Diesel fuel viscosity also affects the spray pattern in the combustion chamber. Figure 14-5. Low viscosity creates a fine mist, while high viscosity results in coarse or heavy atomization. In other words, viscosity affects:

- Lubrication capability at various temperatures.
- Atomization, or spray capability.
- Ignition and burning characteristics.
- Therefore, viscosity is a very important consideration when selecting a diesel fuel.

### Carbon Residue

Ash or carbon residue is the deposit left in the combustion chamber due to incomplete combustion or the use of fuels made from residual blends. It can be measured in the laboratory by heating a measured fuel sample in a closed container in the absence of air. Carbon residue is the final product that remains in the container after heating. This product is then expressed as a percentage by weight of the original sample.

The amount of carbon residue considered acceptable in diesel fuel varies depending on the combustion chamber design, the injector adjustments, and the general condition of the engine. This amount is generally more critical in small high-speed engines than in large slow-speed industrial engines.

### Sulfur Content

Sulfur is present in all petrofuels, which originates from either additives or the crude oil itself, also causes wear of fuel injection components, the pistons, and the piston rings. Standard requirements allow for a maximum of 0.012% sulfur content. Due to air quality concerns, future legislation may further limit the amount of sulfur in diesel fuel.

### Fuel Additives

Fuel additives that will reduce smoke and corrosion of vital engine components include:

- Lubricants:
  - Additives in the fuel system will hold less dissolved moisture. There is currently no common method of removing dissolved water from diesel fuel.
  - Free or nondissolved water in the fuel tank usually comes from bulk storage tanks, from condensation, or from dissolved water. Free water mixes with the fuel as storage tank bottoms become agitated while dispersing or receiving fuel. When water in vapor form is present in air, it is called humidity. As air replaces fuel in storage tanks or vehicles, the watertank becomes agitated, wetting or emitting fuel, moisture in the form of humidity finds its way into the fuel system. From there, moisture may condense as fuel and water returning from the injectors flows back to the cooler fuel tank. Free water in liquid form is heavier than diesel fuel and settles on the low flow or slow flow areas of the fuel system. The reverse is true when water freezes. Ice is lighter than diesel fuel and flows in the system to create plugs in fuel pumps, filters, even going as far as the fuel pump injectors.

### Oxidation and Water

Oxidation and water cause varnish to form on the piston skirt and creates oil sludge in the engine crankcase. Sulfur also combines with water to form corrosives as a result of the combustion process. These corrosives cause, accelerate engine wear, attack softer metals (such as bearings), and deteriorate engine oil. Similar corrosion damage from sulfur is frequently found in the engine’s exhaust system.

### Oxidation and Water

Sulfur and aromatic content of diesel fuel are most responsible for harmful exhaust emissions. Sulfur dioxide emissions are reduced when sulfur content is reduced. The reduction of aromatics will reduce carbonaceous particle emissions.

Sulfur is removed from diesel fuel in a process called hydrotreating. Hydrogen is used with a catalyst at temperatures between 500 and 800°F (260 and 430°C) to react with the sulfur compounds present. The reaction forms hydrogen sulfide, which is separated from the hydrocarbon and sent to a sulfur plant to be converted to elemental sulfur. The sulfur content can only be determined by chemical analysis of the fuel.

### Oxidation and Water

EPA regulations mandate the sulfur content in diesel fuel. The 2004 standards called for a sulfur content of no greater than 500 parts per million (0.05% by weight) and a maximum aromatic content of 35% in all on-highway diesel fuels. EPA regulations for 2007 on-highway engines require the use of ultra-low sulfur diesel fuel (ULSD). ULSD has a dramatically lower sulfur content than previous on-highway diesel fuels. The sulfur content of ULSD cannot exceed 15 parts per million (0.0015% by weight).

Using ultra-low sulfur diesel dramatically reduces diesel exhaust emissions. Diesel fuel containing sulfur produces fewer sulfate emissions. It also enables use of emission reduction equipment, such as particulate traps and catalytic converters, that lowers emissions of particles and nitrogen oxides (NOx). When these systems are used with ULSD, emissions of fine particulates can be reduced by more than 90%.

### Oxidation and Water

Even without special emission reduction equipment, using ULSD reduces sulfate pollutants. ULSD provides significant clean-air benefits while ensuring the same energy and performance standards as regular highway diesel. Ultra-low sulfur, low aromatic, and high cetane number diesel fuel enhances engine performance because improved engine combustion results in easier starting, smoother running, less noise, and less smoking during start-up.

