

LEAD EMISSIONS FROM AIRCRAFT FUELS

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NM State Senator District 37
2013 to Present



DID YOU KNOW-

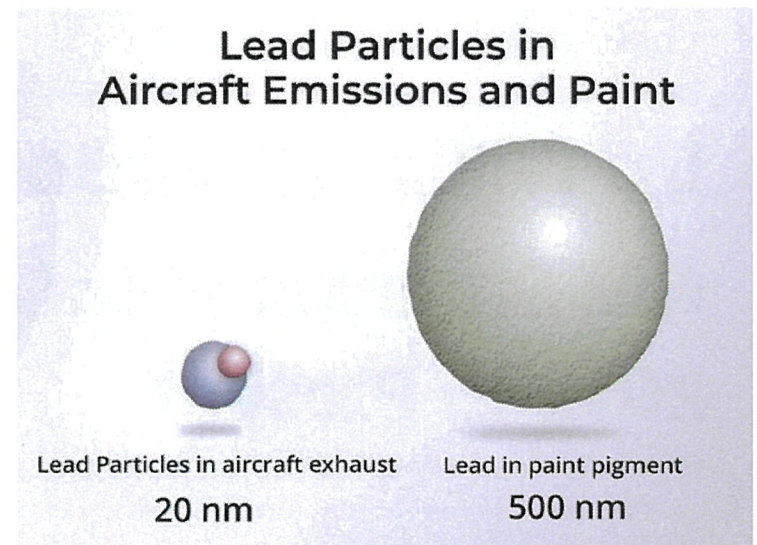
Lead Particles are Toxic to Humans?

Lead poisoning can be hard to detect — even people who seem healthy can have high blood levels of lead.

Signs and symptoms usually don't appear until dangerous amounts have accumulated.

-MAYO CLINIC

Tetraethyl Lead Particle Size



Lead poisoning symptoms in newborns –

Babies exposed to lead before birth

- Premature birth
- Have lower birth weight
- Have slowed growth rates

Lead poisoning, symptoms in children

- Developmental delay
- Learning difficulties
- Irritability
- Loss of appetite
- Weight loss
- Sluggishness and fatigue
- Abdominal pain
- Vomiting
- Constipation
- Hearing loss
- Seizures

Who is sounding the Alarm?

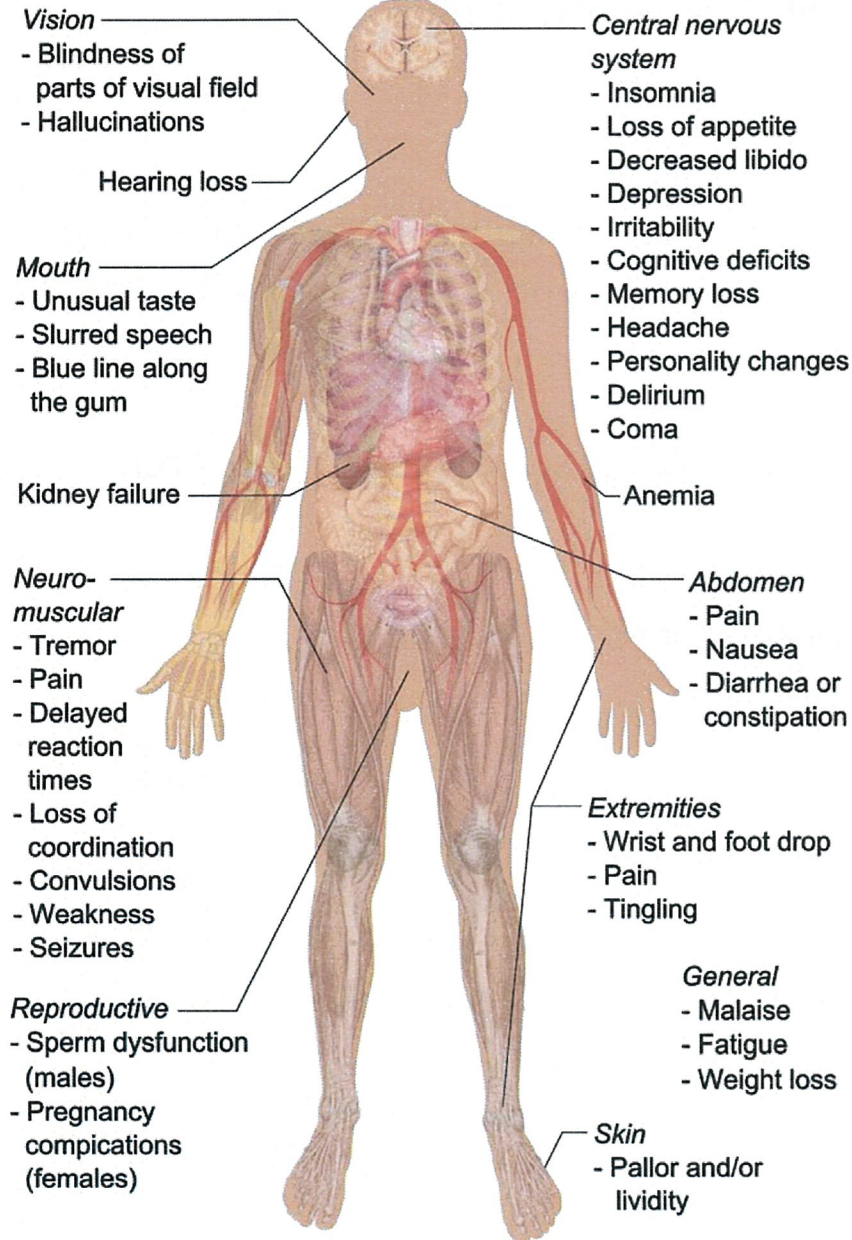
Mayo Clinic
WHO
AMA
US-EPA
NIH
Cleveland Clinic
OSHA
Boston Children's Hospital
Texas State Dept of Health
FDA
NM DOH

Are Lead Particles are Toxic to Adults?

