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Leads Continued Use In Avgas

Pasquale J. Storino

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A glimpse as to why piston powered airplanes still use leaded fuel, how the leaded fuel used in these airplanes escaped environmental regulations eliminating the use of lead in automotive gasoline, and the future of the fuel used by these piston powered airplanes.

Pasquale Storino

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I. Intro

A Brief History of Lead's Use

According to the EPA, lead is a naturally occurring toxic substance found in the earth, which can cause health effects in humans.[1] Even though lead is naturally occurring, most exposure stems from human activities resulting in lead particulates being released into the environment.[2] Lead has been used since the Romans for a variety of purposes including plumbing, the making of ceramic pottery, the paint used inside of our homes, ammunition, and as an additive to fuels.[3] Even though lead has been banned in paint since 1978[4] and completely phased out of gasoline since 1996[5], it continues to be a problem. Older homes may still contain lead based paint, which as it deteriorates emits lead particulates into the environment, products from foreign countries without strict controls on manufacturing processes occasionally still contain lead, and some types of aviation fuels still burn and emit small amounts of lead.[6][7] Some of the major former sources of lead exposure and poisoning in humans were lead being used in automotive gasoline resulting in particulate matter being released into the environment, household paint including lead in it deteriorating, and the widespread use of plumbing

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[1] U.S. EPA, Learn about Lead, http://www2.epa.gov/lead/learn-about-lead#lead (last updated July 22, 2013).
[2] *Id.*
[3] Jack Lewis, EPA Journal (May 1985), http://www2.epa.gov/aboutepa/lead-poisoning-historical-perspective.
[4] U.S. EPA, Lead: Protect Your Family, http://www2.epa.gov/lead/protect-your-family#sl-home (last updated November 4, 2013).
[5] U.S. EPA, Leaded Gas Phaseout Air Quality Fact Sheet (June 1995), http://yosemite.epa.gov/R10/airpage.nsf/webpage/Leaded+Gas+Phaseout.
[6] Lead: Protect Your Family
[7] U.S. EPA, Lead in Outdoor Air, http://www2.epa.gov/lead/lead-outdoor-air (last updated February 14, 2013).

manufactured with lead leading to trace amounts ending up in drinking water.[8] The burning of lead fuels in automobiles and heavy industry leads to its release in the air as particulate matter, where it may travel before settling into the ground and remaining there attached to soil or seeping into and contaminating groundwater.[9]

The lead used in automotive fuels was called tetraethyl lead and the start of its use as an additive in fuel began during the 1920's[10]. Use of tetraethyl lead in gasoline can be credited to engineers working for General Motors, who discovered it in 1921 while searching for an additive to the fuel used in their engines that would help to reduce engine knock.[11] However the discovery of tetraethyl lead and its heavy usage during the 1900's was not without trouble and incidents. Notably, the engineer responsible for discovering tetraethyl lead's beneficial effects on engine knock, Thomas Midgley, Jr. was forced to take a year's break from his work due to lung problems, which later were associated with lead poisoning.[12] [13] His were not the only health related issues during the 1920's due to exposure to high amounts of tetraethyl lead. Standard Oil's Bayway Refinery building which manufactured leaded gas during the time period became known as the "looney gas building," due to the hallucinations and other ill effects felt by employees of the plant.[14] After several deaths of those handling lead at the plant during this time period the New York City Board of Health, the State of New Jersey, and the City of Philadelphia all banned the sale of gasoline containing tetraethyl lead for a short period, due to the suspected

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[8] Lewis
[9] Learn about Lead
[10] Lewis
[11] Jamie Lincoln Kitman, The Secret History of Lead, The Nation (March 2, 2000), http://www.thenation.com/article/secret-history-lead?page=full#.
[12] *Id.*
[13] Lewis
[14] Kitman

ill effects of lead.[15] Yet, Midgley and other engineers and scientists working for General Motors were unrelenting and ensured the Federal Government lead's health effects were not serious. After review by the Surgeon General, Public Health Service, and Bureau of Mines tetraethyl lead was found to be safe and the ban's on leaded gasoline were overturned.[16] [17]

The use of lead in gasoline was important for various reasons. It acted as an inexpensive octane booster and reduced wear and tear on certain engine components such as valves. By mixing tetraethyl lead into gasoline the octane rating (the number next to the gas at the pump, such as 87 or 91) was raised, improving the engines combustion, increasing power output, and reducing engine knock. [18] The use of tetraethyl lead was also extremely important when used in early high-powered piston aircraft engines, which were the only type of the day.[19] Theses engines needed enormous amounts of power to fly, which in turn required high octane fuels and the easiest way to attain these high octane ratings was through the use of adding tetraethyl lead into their gasoline.[20]

The use of tetraethyl lead as an additive to fuels was considered the norm throughout most of the 20th century, until its harmful side effects became apparent throughout the country beginning in the early 1970's.[21] The greatest concern regarding lead in the environment are the health effects on humans exposed to it. Children and pregnant woman often suffer the most

