It can't have escaped your notice in the news that E10 fuel is about to be made available at UK petrol station forecourts in September this year, containing twice as much ethanol as the current E5 fuel. It probably has also not escaped your attention that when you try to find TVR in the Department of Transport's *(DfT)* vehicle compatibility checker for E10 fuel, it isn't listed. Not a tool that inspires confidence then, further substantiated when you see that if your car is not listed, you should contact the manufacturer. So, what should you do if you drive a TVR, and what are the concerns and points to be cautious about?

Select your vehicle manufacturer

TVR - Not Found

▼ My manufacturer is not listed

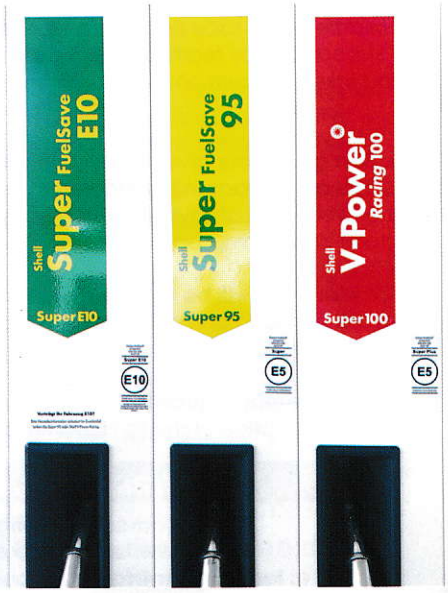
Not all manufacturers publish E10 fuel compatibility.

If you're not sure if you can use E10 in your vehicle:

- check the vehicle owner's manual, the instructional booklet is specific to your vehicle
- look inside of the fuel filler flap
- ask the car, motorcycle or scooter manufacturer

If you're still not sure, use E5 petrol. It will still be available in the super grade at many filling stations.

It all started when the 2009 European Union Fuel Quality Directive went ahead with its plans to introduce a new market petrol specification from 1st January 2011 that could contain up to 10% ethanol by volume, known as *"E10"*. At this time, the UK enacted a legislative framework known as the Renewable Transport Fuel Obligation *(RTFO)* to achieve compliance with this package of EU measures by 2020. The process was harmonised across Europe and a new set of fuel labels were seen on pumps to ensure clarity, as E10 fuel was quickly adopted in countries such as Finland, Belgium, France and Germany, alongside E5 grades. September 2019 saw compulsive fuel labelling introduced so that consumers knew and could be certain about which fuel they were filling their cars with.



Pump labelling in Germany for E10 and E5 fuels. On the E10 fuel, it asks if your vehicle is compatible with E10 and if not consult your manufacturer. If in doubt use Super 95 or Super 100.

FUEL FOR THOUGHT

E10 FUEL

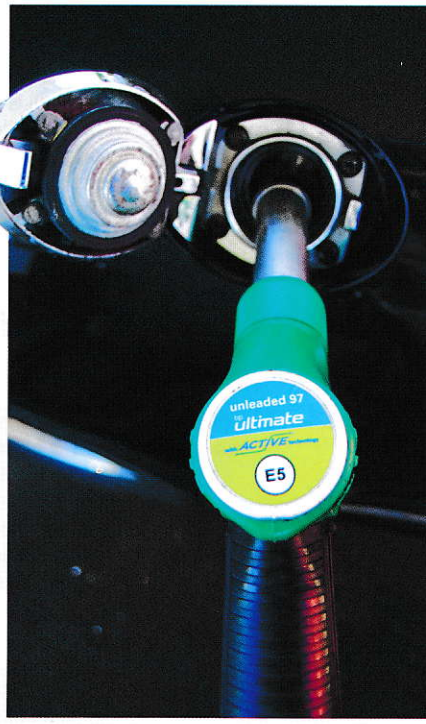
Effects of E10 fuel and its consequences for your TVR

Words courtesy of Mark Hickery *(S Series Editor)*
Photographs courtesy of Oliver Edwards, Mark Hickery & 123RF

The UK's enactment to adopt E10 came later in March 2020, when the UK government published its proposal to introduce E10 petrol as the standard fuel across the UK. E10 fuel would be 95-Octane and have a maximum of 10% ethanol by volume, whilst the current higher 97+ octane fuels must remain as E5 fuel, defined as *"protection"* grade and labelled *"Super E5 Protection"*.

Why is E10 fuel being introduced? The UK government is complying with its RTFO obligation to meet climate change targets and make significant cuts in CO2 emissions, with the DfT stating that emissions will be cut by 750,000 tonnes per year *(or the equivalent of taking 350,000 cars off the road)*. This, together with the Government's announcement that the sale of petrol and diesel cars will cease in 2030, begs the question of what fuels may be available in the future and whether classic cars such as TVRs can run on them.

