





Preparing for an unleaded future

Laying the groundwork to find the next avgas

BY AOPA STAFF

No bigger issue faces general aviation than finding the right path to an unleaded fuel. Aircraft owners for generations to come will be affected by decisions made in the next few years regarding the transition, and the industry has only one chance to get it right.

No single “silver bullet” solution for how best to replace leaded avgas has been identified, but AOPA is laying the groundwork to find that future fuel, streamline regulatory approval, and get it to the general aviation fleet without disruption. At the same time, AOPA will make sure that avgas remains plentiful and commercially available as long as GA pilots require it, so current aircraft engines will be viable for many years to come.

“Avgas as we know it today will not go away in the near future,” said Rob Hackman, AOPA vice president for regulatory affairs, who is coordinating the association’s actions with a broad coalition of GA advocacy groups. “AOPA is working hard to ensure that 100LL won’t go away until we’re ready for it to go away, and no date has been set for it to be replaced.”

However, it is clear that federal health and regulatory agencies will require the

general aviation industry within the next few years to show a path to a future that is free of leaded fuel, no matter how small the amount of lead emitted by aircraft engines. Beyond the environmental arguments around leaded fuel are the economic ones. Only one company in the world continues to produce the lead additive used in avgas, because production quantities are so small and environmental liabilities are so high. Avgas requires

Where we started

BY SARAH BROWN

It sounded like the perfect additive. Researchers at the Ethyl Corporation, a General Motors subsidiary, discovered in 1921 that adding a small amount of tetraethyl lead to fuel silenced the knock that could cause an engine to tear itself apart during operation.

The discovery of lead as a cheap octane-booster paved the way for high-power, high-compression engines and carried the United States automotive industry through 50 years of production. Tetraethyl lead made possible the development of powerful engines for such classic American aircraft as the P-51 Mustang and the B-29 Superfortress, powerhouses that contributed to the Allied victory in World War II. But the performance benefits of the additive came at a cost.

The Environmental Protection Agency (EPA) concluded in 1973 that lead from automobile exhaust was posing a threat to public health and moved to regulate it under the Clean Air Act, gradually reducing the lead in auto fuel and then eliminating it completely. When the agency took the last steps in the phaseout a decade later, EPA Administrator Carol Browner called the elimination of lead from auto fuel “one of the great environmental achievements of all time.” Now, American aviation is expected to follow suit.

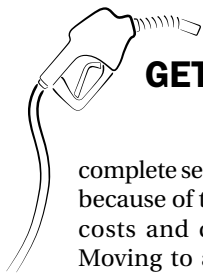
For 30 years, the GA industry has been looking for

a fuel that has all the benefits of the current avgas that uses tetraethyl lead but none of the drawbacks.

The industry faces two separate challenges regarding leaded avgas: In the short term, it must reduce lead emissions, and in the long term, it faces the regulatory process set in motion by an advanced notice of proposed rulemaking that has the potential to advance the elimination of lead from avgas. But no date for the elimination of leaded avgas has been set.

“The EPA has not established or proposed any date by which emissions from aircraft operating on leaded avgas would need to be reduced,” said Margo Oge, director of the office of transportation and air quality for the EPA. “In fact, the EPA does not have authority to control aviation fuels. Any EPA action to require piston-engine aircraft to reduce emissions of lead in the future will involve a thorough process of identifying options and will consider safety, economic impacts, and other aspects.”

The issue is much more than just achieving an octane number. The industry and the EPA need a better picture of how the transition will affect all general aviation aircraft; owners and pilots can explain how the transition will affect them in comments to the EPA’s advance notice of proposed rulemaking online (www.regulations.gov, and search for the ID, EPA-HQ-OAR-2007-0294-0100; currently, comments close August 27, 2010).



GETTING THE LEAD OUT

complete segregation from all other fuels because of the lead additive, driving up costs and driving down efficiencies. Moving to an unleaded solution may eliminate some of these shortcomings.

