Bell Performance, Inc.
1340 Bennett Drive
Longwood, FL 32750

tel 407-831-5021
fax 407-331-1125
www.bellperformance.net

Common Questions Concerning Fuels

1. What is the number one problem you see with diesel fuel?

Without a doubt, the number one reported problem with diesel fuel is water contamination. Diesel engines produce water when hot fuel from the injectors is returned to the fuel tank; this produces water from condensation, which settles under the fuel. This water has the potential to cause multiple problems – freezing in cold weather, providing a growth medium for bacteria and fungi, accelerated aging of the fuel to produce gums and shellacs, and causing injector tips to malfunction.

The best way to control water in fuel is with a product such as Bell Performance's **DFS Plus**. **DFS Plus** absorbs water into the fuel at a controlled rate so it can be combusted with the fuel.

2. What problems can ultra-low sulfur diesel fuel cause?

Ultra-low sulfur diesel fuel contains higher levels of wax than previous diesel fuels. This is caused by the hydro-treating process conducted at the refinery level to remove sulfur. The wax content is not only higher but the physical shape of the wax platelets is very different from what we would normally see.

This ultra-low sulfur diesel fuel, referred to as ULSD, is especially hard to handle in the northern climates, where outside air temperatures regularly drop well below 40 degrees F. At this and lower temperatures, the dissolved wax in the fuel comes out of solution and may start to plug filters and shut down engines.

Bell Performance has two products designed to prevent the wax particles from sticking together. When used according to instructions, these products prevent ULSD fuel from gelling down to -15 degrees F and below. These two products, **Dee-Zol Plus** and **Cold Flow Improver**, both utilize the newest type of anti-gel technology to treat ultra-low sulfur diesel fuels and address these cold weather problems.

3. Since the widespread introduction of ultra-low sulfur diesel, what effects have been seen in diesel engines?

The most pronounced effect that ultra-low sulfur diesel (ULSD) has had on engines and fuel systems is an increase in wear due to the removal of the sulfur. Diesel fuel acts as a natural lubricant in the engine, providing both 'hydrodynamic' and 'boundary' lubrication. Hydrodynamic lubrication happens when the fuel forms a physical layer of liquid between two opposing surfaces, such as what happens in fuel pumps and injectors. This lubrication functions until the loads and speeds become so high that the liquid is squeezed out from between the surfaces. At this point, boundary lubrication takes over in that certain substances from the fuel will have adhered to the metal surfaces to form protective anti-wear layers. As the hydrodynamic lubrication fails, it is these substances that continue to provide lubrication and protect against wear.

Traditionally it has been thought that the sulfur in diesel fuel functions as a natural lubricant. Unfortunately, the presence of sulfur in diesel fuel is also associated with harmful environmental emissions such as sulfur dioxide. For this reason, the EPA has mandated the almost-total removal of sulfur from diesel fuel. Removing the sulfur from fuel is done by hydro-treating the fuel at the refinery. Unfortunately this creates a fuel with very low lubricity, because the hydro-treating process destroys or alters the lubricity-enhancing compounds which provide boundary lubrication. All of this leads to premature wear and failing of moving parts in the fuel

injection system. This has seemed to be more common in smaller diesel engines than in larger diesel engines used in class 7 and 8 tractors.

Premature wear also seems to be the cause where engines running on ULSD experience hard starting, rough idling, stoppage for no apparent reason and complete engine shutdown.

To alleviate the low-lubricity problem, there have been cases of some people adding transmission fluid, crankcase oil and other strange fluids to the fuel to improve lubricity. Extreme measures like these are not recommended - this can cause severe engine damage as none of these fluids will burn cleanly because they are not formulated to be combustible, and will leave carbon and other deposits in the combustion chamber.

To prevent potentially serious problems associated with the lack of lubricity in diesel fuel, it is recommended to use a lubricity treatment such as Bell Performance's **Lube-Pro** diesel fuel treatment. Using one quart of **Lube-Pro** to 250 gallons of diesel fuel will bring an immediate improvement for any problem associated with lack of lubricity, at a cost of pennies per gallon.

