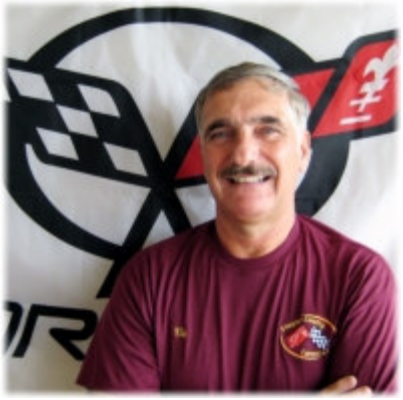
Technical Notes — September '08' - Impact of 10% Dreaded Ethanol



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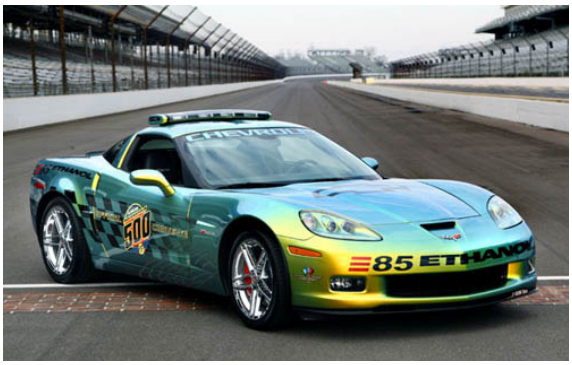
Technical Committee —Chair

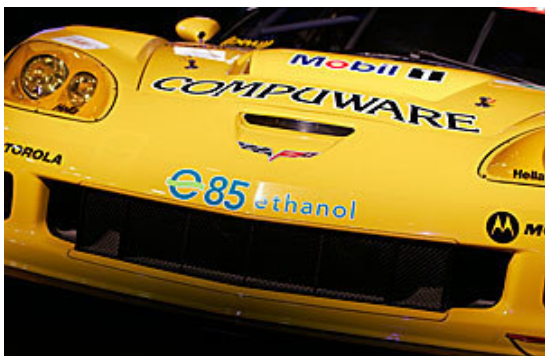
Gasoline again! As you may recall, my very first Tech article covered Top Tier gasoline, fuel octane ratings and how they affect your Corvette. Usually, I try not to repeat the subject matter in my monthly articles; however, I have had so many Club members recently ask me about the new ethanol blends of gasoline, that I felt I should revisit the fuel subject one more time. So, this month we will discuss the dreaded up to 10% ethanol that is added to the gas you now buy.

First, let's discuss the definitions used in ethanol blended fuels and the current state of the fuel supply in Florida. Ethanol is only another is the long line of oxygenated compounds added to auto fuel to reduce emissions and increase octane. It contains not only hydrogen and carbon atoms found in petroleum fuels, but oxygen. If you been awake in the past two years, you are well aware of the high price of crude oil and the direct effect it has on gasoline prices. The President has mandated the increased use of ethanolblended fuel to increase the overall amount of fuel available to drivers and thus, help lower the price of all automotive fuels. The Florida legislature, in lock step, has mandated that by the year 2010 all fuels in Florida will contain an ethanol blend. Thus, the dilemma: Even if a driver would be willing to pay the extra price, straight gasoline will not be available for use. We must deal with ethanol-blended gasoline, like it or not.

Ethanol blend fuels come in many varieties, but the two most prevalent are 10% ethanol "gasohol" and "E85" fuel. Gasohol, a mixture of 10% ethanol and 90% gasoline, is nothing new to automobiles. It became much more popular after the first Arab oil embargo in 1973 and Energy Tax Act of 1978 subsidized its production to help increase fuel supply. E85, however, is a relative newcomer to the fuel world. It is composed of 85% ethanol and 15% gasoline. In this article I do not want to get wrapped up in many of the ongoing controversies surrounding ethanol fuel production. Issues like: Does it cost more energy to produce than it provides; does it help lower ground water infiltration common with MTBE but raise other pollutant levels; does it really lower greenhouse gases; does it raise the price of food by diverting corn to fuel production and a host of others would fill pages of this newsletter. I will stick to the following: How will this affect the Corvette sitting in my garage?

