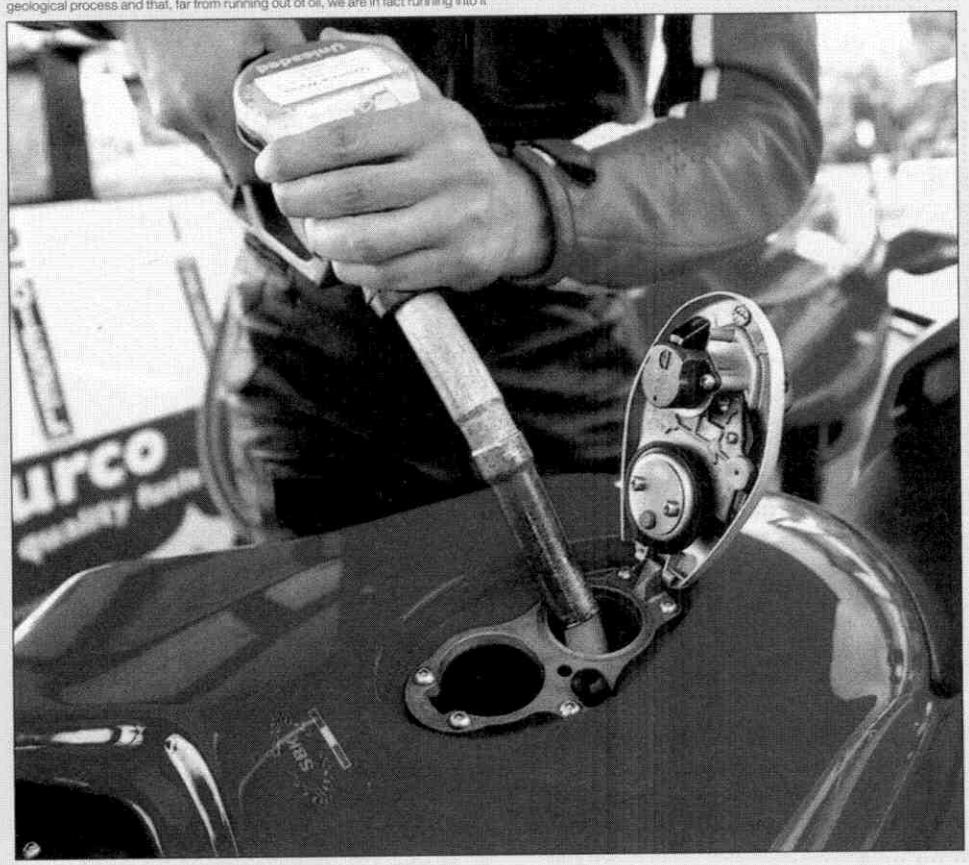
*Actually, the biogenic origin of petrol is a matter of hot debate in geological circles. Some experts believe oil develops deep in the earth's crust from a purely abiotic geological process and that, far from running out of oil, we are in fact running into it

Petrol

Thank the prehistoric trees*. They died so you can ride



After millions of years of heat and pressure, a pile of dead trees and plants buried deep in the earth gets broken down and transforms into crude oil. Sooner or later, a fat Texan pumps it out of the ground, then refines and separates the stuff down to its constituent parts. And every hundred miles or so, you fill up your bike's tank with one of the liquids produced as a result.

The clear fluid we know as petrol is a combination of different hydrocarbons – compounds of hydrogen and carbon elements – ranging from seven to 11 carbon atoms in length. Mostly, it's octane (the hydrocarbon with eight carbon atoms). Petrol contains huge potential energy – a gallon contains the equivalent of 31 million calories (or, in food terms, 63 Big Macs).

