

# Working with Bioethanol-Blended Petrol

A new fuel for New Zealand Drivers



# A new choice

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Sustainable biofuels have many benefits over fossil fuels. Most importantly, they are renewable and result in lower carbon dioxide emissions. Biofuels are already available in parts of the country and more may become available to Kiwi motorists. One of the main types of biofuel is bioethanol-blended petrol.

Introducing biofuels is a move to reduce overall emissions of carbon dioxide (CO<sub>2</sub>) from New Zealand's vehicles. Carbon dioxide is the main greenhouse gas contributing to global climate change.

Biofuels have been in use worldwide for over 20 years. South America, the United States, Canada, parts of Europe, Asia and Australia all use biofuel blends so its use is well established.

Using sustainable biofuels in our vehicles is one simple step New Zealanders can take in working towards sustainability. New Zealand is known for being clean and green, so now it is time to add biofuels to the list of things we are doing to help the environment.

It is important that biofuels are produced so they have a positive effect on the environment. The criteria to determine the sustainability of biofuels is currently under active discussion around the world and here in New Zealand. The government is developing sustainability requirements for biofuels to ensure that biofuels available in New Zealand are sustainably produced.

This guide has been developed especially for the motor trade and anyone who sells or services vehicles to help answer the questions you and your customers may have about bioethanol-blended petrol. It complements a brochure that provides information in brief on bioethanol-blended petrol for the general public.

If you need more information, visit [www.eeca.govt.nz](http://www.eeca.govt.nz) or [www.biofuels.govt.nz](http://www.biofuels.govt.nz)

## Bioethanol-blended petrol – a summary

- Bioethanol-blended petrol must meet the government's petrol specifications.
- Retail blends are limited to a maximum of 10% bioethanol. Some oil companies are offering lower blends, for example 3%.
- Most new and many older vehicle models can run on bioethanol-blended petrol without any engine or fuel system modifications.
- Pumps must be clearly labelled, and service stations must provide consumer information on-site. Brochures for drivers are available from the Energy Efficiency and Conservation Authority at [www.eeca.govt.nz](http://www.eeca.govt.nz)
- Bioethanol-blended petrol must not be used in any aviation or marine application.
- If water is present in the tank, there is a small risk that minor problems could be encountered when bioethanol-blended petrol is first used. Drivers should check for water in the tank before use and make the first fill a big fill.
- To find out if a vehicle has been confirmed as supporting the use of a bioethanol blend, look in the owner's vehicle handbook, visit [www.aa.co.nz](http://www.aa.co.nz) or [www.mia.org.nz](http://www.mia.org.nz) or contact the official representative of the vehicle manufacturer in New Zealand. Contact details for representatives can be found in the owner's handbook or online at the vehicle manufacturer's New Zealand website.

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# Background on biofuels

## What is bioethanol-blended petrol?

Bioethanol is an alcohol made from sugar and products containing sugars or starches, through a process of fermentation and distillation.

Bioethanol is a renewable fuel from agricultural sources, not a fossil fuel. Its main benefit is that it reduces overall CO<sub>2</sub> emissions. Bioethanol can help New Zealand meet its international obligations to reduce emissions of greenhouse gases that contribute to global climate change.

Not all biofuels around the world are produced in a way to help fight climate change. New Zealand is working towards ensuring we only produce and access sustainable biofuels both today and in the future.

In the future bioethanol might be made from wood, grasses, or household rubbish. Bioethanol can also come from overseas agricultural sources where it is produced from crops such as sugarcane. The exact environmental benefits of using bioethanol as a fuel may differ depending upon its source and processing.

Bioethanol-blended petrol can also burn more cleanly, and can help reduce pollution and improve air quality. However, the difference it makes to air pollution also depends on the design and condition of an engine and how the vehicle is driven.

## Government specifications

In New Zealand, petrol quality is governed by the Engine Fuels Specifications Regulations (formerly the Petroleum Products Specifications Regulations). These specifications ensure the fuel has characteristics suitable for New Zealand's vehicles.

All petrol sold in retail outlets must meet these standards and bioethanol-blended petrol is no exception.

### Bioethanol-blended petrol is the right choice!

- Using bioethanol-blended petrol in your vehicle can help reduce overall emissions of carbon dioxide. Carbon dioxide is the main greenhouse gas contributing to global climate change.
- Bioethanol-blended petrol can burn more cleanly, and can help reduce pollution and improve air quality.
- Bioethanol-blended petrol can reduce environmental impacts from the use of fossil fuels and reduce New Zealand's dependence on imported transport fossil fuels.
- By using biofuels, we can be part of New Zealand's move to be a world leader in sustainable, renewable fuels.

