Ethanol in Petrol Summary

Effects of ethanol in spark ignition engines

These may be considered under the three different headings of Compatibility, Corrosion and Combustion:

Compatibility

Some elastomers, plastics and composite materials are not compatible with petrol containing ethanol. Where problems are experienced, incompatible materials in the fuel system should be replaced with compatible alternatives.

Material	Recommended	Not recommended
Elastomers	Buna-N (hoses and gaskets)	Buna-N (seals only)
	Fluorel	Neoprene (seals only)
	Fluorosilicone	Urethane rubber
	Neoprene (hoses and gaskets)	Acrylonitrile-butadiene hoses
	Polysulfide rubber	Polybutene terephthalate
	Viton	
Polymers	Acetal	Polyurethane
	Polypropylene	Polymers containing alcohol groups (such as alcohol-based pipe dope)
	Polyethylene	
	Teflon	Nylon 66
	Fibreglass-reinforced plastic	Fibreglass-reinforced polyester and epoxy resins
		Shellac
Others	Paper	Cork
	Leather	

Acknowledgement and thanks to CONCAWE who provided the above data.

Corrosion

Long-term storage of petrol-ethanol mixtures (eg over a winter period) can lead to corrosion in historic vehicle fuel systems. The mechanism of this potential corrosion lies in the falling pH values, ie greater acidification, which may occur with degradation (oxidation) of fuel-grade ethanol over time. Many historic vehicles have fuel systems containing metals such as fuel tanks made from terne plate, (lead-tin or zinc-tin coated steel), copper fuel lines and brass fittings, and zinc-based carburettor castings, which can be vulnerable to fuel acidity. Following tests, a number of corrosion inhibitor additives which are effective at protecting fuel system metals have been identified and endorsed by the Federation. The corrosion inhibitor additives which passed the tests carried out by the FBHVC are as follows, in alphabetical order:

- Ethanolmate from Flexolite

  (www.flexolite.co.uk, email: sales@flexolite.co.uk

- Ethomix from Frost ART Ltd.

  (www.frost.co.uk, email: order@frost.co.uk

- VSPe Power Plus, VSPe and EPS from Millers Oils

  (www.millersoils.co.uk, email: enquiries@millersoils.co.uk)

These products achieved an 'A' rating in the corrosion tests carried out, permitting each to carry an endorsement from the FBHVC. The endorsement takes the form of the FBHVC logo and the words "*endorsed by the FBHVC as a fuel additive for protection against corrosion in metals*".

In the absence of effective inhibitors, corrosion in historic vehicle fuel systems can result where fuel grade ethanol is included in petrol at 5% volume. The risk of corrosion is greater where 10% volume ethanol is added to petrol. However, these additives will provide effective protection with 10% ethanol.

Combustion

There is no evidence that the addition of ethanol to petrol directly affects combustion adversely, but ethanol does have a leaning effect; fuel mixture strength becomes slightly weaker, and this is particularly true for higher ethanol blends. Whereas the inclusion of 5% volume ethanol in petrol leans the air-fuel mixture by 1.8%, which may be regarded as negligible, the addition of 10% ethanol would result in a mixture-leaning effect equivalent to 3.6%, which may be felt as a power loss, but also could contribute to slightly hotter running. Adjusting mixture strength (enrichment) to counter this problem may prove beneficial. There is a further secondary effect on engine operation from the addition of ethanol to petrol, in that it adversely affects fuel boiling characteristics by increasing volatility at lower temperatures, and so could exacerbate vapour lock problems.

Boiling characteristics (fuel volatility)

The volatility of spark ignition fuels has increased significantly in most European countries since historic vehicles were initially produced. This can lead to operational difficulties, and a significant number of members have experienced vapour-lock related problems, such as over-heating, power loss, poor hot starting, erratic running, excessively lean or rich operation, poor acceleration, flat-spots etc. These difficulties can in many cases be traced to the formation of bubbles of vapour in the liquid-fuel metering zones of carburettors, or in fuel pumps supplying liquid fuel to caburettors. These vapour bubbles result from the proportion of fuel boiling at low temperatures (so called *"front-end volatility*") being much greater than was the case when the vehicle was designed and first produced. Unwanted vapour formation of this kind disrupts the normal fuel metering process and produces erratic distortions in the ratio of fuel to air supplied to the engine combustion chamber. Inclusion of ethanol in petrol tends to make these observed problems worse, because of the relatively low boiling point of ethanol. As the percentage of ethanol increases, the distortion to the distillation curve becomes more marked. The negative impact on the operation of some historic vehicles would therefore be expected to be greater with 10% ethanol than for 5% ethanol. Not all historic vehicles experience such problems, but those where the inlet and exhaust manifolds are on the same side of the combustion chamber, or where fuel pumps are placed in a location receiving a lot of exhaust heat for example, are more likely to suffer problems of this kind. If fuel mixture strength is not adjusted (made richer) when running on petrol containing 10% ethanol, the leaner operation is likely to increase any potentially negative effects of distortion of the distillation curve caused by adding 10% ethanol to the fuel.

The Federation has published detailed information about simple practical steps which can be taken to overcome problems such as vapour lock. A summary of the recommendations is given below:

- reduce the flow of (exhaust) heat to the liquid fuel supply to the engine
- route fuel lines away from heat sources
- locate the fuel pump (eg electric pump) away from heat sources
- use a thermal break (eg plastic spacer) where possible for mechanical (engine-mounted) pumps
- shield carburettor(s) from radiant exhaust heat (especially where inlet and exhaust are on the same side of the engine)

- check radiators for condition and effective dissipation of engine heat. Many old radiators may have become furred-up or partially blocked, leading to significant reduction in their ability to keep the engine cool in traffic
- consider the use of an auxiliary electrically powered cooling fan to reduce coolant temperatures

Often, relatively simple modifications such as these can be extremely effective in preventing the formation of unwanted vapour bubbles in the liquid fuel. Relatively minor changes need not alter the essential character of a historic vehicle, while thermal baffles and heat shields can be fitted sympathetically to provide minimal visual impact. It is accepted however, that the standard and original condition of some vehicles will be compromised by the changes described above. However, the advice given here about practical steps to counter these difficulties can produce real operational benefits.

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