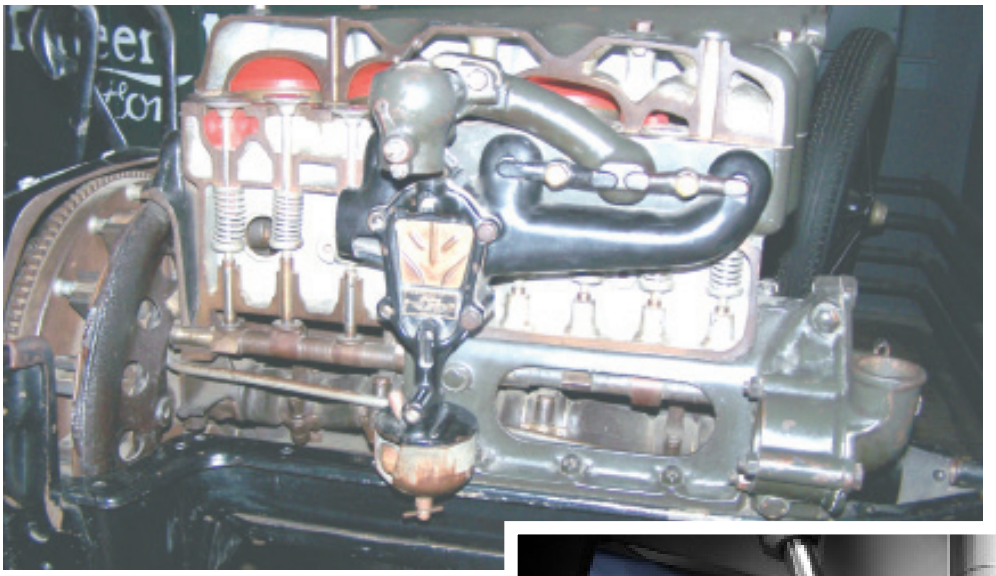
Ethanol/An American Perspective

By Rich Cregar

I enjoyed getting a Canadian perspective on Ethanol from Terence McKillen in the last issue of the Stag News.



Model T Engine with Ethanol capable Carb — Photo

As a Stag(s) owner, automotive technician, former petroleum retailer and someone who teaches combustion chemistry, emission control systems and engine management I would like add some additional commentary to this fascinating and amazingly controversial subject.

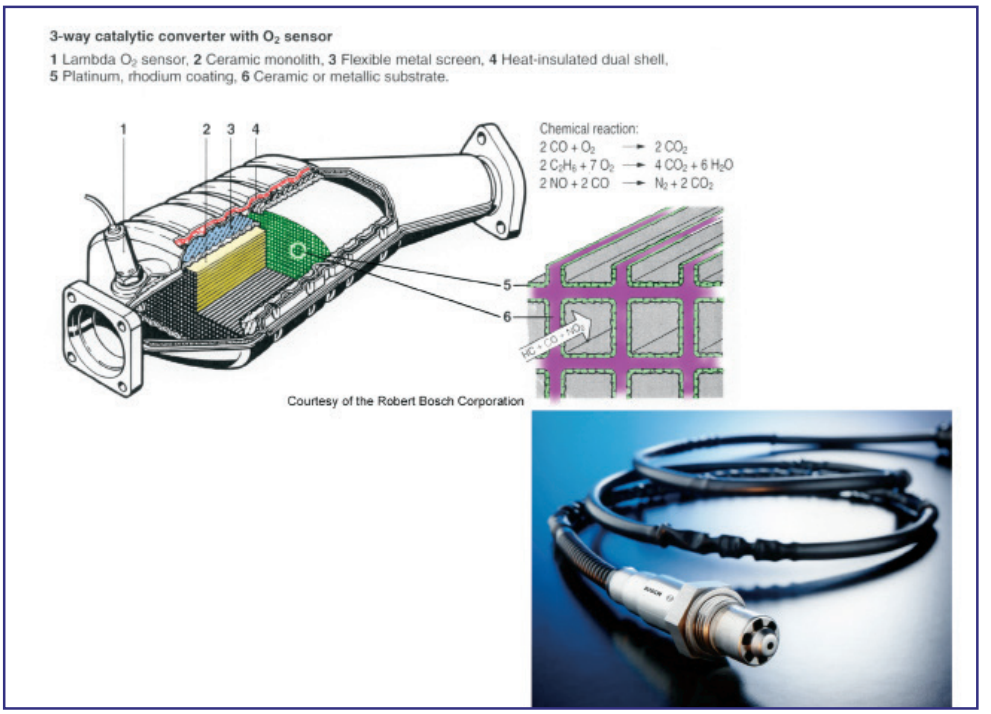
I was a service manager in a British Leyland/Jaguar dealership in the Midwest United States during the 70's. In fact it was during this time that I first set eyes upon a new Stag and resolved then and there that I would own one. That is one dream I have achieved in full measure!