For now, however, this article focuses not on the future concerns of fuelling, but on the effect of ethanol in fuel and its consequences to running a TVR today.



Let's start with a couple of simple definitions and facts:

- **E10 petrol contains 90% regular unleaded, a minimum of 5.5% bioethanol and a maximum of 10% bioethanol.**
- **E5 petrol or Super E5 Protection petrol contains up to 5% bioethanol but does not necessarily need to contain any bioethanol. So certain E5 labelled petrol may be devoid of bioethanol - labelling of specific biofuel content is currently not mandatory.**
- **As a rule, cars registered prior to 2002 are advised by the RAC not to use E10 in their vehicle.**

Thanks to the excellent work of the Federation of British Historic Vehicle Clubs *(FBHVC)*, the supply of Super E5 Protection fuel has been guaranteed for the next five years, after which the government will review again to assess the needs of the market. However, if no viable fuel alternative is found, then a further five years is likely.

Petrol stations that stock two grades of petrol and sell more than 1 million litres a year will need to ensure that one product is Super E5 Protection grade. Appreciably not all stations fulfil these criteria, though most towns will have stations that will be able to supply Super E5 Protection grade. An exemption process will ensure that, should you be taking off to the Highlands or Scottish Islands in your TVR, refuelling will still be possible, as smaller stations in remote regions will not be required to fulfil these criteria and can still stock 95-Octane E5.

E10 fuel and the effects on the components **in your TVR**

What are the implications of the introduction of 95-Octane E10 fuel for your TVR? E5 fuel has been used in the UK for several years and its use in classic cars has not been the problem it was feared to be. However, doubling the content of ethanol may well bring notable issues to the running and the longevity of some of the mechanical components of your TVR.

The rising amount of ethanol in fuel raises concerns that broadly fall into three distinct areas:

1. Elastomer compatibility - main components affected: seals, flexible pipes and gasket materials as well as some plastic components such as carburettor floats and fuel filter housings.

2. Corrosion of metal components - main components affected: fuel tank, fuel filter, fuel pump, carburettors.

3. Air/fuel ratio enleanment - main effects: mixture leaning, slight power loss, possibility of running hot, vapour locking.

1. Elastomer Compatibility

Ethanol causes swelling, shrinking, and cracking of elastomers *(seals and flexible pipes)* and other incompatible gasket materials. This is because ethanol differs from other fuel hydrocarbons with respect to its compatibility with elastomeric materials *(e.g. rubber)* typically used in fuel supply and distribution systems by the following two main chemical properties:

a) the relatively smaller size of the ethanol molecule. As ethanol is a small and polar *(charged)* molecule there is a lower energetic barrier for ethanol diffusing into and through elastomeric materials. Over time, ethanol can accumulate in these materials, leading to an overall weakening of the elastomeric structure.

The weakening in structure is due to:
b) the presence of the polar hydroxyl *(-OH)* group. The increased diffusion of the small ethanol molecule facilitates a greater propensity to interact with elastomer constituents. Chemical bonds *(hydrogen bonds)* of elastomers can be substituted by the hydroxyl group *(-OH group)* of the ethanol, making the structure of the elastomer components unstable, leading to degradation.

Thus, the permeability of hoses is one of the key reasons why older hoses are incompatible with fuel containing ethanol. The higher the permeability, the more the small ethanol vapour molecules find their way through the hose wall, and as they do so, any ethanol component gradually *"dries out"* the synthetic materials that keep the hose supple.

Hoses therefore lose their structural integrity over time due to the loss of stabilizing hydrogen bonding interactions. Cracks then develop, and eventually the fuel finds a way through - though the time taken has proven to be quite unpredictable. The higher ethanol content speeds up the whole process - again emphasizing the reason why E10 fuel is an increasing concern to owners of older vehicles. Moreover, ethanol can also extract plasticizers *(substances used in hoses that make them softer and more flexible)*, reducing the flexibility and toughness of the elastomer products.