Up to a 10% blend level, the performance of bioethanol-blended petrol is very similar to ordinary petrol.

### Why up to 10%?

Up to a 10% blend level, the performance of bioethanol-blended petrol is very similar to ordinary petrol. At higher levels however, some engines may begin to exhibit problems; for example, stumbling under slight acceleration. The fuel also has more aggressive properties at higher concentrations of bioethanol which increases the possibility of deterioration of some components. The Engine Fuel Specifications Regulations 2008, which came into force 1 July 2008, require that bioethanol petrol blends have corrosion inhibitor added as an extra protection.

### Fuel volatility

Petrol must be volatile enough to move easily from the carburettor or injectors into the cylinders and to vaporise prior to combustion.

However, it can't be so volatile that it vaporises and boils in the injectors, carburettor, fuel lines or fuel pump, which could prevent it from being metered correctly. Also, if petrol is too volatile, more evaporates into the air adding to environmental problems. There are a number of volatility specifications to ensure suppliers get this balancing act right.

Adding bioethanol to petrol as low-level blends increases volatility of the blended fuel. The Engine Fuel Specifications Regulations specify volatility measures for bioethanol-blended petrol and petrol. The limits for blends are similar to those for petrol in the recent past so no vehicle problems are expected.



# The facts

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## Mixing and matching is OK



You can switch between using bioethanol-blended petrol and ordinary petrol at any time.

## Fuel consumption

Drivers should be aware they might experience a slight increase in fuel consumption but that this may not be noticeable due to the small size of the change.

For example, most drivers are not aware of the changes in fuel consumption that result from switching between seasonal grades of petrol which would be of the same order, winter grade petrol having less energy per litre than summer grade. These changes are the result of specifying petrol according to expected temperatures. A more volatile fuel, which is less energy dense, is required in winter to counter cooler temperatures.

One litre of bioethanol-blended petrol has slightly less energy than one litre of ordinary petrol.

Theoretically, and based solely on energy content, use of 10% bioethanol-blended petrol would increase fuel consumption by 3.5%. In practice, however, bioethanol-blended petrol is found to be generally more efficient in the average vehicle, resulting in an average on-road increase in fuel consumption of the order of 2-3%. Different engines will respond differently.

Driving in bad weather or accelerating harder than usual could have a far more significant effect on fuel consumption. You may get widely differing reports from drivers, ranging from a slight decrease in fuel consumption to an increase of 10% or more. These variations have been found in strictly controlled laboratory tests, but it would be hard to confirm them on the road. There are other impacts that can affect consumption more, including differences in traffic flow, temperature and driving habits, to mention a few. It is also difficult to fill a tank to the same level every time. There is often an error of up to 1 litre, due to air locks in the fuel tank or other reasons. This alone would typically represent a 5% error for a 200 km trial.

Drivers who believe they are getting poor fuel consumption on bioethanol-blended petrol should be made aware there are many reasons for the variations they are experiencing. They should be encouraged to keep a logbook. The vehicle may also be out of tune, which can be confirmed for example if it stumbles under part-throttle acceleration.

If the problem continues, the driver should switch to non-bioethanol petrol. The issue may then be found to be unrelated to the fuel or be one of perception.

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## **Exhaust emissions – an overall improvement**

Although actual exhaust emissions depend on engine design, condition and how the vehicle is used, bioethanol-blended petrol offers potential for improved air quality as overall its emissions signature is better than for ordinary petrol.

The oxygen that is chemically bound into bioethanol-blended petrol effectively creates an increased air-to-fuel ratio. This results in more complete combustion and reduced carbon monoxide (CO) emissions. The reduction actually achieved depends on many factors, including engine technology and the state of the tune. However, the decrease in CO could be as much as 10% for older vehicles, or even up to 30% for the worst emitters. Modern vehicles will also tend to emit less CO and hydrocarbons when using bioethanol-blended petrol.

As well as reducing emissions of volatile organic compounds, including ozone/smog-forming hydrocarbons, using bioethanol-blended petrol reduces particulate emissions.

Emissions of oxides of nitrogen may increase or decrease. Emissions of acetaldehyde will increase.

