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March 17, 2008

Air and Radiation Docket
Environmental Protection Agency
Mailcode: 6102T
1200 Pennsylvania Ave., NW
Washington, DC 20460
Attention Docket ID No. OAR-2007-0294

Re: Docket No. OAR-2007-0294 Petition Requesting Rulemaking To Limit Lead Emission from General Aviation Aircraft; Request for Comments

The Aircraft Owners and Pilots Association (AOPA) is a not-for-profit individual membership organization of more than 415,000 pilots. AOPA's mission is to effectively serve the interests and needs of its members as aircraft owners and pilots to establish, maintain, and articulate positions of leadership to promote the economy, safety, utility, and popularity of flight in general aviation aircraft. Representing two thirds of all pilots in the United States, AOPA is the largest civil aviation organization in the world.

On November 16, 2007, the Environmental Protection Agency (EPA) issued a notice of petition for rulemaking titled "Petition Requesting Rulemaking to Limit Lead Emission from General Aviation Aircraft." Through this petition the EPA is seeking information on general aviation's use of leaded gas.

AOPA has a long history of involvement in issues surrounding aviation fuels and has worked with the Federal Aviation Administration's (FAA) William J. Hughes Technical Center, the Coordinating Research Council's (CRC) Unleaded Avgas Development and Aviation Engine Octane Rating subcommittees and the American Society for Testing and Materials (ASTM) to find a suitable and safe alternative to the current leaded fuel used in piston-powered general aviation aircraft. The comments provided below reflect experience in addressing aviation fuel issues.

General aviation piston aircraft are reliant upon the use of 100 octane leaded aviation gasoline (100LL avgas). Currently, there is no simple alternative for 100LL avgas. Any change in the current fuel standard will have a direct impact on the safety of flight and therefore must be fully tested and FAA approved before any operational changes occur.

Any change in the fuel used by general aviation aircraft must be compatible with all existing and new piston-powered aircraft.

General Aviation Important Part of U.S. Aviation System

Pilots flying in the United States experience first hand the safest and most efficient air transportation system in the world. The network of 5,200 public use airports, complemented by the more than 13,000 privately owned landing facilities is a unique national resource. General aviation includes business and personal transportation and the use of aircraft from a two seat piston-engine propeller aircraft to a large business jet.

General aviation aircraft are involved in all civilian flight-training operations, including that done at the collegiate level, medical evacuation and medical transport flights, law enforcement and firefighting operations, wildlife surveying and agricultural operations. General aviation is also an integral part of the air transportation system that supports communities across the United States. General aviation provides communities with essential air travel options that allow businesses to operate more effectively and efficiently.

General aviation aircraft are as varied as general aviation operations. An overwhelming majority of the 220,000 aircraft that make up the U.S. fleet are piston-powered and operate in the general aviation flight environment. A typical piston-powered general aviation aircraft is the Cessna 172, which has four seats, one engine, a 115 mph maneuvering speed and a maximum weight of 2200 pounds. While the Cessna 172 is a typical general aviation aircraft, the fleet varies widely in aircraft size and capacities.

A majority of the 167,000 piston-powered aircraft registered in the United States are certified by the FAA to fly on a leaded fuel.

General aviation comprises the vast majority of total aircraft operations in the U.S. According to the FAA:

- General aviation constitutes over fifty percent of the flying done in the U.S. and almost eighty percent of all U.S. departures.
- An estimated 70 percent of all general aviation flight hours are conducted for business transportation.
- General aviation transports approximately 166 million passengers annually.

General Aviation's Impact on the Economy

General aviation has a substantial positive impact on the U.S. economy. The direct and indirect effect of general aviation on the national economy exceeds $150 billion annually.[1]

Activities related to general aviation account for over 1.3 million U.S. jobs. The annual earnings of these employees are over $53 billion. Economic activity within the general aviation arena includes the purchases of fuel, maintenance services, aircraft and related manufacturing and piloting services. Those employed by the general aviation industry work as pilots, flight instructors, mechanics, line workers and aircraft refuelers, avionics technicians, aircraft salespersons and manufacturers.

Lead is Needed in Aviation Fuel

The two main types of fuel used in aviation are Jet A and 100LL. Jet A is a kerosene-based fuel that powers jet aircraft. 100LL (spoken "100 low lead") is a 100-octane rated fuel that contains up to 2.2 grams of lead, sourced from tetra ethyl lead, or TEL, per gallon of fuel. Lead is used to boost the octane of the fuel used in piston-powered aircraft.

The use of a leaded fuel in high compression aircraft engines ensures safe flight. Lead protects aircraft engines against detonation, which can cause an engine to literally tear itself apart during operation. Lead also protects engine components against the long-term damage caused by high pressures and wear brought about through normal engine usage.