There are several promising high-octane unleaded fuels being tested as potential replacements to today's 100LL avgas. They include a fuel developed by Swift Enterprises that can be derived from petroleum or bio-mass (see "Grass for Gas," September 2009 *AOPA Pilot*), and another backed by General Aviation Modifications Inc. (GAMI) that it calls

find out whether they can be produced and distributed economically, stored, mixed with avgas, and flown safely—and whether emissions are less harmful than today's leaded avgas.

"We're not advocating a specific solution," Hackman said. "We're getting a process in place where every potential avgas replacement can be fully researched. Let's evaluate all of them. We need to know about the performance, the economics, and whether they can be reliably produced in industrial quantities. That way we can compare and make the

million gallons of avgas sold each year. As a point of reference, keep in mind that the petroleum industry produces about 300 million gallons of auto gasoline *a day*. The small quantities of avgas sold each year make the costs prohibitive for FBOs to store and sell more than one kind of fuel for piston aircraft. By every definition, avgas is already a boutique fuel. Further segmenting the already small market for aviation gasoline will drive costs higher.

At the same time an unleaded fuel is being developed, aircraft engine manufacturers are sure to introduce new engines and electronic controls that will allow them to run on fuels with varying octane levels.

Teledyne Continental Motors (TCM) recently introduced a turbocharged IO-550 engine for the Cirrus SR22T that TCM officials say is capable of running on unleaded 94-octane fuel (see "Cirrus SR22T: Cirrus Amps its Turbo Line," July 2010 *AOPA Pilot*), and Lycoming has been flying its iE2 engine with electronic ignition and a single power lever on a Lancair Evolution for months. Both companies have been developing FADEC engines with variable timing and knock sensors that could allow them to run safely on fuels with varying octane levels. And GAMI has been working for years on a retrofit system it calls Prism that would allow today's turbocharged and high-compression engines to do the same thing.

AOPA has asked Congress to approve an administration request for an additional \$2 million in the FAA's 2011

AOPA has long held that any solution must consider the entire GA fleet.

G100UL (see "Look, Ma, No Lead," May 2010 *AOPA Pilot*).

AOPA and other members of the coalition—the American Petroleum Institute (API), Experimental Aircraft Association (EAA), General Aviation Manufacturers Association (GAMA), National Air Transportation Association (NATA), National Business Aviation Association (NBAA), and National Petrochemical and Refiners Association (NPRA)—are working with the Environmental Protection Agency (EPA) and the FAA to ensure that all potential avgas replacements are thoroughly and fairly vetted. In addition to weighing the technical merits of new fuels, AOPA and the coalition are working to develop a path that will allow for the evaluation of potential solutions and to

best decision. The evaluation needs to go far beyond the technical aspects," he said.

The worst thing the industry can do is to rush into an unproven solution that a few years down the road turns out to have some troubling characteristics that damages engine or fuel system components, leads to new environmental problems, or turns out to be difficult or overly expensive to manufacture or distribute.

AOPA has long held that any solution must consider the entire GA fleet. About 70 percent of the piston GA fleet could switch to unleaded fuels with the stroke of a pen. But the remaining 30 percent of U.S. aircraft with high-compression or turbocharged engines require 100-octane fuel to operate safely, and those aircraft consume about 70 percent of roughly 250



Answers to your avgas questions

By Rob Hackman, AOPA vice president for regulatory affairs

Q. Pilots have been hearing about the imminent demise of leaded avgas for 30 years and nothing's happened. What's different now?

A. The main difference is the action that has been taken by the EPA as a result of a petition filed by the environmental action group, the Friends of the Earth. As a result of this petition, the EPA is required to investigate whether aircraft lead emissions cause or contribute to air pollution, which may reasonably be anticipated to endanger public health. On April 28, 2010, the EPA published an advanced notice of proposed rulemaking,

which could lead to ultimately limiting or eliminating the amount of lead that may be used in avgas.