### Oxidation and Water

Only on-highway ULSD diesel engines can currently use higher sulfur content fuels. These include farm tractors, boats, locomotives, and stationary engines. The 2007 sulfur content standard for non-road, locomotive, and marine fuel (NRML) is 500 parts per million (ppm). In 2010, all on- and off-highway non-road (NR) diesel fuel will need to meet a limit of 15 ppm sulfur, and in 2012, locomotive and marine (LM) diesel fuel will also be regulated at 15 ppm.

### Oxidation and Water

**Fungi and Bacterial Contaminants**

Fungi and bacteria are the most common contaminants found in diesel fuels. Fungi and bacteria live in the water and feed on the hydrocarbons found in diesel fuel. These contaminants are called hydrocarbon utilizing microorganisms (HUM). HUM will spread through a fuel system where monotonic amounts of water are present. The resulting bacterial problems can shorten engine filter life. Draining the fuel system will reduce HUM activity, but will not eliminate it. The only way to eliminate HUM growth entirely is to treat the fuel system with a biocide.

### Oxidation and Water

**Fuel Handling and Storage**

The importance of clean fuel in the operation of a diesel engine cannot be overemphasized. Diesel fuel is generally delivered clean and free of impurities. However, every time it is transferred or handled, the risk of contamination increases. While fuel storage and its handling are not normally within the engine technician’s job classification, the results of improper handling and storage can be disastrous.

One of the major problems either in storage or in the engine’s fuel system is leakage. Each connection or fitting in either system is a potential source of leakage. There are two phases to the leakage problem:

- The visible leakage of fuel from a line during operation and shutdown.
- The opening in a suction line or fitting which draws foreign material into the system during operation and may or may not present a visible leak during shut-down.

Visible leakage should be stopped as soon as it is discovered. Loss of flow volume generally means a loss of pressure. The leak which allows fuel contamination by pulling in air, water, or dirt is more difficult to locate and can be more damaging. Foreign materials, such as air, sediment (dirt), and water present problems and can enter the fuel system in various ways.

### Oxidation and Water

**Air**

Air drawn into the fuel system may pick-up of fuel much more difficult or prevent it entirely. In addition, it may show up as:

- Low power.
- Gear pump wear.
- Rough operation.
- Soft or non-responsive throttle.
- Fuel turbulence, especially when coupled with poor tank venting.
- Fuel pick-up point near return.
- Combustion gases entering injector.

### Oxidation and Water

**Fuel Additives**

Generally, no fuel additives are necessary when a good quality, clean, and properly selected fuel is used. Certain fuel characteristics, however, can be improved by treatment with a fuel additive or conditioner. As already mentioned, additives are used to improve fuel flow properties under cold or winter-like conditions, increase the cetane number of the fuel, and to introduce a biocide to the fuel to prevent fungi and bacteria from growing in the diesel fuel.

There are a number of commercially available fuel additives that will reduce smoke and corrosion of vital parts and others that are oxidation inhibitors. In addition, remember that geographical locations, operating conditions, type of fuel storage, handling methods, and maintenance procedures are all factors that can determine whether or not a fuel additive might help a diesel fuel. In most cases, the fuel supplier or marketer will select and add the additive they believe will best improve the quality of their fuels. Fuels containing special additives may be more expensive than those without additives.
Dirt

Dirt is as damaging to moving parts in the fuel system as it is in any other part of the engine. Dirt can:
- Clog filters.
- Ablade metal surfaces.
- Increase combustion chamber deposits.
- Dirt enters the fuel when:
  - A suction leak is in an exposed area.
  - Dirt collection in the tank allows it to be picked up with the fuel.
- Careless filling and handling permits mud, dust, or grime to enter tank or lines.
- The technician may unintentionally add dirt to the fuel system by:
  - Using containers and tools exposed to dirt.
  - Using lines and fittings that have accumulated dirt or dust without cleaning them out.
  - Allowing dirt to enter a line while it is being repaired. This is especially critical between filter and pump.

Water

Water in the fuel may show up as low power, also, but it is even more damaging as already stated when it simply contributes to corrosion on fuel system components. Water enters the fuel system through:
- A suction leak in an exposed location.
- As condensation due to warm fuel.
- Careless storage and handling.
- Careless storage and handling.
- Water is even more damaging as already stated when it simply contributes to corrosion on fuel system components. Water enters the fuel system through:
  - A suction leak in an exposed location.
  - As condensation due to warm fuel.
  - Careless storage and handling.
  - Careless storage and handling.
  - Water enters the fuel system through:

Alternative Fuels

The Clean Air Act of 1990 requires that all centrally fueled on-highway transportation operations of 10 or more vehicles in certain high-emission areas be phased in alternative fuel vehicles beginning in 1998. The act does not mandate any specific alternative fuels such as gasoline or diesel. The alternative fuels now being considered for use with compressed (diesel) type engines are compressed natural gas (CNG), liquid petroleum gas (LPG), liquid natural gas (LNG), and alcohol based products such as methanol and ethanol.

