Getting the lead out

*Leaded avgas may have no more than seven to ten yearsof life left; **Pat Malone** looks at why supplies cannot be maintained*

The powerful US Environment Protection Agency has begun a consultation on eliminating lead from aviation fuel, which will give new impetus to the drive to find an alternative to avgas across the world.

When the EPA mandated the removal of tetra-ethyl lead (TEL) from car fuel decades ago, aviation was granted an exemption as long as progress was being made towards a suitable alternative. While the Bush administration showed no interest in forcing the issue, times have changed, and under pressure from the environmental group Friends of the Earth and others, the EPA has issued an advance notice of proposed rulemaking inviting interested parties to comment on the issue in the next month. They have set no deadline for the removal of lead, but unofficially EPA staff have said they would like to see lead removed from all aviation fuel by 2017.

While unleaded avgas has been available in Europe for a generation, it has a number of drawbacks. Making it widely available is a logistical nightmare, it is not suitable for higher-powered avgas engines (above 260hp) and it could well be crushed under the commercial weight of the American oil producers, who will not accept imports and will seek to corner the global market.

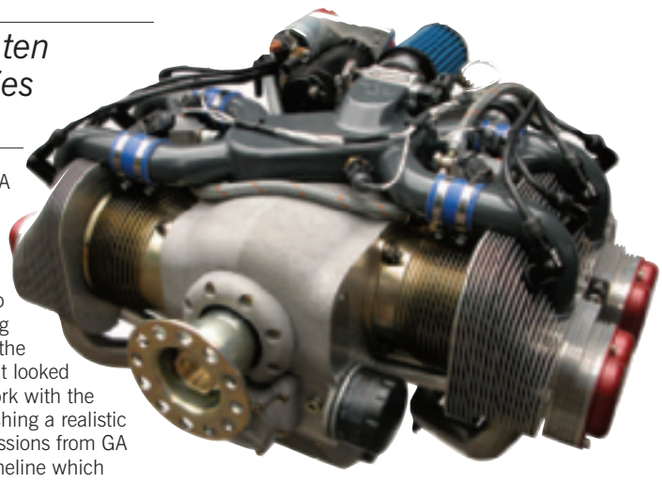
The EPA recognises that the transition will not be easy. In its announcement, made in mid-April, it says: "Converting in-use aircraft and engines to operate on unleaded aviation gasoline would be a significant logistical challenge, and in some cases a technical challenge as well… Given the potentially large number of affected aircraft and the potential complexities involved, a programme affecting in-use aircraft engines would need careful consideration by both EPA and FAA, and the two agencies would need to work together in considering any potential program affecting the in-use fleet."

In the United States, AOPA has for 20 years been working with other groups under the banner of the 'Co-ordinating Research Council' to seek a solution to the avgas problem. Following the EPA's announcement at the end of April, AOPA US said it looked forward "to continuing to work with the EPA and the FAA on establishing a realistic standard to reduce lead emissions from GA aircraft along a transition timeline which balances environmental benefit with aviation safety, technical feasibility and economic impact upon the GA industry."

Luckily, all sides recognise that this is not the most pressing environmental issue. Even in America, avgas amounts to three tenths of one per cent of car fuel sold. In Europe the level is far lower – it has been estimated here that avgas volumes equal one quarter of the fuel that evaporates from car tanks. Compared to a generation ago when cars ran on unleaded fuel, the amount of lead emitted is statistically insignificant.

Shrinking market

But even without the lead problem, avgas supplies are drying up. It is no longer made at the Coryton refinery in Essex, sold by BP in 2006, and last year an Exxon refinery in Sicily stopped production. Total's La Mède plant in the south of France and Shell's Pernis refinery in Holland are the sole remaining European producers. A production run of avgas 100LL requires a subsequent purge of the refinery, which is very costly and time-consuming, before production of unleaded motor fuel can be resumed. Avgas is difficult to blend – there's no leeway in the specification for failure, and the testing regime is many times more rigorous than for car fuel. If a batch 'fails' you can't just pour it back into the crude stream like you can with failed motor fuel – it has to be destroyed. Because of its lead content, avgas is deemed to contaminate everything it touches. Pipelines and tankers used for avgas cannot then be used for other fuels without the sort of cleaning that is prohibitively expensive or borderline impossible. Refineries have to have dedicated distillation towers for avgas, dedicated tanks and dedicated jetty pipes, and dedicated ships.



The ULPower UL260i aero engine runs on both avgas and mogas

In America, the EPA has classified used motor oil as a non-hazardous substance because it contains less than 10 parts per million of lead. But used oil from piston-engine aircraft contains significantly more lead and must be more expensively disposed of.

Globally only one remaining company, Innospec, in Ellesmere Port, produces TEL. Worse still, one of the components of avgas, ethylene dibomide – necessary for scavenging lead residues – was banned under the Montreal Protocol of 1987, signed by every EU country, because of its environmental effects. But general aviation cannot run without avgas – high-performance Lycoming and Continental engines are manifestly unsafe when run on anything else – and piston-engined planes and helicopters remain the last market of any size for leaded fuel.

Avgas contains lead because it must have a high 'octane rating', which reduces detonation, in an engine. The octane rating is the fuel's ability to 'wait for the spark', in that it will not ignite spontaneously under compression, even in a high-compression engine. Detonation causes loss of power and can even blow up your engine.

In testing, avgas must pass two octane specifications. The first is 'motor octane number', which is a more severe version of the 'research octane number' test often quoted for car fuel quality. Typical top quality automotive gasoline has a motor octane number of about 88 – avgas 100LL must exceed 99.5. However, even this is minor consideration when compared to the second octane test, 'supercharge'. Here, the avgas is run in a special single-cylinder fuel-injected supercharged engine (there are only a handful of these testing engines in the world) and the mixture is pushed to the absolute limits to try to induce detonation. If a sample fails this test, the whole batch – refineries blend batches of around 2,000 tonnes at a time – may have to be destroyed.