4. Do all fuel additives work in the same amount of time?

In an ideal world, all fuel additives would provide their benefits instantaneously. The reality is, different types of additives provide their benefits over different time frames. Cetane improvers, such as **Super-Tane**, provide immediate results in quieting the engine and providing both smooth running and improved power. Detergents and lubricity agents, by contrast, provide their benefits over longer periods of time. Detergents especially may take into the thousands of miles for their effects to be fully realized. This is because they remove deposits slowly and in layers, in the same manner that deposits are laid down on engine surfaces.

5. Do fuels vary in some important way across the country and if so, in what respect?

All gasolines and diesel fuels are the same with the respect to the fact that they are required to meet the ASTM specifications for certain important properties such as flash point and distillation, ash content and sulfur.

Beyond this requirement, fuels can differ as you go from state to state and for certain reasons. The first reason is that crude oil feedstocks from which these fuels are processes can vary. Different areas of the world and areas of the country provide crude oils which have different properties – remember that oil is merely an agglomeration of dead biological mass, so this should not surprise anyone. The inherent differences in the crude oil are minimized by the distillation of gasoline and crude from the oil barrel and subsequent treating of the fuels so that they meet the afore-mentioned specifications. But there remains some difference in diesel fuels, especially with respect to cold flow properties. A diesel fuel produced in Minnesota might behave differently in cold weather than a diesel fuel produced in Southern California.

Secondly, different states have requirements for environmental impacts which may differ from the federal EPA standards. This means the gasoline or diesel you buy in different states might have differing levels of additives such as oxygenates. This is especially true in California which has the toughest emissions controls of any state in the Union - the California Air Resources Board (CARB) sets regulations in the state. Fuel regulations in California require that diesel fuel contain no more than 10% aromatic content, lower than the federal requirement. Refiners meeting this standard have to conduct more severe hydrotreating of the fuel, which lessens the lubricity of the fuel. Thus these refiners may elect to add lubricity or cetane-enhancing additives in order to simultaneously meet the California standards while producing a fuel which minimizes problems for the

consumer. Other formulations of diesel fuel are also allowed if they can demonstrate they achieve the same or lower emissions as a 10% aromatics fuel. More than 20 alternative formulations have been approved by CARB thus far, and CARB estimates that the use of these formulations has reduced sulfur dioxide emissions by 82% and particulate emissions by 25% since 1993.

6. How can an additive prevent gelling of fuel in cold weather?

All diesel fuels contain wax which normally is dissolved in the fuel and contributes to the fuel's BTU heat value (helping to provide power). As ambient temperatures drop to 20 degrees F and below, the wax starts to come out of solution. These wax particles then begin to stick together, increasing in size as the fuel changes to a gel-like consistency. Eventually the particles reach a point where they are large enough that they can plug the primary fuel filter. Some engine manufacturers have tried to solve this problem by locating the fuel pump and filter at locations where they will receive the most heat from the engine. But in general, this gelling remains a problem for most vehicles.

Anti-gel products act as dispersants to prevent these wax crystals from sticking together. The anti-gel "polymer" molecules actually attach themselves to the wax crystals, changing their shape in such a way that the other crystals can't attach themselves to each other and form larger crystals.

In order to work properly, an anti-gel product must be added to the fuel before the temperature drops sufficiently for the wax to come out of solution. Anti-gels are preventative products - they will not work once the fuel has actually gelled. It is also best to add an anti-gel to the fuel before adding new fuel (splash blending) so that proper mixing can be achieved. Recommended anti-gel products include Bell Performance's **Dee-Zol Plus** and **Cold Flow Improver**.

7. What can be done if a fuel becomes gelled?

If fuel has already gelled, adding an anti-gel product will not "rescue" the fuel. This is because anti-gels operate by preventing wax crystals from sticking together. Once the wax has clumped together, an anti-gel will not reverse this.