Q. AOPA has a great track record of beating back onerous government proposals such as ATC user fees. Why won't AOPA take on the EPA over lead?

A. Political, environmental, and economic forces are pushing the aviation industry to an unleaded fuel. AOPA is focused on ensuring that the aviation industry has the time, resources, and procedures in place to fully and fairly evaluate potential

research and development budget. This money is specifically intended to support the development of an alternative to leaded avgas.

The EPA has been largely driving the process that is likely to result in more stringent emission standards on lead and pressure to remove lead from aviation fuels. The agency, spurred by a petition filed by Friends of the Earth, has published an advanced notice of proposed rulemaking indicating that it will launch a study of lead levels at airports around the country, an early step to what is likely to be a years-long process of lowering lead emission standards.

As specified in the Clean Air Act, the FAA is the ultimate arbiter of air safety issues, and the FAA—not the EPA—will have the last word in determining when, or if, leaded aviation fuel is banned. Lead has been an essential ingredient in piston aircraft engines for generations because it protects against destructive detonation, and all of today's turbocharged and high-compression engines were designed to run on leaded fuel.

AOPA, along with the members of the GA Avgas Coalition, is working to ensure that the FAA has the necessary manpower and data to meet its responsibilities; that avgas producers, distributors, and FBOs will have the necessary lead time; and that the GA industry, as well as individual aircraft owners and pilots, have tools to take the aviation industry to an unleaded future.

AOPA

GA advocacy groups stand united on avgas issue

The general aviation community is on the path to finding a viable solution to the problem of leaded avgas—together. Senior regulatory affairs staff and GA association heads of a coalition dedicated to addressing the issue of leaded avgas outlined their short- and long-term plan to address pressures to reduce and remove the lead from aviation fuel in late July.

Association heads of the coalition include AOPA President Craig Fuller, Experimental Aircraft Association Chairman Tom Poberezny, General Aviation Manufacturers Association President and CEO Pete Bunce, National Air Transportation Association President Jim Coyne, and National Business Aviation Association President and CEO Ed Bolen.

“We take this coalition very, very seriously.” —Craig Fuller

Reducing and/or removing lead from aviation fuel is a complicated issue, the association presidents acknowledged, but one they are committed to addressing as a united front. “We take this coalition very, very seriously,” said Fuller. It’s much easier to bring people together on an up-or-down issue such as user fees, Fuller said, but the associations are committed to addressing the complex considerations of a transition to an unleaded fuel.

“This issue is probably the most important issue we’ve faced as a community in a long time,” Poberezny said. The associations are in a marathon, not a sprint, he explained.

There’s no need to be “Chicken Little” about the transition, Coyne said. But at the same time, GA groups will not sit by and pretend the issue does not need to be addressed. “This is not a time for us to stick our head in the sand. We clearly have an issue that calls out for leadership,” he said.

It calls for leadership from industry groups, but also from the FAA, Fuller said. FAA Administrator Randy Babbitt and senior FAA staff have been accessible to GA groups, he said, and understand the issues at hand.

While the industry works toward the long-term goal of developing specifications for certifying and transitioning to an unleaded fuel, the associations support gathering as much data as possible now to help make informed decisions down the line—that means supplemental type certificate processes alongside the ASTM process, which sets the ultimate standards for a fuel.

fuel alternatives, and make a safe and effective transition to an unleaded fuel.

Q. What’s so hard about finding a way to raise the octane level of unleaded fuel? Are there other properties that make avgas unique?

A. The octane number isn’t the only measure of a fuel’s suitability for aircraft use. Aviation fuel must be compatible with multiple fuel-system components and designs, and perform throughout a broad range of altitudes and temperatures. It

must have hot- and cold-start capabilities, and be compatible with all materials used in fuel systems including bladders, lines, and seals. Freeze points and distillation curves are among the myriad technical aspects required to ensure safe operation.