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[15] *Id.*
[16] *Id.*
[17] Lewis
[18] Kitman
[19] U.S. FAA, Unleaded AVGAS Findings & Recommendations, FAA UAT ARC Final Report Part I Body (February 17, 2012), https://www.faa.gov/regulations_policies/rulemaking/committees/documents/media/Avgas.ARC.RR.2.17.12.pdf.
[20] *Id.*
[21] Lewis

severe effect from lead poisoning, but lead also has adverse effects on healthy adults and animals.[22] Lead poisoning is rarely seen as a single high dose, but instead as a gradual poisoning caused by constant exposure through small amounts in the environment.[23] Lead poisoning manifests itself by causing damage to the nervous system, resulting in brain damage, reduced growth in unborn babies and children, and other neurological ailments, lead can also cause cardiovascular problems.[24] Lead has a tendency to effect children to a much great extent than adults because of their tendency to place fingers or foreign objects in their mouth's increasing their likelihood of ingesting lead particulates and due to their rapidly growing bodies and central nervous system, which make the effects of lead more pronounced often leaving life long consequences for children who are exposed.[25] While the health concerns from lead in children aren't talked about nearly as much as they were during the 1970's and 1980's, lead poisoning remains a large problem for many children. The Centers for Disease Control reduced the blood lead "reference value" at which intervention is recommended by half to 5 μg/dL in the spring of 2012, with an estimated 450,000 children having blood lead levels above that reference value in the United States.[26]

The regulation of this toxin has been very effective in reducing the levels of lead found in the blood of children, which can be measured decreasing alongside the amount of lead found in the environment. Today, the average level of lead found in the blood of children in the United

[22] Learn about Lead
[23] U.S. Nat'l Library of Medicine, Lead Poisoning, MedicinePlus, shttp://www.nlm.nih.gov/medlineplus/ency/article/002473.htm (last updated October 31, 2013).
[24] Learn about Lead
[25] Lead Poisoning
[26] CDC Response to Advisory Committee on Childhood Lead Poisoning Prevention Recommendation in "*Low Level Lead Exposure Harms Children: A Renewed Call of Primary* Prevention", http://www.cdc.gov/nceh/lead/acclpp/cdc_response_lead_exposure_recs.pdf (last visited November 30, 2013).

States is 1.2 μg/dL, down from 15 μg/dL between 1976 and 1980.[27] [28] The regulation of lead in household products began to gain traction in 1978 with the banning of lead from residential housing paint, followed by plumbing nine years later in 1986, and eventually from the solder used in food cans in 1995.[29] While lead was banned outright in these products, the Clean Air Act required levels of particulates in the air including lead to be reduced, eventually leading to lead being phased out of automotive gasoline by 1996 and metal-processing facilities having to enact tighter controls on their emissions of lead particulates.[30] These controls reduced the amount of lead in the atmosphere by 98% between 1970 and the end of lead in automotive gasoline in 1996.[31] By removing the largest source of lead pollution, automotive exhaust, the Clean Air Act has had an enormous effect in reducing human exposure to lead and incidences of lead poisoning by directly reducing the amount of lead in the environment. Below are two charts showing lead emissions from the 1920's through the 1990's and how regulation, specifically the Clean Air Act phasing lead out of gasoline, greatly reduced lead emissions. [32] [33]

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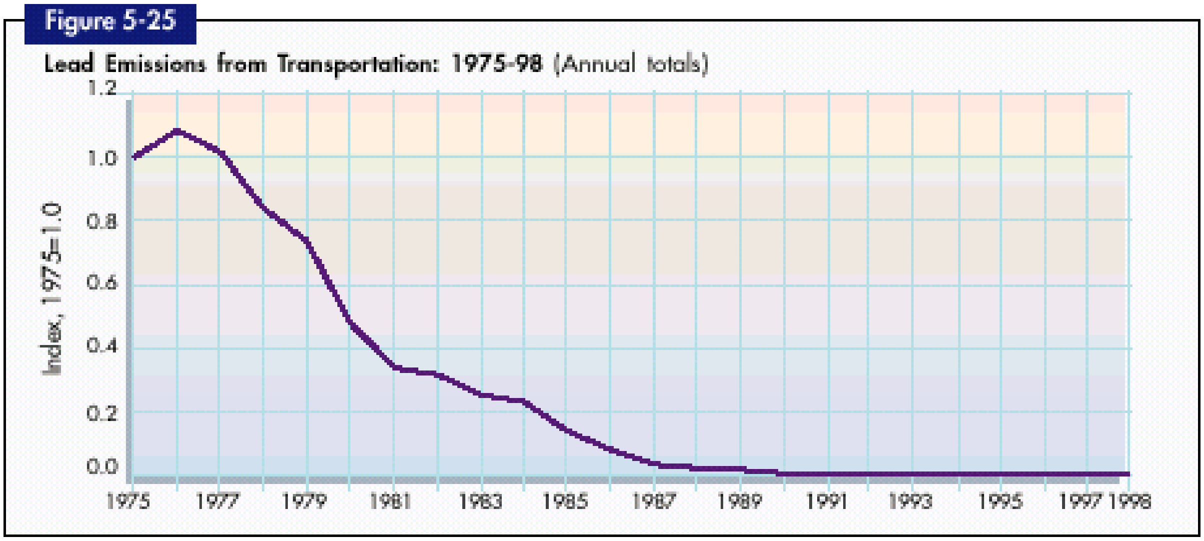
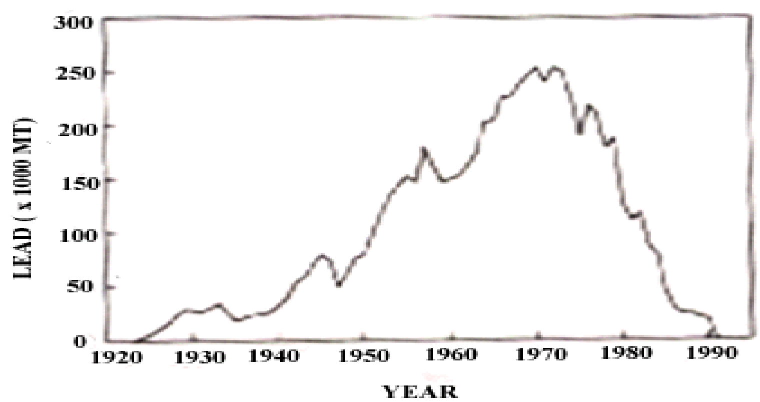
[27] Rebecca Kessler, Sunset for Leaded Aviation Gasoline?, Environmental Health Perspectives (February 2013), http://ehp.niehs.nih.gov/121-a54/.
[28] U.S. EPA, Nat'l Air Pollutant Emission Trends, 1900-1998 (March 2000), http://www.epa.gov/ttn/chief/trends/trends98/trends98.pdf.
[29] U.S. EPA, Lead In Your Home: A Parent's Reference Guide (June 1998), http://www2.epa.gov/sites/production/files/documents/leadrev.pdf.
[30] Kessler
[31] Nat'l Air Pollutant Emission Trends
[32] U.S. Dept. of Transportation, Research and Innovative Technology Admin., Bureau of Transportation Statistics, Lead Emissions from Transportation: 1975-98 http://www.rita.dot.gov/bts/sites/rita.dot.gov.bts/files/publications/the_changing_face_of_transportation/html/figure_05_25.html (last updated June 28, 2000).
[33] Patterns of Lead Emission and Deposition, http://www.yale.edu/fes519b/pitchpine/consumption.html (last visited November 17, 2013).