Restoring gelled fuel to a condition where it can be combusted typically involves warming the fuel and the fuel system to a sufficient temperature for a sufficient length of time that the wax crystals go back into solution. The length of time this takes varies dependent upon the vehicle but usually involves at least several hours of time. This, combined with a possible towing charge if the vehicle has broken down on-road, and the business disruption, can spell a cost to a business of thousands of dollars.

Alternatively, Bell Performance offers a specialty product called **Quick Thaw** which will liquefy gelled fuel and re-dissolve wax crystals which have come out of solution. The **Quick Thaw** product, when used according to directions, will restore gelled fuel to usable condition within 20 minutes. Keeping a product like this on-hand for emergency situations is a cost-effective contingency to the cost of towing a vehicle sidelined by gelled fuel.

8. What causes fuel to lose stability? What special precautions should be taken with diesel fuel that must be stored for a long period of time?

Bell Performance, Inc. **tel** 407-831-5021
1340 Bennett Drive **fax** 407-331-1125
Longwood, FL 32750 www.bellperformance.net

Fuel instability is a bigger problem with diesel than with gasoline because diesel fuels tend to be stored more often than gasoline is. Fuel instability is a concern because it results in gum formations which lead to injector deposits or particulates which can plug fuel systems. Typical causes of fuel instability include exposure to water, light or oxygen, or microbial contamination.

Fuel instability is really a chain reaction of interactions between pre-cursors in the fuel and outside elements (oxygen, water, light, certain metals) which start or contribute to the chain reactions. These precursors are chemically altered, through oxidation or other reactions, and change into heavier compounds which do not stay dissolved in fuel. At this point they drop out of solution and aggregate together to form gums, varnishes and other deposits. Adding a stability additive stops this process by blocking one or more of the pathways in the multi-step reaction.

Curiously, two fuels which have good stability individually may also form a less stable blend if they are combined. Each fuel contributes some instability precursors to the blend; when both sets of molecules are put together, a complete precursor set is formed and instability reactions may take place which would not otherwise take place without the presence of both fuels together.

Storing fuel for longer periods of time may require steps to be taken to maintain fuel integrity.

- Purchase clean dry fuel from a reputable supplier. Keep the stored fuel clean and dry, to eliminate the presence of free water which can encourage corrosion of metal storage tanks and microbial growth.
- Add an appropriate stabilizer (like **Bell Performance Sta-Bell**) that contains an antioxidant and corrosion inhibitor. No stabilizer can contain a biocide unless it is a single purpose product.
- Regularly test the fuel and polish it by running it through portable filters and adding fresh stabilizer.

9. What is cetane number and why is it important?

Cetane number is a measure of the combustion quality of diesel fuel; specifically, a measure of a fuel's ignition delay (the time period between the start of injection within the cylinder and the start of combustion). Due to the nature of the refining process, diesel fuel is composed of a broader range of hydrocarbons than gasoline is – hydrocarbon molecules of varying lengths. During the power stroke, gas pressure increases as the cylinder moves upwards towards top-deadcenter and the shorter molecules have the tendency to combust first. A lower cetane fuel will have more of the shorter-chain molecules which "prematurely" combust, resulting in a wider gap between the ignition of the fuel (due to pressure) and the piston reaching top-deadcenter. Higher cetane fuels (with more longer molecules of the same size) will have shorter ignition delay periods because less of the fuel starts to combust before the piston reaches the optimum position for maximum power.

Cetane also functions like octane by reducing engine knock. Engine knock is a result of the rapid pressure rise which occurs when the gases in the cylinder combustion and expand rapidly. Increasing the cetane number of a fuel decreases engine knock by shortening the ignition delay of the fuel. With a shorter delay, there is less time from the point where fuel starts to be injected into the cylinder and when it combusts. With a shorter ignition delay, there is less time for the fuel to mix with the air before combustion, resulting in a smaller rapid pressure rise and less knocking and pinging.

