

Statement for the Record
House Committee on Oversight and Reform
Subcommittee on Environment

Hearing on: “Toxic Air: How Leaded Aviation Fuel Is Poisoning America’s Children”
Submitted by: Matthew A. Grisius, a Concerned Father, Grandfather and Angry Taxpayer -
(<http://close1d2.org>) 08-28-2022 #4 FINAL

Let’s be perfectly honest, there is truly a proven need for the small percentage of *real* airports with *real* aircraft that actually provide *real* demonstrable transportation needs, *real* jobs and *real* tax revenues, many others are simply self-perpetuating personal hobby, sport, recreational entertainment social venues cleverly protected & mostly hidden by the world’s largest groups of Special Interests & Industry Lobbyists amongst overall aviation statistics that enable increased non-essential aircraft, including helicopter take-offs, landings, accidents & crashes, coupled with “disturbing the peace” and “public nuisance” revenge fly-bys intended to bully, harass and intimidate providing Communities utterly ZERO Socially Redeeming Values (SRVs) including unnecessary Negative Aviation Impacts (NAIs):

- Adverse Health, Safety and Welfare impacts
- Environmental impacts of toxic pollution & noise pollution
- Diminished quality of life
- Reduced Community desirability & property valuation
- Wasted taxpayer money

The So-Called General Aviation (GA) “Fleet”

The So-Called “General Aviation Fleet” of ~170,000 Predominantly Personal Hobby, Sport, Recreational Social Entertainment Piston-Engine Aircraft (PEA):

- Burn about 192 million gallons of 100LL Leaded Aviation Fuel AKA Avgas yearly
- Average over 1,120 gallons per each Piston-Engine Aircraft (PEA) yearly
- Average 50 year age of Piston-Engine Aircraft (PEA) AKA Flying Junk Piles (FJPs)
- 2.2 grams of Tetraethyl Lead ([TEL](#)) per gallon
- 2.2 grams of Ethylene Dibromide ([EDB](#)), a [chemical scavenger](#), per gallon
- From 1970 to 2007, General Aviation (GA) aircraft emitted about 34,000 tons of lead into the atmosphere [*1].
- Releases 468 tons of Lead byproducts yearly into the atmosphere based on current US Environmental Protection Agency (EPA) estimates
- Represent an on-going “192 million gallon a year” Public Health, Safety & Welfare loophole – nightmare across the United States for absolutely no rhyme or reason defying logic
- Besides the immeasurable toll on Human, Health, Safety & Welfare the Societal cost estimates of \$10.00 per gallon of 100LL Leaded Aviation fuel AKA Avgas sold [*2], or almost \$2 Billion dollars to minimally address the on-going Human damage, AND this doesn’t include ANY existing *cleanup* or *remediation* effort(s) anywhere.
- Toxic Air: How Leaded Aviation Fuel Is Poisoning America’s Children ([html](#)) 07-28-2022 | House Committee on Oversight and Reform. [YouTube](#) – Thursday, July 28, 2022, at 2:00 p.m. ET. The

hearing is well worth listening to. It runs for 106-minutes, listening time is only 76-minutes, due to a 30-minute recess (starts at minute-24, skip ahead to minute-54) for a House Vote.

- “Toxic Air: How Leaded Aviation Fuel Is Poisoning America’s Children” ([html](#)) | Congress.gov | Library of Congress SEE: Video of Proceedings, Witness Testimony, Supporting Documentation, etc.

20,000 aviation facilities in the US use 100LL Leaded Aviation Fuel AKA Avgas, within 1 kilometer of those facilities, there are over **16 million** people, including **3 million** children [*1]. Over **600 schools** are located within **half a kilometer** of such sites. This includes three Michigan Plymouth Township & Canton Township area Schools, two which are Plymouth Canton Community Schools (PCCS) all within hundreds of feet of both “Run Up” areas at Michigan Department of Transportation (MDOT) owned non-essential Personal Hobby, Sport, Recreational Social Entertainment Venue Canton Plymouth Mettetal 1d2 airstrip in Canton Township Michigan.

Of the 20,000 facilities in the United States, the “Majority” of these facilities, using the 80/20 rule ([Pareto Principal](#)), have:

- NOTHING to do with real transportation needs, real jobs or real taxes, real prosperity or the future of anything in the entire Nation!
- NOTHING remotely to do with ‘Critical Infrastructure’ in any sense of the word.
- Perform ZERO, absolutely NO Mission Critical Functions for Local, County, State or Federal taxpayers.
- NOTHING that would be missed by anyone except Special Interests + Industry Lobbyists that use them, ZERO ROI.
- NOTHING, absolutely ZERO to do with Science, Technology, Engineering, Arts or Math (STEAM).

General Aviation (GA) 50 Year Old Flying Junk Piles (FJPs) & Safety

Taxpayers don’t care about personal 1930s & 1940s Piper Cubs, 1950s Aeroncas, 1960s Mooneys, 1970s Cessnas or Pipers, 1980s Beechcraft Bonanzas, home garage (clown) built Experimental Amateur Built ([E-AB](#)), WWI Bombers, museum pieces, collectors’ items or other flying toys for the wealthy.

50 year old PEA AKA Flying Junk Piles (FJPs) have absolutely *nothing* to do with the future of *anything*.

Many FJPs are barely capable of Visual Flight Rules ([VFR](#)) | [SKYbrary Aviation Safety](#) while Federal Aviation Administration (FAA) certified [mechanics](#) have a difficult time *personally* signing off airworthiness due to airframe fatigue & stress, corrosion, dry-rotted wire harnesses, poor, including amateur hack DIY, powerplant maintenance, etc. not to mention the lack of *any* contemporary let alone modern avionics. While many Ford Pinto’s and GM Corvair’s are still “drivable” we don’t send our children out to drive them to school or retrofit National Highway Traffic Safety Administration ([NHTSA](#)) Federal Motor Vehicle Safety Standards ([FMVSS](#)) to accommodate these antique “Driving Junk Piles” for good reason.

General Aviation (GA) is uniquely hazardous. Between 1984 and 2017, the GA sector accounted for 94% of all aviation accidents in the US – 1,143 in 2014 alone. **NOTE:** General Aviation (GA) has not benefited from **any real** improvements in **safety** over the **past three and a half decades** with respect to crash rates. Meanwhile, *Commercial* Aviation witnessed a crash reduction of 16% between 1986 and 1995 and a further 6% reduction between 1996 and 2005 [*3].

What Are the Community of Subject Matter Experts (SMEs) Including Owners, Pilots, Students, Instructors and Aviation Professionals Really Saying?

[*7] Reddit | [Flying](#). Created September 3, 2008. 197,513 members. About Community: This community is for discussion among pilots, students, instructors and aviation professionals. Someone has it out for 1D2... ([html](#)) 09-07-2018:

- I also feel like inaction by GA in general hasn't helped. 100LL is a health hazard. Most General Aviation companies seem happy to just leave things as they are, with the vague **hope** that the FAA will approve a suitable alternative **soon**. The vast majority of new certified single-engine piston aircraft still rely on 100LL; that seems like an industry with its head in the sand to me.
- Likewise, very little seems to be being done to reduce aircraft noise. The design of modern aircraft should adapt to modern conditions - flying in or out of a lot of airports nowadays causes a fair bit of noise pollution for literally thousands of people. Is a modern C172 any quieter than a 1960s one? Why not?
- A modern day 172 is a 1960's 172 for the most part.

General Aviation (GA) Decline & Irrelevance

America's General Aviation sector has witnessed significant demographic shifts since the turn of the century. The number of certified, private pilots, non-fatal aircraft accidents, fatal aircraft accidents, and number of General Aviation (GA) hours flown are all in decline. Meanwhile, the average age of an American private pilot has increased by several years. All of these factors indicate that the General Aviation (GA) Industry is in **decline**. The average age of the private pilot demographic is increasing, as the overall size of the demographic decreases. These findings prove *ominous* for a **shrinking** community that relies on its *size* to *leverage* [**dupe**] the government & **public** for support and recruitment [*3].

Aviation Training, Mechanic or Flight Schools & Privately Owned Public Landing Facilities **are** Privately Owned Businesses, while other problems or issues such as Personal or Financial constraints, Commercial Airline Pilot Shortages, increasing General Aviation (GA) Popularity & Access are Special Interest & Industry Lobbyist problems. NONE of these are taxpayer problems and should NOT utilize ANY taxpayer money at all. Certainly, no more support than Hunting, Fishing, Boating, Golf, Bowling, National Parks & Camp Grounds or other personal hobby sport recreational social entertainment venues or pursuits receive.

True General Aviation (GA) Total Addressable Market (TAM), Industry Reach, Revenues

"Lies, damned lies, and statistics" is an old saying describing the persuasive power of statistics (e.g. baffle with BS numbers) used to bolster weak arguments, the General Aviation (GA) Total Addressable Market (TAM), influence, reach and revenues are no different. Loaded with typical Special Interest & Industry Lobbyist rhetoric, grandiose smug self-congratulatory wishful thinking & hyperbole.

State of the Industry: General Aviation Market Strong Heading into 2022 ([html](#)) 02-23-2022 | [NBAA](#) - National Business Aviation Association. General Aviation Manufacturers Association ([GAMA](#)) General Aviation [Shipments](#) Report 2021 - Year End ([pdf](#)). Earth Shattering, oops Paltry PEA growth, summarized here:

- Airplane shipments in 2021, when compared to 2020, saw Piston Engine Aircraft (PEA) deliveries increase 5.5%, with 1,393 units;
- Piston Engine Helicopter (PEH) deliveries for 2021, when compared to 2020, saw an increase of 27.5%, with 181 units;

General Aviation (GA) Market ([html](#)) | 2022 - 27 | Industry Share, Size, Growth - [Mordor Intelligence](#).

The General Aviation (GA) Market was valued at USD 19.91 billion in 2020 and is projected to reach USD 24 billion by 2026, registering a CAGR of about 3% during the forecast period (2021 - 2026). Most of the orders for fixed-wing Piston Engine Aircraft (PEA) & Piston Engine Helicopter (PEH) are from pilot training institutes, while a handful of them are purchased by private aviation enthusiasts and aircraft racing enterprises, while demand for civil helicopters is also witnessing growth due to rotorcraft services such as privately owned air taxis and air ambulances. NOTE: predominately PRIVATELY owned *Businesses* (Commercial) are responsible for the minute volume & growth. It should also be noted that many of the PEA manufacturers are now located off-shore.

NOTE: the major US Aerospace & Aviation industry players have increasingly turned directly to Defense related dollars for diversification & stability in areas such as Space Systems cubesat/nanosat, or just to name a few others, which btw none have anything to do with General Aviation (GA) PEA, realizing there is ZERO to little market growth to truly grow “Best in Class” Global competitive companies with outdated dead-end toxic technologies:

- Future Vertical Lift (FVL) Family of Systems ([html](#)) – USAASC United States Acquisition Support Center. Future Vertical Lift (FVL) is a family of vertical lift solutions that will deliver next generation capabilities at the tactical, operational and strategic levels. They will enable joint force mission effectiveness in the transregional multidomain and multifunctional threat environment. The FVL Family of Systems seeks to improve vertical lift dominance by improving performance and optimizing affordability, life cycle management, interoperability and supportability. The U.S. Army is the lead service for the development of Future Long Range Advanced Aircraft, a medium size Assault/Utility aircraft, and the first of five Capability Sets that will provide improved speed, range, agility, endurance and sustainability over current rotorcraft.
 - Future Long-Range Assault Aircraft (FLRAA) ([html](#)) ([pdf](#)) 09-24-2020 | Article | [The United States Army](#).
 - Future Attack Reconnaissance Aircraft (FARA) ([html](#)) ([pdf](#)) | Article | [The United States Army](#).
 - Future Tactical Unmanned Aircraft System (FTUAS) ([html](#)) ([pdf](#)) | Article | [The United States Army](#).
- U.S. GAO – Weapon Systems Annual Assessment: Knowledge Gaps Pose Risks to Sustaining Recent Positive Trends 04-25-2018 ([html](#)) (Highlights [pdf](#)) (Full Report [pdf](#)). We report annually on the programs DOD uses to buy its **86 major weapon systems**— which are worth **\$1.66 trillion**. We looked at changes to DOD’s weapon system portfolio since our 2017 report, including DOD’s progress implementing purchasing reforms.

Global Aviation Gasoline (Avgas) Market to Reach USD 2.32 Billion ([html](#)) 07-05-2021 | [GlobeNewswire](#) | [Fortune Business Insights](#). The market was worth USD 1.52 billion in 2020. Additionally, 100LL Leaded Aviation Fuel AKA Avgas variety is available for consumption across the globe, predominantly in the US. 100LL Leaded Aviation Fuel AKA Avgas is largely adopted in small-sized and old Piston Engine Aircraft (PEA).