Further and larger improvements in emissions are expected through the purchase of vehicles with clean engine technologies, using good vehicle maintenance practices and better use of vehicles such as more constant engine operation and avoiding travel in times of congestion.

Bioethanol-blended petrol offers potential for improved air quality as overall its emissions signature is better than for ordinary petrol.

## **Effect on octane**

The octane rating refers to the 'Research Octane Number' (RON). Whether it is 91 (regular), 95 (premium), or one of the brand name fuels with a higher octane rating, it is determined using a specified set of tests on a special engine.

Bioethanol has a relatively high octane rating resulting in an increase in the octane rating of the mixture by up to 2.5 octane numbers over that of the base petrol. However, suppliers may supply the base petrol at a lower octane rating, so that the octane rating of the blend meets the pump's normal advertised octane rating.

# When not to use bioethanol-blended petrol



## NOT for use in aircraft and microlights

Aircraft fuel tanks normally vent to the air and aircraft can be left for a time between use. There is a risk that water can enter the fuel system and the bioethanol-blended petrol could separate, with potentially disastrous consequences. For more information on the risk of phase separation with bioethanol-blended petrol, see pages 10 and 11.

Also, the tolerance of bioethanol-blended petrol to water reduces as temperatures fall. A fuel that appears clear and bright on the ground may phase separate at cooler temperatures at altitude – again, with potentially disastrous consequences.



## NOT for use in boats and marine applications

Bioethanol-blended petrol is not suitable for use in marine applications. In boats and other water craft there is a greater risk that bioethanol-blended petrol will be contaminated with water – through general splashing, large waves or poor fuel handling. This contamination could have grave consequences where the boat is used in open water.



## OK to use in lawn mowers, tractors and other applications

Bioethanol-blended petrol can be used in almost any petrol engine, from lawn mowers to generators, but there is one precaution you need to take – don't leave bioethanol-blended petrol in the tank for longer than two months.

Check the handbook or check with the equipment supplier first, to make sure the engine can run on the blend.







Bioethanol-blended petrol is a proven fuel, and drivers are unlikely to experience any problems.

## Sensible precautions

Bioethanol-blended petrol is a proven fuel, and drivers are unlikely to experience any problems.

However, there are some sensible precautions that should be taken, especially with used imports, older vehicles or ones that have been fitted with non-approved parts, such as home-serviced vehicles. Drivers need to be aware of the possibilities and manage the risks.

As a minimum, drivers should be particularly vigilant during the first days of using bioethanol-blended petrol, checking for fuel leaks or wet patches on the ground after the vehicle has been parked for a while and also being alert to any unusual smell of petrol fumes.

If the vehicle is older, home-serviced or not well-maintained:

- The fuel tank should be checked for water. The older a vehicle is, the more likely it is that water will have accumulated at the bottom of the fuel tank.
- The fuel system should be checked (where possible) to see if standard or approved hoses and parts have been fitted. This would be a 'best endeavours' inspection as documentation on what parts are compatible with bioethanol-blended petrol, or ordinary petrol for that matter, is often not available. Also, it is often difficult to identify particular types of flexible hose materials and see all hoses.
- Where practical any O-rings or other shaft seals that are in contact with the fuel should be checked for deterioration and replaced if necessary. This is good practice even when using ordinary petrol.

# Working with bioethanol-blended petrol

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## Vehicle performance

It is unlikely drivers will notice any performance difference with bioethanol-blended petrol.



In some older vehicles there might be an occasional stumble under acceleration, especially in colder weather, but that is more likely to be due to the state of tune of the engine not being ideal.

Bioethanol introduces more oxygen into the fuel. In vehicles with simple fuel metering systems such as carburettors, this causes the mixture to become a little leaner. Leaning is good for fuel economy and is generally good for lowering some types of exhaust emissions. However, it may cause some engines to stumble if they are already tuned reasonably lean. If a vehicle stumbles on bioethanol-blended petrol, re-tuning should solve the problem. A vehicle tuned correctly for use on ordinary petrol would normally not exhibit problems when using bioethanol blends.

Irrespective of using bioethanol-blended petrol or not, vehicles should be properly tuned and serviced at all times to help reduce exhaust emissions and provide good fuel economy.

In more modern vehicles, engines generally have computer-controlled fuel metering that adjusts the mixture automatically. No difference in performance is expected with these vehicles. Older vehicles fitted with carburettors do not normally have an automatic fuel adjustment system. However, the tuning of these vehicles is usually such that little difference in performance will be noticed. It is only the rare older vehicle that has been tuned leaner than normal that may exhibit a change.