Practically speaking, diesel fuels with higher cetane numbers provide faster and easier start-up, lower emissions (especially start-up emissions) and more power in acceleration. Regular diesel fuel typically has a cetane rating between 40 and 46, while "premium" diesel fuel will have a cetane rating between 45 and 55, depending on

which organization is making the standard. The NCWM floor for premium diesel cetane is 47, while the Engine Manufacturers Association minimum is 45.

Vehicles which have difficulty starting or which run roughly may benefit from a cetane-improving additive such as Bell Performance's **Super-Tane**. The **Super-Tane** additive works by interacting with the shorter molecules of the fuel blend such that it retards their tendency to combust prematurely. The **Super-Tane** additive is formulated to improve cetane rating between 4 and 8 points which, when added to regular diesel fuel (cetane rating of 44), can increase its cetane rating to that of premium diesel (cetane rating increased to 48-52).

10. What causes smoke from diesel engines?

Diesel engines don't have much problem meeting emissions standards for carbon monoxide and hydrocarbons. It is particulate matter (PM) where the emissions challenges for diesel engines lay. Diesel engines emit particulates on a regular basis, usually in particle sizes too small and in too small concentration to be visible. When there is visible black smoke, that indicates a problem – an incorrect fuel-air ratio (too much fuel for the available air to burn) being the first suspect.

This problem is usually corrected as the engine warms up and the black smoke diminishes. Smoke after engine warmup can be an indication of a maintenance or adjustment issue – an air filter might be clogged (allowing too little air to pass) or worn injectors could be supplying too much fuel for the available air. Making the proper mechanical adjustments or repairs can many times solve this problem.

For some diesel engines experiencing rough running and smoke, a cetane improver such as **Super-Tane** can provide immediate visible results. Improving the cetane of the fuel (within limits) can greatly reduce the black smoke produced as the engine warms up, by shortening the ignition delay of the fuel such that less fuel is injected which fails to be combusted (ending up as partially burned fuel in the form of black smoke).

11. Can a higher cetane fuel make my diesel engine easier to start?

Diesel engine owners know well the difference in ease of starting between diesel and gasoline engines. The reason for the difference comes down to the difference between how their combustion systems work. At cold start, the engine is cold and has no heat energy contained inside. Gasoline engines use sparks to provide the heat energy necessary for the fuel to combust. Since diesel engines do not use spark plugs, the only energy available at cold start to heat the gas is the heat of compression. Remember that diesel engines compress the air in the cylinder before injecting fuel; as the air is compressed, its temperature increases. This heat of compression must heat the gas in the combustion chamber to a temperature high enough to cause spontaneous combustion of the fuel (usually about 750 degrees F). Not only this, but the heat of compression must overcome the fact that the walls of the diesel cylinder are cold and actually absorb heat. Thirdly, the cranking speed of a diesel engine is slower than the operating speed, which means there is more time during the starting process for the compressed air to lose some of its built-up heat to the cold chamber walls.

For these reasons, a diesel engine takes longer to start than a gasoline engine, especially in cold weather. A fuel with a higher cetane fuel will make starting easier because it combusts more easily. In colder weather, even premium diesel fuels may not provide enough cetane to start the engine satisfactorily. In cases like this, use of an aftermarket cetane improver such as **Super-Tane** can provide immediate and impressive results with respect to improving ease of starting.

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12. How do microbes live in diesel fuel? What problems can they cause?

If a diesel fuel contains water, it is almost inevitable that microbial growth will follow if that water is not removed promptly. Bacteria and microbes thrive in a fuel tank by living in the interface where settled water meets diesel fuel. The microbes then draw nutrients from the diesel fuel and needed moisture from the water. Left unchecked, microbes can multiply and start to cause problems. The microbes can produce acidic byproducts which lead to accelerated corrosion in the fuel system. Dead microbes can also form "sludge" which will plug filters.

13. Are there any reliable ways to prevent microbial growth and treat microbial infestations once they are present?

The best way to prevent microbial growth in fuel tanks is to prevent the accumulation of free water. Without free water, bacteria have no interface in which to thrive. This is not easy to do, especially with fuel tanks which are above ground and subject to the cycles of daytime heat and nighttime cold which lead to moisture from the outside air condensing within the fuel tank (as all fuel tanks are vented to the outside).