Another tough test concerns the ability of avgas to remain in storage for long periods without detriment to safety. Car fuel is usually

Avgas 100LL manufacture and distribution is difficult and costly

used within a couple of weeks, and if it lies around for a long time it can form gummy deposits that will clog carburettors. Avgas, however, may have to sit all winter in wings, or possibly for years in drums. Part of the chemical blend is aimed at preventing gum formation, and fuel from each batch is heated to 100 degrees, with 100 PSI of oxygen over the fuel, and held for 16 hours (five hours in the US) to make sure gum formation is kept to a minimum.

Avgas quality is governed by the American standard ASTM D910, and in the UK by Defence Standard 91-90. It must have qualities that prevent vapour locks at altitude – fuel warmed to 25 degrees C on an airfield can within a few minutes experience a pressure reduction of 17% as a plane climbs to 5,000 feet, and the fuel must tolerate vast temperature changes. Even the dye that turns it blue is specified to ensure consistent quality.

There are severe restrictions on the refinery components that can be used to blend avgas. Only the best hydrocarbon streams can be used, carefully blended in segregated tanks to ensue no contamination from other products. No detergents, common in car fuels, have been approved. There is a minimum energy specification for avgas – there's no such requirement for car fuel. For almost all oil companies, producing leaded avgas is more trouble than it is worth.

Ultimately GA must find a fuel that is not exclusive to piston-engined aircraft

Unleaded avgas

In Sweden, unleaded avgas has already gained a significant share of the market. It suits most GA engines and has some advantages over 100LL in terms of production, transport and engine maintenance. Produced by Hjelmco Oil, it has been approved since 1995 for use in a majority of Textron-Lycoming engines up to 180 hp, and also the 235 and 260hp Lycoming O-540s as well as all Continental 100 and 145hp engines, without modification. In 2006 Hjelmco 91/96 UL avgas was certificated for use in all Rotax engines. While that means the 200hp Lycoming O-360 in the Arrow 200 is excluded, it covers the familiar Cherokee, Warrior, 172 and 150 types and some twins, such as the Piper Aztec, Twin Commanche and many more – and of course, anything with a Rotax. In Sweden, Hjelmco Oil has 70 percent of the general aviation fuel market and serves about 150 airports.

Unleaded aviation grade fuel can meet the specifications for avgas without resorting to TEL mainly by being very selective about the quality of the ingredients and using the most stringent quality control methods. Unleaded avgas is much easier to transport and store than its leaded counterpart, but the reason it hasn't spread across Europe is that it would require duplication of fuel facilities at many airfields – separate tanks and nozzles, separate delivery tankers. In-service experience with unleaded 91/96 has been good. Typically, a Lycoming with a 2000-hour TBO will go to 3000 hours (in Sweden they're allowed to extend by 50 percent on condition) using 91/96 – largely because you don't get the lead fouling problems that bedevil 100LL users.

In terms of production values and volumes, general aviation fuels are pharmaceutical products, and the ultimate aim must be to settle on a fuel that is not specific to GA aircraft. ■

Letters to the Editor

Western welcome

Sir,

Please advise your readers that we very much welcome GA pilots to Land's End. The Airport has a new flying school, MSH Flight Training (www.mshflighttraining.co.uk), Skybus scenic flights using a C172 (*www.landsendairport.co.uk*), based private aircraft and a healthy number of regular light aircraft visitors. We offer both Jet A1 and Avgas. We are an ideal stop for a refuel before commencing the popular crossing to the Isles of Scilly (no fuel facilities for GA). We also have a very good cafe (01736 785245) overlooking the airfield and serving a full menu including all-day breakfasts and, of course, Cornish pasties! There is a new dedicated GA computer area in the cafe for pilots wishing to access the latest weather, Notams, etc. We have space in our hangar for GA aircraft – the only downfall is that we do not currently open on a Sunday. We won the AOPA most friendly Airport in 2007 and believe we have maintained these standards.

As an Airport that has a based scheduled operator (Skybus) we do ensure that our standards are maintained – such as requesting all visiting pilots use high visibility vests, PPR is obtained (01736 788944), and Air Traffic Control instructions are followed within the ATZ.

I hope that you will put us back on the map as a friendly place to visit and invite you to join us and AOPA corporate member, 'MSH Flight Training' at any time,

Chris Pearson
Airport Manager/SATCO
Land's End Airport

Quango time

Sir,

I read in the *Telegraph* on Thursday 22 April 2010 an article saying that (CAA Chairman) Dame Deidre Hutton, who by her own admission knows nothing about flying, is paid £130,000 a year for, wait for it, a two day, yes, a two day week.

Who are the cretins who awarded these ridiculous sums to quango figureheads. The industry particularly GA is suffering with all the CAA red tape, restrictions and hoops to jump through costing more overheads to organisations struggling to survive.

No wonder the country is in a mess.

A.H. Manser

A couple of things to bear in mind: while neither Dame Deidre Hutton nor new CEO Andrew Haines has aviation expertise, that's not something the CAA is short of. What it needs is organisational ability, common sense and enough business acumen to know how to run a whelk stall. We can only hope this new blood can provide it. The last CAA Chairman, Sir Roy McNulty, was a part-timer who also chaired the Olympic Delivery Authority. Although he worked four days at the CAA, Sir Roy was both Chairman and Chief Executive. The new Chairman's job is to keep the politicians off the Chief Executive's back, and if she can pull it off, she'll be worth as much as we pay a country GP. – Editor ■