General Aviation and Its' Use of Leaded Fuel

Even though lead is no longer used in automotive gasoline due to the Clean Air Act, parts of the aviation community still use a leaded gasoline called 100LL (low lead) more commonly known as "avgas."[34] Avgas is similar to the gasoline pumped into our cars, except it has a higher

[34] Shell Global, AVGAS Grades and Specifications, http://www.shell.com/global/products-services/solutions-for-businesses/aviation/shell-aviation-fuels/fuels/types/avgas.html (last visited November 5, 2013).

octane rating of 100 and contains low amounts of lead (1.2-2 grams per gallon).[35] Avgas is not used by jet engines or turboprops, which instead use jet fuel, a derivative of kerosene.[36] Avgas is used mostly in the general aviation world and only by piston-powered aircraft. These airplanes are powered by engines similar to the ones found inside cars, which turn a propeller instead of wheels. Piston powered aircraft are not just small single engine airplanes used for recreation such as Cessna's, piston engines are also used on larger multi engine airplanes flying commercial operations for cargo companies and business.[37]

While the general public is only aware of aviation as big airports scattered across the country served by five or six major airlines, the aviation industry includes far more than the major airlines. "General aviation" refers to the aviation industry apart from the scheduled airlines. This includes everything from the corporate executive flying on private jets to bush pilots flying single seat Piper's to deliver supplies in remote parts of Alaska.[38] Avgas is still widely used in this part of the aviation community. In fact, approximately 167,000 piston engine aircraft in the United States use avgas, which amounts to 73% of the country's general aviation fleet.[39] Unlike cars, only approximately 900 new piston powered aircraft enter the fleet each year. This portion of the general aviation fleet is used for a variety of purposes, of which over 2/3 of the flight hours flown are business related.[40] These flights operate in a variety of places

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[35] Experimental Aircraft Ass'n., Avgas Specifications US Military and Commercial Specifications, http://www.eaa.org/autofuel/avgas/avgas_specs.asp (last visited November 5, 2013).
[36] U.S. Fed. Aviation Admin., Pilot's Handbook of Aeronautical Knowledge (2008), http://www.faa.gov/regulations_policies/handbooks_manuals/aviation/pilot_handbook/media/PHAK%20-%20Chapter%2006.pdf.
[37] Unleaded AVGAS Findings & Recommendations
[38] General Aviation Manufacturers Ass'n, What is GA?, http://gama.aero/what-ga (last visited November 5, 2013).
[39] Unleaded AVGAS Findings & Recommendations
[40] *Id.*

across the country, not just to larger cities as the commercial airlines. The general aviation fleet makes use of the 5,261 public use airports and over 11,500 privately owned landing strips throughout the country, creating a lifeline to rural corners of the country otherwise not easily accessible.[41]

General aviation serves a wide variety of purposes. It creates many jobs across all of these airports and provides extremely critical services to many areas by utilizing these landing strips.[42] Some of these services include medical transportation, freight and transportation services for businesses located in rural areas, vital supplies for these communities, and a needed link in the event of a natural disaster or other emergency.[43] Without these general aviation airports and services, many portions of the country, especially Alaska, would be inaccessible in "time critical" situations. The general aviation industry also continues to manufacturer and design airplanes, avionics, and other aircraft parts in this country from business jets to single engine piston planes creating many high-skill jobs and contributing over $150B to the US economy.[44] [45] General aviation is also the training ground for our commercial and military pilots, who learn to fly on piston powered aircraft and often work within the general aviation industry flying piston powered aircraft to build experience before moving on to turbine aircraft and flying for the airlines or military.[46]

To fully understand the history of avgas and its' continued use as a necessary fuel today, we must look at the history of airplanes. Aviation was just beginning to take off in the early