First, vehicle manufacturers do not recommend E85 fuel unless your car is specifically designed for its use (flex fuel vehicles.) So far only a handful of Corvettes meet that specification. There was one E85 Z06 Corvette Pace Car showcased at the Indianapolis Motor Speedway for the 2008 Indy 500. In addition, the C6 racecars used in the American LeMans series racing series all use E85, which was introduced for this year's series. For all other Corvette owners, ethanol blended fuel is, in fact, 10% ethanol. You see that little sticker on the pump at every fill-up, "contains up to 10% ethanol." While I'm on the subject, we are lucky in Florida. It is one of the states that mandate the notification of ethanol use in automobile fuel no matter what the mixture ratio with gasoline. As of the date of this article, I know of at least a couple of gas stations that are still using straight gasoline. But, that will not last long.





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What are the desirable characteristics of gasohol as they pertain to motor fuel? First and foremost, pure ethanol has an extremely high octane rating, near 115, (R+M)/2. The IRL cars actually use it full strength partly for that reason. Ethanol is used to boost the octane rating of true gasoline. Therefore, by using ethanol, oil companies can eliminate more ecologically undesirable octane boosters such as methyl tertiary-butyl ether (MTBE). Ethanol is also a strong cleanser. When used in motor fuel, it tends to rid fuel systems from varnish and other contaminant build-up. Finally, gasohol is purported to be up to eight cents a gallon less expensive that the corresponding octane rated pure gasoline. However, up until last year the Federal government was supporting ethanol production to the tune of 51 cents a gallon, or 5.1 cents per gallon of gasohol. That subsidy been lowered a nickel or so recently, but it is obvious that gasohol's cost advantage is mitigated in some respects.

So, what are the problems using with this fuel in lieu of straight gasoline? They mainly fall into two categories, water affinity and corrosion. Ethanol has a great affinity for water, much more so than other hydrocarbon compounds. The "shelf life" of gasohol according to most sources I have read is on the order of 90-100 days. Thus, if you let gasohol sit around in exposed storage for a long period of time, the water in the air will combine with the ethanol in the fuel. If undisturbed, it will settle to the bottom of the container or fuel tank. Thus, the gasoline at the top of the mixture will be "octane starved" and can be as much as 3 points lower than the original blend. Correspondingly, the fuel at the bottom of the tank has a higher concentration of water. If this mixture is fed to the engine induction system, it can cause vapor lock. For this reason, any small aircraft that have had a modification, called and STC, to run automobile gasoline instead of aviation gas are forbidden to use any ethanol-blended fuels by the FAA.

Corrosion is another issue in the argument against gasohol. Modern cars produced in the 1980s and beyond all have components meant to withstand the corrosive effects of ethanol. In particular, ethanol can cause pitting in brass and aluminum; can cause cork to decompose and rubber and other elastomers to either swell or become brittle. Although the effects on metals can be very long term and influenced by the amount of water absorbed by the fuel, rubber is particularly susceptible to the drying effects of any alcohol. Elastomers used in gaskets, seals, "o-rings" or fuel lines can become non-flexible and fail, or swell and become unfit to contain pressurized fuel. Ethanol is also a strong solvent and can dissolve or break loose varnish and other substances that have accumulated on fuel system components. When they break loose or dissolve, the resultant fuel mixture they can clog fuel filters and in extreme cases, injector nozzles or carburetor jets. Signs of ethanol's corrosive action in motor fuels include leaks with in the fuel system, a rough running engine, or an engine that is suddenly difficult to start or one that stalls or stops. These symptoms can be caused by high water concentrations or particulate contamination in the fuel.

Reduced fuel economy is yet another reported problem associated with gasohol's use in any vehicle. Although not harmful to your car, it may put a noticeable dent in your wallet. By chemical analysis, pure ethanol has a hydrocarbon heating value of 76,000 BTU per gallon, which is approximately 30 percent less than gasoline's heating value (which is approximately 109,000 to 119,000 BTU/gal). Thus, using fractional mathematical analysis, gasohol should yield roughly 3% less fuel economy. Unfortunately, the fuel efficiency argument between the detractors and proponents of ethanol is all over the lot and produces claims that vary greatly. I have had some people tell me anecdotal accounts of tremendous losses in fuel economy (3-4 mpg in 25 mpg). On the other side, the American Coalition for Ethanol published a 2005 study where they said the economy loss was only 1.5%. If you read their report carefully, though, you'll note a tiny footnote at the bottom of the report saying, "Admittedly, the test used a very small sample, but the results suggest that a large and more detailed study be completed in the near future." From my research, I agree wholeheartedly. More extensive scientific study needs to be done to get a real handle on ethanol's effect on fuel economy. Unfortunately, given all governments' strong propensity to force the use of ethanol, we as consumers may never get a clear answer to this issue. Nevertheless, a tune up specifically designed to compensate for ethanol may be necessary to maximize economy.

