

2012 Airport Lead Study

Auburn Municipal Airport and Harvey Field

Final Report



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June 25, 2013

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Background

On October 15, 2008, the Environmental Protection Agency (EPA) substantially changed the National Ambient Air Quality Standards (NAAQS) for lead (Pb). The revised standards are now 10 times more stringent than the previous standards and are designed to improve health protection for at risk groups, especially children. The new revised health-based standard is 0.15 μ g/m3, measured as total suspended particulate (TSP). EPA also revised the secondary (welfare based) standard to be identical to the primary standard.

Scientific evidence concerning lead has dramatically increased since EPA issued the initial standard of $1.5 \,\mu$ g/m3 in 1978. More than 6,000 studies on the health and environmental effects of lead in the air have been published since 1990. Evidence from these studies shows that adverse effects occur at much lower levels of lead than previously thought. Children are particularly vulnerable to the effects of lead. Exposures to even low levels of lead early in life have been linked to negative effects on IQ, learning, memory, and behavior. EPA has concluded there is no safe level of lead in the body.

Like the 1978 standard, the new standard will be measured as the concentration of lead in TSP, reflecting evidence that lead particles of all sizes pose potential health risks.

EPA also revised the averaging time and form of the lead NAAQS. These are the air quality statistics (based on measured values) that are compared to the level of the standard to determine whether an area meets or violates the standard. Specifically, EPA changed the calculation method for the averaging time to a "rolling" three month period with a maximum (not-to-be-exceeded) form. This replaces the previous approach of using calendar quarters. A rolling three-month average takes into account each of the 12 three-month periods associated with a given year, not just the four calendar quarters within that year.

On December 14, 2010, EPA revised the ambient monitoring requirements for measuring lead in the air. Though the regulation maintained the 1.0 ton per year (tpy) lead emission threshold for monitoring at airports, it also required a one year monitoring study at 15 airports with lead emission inventories between 0.50 to 1.0 tpy that EPA indentified as having characteristics that may contribute to a violation of NAAQS.

Federal Regulations (40 CFR 58) required eight States (See Table 1) to conduct ambient air monitoring for lead at 15 airports for a period of 12 consecutive months starting December 27, 2011.

Objectives

In addition to assessing the ambient air lead concentrations and potential exposure to lead from the use of leaded aviation gasoline (avgas) in piston engine powered aircraft, the principal objective of this study was to determine if continuing airport monitoring would be required.

Federal regulations require monitors that read more than 50 percent of the NAAQS $(0.075 \ \mu g/m^3 \text{ on a rolling three-month average})$ to continue operations (40 CFR part 58 Appendix D, paragraph 4.5(a)(ii)). The purpose of this provision is to ensure monitoring continues in areas where ambient concentrations could be of concern. EPA applied this rationale to the airport monitors; stating that 40 CFR part 58 Appendix D, paragraph 4.5(a)(ii) applies to the results from the airport monitors that show concentrations higher than 50 percent of the NAAQS. Such monitors are required to remain in operation and states must include them in their annual monitoring network plans, i.e., the monitors will become a part of the state's required monitoring network.

EPA will also use the results from this study to assess the need for additional lead monitoring at airports.

Study Design (Selection of Airports)

The EPA National Vehicle and Fuel Emissions Laboratory designed the study, selected the airports and designated the specific sampling locations using the following criteria.

Airport Lead Emissions

EPA identified 58 airports with lead emissions between 0.50 tpy and 1.0 tpy. The cutoff of 0.50 tpy was selected because it was the original proposed emission threshold for airport monitoring, and the higher the emission rate, the higher the potential ambient lead impact. EPA determined the initial list of candidate airports using the 2008 National Emission Inventory (NEI) along with airport specific information.