To prevent accumulation of water in fuel tanks, it is useful to incorporate a product such as Bell Performance's **DFS Plus**, which is formulated to absorb water and suspend it within the diesel fuel. This prevents the water from accumulating to the degree necessary to support microbial growth.

Once bacteria are present, it is necessary, at the least, to remove the water present which supports their growth (through pumping from the tank). It may also be advisable, depending on the situation, to use a biocide specifically to kill the bacteria present in the tank. Otherwise the problem may simply repeat itself in the near future.

14. My fuel tanks are currently contaminated with fungus that I need to get rid of. I saw a multi-purpose product which claims to have a biocide ingredient which "controls microbes." Is this the kind of product I should be using to get rid of the fungi?

To best answer this, it is important to note the difference between actively killing existing microbes (like fungi or bacteria) and preventing their growth or even eliminating the conditions by which they can thrive.

To get rid of an existing infestation, you can do two things: use a biocide product to kill the living organisms, or use a product which changes the conditions in the tank such that the specific things the microbes need to survive are removed and the microbes slowly die off. The most common way to do the latter is to remove the water interface which the microbes need to grow.

Multi-purpose products which claim to "control microbial growth" likely only change the conditions which the microbes need to grow – they don't contain an actual biocide which actively kills the microbes. This is because the EPA strictly controls biocide products (due to their hazardous nature) and, by law, will not allow them to be mixed with other ingredients, as you would see in a multi-purpose product. So any multi-purpose product (such as a fuel stabilizer with microbial-growth controlling agent) cannot contain a biocide agent; however, it can contain ingredients such as water-control substances, which would control or prevent their growth by changing the conditions under which they need to grow.

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Which one is best for your problem? If your tanks are already infected with microbes, it is best to use a single-purpose biocide like **Bellicide** to disinfect your tanks (to kill the infection), and then treat regularly with a product such as Bell Performance **DFS Plus** or **Marine Dee-Zol** which will prevent bacterial growth in the future by controlling the water buildup they need to survive.

15. I see more and more gasohol, such as E85, available. Can the use of gasohol in my engine cause any problems?

Gasohol is a blend of gasoline and ethanol – a by-product of corn or related agricultural products. Its biggest benefit compared to fossil fuels is that it is a renewable resource.

The primary problem associated with the use of ethanol-blend fuel in engines is water attraction. All alcohols contain water and gasohol has the tendency to attract and absorb water from the environment. This water can accumulate in a fuel tank, cause corrosion problems, and can be in danger of freezing in the wintertime. The presence of water can "pull" unstable molecules such as shellacs and varnishes out of the diesel fuel portion of the gasohol blend, accelerating the aging of the fuel. Similarly, ethanol blends are also associated with "phase separation" problems, where the water and fuel separate upon standing for long periods of time – a 10% ethanol blend can become unstable from the presence of as little as 0.5% water, and the percentage of water needed to do this goes down as the proportion of ethanol increases.

Gasohol reduces fuel mileage, depending on the amount of ethanol in the fuel blend – this is due to the fact that a given volume of ethanol contains less heat energy than the same volume of gasoline.

Bell Performance has introduced a multi-purpose additive for gasohol blends called **Marine MXO**. **Marine MXO** contains ingredients to control the problem of water attraction to gasohol, plus contains added combustion improvers, stabilizers, detergents and lubrication agents, to offer a complete problem-solving treatment for blend of gasohol from E5 to E85.

16. What are the advantages of bio-diesel?

Bio-diesel is typically a blend of #2 diesel fuel and a treated vegetable or animal fat – most commonly soybean oil. It is produced with the large-scale goal of helping to contribute to the reduction of our nation's dependence on foreign crude oil. Typical bio-diesel blends can contain 2%, 5% or 20% vegetable oil. Blends above 20% bio are rare because engine manufacturers won't guarantee their warranties for blends that high.