The Clean Air Act regulations are closely tied to clean fuel vehicle programs in each state’s air quality implementation plan. Since the supply of certain fuels varies across the country, not all states favor the same fuel. Southern states are a big supporter of natural gas, while some western states favor liquid petroleum gas, and a number of midwestern states actively tout ethanol.

Some engine companies are devoting research and testing to natural gas. Many of their initial products are being offered for urban buses, which are on a stricter emission schedule than medium and heavy duty trucks. Engine makers face the challenge of designing new engines with efficiency as close as possible to that of a diesel without making major component changes.

Compressed and Liquefied Natural Gas

Natural gas has been used for 60 years to power industrial internal combustion engines. Natural gas is one of the lightest fractions (pant of crude oil). Chemically, it is very similar to gasoline. Unlike gasoline, natural gas contains several light gases, heavy gases, and other impurities. For natural gas to be used as an alternative fuel for on-highway vehicles, it must be refined into either compressed natural gas or liquefied.

Compressed natural gas (CNG) is composed primarily of methane and hydrocarbons that have a high carbon-to-hydrogen ratio. Hydrogen is an ideal fuel that burns well while producing little pollution. It is the main reason CNG is a very desirable fuel. It produces good power, economy, and low exhaust pollution levels.
LPG has operating characteristics almost identical to those of gasoline and diesel. However, because it is already a gas, the problem of breaking up liquid fuel is eliminated. Since the fuel enters the intake manifold as a vapor, combustion is much more efficient. For this reason, LPG is generally an excellent alternative fuel. Liquefied natural gas (LNG) has the same characteristics as LPG.

A heavy-duty truck would need too many fuel storage tanks to make it a feasible concept at this time. Conversions on city buses, however, are presently being done in several big cities, since fuel tank storage is not as great a problem. Figure 14-10. In most cases there is adequate clearance underneath the bus, Figure 14-11, to allow for several tanks. In addition, most city buses do not accumulate as many miles in a day as would a long-haul tractor/trailer. Buses can also be fueled up locally at their depot by a fast-change facility, which takes about the same length of time as it would to fuel up a diesel-powered bus.

Alcohol-Based Fuels
Alcohol-based fuels are being studied as an alternative fuel for the transportation industry. The two types used to power internal combustion engines are ethyl alcohol (ethanol) and methyl alcohol (methanol). Alcohols are especially desirable as an automotive fuel because they can be manufactured from sources other than crude oil. Alcohol intended as an automotive fuel must be almost pure. Quite often, several refining steps are needed to approach this purity.

Denatured ethanol or “grain alcohol” is colorless, harsh tasting, and highly flammable. It can be made from numerous farm crops such as wheat, corn, sugar cane, potatoes, fruit, oats, soy beans, or any material rich in carbohydrates. Crop wastes are also a source. One of the major drawbacks of using ethanol, clean burning as it is, is that it does emit carbon dioxide \((CO_2)\).

Methanol or wood alcohol can be made from wood chips, coal, oil shale, tar sands, cornstarch, garbage, or even manure. Like ethanol, methyl alcohol is a colorless, odorless, flammable liquid. Methanol is currently being used in several urban diesel powered bus fleets with some success. It is one of the major contenders as a feasible alternative fuel for heavy-duty high-speed diesel engines.

Biodiesel Fuels
Biodiesel is a comparative latecomer to the alternative fuels scene, but as on-Highway, off-Highway, stationary and even marine engine manufacturers continue to investigate any and all alternative sources of fuel, biodiesel is quickly gaining support in the transportation industry. At present, the most popular is a biodiesel blend of number 2 diesel fuel and soybean oils. There is also especially strong interest in biodiesel from the agricultural community because used cooking oils in addition to soybean and processed animal fats can be used in the making of biodiesel fuels.

Industry interest is high in biodiesel since it is not a stand-alone fuel like the other alternative fuels, but rather a blend with existing diesel fuels. This means little or no alterations to the fuel injection system are necessary, nor is any special training of service personnel needed. The two most popular blends today are 20-30% soybean oil to 80-70% diesel oil. In physical properties, biodiesel has almost the same btu/gallon ratio as number 1 diesel. Further, it has slightly better lubricating qualities than number 1 diesel, can handle winterizers and has a gel point slightly higher than number 2. It has very low toxicity if ingested and is actually biodegradable by some standards.