In the 1930's the U.S. military first used leaded fuel in aircraft. Research showed that lead successfully increased octane, which allowed the use of higher compression engines that produced more horsepower and advanced capabilities of aircraft. Specifically, lead controlled detonation in high compression engines; due to the audible sound that detonation produces, it is commonly referred to as "knock."

Knock is a serious engine condition that is caused when the fuel-air mixture necessary for combustion explodes too soon in the combustion process. This premature explosion causes a loss of engine power and serious damage to the aircraft engine. In severe instances of knock the engine literally tears itself apart. In flight, knock can result in engine failure and an accident or, at best, a successful off-airport landing. Additionally,

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[1] Allen, W. Bruce, PhD. Blond, David L., PhD. Gellman, Aaron J., PhD. "General Aviation's Contribution to the U.S. Economy" May 2006. Feb. 25 2008 <http://www.gama.aero/PUBLIC/GAcontribution.pdf>

high-octane leaded fuel also protects engine pistons and cylinders from wear and burns cleaner than lower octane fuels.

Because TEL has successfully provided the desired benefits listed above and increased engine reliability and safety of flight, it has continued to be used in avgas. Even today's new aircraft are designed around engines relying on 100LL.

Previous Move to Lower Lead Fuel

Before 100LL came on the market, the primary type of avgas for piston-powered general aviation aircraft was 130 (130 octane, leaded fuel). Avgas 130 contained approximately four grams of lead per gallon. As concerns about the use of leaded fuels grew in the U.S. the aviation industry transitioned to 100LL in the1970's. 100LL contains approximately two grams of lead per gallon or half the lead contained in avgas 130. The transition from 130 to 100LL decreased the amount of lead used in aviation fuel while still providing protection against knock and enough horsepower for aircraft to meet the published power outputs and range estimates as certified by the FAA.

Industry Research Identifies Significant Issues with Removing Lead from Avgas

Experts within the general aviation community often refer to the "70/30" split. This split refers to the percentage of the general aviation fleet that could run on a fuel with an octane rating less than that offered by 100LL.

It is estimated that 70 percent of the general aviation fleet could run on a lower octane achieved without adding lead. Many low compression engines used in general aviation aircraft can operate on similar standard to mogas, short for automotive gas, which has a lower octane rating than 100LL.

However, the remaining 30 percent of the fleet **would be unable to safely operate on a fuel with an octane rating less than that currently provided in 100LL** without modifications and/or detrimental performance and utility penalties. This 30 percent represents the highest performance aircraft in the fleet. It is estimated that this portion of the fleet burns about 70 percent of the avgas. Avgas consumption by this portion of the fleet is estimated to be high for two reasons: these aircraft burn more fuel per hour of operation than aircraft with smaller compression engines and these aircraft are employed in business transport and long haul trips more often than aircraft with smaller engines.

AOPA Supports Ongoing Alternate Fuels Research

AOPA has and continues to work with petroleum producers, researchers and other interested parties to review and develop alternative fuels. This cooperative research effort, conducted under the auspices of the Coordinating Research Council (CRC), shows the most promise for ultimately producing an unleaded replacement for 100LL that requires minimal modification to the existing piston-powered fleet.

The CRC is a group of more than 50 experts from more than 30 companies, representing airframe, engine, and component manufacturers, as well as the FAA, AOPA, universities and industry trade organizations. The panel has been working on a regular basis to exchange ideas and hopefully come up with a transparent solution to replace 100LL. The majority of the CRC's work has been on testing an unleaded fuel that can provide the same octane level as 100LL. The CRC has looked at and reviewed the fuels and technology below as possible replacements for 100LL:

- High-octane unleaded replacement fuels that use additives other than TEL.
- 91/96 octane unleaded fuel as a replacement fuel for engines that can currently run on auto fuel.
- Ignition timing control devices necessary to burn an alternate fuel.
- Diesel.

The aviation industry has been working on a lead free avgas solution since the 1990's. In addition to the testing done by the major oil companies, fuels testing research has been completed at the FAA's William J. Hughes Technical Center. AOPA has, and will continue to, seek funding of the FAA Technical Center for the purposes of fuel and engine technology testing.

In 2007, the U.S. House of Representatives passed H.R. 2881 which included an AOPA supported provision on that would require the FAA to research an economically viable alternative to leaded avgas that could satisfy the needs of the entire existing general aviation piston-engine fleet. The budget request for FY09 recently submitted by the FAA includes a request for funding research on an unleaded replacement to 100LL.

In order for a fuel to be legally used in an FAA type certificated aircraft it must conform to a standard set by ASTM. AOPA is a member of the petroleum standards development group of ASTM and works to ensure that ASTM includes standards for all current and future aviation fuels. AOPA supported the reinstitution of the 91-octane unleaded avgas standard into the ASTM avgas specification. This specification is an unleaded fuel standard that can be used for testing the performance of an unleaded fuel on aircraft engines of different sizes.