Lead poisoning is also dangerous for adults. Symptoms in adults include:

- High blood pressure
- Joint and muscle pain
- Difficulties with memory or concentration
- Headache
- Abdominal pain
- Mood disorders
- Reduced sperm count and abnormal sperm
- Miscarriage, stillbirth or premature birth in pregnant women

Symptoms of Lead poisoning



Levels of Lead Poisoning?

Low Levels-

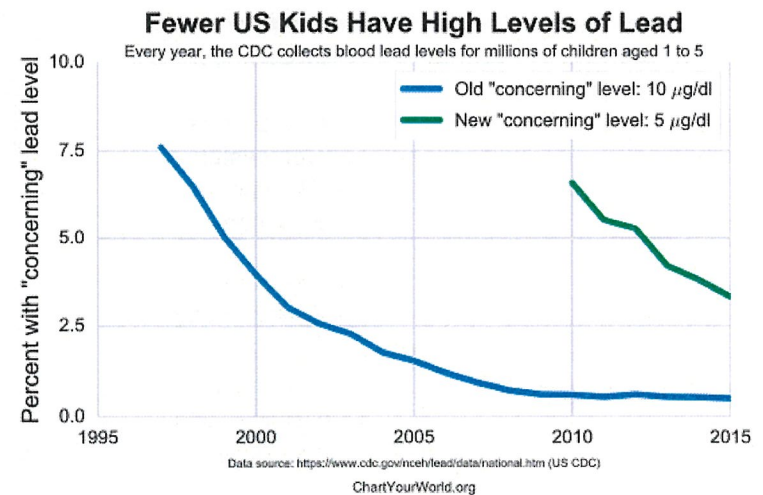
Exposure to even low levels of lead can cause damage over time, especially in children. The greatest risk is to brain development, where irreversible damage can occur.

Higher levels-

Can damage the kidneys and nervous system in both children and adults.

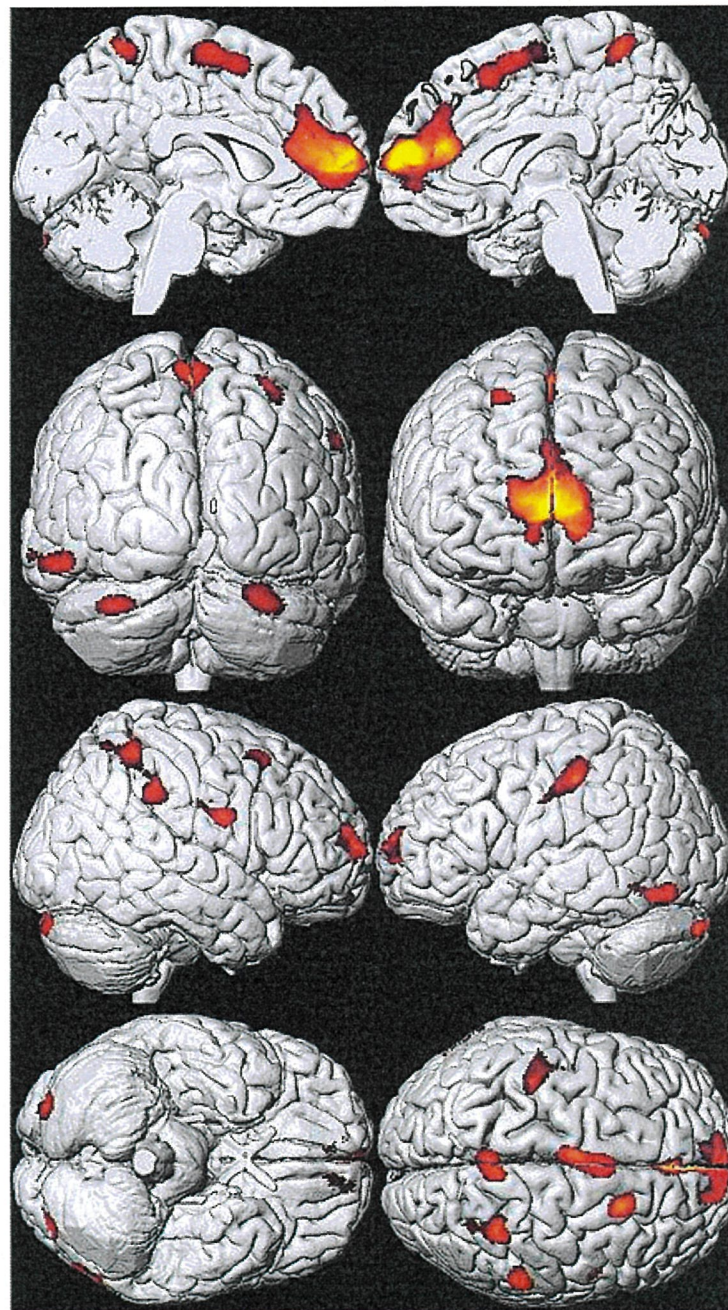
Very high lead levels-

Can cause seizures, unconsciousness and death.