Runway Configuration and Meteorology

Local-scale impacts of piston-engine aircraft emissions on air quality are expected to be greatest in the area immediately downwind from the aircraft run-up and takeoff locations. EPA believes the highest lead concentrations are expected to occur immediately downwind from the most frequently used runway. Runways are aligned with the prevailing wind. Consequently, EPA used the local wind and airport operations data to determine which runway is used most frequently. In addition, EPA also used information provided in airport master plans, noise studies, airport layout plans, and from airport managers to determine which runways at each airport were most frequently used.

Proximity of Ambient Air

EPA defines ambient air as "any location to which the general public has access." At airports, the general public includes recreational pilots and their passengers, members of the public who visit the airport for special events, and others (people who rent hangars, etc.). Locations at airports that meet this definition include parking lots, observation decks, hangars, and access roads to hangars. Studies^{1,2,3} have shown that ambient lead concentrations decrease sharply with distance from the source and it is less likely that an exceedance of the NAAQS for lead will occur at greater distances. With this in mind, EPA selected a screening distance of 150 meters between the emissions source (run-up and takeoff areas) at each airport and ambient air. The location of predicted maximum lead concentrations at airports is downwind of the area where pilots carry out their preflight run-up checks and takeoffs. The run-up area is a location at the airport where pilots perform checks of their aircraft to verify engine operation. EPA used Google Earth, and information provided on airport websites, airport

diagrams, and from airport mangers to identify areas of ambient air that would have potential maximum lead concentrations.

Using the criteria described above, along with landing and takeoff (LTO) data, EPA evaluated every airport in the draft 2008 National Emission Inventory (NEI) and selected the following 15 airports for the 2012 Airport Lead Study.

Airport	County	State	ТРҮ
Merrill Field	Anchorage	AK	0.62
Pryor Field	Limestone	AL	0.55
Palo Alto Airport of Santa Clara	Santa Clara	CA	0.66
McClellan-Palomar	San Diego	CA	0.59
Reid-Hillview	Santa Clara	CA	0.53
Gillespie Field	San Diego	CA	0.90
San Carlos	San Mateo	CA	0.53
Nantucket Memorial	Nantucket	MA	0.76
Oakland County International	Oakland	MI	0.59
Republic	Suffolk	NY	0.53
Brookhaven	Suffolk	NY	0.50
Stinson Municipal	Bexar	TX	0.55
Northwest Regional	Denton	TX	0.63
Harvey Field	Snohomish	WA	0.50
Auburn Municipal	King	WA	0.61

Table 1 - Selected Airports for 2012 Airport Lead Study

¹South Coast Air Quality Management District (2007) Community Scale Air Toxics Monitoring.

²South Coast Air Quality Management District (2010) General Aviation Airport Monitoring Study.

³ U.S. EPA (2010) Development and Evaluation of an Air Quality Modeling Approach for Lead Emission from Piston Engine Aircraft Operating on Leaded Aviation Gasoline.

Site Selection and Descriptions

Based on the criteria provided above, EPA selected Auburn Municipal Airport and Harvey Field in Washington State as two of the 15 airports required to participate in the 2012 Airport Study. Though there is limited data available on ambient lead concentrations at airports, EPA believes that airport lead emissions may approach or exceed the NAAQS. Therefore, the monitors were required to be sited to measure the maximum lead concentrations in ambient air taking into account logistics and the potential for population exposure. The following summarizes the information used by EPA in their determination of the sampling locations for these two airports.

Auburn Municipal Airport

Auburn Municipal Airport has one runway: 34/16. For identification purposes each runway is given a two number designation that is derived from the magnetic compass heading of the runway ends. The runway end numbers are reported in ten degree increments by dropping the zero such that runway 34/16 is a runway with magnetic compass headings of 340 degrees and 160 degrees respectively. The Auburn airport manager (Mike Shipman) indicated that almost all activity at the airport is piston engine powered and the only fuel sold is leaded aviation gasoline (avgas). The most dominant winds are from the north and takeoffs are most frequently from runway 34. Run-up checks are conducted at one location just before entering the runway. The airfield is not controlled; therefore, daily operations data was not available. EPA estimated that 36,000 piston engine operations occur in a three month period.

