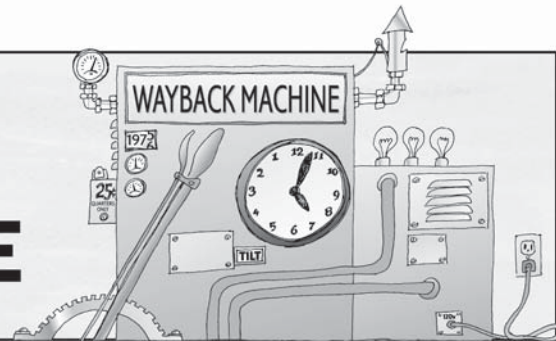


# THE WAY WE WERE



*It has been duly noted that the TDR has reprinted material from previous magazines. Realizing when this practice is appropriate is a difficult task—darned if you do, darned if you don't.*

*From time to time we will crank up the "way-back machine" and repeat material that is relevant. In the last issue of the magazine (Issue 38, page 64) writer Bill Swails introduced a new definition for the word moron. To save you from shuffling through your stacks of old magazines, Bill's definition was as follows:*

mo-ron (môr án) *n.* a person named Bill (AKA EarthRoamer) who puts 42 gallons of UNLEADED fuel in his Cummins turbo DIESEL powered truck.

*Yes, we all make mistakes and I think Bill was a bit too hard on himself. However, his article has prompted several e-mails asking about potential harm to the engine should gasoline be mixed with diesel fuel. The following excerpt from Issue 26 will give you the answer.*

## MIXING GASOLINE AND DIESEL

My wise old mechanic who has worked on Mercedes for years told me that if I put one gallon regular gas to a tank full of diesel after about every four tanks that it would perform essentially the same job as a fuel injector cleaner at a fraction of the cost. I would like to hear a technical opinion.

**BILL CARSON**  
e-mail

***Bill, I'll turn the answer to your request for a technical opinion over to Brian Kmetz. As a mechanical engineer, Brian's daily task at work is to extract BTUs through oxidation from mass quantities of methane and fuel oils. Needless to say, he knows how the fuel "stuff" works. Brian writes:***

We hear this one all the time. Another version is to add one gallon of gasoline to 20 gallons of diesel fuel as a cheap easy anti-gel for winter fuel. I'll include alcohols in this discussion because a lot of guys add it instead of gasoline. Both fuels have the same detrimental effect on diesel fuel and are very close in weight and BTU content.

The mechanic meant well and probably never saw a fuel pump or injector failure due to improper blending of fuels. But that doesn't mean one is not risking damage, even in small dosages.

Gasoline and alcohols hit diesel fuel right where it hurts the most. Those light thin fuels will lower the cetane number and lubricity. To explain how octane and cetane DO NOT work together, I'll have to review more crude oil and fuel fundamentals.

The light distillates that gasolines are made from have a natural high-octane index. The middle distillates that diesel fuels come from have a high cetane index. The octane and cetane indexes are INVERSE scales. A fuel that has a high octane number has a low cetane number, and a high cetane fuel has a low octane number. Anything with a high octane rating will retard diesel fuel's ability to ignite. That's why each fuel has developed along with different types of engine designs and fuel delivery systems. Gasoline mixed in diesel fuel will inhibit combustion in a diesel engine and diesel fuel mixed in gasoline will ignite too soon in a gasoline engine.

A lot of old-time mechanics added some gasoline to diesel to supposedly clean the carbon deposits out of the cylinders. I have never read anything that said it worked. Gasoline will make the fuel burn hotter, and hotter burning fuels burn cleaner. That's probably where the theory got started. In the older diesel engines that belched lots of black smoke even when properly tuned, the result of adding gasoline was probably more white smoke instead of black. This might lead one to believe the engine was running cleaner. Maybe so, probably not. Here's what happens.

Gasoline will raise the combustion temperature. This might or might not reduce carbon deposits in the cylinder. This also might or might not overheat the injector nozzle enough to cause coking on the nozzle. That's a clogged injector tip in layman's terms. The fuel being injected is the only thing that cools the nozzle. Diesel fuel has a lower combustion temperature than gasoline. The fuel injectors depend on the fuel burning at the correct rate and temperature for a long life. If the combustion temperature is raised long enough, the gums and varnishes in gasoline will start to cook right in the fuel injector and turn into carbon. These microscopic carbon particles will abrade the nozzle. High combustion temperatures alone will shorten fuel injector life; gasoline makes the problem worse.

Gasoline and alcohols do have an anti-gel effect on diesel fuel, but these fuels are too thin and will hurt the lubricity. Alcohols work as a water dispersant in small amounts, but also attract water in large amounts. Diesel fuel is already hydrophilic (attracts water), so why add to the problem? The old timers got away with this because high sulfur diesel fuel had enough lubricity to take some thinning. Today's low sulfur diesel fuels have adequate lubricity, but I wouldn't put anything in the tank that would thin out the fuel, reduce lubricity, or attract water.