Total operating revenues of the U.S. airline industry 2021 ([html](#)) | Statista. Using only about 6,000 aircraft the combined operating revenue of U.S. airlines increased each year since 2015, reaching an all-time high of 248 billion U.S. dollars in 2019. In 2020, due to the coronavirus pandemic, U.S. airlines generated only 131 billion U.S. dollars in operating revenue. Air cargo market in the U.S. - Statistics & Facts ([html](#)) | [Statista](#). Cargo revenue for Commercial carriers accounted for over 40 percent of their total revenues for a total \$43 Billion dollars.

Airport-Generated Revenue or Operating Revenue ([html](#)) – Aligning Community Expectations with Airport Roles | Transportation Research Board ([TRB](#)) Cooperative Research Program ([CRP](#)) | National Academies of Science Engineering Medicine ([home](#)). GA airports generate revenue from user fees associated with aircraft parking and storage, aviation-related ground and building rent, landing fees, and fuel flowage fees. It is **not uncommon for GA airports to operate at a loss**. Airports are capital-intensive enterprises, and the amount of money needed to meet FAA safety and operational requirements generally far outweighs the ability of General Aviation (GA) airports to generate revenue. This fact alone highlights the need to invest in Municipal or Governmental owned Local, County, State or Federally owned *Commercial* Grade facilities to ensure long term ROI using taxpayer dollars.

The Future of the Airline Industry After COVID-19 ([html](#)) 04-02-2021 | [McKinsey](#). As they look beyond the pandemic, airlines need to grapple with five new realities—and devise strategies to adapt:

1. Leisure trips will fuel the recovery
2. Staggering debt levels will lead to ticket price increases and a larger role for government in the sector
3. We will see a greater disparity of performance among airlines in the future
4. Aircraft markets may be oversupplied for some time to come
5. Air freight will see undersupply for some time. Among these 21 airlines, cargo revenue accounted for over 40 percent of total revenues on average. Overall air freight is expected to stay smaller than before the pandemic for several years.

It is interesting to note that any required *real* revenues to support *real* aviation facilities have absolutely nothing to do with the General Aviation (GA) Market paltry Piston Engine Aircraft (PEA) growth at all.

General Aviation (GA) Analysis Paralysis – A Starting Point – Over 3,000 County or Regional Level Airports Need Investment NOT Privately Owned Businesses Including the More than 10,000 Private Airstrips, Private Flight Schools or Private Venues Devoted to Hobby, Sport Recreational Social Entertainment Looking for Increased “Government Handouts”

While the Industry’s goal is to find a drop-in 100-octane fuel that can be safely be used by *all* piston powered aircraft in the exaggerated General Aviation (GA) “Fleet” is a noble goal, and is replete with typical Special Interest & Industry Lobbyist “Greenwashing” and “Hand Waving”, it is still just that, a goal, and maybe NOT so noble after all.

In reality, it’s an **aggressive**, unrealistic, unreachable false goal with ZERO plans & ZERO commitments & ZERO methods of attainment or compliance identical to the previous 50 year Special Interest & Industry Lobbyist pipedream of artificial delays all while incinerating taxpayer money at will with ZERO progress for a half of a Century. Wow, say that again so it’s clear, no progress in “Half a Century!”

What Are the Community of Subject Matter Experts (SMEs) Really Saying About Recent Developments?

At the July 28, 2022 House Committee on Oversight and Reform Hearing on Toxic Air: How Leaded Aviation Fuel Is Poisoning America's Children referenced above, Congresswoman [Yvette Herrell](#), newly appointed Ranking Member of the Subcommittee on the Environment submitted a "Statement for the Record" from the Aircraft Owners and Pilots Association (AOPA) ([pdf](#)) that states:

"As I stated previously, EAGLE's single mission is to eliminate the use of leaded aviation fuels for piston-engine aircraft in the United States **no later than** December 31, 2030, **hopefully** sooner, and without adversely **impacting** the existing **GA fleet**."

At the Experimental Aircraft Association ([EAA](#)) 2022 [AirVenture](#) Oshkosh | Oshkosh, Wisconsin | Fly-In & Convention Federal Aviation Administration ([FAA](#)) Eliminate Aviation Gasoline Lead Emissions ([EAGLE](#)) Forum on unleaded fuel the newly appointed FAA Head of Certification [Lirio Liu](#):

"expressed **optimism** that the finish line **could come sooner**" than the group's published target date of 2030 but would not promise a detailed timeline. [*4]

Unleaded fuel update draws crowd ([html](#)) 07-26-2022 - Aircraft Owners and Pilots Association ([AOPA](#)). 100LL Transition to No Lead V2 ([html](#)) | [AOPALive](#) – [YouTube](#). Retired AOPA Senior Vice President stated:

"We only have **one** chance to get this right. We want it to be done quickly but safely; I, like **all of you**, do not want to put **my family** in an **unsafe situation**."

GA Pilots Press Committee on Lead-Free Fuel ([html](#)) 07-25-2022 - [FLYING Magazine](#).

More delays now blaming "economic ripple effects created by Russia's invasion of Ukraine". FAA acknowledged that the program's goal of 2030 is "**aggressive**." This EAGLE program is going to take **\$100 million** of **taxpayers** money, and it won't **guarantee anything**.

A few thoughts on the Industry SME, Special Interest & Industry Lobbyist comments:

- Few would argue that "**optimism**" and "**hope**" are certainly NOT the way to administer Public, Health, Safety or Welfare policies, guidelines, decisions or plans with millions of expendable Human "Guinea Pigs", "Cannon Fodder" and "Collateral Damage" at stake including pregnant moms, babies & school children.
- A Retired AOPA Senior Vice President is worried about **HIS** family and the families of **HIS** organizational members. What about the millions of **other** families subjected to "Involuntary Poisoning"?
- More Excuses, delays and yet another "aggressive" "one chance" \$100 million dollar spend of taxpayer money with no project plan, no timeline, no phases, no milestones, no deliverables, or even ANY *real* commitments? Zero oversight? How is this even possible? It seems like amateur night with Government Regulations 101 with every Special Interest & Industry Lobbyist, literally the alphabet soup of "Who's Who" in Aviation, lining up for more taxpayer funded "Government Handouts", but no action plan just a lot of hand waving, head nodding, back slapping, fear mongering and "Greenwashing".

- Please remember we're talking about predominantly *Personal* Hobby Sport Recreational Social Entertainment FJPs, venues and pursuits vs pregnant moms, babies & school children.

General Aviation (GA) Analysis Paralysis – Federal Aviation Administration (FAA), Special Interests & Industry Lobbyists Leading Team of 1000s Try to Boil the Ocean Again for Sixth Decade and Counting

Previous Tetraethyl Lead (TEL) elimination effort cycles appear to take roughly about a decade, give or take a few years. At this rate this is roughly the sixth iteration over the last fifty years and **might** be done by 2030. Six Decades to get this right? With NO *real* end in sight? Really?

Besides, eliminating 100LL Leaded Aviation Fuel should NOT be a ONE time or ALL or NOTHING proposition which would be irresponsible, negligent and harm many millions of people for the next eight years until 2030 or **sooner**? "Sooner", what does that mean? Is this some sort of game? We're talking about people's lives, pregnant women, babies school children and their health, right?

It should also be time to immediately focus on priority exceptions for mission critical operations to identify, isolate, plan and budget for the "So-Called" mission critical operations & locations, stop the "hand waving" and artificial delays, get this important topic "Out in the Open" to determine *exactly* what missions where truly need Government supplied Taxpayer Money and on-going support including:

- Natural disaster front-line relief support, humanitarian assistance, search, rescue & recovery
- Transport of emergency medical personnel & medical supplies
- Agricultural aviation activities AKA "Crop Dusting"
- Law Enforcement, Border Control, Fire Fighting, etc.
- Wildlife surveys, map wetland losses and soil erosion, detect pipeline spills, etc. (displaced by drones soon)

It is apparent to many that there doesn't seem to be ANY 'requirement' or 'mandate' that 'requires' the use of 100LL Leaded Aviation Fuel AKA Avgas for these "missions" to be successful for any of these endeavors. Instead, it seems obvious it's time to *invest & update* mission critical operations & locations with modern or at least contemporary aviation capabilities that DO NOT require 100LL Leaded Aviation Fuel AKA Avgas. Let's not "Throw out the baby with the bathwater" AKA Avgas! It should also be noted that many of these missions will be displaced by Unmanned Aerial Vehicles (UAVs) AKA drones, sooner rather than later.

It's time to stop living in the past as a crutch to protect current investments in outdated toxic, dangerous aircraft & practices once and for all. Seems like true "Multiple Conflicts of Interest" from the "Gate Keepers" on many levels across many Special Interests for sure.

Time to ban 100LL Leaded Aviation Fuel AKA Avgas and if necessary, retire 1/3 personal, hobby, sport, recreational social entertainment FJPs of the so-called GA "Fleet" that cannot utilize existing Unleaded Fuels on behalf of the millions being "Involuntarily Poisoned" violating individual "Bodily Integrity" protected by the US Constitution including vulnerable populations such as pregnant moms, babies, school children & elderly.

General Aviation (GA) Analysis Paralysis - Summary: A Constructive Way Forward - Time to Shift General Aviation (GA) Focus to End Entitlements, Grants & Government Handouts to Private Entities, Businesses & Companies

The **real question** everyone appears to be asking: How to plan, deploy and execute an enormous roll out of already existing Unleaded Aviation Fuels immediately & without delay?

Time to shift taxpayer focus to long term investment in Municipal & Governmental Owned Public Access Regional Airports capable of supporting *Commercial* Aviation instead of **DUPING** Taxpayers into supporting *Personal* Hobby Sport Recreational Social Entertainment General Aviation (GA) "One-Size-Fits All" venues justified with Special Interest & Industry Lobbyist statistics, double-talk & gibberish.

A good starting point would be to designate at least one regional level airport / development facility per each US County as a minimum. To receive ANY taxpayer dollars these locations should be responsible, accountable enforceable Local Municipal, County, State or Governmental owned Facility, and as many as possible that are FAA Towered to bolster Public confidence & acceptance. BTW: this is **NOT** a new idea at all.

The National Aeronautics and Space Administration (NASA) realized that 90 percent of the population live within a 30-minute drive of a regional airport, with only 60 percent in the same proximity to a Large Commercial Airport. More passengers might opt for air transport for mid-distance journeys of 50 to 500 miles via Regulated Regional *Commercial* Grade Airports, an accessible and *underused* resource for *any* future air mobility needs.

NASA Seeks to Increase Accessibility of Regional Air Travel ([html](#)) 04-23-2021 | National Aeronautics and Space Administration ([NASA](#)). America is home to more than 5,000 airports, yet just 30 of these airports serve more than 70% of all travelers. The *majority* of airports are *underutilized* due to air transportation services trending towards putting more people into larger aircraft on well-traveled routes.

Regional Air Mobility (RAM) ([html](#)) ([pdf](#)) – Systems Analysis and Concepts Directorate ([SACD](#)) | National Aeronautics and Space Administration ([NASA](#)). Regional Air Mobility (RAM) will increase the safety, accessibility, and affordability of regional travel while building on the extensive and *underutilized* [governmentally owned and/or FAA Towered] Federal, State, and Local investment in our nation's airports & infrastructure AKA National Plan of Integrated Airport Systems (NPIAS).

SEE: what few would argue is a hopelessly antiquated National Plan of Integrated Airport Systems ([NPIAS](#)) | Federal Aviation Administration ([FAA](#)) that focuses on a handful of ~30 mega airports complete with inadequate & outdated Air Traffic Control (ATC). The National Plan of Integrated Airport Systems (NPIAS) identifies nearly **3,310** existing and proposed airports that are included in the national airport system. The bloated unrealistic wasteful NPIAS contains all **Commercial Service** Airports, many *true Reliever Airports*, and selected **Public-owned** General Aviation (GA) airports. Order [5090.5](#), Formulation of the NPIAS-ACIP. Establishes guidelines for managing and maintaining two federal plans that are essential to airport development: the National Plan of Integrated Airport Systems (NPIAS) and the Airports Capital Improvement Plan (ACIP) AKA "**Government Handouts**". SEE Evaluating the Formulation of the National Plan of Integrated Airport Systems (NPIAS) ([pdf](#)) November 2015, Formulation of the NPIAS and ACIP, Order 5090.5 ([html](#)) ([pdf](#)) September 3, 2019, Formulation of the NPIAS and ACIP Summary ([pdf](#)) August 2019.