Use of Automotive Fuel Presents Major Challenges

Aircraft and aircraft engines are individually certified by the FAA to operate on fuel that meets the standards set forth by the ASTM. The fuel standards set for aviation fuels are very strict and provide for little variability across refineries. The ASTM standards on mogas do allow for some variation and the addition of additives. These variations can occur from refinery to refinery or across different regions of the country.

Even with the variations in mogas, some aircraft with low compression engines do have FAA permission to run on mogas. These low compression aircraft engines do not need the knock protection offered by 100LL and have an FAA issued supplemental type certificate (STC) to operate on mogas.

Mogas STCs specifically state that the fuel used in aircraft *cannot* contain Ethanol. The increasing use of Ethanol in automotive fuel is making it very difficult for aircraft authorized to operate on auto fuel to find a safe supply of fuel. It is currently estimated that 51 percent of all automotive gas contains Ethanol. This percentage is expected to increase under future government mandates.

In 2006 the FAA issued a special airworthiness information bulletin (SAIB) that addressed the use of Ethanol as a fuel additive and its affect on aircraft approved to use an auto fuel STC.

The SAIB states that automobile gasoline containing alcohol is not allowed to be used in aircraft for the following reasons:

- The addition of alcohol to automobile gasoline adversely affects the volatility of the fuel, which could cause vapor lock.
- Alcohol present in automobile gasoline is corrosive and not compatible with the rubber seals and other materials used in aircraft, which could lead to fuel system deterioration and malfunction.
- Alcohol present in automobile gasoline is subject to phase separation, which happens when the fuel is cooled as a result of the aircraft's climbing to higher altitude. When the alcohol separates from the gasoline, it may carry water that has been held in solution and that cannot be handled by the sediment bowl.
- Alcohol present in automobile gasoline reduces the energy content of the fuel. Methanol has approximately 55 percent of the energy content of gasoline, and ethanol has approximately 73 percent of the energy content of automobile gasoline. The greater the amount of alcohol in the automobile gasoline, the greater the reduction in the aircraft's range.[2]

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[2] Rouse, Peter L. Special Airworthiness Information Bulletin CE-07-06. Federal Aviation Administration October 27, 2006. March 5, 2008 <
http://rgl.faa.gov/Regulatory_and_Guidance_Library/rgSAIB.nsf/dc7bd4f27e5f107486257221005f069d/6f3250f958b6a22286257259006d6dab/$FILE/CE-07-06.pdf>

This guidance underscores the importance of having the correct, Ethanol free, fuel available. To help ensure the correct fuel is available to pilots who operate on an auto fuel STC many states have exempted high-octane rated auto fuel from Ethanol mandates.

Ethanol is Not a Suitable Replacement Fuel

Using pure Ethanol as a sole replacement fuel has been suggested and researched as an alternative fuel for piston-powered aircraft. Despite claims made by proponents of Ethanol, the general aviation industry has significant concerns about Ethanol's use in aviation.

Research has shown that pure Ethanol would introduce numerous serious safety concerns into the general aviation fleet. In 2002, Cessna highlighted concerns regarding ethanol-based fuels. These concerns are similar to those previously addressed for mogas that contains ethanol.

Finally ethanol also decreases the range of an aircraft. An aircraft running on pure Ethanol would not be able to fly as far as an aircraft using avgas.

Engine Modifications Required by Existing Aircraft to Burn an Unleaded Fuel

FAA approval is required for all aircraft engine modifications, including a change in the fuel used. Unlike the auto industry, which can implement engine design changes very quickly, the aviation industry must go through the time and expense of obtaining FAA approval on all design modifications. This slows, if not discourages progressive changes such as engine combustion chamber improvements and sophisticated ignition units and fuel metering systems that would be required on new and existing aircraft should the industry transition to a fuel other than 100LL.

Engine modifications required for existing aircraft to burn an unleaded fuel would typically be obtained through the STC process. STCs allow a company or individual to legally make modifications to aircraft after receiving FAA approval. Individuals who wish to apply for an STC can so do without involving the aircraft manufacturer. STC modifications undergo FAA review and receive FAA approval before being installed on aircraft. Because it affects safety, the FAA approval process for an STC takes time and is not easily navigated by many STC applicants. Additionally, because many STCs are held by individuals and address very specific issues on a small set of aircraft it is anticipated that multiple STCs would be needed to address the needs of the current fleet.

Replacement Fuel Must Work For All

A suitable unleaded replacement fuel is one that can be used in *<u>all</u>* existing and new piston-powered general aviation aircraft. AOPA understands that for a small percentage of aircraft this may require engine and airframe modifications.

Any transition plan must include adequate time for the aviation and petroleum industries to select the appropriate fuel octane and for any necessary aircraft modifications to be accessed and addressed.