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So, what recommendations do I have? First of all, if you use your Corvette regularly (daily or weekly) and it is a C4, C5 or C6, the only real issue I see is that of fuel economy. Your fuel system is probably not going to be affected by the corrosive effects of the ethanol given the manufacturers' improved materials to withstand oxygenated compounds in automotive fuels. Also, there will be little phase separation due to water infiltration. Why? Well, starting in 1971 automotive fuel systems were modified to prevent fuel vapors from entering the atmosphere. The system, called EVAP (Evaporative Emissions Control) effectively seals the fuel system both from fuel vapors escaping and ambient air from entering. Remember that hissing you hear when you loosen your gas cap or the "check engine" light you get when you fail to screw on the cap after refueling? Your gas tank is sealed during normal use and the chances of getting water mixing with the ethanol from humid air entering your tank is remote.

On the other hand, those of us with C1, C2 and early C3 'Vettes have clear concerns. First of all, many pre-80s cars do not have an EVAP system. In Flagler County we encounter high humidity and due to the proximity to the ocean, we are subjected to a higher concentration of salt in that air. Those factors coupled with the fact that most of these antique vehicles are not driven often, give us a real exposure to the water-ethanol bonding. The fuel tanks are more susceptible to phase separation where the ethanolwater mix settles to the bottom of the tank. Unfortunately, you cannot go into your garage and shake up your car every few weeks to blend the fuel into a more homogeneous mixture. Nor are water separators practical or inexpensive. The second part of the issue with older vehicles is the fuel system components. Such vehicles are more likely to have rubber, cork and other materials affected by ethanol's corrosive effects. They are also likely to have more varnish and other built up materials on the walls of fuel system parts. Therefore, the fuel fed to the engine may be more likely to contain sludge or suspended contaminants.

So, what can vintage Corvette owners do to avoid gasohol-induced problems? First, if you are going to store your car for a long period of time, consider draining the fuel tank. Second, if you must use gasohol, avoid constantly blending it with fuel that contains MTBE. The water absorption of the combined chemicals is greater than either one alone. Third, you can consider using fuel stabilizers and water filters that can mitigate the effects of phase separation and water-ethanol bonding. Just make sure the fuel stabilizer is not alcohol based as that could make the problem worse. As an aside, I would be very wary of some of the claims of these products. You know the old adage, "if it sounds too good to be true…"

Finally, inspect your fuel system often and closely for leaks and contaminant issues. Remember, there can be a rubber hose between the tank and fuel line running along the frame, so a total leak inspection may involve getting under the car. Check for contamination caused by ethanol "cleansing" the fuel system. If you have a carburetor with a self-contained fuel filter, you should pull it for inspection. Also remember that many of these small filters had integral rubber gaskets. This seal may internally fail, so check to see the small gasket is still pliable. Some of the early Corvettes have metal can type fuel filters that cannot be inspected for contamination. In this case, more frequent replacement is the only option. In my '62, I am lucky. My fuel filter sits in a small glass bowl. How convenient of Chevrolet engineers to think of this issue when they designed the car in the 1960s, huh?

I know, "what about my C3 or early C4?" If you've ever been to a Sunoco station and seen the warning stickers on their fuel pumps about mid-80s vehicles, you know what I'm talking about. Unfortunately, there is no one point in time when manufacturers changed all their elastomer components to materials that resist chemical attack. However, I have some evidence to support the fact that manufacturers started to address this problem as early as 1975 and made rather substantial improvements in 1980 with the passage of legislation that encouraged the use of oxygenated compounds in auto fuel. My gut feeling is that C4 drivers are not overly exposed to corrosion effects, since automotive fuels have contained detergents for years. Remember Top Tier?

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In closing I must confess that I have been hiding something important from you all along. In the late 1970s, lead was phased out of auto fuel for health concerns. The oil industry's answer to that mandate was to increase the use of oxygenated compounds like MTBE and eventually ethanol. If you started reading this article thinking ethanol was the great Satan, let me tell you this one little tidbit. MTBE has been eating away at your car's fuel system for years. It's been in the gasoline you've been using since the late 1970s and has similar corrosive effects to ethanol. True, there are concerns with ethanol from the standpoints of fuel economy and water bonding. But a sharp Corvette owner should have been regularly inspecting their fuel filters, hoses, etc. since the 1980 time frame to avoid some of the long-term corrosive effects of oxygenated compounds like MTBE, right?