Q. AOPA has been aware of threats to leaded avgas for many years but seems to have been caught off guard by recent developments. Is AOPA on top of this issue?

A. AOPA has been closely monitoring this issue for decades and participating alongside the petroleum industry and engine



One chance

Finding the right solution to 100-octane



BY MICHAEL KRAFT
Senior vice president and
general manager,
Lycoming Engines

The U.S. Environmental Protection Agency, prompted by environmental concerns, has begun a process that may ultimately lead to leaded aviation gasoline elimination, today solely 100LL avgas. While the FAA has the ultimate authority on the outcome, uncertainty on the long-term fuel supply and a certain but unknown impact on aircraft owners add up to a critical topic.

We have a difficult problem to solve. We cannot hide under the bedsheets hoping an FAA flight safety determination will counter EPA findings. Leaded automotive gasoline has been removed from the market, leaving avgas as the single largest airborne lead emissions source.

The dialog that has ensued has not brought clarity. We operate piston aircraft ranging from the smallest and

newest experimental to older certified aircraft used in commercial operations. We are a diverse and passionate group that encompasses the globe, connected by a special fuel designed to enable global transport.

Competing voices and self-interests will not serve us well. Fragmentation of the community will place the future of piston-powered general aviation at risk.

Our focus must be on stabilizing the avgas fuel supply, with the realization that small volume and highly specialized production will only justify a single aviation-grade gasoline.

Fuels, engines, and airframes were jointly engineered to enable the aircraft performance we enjoy today. Avgas fuel design made safe commercial global transport via aircraft possible. Decades ago we engineered and deployed a fleet of aircraft designed around aviation

fuel—and it changed the world. The fuel included tetraethyl lead (TEL) to achieve high octane. Because fuel is part of the aircraft design, when you change a performance characteristic (octane) you risk changing the aircraft performance.

The truth is that if 100 motor octane number (MON) avgas were to drop six to nine octane to 91 to 94 MON unleaded avgas, approximately 25 percent of piston aircraft would no longer be able to perform their current missions. The affected group consumes an estimated 60 percent of the avgas produced. This group is most likely to consist of the operators we put forth to the public as the example of general aviation serving “essential services.” They would require



Avgas questions *continued*

and airframe manufacturers in the American Society for Testing and Materials and Coordinating Research Council, actively seeking a solution for the entire industry. We are still working to that end, now with the much-needed help and attention of the FAA and other industry leaders. We have joined forces to state that we need the FAA to lead a process that will fully evaluate and ultimately decide the best solution for the safety and wellbeing of the general aviation industry. We have been actively engaged with the EPA, FAA, and leaders in Congress, and we will remain focused on this critical issue.

Q. A new group of aircraft owners known as the Clean 100 Coalition has been formed to lobby on behalf of maintaining a minimum 100-octane aviation fuel. Does AOPA support this group, or its stated goals?

A. AOPA supports a process to evaluate all potential solutions and determine the best option for the industry as a whole. We encourage all fuel producers, engineers, chemists, or others to come forward with any potential replacement fuels so

that they may be fully evaluated as replacement options for 100LL. This evaluation must be done systematically and thoroughly with input from representatives of aircraft owners and operators, engine and aircraft manufacturers, FAA, EPA, and the petroleum industry so that we end up with a final product that is safe, producible, economical, and environmentally less harmful than leaded fuel. We will keep our members well informed throughout the process.

Q. AOPA has been working quietly to build consensus within the general aviation industry to find a way forward, but no consensus seems to exist. Why haven't aircraft owners and engine and airframe manufacturers agreed on a common solution?

A. A consensus does exist in that we all want a solution that will work for the entire industry. Until all alternatives have been evaluated, it is impossible to say what the final outcome should be. This highlights the importance of establishing a path that will determine the technical, economic, and environmental evaluation criteria and methods to be used.

major engine retrofits to avoid substantial reduction of aircraft capabilities. In some cases there would be no viable solution.