For a replacement fuel to be viable it will also have to be a single source replacement. Aviation fuel makes up only a quarter of a percent (0.25%) of all petroleum products in the U.S. and is considered a specialty fuel. Due to the very low volume of avgas produced, manufacturers and some aviation fuel retailers have stated that they will not produce or sell multiple fuels for general aviation.

A solution that includes more than one fuel would have a direct negative affect on airport infrastructure. Additional storage and pumping facilities would have to be installed at airports to accommodate an additional fuel. Adding an additional fuel would also increase the chance of a misfueling, which occurs when the wrong fuel is put into an aircraft.

For safety and supply reasons AOPA strongly supports a single fuel solution that can be used on new and existing aircraft.

General Aviation Has Decreased its Fuel Use

The Department of Energy (DOE) and the FAA both keep statistics on the amount of avgas consumed. The DOE statistics reflect actual sales of avgas and the FAA statistics are based on flight time. Both departments' statistics show a decline in the consumption of avgas. In May 2007, the DOE avgas consumption numbers were the lowest on DOE record since 1983.

According to the FAA avgas (100LL) consumption has been declining for at least the years between 2000 and 2005 (last number for which actual data is available). During this period avgas consumption declined by almost four percent (3.9%). Past FAA forecasts regarding the consumption of avgas foreshadowed more robust usage than the actual consumption numbers revealed. This resulted in revised forecasts that adjusted the fuel consumption numbers downward. To get a prospective on the volume of avgas used, compare the *annual* consumption of avgas listed in the table below to the *daily* consumption of car gasoline in America, estimated at 388 million gallons a day. [3] The U.S. uses more car gasoline in one day than general aviation uses of avgas in one year.

[3] "Basic Petroleum Statistics" *Energy Information Administration* March 2008. 11 March 2008 < http://www.eia.doe.gov/basics/quickoil.html >

General Aviation Aircraft Fuel Consumption
(In Millions of Gallons)

Calendar Year	Total Avgas Fuel Consumption [4]
2000	332.8
2001	279.2
2002	276.7
2003	272.4
2004	272.9
2005	255.4
2006E	262.2
Average Annual Growth	**-3.9%**
2020 (Forecast)	301.2

Decreased avgas consumption has not resulted in a corresponding decrease in avgas prices. A poll of over 3,500 fixed based operators (FBOs), aviation fuel retailers nationwide showed that the average cost of 100LL is $4.71 per gallon with a minimum cost of $3.00 per gallon and a maximum cost of $7.81 per gallon. [5]

Proper Fuel Straining Practices

Aircraft fuel is strained before each flight, per the aircraft manufacturer's recommendations, and visually inspected for contaminations such as water and debris. The overwhelming majority of fuel samples are clean and can be added directly back into the aircraft's fuel tanks. In the rare event that the fuel sample is contaminated it must be discarded. Many airports clearly outline the acceptable fuel disposal practices for contaminated avgas. These practices generally include the use of a common fuel waste system or disposal bucket that is available to all pilots.

FAA Should Lead the Way

As the aviation regulator, the FAA should lead any efforts to change the fuel currently used in general aviation. In January 2008, the FAA announced plans to study aviation's affect on the environment and draft a plan to combat any negative effects. The plan is five-pronged and begins with increasing the basic understanding of the extent and nature

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[4] "General Aviation Aircraft Fuel Consumption" *FAA Aerospace Forecasts FY 2007-2020* March 2007. Feb 21 2008 <http://www.faa.gov/data_statistics/aviation/aerospace_forecasts/2007-2020/media/Web%20GA%2007%20Tab.xls>

[5] "Fuel Price Report" *AirNav* 25 Feb. 2008. 25 Feb. 2008 <http://www.airnav.com/fuel/report.html>

of aviation's effect on the environment. Subsequent steps of the FAA's plan include working with industry to development an environmentally friendly aircraft and increasing research on alternative fuels. AOPA will work with the FAA to ensure any change in the fuel standard maintains the current level of safety.

The EPA's efforts should not duplicate what the FAA is already planning on doing as part of this study and, because the FAA is ultimately responsible for the safety of flight. The EPA should follow the FAA's lead with regard to any fuel or aircraft system changes that would effect piston-powered aircraft's reliance on a leaded fuel.

Summary

Getting the lead out of aviation fuel is not a simple, straightforward process. The aviation industry has been researching a lead free fuel option, which ensures the safety of the aviation industry including its aircraft, pilots and passengers, since the 1990's.

A change in the fuel used in general aviation could affect aviation safety, fuel supply and the $150 billion general aviation industry. For these reasons AOPA believes that any change must be fully tested before being introduced into the industry. Additionally, any replacement must be compatible with new and existing piston aircraft engines and technology.

Sincerely,

Andrew V. Cebula
Executive Vice President
Government Affairs