Bio-diesel's advantages include increased fuel lubricity (just a 2% blend of bio-diesel has as much lubricity as diesel fuel from before the elimination of sulfur) and the advantage of being a renewable resource produced naturally by our domestic agriculture industry.

More importantly for the environment, bio-diesel is associated with a dramatic reduction in exhaust emissions. This can help reduce the atmospheric levels of smog, particulates, carbon dioxide and carbon monoxide. These atmospheric emissions are an especially big concern in metropolitan urban areas, many of which have already failed to meet EPA mandates for air quality and are looking for solutions to address this.

There is currently a strong push by governmental agencies and the farm lobby to encourage the use of bio-diesel fuel. Some states have mandated the sale of bio-diesel (such as a 2% blend) and consumers have been encouraged to use bio-diesel through the offering of fuel tax and energy credits.

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17. What disadvantages are there to using bio-diesel?

In exchange for its advantages, bio-diesel does have some drawbacks.

First, it has a lower BTU value than straight diesel fuel, which means you achieve somewhat lower mileage compared to regular diesel.

Second, bio-diesel ages faster than straight #2 diesel fuel, forming shellacs and varnish deposits which can lead to injector deposits. Using a stabilizer product formulated for biodiesel, such as Bell Performance **Bio Dee-Zol** can help with this problem.

Third, bio-diesel has problems when water accumulates in the fuel. A fuel-water interface provides a breeding place for microbes, which love to feed upon the vegetable oil portion of the fuel. This can lead to tremendous problems associated with microbial infestation.

Fourth, bio-diesel has problems flowing in cold weather. As the percentage of vegetable oil in the blend increases, cold weather problems also increase, especially as the ambient temperature approaches 35 degrees F.

Lastly, there have been some quality-control problems with the companies trying to produce bio-diesel with the optimum specifications. A random sampling by the National Biodiesel Board in 2006 of over 300 samples of bio-diesel fuel found that over half of the samples did not meet minimum standards for important fuel qualities such as acid number and total free glycerin (both of which can cause major engine problems if out of spec). If you choose to use bio-diesel fuel, make sure that your supplier has documentation showing that the fuel meets the ASTM standards for bio-diesel fuel.

18. Do cold flow improvers work the same in bio-diesel as they do in regular fuel?

Traditional cold flow improvers do not work as effectively in bio-diesel blends as they do in regular diesel fuels. This is due to the fact that a bio-diesel blend consists of two different "phases" – diesel fuel and vegetable oil – which gel for different reasons. Diesel fuel gels due to the presence of paraffin wax within the fuel, and traditional anti-gels work well to combat this. However, the vegetable oil phase of the fuel does not contain paraffin and does not gel because of it; it gels due to other constituents. Traditional anti-gel polymers are ineffective at keeping the vegetable oil phase from gelling.

To effectively address bio-diesel blend gelling, it is necessary to use an anti-gel product which contains components to address both problems. Bell Performance's **Bio-DeeZol Plus** product is an anti-gel product specifically formulated with ingredients to target the gelling of both phases of a bio-diesel blend. At recommended treat ratios, the product can reduce cold filter plug point of bio-diesel by as much as 15 degrees F.

19. Do all cold flow improvers work equally well in all types of diesel fuel and bio-diesel?

The short answer to this is no, and the reason for this stems from the variability of diesel fuel stocks and the bio-diesel industry. Biodiesel is very easy to make but equally easy to produce a batch of fuel which does not meet ASTM specifications. Thus there is a much greater variance in biodiesel properties compared to the more rigidly controlled gasoline and diesel fuel market. To its credit, the bio-diesel industry and associated groups

(such as the National Biodiesel Board) have worked hard to standardize the industry and remove as much variance as possible between fuels. But the variance is still there. In addition to this, characteristics of biodiesel with respect to cold flow properties can vary with the kind of feedstock used, whether it be soybean oil or palm oil or animal fats. Different biodiesels may not all respond equally to the same cold flow improver. The best way to minimize this problem is to only use biodiesel which meets ASTM specifications for biodiesel. Using biodiesel which meets this specification will minimize the chance of encountering problems with a batch of fuel which does not respond at all.