Brains of adults who were exposed to lead as children show decreased volume, especially in the prefrontal cortex, on MRI scans.

Areas of volume loss are shown in color over a template of a normal brain. [\[74\]](#)



How you “get” lead Poisoning?

Sources of Lead Contamination Around You –

Lead is a metal that occurs naturally in our soil

Lead was once used in paint (banned in 1978), and car gasoline, (banned 1973 -1996) in the USA

Lead is still used in ammunition, car batteries, solder, pipes, pottery, roofing materials, some cosmetics and aircraft gasoline in the USA

Mining, burning fossil fuels and manufacturing historically caused concentrated & widespread contamination.

Lead can be found in food, feedstock and cannabis when grown in soil that is high in lead

Airborne lead contaminates crops, & animals eat lead in their diet



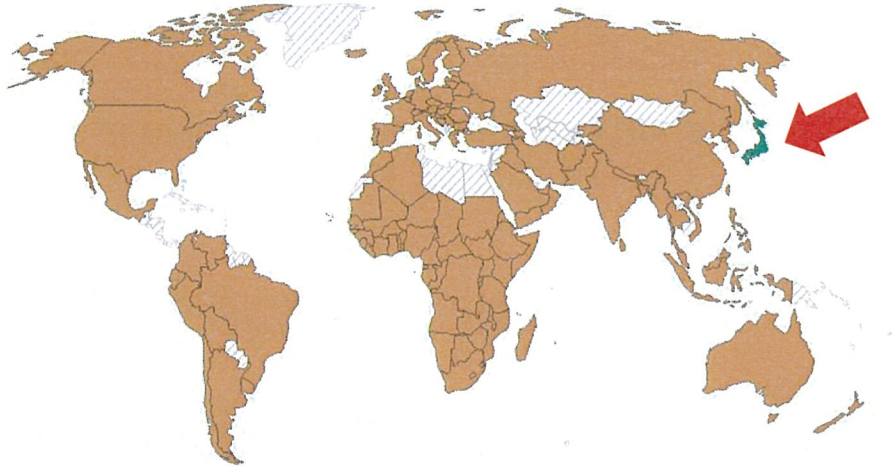
Exposure to lead occurs by contaminated air, water, dust, food, or consumer products-



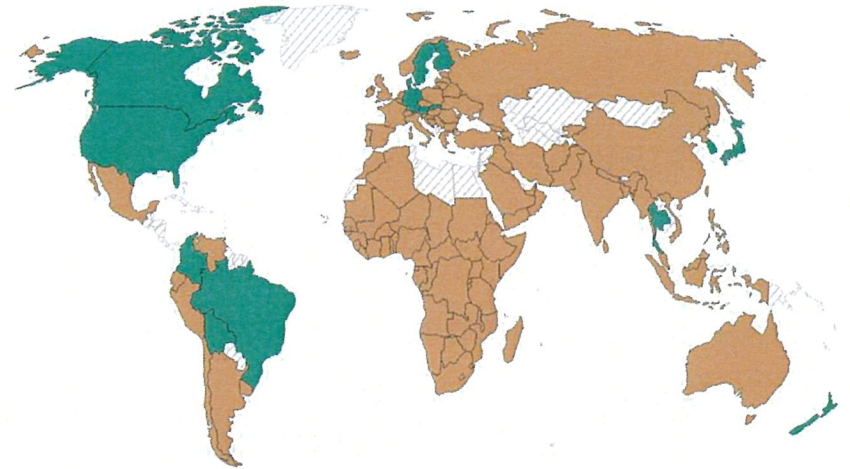
- We inhale it
- We eat and drink it.
- We absorb Lead thru our skin