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[41] *Id.*
[42] *Id.*
[43] *Id.*
[44] General Aviation Manufacturers Ass'n, General Aviation Statistical Databook & Industry Outlook (2010), http://gama.aero/files/GAMA_DATABOOK_2011_web.pdf.
[45] Unleaded AVGAS Findings & Recommendations
[46] *Id.*

twentieth century and as airplanes purpose shifted from a mere novelty they quickly became larger, heavy, and faster in response to the demand for them. These larger, faster planes needed more powerful engines in order to get off the ground and continue running at high speeds and altitudes and a fuel strong enough to power these engines.[47] Tetraethyl lead served this purpose. The high performance planes used during World Ward II needed extremely high-octane fuels and tetraethyl lead was used to help that fuel reach octane ratings of over 115 for these planes. The amount of lead used in gas to reach these high octane ratings was 4.6 grams per gallon, as opposed to the 1.2-2 grams/gal used for today's 100LL avgas.[48] After the War and through out the 1950's commercial aviation became increasingly popular and these first generation passenger planes were outfitted with large piston engines requiring high octane fuels containing large amounts of lead. During this time period at airports around the country there was frequently a selection of aviation fuels available, since aircraft with smaller engines did not need the high performance fuels larger aircraft did. Fuels were available with six different octane ratings from 73 all the way up to the 115 required for high performance commercial and military planes, some of these were leaded while other lower octane fuels were not.[49]

However, the 1960's brought change to the aviation industry as the world entered the "jet age."[50] These more modern planes used turbine engines, which relied upon kerosene jet fuel that does not contain lead.[51] In the 1970's, the Clean Air Act was enacted eventually requiring lead to be discontinued as an additive in automotive fuels by 1996.[52] The Clean Air Act however

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[47] *Id.*
[48] *Id.*
[49] *Id.*
[50] *Id.*
[51] *Id.*
[52] Leaded Gas Phaseout Air Quality Fact Sheet

separated and exempted aircraft emissions from the same lead regulations as automotive emissions were subject to, allowing for the continued use of tetraethyl lead in avgas.[53]

Avgas Today

During the time period when lead was beginning to be regulated in automotive fuels, between late 1970's and the early 1980's, the varying octane ratings of avgas were being consolidated.[54] The popularity of avgas as aviation's fuel of choice was declining by it's heaviest users due to the increased use of jet engines by the airlines and military. This decline made it unfeasible to continue to produce and supply the six octane ratings of aviation fuels available at the time, so a compromise was made.[55] That compromise resulted in only one type of avgas remaining on the market 100LL, the same avgas still available today. This compromise was not great for any one party, instead it was the best solution available in order to ensure a continuing supply to best meet the demands of those still needing avgas. The larger high performance planes still around and using avgas would be forced to make use of the fuel operating less optimally, lowering performance characteristics. On the other hand, smaller general aviation planes such as Cessna's would have to utilize a fuel having a higher octane rating then they were designed for leading to engine fouling.[56] The problem of avgas still containing lead today is largely a result of this. 100LL avgas is necessary in very few new high performance planes and historic planes, but for the remaining fleet of piston powered planes,

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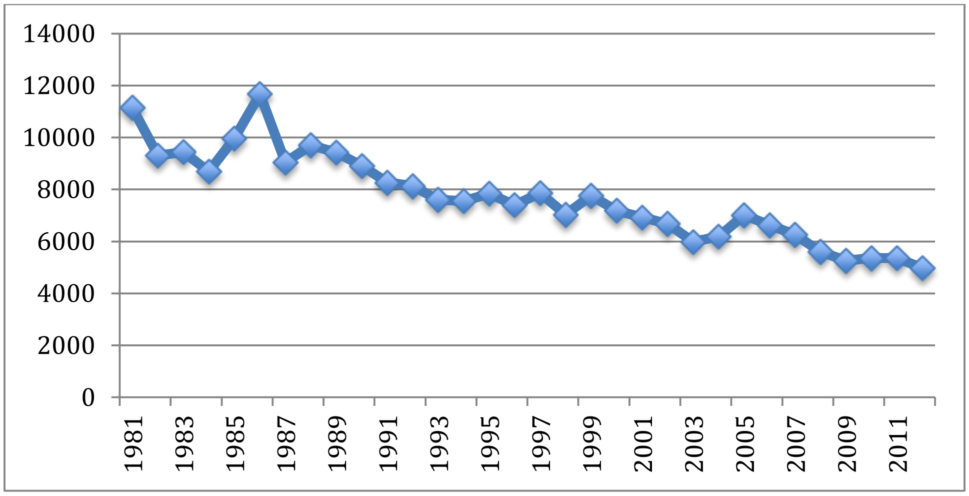
[53] U.S. EPA, Clean Air Act Title II – Emission Standards for Moving Sources, http://www.epa.gov/air/caa/title2.html (last updated August 15, 2013).
[54] Unleaded AVGAS Findings & Recommendations
[55] *Id.*
[56] *Id.*

around 70% of the fleet, this fuel's octane rating is excessive and they could fly on a lower octane or even unleaded fuels.[57]



58 Avgas Used In United States 1981-2012
(In Thousands of Barrels)
1981 = 11,147   2012 = 4,975

The high cost of avgas, it's average price is around $5.91 per gallon as of November 7, 2013,[59] and the heavy users of avgas retiring the older portions of their fleet that still use it in favor of turbine aircraft is leading to a greatly reduced demand for the fuel. As can be seen above the yearly use of avgas is down to about 4.975 million barrels a year from a high of 11.6 million barrels in 1986.[60] This is an extremely small amount of fuel being used by piston powered aircraft, especially when compared to the amount of gasoline used by cars in the United