EPA determined that ambient air is less than 50 meters to the east of the takeoff and run-up area for runway 34. This would be the area general aviation parking lot. In addition, a hotel with swimming pool is located approximately 100 meters downwind. For these reasons, EPA selected the monitoring location downwind from the run-up and takeoff areas of runway 34 (see Figure 2).



Figure 2 - Auburn Municipal Airport Monitoring Location

Harvey Field

There is currently only one runway at Harvey Field: 33/15. The airport is not controlled; therefore, daily operations data were not available. The airport website describes sky diving, aero tours, and flight lessons, suggesting that aircraft operations are higher in the summer. Winds directions in the summer alternate from north to south.

Both runway 33 and 15 have ambient air within 150 meters. Depending on the run-up location for runway 15 there is ambient air approximately 50-100 meters from the maximum impact site. This is the hangar area where general aviation pilots park their cars and access their aircraft (Figure 3). For runway 33 there is ambient air approximately 15-90 meters away in the form of hangars, near-by road and residences. Based on this information EPA selected the monitoring site downwind from the run-up and takeoff area of runway 33 (Figure 4).



Figure 3 - Harvey Field (overview)



Figure 4 - Harvey Field Monitoring Location

Monitoring Protocols

As provided for in 40 CFR part 50 Appendix Q, the Federal Reference Method (FRM) for determining lead in total suspended particulate matter (Pb-TSP) was used to ensure that the results of the study would be directly comparable to the lead NAAQS.

To achieve the lowest possible detection limits the sample filters were analyzed by the Department of Ecology Manchester Environmental Laboratory in Port Orchard, Washington, by means of EPA method 200.8 - Inductively Coupled Plasma-Mass Spectrometry (ICPMS).

Sampling Frequency and Duration

As required by Federal Regulations (40 CFR 58), 24 hours integrated sampling was performed once every six days (1/6) for a period of 12 consecutive months starting on December 27, 2011. Sampling was completed on December 29, 2012.

Results and Conclusions

With the exception of the rounding convention and handling of non-detects, the data handling and computations in 40 CFR part 50 Appendix R (Interpretation of the National Ambient Air Quality Standards for lead) were used to interpret the results. The daily values, monthly averages, and three-month rolling averages were rounded to the nearest thousandths μ g/m3 (0.XXX) as opposed to the nearest hundredths of a microgram. One half of the minimum detection limit (MDL) was substituted for non-detects. The Manchester Laboratory tested and reported the lead MDL to be 0.014 μ g/m3 (1/2 MDL = 0.007 μ g/m3).

Figures 5 and 6 graphically depict the 1/6 day sampling results, monthly averages and three-month rolling averages for both airports. EPA specified that if any study site measures a rolling three-month rolling average that exceeds 50 percent of the NAAQS (as determined according to 40 CFR part 50, Appendix R) it will become a required monitor under (40 CFR part 58 paragraph 4.5(c)).

During the study period, the maximum three-month rolling average at the Auburn Airport was $0.055 \ \mu g/m3$ (37% of NAAQS), which is below 50 percent of the NAAQS (Figure 5). During the same period, the maximum three-month rolling average at Harvey Field was $0.032 \ \mu g/m3$ (21% of NAAQS), which is below 50 percent of the NAAQS (Figure 6). Neither airport measured a three-month rolling average that



exceeded 50 percent of the NAAQS. Consequently, the lead monitoring at both airports has been concluded.

Figure 5 - Auburn Municipal Airport Lead Results



Figure 6 - Harvey Field Lead Results

Reporting

The results and associated assurance information have been submitted to the EPA Air Quality System (AQS) database according to the requirements of 40 CFR part 58.16. The results were reported to AQS in units of micrograms per cubic meter (μ g/m3) at local conditions.

Appendix

Quality Assurance Assessment

The State of Washington's ambient air quality monitoring network is designed to collect vital air data for national, state, local, and tribal agencies. It is important that ambient air data are of known, acceptable, and comparable quality. Decision makers and data users also need to be aware of the amount of error in the data. The data used in these decisions are never error free and always contain some level of uncertainty.