Countries Banning Lead in Fuels

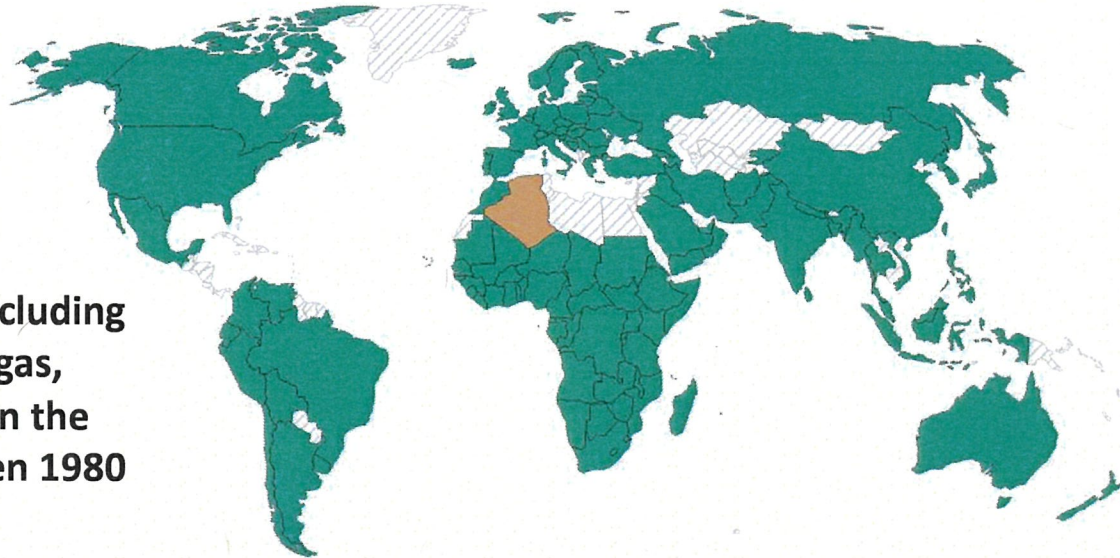
Prior To 1995



As of 1996



As of 2020



US-EPA's regulatory efforts including the removal of lead from car gas, resulted in the levels of lead in the air decreased by 98 % between 1980 and 2014.

Soil & Water contamination from Aircraft Gasoline, (100 LL)

Lead is sprayed from exhaust pipes into the air from piston engine aircraft flying overhead.

Lead particles can drift in the wind and may travel long distances before settling to the ground, where it usually sticks to soil particles.

Lead particles can move into the soil and percolate into ground water or mix with rainwater runoff and flow into rivers, ponds and lakes.



Soil & Water contamination from Aircraft Gasoline, (100 LL)

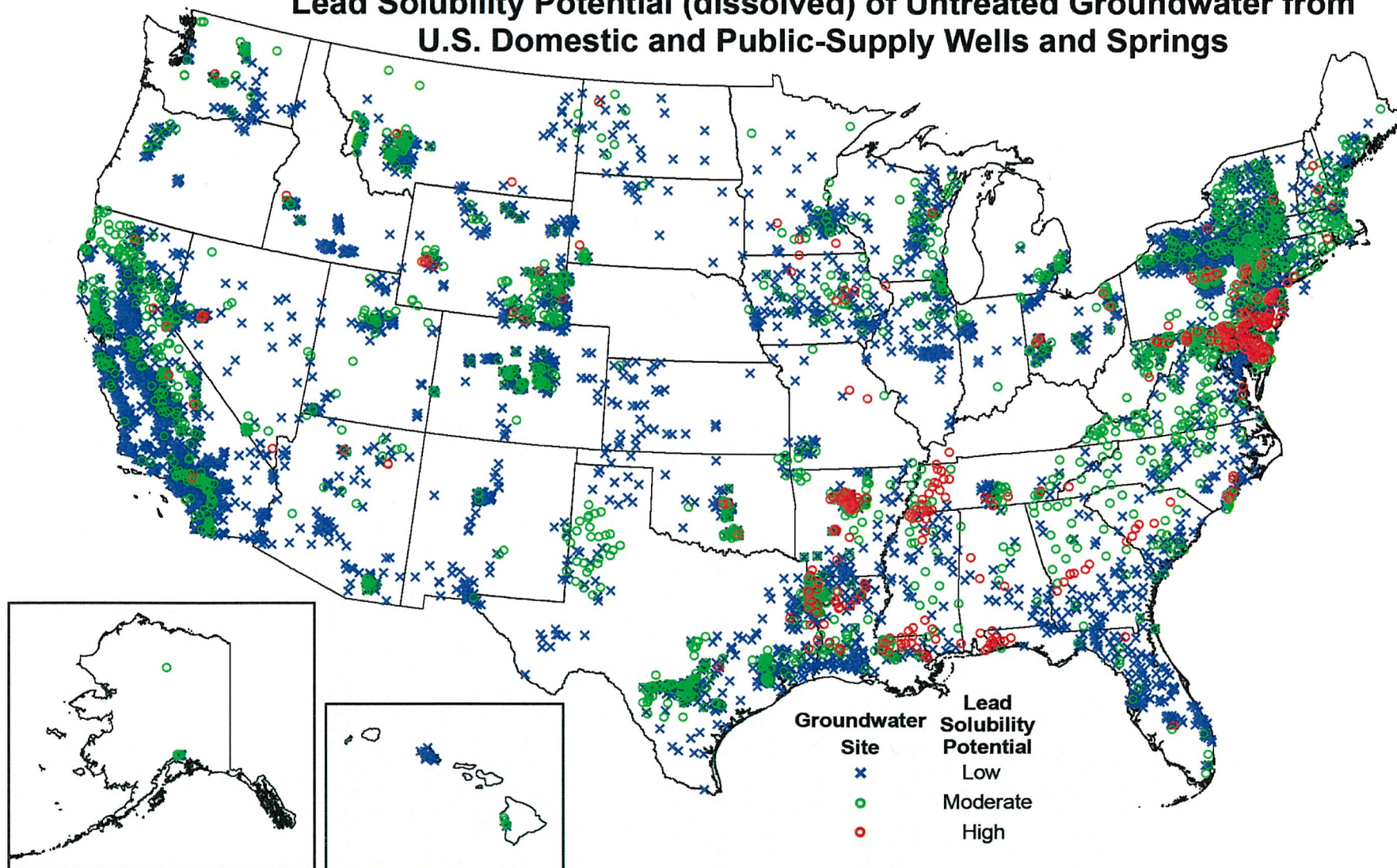
Is lead soluble or insoluble in water?