With respect to #2 diesel fuel, there can be some variability in how cold flow improvers interact with both the fuel and the fuel system. When we speak of interaction with fuel systems, what we mean is that different fuel systems may plug at different temperatures with the same fuel, because the plugging of the filters in the system is the second part of the whole cold flow operability equation.
When we mention variability with fuels, we mean that cold flow improvers will vary slightly in their effectiveness with different fuels because those fuels can have differing amounts of differing shapes of wax crystals. Conventional cold flow improvers work by interacting physically with those wax crystals and changing their shapes so they can't stick together. Variability in the wax crystal shape will lead to some variability in polymer effectiveness. Keep in mind that we don't mean the variability will be so great that one certified fuel plugs at 10 degrees and another at -20. The variability is more along the lines of a few degrees. But it is important to remember that properties like cold flow are somewhat dynamic and cannot be nailed down to an exact temperature which will be exactly same every time the same situation arises. This is part of the reason the ASTM does have not an official specification for cold flow properties of diesel fuel – the variability and situation-dependence of the property is too great.

20. I saw a fuel additive which said it was "EPA-registered". Does this mean the EPA endorses that product?

Any product intended to be sold as an additive for gasoline or diesel fuel must have its formulation registered with the EPA. During the registration process, the manufacturer discloses the ingredients in the formulation, so that the EPA can ensure that the ingredients won't cause damage to engines. This is done through a requirement that all additive ingredients be "substantially similar" to what is already naturally found in gasoline. Since the hydrocarbons in fuel won't harm engines, substances "substantially similar" to what is in fuel alone won't harm engines either.

The claim "EPA-registered" means only that the additive manufacturer has satisfied this requirement by submitting its ingredients for inspection. It absolutely does not mean that the EPA either endorses the product or has tested the product to ensure that it does what it claims to do. In fact, any company which implied or claimed that the EPA endorsed its product could be subject to large fines by the Agency.

21. What's the significance of diesel fuel specifications in terms of what problems having an out-of-spec fuel might cause?

The names of different specifications are often discussed but their significance is not always explained, leaving the consumer in the dark. Following are the most important diesel fuel specifications and what properties of the fuel or fuel-related problems they are most closely related to:

> ***Flash Point*** – Related to fuel safety and handling and use. Flash point is not directly related to engine performance

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Water and Sediment – Affects the health of fuel filters and injectors

Volatility – Ease of starting and smoke production

Viscosity – Affects the fuel spray atomization and fuel system lubrication. Proper atomization is important for the engine to operate at highest efficiency.

Ash – Combustion chamber deposits and potential damage to fuel injection system

Sulfur – Particulate emissions, cylinder wear and deposits

Copper Strip Corrosion – The fuel's potential for corrosive attack on metal parts

Cetane Number – Closely tied to ignition quality, cold starting, combustion and emissions

Cloud and Pour Point – Operability at low temperatures

Carbon Residue – Coking tendency of fuel and fuel's tendency to leave engine deposits

Heating Value – Directly related to fuel economy

Density – Affects heating value of the fuel and therefore fuel economy.

Thermal Stability – Potential to form insolubles (gums, varnishes and deposits) during use and storage

Lubricity – Wear on fuel pump and injectors

22. I accidentally mixed gasoline with my diesel. What can I do?

Adding as little as 1% gasoline will lower the flash point of the blend below the specification minimum for diesel fuel. It doesn't affect engine performance but makes fuel more hazardous to handle. Adding larger amounts of gasoline will lower the viscosity and cetane numbers below specification minimums. This can degrade combustion and increase engine wear.

23. Can I blend used engine oil or transmission fluid into diesel fuel to get rid of it?

This used to be a common practice, but results in a blend which does not meet fuel specifications. It can affect specifications of 90% boiling point, sulfur content, ash, water and sediment, viscosity and carbon residue. In California, blending used engine oil in diesel fuel is illegal and a violation of hazardous waste regulations.