ENVIRONMENTAL PROTECTION AGENCY

40 CFR Part 87

[EPA–HQ–OAR–2007–0294; FRL–9141–7]

RIN 2060–AP79

Advance Notice of Proposed Rulemaking on Lead Emissions From Piston-Engine Aircraft Using Leaded Aviation Gasoline

AGENCY: Environmental Protection Agency (EPA).

ACTION: Advance notice of proposed rulemaking.

SUMMARY: EPA is issuing this Advance Notice of Proposed Rulemaking (ANPR) to describe information currently available and information being collected that will be used by the Administrator to issue a subsequent proposal regarding whether, in the Administrator's judgment, aircraft lead emissions from aircraft using leaded aviation gasoline (avgas) cause or contribute to air pollution which may reasonably be anticipated to endanger public health or welfare. In this ANPR we describe and request comment on the data available for evaluating lead emissions, ambient concentrations and potential exposure to lead from the continued use of leaded avgas in piston-engine powered aircraft. We also describe and request comment on additional information being collected that will inform any future action.

This ANPR is being issued to further respond to a petition submitted by Friends of the Earth (FOE) in 2006. Emissions of lead from piston-engine aircraft using leaded avgas comprise approximately half of the national inventory of lead emitted to air. There are almost 20,000 airport facilities in the U.S. at which leaded avgas may be used. EPA has long-standing concerns regarding exposure to lead, particularly during childhood. The most recent review and revision of the National Ambient Air Quality Standard (NAAQS) for lead, promulgated in 2008, found that serious health effects occur at much lower levels of lead in blood than previously identified and did not identify a safe level of lead exposure.

DATES: Comments must be received on or before June 28, 2010.

ADDRESSES: Submit your comments, identified by Docket ID No. EPA–HQ–OAR–2007–0294, by one of the following methods:

- *http://www.regulations.gov:* Follow the on-line instructions for submitting comments.
- *E-mail: a-and-r-docket@epa.gov.*
- *Fax:* (202) 566–9744.
- *Mail:* Environmental Protection Agency, Mail Code: 6102T, 1200 Pennsylvania Ave., NW., Washington, DC 20460. Please include two copies.
- *Hand Delivery:* EPA Docket Center (Air Docket), U.S. Environmental Protection Agency, EPA West Building, 1301 Constitution Avenue, NW., Room: 3334 Mail Code: 2822T, Washington, DC. Such deliveries are only accepted during the Docket's normal hours of operation, and special arrangements should be made for deliveries of boxed information.

Instructions: Direct your comments to Docket ID No. EPA–HQ–OAR–2007–0294. EPA's policy is that all comments received will be included in the public docket without change and may be made available online at *http://www.regulations.gov,* including any personal information provided, unless the comment includes information claimed to be Confidential Business Information (CBI) or other information whose disclosure is restricted by statute. Do not submit information that you consider to be CBI or otherwise protected through *http://www.regulations.gov* or e-mail. The *http://www.regulations.gov* Web site is an "anonymous access" system, which means EPA will not know your identity or contact information unless you provide it in the body of your comment. If you send an e-mail comment directly to EPA without going through *http://www.regulations.gov* your e-mail address will be automatically captured and included as part of the comment that is placed in the public docket and made available on the Internet. If you submit an electronic comment, EPA recommends that you include your name and other contact information in the body of your comment and with any disk or CD–ROM you submit. If EPA cannot read your comment due to technical difficulties and cannot contact you for clarification, EPA may not be able to consider your comment. Electronic files should avoid the use of special characters, any form of encryption, and be free of any defects or viruses. For additional information about EPA's public docket visit the EPA Docket Center homepage at *http://www.epa.gov/epahome/dockets.htm.*

Docket: All documents in the docket are listed in the *http://www.regulations.gov* index. Although listed in the index, some information is not publicly available, *e.g.,* CBI or other information whose disclosure is restricted by statute. Certain other material, such as copyrighted material, will be publicly available only in hard copy. Publicly available docket materials are available either electronically in *http://www.regulations.gov* or in hard copy at the EPA Docket Center, EPA/DC, EPA West, Room 3334, 1301 Constitution Avenue, NW., Washington, DC. The Public Reading Room is open from 8:30 a.m. to 4:30 p.m., Monday through Friday, excluding legal holidays. The telephone number for the Public Reading Room is (202) 566–1744, and the telephone number for the Air Docket is (202) 566–1742.