Measurement Quality Objectives

A measurement quality objective (MQO) is a goal set by EPA guidance that represents a reasonable expectation of what one should be able to achieve for a specific data quality indicator. In order to maintain acceptable levels of uncertainty throughout the study, data completeness, sampler flow rate accuracy, and analytical precision and accuracy were determined.

Quality Assurance for Lead (Pb) Measurements

The TSP sampler is designed to collect particulate matter at a specific flow rate for a 24 period. Post sampling, the filters were mailed to the Department of Ecology Manchester Laboratory and processed. A section was cut from each filter and analyzed for Pb by means of ICPMS (EPA Method 200.8).

Data Completeness

To be eligible for NAAQS determinations, the three month rolling average data capture rate must be greater than or equal to 75 percent (40 CFR part 50 Appendix R). The monthly data capture rates (expressed as a percentage) were calculated by taking the number of creditable samples for any given month and dividing by the number of scheduled samples for the same month. The result was then multiplied by 100 (not rounded). The three month rolling data capture rate was calculated by taking the sum of the three corresponding unrounded monthly data capture rates and dividing by three. The result was rounded to the nearest integer (i.e., zero decimal places). Figure A-1 depicts the three month rolling average data completeness for each airport.

Table A-1 - Data Completeness	(Three Month	Rolling	Average)
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Site	May	April	May	June	July	Aug	Sept	Oct	Nov	Dec
Auburn	100	100	100	93	93	93	100	93	93	87
Harvey	87	100	93	87	80	87	93	100	93	93

Quality Control Checks

One-point flow rate checks were performed each month by the air monitoring personnel. These checks were used to determine sampler flow bias. A positive value indicates the air sampler flow rate was operating above the actual (true) value. A negative value indicates the sampled flow rate was below the actual value. The State's MQO of $\pm 10\%$ was met for all the one-point flow checks (Figures A-2 and A-3).

Flow Rate Performance Audits

Flow rate performance audits are similar to the one-point flow rate checks, but are performed less frequently and by independent quality assurance personnel. Using independent flow measuring standards, the flow rate of the air sampler was measured and the results depicted as a percent difference Figures A-2 and A-3.



Figure A-2 - Auburn Flow Rate Checks and Audit Results



Figure A-3 - Harvey Field Flow Rate Checks and Audit Results

Figures A-2 and A-3 depict the results of the quality control checks and performance audits performed during the study. The quality control checks averaged 3.6 percent at Auburn Municipal Airport and 3.4 percent at Harvey Field. These values were confirmed by the independent flow audits at Auburn Municipal Airport (2.0 percent) and Harvey Field (3.2 percent). Though the quality assurance checks indicate a positive bias in the sampler's flow rate, they fell well within acceptable limits.

Precision Estimate

A collocated sampler was sited at the Auburn Municipal Airport and operated on the once every twelve day sampling schedule. The results were used to estimate precision by calculating the percent difference between the primary and collocated samplers. The MQO for the precision estimate is $\pm 20\%$ for samples > 0.02 µg/m³.

Table A-2 - Precision Estimates for Lead

Precision Estimates for Lead Coefficient of Variation In Percentage									
	1 st Quarter	2 nd Quarter	3 rd Quarter	4 th Quarter	2012				
Auburn	13.35	17.97*	19.64*	5.81	10.31				

* The precision estimates are in part affected by the flow rate differences between the collocated instruments. In addition, the field and analysis precision variances are greatest at low lead concentrations.

Analytical Bias

Specially prepared "spiked" quartz fiber filter strips were prepared by an independent EPA contractor and analyzed by the Manchester Laboratory to estimate analytical bias. Twelve sets of lead audit strips were analyzed following identical laboratory procedures as used during the study. The MQO for these lead strip audits is $\pm 10\%$ (Figure A-4).



Figure A-3 - Lead Strip Audit Results