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[57] David Freed, The Fight Over Avgas, Air & Space Magazine (August 2013) http://www.airspacemag.com/flight-today/The-Fight-Over-Avgas-215585091.html.
[58] U.S. Energy Info. Admin., U.S. Product Supplied of Aviation Gasoline, http://www.eia.gov/dnav/pet/hist/LeafHandler.ashx?n=PET&s=MGAUPUS1&f=A (last updated September 27, 2013).
[59] AirNav.com, Fuel Price Report, http://www.airnav.com/fuel/report.html (last updated November 7, 2013).
[60] U.S. Product Supplied of Aviation Gasoline

States, which consume a daily average of over 8.5 million barrels.[61] A big cause in this reduced demand is a reduced demand for piston-engine aircraft flying by the two distinct groups using these aircraft. The recreational pilots can no longer afford to fly as often as they once did, these pilot's who frequently rent or own their own planes and fly less than 100 hours per year are extremely sensitive to the price of avgas. To them an increase in the price of avgas directly leads to a lowered consumption of avgas.[62] The other group is made up of high utilization operators who generally fly their piston aircraft in commercial operations well over 300 hours a year. These operators fly larger usually multiengine aircraft and consume the majority of avgas produced.[63] While this group isn't as sensitive to price increases in fuel, their demand for avgas is decreasing as well as they replace their aging fleets with newer equipment that frequently runs on jet fuel.[64]

The Current Extent of Lead in the Environment

To understand if the continued use of lead in avgas is a legitimate health concern or a concern to the environment, the current and historical amounts of lead in the environment need to be compared. Lead in the environment takes the form of particulate matter and is measured in both parts per million and lead per cubic meter of air.[65] Natural levels of lead in soil range between 50 parts per million (ppm) and 400 ppm.[66] In 2008 the EPA established stricter standards designed to limit the amount of lead in ambient air. Over a three-month period, the

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[61] U.S. Energy Info. Admin., How much gasoline does the United States consume?, http://www.eia.gov/tools/faqs/faq.cfm?id=23&t=10 (last updated July 18, 2013).
[62] Unleaded AVGAS Findings & Recommendations
[63] *Id.*
[64] *Id.*
[65] U.S. EPA, Human Health and Lead, http://www.epa.gov/superfund/lead/health.htm (last updated November 25, 2013).
[66] Human Health and Lead

average concentration of lead (as measured in total suspended particles) cannot be greater than 0.15 micrograms of lead per cubic meter of air (0.15 µg/m3).[67] When looking at the current sources of lead emissions in the United States, lead coming from the tetraethyl lead additives used in avgas is overwhelmingly the largest contributor at 45%, followed by heavy industry at 37%.[68] The heavy industry contributing to lead emissions is mostly ore and metals processing facilities.[69] The chart on the next page shows a breakdown of where lead emissions come from.[70] In 2008 piston powered aircraft created 571 tons of lead emissions, while industrial processes and electric generation created around 308 tons of lead emission.[71] However when looking at the leading individual facility producers of lead, airports do not appear in the top 50 lead producers in the nation.[72] Today, the highest levels of lead in air are found near lead smelters and ore processing facilities. This leads to the belief that while aircraft emissions are the largest producers of lead emissions, they are not causing nearly as much pollution as other sources because there use is mobile and spread throughout the entire country, rather than concentrated in a few select areas as heavy industry is.

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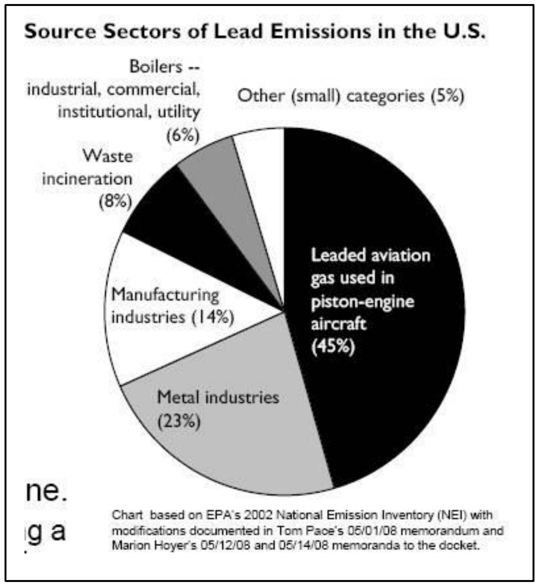
[67] Human Health and Lead
[68] Kessler
[69] U.S. EPA, Lead in Air, http://epa.gov/airquality/lead/ (last updated April 12, 2013).
[70] Joe Koncelik, U.S. EPA's Tighter Lead Standard Should Be No Big Deal for Cleveland, Ohio Environmental Law Blog (October 20, 2008), http://www.ohioenvironmentallawblog.com/uploads/image/lead%20emissions.jpg.
[71] Kessler
[72] U.S. EPA, 2008 Nat'l Emissions Inventory v3, https://www.google.com/fusiontables/DataSource?docid=16gJi7ePu_IX_2Hyu46sp7sFdu4cOP9_Zb3x3Zks#rows:id=1 (last updated July 12, 2013).