FOR FURTHER INFORMATION CONTACT:
Marion Hoyer, Assessment and Standards Division, Office of Transportation and Air Quality, 2000 Traverwood Drive, Ann Arbor, MI 48105; telephone number: (734) 214–4513; fax number: (734) 214–4821; e-mail address: *hoyer.marion@epa.gov.*

SUPPLEMENTARY INFORMATION:

I. General Information

A. What should I consider as I prepare my comments for EPA?

1. *Submitting CBI.* Do not submit this information to EPA through *http://www.regulations.gov* or e-mail. Clearly mark the part or all of the information that you claim to be CBI. For CBI information in a disk or CD ROM that you mail to EPA, mark the outside of the disk or CD ROM as CBI and then identify electronically within the disk or CD ROM the specific information that is claimed as CBI. In addition to one complete version of the comment that includes information claimed as CBI, a copy of the comment that does not contain the information claimed as CBI must be submitted for inclusion in the public docket. Information so marked will not be disclosed except in accordance with procedures set forth in 40 CFR Part 2.

2. *Tips for Preparing Your Comments.* When submitting comments, remember to:

- Identify the rulemaking by docket number and other identifying information (subject heading, **Federal Register** date and page number).
- Follow directions—The agency may ask you to respond to specific questions or organize comments by referencing a Code of Federal Regulations (CFR) part or section number.
- Explain why you agree or disagree, suggest alternatives, and substitute language for your requested changes.
- Describe any assumptions and provide any technical information and/or data that you used.
- If you estimate potential costs or burdens, explain how you arrived at your estimate in sufficient detail to allow for it to be reproduced.

• Provide specific examples to illustrate your concerns, and suggest alternatives.

• Explain your views as clearly as possible, avoiding the use of profanity or personal threats.

• Make sure to submit your comments by the comment period deadline identified.

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I. Overview

EPA is publishing this ANPR in further response to a petition submitted by Friends of the Earth (FOE) entitled "Petition for Rulemaking Seeking the Regulation of Lead Emissions From General Aviation Aircraft Under § 231 of the Clean Air Act." [1] In the petition, FOE requests that the Administrator of EPA: (1) Make a finding that lead emissions from general aviation aircraft endanger public health and welfare and issue a proposed emission standard for lead from general aviation aircraft under the Clean Air Act (CAA) or, alternatively, (2) if the Administrator of EPA believes that insufficient information exists to make such a finding, commence a study and investigation of the health and environmental impacts of lead emissions from general aviation aircraft, including impacts to humans, animals and ecosystems under the CAA and issue a public report on the findings of the study and investigation. Section I.C of this notice discusses the background on the petition and EPA's response to date and Section I.D discusses EPA's statutory authority under section 231(a) of the CAA. Under the CAA, if, in the Administrator's judgment, lead emissions from the use of leaded avgas cause or contribute to air pollution which may reasonably be anticipated to endanger public health or welfare, then EPA would be required under our statutory authority to prescribe standards to control the emissions of lead from piston-engine aircraft. In promulgating such standards, the EPA would be required to consult with the Federal Aviation Administration (FAA), and could not change standards if doing so would significantly increase noise and adversely affect safety. FAA would then be required, after consultation with EPA, to prescribe regulations to insure compliance with any standards to control the emissions of lead from piston-engine aircraft. Under 49 U.S.C. 44714, FAA would also be required to prescribe standards for the composition or chemical or physical properties of piston-engine fuel or fuel additives to control or eliminate aircraft lead emissions.

In this notice, we discuss our analysis of the relevant information and issues to date, and we seek further public input regarding FOE's petition. For the purposes of this notice, we will refer to the positive or negative exercise of judgment as to whether lead emissions from aircraft engines resulting from the use of aviation gasoline (avgas) cause or contribute to air pollution which may reasonably be anticipated to endanger public health or welfare as the "endangerment finding" and the "cause or contribute finding." This short-hand use of "endangerment finding" and "cause or contribute finding" is strictly for purposes of simplifying the discussion, and should not be read as implying that EPA considers the exercise of the Administrator's judgment to require a formal "finding" or "determination."