The other truth is that 75 percent of the fleet would see little performance impact from a drop to 91 MON unleaded. These aircraft, however, largely used for personal or recreational purposes, may also be affected in unanticipated ways.

The economic impact is driven by the legacy fleet. Lowering octane may force those who consume the majority of the avgas to park their aircraft. It is a cascading event scenario that would place even a new, lower-octane unleaded avgas supply at risk. This decision could cost aircraft owner-operators, FBOs, and related airport industries multiple billions of dollars.

Existing fleet performance, flight safety, and fuel demand are the reasons why Lycoming advocates focusing on 100-octane unleaded avgas. Ultimately, however, the choice is up to the owner-operators. This is not a decision to be left to equipment manufacturers and fuel producers.

The situation is not all doom and gloom. More than one company has shown that a 100-octane unleaded fuel is possible. Have they replicated the current ASTM D910 100LL avgas? No. Could we live with the consequences? Likely. Lycoming's position is that the largest downside will result from the performance impact of dropping octane. It is worth close examination to determine if we can compromise areas other than performance. We will need to compromise somewhere. Decades of research have shown that you cannot have it all.

Our weakness is that a community with a fractured opinion makes little case for investment or allocation of governmental or industrial budgetary resources toward a solution. This is why we need a consistent voice on the subject.

The industry associations have proposed a path from 100LL to an unleaded fuel. The approach would reduce airborne lead emissions in the near term and allow our industry time to logically transition to a new fuel standard. What is missing is the unified

voice from the owner-operators on what they are willing to sacrifice—and *fully funded* guidance and support from the FAA.

Lycoming is highly concerned that the effort needs to deliver 100 MON unleaded avgas or we risk breaking the back of piston general aviation. Our position is wrong if the owner-operators are willing to accept a dramatic overall decrease in aircraft performance and the higher costs that will likely come with lower demand for piston aviation fuel and services.

The decision on the path forward must come from those who have the greatest stake in this: owners and operators.

We urge you to write to your associations and your governmental representatives. Ask for their support of a logical transition plan. Ask them to fund an FAA mandate to support this issue. Tell them 100-octane unleaded aviation fuel is important for everyone.

A good solution will not happen without your voices being heard. We have one chance to get this right. **AOPA**

Q. We've heard about some promising developments involving Swift Enterprises and GAMI and their high-octane, unleaded avgas replacements. Why isn't AOPA promoting one, or both, of them?

A. AOPA encourages all companies with potential solutions to provide data so that they can be fully evaluated. At this time, it is premature to endorse any one solution.

Q. When leaded car gas went away, automobile manufacturers found creative ways to use computerized, electronic controls to boost engine performance and reliability. Have aircraft engine manufacturers developed similar technologies to allow piston aircraft engines to perform reliably on a variety of fuels?

A. Aircraft engine manufacturers have been developing improvements to engine performance and controls. Although these systems can be integrated into newly manufactured engines, it is a greater challenge to retrofit them on existing engines. AOPA encourages manufacturers to consider systems that lead to easier and more efficient operations of aircraft engines.

Q. Is AOPA working with the FAA to come up with a streamlined certification process that will allow my airplane to fly on unleaded fuel in the future, without recertification or costly STCs? Has AOPA found a way to get electronic engine controls into the fleet without going through the typically cumbersome, expensive, and slow FAA bureaucracy?

A. AOPA is working with the FAA and Congress to ensure that the path and resources are in place to address the certification issues that will arise as we transition to a new fuel.

Interested in more on the avgas transition? Look for special editions of the AOPA ePilot e-mail newsletter on avgas in your e-mail box starting in early September.

If you would like more answers to questions concerning AOPA's position on finding a replacement for 100-octane fuel or other information, visit the website (www.aopa.org/whatsnew/reglead).

(E-mail the author at rob.hackman@aopa.org).

AOPA