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## Vehicle support and warranties

Most new and many older vehicles can use bioethanol-blended petrol. To find out if a vehicle has been confirmed by the manufacturer as supporting a bioethanol blend, look in the owner's handbook or contact the official representative of the vehicle manufacturer in New Zealand.

Contact details for representatives can be found in the owner's handbook or online at the vehicle manufacturer's New Zealand website.

For a list of bioethanol supported vehicles see the insert in this booklet. This list has been compiled from information provided by members of the Motor Industry Association (MIA) to show which vehicles are stated by the manufacturers' as being suitable for E3, E5 or E10 blends.

- For an up-to-date list of New Zealand-new bioethanol supported vehicles visit [www.mia.org.nz](http://www.mia.org.nz) or [www.aa.co.nz](http://www.aa.co.nz)
- Japanese manufacturers have confirmed that all vehicles made for the Japanese domestic market can use E3 blends. Many new Japanese vehicles made for the export market can use 10% bioethanol, as well as many second-hand imports built after 2005. Owners should contact the vehicle manufacturer in New Zealand.
- The specification for petrol in Europe allows up to 5% bioethanol in petrol and European manufacturers generally allow use of bioethanol blends up to this level. Some European manufacturers have extended this to allow use of up to 10% bioethanol in petrol.

## Most new and many older vehicles can use bioethanol-blended petrol.

- Petrol vehicles sold in the US and Canada can use up to 10% bioethanol in petrol.
- For vehicles from other countries, check with the manufacturer.
- Some used vehicles are sold with mechanical breakdown insurance policies provided by the seller and are not necessarily provided by the vehicle's manufacturer or its representative. These policies may or may not be affected by the use of bioethanol-blended petrol and vehicle owners should check with the person who sold them the vehicle.
- Some motorbike manufacturers do not recommend the use of bioethanol in petrol at any level.
- Two-stroke and four-stroke engines in lawnmowers, chainsaws etc. can also use ethanol-blended petrol. Check with the manufacturer or equipment supplier.



## **Water and the potential for phase separation**

The fuel systems in most vehicles usually have some water in them, generally caused by water in the air condensing in the petrol tank.

Water is not very soluble in ordinary petrol and is heavier. It usually just settles at the bottom of the tank, although a tiny proportion gets carried through the engine, causing no problems.

However, bioethanol and water can mix together and so water can more easily mix with bioethanol-blended petrol.

This isn't a problem with small amounts of water – it is just evaporated and passed through the engine. In fact, because bioethanol-blended petrol is more water-absorbent, it is actually better for carrying water away and keeping a vehicle's fuel system dry.

However, there is a limit to how much water bioethanol-blended petrol can absorb. If there is too much, it can cause the blend to phase separate.

Phase separation leaves a petrol-rich layer on top and a bioethanol/water-rich layer at the bottom of the tank. As there will be more of the bioethanol/water layer than there was of the water alone, it can reach the level of the fuel outlet located just above the bottom of the tank. This bioethanol-water mix will be delivered to the engine first and will make the engine stumble or stop. This will not damage the engine, but the fuel system will need to be flushed out. Once the fuel system is dry, the vehicle can use bioethanol-blended petrol or ordinary petrol.

The increased risk of the presence of water is the main reason that ethanol-blended petrol is not recommended for marine use.

A simple precaution for motorists is to make their first fill with bioethanol-blended petrol a big fill on a near-empty tank.

## **Phase separation in cold temperatures**

The potential for phase separation and engine problems is greater in colder conditions. This is because the ability of bioethanol-blended petrol to absorb water decreases as temperatures drop.

For example, at 20°C, a 10% bioethanol-blended petrol can tolerate approximately 0.5% water before phase separation becomes a risk. This is about a cup full of water in a 50 litre tank. This reduces to about a half cup at 0°C.

It is certainly something for motor trade professionals to be aware of when dealing with motorists in cold parts of the country who are using bioethanol-blended petrol, particularly for the first time.

Cold temperatures at altitude is one of the main reasons bioethanol-blended petrol must not be used in aircraft.



## Dealing with phase separation

Bioethanol-blended petrol that has phase separated has two distinct layers.

If separation occurs the tank will require draining of the water/bioethanol-rich layer and refilling. The fuel filter may also require cleaning, or replacement if it is old. It is unlikely the problem will occur again as bioethanol-blended petrol helps keep the fuel system dry.