In 2006, EPA completed the Air Quality Criteria Document (AQCD) for Lead, which critically assesses and integrates relevant scientific information regarding the health effects of lead.[2] EPA concluded that the latest evidence indicates adverse health effects, most notably among children, are occurring at much lower levels than previously considered. In 2008, EPA decreased the level of the primary National Ambient Air Quality Standard (NAAQS) for lead from 1.5 micrograms per cubic meter (µg/m³) to 0.15 µg/m³ in order to provide increased protection for children and other at-risk populations against an array of adverse health effects, most notably neurological effects in children, including neurocognitive and neurobehavioral effects.[3] Neurotoxic effects in children and cardiovascular effects in adults are among those best substantiated as occurring at blood lead concentrations as low as 5 to 10 µg/dL (or possibly lower); and these categories are currently clearly of greatest public health concern (AQCD for Lead, p. 8–60). The U.S. Centers for Disease Control and Prevention (CDC) concluded in 2005 that no "safe" threshold for blood lead has been identified, and emphasized the

[1] *See* docket item EPA–HQ–OAR–2007–0294–0003.

[2] U.S. Environmental Protection Agency (2006) Air Quality Criteria for Lead. Washington, DC, EPA/600/R–5/144aF. Available online at: *http://www.epa.gov/ncea/*.

[3] National Ambient Air Quality Standards for Lead 73 FR 66965 (Nov. 12, 2008).

importance of preventative measures.[4] [5] To provide increased protection against lead-related welfare effects, in 2008 EPA revised the secondary standard to be identical in all respects to the revised primary standard. Section II of this ANPR provides more detail regarding health and welfare effects of lead.

Given the recent findings of the science summarized by EPA in the AQCD for Lead as well as the findings of the CDC, the Agency is concerned about the potential for health and welfare effects from exposure to lead emissions from aircraft engines using leaded avgas. On a national basis, emissions of lead from aircraft engines using leaded avgas are the largest single source category for emissions of lead to air, comprising approximately half of the national inventory.[6] There are almost 20,000 airport facilities in the U.S. at which leaded avgas may be used, and in some areas of the country there are densely populated residential developments immediately adjacent to these airport facilities. As described in Section V, we estimate that up to 16 million people reside and three million children attend school in close proximity to airport facilities servicing piston-engine aircraft that are operating on leaded avgas.

Exposure to lead occurs through multiple routes (*e.g.,* inhalation, ingestion and dermal adsorption), and lead emitted to the atmosphere can contribute to lead levels in multiple media (*e.g.,* air, soil and water). The lead monitoring studies conducted at or near airports, described in Section IV of this ANPR, indicate that lead levels in ambient air on and near airports servicing piston-engine aircraft are higher than lead levels in areas not directly influenced by a lead source. In addition, the emissions of lead from these engines are also expected to distribute widely through the environment. This is in part due to the emission of lead at various altitudes during aircraft operations as well as the fine particle size of lead emitted by piston engines. Continued use of leaded avgas provides an ongoing source of new lead that is deposited in various environmental media and participates in long term cycling mechanisms in the environment, thus adding to the pool of lead available for uptake by humans and biota. We expect the lead from avgas to be bioavailable in the same way as the lead emitted by motor vehicles in the past, which was well documented to contribute to blood levels through both ingestion and inhalation.

As noted in Section II of this ANPR, once deposited to surfaces, lead can subsequently be resuspended into the ambient air and, because of the persistence of lead, emissions of this metal contribute to environmental media concentrations for many years into the future. Lead that is a soil or dust contaminant today may have been airborne yesterday or many years ago. Therefore lead emissions from piston-engine aircraft could contribute to increased lead exposure and risk currently or at some time in the future.

Section VI of this ANPR provides an overview of additional information that will be available for the NPRM to evaluate the potential for public health and welfare impacts from lead emitted by piston-engine aircraft. These additional data will come from lead monitoring being planned to satisfy requirements of the Lead NAAQS, air quality modeling planned at EPA and any information submitted to EPA during the comment period for this ANPR.

The remainder of this section provides background on leaded avgas, FOE's petition and EPA's response to the petition to date, and statutory authority over emissions, fuel for aircraft and Federal actions to reduce lead exposure. Section II provides a discussion of the health and welfare effects of lead. Sections III, IV and V describe the emissions of lead from avgas, ambient lead concentration in the vicinity of airports and potential exposure to lead from leaded avgas, respectively. In Section VI, we describe the additional information EPA is collecting and considerations regarding engine emission standards. Section VII contains information on statutory and executive order reviews covering this action.