BTW: **100%** of the Continental US population is within 100km (62.1371 miles) of an international airport according to: Future of Aviation ([html](#)) International Civil Aviation Organization ([ICAO](#)).

What Are the Community of Subject Matter Experts (SMEs) Including Owners, Pilots, Students, Instructors and Aviation Professionals Really Saying About Eliminating 100LL Leaded Aviation Fuel Government, Special Interest and Industry Lobbyist Delays & Disinformation?

[*4] AirVenture EAGLE Forum On Unleaded Avgas Drew A Large Crowd ([html](#)) 07-26-2022 – [Avweb](#). A main driver to remove Tetraethyl Lead (TEL) from 100LL Leaded Aviation Fuel AKA avgas is an expected “Endangerment Finding” proposal from the Environmental Protection Agency (EPA) expected in October 2022. A final finding is not expected until a year later 2023, based on past performance and urgency it *could* take five to eight years before the finding is acted upon — thus the 2030 projected deadline for FAA to Eliminate Aviation Gas Lead Emissions (EAGLE) program. SEE Subject Matter Expert (SME) comments:

- The problem I see with the STC route is gaining the on airport infrastructure to support the sale of a new fuel. FBOs will not invest in the infrastructure until there is a crystal clear path and even then they may **resist spending the money** (ie. wait on a path to apply for a **government grant** that currently doesn’t exist). Because of this I think an STC for an alternative fuel is a bridge to **no-where**.
- Unfortunately [AvFuel](#) is not very bright about helping people find G100UL. They could work for FAA. :-o)
- Still not hearing WHY E0 mogas, whatever octane, cannot work. It only took auto industry a couple years to get rid of lead. It’s taken, so far, over 40 YEARS, and the FAA still has nothing but **hype and hyperbole**.
- The hurdle is that fuel distributors don’t want to sell a third fuel.
- FAA should immediately approve GAMI’s STC package or specify the safety reason for continuing to withhold approval.
- I noticed that their goal is not to streamline processes or reduce prices. I would expect that from a 100 member government/industry collaboration.
- The FAA and over 100 member alphabet groups team up against GAMI’s G100UL. Wow..., if G100UL is so bad at least one of these elite experts should be able to inform the public of why?
- Does anyone really believe that a 100 person committee will be able to agree on anything? Pure nonsense!
- So what is the legal holdup to widespread use?
- SEE: EPA to Evaluate Whether Lead Emissions from Piston-Engine Aircraft Endanger Human Health and Welfare ([html](#)) 01-12-2022 | US EPA plans to issue a proposal for public review and comment in 2022 and take final action in 2023. A Finalized EPA Endangerment Finding for Leaded Aviation Fuel will form the basis for regulatory control & phase-out of Leaded 100LL Aviation Fuel AKA Avgas with Tetraethyl Lead (TEL).
- SEE: Supporting Petitions and EPA Response Memorandums related to Lead Emissions from Aircraft ([html](#)) | US EPA.

[*5] The Catch-22 of unleaded avgas ([html](#)) 05-10-2021 — General Aviation News. But lead can be a health hazard if it enters a person’s bloodstream. So why is it so widely used? The main answer is that lead, in most forms, will not enter the bloodstream, so is **safe** to use — if done properly. The interesting part is that no one really knows how the metals work. There were a lot of studies done to prove the

health hazard of leaded gasoline, but **none** proved any thing conclusive. As it turned out, all of the people who called for an unleaded fuel stayed away in droves. But science is based on data, not what sounds good. So, what should we do based on the facts and data that we have? That answer is very simple: **Nothing. Make no change at all.** SEE Subject Matter Expert (SME) comments regarding Disinformation:

- What kind of pseudo-scientific garbage is this? Does this “publication” even have a chief editor? If so, is that individual aware of being employed here? Permanently removed from my news feed.
- Lead is incredibly dangerous as has been shown by numerous scientific studies. Please stop spreading misinformation. I’m also a GA enthusiast and a pilot, but I would never argue that lead is harmless.
- Secondly, lead is quite toxic. Pregnant women are advised against eating fish due to lead in the fish from environmental contamination. Numerous studies have shown developmental problems in children from environmental lead contamination. I believe that there are significant proven risks to the use of lead in fuels. This is not a manufactured theory: it is real.
- After reading this, I’m blocking General Aviation News from my feed.

[*6] Getting the lead out of avgas will require a concerted effort among pilots, FAA, fuel providers, and more ([html](#)) 01-21-2021 — [General Aviation News](#). A [new congressionally mandated report](#) from the National Academies of Sciences, Engineering, and Medicine states: “While *efforts* are underway to develop an unleaded aviation fuel that can be used by the *entire* gasoline-powered fleet, the *uncertainty of success* means that *other* steps *also* should be taken to *begin* reducing lead emissions and exposures.” SEE Subject Matter Expert (SME) comments:

- It’s plain and simple MONEY! TEL works. TEL is CHEAP. **Operators and pilots won’t change anything until they have to. The only way lead will go away is if the Feds simply outlaw it.** Either ban it or ignore it. This cat and mouse game is *embarrassing* and *childish*. For the record I’m a GA pilot and aircraft owner. I’ve been listening to this BS for 30 years. It can be done.
- It’s astounding that this neurotoxin is still allowed anywhere. If necessary, **retire the 1/3 of the fleet** which won’t run without the neurotoxic fuel.
- **2/3 of all GA aircraft can use mogas.** Mogas has no lead so why don’t they? First it is drummed into their heads that mogas is bad for the engines, nonsense. Secondly you have to buy a STC to use it in certified aircraft. Many won’t. Most airports do not carry mogas, so their thinking is if I only have the equipment for one it will be a fuel everyone can use.
- So the short of it is **2/3 of general aviation is subsidizing** the aircraft that **can’t use** current mogas.
- The reality is that removal of lead from motor vehicle gasoline reduced lead in the air by 98 percent between 1980 and 2014. That was the low hanging fruit. Eliminating the remaining lead sources in the environment in effect become a **lower priority**.
- However once should keep in mind that the NAAQS threshold is somewhat arbitrary in the sense that it’s been shown that there’s no “**safe**” amount of lead below which it’s fine – in all cases the more lead the worse. So even though I fly planes that use 100LL I’ll still be happier when we get to a zero lead solution.
- They do not mention that the soil located underneath a busy GA airport may become polluted as well. For most that may not be a biggie, but for a family with **young kids** that play in the yard?
- It sounds to me that it’s nothing more than **greed** ! It always has and always will be.

- Availability is hindered by the **political clout** of the **minority** that uses the **majority** of the **avgas**.
- I downloaded and read the “Consensus Study Report” (CSP) and was extremely disappointed by the lack of research used to present the state of AVGAS. A typical waste of money by government. The valuable information could have been condensed to about 20 pages.
- I am guessing most don’t want to go to that level of trouble just to help the environment.

Remember, There are NO General Aviation (GA) Silver Bullets, “Easy Buttons” or Panaceas

Of course, simply eliminating Tetraethyl Lead (TEL) does NOT mean there are no remaining dangers or hurdles in deploying Proprietary Unleaded Chemical Compositions (PUCCs) that are NOT tested for ‘long term human exposure’ in the Health, Safety and Welfare (medical) sense *especially* amongst densely populated neighborhoods close to schools, there’s still much work to do to isolate any “Shiny New” lead-free panacea’s. What about THAT testing? Are ALL of these efforts about *only* protecting Flying Junk Piles (FJPs) and owners?

And finally, what about the Cleanup, Remediation & Disposal of the existing General Aviation (GA) Tetraethyl Lead (TEL) contamination mess? Who is going to fund that? Yet another massive non-taxpayer problem without a solution. Shouldn’t users of 100LL Leaded Aviation Fuel AKA Avgas pay for their past, present and continued usage? Any reasonable person might think so?

References

[*1] Myths & Realities of Leaded Aviation Fuel (100LL AKA Avgas) ([pdf](#)) September 2016. Approximately 50 percent of lead emissions in the United States are from piston-engine aircraft. From 1970 to 2007, general aviation aircraft emitted about 34,000 tons of lead into the atmosphere. Twenty thousand airport facilities across the U.S. operate using leaded fuel and an estimated 16 million people live within 1 kilometer of the 20,000 airports where leaded avgas is used. Three million children attend a school within 1 kilometer of these facilities, and these children have demonstrably higher blood lead levels than those further from airports.

[*2] Zahran, S., Iverson, T., McElmurry, S. P., and Weiler, S., The Effect of Leaded Aviation Gasoline on Blood Lead in Children, Journal of the Association of Environmental and Resource Economists, (2017) (online at <https://www.journals.uchicago.edu/doi/abs/10.1086/691686>) Links time and spatially referenced Blood Lead Level (BLL) data from over a million children to 448 nearby airports in Michigan.

An earlier version of the study: The Effect of Leaded Aviation Gasonline [sp] on Blood Lead in Children ([html](#)) ([pdf](#)) 2014! | Munich Personal RePEc Archive ([MPRA](#)) | Universitätsbibliothek Library ([html](#)) | Ludwig-Maximilians-University Munich ([html](#)). Many Thanks to such a **great** institution!

[*3] Examining Crucial Demographic Trends in General Aviation ([html](#)) ([pdf](#)) 2021-03-01 | Air Force Institute of Technology ([AFIT](#)) Scholar ([home](#)) | Wright-Patterson Air Force Base ([WPAFB](#)) | US Air Force ([USAF](#)).

Examining Crucial Demographic Trends in General Aviation ([html](#)) ([pdf](#)) 2021-03-01 | Defense Technical Information Center ([DTIC](#)) | [Fort Belvoir](#) | [U.S. Army](#).

Further Reading

Bioaccumulation of lead (Pb) and its effects on human: A Review ([html](#)) ([pdf](#)) August 2022 – ScienceDirect. <https://doi.org/10.1016/j.hazadv.2022.100094>. [Journal of Hazardous Materials Advances, Volume 7](#), August 2022. Details the health effects in humans due to long-term exposure to lead. Lead poisoning affects most organs in both children and adults. *Preventing* exposure to lead is the primary therapy. Keeping in mind that once lead enters the body, it cannot be totally removed.

- [Toxic Fuel — Quartz](#). 06-16-2022 – A special report regarding Avgas AKA 100LL Leaded Aviation Fuel.
- Do you live near enough to a small airport to have lead exposure? ([html](#)). **Families need to know** that living **within 13 blocks** of a small airport will likely result in an elevation of their child's blood lead level. The searchable library of maps showing the areas surrounding 95 of the top lead-emitting airports in the US includes Michigan Oakland County International Airport ([KPTK](#)).
- Leaded airplane fuel is poisoning a new generation of American children ([html](#)). Dr. Sammy Zahran turned to Michigan to analyze lead levels in [1 million children living around Michigan civil aviation airports](#). Not only did the levels of lead in children's blood rise in proximity to airports, they tracked the monthly peaks and valleys of air traffic. It was as **close a link to avgas and lead exposure** as scientists **had ever found!**
- Living with the risk of childhood lead exposure: A day in the life ([html](#)).
- 50 years of research shows there is no safe level of childhood lead exposure ([html](#)).
- Leaded Airplane Fuel Is Poisoning a new Generation of American Children ([html](#)) 07-16-2022 | [Pulitzer Center](#).

Cardiovascular Mortality and Leaded Aviation Fuel [100LL AKA Avgas]: Evidence from Piston-Engine Air Traffic in North Carolina ([html](#)) ([pdf](#)) 04-22-2022 | International Journal of Environmental Research and Public Health ([IJERPH](#)) Special Issue [Effect of Air Pollution Exposure on Children and Elderly's Health and Neurological Functions](#). Leaded fuel used by piston-engine aircraft is the largest source of airborne lead emissions in the United States. We found higher rates of cardiovascular mortality within a few kilometers downwind of single- and multi-runway airports. We also found significantly higher cardiovascular mortality rates within a few kilometers and downwind of single-runway airports in years with more piston-engine air traffic. These results suggest that (i) *reducing lead emissions from aviation* could yield health benefits for adults, and (ii) more refined data are needed to obtain more precise estimates of these benefits.

Cardiovascular Mortality and Leaded Aviation Fuel: Evidence from Piston-Engine Air Traffic in North Carolina ([html](#)) ([pdf](#)) 05-13-2022 – PubMed Central ([PMC](#)) | National Center for Biotechnology Information ([NCBI](#)) | National Library of Medicine ([NLM](#)) | National Institute of Health ([NIH](#)) | U.S. Department of Health & Human Services ([HHS](#)) | [USA.gov](#). Similar articles in PubMed ([html](#)).

