

With the immanent demise of leaded petrol, the following article has been produced as a guide to address the confusion that many people appear to have on this subject. Questions from customers show they have the following concerns:-

- a) Unsure whether they can run unleaded fuel without damaging their engine
- b) Confuse petrol lead content with octane rating

### **A short chemistry lesson.**

All flammable liquids have a flashpoint i.e. a specific temperature at which point they will self-ignite. When this happens to petrol inside an engine this is called 'detonation' and is very harmful. Detonation or 'pinking' is caused by high combustion temperatures created primarily, by high compression ratios. The result of this is a shockwave within the cylinder where the uncontrolled flame collides with the controlled flame front produced by the ignition spark. Detonation not only reduces engine power but if left unchecked causes considerable damage, especially to the pistons. Most cases of detonation can be rectified by using the correct octane fuel. However, the engine may also require adjustments to the fuel/air mixture and/or the ignition timing.

### **Octane ratings explained.**

Petrol is blended to re-create the detonation or 'knock' resistance of a reference fuel produced by mixing Iso-Octane with N-Heptane. Pure Iso-Octane has a knock value of 100 and N-Heptane a knock value of zero. The research octane number (RON) denotes the octane rating or knock resistance of a blended fuel compared to pure Iso-Octane 100 RON, so a blend of fuel with a 97 RON octane rating would have the same knock resistance as a mixture of 97% Iso-Octane and 3% N-Heptane. To avoid expensive refining, additives are used to increase octane levels. Benzene, Toluene and Xylene are the three most commonly used in modern fuels but by far the best additive ever used for this purpose was Tetra Ethyl Lead (TEL).

### **The unique properties of leaded petrol.**

Tetra Ethyl Lead (TEL) is a cheap and amazingly effective petrol additive. It not only boosts the octane rating of the fuel, but also forms a protective coating on valves, seats, guides and the upper cylinder. In addition to this, it acts as an efficient lubricant for pumps, injectors and other moving parts within the fuel system. Modern unleaded fuels do not provide this protection which is vital for older type engines designed to be run with leaded fuel. By the far the biggest problem arising from using unleaded fuel on older engines is a condition known as 'valve seat recession' (VSR). Without the protective lead coating on the exhaust valve seats, the intense heat (650 deg.C) plus the hammering effect of valves opening and closing, causes iron deposits from the valve seat to become micro-welded to the valve edge. Left unchecked, this continual tearing away of metal particles will result in the exhaust valve digging a deeper hole for itself into the cylinder head. Within only a few thousand miles, the engine will fail completely and it will require an expensive overhaul. To combat this problem, modern petrol engines have special hardened valve seats which can withstand this harsh environment.

### **Lead Replacement Petrol and Anti-Wear Additives.**

As from the 1st January 2000, leaded petrol will no longer be available in Queensland and Western Australia. For motorists still using cars with engines designed to run on leaded fuel only, the oil companies will be offering Lead Replacement Petrol and/or Anti-Wear Additives. Sodium and phosphorous are the two chemicals currently used as 'lead substitutes' but neither comes anywhere near to giving the sort of protection provided by Tetra Ethyl Lead. Phosphorous works well at lower temperatures and loads, but tests have shown that the coating burns off during higher load conditions e.g. towing, heavy acceleration, high speed, etc. Sodium appears to offer better protection than phosphorous, especially in high performance situations and both Wynn's Lubrivalve and Redline's Lead Substitute are sodium based additives.

Where petrol stations choose to retail Lead Replacement Petrol then this will be offered as a direct replacement for leaded petrol. The reality is that very few sites will have Lead Replacement Petrol but instead

# The Elan Factory - Information Sheet



## Unleaded fuels - the real issues

---

will choose to stock a variety of additives for mixing with their unleaded fuels. Regarding the use of Lead Replacement Petrol and Anti-Wear Additives in older cars, the petrol companies have commented that their products will provide adequate protection in normal driving conditions. However, no additives provide as much protection as lead and if your car often spends time at high speeds or towing a trailer you may need to consider having your engine modified.

### Summary.

When choosing which fuel to use, remember that it is the octane rating which is most important. Modern fuels tend to burn more slowly for a given RON index and this may allow higher compression ratios than normal to be used. If you are running very high compression ratios (10+:1) or high turbo boost pressures, use a high octane additive otherwise detonation will destroy your pistons.

Unlike Tetra Ethyl Lead, Anti-Wear Additives or lead substitutes are not octane boosters. These two entirely different additives should not be confused by the function they perform.

For older cars not suited to unleaded fuel (pre 1985 for most cars but many others were not converted till circa 1990) time is now running out. If your annual mileage is minimal and normal engine loads are not to be exceeded then the regular use of a suitable additive should prevent any engine damage. The only permanent solution is to have the cylinder head modified to run on unleaded fuel. If the head is being removed for other work or the engine overhauled it would be an ideal opportunity to have this conversion work carried out. On a 4 cylinder engine averaging 30 mpg and currently using leaded petrol, the fuel saving costs should recoup the cost of an unleaded conversion within 10,000 miles. But then what price does one put on reliability and peace of mind!

### Unleaded Engine Conversions.

The Elan Factory can provide this service for just about any Lotus engine type. This operation involves the reduction in compression ratio and can be achieved in a number of different ways according to customer's preference. It may also be necessary to replace valve seats and valve guides depending on the condition of the relevant components.

We also recommend the fitment of stainless steel valves, copper-nickel silicon valve guides and high quality valve seat inserts. Special heat treated alloys are used in the production of these inserts, the two most common being nickel/chromium and vanadium/molybdenum.

**For further information regarding engine modifications, synthetic oils, performance products or genuine Lotus products, please phone The Elan Factory on (613) 9761-1903 or fax on (613) 9739-8944. Alternatively you can write to The Elan Factory at 5 Marong Court, Boronia Heights 3155, Melbourne, Australia or e-mail at [elanfactory@optusnet.com.au](mailto:elanfactory@optusnet.com.au)**