A. Background on Leaded Aviation Gasoline

In 1996, EPA promulgated regulations that banned the use of leaded gasoline in highway vehicles.[7] The addition of lead to fuel used in piston-engine powered aircraft was not banned in this action, and the use of leaded avgas is the largest remaining source category of lead emissions. Lead is not added to jet fuel that is used in commercial aircraft, most military aircraft, or other turbine-engine powered aircraft. Most piston-engine aircraft fall into the categories of either general aviation (GA) or air taxi (AT). GA and AT aircraft include a diverse set of aircraft types and engine models and are used in a wide variety of applications.[8]

Lead is added to fuel for piston-engine aircraft in the form of tetraethyl lead (TEL). This lead additive helps boost fuel octane, prevents knock, and prevents valve seat recession and subsequent loss of compression for engines without hardened valves. There are two main types of leaded avgas: 100 Octane, which can contain up to 4.24 grams of lead per gallon; and 100 Octane Low Lead (100 LL), which can contain up to 2.12 grams of lead per gallon. Currently, 100LL is the most commonly available and most commonly used type of avgas.[9] [10] TEL was first used in piston-engine aircraft in 1927.[11] Into the 1950s commercial and military aircraft in the U.S. operated on 100 Octane leaded avgas, but in subsequent years, the commercial and military aircraft fleet largely converted to jet turbine-engine propelled aircraft. However, the use of avgas containing 4 grams of lead per gallon continued in piston-engine aircraft until the early 1970s when 100LL became the dominant leaded fuel in use. Currently, very little 100 Octane is supplied in the U.S. and we use the lead content of 100LL (2.12 grams per gallon) to characterize the lead available from avgas.

Since lead is a persistent pollutant, it is important to characterize the historical use of this fuel.

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[4] Centers for Disease Control and Prevention (2005) Preventing lead poisoning in young children: a statement by the Centers for Disease Control and Prevention. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service. August.

[5] Advisory Committee on Childhood Lead Poisoning Prevention (ACCLPP) (2007) Interpreting and managing blood lead levels <10 ug/dL in children and reducing childhood exposures to lead: Recommendations of CDC's Advisory Committee on Childhood Lead Poisoning Prevention. Morbidity and Mortality Weekly Report. 56(RR–8). November 2, 2007.

[6] U.S. Environmental Protection Agency Electronic Report on the Environment. Available at: *http://cfpub.epa.gov/eroe.* Updated in December 2009 using the 2005 National Emissions Inventory.

[7] *See* "Prohibition on Gasoline Containing Lead or Lead Additives for Highway Use" 61 FR 3832 (Feb. 2, 1996).

[8] Commercial aircraft include those used for scheduled service transporting passengers, freight, or both. Air taxis fly scheduled and for-hire service carrying passengers, freight or both, but they usually are smaller aircraft than those operated by commercial air carriers. General aviation includes most other aircraft (fixed and rotary wing) used for recreational flying, business, and personal transportation.

[9] ChevronTexaco (2006) Aviation Fuels Technical Review. FTR–3. Available online at: *http://www.chevronglobalaviation.com/docs/aviation_tech_review.pdf.*

[10] ASTM International (2007) Standard Specification for Aviation Gasolines D910–06.

[11] Ogston, A.R. (1981) A Short History of Aviation Gasoline Development, 1903–1980. Society of Automotive Engineers. Paper number 810848.

Approximately 14.6 billion gallons of leaded avgas have been consumed in the U.S. between 1970 and 2007. If this fuel was all 100LL, it would account for approximately 34,000 tons [12] of lead emitted to the air.[13] In terms of the potential impacts from long-term use of leaded avgas at and near airports, older facilities would be expected to have a legacy of lead, particularly those that supported military and commercial aircraft operating on 100 Octane. Over 3,000 of the 20,000 airport facilities in the U.S. are at least 50 years old and some airports have been in operation since the early 1900s.