Identifying sensitive windows of airborne lead exposure associated with behavioral outcomes at age 12 ([html](#)) April 2021 | [Environmental Epidemiology](#). Official Journal of the International Society for Environmental Epidemiology ([ISEEPI](#)). Exposure **to very low concentrations** of airborne lead during childhood is associated with poor behavioral outcomes. Sensitive windows of exposure to airborne lead are identified in mid- and late childhood for increased anxiety and atypicality scores and sensitive windows for increased aggression and attention problems immediately following birth. Observed associations between exposure to airborne lead concentrations and poor behavioral outcomes at

concentrations **10 times lower** than the National Ambient Air Quality Standards ([NAAQS](#)) ([Wikipedia](#)) ([NAAQS Table](#)) set by the US Environmental Protection Agency ([EPA](#)). The increased vulnerability to ambient airborne lead exposure and behavioral problems in 12-year-old youth whose exposure to airborne lead **NEVER** exceeded the United States Environmental Protection Agency (EPA) standard.

Electron microscopic characterization of exhaust particles containing lead Dibromide beads expelled from aircraft burning leaded gasoline ([html](#)) ([pdf](#)) September 2020. <https://doi.org/10.1016/j.apr.2020.05.026> – [ScienceDirect](#). Jack D.Griffith, Lineberger Comprehensive Cancer Center ([html](#)), Departments of Microbiology and Immunology ([html](#)) ([html](#)), and Biochemistry and Biophysics ([html](#)), School of Medicine ([html](#)) University of North Carolina at Chapel Hill ([UNC](#)), Chapel Hill, NC, 27955, USA. Lead dibromide particles from aircraft exhaust are much smaller than from motor vehicle exhaust. Lead dibromide particles from aircraft exhaust may be highly toxic to the lungs. Of significant concern, the smaller aircraft particles could penetrate mucosal barriers in the lung and be readily taken up by epithelial cells. NOTE: SEE EPA PM2.5 comparison ([image](#)).

Crime of the Century: The Lead Pandemic ([html](#)) 10-25-2018 - Little Things Matter. Research has found that lead accounts for about 185,000 deaths every year, making lead the leading cause of fatal heart attacks in the United States. Lead toxicity affects people over their entire life. Children who have higher lead exposure never reach the same peak ability as children with lower exposure. Even after Tetraethyl Lead (TEL) was declared a known toxin it continues to be added to 100LL Leaded Aviation Fuel AKA Avgas. Children's exposures to lead are reflected roughly 21 years later in life.

Little Things Matter: The Impact of Toxins on the Developing Brain ([html](#)) 7:01m – YouTube. We've been studying the impact of toxins on children for the past 30 years and reached the inescapable conclusion: little things matter. NOTE: "Distribution of IQ Scores in Lead Exposed Children" at 4:43m that correlates to the alarming 47% increase of Autism Spectrum Disorder ([ASD](#)) and Attention Deficit Hyperactivity Disorder ([ADHD](#)) in Plymouth Canton Community School System (PCCS) students ([html](#)) 07-17-2019. SEE report: The Impact of Toxins on the Developing Brain ([html](#)) ([pdf](#)) March 2015, Dr. Bruce P. Lanphear | Annual Review of Public Health.

Environmental Protection Agency (EPA) Details: Strategy to Reduce Lead Exposures and Disparities in U.S. Communities Related to EPA "Endangerment Finding"

16 organizations and 146 individual signatories from across the US sent urgent email 05-23-2022 to EPA Michael Regan ([pdf](#)) in support of both an "Endangerment Finding" for leaded aviation gasoline (Avgas) AKA 100LL Leaded Aviation Fuel, as well as a *complete ban* on Avgas AKA 100LL Leaded Aviation Fuel. The request asked the EPA to *expedite* the elimination of 100LL Leaded Aviation Fuel AKA Avgas at the earliest possible opportunity to *protect* vulnerable populations from continued harm.

Some background: In a March 21, 2022 letter to EPA Administrator, Michael Regan ([pdf](#)), the local and regional governments listed below announced their support for the petition urging the U.S. Environmental Protection Agency (EPA) "to make a long-overdue endangerment finding for leaded aviation gasoline ('avgas')." They are joining with 57 organizations and 146 medical professionals, professors, advocates, and other individuals who endorsed the October 12, 2021 updated petition ([pdf](#)) ([pdf](#)). The initial August 24, 2021 filing ([pdf](#)) included Alaska Community Action on Toxics ([ACAT](#)), Center for Environmental Health ([CEH](#)) ([html](#)), Friends of the Earth ([FoE](#)), Montgomery-Gibbs Environmental Coalition ([home](#)) San Diego California, and Oregon Aviation Watch ([home](#)) Washington County Oregon.

Per the letter, "We write to urge the EPA to make an affirmative finding on the announced timelines that leaded avgas contributes to air pollution that endangers public health and welfare, and to swiftly issue emissions standards that will eliminate this last remaining leaded transportation fuel. Daily exposure to lead from avgas causes severe and avoidable harm to vulnerable communities across this nation, and eliminating it should be treated as an environmental justice priority of this federal Administration." The signatories include:

- Bay Area Air Quality Management District ([BAAQMD](#))
- County and City of San Francisco ([home](#)).
- City of Oakland ([home](#)).
- City of Santa Monica ([home](#)).
- County of Santa Clara ([home](#)). Reid-Hillview Airport Airborne Lead Study ([html](#)) - Office of Communications and Public Affairs - County of Santa Clara. SEE: Pilot Response to EPA re Aviation Lead Study at Reid Hillview Airport ([pdf](#)) 02-28-2022. Questionable pseudo-science that sounds good to some that for unknown reason(s) want to 'protect' Avgas AKA 100LL Leaded Aviation Fuel with Tetraethyl Lead (TEL) over the Health, Safety & Welfare of human beings.
- Dane County Towns Association – Advocate for town government in Dane County ([home](#)), Wisconsin. Request for Dane County Towns Association (DCTA) Letter of Support for Petition to the EPA regarding Leaded Aviation Gas ([pdf](#)).
- Town of Middleton ([home](#)), Wisconsin. City of Middleton ([home](#)) Municipal Airport - Morey Field ([C29](#)) Updates ([html](#)).

Environmental Protection Agency (EPA) Draft Strategy to Reduce Lead Exposures and Disparities in U.S. Communities

Draft Strategy to Reduce Lead Exposures and Disparities in U.S. Communities ([html](#)) ([pdf](#)) October 28, 2021 | [US EPA](#). The EPA sought input from communities affected by lead contamination through virtual workshops nationwide. The public comment period closed on March 16, 2022.

Strategy to Reduce Lead Exposures and Disparities in U.S. Communities ([html](#)) Docket [EPA-HQ-OLEM-2021-0762](#), Posted by the Environmental Protection Agency on Oct 28, 2021 | [Regulations.gov](#). The number of public comments received was 51,945.

Comment submitted by Office of the Attorney General of the State of New York et al. The Attorneys General of New York, California, the District of Columbia, Massachusetts, Pennsylvania, Delaware, Connecticut, Hawaii, Iowa, Maine, Maryland, Michigan ([AG](#)) ([html](#)) 03-21-2022, Minnesota, New Mexico, North Carolina, Oregon, Rhode Island, Vermont and Wisconsin submit the attached comments to on EPA's Draft Strategy to Reduce Lead Exposures and Disparities in U.S. Communities ([html](#)) ([pdf](#)) 03-16-2022. NOTE: Lead in Air: The Lead Strategy does not adequately address leaded aviation gasoline (avgas) AKA 100LL Leaded Aviation Fuel.

Comment submitted by Earthjustice et al ([html](#)) 03-18-2022 ([pdf](#)) 03-16-2022. It is long past time to finally end lead exposure to prevent the irreversible harms it causes. These comments are submitted by 126 groups and 53 individuals on EPA's Draft Lead Strategy. 23,771 members of the public submitted personalized comments. EPA has a major opportunity to transform federal environmental protections from lead exposure as a result of statutory deadlines, court orders, settlement agreements, and voluntary commitments that require it to adopt numerous rules related to lead over the next several

years. In accord with this Administration’s environmental justice commitments, EPA should commit to specific and swift revisions to existing policies, considering cumulative exposures to lead across all routes and pathways. [Earth Justice](#) made the final set of comments submitted to EPA available ([pdf](#)). SEE: Groups Ask EPA to Regulate Lead Pollution Around Nation’s Airports ([html](#)) 08-24-2022.

Comment submitted by County of Santa Clara ([html](#)) ([pdf](#)) 03-24-2022. Ongoing Exposures to Lead from Avgas Should be Treated as a Public Health and Environmental Justice Crisis. EPA must move swiftly to eliminate use of leaded aviation fuel [AKA Avgas or 100LL] nationwide under Section 231 of the Clean Air Act. EPA Should Use its Stated “Whole of Government Approach” to Mitigate Impacts on Lead Emission While Regulatory Action is Pending.

Comment submitted by Oregon Aviation Watch ([home](#)) Miki Barnes ([html](#)) ([pdf](#)) 03-16-2022 | . Airports Servicing Piston-Engine Aircraft Serve a Miniscule Minority. NAAQS Levels for Lead Fail to Protect Public. Inadequate Blood Lead Level Testing standards & efforts.

National Academies: Lead emissions from small aircraft can be reduced, benefiting public health and Options for Reducing Lead Emissions from Piston-Engine Aircraft

Lead emissions from small aircraft *can* be reduced, benefiting public health ([html](#)) 2021 | [National Academies](#).

Options for Reducing Lead Emissions from Piston-Engine Aircraft ([html](#)) 2021 | The National Academies Press ([NAP](#)). Smaller lead beads would rapidly transit the lung defenses and gain access to the epithelial cells. Such particles have the potential of rapidly penetrating the lung defenses. In addition, in the nasal passage, such small particles could gain *direct access* to the brain. Based on grams of lead emitted into the air for the particle size range considered by Griffith (2020) ([html](#)) ([pdf](#)), there may be 5 to 10 times more single lead-containing particles from Piston Engine Aircraft (PEA) using 100LL Leaded Aviation Fuel AKA Avgas than from legacy [automobile] motor-vehicle emissions. NOTE: SEE EPA PM2.5 comparison ([image](#)).

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[*8] Appendix - Input Provided to the National Academies of Science Project: Lead Emissions from Piston-Powered General Aviation Aircraft TRB-CAAS-18-03: September 14, 2020

The <https://close1d2.org> Team Provided Input to the National Academies of Science ([NAS](#)) Project: Lead Emissions from Piston-Powered General Aviation Aircraft TRB-CAAS-18-03 ([html](#)) September 14, 2020 v5.1.

NOTE: in September 2020 the EPA system was in BETA testing transition, some of the URLs are no longer valid and are in the process of being updated. New information for 2020 forward also needs to be added. However, there are many useful URLs that are of value referencing the distinct, disappointing and shocking lack of ANY progress over the last 50 years, literally a “Half Century” of wasted time & taxpayer money, and most importantly continued Tetraethyl Lead (TEL) damage to millions of people. Very sad results based on the number of resources that have been applied and are currently still being applied to the 100LL Leaded Aviation Fuel with Tetraethyl Lead (TEL) epidemic in 2022!

**** The pages of the NAS PDF input have been concatenated here as reference ****

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Subject: Updated References from the <https://close1d2.org> Team re Leaded Aviation Fuel with Tetraethyl Lead (TEL) and Ethylene Dibromide (EDB), Monday September 14, 2020 v5. Latest version of *this* document ([html](#)).

With Reference to Project: Lead Emissions from Piston-Powered General Aviation Aircraft TRB-CAAS-18-03. Project: ([html](#)). Our Work: ([html](#)) | Projects ([html](#)).

National Academies Public Access Records Office ([PARO](#)) Dropbox: TRB-CAAS-18-03 ([html](#)).