- Lead is soluble in nearly all natural water with a pH 6–8
- Any water in contact with Lead can acquire elevated concentrations of dissolved lead



USGS

Lead Solubility Potential (dissolved) of Untreated Groundwater from U.S. Domestic and Public-Supply Wells and Springs



What is a “SAFE” Level?

Testing from 1976-1980 to 2015-2016, the average blood lead level (BLL) of the US population aged 1 to 74 years dropped from 12.8 to 0.82 $\mu\text{g}/\text{dL}$, a decline of 93.6%.

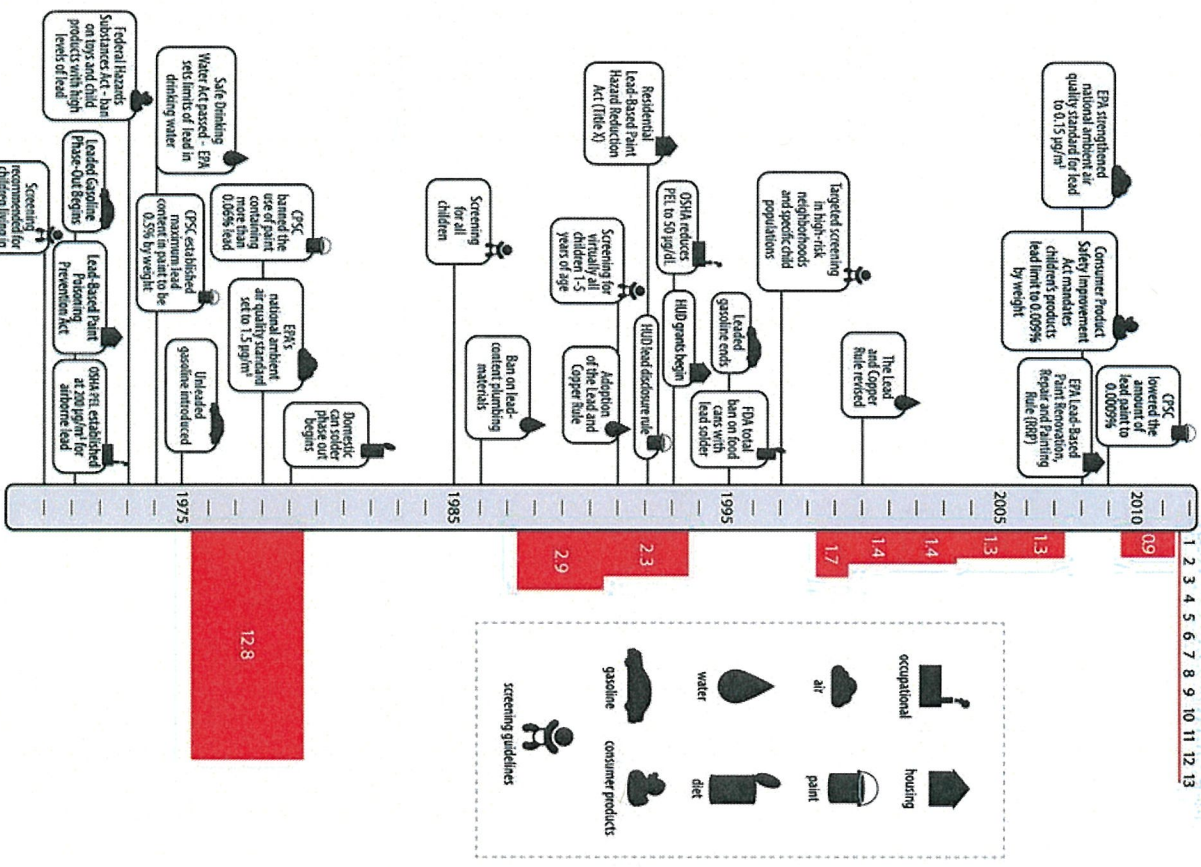
Yet, an estimated 500,000 children aged 1 to 5 years have BLLs at or above the blood lead reference value of 5 $\mu\text{g}/\text{dL}$ established by the Centers for Disease Control and Prevention.

There is no safe level of lead exposure, and child BLLs less than 10 $\mu\text{g}/\text{dL}$ are known to adversely affect health, IQ and behavior.

When the exposure source is known, approximately 95% of BLLs of 25 $\mu\text{g}/\text{dL}$ or higher are work-related among US adults. Despite much progress in reducing exposure to lead in the United States, there are challenges to eliminating exposure. **(NIH)**

Geometric Mean Blood Lead Levels (µg/dL) Among Persons 1+ Years Of Age

1 2 3 4 5 6 7 8 9 10 11 12 13



PEL=Permissible Exposure Limit, CFSQ=Consumer Product Safety Commission, OSHA=Occupational Safety and Health Administration, EPA=Environmental Protection Agency, HUD=Housing and Urban Development, RPA=Food and Drug Administration

How did we get here?