Fuel system components such as seals, gaskets and hoses, that are made from polymers and elastomers must therefore be used, that retain their structural integrity, strength, and flexibility after extended exposure to ethanol/petrol blends. The industry standard in hoses is regulated and maintained by the Society of Automotive Engineers *(SAE)*, which issues a series of regularly updated standard specifications - known as SAE J30Rx. These standards have continually evolved from straightforward oil and ozone resistant synthetic rubber tube known as R2, to the current R9 standard where the hoses have a permeability of under 3% of the previously approved R6 hoses. For older vehicles, the SAE J30R9 fuel hose has become widely accepted as an all-round general replacement due to its permeation properties *(15 g/m²/day)*, pressure capability *(up to 180psi)*, and due to its fluro-elastomer inner lining which is resistant to chemical attack, swelling, and permeation by petrol, diesel, ethanol, and oil or lubricants and vapours. The outer coating is also ozone - and abrasion-resistant. R9 is readily available through reputable parts suppliers and on the internet. It's worth pointing out here that you should only buy a genuine, branded hose of the correct internal diameter - from makers with familiar and respected names. Clear indication of manufacturer, tube diameter and the relevant SAE J30R9 specification should be marked along its entire length.
Do not purchase unbranded generic hoses that are cheap and that are likely to have been manufactured in China.

Clearly then, the biggest concern is that ethanol itself can have a slow, detrimental, but unpredictable effect on older rubber hoses, especially fuel hoses used to connect tanks, fuel lines, pumps, filters and carburettors. It is therefore recommended that any surviving original hoses - and any replacements fitted before 2000 - should be replaced on your TVR with SAE J30R9 hoses.
For more information about purchasing these types of fuel hoses, why not contact Andrew Gray of Gray's Motoring Solutions on e: andrewgms@gmail.com.

"The consequence of not doing so is clear, as leakages anywhere in petrol vehicle fuel lines are an extreme safety hazard with inherent consequences of the risk of fire, which can quickly destroy a valuable car"

A good reason then to consider purchasing a Fire Safety Stick from the TVR Car Club. As a member, you get a substantial discount from the recommended retail price at:
www.tvr-car-club.co.uk/shop

2. Corrosion of metal components

Ethanol used in fuels has increased acidity, conductivity and inorganic chloride content when compared to conventional petrol. All of these characteristics enhance the ability of ethanol in petrol to cause corrosion and tarnishing of metal under certain conditions *(see Table 1)*. Normally these characteristics are controlled in the ethanol used to blend E5 and E10 in UK petrol by corrosion inhibitors that help to limit corrosion. Such corrosion inhibitors are very effective in controlling ethanol-derived corrosion; however, it is unclear if these are universally added to E5 and E10 fuels.

If you have concerns about the longer-term effects of any fuel containing ethanol, a couple of precautionary measures can be considered if you do not use your TVR so frequently or when garaging the car over the winter. For the last tank of the season, you should try and locate a station selling E5 with no ethanol, or if the tank does have E10, add a fuel stabiliser to prevent fuel oxidation. Moreover, at the time of lay-up, as an extra precaution it is recommended to add an aftermarket corrosion inhibitor that can provide further protection against metal corrosion in your TVR.

Ethanol is also hygroscopic, meaning it absorbs water. Over time, water and ethanol form a mix denser than petrol, and in a process known as *"phase separation"* this produces a mixture that sinks to the bottom of the fuel tank. With E10, the corrosion process starts with the absorption of a mere 0.5% water into the fuel mixture. The suspension of water within the ethanol/petrol blend may enhance rusting and/or galvanic corrosion.

In modern and well-used vehicles running on E5 fuel, neither the amount of water build-up nor phase separation has proven to be of concern. But, if you run an older TVR and haven't thoroughly checked the condition of its fuel system, now might be a good time... especially if it's used infrequently, or perhaps regularly stored over winter or longer. Given time sitting still, absorbed moisture could be enough to initiate rust inside a near-empty fuel tank, building up over time to the point where rust granules might eventually block a tank outlet, fuel filter or carburettor jet. This stagnant mixture, built up in the tank over months, might be pumped into the carburettor after vehicle storage, making starting difficult if not impossible - and the hygroscopic nature of E10 will make all these things worse.

Longer term effects on vehicles built before 2000 can't be ignored either. In the past, carburettor and fuel pump components were often made from alloys involving zinc and galvanized materials, some of which have been shown to be susceptible to ethanol-induced corrosion. So, when dismantling fuel system components, look for signs of white deposits where fuel flows - or where a fuel/air mixture is present. For different reasons similar effects are possible anywhere fuel and dissimilar metals come into contact. With E5 fuel, again few problems have surfaced.

Not only can ethanol affect metal components, but it can also affect some plastics, elastomers and composite materials, as used in floats, diaphragms, needle valves, seals and so on - making such components worth examining for deterioration. Cork seals and "*O*" rings are also at risk, seldom an issue in newer cars, but older ones were not designed for higher ethanol exposure. It is therefore recommended to check all of these in your TVR regularly should you decide to use E10 fuel.