- National Academies ([NA](#)) [[Wikipedia](#)]
- National Academy of Sciences ([NAS](#))
 - Proceedings of the National Academy of Sciences ([PNAS](#)), official journal of the National Academy of Sciences (NAS)
 - Organization of the National Research Council (NRC) ([html](#))
 - Articles of Organization of the National Research Council (NRC) ([html](#))
 - The Research Council's Permanent Status and the Academy's New Home - The National Academy of Sciences ([html](#)) ([pdf](#)) - NCBI Bookshelf ([html](#)). Chapter: 9 The Research Council's Permanent Status and the Academy's New Home ([html](#))
- National Academy of Engineering ([NAE](#))
- National Academy of Medicine ([NAM](#))
- National Academies Press ([NAP](#))
 - Airport Cooperative Research Program (ACRP) Featured Reports & Resources from ACRP ([html](#))
- Transportation Research Board ([TRB](#)) - [TRB.org](#)
 - Airport Cooperative Research Program ([ACRP](#))
 - All Projects ([html](#)) | ACRP
 - Airport (ACRP) | Publications ([html](#))
 - Webinars ([html](#))
 - Webinars about Aviation ([html](#))
- TRB Webinar: Reducing the Impact of Lead Emissions at Airports April 25, 2017 ([html](#)) ([vimeo](#)) ([pdf](#)). [ACRP Report 162](#): Guidebook for Assessing Airport Lead Impacts. The guidebook also provides a history of lead in aviation gasoline and EPA regulations. The strategies examine how the impact from lead emissions may be minimized. The report includes a Frequently Asked Questions ([FAQ](#)) document about aviation and lead, and the Contractor's Final Report ([docx](#)). DOI: [10.17226/23625](#)
- International Civil Aviation Organization ([ICAO](#))
 - Environmental Protection ([html](#))
 - 2019 Environmental Report - Aviation and Environment ([html](#)) ([pdf](#)).

PubChem ([html](#)) | National Library of Medicine ([NLM](#)), National Center for Biotechnology Information ([NCBI](#))

Tetraethyl Lead ([TEL](#)).
Ethylene Dibromide ([EDB](#)) 1,2-Dibromoethane.
Ethylene Dichloride ([EDC](#)) 1,2-Dichloroethane.

Agency for Toxic Substances and Disease Registry ([ATSDR](#))

Toxicological Profile: Lead, CAS: 7439-92-1, August 2020 ([html](#)) ([pdf](#)). Updates for organic lead, e.g. Tetraethyl Lead (TEL), CAS: 78-00-2, absorption via inhalation exposure, oral exposure, dermal exposure, metabolism, etc.

Toxicological Profile: 1,2-Dibromoethane (Ethylene Dibromide EDB) CAS: 106-93-4, 09-2018 ([html](#)) ([pdf](#)) ([pdf](#)) (July 1992 [pdf](#)).

Toxicological Profile: 1,2-Dichloroethane (Ethylene Dichloride EDC) CAS: 107-06-2, 09-2001 ([html](#)) ([pdf](#)).

National Institute for Occupational Safety and Health ([NIOSH](#)) | Centers for Disease Control and Prevention ([CDC](#)) | Immediately Dangerous to Life or Health ([IDLH](#)).

Immediately Dangerous to Life or Health (IDLH) Value Profile: Ethylene Dibromide (EDB) (CAS: 106-93-4) July 2020 ([html](#)) ([pdf](#)).
DOI: [10.26616/NIOSHPUB2020125](https://doi.org/10.26616/NIOSHPUB2020125).

Immediately Dangerous to Life or Health (IDLH) Concentrations: Tetraethyl lead (TEL) (as Pb) (CAS: 78-00-2) May 1994 ([html](#)).

Immediately Dangerous to Life or Health Concentrations (IDLH): 1,1-Dichloroethane (Ethylene Dichloride EDC) (CAS: 107-06-2) May 1994 ([html](#)).

Tetraethyllead (Tetraethyl Lead TEL) ([html](#)) – Wikipedia.
1,2-Dibromoethane (Ethylene Dibromide EDB) ([html](#)) – Wikipedia.
1,2-Dichloroethane (Ethylene Dichloride EDC) ([html](#)) – Wikipedia.

Environmental Protection Agency (EPA)

- [US EPA](#)
- Lead (Pb) Air Pollution ([html](#))
 - Basic Information about Lead Air Pollution ([html](#))
- Airport Lead Monitoring and Modeling | Regulations for Emissions from Vehicles and Engines ([html](#))
- National Service Center for Environmental Publications ([html](#))

- Simple Search ([html](#))
- Advanced Search ([html](#))
- Fields Search ([html](#))
- Browse Publications ([html](#))
- Fuels Registration, Reporting, and Compliance Help ([html](#))
 - Registered Fuels & Fuel Additives Under 40 CFR Part 79 ([html](#))
 - Alphabetical List of Registered Gasoline and Diesel Additives ([html](#))
 - List of Registered Gasoline Additives ([html](#))

For access to the rulemaking docket containing documents relevant to the EPA's evaluation & proposed finding on the question of endangerment visit either:

- regulations.gov and enter EPA-HQ-OAR-2007-0294
- regulations.gov Legacy EPA-HQ-OAR-2007-0294 ([html](#))
- regulations.gov Beta EPA-HQ-OAR-2007-0294 (Beta [html](#))

NOTE: NEW regulations.gov is in '[Beta test](#)', URLs may change in the future.

Sunday 09-13-2020: "Regulations.gov will start redirecting users to the Beta at <https://beta.regulations.gov> on Mondays, Wednesdays, and Thursdays for 24 hours starting at 8am ET. Please note that all comments that are submitted through the Beta, both during the redirect and regular operations are provided to agencies."

Two Current Ambient Air Quality Standards for Lead

Current Ambient Air Quality Standards for Lead		
	30-Day Average	Rolling 3-Month
Average		
National Ambient Air Quality Standard	None	0.15 µg/m ³
California Ambient Air Quality Standard	1.5 µg/m ³	None

Some experts suggested revising average limits as low as 0.025 µg/m³ in 2007, this is even more urgent based on contemporary knowledge of Tetraethyl Lead (TEL) poisoning of vulnerable populations.

Decision on Lead Emissions Weighs Heavily on EPA 05-18-2007 ([html](#)) | [Science](#) | American Association for the Advancement of Science ([AAAS](#))

Lead & Health ([html](#)) | California Air Resources Board ([ARB](#)).

Intellectual Property (IP) Search

- Google Patents ([html](#))
 - unleaded aviation gasoline ([html](#)) ([csv](#)). About 654 results.
 - "unleaded aviation gasoline" ([html](#)) ([csv](#)). About 114 results.

- United States Patent and Trademark Office ([USPTO](#))
 - Search for patents ([html](#))
- World Intellectual Property Organization ([WIPO](#)). International and National Patent Collections.
 - WIPO – Simple Search ([html](#))
 - WIPO – Advanced Search ([html](#))
- Justia Patents Search ([html](#))
 - Search Patents – unleaded aviation fuel ([html](#))
 - Search Patents – “unleaded aviation fuel” ([html](#))

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- U.S. Government Publishing Office ([GPO](#))
 - govinfo ([html](#))
- Electronic Code of Federal Regulations ([eCFR](#))
 - Title 40: Protection of Environment ([html](#))
 - PART 80—Regulation of Fuels and Fuel Additives ([html](#))

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Aviation Fuels Technical Review ([pdf](#)). See chapters 7 thru 12 for overview info re Aviation Gasoline and Aircraft piston engines | Chevron Aviation Fuels ([html](#)) — [Chevron.com](#)

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Avgas ([html](#)) – Wikipedia

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.....2020s;.....
The Environmental Protection Agency (EPA) is evaluating the impact of lead emissions from aircraft using leaded aviation gasoline in order to make a determination regarding whether aircraft lead emissions cause or contribute to air pollution which may reasonably be anticipated to endanger public health or welfare.

The EPA currently intends to issue a proposed finding on the question of endangerment in 2017. This proposed finding will then undergo public notice and comment. After evaluating comments on the proposal, EPA plans to issue a final determination in 2018 ([html](#)) (*still delayed as of September 2020*).

Fact Sheet: Technical Update for Reports on the Impact of Lead Emissions from Piston-Engine Aircraft on Air Quality Near U.S. Airports ([pdf](#)) (4 pp, 140 K, February 2020, EPA-420-F-20-008).

- Model-extrapolated Estimates of Airborne Lead Concentrations at U.S. Airports ([pdf](#)) (144 pp, 4.1 MB, February 2020, EPA-420-R-20-003). This report provides estimated ranges of lead concentrations at and near airports where leaded aviation gas is used.
 - EPA Response to External Peer Review Comments on the EPA Report: Model-extrapolated Estimates of Airborne Lead Concentrations at U.S. Airports ([pdf](#)) (67 pp, 1.4 MB, February 2020, EPA-420-R-20-004)
- National Analysis of the Populations Residing Near or Attending School Near U.S. Airports ([pdf](#)) (28 pp, 1 MB, February 2020, EPA-420-R-20-001). This report provides a national-scale analysis of the number of people who live or attend school within 500 meters (one half kilometer) of airport runways in the U.S.
 - EPA Response to External Peer Review Comments on the EPA Report: National Analysis of the Populations Residing Near or Attending School Near U.S. Airports ([pdf](#)) (135 pp, 2.7 MB, February 2020, EPA-420-R-20-002)

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Leaded Aviation Fuel May Present Long-Term Effects on Campus Life from the Adjacent Albert Whitted Airport, 08-25-2020 ([html](#)) ([pdf](#)) | [ChemRxiv](#) ([html](#)). AirNav: KSPG - Albert Whitted Airport ([html](#)). Albert Whitted Airport ([html](#)) – Wikipedia. Albert Whitted Airport ([html](#)) - St. Petersburg. University of South Florida, St Petersburg. City of St Petersburg: Albert Whitted Airport ([html](#)) - Google Maps.

Medical & University Facilities dangerous distance's from KSPG airport:

- University of South Florida, St. Petersburg - 100 m

- Johns Hopkins All Children's Hospital - 575 m
- Johns Hopkins All Children's Child Development and Rehabilitation Center - 655 m
- Ronald McDonald House - 530 m
- All Children's Hospital Outpatient Care Center - 629 m
- Bayfront Health St. Petersburg - 779 m

Lead emissions from the use of leaded avgas in Turkey 08-06-2020 ([html](#)) | Aircraft Engineering and Aerospace Technology ([html](#)) | Emerald Insight ([html](#)). DOI: [10.1108/AEAT-05-2020-0108](#)

Review of DoD's Proposed Occupational Exposure Limits for Lead 2020 DELS-BEST-18-05. Project: ([html](#)). Our Work: ([html](#)). | Projects ([html](#)) | [NAS](#) | [NAP](#). Consensus Study Report.

Introduction - Review of the Department of Defense Biokinetic Modeling Approach in Support of Establishing an Airborne Lead Exposure Limit ([html](#)) ([pdf](#)) | NCBI Bookshelf ([html](#)), National Center for Biotechnology Information ([NCBI](#)), U.S. National Library of Medicine ([NLM](#)).

Measuring Quality of Life in Communities Surrounding Airports 2020 ([html](#)) [NAP](#). ACRP Research Report 221.

Guidance for Using the Interactive Tool for Understanding NEPA at General Aviation Airports 2020 ([html](#)) | [NAP](#). ACRP Research Report 211.

Airport Environmental Research Roadmap Narrative Report 2020 ([html](#)) | [NAP](#). Web Only Document 45.

2010s
 Progress Report on the Federal Action Plan to Reduce Childhood Lead Exposures and Associated Health Impacts, EPA October 2019 ([pdf](#)) (48 pp, 20 MB)

Implementation Status Report for EPA Actions under the December 2018 Federal Action Plan to Reduce Childhood Lead Exposures and Associated Health Impacts ([pdf](#)) (32 pp, 8 MB, April 2019, EPA 100-R-19-003)

Airport Management Guide for Providing Aircraft Fueling Services 2019 ([html](#)) | [NAP](#). ACRP Research Report 192.

The concurrent decline of soil lead and children's blood lead in New Orleans ([html](#)) ([pdf](#)). PNAS October 29, 2019 116 (44) 22058-22064; first published October 14, 2019 | [PNAS](#). Author comment: other researchers, however, have indicated that Pb contamination of soil from TEL [Tetraethyl Lead] is at least as

important, if not more so, than lead-based paint as a source of children's Pb exposure.

DOI: [10.1073/pnas.1906092116](https://doi.org/10.1073/pnas.1906092116)

Recent Increases in Air Pollution: Evidence and Implications for Mortality ([html](#))
Karen Clay & Nicholas Muller, NBER Working Paper, October 2019. Air quality has worsened since 2016, associated with more premature deaths in U.S. The health implications of this increase in PM2.5 between 2016 and 2018 are significant. The increase was associated with 9,700 additional premature deaths in 2018. At conventional valuations, these deaths represent damages of \$89 billion.

Air quality has worsened since 2016, associated with more premature deaths in U.S. ([html](#)) ([pdf](#)) 11-27-2019 | [Phys.org](#). Decreases in enforcement of the Clean Air Act: Enforcement of this law may influence compliance by firms, and the study found that the most frequent type of enforcement of the Clean Air Act fell from 2009 to 2016 and continued to fall from 2016 to 2018.