The Department of Energy's (DOE's) Energy Information Administration (EIA) provides information on the volume of leaded avgas supplied in the U.S.[14] The Department of Transportation's (DOT's) FAA provides information on the volume of leaded avgas consumed in the U.S.[15] EPA has historically used the DOE EIA avgas fuel volumes supplied to calculate national lead inventories from the consumption of leaded avgas. We are currently evaluating methods used by DOE and DOT to calculate annual avgas supply and consumption volumes. In this document, we provide avgas fuel volume data supplied by DOE and DOT and we note the source of the data for clarity. Over the past ten years, DOE estimates of the volume of leaded avgas supplied has ranged from 326 million gallons in 1999 to 235 million gallons in 2008 (Figure 1). Applying the concentration of lead in 100LL (2.12 grams of lead per gallon), the total quantity of lead supplied in avgas in the nation has ranged from 762 tons in 1999 to 550 tons in 2008 (a 28% decrease over that time period). The decrease in fuel consumption is attributed to the decrease in piston-engine aircraft activity over that time period and not due to a shift to unleaded fuel. There are currently over 200,000 piston-engine aircraft in the U.S. that continue to consume leaded avgas and approximately 2,000 new piston-engine aircraft requiring leaded avgas are manufactured annually.[16] As described in Section III.B of this ANPR, there is a slight growth in the activity of general aviation aircraft projected to 2025.

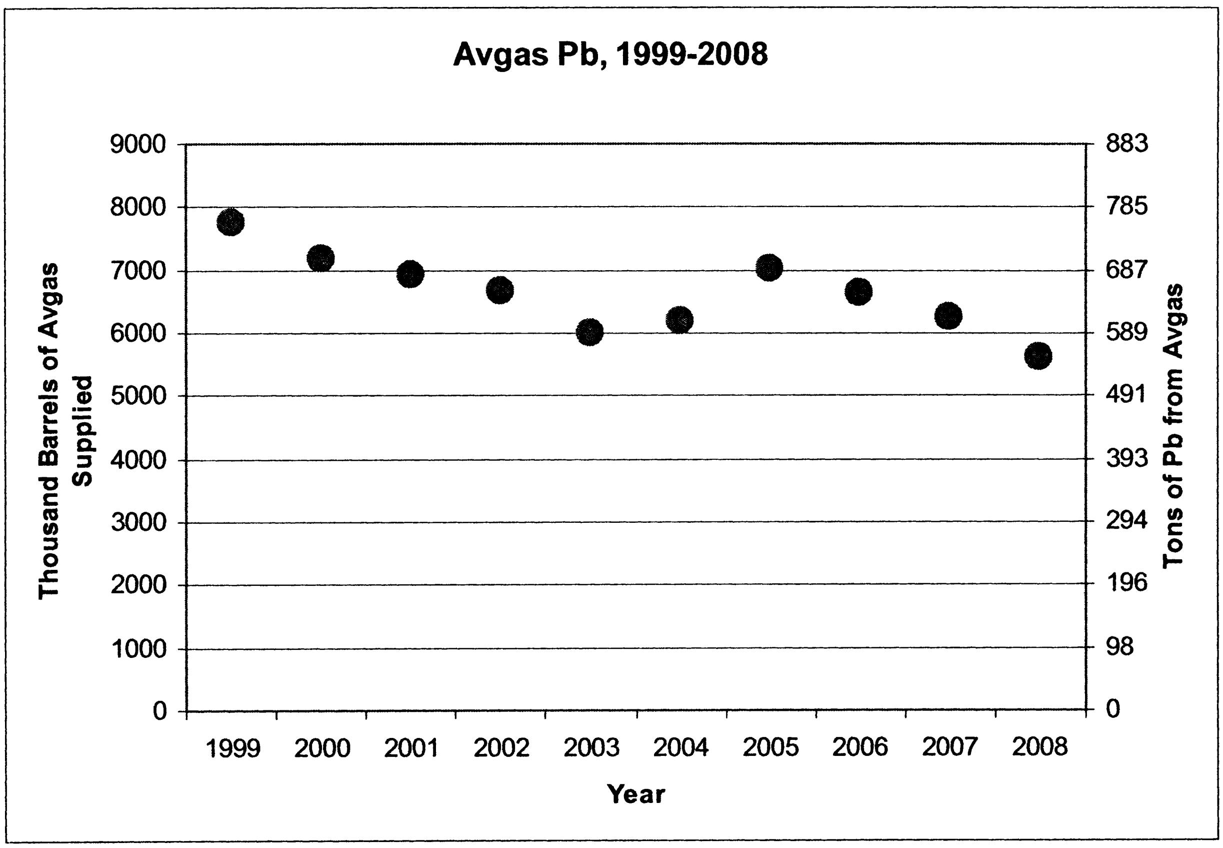

Figure 1. Tons of Lead Supplied in Aviation Gasoline Annually from 1999 – 2008.

Source: DOE Energy Information Administration

[12] In this ANPR and in EPA's National Emissions Inventory, the use of the unit tons refers to short tons.