But this energy needs to be released. That involves mixing the petrol with air and squirting it into an engine's combustion chamber to be ignited by the spark from the plug. The theoretically perfect mix of air:fuel is 14.7:1 (known as the 'stoichiometric ratio'). Under these conditions, the hydrocarbons burn completely. Hydrogen atoms join with oxygen atoms, creating H_2O (water) and all the carbon bits turn into CO_2 (carbon dioxide). In practice it never happens that perfectly, thanks to the presence of other contaminants in fuel and air, but that's the idea at least.

Before the spark plug sparks, this mix of air and fuel is compressed by the piston's compression stroke. Cars typically run a compression ratio of about 8:1 (squashing the gas into an eighth of its volume). Bikes run much higher ratios to generate more power: the relatively gentle Suzuki SV650 runs at 11.5:1 and the monster Kawasaki ZX-10R at 12.7:1.

The problem with high compression ratios is that heptane (one of the hydrocarbons found in petrol) doesn't react well when it's squashed. Its molecular bonds are weak, so compress it a little and it ignites spontaneously. The bonds in octane are far stronger, so it takes much more compression before it ignites. This is why tuned engines are run on high-octane petrol.

What do octane ratings mean?

At the petrol pumps you're often faced with two types of unleaded – regular (95 RON) or super (with a higher value). RON stands for Research Octane Number, a measure of how resistant the fuel is to igniting under compression.

A fuel of 95 RON, such as regular unleaded, has the same resistance to compression as a mix of 95 per cent octane and 5 per cent heptane. Fuels of more than 100 RON are made by adding chemicals that are more resistant than octane. Shell Optimax claims a 98 RON rating; BP Ultimate Unleaded is 97 RON.

Octane alone won't increase power. It only allows the potential for an engine to run a high compression ratio – and that's what will increase power. Run a high-compression engine on low octane fuel and detonation occurs – and that can destroy a motor.

What is detonation?

Detonation – also known as knock – occurs after the spark plug has sparked. The spark starts a flame in the middle of the cylinder, which should spread out to the edges with a single flame front. But if gas at the edge of the cylinder ignites (due to high temperature or pressure) before the flame meets them, it causes multiple flame fronts in the cylinder. When these collide they create a sharp rise in heat and pressure. Occasional, slight detonation isn't a problem but constant, severe detonation will wreck an engine.

Some bikes, like BMW's extremely high compression K1200S (13:1) use a knock sensor. This detects frequencies in the cylinder and, if it registers those associated with knock, tells the engine management system. This then retards the ignition advance (how far ahead of the piston reaching Top Dead Centre the spark plug fires). Ignition advance is necessary because petrol takes time to burn, so igniting the mixture when the piston is already at the top of its travel is a waste of energy. As revs increase, the piston speeds up so more advance is needed. Retarding the amount of advance will reduce power but lowers temperature and pressure, reducing the conditions that cause knock.

How is race fuel different?

Contrary to popular belief, race fuel isn't super-high-octane juice. FIM regulations for MotoGP and Superbikes only allow fuels between 95 and 102 RON – not a world apart from the octane of petrol we buy at the high street pump. In fact, race teams want to use the lowest octane fuel they can get away with, as a side effect of high octane is slow combustion.

The big difference between race fuel and road petrol is that fuel companies work closely with race teams (such as Shell Advance with the Ducati GP team) to develop a bespoke fuel for a specific bike's demands, which change from day to day. Pump unleaded has to work in a variety of vehicles and conditions. So nicking a drum of Desmosedici fuel for your road-legal 999 won't magically increase its power. ■

Use Your Knowledge

So what should you fill up with? Simple. Assuming you haven't changed your compression ratio, run your bike on what the manual tells you to. In the case of most road bikes, that's standard 95 RON. Extra octane won't increase power – it really is just a waste of money. If the book asks you to run it on higher-octane fuel then stick to it rigidly, unless you have a knock sensor – like BMW's K1200S or new R1200 models. In this case, if you want to save a few quid and don't mind losing some bhp, you can use regular. You're safe to mix and match regular and super, too.