The EPA lists twenty-one nonattainment areas for lead pollutant in the ambient air, they are scattered throughout the country with Missouri, Ohio, and Pennsylvania having the greatest amount of nonattainment areas.[73] Jefferson County Missouri is home to the Doe Run Company whose primary lead smelting plant alone emits over 19 tons of lead particulates per year,[74] out of the less than 1000 tons emitted per year in the United States.[75] Nearly every county found on the EPA's list of nonattainment areas, with the exception of Los Angeles County, contains one of the top 30 lead emitters from the EPA's 2008 national emissions inventory. These few and identifiable plants alone contribute significantly to the 308 tons of lead emissions given off by heavy industry annually and are located in a few select areas of the country. This information

[73] U.S. EPA, Lead NAAQS Final Nonattainment Designations Rounds 1 and 2 (November 8, 2011), http://www.epa.gov/leaddesignations/2008standards/documents/2011-11-08/LeadNAAreaList.pdf.
[74] 2008 Nat'l Emissions Inventory v3
[75] Kessler

suggests that while aircraft emissions do make up the largest source of lead in the environment, emissions from aircraft are not concentrated enough to pose a risk.

II. Avgas Under the Clean Air Act

The simplest way to get the lead out of avgas would seem to be the same way it was phased out of automotive gasoline, through the Clean Air Act. Yet avgas still contains the same tetraethyl lead removed from the road because of its dangers.

The Clean Air Act passed in 1970 was put in place to protect the nations health by authorizing the EPA to establish safe levels of air quality known as NAAQS (National Ambient Air Quality Standards) and to pass regulations limiting emissions from both stationary and mobile sources, such as factories and automobiles.[76] The EPA also regulates lead emissions through NESHAP's (National Emissions Standards for Hazardous Pollutants), but this set of regulations wouldn't apply to emissions from piston-powered aircraft because they are geared towards stationary industrial sources.[77] The 1970 Clean Air Act gave the EPA power to create these regulations and enforce them and also gave states certain obligations to develop plans in order to set standards in air quality.[78] Amendments passed to the Clean Air Act legislation in both 1977 and 1990 provided both greater regulatory and enforcement powers to the federal government and EPA to better control pollution.[79]

[76] U.S. EPA, Summary of the Clean Air Act, http://www2.epa.gov/laws-regulations/summary-clean-air-act (last updated July 26, 2013)
[77] U.S. EPA, Overview by Section of CAA, http://www.epa.gov/ttn/atw/overview.html (last updated August 8, 2013).
[78] U.S. EPA, Clean Air Act Requirements and History, http://www.epa.gov/air/caa/requirements.html (last updated on August 15, 2013).
[79] U.S. EPA, History of the Clean Air Act, http://www.epa.gov/air/caa/amendments.html (last updated August 15, 2013).

Title II of the Clean Air Act, Emissions Standards for Moving Sources, is what gives the EPA power to regulate lead emissions from moving vehicles. The EPA used Part A – Motor Vehicle Emissions and Standards, of this legislation to phase out and eventually ban the use of lead in automobiles.[80] In regards to the emissions coming from aircraft, the EPA does have the power to regulate here under the Clean Air Act, Title II Part B - Aircraft Emissions Standards.[81] The EPA under Part B has a duty to investigate whether emissions from aircraft cause or contribute to air pollution posing an endangerment to public health and safety and if so issue proposed emissions standards to address them.[82] While power is granted to the EPA in this statute to investigate whether emissions from aircraft pose a threat to air quality or the public health and welfare, their power is limited by the EPA's having to consult with the FAA regarding proposed regulations. The EPA cannot implement regulations if the FAA finds they pose a safety risk.[83] Also, if the Secretary of Transportation were to make a finding that a regulation regarding aircraft emissions standards promulgated under this legislation were to create a hazard to aircraft safety, the President may disprove the regulation.[84] Because of this system, if the EPA were to make a finding that the emissions from aircraft due to the lead in avgas were affecting air quality, the EPA would first have to consult with the FAA and could not create a regulation if it were to have an affect on aircraft safety. Furthermore, under Title II Part B of the Clean Air Act, no state may enact a regulation regarding aircraft emissions unless it is identical to a standard applicable under Title II Part B.[85]

[80] 42 USC §7522
[81] Clean Air Act Title II – Emission Standards for Moving Sources
[82] 42 USC §7571
[83] 42 USC §7571
[84] 42 USC §7571
[85] 42 USC § 7573

The EPA has never created a regulation under Title II Part B to address the lead emissions coming from the avgas used by piston-engine powered airplanes. While the EPA does have the authority to regulate in this area, it has yet to find a lead based endangerment coming from the emissions of piston-powered aircraft and felt the need to try and reduce these emissions. Friends of the Earth has been trying since 2003 to get the EPA to make a finding that the lead in avgas poses an endangerment to public health and welfare, in order to open the door to regulation eventually banning the use of tetraethyl lead in aviation fuel as was done in automotive fuels.[86] They have petitioned and sued the EPA to try and make an endangerment finding regarding the lead being used in avgas. Friends of the Earth claims the EPA has "unreasonable delayed" making a finding on the matter. The EPA has responded to the petition and suit by saying there is not enough information available regarding lead in these emissions to make an endangerment finding and has so far been successful.[87] In March of 2013, the United States District Court for the District of Columbia ruled in favor of the EPA granting summary judgment. The court concluded the EPA was not compelled to make an endangerment finding.[88] Were the EPA to make an endangerment finding regarding lead in the emissions from piston-powered aircraft, they would still first have to consult with the FAA regarding any potential safety concerns and then even were a regulation passed, the Secretary of Transportation may find it poses a hazard to aircraft and the President may disapprove.