Opposites do not attract in this case. Use any of the diesel fuel additives available to clean out carbon deposits, not gasoline or alcohols.

## THE WAY WE WERE . . . . Continued

*Editor's Note: Inquiring minds want to know, should the gas-in-diesel mistake occur and the mistake caught early in the filling process, is there a point of too much danger? Because of the liability I could not get an answer "for the record." However, the consensus among many in the diesel business was that a five-percent or less mixture is acceptable. This goes hand-in-hand with the story that Brian related to you in his second paragraph, "The mechanic meant well . . . but that doesn't mean one is not risking damage, even in small dosages." Amounts greater than five-percent lower the flash point of the gasoline/diesel brew. The resulting brew makes the fuel hazardous to handle as well as making the brew below diesel specifications thereby degrading combustion and increasing wear.*

While we're on the subject of fuels, let's discuss another common question. What is cetane?

Cetane is to diesel fuel what octane is to gasoline. It is a measure of the fuel's ignition quality and performance. Cetane is actually a hydrocarbon chain; its real name is 1-hexadecane. It is written as C<sub>16</sub>H<sub>34</sub>, or a chain of 16 carbon atoms with 34 hydrogen atoms attached. All HC chains are also referred to as paraffins. Cetane is a hydrocarbon molecule that ignites very easily under compression, so it was assigned a rating of 100. All the hydrocarbons in diesel fuel are indexed to cetane indicating how well they ignite under compression. There is very little actual cetane in diesel fuel.

All the hydrocarbons in diesel fuel have similar ignition characteristics as cetane. Cetane is abbreviated as CN. A very loose way to think about cetane is if the fuel has a CN of 45, then the fuel will ignite 45% as well as 100% cetane. Diesel engines run just fine with a CN between 45 to 50. There is no performance or emission advantage to keep raising the CN past 50. After that point the fuel's performance hits a plateau.

Diesel at the pump can be found in two CN ranges: 40-46 for regular diesel, and 45-50 for premium. The minimum CN at the pump is supposed to be 45. The legal minimum cetane rating for #1 and #2 diesel is 40. Most diesel fuel leaves the refinery with a CN of around 42. The CN rating depends on the crude oil the fuel was refined from. It varies so much from tanker to tanker that a consistent CN rating is almost impossible. Distilling diesel is a crude process compared with making gasoline. Gasoline is more of a manufactured product with tighter standards so the octane rating is very consistent. But, the CN rating at the diesel pump can be anywhere from 42-46. That's why there is almost never a sticker on a diesel fuel pump for CN.

Premium Diesel has additives to improve CN and lubricity, detergents to clean the fuel injectors and minimize carbon deposits, water dispersant, and other additives depending on geographical and seasonal needs. More biocides are added in the south in summer, more anti-gel added in the north in winter. Most retailers who sell premium diesel will have little brochures called POPs (Point of Purchase) at the counter explaining what's in their fuel. Please don't ask the poor clerk behind the counter any technical questions after reading this discussion. All they need to know is how to sell you beer, milk, cigarettes, lottery tickets, and take your money.

Texaco and Amoco are two big names who sell Premium Diesel in limited markets. Amoco primarily sells its Premier to specialized industrial and agricultural markets. I cannot get either in my area. Most fuel retailers buy additives or buy treated fuel. In the Northern plains states, Koch is a well-known marketer of Premium Diesel. I buy it when I travel into Northern Wisconsin.

Because there are no legal standards for Premium Diesel yet, it is very hard to know if you are buying the good stuff.

*Editor's Note: Recent TDR Issue 36 had a lengthy discussion on the subject of Premium Diesel fuel and its ambiguous definition.*

Diesel fuel is an international commodity for industry. Therefore, you should be picky about where you fill up. Shop for price from a large volume retailer so you have the freshest fuel. That's about the best advice I can give.

The 1994 legislation and reformulation of diesel fuel in North America is due to an international effort for lower emissions. Cleaner diesel fuel is on the way in 2006. Without getting too technical (this is over-simplified and very generalized), diesel fuel for the most part is made up of two different hydrocarbon families: paraffins and aromatics. The paraffins have a naturally high cetane index, burn clean, but cause the annoying gel problem in winter. The aromatics have a naturally high lubricity, low cetane index, and cause a lot of diesel emissions and soot. Reformulated diesel will have a higher paraffin content, higher cetane number, and a much lower aromatic and sulfur content. It will also be more prone to jelling and have a lower lubricity. "Big oil" is working on improved additives needed to bring the 2006 fuels to market.

**Brian Kmetz**



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