History of aviation piston engines and fuel

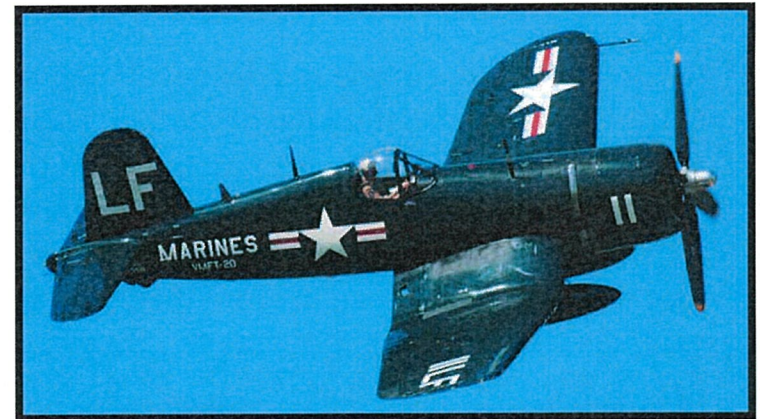
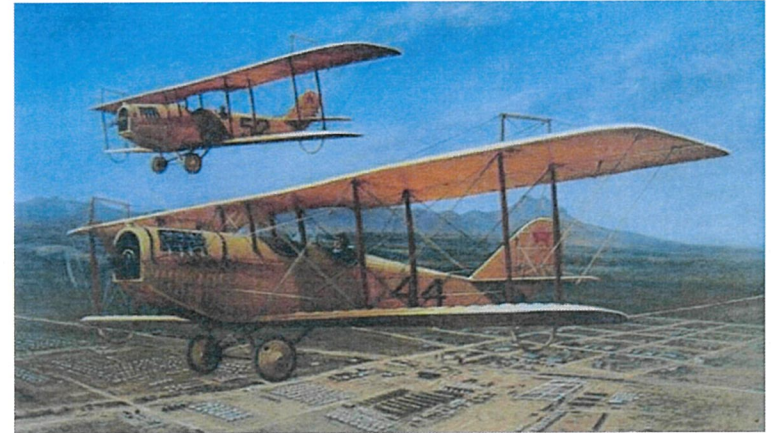
1903-1930's - Early auto and aircraft engines had very low cylinder compression and horsepower and could use almost any low octane (**fast burning**) gasoline

1930-World War-2 - Axis/Allied Power Military requirements for high performance fighter aircraft needed High octane (**slower burning**) gasoline for new high compression & supercharged engines to reduce combustion detonation or "knocking."

The search for octane enhancing compounds to prevent detonation ensued and a **quick fix** was found by adding Tetraethyl lead, which looks like honey

Post World War-2- 1980's - Entering the 1950's world militaries adopted jet engine powered fighters and bombers. Jet engines use a Kerosene- based fuel similar to Diesel fuel.

Various formulation were called JP-5 , JP-8 and the commercial jet fuel we use today called JET-A



How did we get here?

1980's to Today - 1980's up to three fuel types were commonly available at commercial airports: fast burning 80 octane, (similar to regular car gas), slower burning 100 octane for higher compression aircraft, (similar to premium car gas) & very slow burning 130 octane for turbo and supercharged engines

In the 1990's with aviation in decline, gas refineries didn't want to supply three different types of AV-Gas & phased out 80 octane and 130 octane aviation fuels. This consolidation forced aircraft owner to use only one grade of fuel and accept lower performance and much higher cost, even though their engine were not designed, tuned or optimized for 100LL.

Across the Pond, Europe rapidly developed & broadly adopted unleaded aviation fuels by 1991. By 2010, the European Aviation Safety Agency (EASA) cleared the Hjelmsco Oil Co. 91/96UL fuel for all aircraft where the aircraft engine manufacturer has approved this fuel, based on about 20 years of trouble-free operations with unleaded this AV-Gas. American Engine manufacturers Teledyne Continental Motors, Textron Lycoming, Austrian Rotax, and radial engine manufacturer Kalisz have cleared the Hjelmsco avgas 91/96UL which in practice means that the fuel can be used in more than 90% of the piston aircraft fleet worldwide.

Meanwhile US fuel suppliers took little or no action to bring any new fuels to the aviation consumer. Legacy aircraft engine manufacturers followed suit & continued producing 1950's technology engines for Americas' GA Fleet while American Auto manufacturers were selling cars with more efficient and modern engines with electronic ignition/fuel injection systems that performed superbly on regular low octane unleaded car gas.

Desperate for an less toxic, lower cost, cleaner gasoline, EAA undertook a multiyear R&D effort to prove to the FAA that modern ASTM-certified auto gas performed very well for and was quite safe for the majority of aircraft.

What is the Lead Content in aviation gasoline now?