III. Why Is There No Regulation In Place?

[86] U.S. EPA, Memorandum In Response To Petition Regarding Lead Emissions From General Aviation Aircraft Piston-Engines (July 18, 2012), http://www.epa.gov/otaq/regs/nonroad/aviation/ltr-response-av-ld-petition.pdf.
[87] *Id.*
[88] Friends of the Earth v. United States EPA, 934 F. Supp. 2d 40 (D.D.C. 2013).

Even though the EPA does have the power to regulate aircraft emissions and could attempt to regulate them in the same way it has auto emissions and ban the tetraethyl lead used in avgas, it has not.

There are many reasons why the EPA has yet to eliminate the use of lead in avgas; the biggest being it has not made a finding that aircraft emissions endanger public health and welfare, which as discussed above the EPA must do before attempting regulation. Beyond this is the safety aspect of eliminating tetraethyl lead from avgas, the economic consequences of suddenly prohibiting the use of lead in avgas, and the little concern and knowledge of the fuel these small planes burn. The task of regulating avgas is a daunting one because there are so many differing needs which all must be met and an extremely limited way to meet all of those needs. The first question which must be asked by the EPA is whether or not lead poses a real risk to the public health and welfare, this answers whether immediate action must be taken to stop the use of lead in avgas or if a slower approach may be taken in reducing general aviation's use of tetraethyl lead. The EPA is currently conducting a study to be completed in May of 2014 regarding the levels of lead in the environment surrounding seventeen airports throughout the United States, with preliminary data from the study already available.[89]

The study being conducted focuses on the area around seventeen of the busiest general aviation airports in the country to monitor the amount of lead around them over a one year period and is due to be out in May 2014.[90] Preliminary data from these seventeen airports is available even though the full yearlong study has not yet been completed. Two of them do exceed the

[89] U.S. EPA, Airport Lead Monitoring Program Update (June 2013), http://www.epa.gov/otaq/regs/nonroad/aviation/420f13032.pdf.
[90] *Id.*

NAAQS lead levels (0.15 μg/m3), with the rest being well below the NAAQS lead levels.[91] For the two airports with levels of lead that exceed the NAAQS limits further sampling and studies are being conducted.[92] From these preliminary reports it seems as though the piston-powered aircraft flying into general aviation airports do slightly elevate the amount of lead found in the environment, but not to levels exceeding the NAAQS. It is important to remember the location of airports could also have an effect on the amount of lead in the soil, other potential sources of lead could lead to increased levels, along with wind patterns and many other factors, which is why the EPA will not comment or make a finding until the study is complete. Even though aircraft emissions account for the largest amount of lead pollution entering the air, after researching the topic it becomes clear that the information regarding levels in the environment around airports is limited. Because of this limited data the EPA has not yet made a finding that the lead in aircraft emissions endangers the public health and welfare, necessitating regulation of the use of tetraethyl lead in avgas. When the study is complete and only then will the EPA be able to make a decision regarding the lead in aircraft emissions.

Even with a finding of endangerment, it is important to note without a viable alternative to the current tetraethyl lead in avgas little can be done to stop it's use due to numerous safety concerns which would arise. While the piston engines in airplanes are similar to car engines, they are also much different which is why the FAA has such exacting standards for the avgas available today.[93] Airplane engines are high compression and run at high power settings for extended periods, without the right fuel mixture they may not run optimally which could limit

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[91] *Id.*
[92] *Id.*
[93] Unleaded AVGAS Findings & Recommendations

performance having serious consequences when taking to the air.[94] The fuel for airplanes must also be able to withstand the cold temperature and pressure differences found at high altitudes, ethanol commonly added to auto fuel cannot be used in avgas because at altitude it could freeze blocking fuel lines.[95]

There are many light single engine piston airplanes that could begin flying on unleaded gas today, but cannot for several reasons. The unleaded fuel available and used by cars is slightly different depending on each states own environmental legislation, leading to a variety of mixtures around the country most of which contain ethanol and are not suitable for aviation.[96] Also, when an aircraft is certified to fly it is limited to the use of certain types of fuel. While many could be certified to run on ethanol free unleaded gas, it is not readily available at airports and even if it were it would be prohibitively costly for those not certified to run on unleaded gas to get recertified to use it.[97] The other 30% of the piston fleet, the high performance portion, need leaded fuel to fly or a comparable alternative to 100LL, without it their engines won't turn. Holding back the availability of ethanol free unleaded fuels at general aviation airports for the planes that could use it is the need for an expensive new infrastructure to dispense a second type of fuel at airports.[98] The planes, which could use unleaded fuel, low powered piston powered aircraft, account for 70% of the general aviation fleet, but their fuel use amounts to only an estimated 20-30% of the avgas used.[99] The general aviation business has been in a state of gradual decline and is not currently in the position to add new tanks, dispensing systems, and

[94] *Id.*
[95] *Id.*
[96] *Id.*
[97] *Id.*
[98] *Id.*
[99] *Id.*

keep two inventories of fuel on hand when the current fuel available is working just fine and most of the fuel dispensed would still be leaded.

IV. What is Currently Being Done?

The aviation industry knows leaded fuels are a thing of the past and is working towards an unleaded future in various ways, in conjunction with the FAA.