Remember – waste fuel must be properly disposed. It is illegal to allow fuel to drain to storm water systems.

This isn't a problem with small amounts of water – it is just evaporated and passed through the engine.

## The first fill should be a big fill

A simple precaution for motorists is to make their first fill with bioethanol-blended petrol a big fill on a near-empty tank. The more bioethanol that goes into the tank, the more water it will be able to absorb, helping to reduce the risk of phase separation problems.

## Checking for water

Excess water is very unlikely to be a problem in vehicles less than 10 years old. However, in older vehicles or where there is doubt, a qualified mechanic or other authorised person should check for water in the tank and clean out the tank if necessary.

Checking for water involves drawing fuel from the bottom of the tank. This can be done by removing fuel from the tank's drain plug, if one is fitted. However, most new vehicles don't have drain plugs and siphoning fuel from the bottom of the tank can be difficult.

In these cases, fuel needs to be taken from near the engine and is best taken after the fuel in the tank has been there for a number of days and the vehicle has been recently used on the road (i.e. maximising the chance that fuel and any water in the tank has been mixed). The presence of water can be tested with a permanganate paste. As an alternative, it may be possible to inspect the tank side of the fuel filter for water droplets. If present, it would be best to flush the tank.

This method does not guarantee there is no water present, but it will minimise the risk that what is in the tank is enough to cause phase separation.

The risks, although small, would be increased where elastomer-based components are already in poor condition.



### **Fuel system hoses and parts**

Petrol has changed over the years. Compared with what was available in the early 1990s, today's fuels are more aggressive on certain components, particularly those made from certain types of elastomer.

A major change has been the increase in the aromatic content of fuel, mainly as a means of boosting octane rating.

Some elastomer components haven't been compatible with these new high-aromatic formulations, leading to hardening or softening, and expansion or shrinkage, sometimes causing fuel leaks.

Bioethanol added to petrol may also cause deterioration of some elastomers, although if the elastomers have proven suitable for use with modern fuels they will probably also be suitable for use with bioethanol-blended petrol.

Permeation, the ease at which fluid or its vapour can diffuse through material, is another issue. There is normally some degree of permeation even with compatible materials.

However, the presence of bioethanol may increase the rate of permeation through certain elastomer materials.

While the components should be compatible with bioethanol-blended petrol, there is a risk that some elastomer-based components may not be compatible with bioethanol blends, the compatibility having not actually been tested. The risks, although small, would be increased where elastomer-based components are already in poor condition (i.e. possibly in older or poorly maintained vehicles) as the presence of bioethanol may cause the components to deteriorate further.

If a fuel filter is already fitted but hasn't been changed recently, it should be changed after the first few fills of bioethanol-blended petrol.

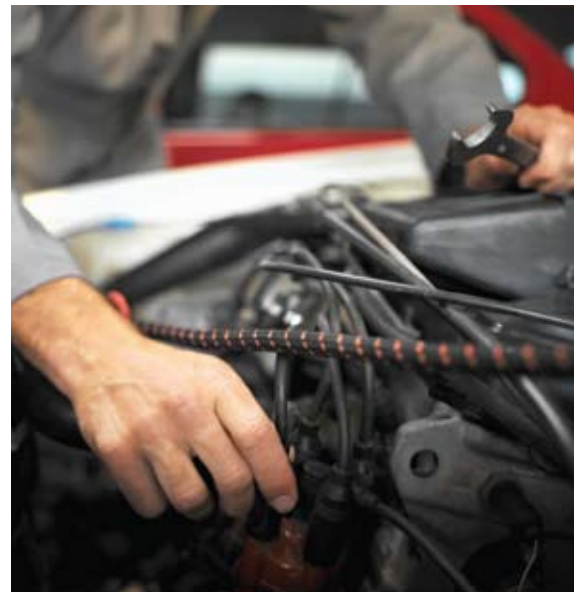
### Filters

Bioethanol has solvent properties which may loosen dirt or coatings from older fuel tanks and lines. Older vehicles should be fitted with a suitable in-line fuel filter before filling with bioethanol-blended petrol if a fuel filter is not already fitted.

If a fuel filter is already fitted but hasn't been changed recently, it should be changed after the first few fills of bioethanol-blended petrol. The risk is that the filter may become plugged with loosened dirt to the point that fuel flow and peak engine power are reduced.