A summary table *(Table 1)* is provided of materials that are recommended or should be avoided.

Material	Recommended	Not Recommended
Metals	Carbon steel with post-weld heat treatment of carbon steel piping and internal lining of carbon steel tanks[2]	Zinc and galvanized materials
	Stainless steel	Brass or Copper
	Bronze	Lead/tin coated steel
	Aluminium	Aluminium *(may be an issue for E100)*
Elastomers	Buna-N *(hoses & gaskets)*	Buna-N *(seals only)*
	Fluorel	Neoprene *(seals only)*
	Fluorosilicone	Urethane rubber
	Neoprene *(hoses & gaskets)*	Acrylonitrile-butadiene hoses
	Polysulfide rubber	Polybutene terephthalate
	Viton	
Polymers	Acetal	Polyurethane
	Polypropylene	Polymers containing alcohol groups *(such as alcohol based pipe dope)*
	Polyethylene	Nylon 66
	Teflon	Fibreglass-reinforced polyester and epoxy resins
	Fibreglass-reinforced plastic	Shellac
Others	Paper Leather	Cork

Table 1. Overview of materials that are either recommended for use or should be avoided when handling ethanol/petrol blends (2.)

3. Air/Fuel ratio enleanment

As ethanol contains 35% oxygen by weight it will have a leaning effect, as the fuel mixture strength becomes slightly weaker. The 5% ethanol standard of current fuel has resulted in few reported problems but increasing the ethanol content may result in notable issues. The Federation of British Historic Vehicle Clubs *(FBHVC)* asserts that use of an E10 blend would result in a mixture-leaning effect equivalent to approximately 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 is advised to maintain performance, driveability and protect the engine from overheating and knock at high loads. Adjustment for E10 fuel in modern, 3-way catalyst equipped vehicles is obviously not required because they are equipped with oxygen *(lambda)* sensors that detect lean operation and adjust accordingly.

Several inter-related issues have been reported for older cars, ranging from less reliable cold starting to sundry flat spots and mid-range misfires. These effects have been found to be quite unpredictable, depending on a range of factors including engine design features, carburettor type, performance demands and state of engine tune. Reports have also emerged of fuel starvation and difficult hot starting, traceable to carburettor *"vapour lock"*, a likely result of fuel vaporisation triggered by heat soak - linked in turn to the increased volatility of ethanol compared to *"neat"* petrol.

Summary

E10 fuel will be legislated by the Department of Transport and introduced as the standard 95-Octane petrol grade by 1st September 2021. The higher-octane 97+ *"Super"* grades are required to remain E5, to provide protection for owners of older vehicles such as TVRs. This product will be designated as the *"Protection"* grade and is the petrol of choice for older, classic cars. Should you be travelling in more remote areas of the UK, such as the Highlands, filling stations will be allowed to keep 95-Octane E5. Note, care should be taken at the pumps that you add the correct fuel to your car. The clear labelling proposed should make this task easy, but always double check.

E5 fuel is, however, still available for your TVR as it was previously, it just costs more. **The bottom line is that whilst you can still run your TVR on Super E5 Protection fuel, the cost of refuelling will be more.**

At the time of writing, E5 fuel in 95-octane unleaded is currently 125.9p/litre, whereas 99-octane Supreme+ is 142.9p/litre. That's a difference of 17p/litre, which will obviously vary depending on the station and where you live. But still, it means that if you are filling up your S Series with its 54 litre tank then the additional cost for filling the car is in excess of £9 per tank. Moreover, as the energy content of ethanol is slightly lower than petrol, its use will also increase fuel consumption. Compared to unleaded petrol, an E5 blend will increase fuel usage by approximately 1-2 percent, further increasing running costs.

Precautions are necessary, particularly with E10 fuel but even with the use of E5 fuel, and so regular checks on the items described in this article should be carried out and parts replaced appropriately sooner rather than later. As a rule, according to the RAC, drivers of cars registered prior to 2002 are advised not to use E10 in their vehicle.

The long-term question, however, is how long will E5 remain available when set against the commercial realities faced by oil companies and filling station operators in stocking a low *(and declining)* volume product with a very low profit margin and high background costs? And with the DfT *"Net Zero"* target by 2050, are we looking at the end of TVR ownership as we know it?

References

1. RAC: www.rac.co.uk/drive/advice/emissions/what-is-e10-fuel-and-how-could-it-affect-you/

2. Guidelines for blending and handling motor gasoline containing up to 10% v/v ethanol. Engelen.B., et al. Concawe report no3/2008.