Lead content in grams of lead per gallon:

100LL = 2 grams (twice what the old leaded car gas had)

80/87 = 0.5 grams

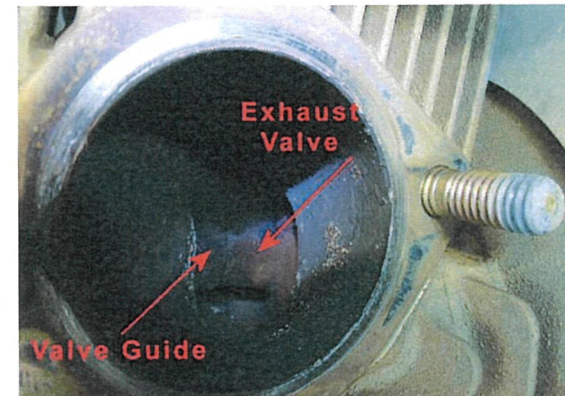
Regular Auto Fuel = 0.1 gram

Unleaded (Premium or Regular) = .001 gram

TEL Additive has > 4 sources worldwide

Lead is also a major safety issue, associated with aircraft engine failure –

- Lead fouls spark plugs,
- Sticks exhaust valves open,
- Contaminates oil
- Airport workers are exposed every day



About 100LL AV-GAS

100LL – Its high quality stuff! Preferred fuel of Car Racers for 3 decades

High Cost – \$6-9/gallon in New Mexico

Only fuel available at most airports and only available at NM airports

Lead content - 2 grams/gallon

Daily 100LL AV-GAS Sales, USA - 400,000 gallons

Annual Lead emitted - 470 tons in the atmosphere

NM by 2030 - about 20 tons of tetraethyl lead sprayed into atmosphere

Take off and Landing flight paths for Gallup NM, only 3 miles from the city



Leading Emitter of LEAD-100LL AV-GAS

particles were not separately identified in this study). The particle number concentration ranged from 5.7×10^6 to 8.6×10^6 particles per cm^3 . The authors noted that these particle emission rates are comparable to those from a typical diesel passenger car engine without a particle filter.⁸⁵ Griffith (2020) collected exhaust particles from a piston-engine aircraft operating on leaded avgas and examined the particles using electron microscopy. Griffith reported that the

Lead emissions from covered aircraft are the largest single source of lead to air in the U.S. in recent years, contributing over 50 percent of lead emissions to air starting in 2008 (Table 1).⁸⁶ In 2017, approximately 470 tons of lead were emitted by engines in piston-powered aircraft, which constituted 70 percent of the annual emissions of lead to air in that year.⁸⁷ Lead is emitted at and near thousands of airports in the U.S. as described in Section II.A.1 of

Engine Aircraft Airport Inventories for Lead for the 2008 National Emissions Inventory.”⁸⁹ The EPA’s National Emissions Inventory (NEI) reports airport estimates of lead emissions as well as estimates of lead emitted in-flight, which are allocated to states based on the fraction of piston-engine aircraft activity estimated for each state. These inventory data are briefly summarized here at the state, county, and airport level.⁹⁰

TABLE 1—PISTON-ENGINE EMISSIONS OF LEAD TO AIR

	2008	2011	2014	2017
Piston-engine emissions of lead to air, tons	560	490	460	470
Total U.S. lead emissions, tons	950	810	720	670
Piston-engine emissions as a percent of the total U.S. lead inventory	59%	60%	64%	70%

Fuel prices within 75 miles of Las Cruces, NM 88001

NOTE: No Mogas (auto) found in the area

Airport / FBO		100LL	Jet A	
		\$5.50—\$8.40 average \$7.05	\$4.82—\$7.32 average \$6.32	
KLRU 9 W	Las Cruces International Airport Las Cruces, NM, USA			
	 ES \$6.99 ES \$6.41			12-Oct update 
	SS \$5.50			12-Oct update
	 ES \$7.06 ES \$7.08			17-Oct update
KDNA 26 S	Dona Ana County International Jetport Airport Santa Teresa, NM, USA			
	 SS \$6.98 ES \$7.98			 
KELP 36 SSE	El Paso International Airport El Paso, TX, USA			
	Independent ES \$7.40 ES \$8.40			23-Aug update
	 SS \$7.03 ES \$8.03			16-Oct update
KALM 49 NE	Alamogordo-White Sands Regional Airport Alamogordo, NM, USA			
	 ES \$7.09 ES \$6.22			04-Oct update
KDMN 50 W	Deming Municipal Airport Deming, NM, USA			
Desert Aviation	ES \$6.80 ES \$6.50			12-Oct update 
E35 57 SSE	Fabens Airport Fabens, TX, USA			
Olivas Aviation	ES \$7.50			19-Oct update
KTCS 61 NNW	Truth or Consequences Municipal Airport Truth or Consequences, NM, USA			
Truth or Consequences Municipal Airport	SS \$6.18 ES \$6.58			12-Oct update
KSVC 74 WNW	Grant County Airport Silver City, NM, USA			
Grant County	Phillips 66 SS \$6.25 ES \$5.95			12-Oct update