[13] Oak Ridge National Laboratory (2009) Transportation Energy Data Book: Edition 28. Available at: *http://cta.ornl.gov/data*. Table A.7.

[14] Department of Energy Information Administration. Fuel production volume data obtained from *http://tonto.eia.doe.gov/dnav/pet/hist/mgaupus1A.htm* accessed June 2009.

[15] U.S. Department of Transportation Federal Aviation Administration Aviation Policy and Plans. FAA Aerospace Forecast Fiscal Years 2009–2025. p.81. Available at: *http://www.faa.gov/data_research/aviation/aerospace_forecasts/2009–2025/media/2009%20Forecast%20Doc.pdf.* This document provides historical data for 2000–2008 as well as forecast data.

[16] General Aviation Manufacturers Association (2008) General Aviation Statistical Databook & Industry Outlook. Available online at: *http://www.gama.aero/files/2008_general_aviation_statistical_databook__indust_499b0dc37b.pdf.*

B. Background Information Regarding General Aviation and Use of Piston-Engine Aircraft

In the U.S., general aviation aircraft fly over 27 million hours and carry 166 million passengers annually.[17] Approximately 66 percent of hours flown by general aviation are conducted by piston-engine aircraft.[18] Aircraft in the general aviation fleet are used for personal transportation (36 percent), instructional flying (19 percent), corporate uses (11 percent), business (11 percent), air taxi and air tours (8 percent) and the remainder include hours spent in other applications such as aerial observation and aerial application.[19] According to the 2008 General Aviation Statistical Databook & Industry Outlook report by the General Aviation Manufacturers Association (GAMA) there were 578,541 pilots in the United States in 2008.[20] According to GAMA, in 2008, the number of active single-engine piston-powered aircraft was 144,220 and the number of active twin-engine piston-powered aircraft was 18,385. In 2008, 1,791 new piston-engine aircraft were manufactured in the U.S.

FAA's Office of Air Traffic provides a complete listing of operational airport facilities in the National Airspace System Resources (NASR) database.[21] In 2008, there were 19,896 airport facilities in the U.S., the vast majority of which are expected to have activity by piston-engine aircraft that operate on leaded avgas. FAA's National Plan of Integrated Airport Systems identifies approximately 3,400 airports that are significant to national air transportation.

[17] General Aviation Manufacturers Association (2008) General Aviation Statistical Databook and Industry Outlook, p.30. Retrieved on August 17, 2009 from: *http://www.gama.aero/files/2008_general_aviation_statistical_databook__indust_499b0dc37b.pdf*.

[18] General Aviation Manufacturers Association (2008) General Aviation Statistical Databook and Industry Outlook, p.30. Retrieved on August 17, 2009 from: *http://www.gama.aero/files/2008_general_aviation_statistical_databook__indust_499b0dc37b.pdf*.

[19] General Accounting Office Report to Congressional Requesters (2001) General Aviation Status of the Industry, Related Infrastructure, and Safety Issues. GAO–01–916.

[20] General Aviation Manufacturers Association (2008) General Aviation Statistical Databook and Industry Outlook, pp.51–55. Retrieved on August 17, 2009 from: *http://www.gama.aero/files/2008_general_aviation_statistical_databook__indust_499b0dc37b.pdf*.

[21] An electronic report can be generated from the NASR database and is available for download from the Internet at the following Web site. *http://www.faa.gov/airports_airtraffic/airports/airport_safety/airportdata_5010/*. This database is updated every 56 days.

C. Background on the Petition and EPA's Response

In a 2003 letter to the EPA, FOE initially raised the issue of the potential for endangerment caused or contributed to by lead emissions from the use of leaded avgas.[22] In 2006, FOE filed a petition with EPA requesting that the Administrator find endangerment or, if there was insufficient information to find endangerment, commence a study of lead emissions from piston-engine aircraft. In 2007, the EPA issued a **Federal Register** notice on the petition requesting comments and information related to a wide range of issues regarding the use of leaded avgas and potential public health and welfare exposure issues.[23] We sought comments regarding exposure to lead from avgas combustion, emissions of lead, fuel options, and piston-engine technology. The comments received to date are publicly available in the docket (EPA–HQ–OAR–2007–0294). The majority of comments received concerned the nature of the industry and fuel supply issues. The commenters did not supply information regarding health or exposure issues. In 2008, the EPA initiated a lead study which will improve the manner in which EPA models emissions from piston-engine aircraft. This study is described in further detail in Section VI of this document. At the time we received FOE's petition, the EPA was in the process of a full re-evaluation of the science supporting the lead NAAQS. Information from that re-evaluation and the relationship between the new lead standard and the emissions of lead from piston-engine aircraft are discussed in this ANPR.