In pursuit of the American Dream I left the dealership to purchase a full service gas station in a small Iowa farm town. In addition to selling motor fuels I also operated a full service repair shop and an ag tire business. During the Carter years Ethanol became a popular additive to gasoline and was blended to a 10% level (E-10). At the time it was called "Gasohol". For obvious reasons Ethanol was then known as a "petroleum extender" in that it could be said it was helping to cut our demand for foreign oil. I proudly sold gasohol to my customers and since most were corn farmers who were (as always) suffering from unstable/low corn prices they were proud to buy it.

As a service technician I serviced my customers vehicles too. My staff and I worked on just about every type of mobile equipment imaginable. From Mercedes-Benz and Jaguars through

Liquid fuel cannot burn and the cold metal surfaces of the combustion chamber will "quench" the flame of the vaporized fuel that is burning! – Photo courtesy Robert Bosch

Chevy trucks and Honda Civics to tractors, skid loaders and maintainers.



The Lambda Sensor – Photo courtesy Robert Bosch

during which the car sat with a hot engine for more than 30 minutes or so. This produced "vapor lock", especially when the vehicle also had a mechanical fuel pump also located under the hood. The result: after spending 30 minutes grocery shopping or taking a meal on a warm day the driver had to crank the starter for an extended period of time before cool liquid fuel could be drawn from the tank to refill the carb bowl and get the engine running again.

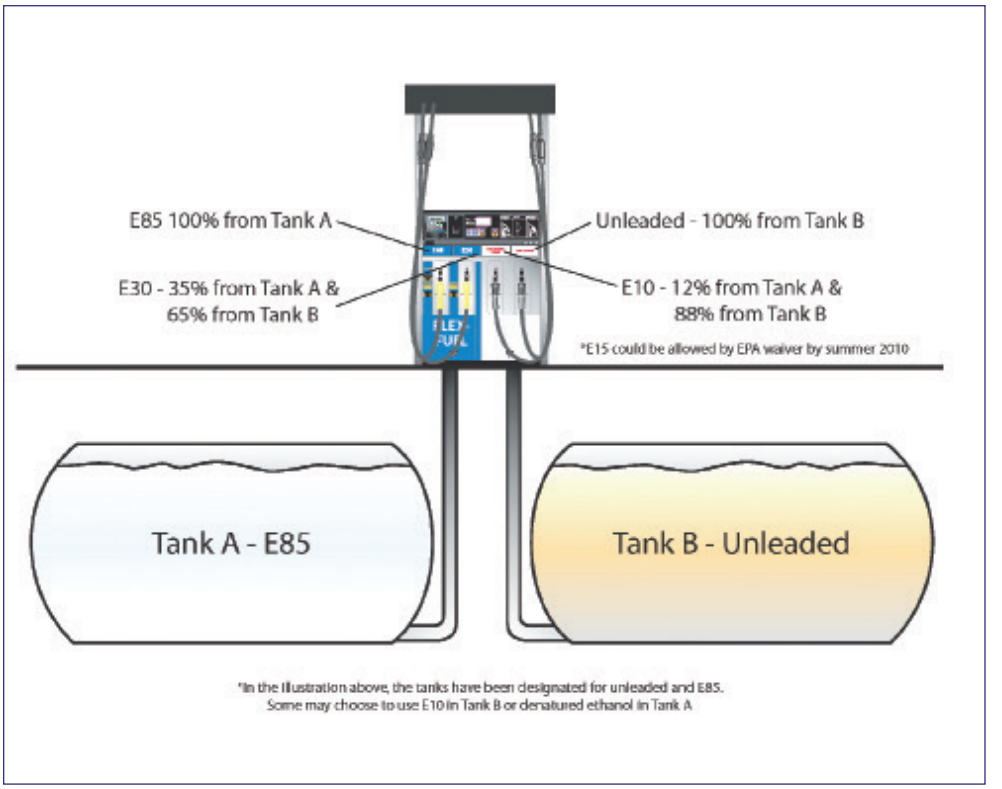
Any other issues beyond that were covered by a maxim I developed back then and stick with today: If you have a drive-ability problem when using Ethanol it is because you have a drive-ability problem! Ethanol may amplify the effect, but a root cause, not Ethanol, is the issue.

