- Great, no training needed to detect fraud.
- Bleach, acid treatment, running through silica gel – they all remove the dye.

Add a high molecular weight marker in low concentration to not disrupt engine performance

- Test for the marker is pretty simple, but involves an instrument.
- Criminals can distill off and sell the diesel portion, leaving the marker behind.
- Note now we are encouraging organized crime due to cheating's added capital expense.

Add a small amount of a marker (Dow's Accutrace is popular) that is smack in the middle of the diesel range of hydrocarbons to make it impossible to remove by any of the means above.

- Employing this approach, the UK retrieved £1 billion in taxes by setting up roadside test stations.
- To make it work, governments must mark (and someone pays the cost) the fuel.
- Have you ever tried to get a collection of governments that have the petro-economy intertwined to agree? In fact, they decided to all go it alone in 2016; I wonder where they are now.

Adulteration
(on the rise, but only for diesel)

Adulteration implies that there is a purposeful misleading of the public. For this to happen, there must be some form of economic gain. The messing around with gasoline is really a very insignificant problem for several reasons. One, gasoline is dangerous to play around with, more so than other fuel types. Second is that much of the fraud involves adding two ingredients, one lighter and one heavier than the base fuel (to make the bulk quality tests stay constant). This bracketing will be in play when we talk about diesel fuel, but gasoline starts with butane (four carbon chain) and anything you add on the lighter end will evaporate like crazy. Also, if you add just a touch of heavier hydrocarbons, like kerosene or diesel, a car's gasoline engine will let you know immediately (runs rough, doesn't want to turn off – dieseling!).

As with tax avoidance, where this becomes more of a problem is with diesel fuel. Mostly things like base oils (motor oil) and bio-oils are the adulterants of choice, but lots of mangy hydrocarbons and fats show up in fuel. At least from what I have seen, the murkiest problem is in Europe, where the adultered diesel tends to originate in Eastern longitudes and heads West where diesel demand is strongest and prices are high. Testing is spotty and inconsistent (or non-existent).

In the US, the UK and Asia, the problem is more the unfettered addition of biodiesel, above the labeled standard. Most engines have a limited tolerance of bio-origin diesel. And, waste oil is pretty cheap, easy to convert, and untaxed when processed outside the system. This is complicated when a certain percentage of biodiesel is allowed, even required. Then how do we tell the extra from the recipe?

From the annals of technology...

A review by Bill Deibel

An article entitled "Vapor Lock"

Problems with Ethanol Blended Fuels and Possible Mitigations by Jim Chase appeared in the July 2017 issue of The Packard Club journal The Cormorant News Bulletin. It is a very comprehensively researched piece with data from technical papers published in 1928,1931,1935, 2005 and 2007. From his research Mr. Chase not only found data regarding the impact of ethanol to the gasoline blend, but a great deal about what actually causes vapor lock and where the problem is created. Through the text Mr. Chase suggests many things that can be done to help minimize the propensity for a car engine to vapor lock.

An SAE paper documents the test of an unidentified 1935 car driven up a 7% grade at 40 MPH for 20 minutes on an 80 F day. At that point the car was stopped and left to idle at 360 RPM for another 25 minutes. Temperatures were measured at the Carburetor flange (hottest point), Coolant (location not noted), Air under hood, Main Fuel Jet, Carburetor Inlet, Carburetor Bowl and Fuel-Pump Inlet (coolest point). After 10 minutes all these temperature had stabilized. Fifteen minutes after stopping at idle all except the Carburetor Flange and the Fuel-Pump Inlet had stabilized. The Carburetor Flange rose from 123 F at start of idling to 241 F after 23 minutes and then steadily declined to 218 F at end of test. The Fuel-Pump inlet rose from 102 F at start of idling and rose to 153 F at end of test however its rate of rise diminished after 20 minutes. Throughout the test the temperature at all of the above points remained in order

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from hottest to coolest as listed above. By 1935 the locations and and mountings of these components had pretty much standardized for the rest of the Classic Era. (All these data are presented graphically and I have interpreted the numbers from the graph.)

Ethanol

The industry measure for fuel volatility is the Reid Vapor Pressure (RVP). This value in psi is based on the point where 10% of the fuel has evaporated. Typical 1931 cars would not perform well with a RVP much over 7 psi. Premium grade gasolines in 1935 were typically 7.1 psi. By 1947 this rose to 7.9, but today it is controlled for all gasolines at 7 psi so that should not be a problem today with non-ethanol gasolines. Gasoline is a blend of components with different boiling points which vaporizes in stages as each component reaches its boiling point. Data taken at 10%, 50% and 90% evaporation shows that the evaporation vs temperature is quite linear without ethanol, but the ethanol all boils off at about 170 F and from 170 to 250 F the fuel is considerably more volatile than gasoline without ethanol — of course the more ethanol the worse the effect. 100% evaporation will not occur until about 375 F. Mr. Chase notes that the ethanol content is sometimes higher in premium octane grades than regular depending on brand.