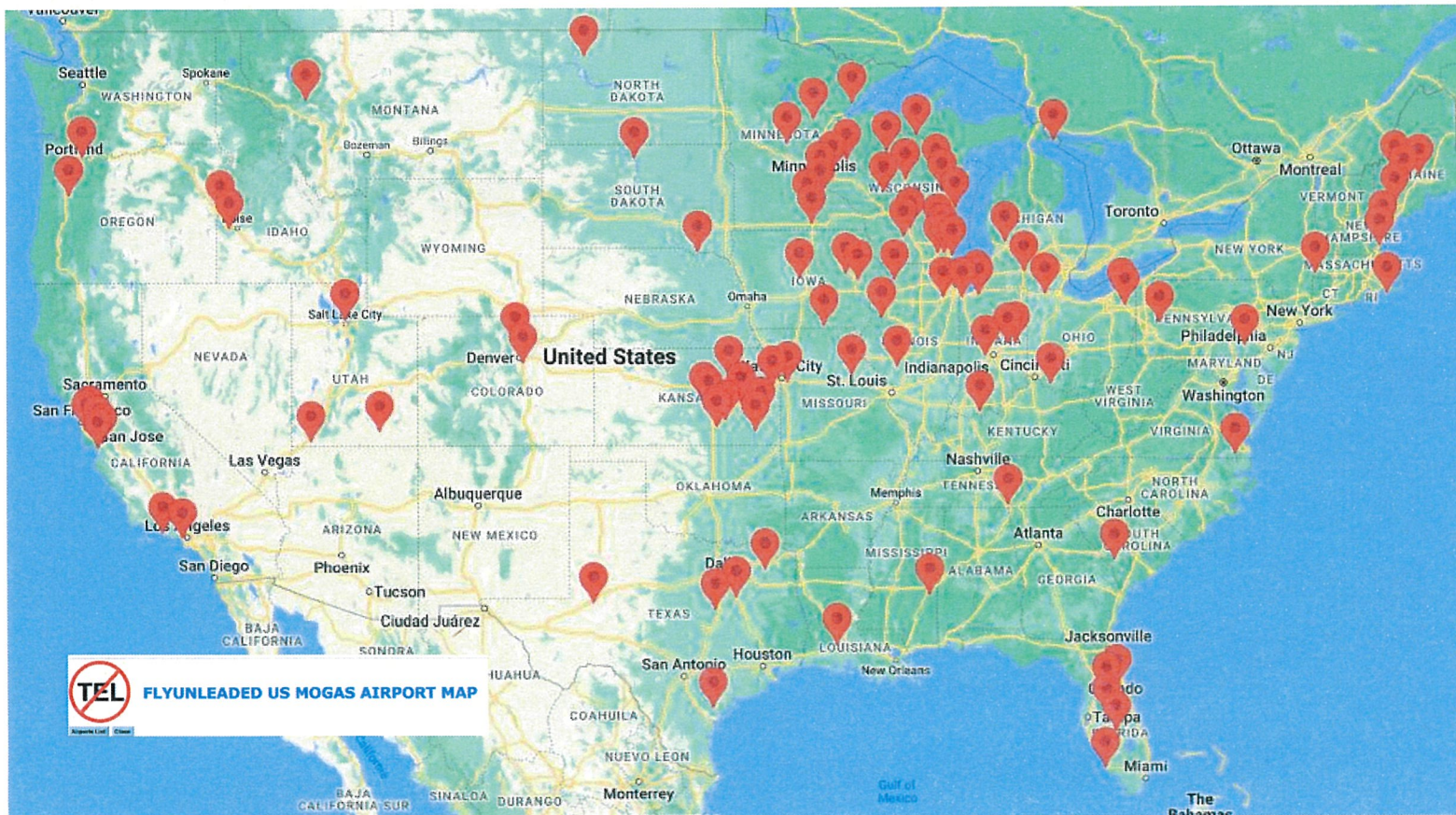
Fuel prices within 50 miles of **KSAF**

NOTE: No Mogas (auto) found in the area

Airport / FBO		100LL	Jet A	
		\$6.10—\$7.72 average \$6.93	\$6.50—\$9.64 average \$7.64	
KSAF	Santa Fe Regional Airport Santa Fe, NM			
	 ES \$7.72 ES \$9.64			
	Independent SS \$7.22 ES \$7.72			18-Oct update
KLAM 18 NNW	Los Alamos Airport Los Alamos, NM			
Los Alamos Avgas, Inc.	SS \$6.57			12-Oct update

Mogas (auto) prices within 100 miles of KAPA

Mogas	
	\$5.60—\$5.60 average \$5.30
Airport / FBO	
KLMO <i>Vance Brand Airport</i> Longmont, CO 38 NNW Fly Elite Aviation	Phillips 66 FS \$5.60 18-Oct update
KEGE <i>Eagle County Regional Airport</i> Eagle, CO 96 W	 Vail Valley Jet Center  RA \$5.00 15-Oct update



SOLUTIONS???

Some Thoughts -

- FAA has supposedly been working on solutions since the 1980's with little progress
- EU has had a solution with high octane unleaded fuel for decades
- 75%+ of the piston aircraft can and do run on premium no alcohol unleaded fuel (MoGas)
- One gas station in Las Cruces carries it, 3-4 in ABQ. (Recreational Fuel is ubiquitous in the Midwest)
- I carry it out to my plane in 5-gallon containers. Not available at any airports in NM.
- Group EAGLE is looking for "100% complete" alternative.
- Several options proposed and tested, none agreed to.
- More expensive
- Goal of a solution by 2030?? I'm skeptical.
- Refineries dragging their feet if it is not their product
- Local airports claim the cost to add an unleaded option is cost prohibitive
- EPA could rule leaded fuel illegal due to environmental concerns
- Should not wait until the last moment or get sued? Lets test now.
- Most planes can fly safely on unleaded MoGas now
- \$5 million fund to provide \$200,000 grants to airports and FBO's to put in unleaded option