Moving forward:

Engine management and emission technology began to mature in the 80's. The development of closed loop engine management, wherein the I saw very few problems caused by Gasohol. Almost all cars were carbureted and the only two significant problems I saw from Gasahol were;

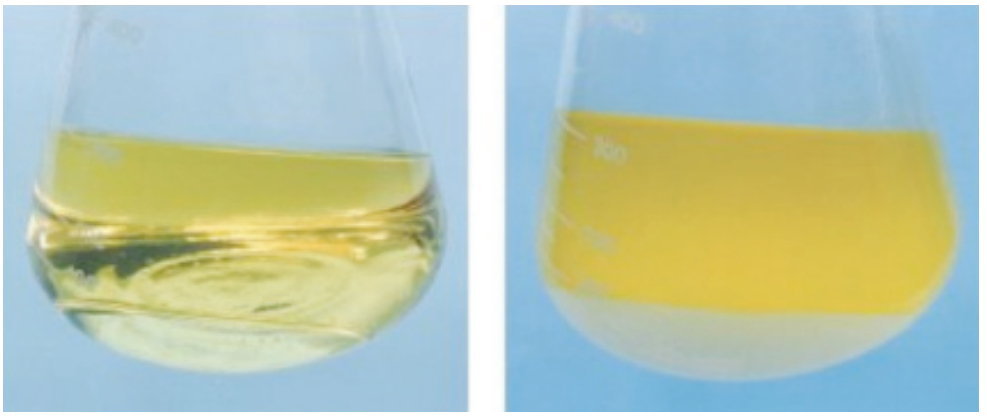
It would saturate the semi-porus composite material that carb floats were made of. While most British cars used a Brass float, domestic manufacturers used a lightweight solid foam. Ethanol broke down the outer layer of these floats and displaced the air in the foam pockets, causing the float to become heavy. A heavy float caused the float level in the bowl to increase. The air fuel ratio went too rich, wasting fuel and increasing air quality emissions substantially.

It would lower the boiling point of the fuel to around 120'F, low enough that the fuel in the float bowl would boil off during a "hot soak", any period



A common site in the midwestern U.S., the "blend pump" – graphic courtesy the CTEP project, US DOE

engine computer (PLC) was able to receive a feedback signal from an exhaust mounted sensor that provided it with a measurement of the Oxygen content in the exhaust stream. With this information the PLC could judge whether the fuel mixture was rich (excess fuel), lean (excess air) or "just right" at a Stoichiometry of about 14.7 lbs/air to 1 lb of fuel. (A gentle nudge to Mr. McKillen; this is a mass ratio, not volumetric!)