The FAA has a committee compromised of the EPA, various aircraft and engine manufacturers, aviation interest groups, and fuel suppliers to develop a path to an unleaded fuel for general aviation. This committee has issued a final report on the use of leaded fuel in general aviation, the viability of finding an unleaded alternative, and the problems likely to be faced in the search for an unleaded alternative.[100] The FAA is now underway testing and researching various fuel alternatives to find an unleaded replacement, which must be both safe and usable, but will also have a chance of making it onto the market.[101] Two companies are in the process of developing alternatives to leaded high-octane fuels and have actually begun testing their products, these companies are Swift Fuels and GAMI. Both Swift and GAMI are working to develop unleaded alternatives to 100LL avgas, which would require no aircraft modifications.[102] However, without extensive distribution networks and the ability to quickly begin manufacturing and distributing large quantities of fuel these companies' products face serious challenges to being used as a "drop in" replacement for 100LL. Even more recently Shell Oil, on December 3rd, announced it had developed a "drop in" replacement for 100LL avgas.[103] What this means is

[100] *Id.*
[101] *Id.*
[102] AVweb, Fuel Project Move Forward, But Slowly (January 24, 2013), http://www.avweb.com/news/features/fuel_projects_stc_faa_avgas_epa_100ll_208068-1.html.
[103] Robert Goyer, Shell Aviation Has Unleaded Avgas, Flying (December 3, 2013), http://www.flyingmag.com/news/shell-aviation-has-unleaded-avgas.

that no modifications or certifications would have to be done to current aircraft, the fuel could simply be used instead of 100LL avgas once approved by the FAA. While additional testing and certification must take place, they claim it could directly replace the leaded avgas used now in the near future. This is very exciting news considering Shell is one of the larger suppliers of avgas and their development of an alternative fuel could quickly be implemented across airports replacing 100LL altogether.

Besides the development of a replacement fuel aircraft and engine manufacturers are slowly beginning to shift away from piston engines that exclusively use avgas in favor of diesel engines, which can burn jet fuel. Cessna's classic 182 model, now known as the 182 Jet-A, comes new with a diesel engine that does not require avgas at all.[104] Diamond Aircraft, a European builder of small piston aircraft has also begun to offer models with available diesel engines, including a twin-engine model.[105] The diesel engines being used in these aircraft are also available as replacements for the engines on existing aircraft that currently burn leaded avgas.[106] These engines however do have some drawbacks; they are very expensive, not many new piston aircraft are sold per year, and being so new they so far have an unproven track record.

V. Recommendations

Eventually the time will come when general aviation's reliance on tetraethyl lead in its fuel supply must end. Going into the future environmental regulations are not going to ease up, they are going to get much more stringent in response to growing environmental concerns

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[104] Stephen Pope, Cessna Introduces Jet-A Skylane, Flying (July 23, 2012), http://www.flyingmag.com/aircraft/pistons/cessna-introduces-jet-skylane.
[105] Robert Goyer, Diesel Economics, Flying (July 26, 2012), http://www.flyingmag.com/blogs/going-direct/diesel-economics.
[106] http://www.flyingmag.com/blogs/going-direct/diesel-economics

throughout the world. Regardless of whether or not the EPA's study finds that the areas around the general aviation airports being studied exceeds the lowered NAAQS limits and makes an endangerment finding, something must happen regarding the use of lead in avgas. Moving forward general aviation, the FAA, and EPA are likely to face increased pressure from environmental groups concerned about leads continued use in avgas regardless of whether it actually creates an endangerment to public health or the environment. The actual switch to an unleaded fuel and the abandonment of leaded avgas isn't something that must be immediate, but as the FAA suggests is something that needs be well planned so a "drop in" ready replacement is a viable option in the near future.

Looking at the various ways the problem of lead in avgas is being dealt with it is interesting to see the interaction between government agencies and private industry in developing a solution. This interaction and common goal is the way a solution will be found to get the lead out of avgas. The FAA has laid out a framework for how the next generation avgas must be developed, tested, and eventually certified and private industry is embracing tat framework developing new fuels. Swift Fuels and GAMI, both relatively small companies both new to fuel development and supply industry have in a short time developed fuels they claim to be viable alternatives to 100LL avgas. The recent developments with Shell Oil and their replacement fuel are even more exciting given how familiar they are with the regulatory processes of developing and supplying fuels for aviation. Their ability to quickly implement a new type of avgas and interest in licensing the formula for their replacement fuel is also a huge milestone for the push to get lead out of avgas. These accomplishments which have accomplished relatively quickly, wouldn't have been possible without the cooperation between regulatory agencies and private industry.

It is important to remember that general aviation cannot be forced to abandon the use of tetraethyl lead in the fuel it uses. If the EPA were to try and impose regulations, without a viable alternative fuel available to power the piston fleet there would be a serious safety issue and the regulations would likely never go into effect. However with increased pressure not only by the FAA and EPA but also by environmental groups, a public more concerned about environmental issues, and members of the general aviation community itself wondering why an alternative to leaded fuel has not yet been developed it is only a matter of time before a new fuel is demanded. The market is responding to these pressures, as it should, by developing a solution. This process however cannot be rushed. Whatever alternative is found to leaded avgas must be properly developed and tested in order to safely work for all current users of avgas, without this an alternative fuel will likely never find it's way into the fuel tanks of aircraft nationwide. The current route being taken by the FAA, encouraging research and develop by working closely with both startups and large multi-national corporations and setting realist goals, seems to be working well. The appropriate way to deal with and eventually end the use of lead in avgas is to allow market based solutions to be developed by private industry alongside and with the guidance of the appropriate administrative agencies, as is currently happening now.