Rethinking the Value of Life: A Critical Appraisal of the Value of a Statistical Life ([html](#)) ([pdf](#)) January 2020 | Center for Growth and Opportunity ([html](#)) at Utah State University ([html](#)). Given that current estimates of the Value of a Statistical Life (VSL) used in regulatory impact analysis are in the range of \$10 million dollars, and that these values are attached to the lives of the elderly, it seems likely that the EPA's benefits estimates are off. Therefore, it's worth considering how alternative metrics might change policy conclusions. This change alone would likely wipe out most of the benefits of EPA air regulations.

The Young, the Old, and the Economists: Rethinking How Agencies Account for Age in Cost-Benefit Analysis ([html](#)) ([pdf](#)) 2015 Yale Journal of Health Policy, Law, and Ethics ([html](#)) Volume 14 Issue 2 Article 3 | Yale Law School ([html](#)).

It might be time to re-examine EPA formulas for calculating the Value of a Statistical Life (VSL) and how this realistically relates to Health, Safety and Welfare of actual human lives, especially with respect to pregnant women, babies and school children.

For more details re EPA formulas see: Mortality Risk Valuation ([html](#)) | Environmental Economics ([html](#)) | [US EPA](#).

A Critical Assessment of the EPA's Air Program at Fifty and a Suggestion for How It Might Do Even Better 2020, E. Donald Elliott. Case Western Reserve Law Review ([html](#)) | Vol 70 | Issue 4 ([html](#)) | Article 6 ([html](#)) ([pdf](#)) | Case Western Reserve University School of Law ([html](#)) | Case Western Reserve University ([html](#)).

U.S. GAO - Environmental Regulation: EPA Should Improve Adherence to Guidance for Selected Elements of Regulatory Impact Analyses (RIA) ([html](#)) ([pdf](#)) (highlights [pdf](#)). GAO-14-519: Published: Jul 18, 2014. Publicly Released: Aug 11, 2014. First, EPA did not monetize certain benefits and costs related to the primary purposes or key impacts of the rules GAO reviewed, such as reducing hazardous air pollutants and water quality effects. EPA officials said resource and data limitations constrained the agency's ability to monetize these effects. OMB guidance acknowledges that monetizing effects is not always possible.

However, without doing so, the public may face challenges understanding the trade-offs associated with regulatory alternatives. Second, EPA estimated effects of its regulations on employment, in part, using a study that, according to EPA officials, represented the best reasonably obtainable data when they conducted their analyses. However, the study was based on data that were more than 20 years old and may not have represented the regulated entities addressed in the RIAs. **NOTE:** as of March 2020 the GAO is keeping two Recommendations in OPEN status:

- #1 As of March 2020, GAO is keeping this recommendation open to ensure the transparency and clarity of information presented for selected elements in and across EPA's Regulatory Impact Analyses (RIA)s.
- #4 As of March 2020, GAO is keeping this recommendation open until it is clearer how EPA is using the Science Advisory Board's (SAB) work to develop its regulatory impact analyses.

See 'Recommendations' tab ([html](#)) for details.

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[SocArXiv](#) Papers | The social cost of leaded gasoline [Leaded 100LL Aviation Fuel]: Evidence from regulatory exemptions ([html](#)) ([pdf](#)) 92 pages, submitted September 22, 2019, last edited: October 23, 2019.
DOI [10.31235/osf.io/rdy6g](https://doi.org/10.31235/osf.io/rdy6g)

Paper was updated, renamed, and resubmitted: The effect of leaded gasoline on elderly mortality: Evidence from regulatory exemptions. Alex Hollingsworth and Ivan Rudik, June 8, 2020.

Original paper: The social cost of leaded gasoline: Evidence from regulatory exemptions ([html](#)) ([pdf](#)) | Semantic Scholar.

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Response Surface Methodology (RSM) in Optimization of Performance and Exhaust Emissions of RON 97, RON 98, and RON 100 (Motor Gasoline) and AVGAS 100LL (Aviation Gasoline) in Lycoming O-320 Engine ([html](#)) 08-19-2019 (03-12-04-0029 Journal Article) - [SAE Mobilus](#). Federal Aviation Administration (FAA)'s 20 years of research and development with 200 unleaded blends and full-scale engine tests on 45 high-octane unleaded blends has *not* found a "drop-

in” unleaded replacement for aviation gasoline (AVGAS) 100 low lead (100LL) fuel.

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Aggressive Canton Plymouth Mettetal 1d2 airstrip expansion & growth by Michigan Department of Transportation (MDOT) in densely populated neighborhoods surrounded by schools directly correlates to 47% increase 07-19-2019 ([html](#)) | Hometown Life - in the number of Autism Spectrum Disorder (ASD) and Attention Deficit Hyperactivity Disorder (ADHD) students at Plymouth-Canton Community Schools ([PCCS](#)) over the last decade.

NOTE: [run-up](#) areas at [Canton Plymouth](#) Mettetal 1d2 airstrip ([html](#)) are dangerously close between 190m to 950m to THREE schools and TWO elderly assisted living & rehabilitation facilities! PCCS Hulsing Elementary School ([html](#)), Plymouth Christian Academy ([html](#)), PCCS East Middle School ([html](#)). Canton-Plymouth Mettetal Airport (1D2) ([html](#)) - Google Maps.

Curtailing Lead Aerosols: Effects of Primary Prevention on Declining Soil Lead and Children’s Blood Lead in Metropolitan New Orleans ([html](#)) ([pdf](#)). Int J Environ Res Public Health ([html](#)) 06-12-2019; 16(12): 68. TEL is a still a legal product in the U.S. and used as an additive to aviation gas or LL100 avgas (containing 0.56 g Pb per L). The U.S. EPA estimates that avgas now accounts for about 60% of the current Pb aerosol in the U.S. An outcome of avgas is that BPb is higher for children living within 0.5–1 km of airports where avgas is used compared with children living 1 km beyond these airports. Particularly concerning is the fact that all grades of fuel, leaded and unleaded gasoline, are transported through the same pipelines. To protect petroleum industry from liability due to lead contamination of fuel an allowable amount of TEL is permitted in unleaded gasoline.

IJERPH ([html](#)) | Free Full-Text | Curtailing Lead Aerosols: Effects of Primary Prevention on Declining Soil Lead and Children’s Blood Lead in Metropolitan New Orleans. ([html](#)) ([pdf](#)). DOI: [10.3390/ijerph16122068](https://doi.org/10.3390/ijerph16122068)

Elemental characterization of general aviation aircraft emissions using moss bags | SpringerLink. Received: 01-13-2019 / Accepted: 3 July 2019 / Published online: 15 July 2019 # Springer-Verlag GmbH Germany, part of Springer Nature 2019 ([html](#)) ([PubMed](#)).

Airport Air Quality Management 101 2018 ([html](#)) | [NAP](#). ACRP Research Report 185.

A review of phase separation issues in aviation gasoline fuel and motor gasoline fuels in aviation 2018 ([html](#)) ([pdf](#)) – [IOPscience](#)
DOI: [10.1088/1757-899X/370/1/012007](https://doi.org/10.1088/1757-899X/370/1/012007)

Ethanol content concerns in motor gasoline (mogas) in aviation in comparison to aviation gasoline (avgas) 2018 ([html](#)) ([pdf](#)) – [IOPscience](#).

DOI: [10.1088/1757-899X/370/1/012009](https://doi.org/10.1088/1757-899X/370/1/012009)

Emissions of piston engine aircraft using aviation gasoline (avgas) and motor gasoline (mogas) as fuel – a review 2018 ([html](#)) ([pdf](#)) - [IOPscience](#)

DOI: [10.1088/1757-899X/370/1/012012](https://doi.org/10.1088/1757-899X/370/1/012012)

Concerns over use of leaded aviation gasoline (avgas) fuel, Chemical Engineering Transactions Vol. 63, 2018 ([pdf](#)) | ([html](#)) Semantic Scholar.

DOI: [10.3303/CET1863031](https://doi.org/10.3303/CET1863031)

A new bottom-up emissions estimation approach for aircraft sources in support of air quality modelling for community-scale assessments around airports ([html](#))

([pdf](#)) | [Europe PMC](#)

International Journal of Environment and Pollution, 12-31-2018, 65(123):43-58.

DOI: [10.1504/ijep.2019.101832](https://doi.org/10.1504/ijep.2019.101832)

Emission Due to Motor Gasoline Fuel in Reciprocating Lycoming O-320 Engine in Comparison to Aviation Gasoline Fuel 07-10-2018 ([pdf](#)). Environment & Ecosystem Science ([EES](#)) 2(2) (2018) 20-24.

DOI : [10.26480/ees.02.2018.20.24](https://doi.org/10.26480/ees.02.2018.20.24)

Pro-inflammatory responses to PM0.25 from airport and urban traffic emissions ([html](#)) | [Europe PMC](#)

The Science of the Total Environment, 06-04-2018, 640-641:997-1003.

DOI: [10.1016/j.scitotenv.2018.05.382](https://doi.org/10.1016/j.scitotenv.2018.05.382)

Chemical composition measurements confirmed that aircraft emissions were the major source to LAX PM0.25. Results demonstrated considerable toxicity of airport-related particles, even at low exposure concentrations, suggesting that airport emission as source of PM0.25 may also contribute to the adverse effects on public health attributable to PM.

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The information EPA and others have been collecting is part of a broad set of information that EPA expects to consider when evaluating the question of whether aircraft lead emissions cause or contribute to air pollution which may

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- Air Force Research Laboratory ([AFRL](#)) Aerospace Systems Directorate ([RQ](#)) - The Aerospace Systems Directorate brings together world-class

facilities including a fuels research facility, structural testing labs, compressor research facility, rocket testing facilities, supersonic and subsonic wind tunnels, flight simulation lab, and many other cutting-edge research labs.

- Wright-Patterson AFB ([WPAFB](#))
- Air Force Materiel Command ([AFMC](#))
- U.S. Air Force ([AF](#)), U.S. Air Force ([USAF](#))

See § 3.3.8 Unleaded Avgas. The Air Force utilizes leaded avgas (100LL) to fuel the MQ-1 Predator UAV to help carry out its mission. There are several problems with using 100LL: 1) a future ban on lead in avgas from the EPA, 2) there is only one supplier of the octane-enhancer additive tetraethyl lead (TEL), 3) lead deposits can decrease performance, increase maintenance, and shorten engine lifetime and 4) its costs outside the continental US are quite high. One solution to solving these problems is to find an unleaded high-octane replacement fuel that is lower in cost. This solution would align with USAF's Energy Strategic Plan in multiple ways. First, it could improve resiliency by negating the need for TEL and avoiding a ban on 100LL. Second, it could reduce demand by providing a solution that consumes less fuel. Third, it could ensure supply by utilizing a renewable fuel. The objective of this project was, therefore, to find an available low-cost unleaded fuel that is suitable for operation in the MQ-1 engine.

Conclusion: All of the four options available have the ability to solve the problems associated with 100LL and save the USAF millions of dollars annually.

- MQ-1B Predator September 23, 2015 ([html](#)) > U.S. Air Force > Fact Sheet Display
- Air Force announces official retirement date for iconic MQ-1 Predator drone 02-16-2018 ([html](#)) | Air Force Times ([html](#))
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Department of Defense ([DOD](#)) Standard Practice Quality Assurance/Surveillance for Fuels, Lubricants and Related Products 03-28-2016 ([pdf](#)). MIL-STD-3004D w/Change 1 28 MAR 2016, Superseding MIL-STD-3004D 10 October 2014.

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14th Report on Carcinogens ([html](#)) U.S. Department of Health and Human Services released the 14th Report on Carcinogens on November 3, 2016. The Report on Carcinogens is a congressionally mandated, science-based, public health document that National Toxicology Program ([NTP](#)) prepares for the U.S. Department of Health & Human Services ([HHS](#)) Secretary ([html](#)).

- Complete 14th Report on Carcinogens ([zip](#))
- 1,2-Dibromoethane, Ethylene Dibromide (EDB) ([pdf](#))
- Lead and Lead Compounds ([pdf](#)) including Tetraethyl Lead (TEL)
- 1,2-Dichloroethane, Ethylene Dichloride (EDC) ([pdf](#))

Myths & Realities of Leaded Aviation Fuel September 2016 ([html](#)) ([html](#)) ([pdf](#)) | Prepared by Center for Environmental Health ([CEH](#)) for Friends of the Earth ([FoE](#)), funding provided by The New York Community Trust ([html](#)).