D. Statutory Authority

1. Background

Section 231 of the CAA sets forth EPA's authority to regulate aircraft emissions of air pollution. As described further in Section I.D.2 of this ANPR, Section 231(a)(2)(A) requires EPA to, from time to time, issue proposed emission standards applicable to the emission of any air pollutant from any class or classes of aircraft engines which, in the Administrator's judgment, cause or contribute to air pollution which may reasonably be anticipated to endanger public health or welfare. EPA has broad authority in exercising its judgment regarding whether emissions from certain sources cause or contribute to air pollution which may reasonably be anticipated to endanger public health or welfare.[24] EPA has discussed its "endangerment finding" authority at length in recent notices for greenhouse gases published in the **Federal Register**, and we refer readers to those notices for detailed discussions of the analytical and legal framework.[25]

In 1976, EPA listed lead under CAA section 108, making it what is called a "criteria pollutant." As part of the listing decision, EPA determined that lead was an air pollutant which, in the Administrator's judgment, has an adverse effect on public health or welfare under then section 108(a). Once lead was listed, EPA issued primary and secondary NAAQS that the Administrator determined were requisite to protect public health with an adequate margin of safety and to protect public welfare from any known or anticipated adverse effects. Section 109(b)(1) and (2). As discussed elsewhere in this notice, EPA issued the first NAAQS for lead in 1978, and recently revised the lead NAAQS by reducing the level of the standard from 1.5 μg/m^3 to 0.15 μg/m^3, measured over a 3-month averaging period. These actions are part of the context for the issues before EPA under section 231(a).

The first part of the endangerment test concerns identification of air pollution which may reasonably be anticipated to endanger public health or welfare. The CAA defines both "air pollutant" and "welfare." Air pollutant is defined in CAA section 302(g) as: "Any air pollution agent or combination of such agents, including any physical, chemical, biological, radioactive (including source material, special nuclear material, and byproduct material) substance or matter which is emitted into or otherwise enters the ambient air. Such term includes any precursors to the formation of any air pollutant, to the extent the Administrator has identified such precursor or precursors for the particular purpose for which the term 'air pollutant' is used." Lead fits within

[22] FOE letter dated December 12, 2003 submitted to EPA Docket EPA–HQ–OAR–2002–0030.

[23] *See* "Petition Requesting Rulemaking To Limit Lead Emissions from General Aviation Aircraft; Request for Comments" 72 FR 64570 (Nov. 16, 2007).

[24] *See, e.g., Ethyl Corp.* v. *EPA,* 541 F.2d 1, 6 (DC Cir.), cert. denied 426 U.S. 941 (1976); *see also Massachusetts* v. *EPA,* 549 U.S. 497, 506, n.7 (2007).

[25] *See,* "Endangerment and Cause or Contribute Findings for Greenhouse Gases under Section 202(a) of the Clean Air Act; Final Rule," 74 FR 66496, 66505 (Dec. 15, 2009); *see also,* "Proposed Endangerment and Cause or Contribute Findings for Greenhouse Gases Under Section 202(a) of the Clean Air Act," 74 FR 18886, 18890–94 (April 24, 2009); *see also* "Regulating Greenhouse Gas Emissions Under the Clean Air Act; Advance Notice of Proposed Rulemaking," 73 FR 44354, 44421–23 (July 30, 2008).

this capacious definition, and has long been regulated as an air pollutant by EPA under the CAA (*see* Section I.E. of this ANPR).

There is no definition of public health in the CAA. The U.S. Supreme Court has discussed the concept in the context of whether costs can be considered when setting NAAQS. *Whitman* v. *American Trucking Ass'n,* 531 U.S. 457 (2001). In *Whitman,* the Court imbued the term with its most natural meaning: "the health of the public." *Id.,* at 466. When considering public health, EPA has looked at morbidity, including acute and chronic health effects, as well as mortality. EPA has long regulated emissions of lead air pollution due to their adverse impacts on public health (*see* section I.E. of this ANPR). Exposure to lead causes "a broad array of deleterious effects on multiple organ systems," among children and adults (AQCD for Lead, p.8–24 and Section 8.4.1). Of particular concern are the neurotoxic effects of lead in young children.[26] *See* Section II of this ANPR for a more complete overview of the public health effects of lead.