Phase separation can be seen on the right as this ethanol is saturated with water.

– graphic courtesy the CTEP project US, DOE

An aside: The Greek letter Lambda notates Stoichiometery and we often refer to air/fuel ratios by their Lambda value. Volvo was the first carmaker to market closed loop systems, so they put the Greek letter on the grille—in case you wondered what it was doing there!

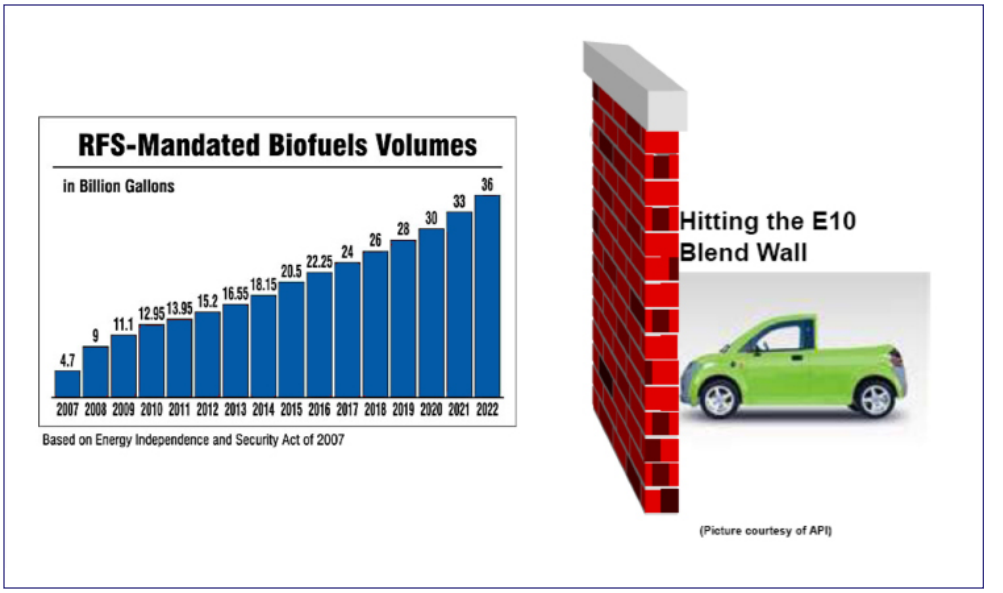
Emission control was also made possible by the introduction of the Catalytic Converter, which rapidly evolved into a device capable of reducing all three air quality pollutants (unburned fuel or HC, Carbon Monoxide or CO and Oxides of Nitrogen or NOx).

Today's problem:

Closed loop controls, coupled with Catalytic Converters have been a resounding success. Most estimates peg the total reduction in air quality pollutants from 1978 to today at above 98%. Yet a problem remains-that other 2%. A study by Chrysler some years back looked at total air quality emissions (HC, CO, NOx) produced over the service life of a vehicle and found that over 90% of these emissions were produced during the first 15 minutes of the vehicles drive cycle. This is not surprising.

Chemical reactions require heat, and the catalytic reactions that take place in the Catalytic Converter and the Lambda Sensor require a heat level of about 600'F. This means that when starting a vehicle engine that has cooled to ambient temperature, both of the systems I have described are "dead". Nothing gets controlled or cleaned up until sufficient heat is generated in the sensors and the converter. In older cars this can take up to 15 minutes.

It gets worse; the combustion chamber of a cold engine is not a friendly environment for burning fuel. First of all, liquid fuel DOES NOT BURN! Any hydrocarbon compound must be in a vapor state before it can combust. Fuel is sprayed into the engine in liquid form and in a cold engine much of it remains liquid until it is flushed out the exhaust port and into a cold converter. Because only a portion of the injected fuel will vaporize the engine management system must inject



– graphic courtesy the CTEP project US, DOE

additional fuel to compensate, up to 150% of normal volume during cold start!