Costs of IQ Loss from Leaded Aviation Gasoline Emissions ([html](#)) ([pdf](#)). Environ Sci Technol. 2016 Sep 6; 50(17): 9026–9033. Published online 08-23-2016. doi: [10.1021/acs.est.6b02910](https://doi.org/10.1021/acs.est.6b02910)

Spatial Differences and Costs of Emissions at U.S. Airport Hubs ([html](#)) | [Europe PMC](#). Southeast Michigan shows annual airport damages of \$25 - \$50 million dollars annually. As the U.S. aviation system grows, it is possible to minimize human and environmental costs by shifting aircraft technologies and expanding service into airports where fewer impacts are likely to occur. Environmental Science & Technology, 03-23-2016, 50(8):4149-4158. DOI: [10.1021/acs.est.5b04491](https://doi.org/10.1021/acs.est.5b04491)

Past, present, future of Fuelling [sp?] ([html](#)) | News and views ([html](#)) | [Air BP](#). Initially developed as an unleaded fuel, a lead additive – Tetra Ethyl Lead (TEL) - was introduced around 80 years ago. TEL has been a vital ingredient in achieving the high octane quality of Avgas. The current grade Avgas 100LL (low lead), which was introduced in the 1970s, is still widely available around the world.

However, environmental pressures to eliminate the use of lead and seek cleaner, greener fuels now face the industry. Air BP introduced *unleaded Avgas (UL91)* in 2016 and will continue to explore and develop unleaded fuel options to satisfy demand.

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- June 10, 2013, FAA issued a request for candidate fuel producers to submit unleaded fuel formulations to be evaluated as replacements for 100LL.
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- Appendices A-E: Human Studies ([pdf](#)) (includes all appendices).
- Appendix A: Human Studies – Neurological Studies ([pdf](#)).
- Appendix B: Human Studies – Immune ([pdf](#)).
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This final report presents the results of EPA's study to develop a modeling approach to quantify how emissions from piston-engine aircraft affect ambient lead levels at the local scale.

- Advance Notice of Proposed Rulemaking ([pdf](#)) (30 pp, 719 K, EPA published April 28, 2010). Federal Register/Vol. 75, No. 81/Wednesday, April 28, 2010/Proposed Rules.
 - Extension of Comment Period ([pdf](#)) (2 pp, 141 K, EPA published June 24, 2010)

Memorandum on Selection of Airports for the Airport Monitoring Study ([pdf](#)) (40 pp, 15 MB, EPA November 18, 2010).

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European Automobile Manufacturers' Association ([ACEA](#)) Position on Metal Based Fuel Additives ([pdf](#)), 11-16-2009. Policy makers have a duty to act proactively to prevent harm rather than reactively when the harm occurs.

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In the 1970s, the US Court of Appeals applied the precautionary principle to a regulation on lead phase-out. It found that the EPA does not have to prove that a product is a public health hazard in order to prohibit its use. It merely should show that the product is likely to be dangerous. This finding allowed the phase-out and the eventual ban on leaded gasoline [for automobiles].

Aircraft emission impacts in a neighborhood adjacent to a general aviation airport in southern California ([html](#)) | [Europe PMC](#).
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DOI: [10.1289/ehp.0800534](#)

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Aircraft hydrocarbon emissions at Oakland International Airport [Michigan] ([html](#)) | [Europe PMC](#). *Environmental Science & Technology*, 02-12-2009, 43(6):1730-1736.
DOI: [10.1021/es801307m](#)

Using estimates of operational fuel flow rates at idle, this analysis suggests that current emission inventories at the temperatures encountered at this airport underestimate hydrocarbon emissions from the idle phase of operation by 16-45%.

.....
Methodology to estimate particulate matter emissions from certified commercial aircraft engines ([html](#)) ([pdf](#)) | [Europe PMC](#).
Journal of the Air & Waste Management Association (1995), 12-31-2008, 59(1):91-100.
DOI: [10.3155/1047-3289.59.1.91](#)

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USEPA (2008) Lead Emissions from the Use of Leaded Aviation Gasoline in the United States October 2008 (Beta [html](#)) ([pdf](#)) - Technical Support Document [EPA420-R-08-020].
.....

USEPA (2008) Natural Attenuation of the Lead Scavengers EDB [Ethylene Dibromide] and 1, 2-DCA [Ethylene Dichloride EDC, DCE] September 2008 (Beta [html](#)) ([pdf](#)) [EPA 600/R-08/107].

Flight performance testing of ethanol/100LL fuel blends during cruise flight 05-2008 ([html](#)) ([pdf](#)). Timothy James Compton, M.S. Thesis | Baylor University ([html](#)) | A Nationally Ranked Christian University, Undergraduate & Graduate Research Colleges Universities Schools in Texas. Approved by the Institute for Air Science ([html](#)), Maxwell E. Shauck, Jr., Ph.D. (CV [pdf](#)), Chairperson.

Executive Summary April 24, 2008 ([pdf](#)), CRC Research Results, Unleaded High Octane Aviation Gasoline, A Report to the CRC Unleaded Avgas Development Panel | Coordinating Research Council ([CRC](#)).

Membership of the CRC Unleaded AVGAS Development Panel currently consists of over 60 individuals representing over 40 different organizations. Working in parallel with this panel, and with mostly a common membership, is the CRC Aviation Engine Octane Rating Panel. Members include:

- Aircraft Owners and Pilots Association ([AOPA](#)) [[Wikipedia](#)]
- Air BP ([html](#))
- Cessna Aircraft | Jet, Turboprop and Piston Models ([html](#)) | Textron Aviation ([html](#))
- Chevron Aviation Fuels ([html](#)) — [Chevron.com](#)
- ConocoPhillips ([html](#)) | Phillips 66 Aviation ([html](#))
- Dixie Services
- EAA Experimental Aircraft Association ([EAA](#)) [[Wikipedia](#)]
- Ethyl Corporation ([html](#))
- ExxonMobil Aviation ([html](#)) | Avgas ([html](#)) | ExxonMobil ([html](#))
- Federal Aviation Administration ([FAA](#)) | William J. Hughes Technical Center ([html](#))
- GAMA General Aviation Manufacturers Association ([GAMA](#)) [[Wikipedia](#)]
- LyondellBasell Fuels ([html](#)) | LyondellBasell Industries ([html](#)) [previously Lyondell Chemical]
- Etc.

Summary

- Motor Octane Number (MON) Screening of 202 Unleaded Fuel Blends
- Full Scale Engine Testing of 30 Unleaded Blends (2002)
- Full Scale Engine Testing of 45 Unleaded Blends (2005 – 2007)
- Engine Tests of Leaded Vs Unleaded Fuels of Similar MON
- ASTM D 6424 was implemented in 1999 and applies to the octane rating of normally aspirated aircraft engines
- NOTE: Final Report issued June 2010

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Aircraft and Airport-Related Hazardous Air Pollutants: Research Needs and Analysis 2008 ([html](#)) | [NAP](#). CRP Report 7.

Research Needs Associated with Particulate Emissions at Airports 2008 ([html](#)) | [NAP](#). ACRP Report 6.

Summarizing and Interpreting Aircraft Gaseous and Particulate Emissions Data 2008 ([html](#)) | [NAP](#). ACRP Report 9.

.....
Calculating Piston-Engine Aircraft Airport Inventories for Lead for the 2008 National Emissions Inventory ([pdf](#)) (22 pp, 738 K, EPA-420-B-10-044, December 23, 2010). This Technical Support Document (TSD) provides the methodology used to estimate airport-specific lead emissions for the National Emissions Inventory (NEI).

.....
Cover letter to Bryan Manning from Dave Atwood, Coordinating Research Council ([CRC](#)), Vice Chairman, Aviation Gasolines Committee 8/29/2007 (Beta [html](#)) ([pdf](#)), concerning 2003 executive summary report describing efforts to find an unleaded replacement for 100LL leaded aviation gasoline, August 29, 2007; and presentation given to Coordinating Research Council (CRC) in 2006 covering recent testing results.

Two attachments

- Executive Summary, Coordinating Research Council (CRC) Research Results Toward Development of an Unleaded High Octane Aviation Gasoline, April 1, 2003 (MS Word [doc](#))
- Presentation to Coordinating Research Council (CRC) Unleaded Avgas Development Group Meeting, May 1, 2006 (MS Powerpoint [ppt](#))

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Request for Public Comment on Petition to Limit Lead Emissions from General Aviation Aircraft ([pdf](#)) (4 pp, 153 K, EPA-HQ-OAR-2007-0294, November 16, 2007)

Petition from Friends of the Earth ([pdf](#)) (12 pp, 311 K, EPA October 3, 2006)

.....
Leaded-Gasoline Additives Still Contaminate Groundwater 09-15-2005 ([html](#)) ([pdf](#)) | Environmental Science & Technology 2005, 39, 18, 378A–384A, DOI: [10.1021/es053352k](#) | Environmental Science & Technology ([EST](#)). Ethylene dibromide (EDB) and 1,2-dichloroethane (ethylene dichloride, EDC) persist at high levels despite a phaseout in the late 1980s, but they get little attention.

Air Quality Management in the United States 2004 ([html](#)) | [NAP](#). Consensus Study Report.

Research Priorities for Airborne Particulate Matter: IV. Continuing Research Progress 2004 ([html](#)) | [NAP](#). Consensus Study Report.

Full-Scale Engine Knock Tests of 30 Unleaded, High-Octane Blends September 2004 (Beta [html](#)) ([pdf](#)), David Atwood and Julian Canizales, Final Report, DOT/FAA/AR-04/25.

Direct Identification of Trace Metals in Fine and Ultrafine Particles in the Detroit Urban Atmosphere 03-17-2004 Environ. Sci. Technol. 2004, 38, 8, 2289–2297 ([html](#)) | Environmental Science & Technology ([html](#)). Most of the trace element particles detected in this study were within a range of 0.01–1.0 µm in size, which has the longest atmospheric residence time (~100 days). Increased chemical reactivity owing to the size of nanoparticles may be expected for most of the trace metal particles observed.

DOI: [10.1021/es035010p](https://doi.org/10.1021/es035010p)

Direct Identification of Trace Metals in Fine and Ultrafine Particles in the Detroit Urban Atmosphere ([html](#)) | [PubMed](#) | ([html](#)) ([pdf](#)) | [CiteSeerX](#).

The Rise and Fall of Tetraethyllead | Organometallics ([html](#)) 2003, 22, 25, 5154–5178, 12-01-2003 ([html](#)) ([pdf](#)) DOI: [10.1021/om030621b](https://doi.org/10.1021/om030621b)

Controlling Lead Exposure During the Process of Cleaning Aviation Spark Plugs, Embry-Riddle Aeronautical University Prescott Arizona Campus, 05-2003 ([html](#)) ([pdf](#)).

Controlling Airport-Related Air Pollution ([html](#)) ([pdf](#)), 2003 — Northeast States for Coordinated Air Use Management ([NESCAUM](#)).

Four decades of gasoline lead emissions and control policies in Europe: a retrospective assessment 07-20-2003 ([html](#)) [Science of The Total Environment, Volume 311, Issues 1–3](#), 20 July 2003, Pages 151-176 – [ScienceDirect](#) | ([html](#)) – PubMed | ([pdf](#)) - [CiteSeerX](#).

DOI: [10.1016/S0048-9697\(03\)00051-2](https://doi.org/10.1016/S0048-9697(03)00051-2)

[Resources](#) - [Library Contents](#) - [FAA](#) - [FAASTeam](#) - [FAASafety.gov](#). 2002 - All About Fuel - P-8740-35 ([html](#)). In 1971, the oil companies began development of a single grade avgas that would meet the needs of all reciprocating powered aircraft. The 70s appear to be the start of the transition from 80/87 to 100LL.

Use of Alternate Fuels in Light Aircraft (2002-01-1539) 04-16-2002 ([html](#)) | Society of Automotive Engineers ([SAE](#)). Research to date demonstrates that there are no real problems and many benefits when operating aircraft on ethanol

fuel, and that there are no problems operating an ethanol-converted airplane on aviation fuel.

Assessment of health effects in workers at gasoline station ([html](#)) ([pdf](#)). Bosnian Journal of Basic Medical Sciences([BJBMS](#)) 2 (1-2) 2002.
DOI: [10.17305/bjbms.2002.3579](#)

Research Priorities for Airborne Particulate Matter: III. Early Research Progress 2001 ([html](#)) | [NAP](#). Consensus Study Report.

Global Air Quality: An Imperative for Long-Term Observational Strategies 2001 ([html](#)) | [NAP](#). Consensus Study Report.

Airports and the General Conformity Process 03-01-2001 ([html](#)) ([pdf](#)) | Institute of Transportation Studies ([html](#)) | UC Berkeley ([html](#)).
Permalink: <https://escholarship.org/uc/item/8nw2z88q>

Airports and the General Conformity Process 03-2001 ([html](#)) | Transport Research International Documentation ([TRID](#)) | Transportation Research Board ([TRB](#)).