The main drawback to biodiesel is its greater cost in comparison to regular diesel fuel. Biodiesel is now being tested in some city buses and is seeing increased popularity for use in marine diesel engines. In the near future, biodiesel fuels may play a major role in the future in reducing engine exhaust emissions. Figure 14-12. More money and time must be spent on alternative fuel engine development, onboard fuel storage, and fueling facilities before they can become a reality. At the present, biodiesel fueled engines are still cheaper and more efficient than any of the proposed alternatives. With the federal mandate of low-sulfur diesel fuel, as well as reformulation procedures, diesel engines will be performing well into the 21st century.
Summary

Hydrocarbons Fungus
Relative volatility Fungus
Distillation Bacteria
Heat valve Leakage
British thermal unit (BTU) Foreign materials
Joule Air
Specific gravity Water
Flash point Underground storage tank
Volatility (UST)
Ignition quality Above-ground storage tank
Cetane number rating AGST
Ignition delay Alternative fuel vehicles
Cloud point Compressed natural gas
Pour point LNG
Viscosity Liquid petroleum gas (LPG)
Carbon residue Liquefied natural gas (LNG)
Soil ash Ethanol
Sulfur Methyl alcohol
Hydrotreating Biodiesel

Review Questions—Chapter 14

Do not write in this text. Place your answers on a separate sheet of paper.

1. Which of the following grades of diesel fuel are recommended for use in high-speed trucks and buses? (A) number 1D (B) number 2D (C) number 4D (D) Both A & B.

2. The _____ of fuel is a general indication of how heat energy is supplied to an engine, and thus, how well the engine converts heat energy into work. (A) heat value (B) viscosity (C) flash point (D) cetane number rating

3. Heavier grades of diesel fuel usually produce ______ and ______ basis to satisfy anticipated temperature conditions.

4. Sulfur is removed from diesel fuel by: (A) distillation. (B) hydrotreating. (C) filtering. (D) None of the above.

5. Which of the following types of tanks should not be used to store diesel fuel? (A) Steel. (B) Fiberglass. (C) Copper. (D) Steel clad with fiberglass.

6. Fuel stored above ground will deteriorate more than fuel stored underground due to the greater temperature ranges found above ground. (A) True (B) False.

7. Name three ways air commonly enters diesel fuel. (A) Fungus (B) Bacteria (C) Leakage (D) None of the above.

8. Technician A says that grade 1D diesel fuel is generally the most refined and volatile diesel fuel available. Technician B says that grade 2D is more widely used in truck fleets due to its greater heat value per gallon, particularly in warm to moderate climates. Who is right? (A) A only. (B) B only. (C) Both A & B. (D) Neither A nor B.

9. Diesel fuel tanks can be made from ______. (A) Steel. (B) Fiberglass. (C) Copper. (D) Steel clad with fiberglass.

10. A large quantity of diesel fuel can be eliminated by draining settled water out of the fuel tanks at regular intervals. Technician B says that this is to treat the fuel system with a biocide. Who is right? (A) A only. (B) B only. (C) Both A & B. (D) Neither A nor B.

A. Which of the following are contaminants of diesel fuel? (A) Water. (B) Dirt. (C) Cetane. (D) Air.

4. All of the following are diesel fuel properties EXCEPT: (A) heat value. (B) pour point. (C) specific gravity. (D) octane rating.

5. The temperature at which wax crystals begin to form in diesel fuel is known as the ______. (A) cloud point (B) pour point (C) viscosity point (D) specific gravity level

6. The volatility of diesel fuel affects all of the following EXCEPT: (A) the lubrication capability of the fuel at different temperatures. (B) the cloud point. (C) the burn capability. (D) the atomization capability.

7. The _____ of diesel fuel is based on the ability of the fuel to ignite. (A) volatility (B) specific gravity (C) cetane number (D) viscosity

8. Technician A says that fungus and bacterial growth in diesel fuel can be eliminated by draining settled water out of the fuel tanks at regular intervals. Technician B says that the only way to eliminate bacterial growth entirely is to treat the fuel system with a biocide. Who is right? (A) A only. (B) B only. (C) Both A & B. (D) Neither A nor B.

9. Diesel fuel tanks can be made from ______. (A) Galvanized copper. (B) Aluminum. (C) Steel clad with neoprene. (D) Fiberglass.

10. Technician A says that as the temperature of diesel fuel goes down it will hold less dissolved water. Technician B says that there is no common method now available for removing dissolved water from diesel fuel. Who is right? (A) A only. (B) B only. (C) Both A & B. (D) Neither A nor B.