Even after some of the fuel manages to vaporize and ignite, all of the cold metal surfaces that the fuel is in contact with, such as the piston and cylinder head, tend to suck out the heat of combustion and literally "put out" or "QUENCH" the flame. Even more unburned fuel (HC) is wasted and flushed into the exhaust.

Engineers realized that if additional Oxygen could be injected into the combustion chamber during this cold start/cold run operating mode the amount of fuel (HC) and Carbon Monoxide (a product of rich combustion) pumped out of the engine could be greatly reduced. The answer is to use a fuel that brings its own Oxygen with it—Oxygenated Fuel!

As Mr. McKillen pointed out, Ethanol contains 30% Oxygen by weight. Think of Ethanol as something like a little supercharger in your engine, carrying additional Oxygen into the combustion chamber when it needs it the most and significantly reducing air quality emissions in the bargain.

As technology evolves, look for engine warm up times to continue to decrease. Many 2014 MY vehicles are in closed loop operation and have a hot Catalyst within 30 seconds after a cold start. Look for the introduction of electrically heated Catalysts that will reduce this time to mere seconds.

Big Oil vs Big Ag

When everyone realized that the EPA was going to require the use of Oxygenated Gasoline, at least in the cold weather months when emission levels are highest, a political battle began to brew in Congress. Big oil wanted to use an Oxygenating compound synthesized (cheaply) from petroleum known as methyl tertiary butyl ether (MBTE). Big Ag- you guessed it! The farmers wanted Ethanol. The battle was fought in the United States Senate and the oil Senators won. Although oil companies could use Ethanol the EPA approved MBTE as an Oxygenating additive and that is what the oil companies delivered.

It soon became apparent that MBTE was bad stuff. Pedestrians in urban centers reported tearing of the eyes and irritated lings. Studies also showed that MBTE did not break down in the environment and once it got into groundwater it never left. In its pure form it was shown to be a cancer-causing agent.

Yet the EPA had backed MBTE so strongly that they refused to acknowledge the naysayers. This led to a bizarre situation during which individual states passed laws banning the sale of MBTE. After 20 or so states banned its use, EPA saw the light and withdrew its approval of MBTE. But do not fear for the price of your petroleum stocks—MBTE is selling well in Asia where it's benefits toward cleaning the air still outweigh its drawbacks.

So where are we now?

As Mr. McKillen noted we have reached the point where we can't seem to pump enough Ethanol into our vehicles to satisfy the requirements of the Renewable Fuels Standard (RFS). This physical limitation, caused by the 10% blend limit on regular gas and a dearth of "flex fuel" vehicles and fueling stations has come to be known as the "Blend Wall" and we are running into it. Advocates, including the EPA, believe that allowing 2001 and newer vehicles to burn an additional 5% Ethanol can at least move the wall down the road a bit. I agree and support the adoption of E15 BY THOSE WHO CHOOSE TO USE IT. I also continue to believe that if your vehicle has a drive-ability problem when using Ethanol it is because your vehicle has a drive-ability problem. Forty plus years doing what I do has not swayed me from that belief.

As far as your Stag is concerned:

Keep your tank full. This reduces vapor space and will prevent condensation from wetting your fuel. It will also keep the Stag tank from rusting out.

Life is too short to put up with Stromberg CD Carbs. Some technologies have evolved, others have mutated. The Stromberg CD is a mutation. Buy the wonderful adapter kit from Tony Fox, find a decent Holley and make your world a better place. Find someone with an exhaust gas analyzer and set up the carb mixture for maximum CO2 output. A Stag in good running condition with a Holley should be able to exceed 14% CO2 by volume. That should provide you a great running engine!

Make sure you have the updated water pump, good radiator core and a 50/50 coolant/distilled water blend. Stags suffer from poor coolant flow and ethanol will produce higher combustion temperatures. Do all the above, keep your valve lash properly adjusted and you should not have problems.

Happy Motoring!
Rich Cregar