Combustion aerosols: factors governing their size and composition and implications to human health ([html](#)) ([pdf](#)) | [Europe PMC](#).
Journal of the Air & Waste Management Association (1995), 08-31-2000, 50(9):1565-618; discussion 1619-22.

DOI: [10.1080/10473289.2000.10464197](#)

PM from internal combustion (IC) engines burning gasoline and diesel, are a significant source of primary particles smaller than 2.5 microns (PM_{2.5}) in urban areas. Particles containing transition metals, ultrafine particles, and soot are emphasized because these types of particles have been studied extensively, and their emissions are controlled by the fuel composition and the oxidant-temperature-mixing history from the flame to the stack.

.....1990s.....
Evaluation of Reciprocating Aircraft Engines With Unleaded Fuels, David Atwood and Kenneth Knopp, December 1999 (Beta [html](#)) ([pdf](#)), Final Report, DOT/FAA/AR-99/70, FAA Technical Center ([html](#)).

Development of the First Unleaded Aviation Gasoline ASTM Specification (1999-01-1569) 04-20-1999 ([html](#)) Society of Automotive Engineers ([SAE](#)).
gasoline.

Implementer's Guide to Phasing Out Lead in Gasoline ([pdf](#)) 160-B-99-001, March 1999. United States Environmental Protection Agency (EPA), Office of International Activities ([html](#)). This Guide is written for officials who are responsible for implementing the phase out of lead additives in gasoline. It assumes that their governments have already made the decision to eliminate the

use of lead additives, but have not yet determined how and when to accomplish this.

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Research Priorities for Airborne Particulate Matter: II. Evaluating Research Progress and Updating the Portfolio 1999 ([html](#)) | [NAP](#). National Research Council (NRC).

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Review of the U.S. Department of Energy Office of Fossil Energy's Research Plan for Fine Particulates 1999 ([html](#)) | [NAP](#). National Research Council (NRC).

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Research Priorities for Airborne Particulate Matter: I. Immediate Priorities and a Long-Range Research Portfolio 1998 ([html](#)) | [NAP](#). National Research Council (NRC).

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Locating and Estimating Air Emissions from Sources of Lead and Lead Compounds May 1998 ([pdf](#)) EPA-454/R-98-006. United States Environmental Protection Agency (EPA), Office of Air Quality Planning and Standards, Research Triangle Park, NC 27711.

.....
Proceedings of the First International Conference on Alternative Aviation Fuels ([pdf](#)), May 1996 Final Report, DOT/FAA/AR-96/42. Office of Aviation Research, Washington, D.C. 20591.

- In about two years [~1998], the U.S. Environmental Protection Agency (EPA) is going to banish TEL(tetra-ethyl-lead) form Avgas (aviation gasoline).
- The EAA's (Experimental Aviation Association) Autogas program is a very good example of both. EAA showed great initiative in responding to the need for safety using Autogas. As a result many light aircraft now operate legally, economically and safely with Autogas.

.....
Prohibition on Gasoline Containing Lead or Lead Additives for Highway Use. SUMMARY: The Clean Air Act prohibits the introduction of gasoline containing lead or lead additives into commerce for use as a motor vehicle fuel after December 31, 1995 ([pdf](#)). Federal Register / Vol. 61, No. 23 / Friday, February 2, 1996, Direct final rule.

.....
Lead in the Americas: A Call for Action 1996 ([html](#)). Institute of Medicine ([html](#)), Washington, DC: The National Academies ([html](#)). DOI: [10.17226/9168](#). National Research Council (NRC). Introduction: Of special concern is lead's impact on children, whose nervous systems are particularly sensitive. Among the most deleterious neuropsychological effects of lead poisoning on the very young are learning and reading disabilities, reduced psychometric intelligence, and childhood behavioral disorders. All of these have been recognized over time to

occur at progressively lower levels of exposure, and all may be predictive of serious behavioral and other disorders later in life.

Permissible Exposure Levels for Selected Military Fuel Vapors 1996 ([html](#)) | [NAP](#). National Research Council (NRC).

Federal Aviation Administration ([FAA](#)) Advisory Circulars ([ACs](#)): Type Certification [[Wikipedia](#)] of Automobile Gasoline In Part 23 Airplanes with Reciprocating Engines ([pdf](#)), Date: 3/2/95 AC No: 23.1521-1B.

Measuring Lead Exposure in Infants, Children, and Other Sensitive Populations 1993 ([html](#)) | [NAP](#). National Research Council (NRC).

Toxic heavy metals: materials cycle optimization ([html](#)) ([pdf](#)) PNAS February 1, 1992 89 (3) 815-820 | [PNAS](#). In fact, there are also major flows of toxic heavy metals into the environment resulting from inherently dissipative use. Tetraethyl lead added to gasoline is the classic example of such a dissipative use. DOI: [10.1073/pnas.89.3.815](#)

Human Exposure Assessment for Airborne Pollutants: Advances and Opportunities 1991 ([html](#)) | [NAP](#). Consensus Study Report.

The Rise And Fall of Leaded Gasoline ([pdf](#)). The Science of the Total Environment ([html](#)), 92 (1990)1~28 13 [Elsevier](#).

Fuels to Drive Our Future 1990 ([html](#)) | [NAP](#). Consensus Study Report.

.....1980s;.....
Alternate Fuels for General Aviation Aircraft with Spark Ignition Engines ([pdf](#)), June 1988 Final Report, DOT/FAA/CT88/05. FAA Technical Center Atlantic City International Airport N.J. 08405.

Air Pollution, the Automobile, and Public Health 1988 ([html](#)) | [NAP](#). Consensus Study Report.

Autogas in General Aviation Aircraft March 1987 (Beta [html](#)) ([pdf](#)), H. Stewart Byrnes et al., Final Report, DOT/FAA/CT-87/05, FAA Technical Center ([html](#)).

Avgas/Autogas Comparison: Winter Fuels ([pdf](#)) July 1986. DOT/FAA/CT-86/21, AD-A174 091. Federal Aviation Administration (FAA) Technical Center ([html](#)), US DOT ([html](#)) | Defense Technical Information Center ([DTIC](#)).

Epidemiology and Air Pollution 1985 ([html](#)) | [NAP](#). National Research Council (NRC).

A 'gift of God'?: The public health controversy over leaded gasoline during the 1920s, April 1985 | PubMed ([html](#)) | PubMed Central ([html](#)) ([pdf](#)) ([pdf](#)). [Am J Public Health](#). 1985 April; 75(4): 344–352.

DOI: [10.2105/ajph.75.4.344](https://doi.org/10.2105/ajph.75.4.344)

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1982, Experimental Aircraft Association (EAA) successfully changed Federal Aviation Administration (FAA) policy to consider the use of automobile gasoline in aircraft. The EAA type certificate program resulted in an FAA Supplemental Type Certificate (STC) being issued for the use of automobile gasoline, rather than aviation gasoline, in the Cessna 150 aircraft, powered by a Continental O-200 engine.

Although it is not clearly stated or recorded when the first legal flight was performed, apparently an engine and airplane were approved to use automotive gasoline ("autogas") by supplemental type certificates (STC) SE634GL and SA730GL, respectively. Both STCs were held by the Experimental Aircraft Association (EAA). The STC documentation stated that compliance was attained "by installation of placards and airplane flight manual supplement."

Auto Fuel ([html](#)) Federal Aviation Administration ([FAA](#)) Supplemental Type Certificate ([STC](#)) | Experimental Aircraft Association ([EAA](#)). The first pilot to legally fly in an aircraft with automobile gasoline was then-FAA Administrator J. Lynn Helms [[Wikipedia](#)]. Since then, more than 24,000 STCs have been issued by EAA.

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Aviation Gasolines and Future Alternatives ([html](#)) ([pdf](#)) | NASA Technical Reports Server ([NTRS](#)). NASA Conference Publication 2267, Proceedings of a workshop held at Lewis Research Center Cleveland, Ohio. February 3-5, 1981. Participants included Mooney Aircraft, Cessna, Lycoming, EAA, FAA, GAMA, NATA, Shell, Philips, Exxon, NASA, etc.

.....1970s;.....
Recommendations for the Prevention of Lead Poisoning in Children 1976 ([html](#)) | [NAP](#). National Research Council (NRC).

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38 FR 1254 (1973) First Regulation of Lead in Fuel (Beta [html](#)) ([pdf](#)), Federal Register, Volume 38, No. 6 – Wednesday January 10, 1973.

Friday, September 21, 1973, Volume 38 Number 183, pages 26435 - 26593
Title 40 Protection of environment.
Chapter 1 Environmental protection Agency.
Part 80 – regulation of fuels and fuel additives.
Controls applicable to motor vehicle manufacturers ([pdf](#)).
On January 10, 1973 (38 FR 154).

.....
1970s – 100LL aviation fuel introduced, 1940s piston propulsion technology virtually unchanged, e.g. basically the same technology used in 2020.

Octane - Tetraethyl Lead (TEL) concentration AMOUNT			
80	100	100LL	
0.13	1.06	0.56	(mL / L)
0.49	4.02	2.12	(g / gal)

NOTE: 100LL has over four times the amount of lead (in milliliters/liter) as 80.

.....1960s;.....
 Experimental Aircraft Association (EAA). EAA began testing and evaluating alternate fuels for aircraft piston engines in 1964 ([html](#)).

Other than bragging rights on who was first to start the alternate aviation fuels effort it is certainly not clear what has been *really* accomplished in 56 years.

.....Summary;.....

Over a half century of massive amounts of resources, time, effort and money, not to mention the continuous destruction of the Health, Safety and Welfare via Tetraethyl Lead (TEL) & Ethylene Dibromide (EDB) poisoning of so many vulnerable populations in this protracted time-frame doesn't sound like progress to many. There is still no end in sight as of September 2020 or any clear project plan, accountability, commitment or the demonstrated will to do so.

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 Additional Thoughts

Thought #1

Journal of Public Health Management and Practice ([html](#)) January/February 2019 - Volume 25 – Issue ([html](#)) Commentary: Lead Elimination for the 21st Century ([html](#)) observes that:

Over time, scientific evidence has accumulated and no safe level of lead for children has been identified. Why then has the elimination of lead hazards in the environment not been more of a priority for society as a whole? Lead poisoning is the longest-lasting childhood epidemic in the United States and has *never* been treated as one.

Tetraethyl Lead(TEL) & Ethylene Dibromide (EDB) poisoning remains an urgent health crisis that requires action, not just calls for more evidence or further studies!

Thought #2

Reddit ([html](#)): Flying ([html](#)) is a community for discussion among pilots, students, instructors and aviation professionals created September 3, 2008, a small but dedicated community with roughly ~134k Members.

After filtering through hostile, threatening, profane almost violent rhetoric from anonymous nom de guerre members, which btw appears to be a standard

contemporary response mechanism, a chosen default modus operandi, a recent post appears to capture one view of the reality of modern flying quite succinctly ([html](#)):

. . . I also feel like inaction by GA in general hasn't helped. 100LL is a health hazard. Most General Aviation companies seem happy to just leave things as they are, with the *vague* hope that the FAA will approve a suitable alternative soon. The vast majority of new certified single-engine piston aircraft still rely on 100LL; that seems like *an industry with its head in the sand* to me.

Likewise, very little seems to be being done to reduce aircraft noise. The design of modern aircraft should adapt to modern conditions - flying in or out of a lot of airports nowadays causes a fair bit of noise pollution for literally thousands of people. Is a *modern* C172 any quieter than a 1960s one? Why not? . . .

NOTE: optimistically the threatening & violent rumblings *against* protecting the Health, Safety & Welfare of Vulnerable Populations do NOT generally represent aviation, aerospace & defense professionals & related workers, enthusiasts, devotees or responsible airmen and airwomen, or do they?

Thought #3

A disappointing note is that Occupational Safety and Health Administration (OSHA) 1910.1025 App A - Substance data sheet for occupational exposure to Lead ([html](#)) notes that OSHA does NOT address Tetraethyl Lead (TEL)! Workers and the general public have rights to be protected or at least notified re TEL hazards.

Thought #4

Leaded 100LL Aviation Fuel with Tetraethyl Lead (TEL) & Ethylene Dibromide (EDB) is the unrecognized "[Secondhand Smoke](#)" of the first decade of the 21st century ([html](#)) ([html](#)), only ten times deadlier! *The Lancet* ([html](#)) paper Low-level Lead Exposure and Mortality in US Adults March 12, 2018 ([html](#)) ([pdf](#)), found that exposure to low levels of lead contributes to as many as 412,000 premature deaths ([html](#)) of residents across the United States each year. This places premature death from lead exposure almost on a par with deaths caused by smoking, which takes more than 480,000 American lives each year ([html](#)) | American Lung Association.