The typical diaphragm-operated fuel pump is designed to work with a mix of liquid and vapor in the fuel line with up to 20 or even 40 times as much vapor as liquid in terms of volume. (Something I never knew.) These pumps are self priming which allows this. As these pumps age and the diaphragms fatigue and stretch, the relative amount of vapor that can be accommodated is reduced — so if you have an old unruptured diaphragm in your pump, it may be contributing to vapor lock without you realizing it. (This is a point I have never considered.) Mr. Chase states "The engineers at the time (1935) understood the problem to be focused at the carburetor and jets. The influence of the fuel system from tank to carburetor float chamber stemming from the increased fuel temperature promoting boiling and interference with the metering at the jets inside the carburetor. (sic) It wasn't from a pump unable to suck liquid fuel out of the tank to deliver to the carburetor."

Measures to minimize the propensity for vapor lock

The carburetor is heated by conduction and convection from the block, head, intake and especially the exhaust manifold. To minimize this there should be a thick non metallic spacer between two gaskets where the carburetor bolts to the manifold. Some cars had a metal heat shield between the carburetor and engine. Check on this and replace if missing or add one anyway. Ideally this shield should be made from stainless steel polished on the side facing the engine This will reduce heat reaching the carburetor. You can drill the mounting holes oversize and use nonmetallic washers under the nuts to go the last mile in reducing heat transfer to the carb.

This is also the case with the fuel pump. Thick non metallic mounting spacers and heat shields were sometimes used. In the case of spacers it is absolutely necessary to follow the parts manual. Adding or omitting this spacer will interfere with the proper stroke of the pump lever. On many cars mechanics will have discarded the heat shield. In this case it should be replaced and if not original equipment one should be added — again using stainless steel polished on the side exposed to the exhaust pipe or other heat source. Another thing suggested is an air scoop under the car which at speed directs air to the fuel pump.

Chase also points out that an exhaust manifold heat riser stuck in the cold position for starting will steadily overheat the intake manifold and carburetor while driving. This is a good point and something that should be checked regularly. Also considerable heat from the hot air passing under the car when moving will heat the fuel in the tank a surprising amount which sends it to the pump already fairly warm This can be minimized by running the fuel line outside the frame rail across the car from the tail pipe and muffler.

Mr. Chase points out "It was noted in 1935 that some (users of) commercial vehicles were reducing the fuel line diameter between the pump and carburetor — not increasing it — to reduce the volume of fuel in the line and alleviate the problem of vapor pressure overwhelming the float valve. It probably makes sense to cut the diameter of that line to the next size smaller. A smaller line here also should reduce the temperature of the fuel entering the carburetor since the fuel will flow faster and have less 'residence time,' reduce the surface area exposed to the hot exhaust manifold, and cool the line faster when engine is restarted. The line between the tank and fuel pump should remain larger to reduce pressure drop on the suction side of the line" (I have never heard of this idea before, but it makes sense and is confirmed by its employment by commercial truckers. Since few of us drive our Full Classics at extreme high speeds this should not effect us with the possible exception of pulling a steep

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grade at wide open throttle.) Chase does note that missing and bucking at high speed can be fuel starvation caused by vapor lock in the line from the tank when the high fuel flow rate reduces the pressure in that line.

Many if not all Full Classics were built with an insulation wrapped exhaust pipe. This is very important in eliminating vapor lock and should be installed even if not authentic. As for the fuel line itself, Chase is undecided about rapping it. That will keep it cooler while driving, but slow up cooling off after the engine is shut down. A shield as described above is a better solution.

Electric fuel pumps

If an electric pump is used, ideally its line should be paralleled outside the frame as above and teed in beyond the regular pump. This will reduce the fuel temperature at the carburetor since only the gas going through the regular pump is heated. Chase advises putting a fuel pressure regulator between any electric pump and the carburetor to keep from overpowering the float valve and flooding the carburetor. He recommends not putting an electric pump in series with a mechanical pump unless it is planned to be run all the time. This is because the mechanical pump will lose some of its effectiveness from having to suck through the resistance of the non energized electric pump. (I like to put a shut off valve at the mechanical pump inlet that can closed should the diaphragm rupture and pass raw fuel into the crankcase or onto the ground causing either an explosion, fire hazard or engine lubrication breakdown.)

Wrap up

Mr. Chase ends his piece thusly: "I submit that the most direct way to solve this problem (vapor locking) would be to install a small electric fan below the engine and duct that transports cool air from beneath the car blowing directly on the carburetor bowl during hot idle and for a period of time after shutdown. It would require a thermostatic or time delay switch to keep from draining the battery. Not an authentic solution, but when you are sitting stalled at a traffic light trying to restart with non-authentic fuel on a hot summer day with irate commuters on your tail, the pride of pure authenticity might wane somewhat."