Over the first few weeks after bioethanol-blended petrol is first used, the flexible fuel lines should be checked for softening or hardening, and also for wetness which would suggest excessive permeation. Fuel lines that are suspect should be replaced. A check should also be made for any leaks or dampness around fuel system components.

Vehicle owners should have the vehicle's fuel system checked by a suitably qualified person. A quick visual inspection may be all that is necessary.




### How to tune for bioethanol-blended petrol

For modern engines, tune the engine as you would for ordinary petrol. For older engines that do not have automatic fuel metering adjustment, such as engines fitted with carburettors, tune the engine for a CO reading between 5-10% lower than recommended for ordinary petrol if the vehicle is being fuelled mostly with 10% bioethanol-blended petrol. If mostly fuelling with 3% bioethanol-blended petrol, retuning is unlikely to be needed. If in doubt, tune as for petrol.







Where tools aren't well maintained or are likely to be left standing for periods of longer than two months, ordinary petrol is recommended.

### **Storage issues and small engine tools**

Non-automotive equipment is often only used in certain seasons and then stored for extended periods.

Petrol deteriorates when stored for a time and can form engine deposits which gum the fuel system. Most manufacturers recommend draining fuel if the equipment isn't going to be used for long periods. It is particularly important to remember this with bioethanol-blended petrol.

Many small engine tools such as chainsaws and lawn mowers have petrol tanks that are open vented to the atmosphere. Over time, there is a risk that enough water will be absorbed by the fuel in the tank to cause phase separation – that is, a petrol-rich mixture on top and a bioethanol/water-rich mixture on the bottom. The engine won't start on a bioethanol/water-rich mixture and it could cause corrosion of some fuel system components.

### **Customised vehicles**

Bioethanol-blended petrol is not recommended for use in vehicles with customised fuel systems or with non-standard parts.

Materials used in customised vehicles may not be compatible with bioethanol-blended petrol unless special attention has been given to the choice of fuel system components. Extra care needs to be taken with these vehicles.

For example – fuel tank leaks have been reported from overseas in vehicles where the original fuel tanks were replaced with customised fibreglass tanks. In this case, the particular resin used in the fibreglass was found to not be compatible with bioethanol.

# More information

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## **Setting the record straight**

Fuels are complex, and unless you have complete and accurate information it is easy to be misled. There are several myths and misconceptions about bioethanol-blended petrol, some of which are based on situations that won't apply in New Zealand, and others that are plain wrong. Here are the factual answers to some frequently asked questions.

### **FAQ: Can bioethanol-blended petrol cause corrosion?**

Corrosion inhibitor is required to be added to bioethanol-blended petrol under the Engine Fuel Specifications Regulations.

Bioethanol-blended petrol sold in New Zealand should not cause any noticeable corrosion to parts. Modern automotive components are normally resistant to bioethanol. Further, petrol fuels must meet consumer protection specifications for corrosion regardless of whether bioethanol is present in the petrol or not. As well, fuel suppliers tend to operate to far more stringent corrosion specifications than those regulated for.

### **FAQ: Can bioethanol-blended petrol damage paintwork?**

The risk of damage caused by bioethanol-blended petrol is similar to that for ordinary petrol.

Modern vehicle paints are hard and less susceptible to damage from fuel spills even though today's petrol is more aggressive than it was 10 years ago. It makes sense to clean off any spills on paintwork regardless of whether bioethanol is present or not.

### **FAQ: Does bioethanol-blended petrol have higher octane?**

Bioethanol does have octane-enhancing characteristics. However, the base petrol the bioethanol is added to may be specified differently to ordinary petrol. There is, therefore, no guarantee that the octane of bioethanol-blended petrol will be much above the octane value displayed at the pump.



**FAQ: Can bioethanol-blended petrol loosen dirt and as a result damage fuel systems?**

Bioethanol was shown to loosen dirt from fuel systems in trials in the 1980s. Since then, changes in petrol have strengthened its cleaning power, and dirt will already have been removed by normal fuel use. However, it is possible that some of that removed dirt has been deposited in water in the bottom of the fuel tank. Because water is absorbed by ethanol blends, that dirt could be picked up and sent through the fuel system. This is another reason to change the fuel filter after the first few fills.

**FAQ: Does using bioethanol-blended petrol mean more maintenance is required?**

Maintenance practices required with bioethanol-blended petrol are no different to those required for ordinary petrol. Apart from the simple checks suggested after first using the blended fuel, there is no need to change servicing requirements. No special lubricants or spark plugs are required.