Regarding "welfare," CAA section 302(h) states that "[a]ll language referring to effects on welfare includes, but is not limited to, effects on soils, water, crops, vegetation, man-made materials, animals, wildlife, weather, visibility, and climate, damage to and deterioration of property, and hazards to transportation, as well as effects on economic values and on personal comfort and well-being, whether caused by transformation, conversion, or combination with other air pollutants." This definition is quite broad, and may include effects other than those listed here as effects on welfare. Welfare effects caused by lead have been evaluated by EPA and were the basis for establishing the secondary lead standard.[27]

By instructing the Administrator to consider whether emissions of an air pollutant cause or contribute to air pollution, the statute is clear that she need not find that emissions from any one sector or group of sources are the sole or even the major part of an air pollution problem. Moreover, section 231(a) does not contain a modifier on its use of the term contribute. Unlike some other CAA provisions, it does not require "significant" contribution.[28] Congress made it clear that the Administrator is to exercise her judgment in determining contribution, and authorized regulatory controls to address air pollution even if the air pollution problem results from a wide variety of sources. The cause or contribute test is designed to authorize EPA to identify and then address what may well be many different sectors or groups of sources that are each part of an air pollution problem.

Section 231(a)(2) refers to contribution and does not specify that the contribution must be significant before an affirmative finding can be made. Any finding of a "contribution" requires some threshold to be met; a truly trivial or *de minimis* "contribution" might not count as such. In the past, the Administrator has evaluated the emissions of the source or sources in different ways, based on the particular circumstances involved. In some mobile source rulemakings, the Administrator has used the percent of emissions from the regulated mobile source category compared to the total mobile source inventory for that air pollutant as the best way to evaluate contribution.[29] In other instances the Administrator has looked at the percent of emissions compared to the total nonattainment area inventory of the air pollution at issue.[30] EPA has found that air pollutant emissions that amount to 1.2 percent of the total inventory met the statutory test for contribution, triggering EPA's regulatory authority.[31]

2. Regulatory Authority for Emission Standards

Section 231 of the CAA sets forth EPA's authority to regulate aircraft emissions of air pollution. Section 231(a)(2)(A) requires EPA to, from time to time, issue proposed emission standards applicable to the emission of any air pollutant from any class or classes of aircraft engines which, in the Administrator's judgment, cause or contribute to air pollution which may reasonably be anticipated to endanger public health or welfare. Section 231(a)(2)(B)(i) directs EPA to consult with FAA on aircraft engine emission standards, and section 231(a)(2)(B)(ii) provides that EPA shall not change the aircraft engine emission standards if such change would significantly increase noise and adversely affect safety. Section 231(a)(3) directs EPA to issue final regulations with such modifications as the Administrator "deems appropriate."

In setting or revising standards, section 231(b) provides that EPA shall have them take effect after such period as EPA finds necessary (after consultation with the Secretary of Transportation) to permit the development and application of the requisite technology, giving appropriate consideration to the cost of compliance within such period. Section 231(c) then states that EPA's regulations regarding aircraft shall not apply if disapproved by the President, after notice and opportunity for public hearing, on the basis of a finding by DOT that such regulations would create a hazard to aircraft safety. Section 232 directs DOT to issue and implement regulations to insure compliance with EPA's standards, while section 233 pre-empts States and local governments from adopting or enforcing any aircraft emission standards that are not identical to EPA's standards.

In recently reviewing this statutory scheme, the U.S. Court of Appeals for the District of Columbia Circuit ruled that it constitutes a "both explicit and extraordinarily broad" delegation of "expansive authority to EPA to enact appropriate regulations applicable to the emissions of air pollutants from aircraft engines." [32]

3. Regulatory Authority for Fuel Standards

Section 211(c) of the CAA allows EPA to regulate fuels used in motor vehicles and nonroad vehicles or engines where emission products of the fuel either: (1) Cause or contribute to air pollution that reasonably may be anticipated to endanger public health or welfare, or (2) will impair to a significant degree the performance of any emission control device or system which is in general use, or which the Administrator finds has been developed to a point where in a reasonable time it will be in general use were such a regulation to be promulgated. This section of the CAA was used to eliminate lead from fuel used in motor vehicles. EPA's authority to regulate fuels is limited to those fuels used in motor vehicles, motor vehicle engines, or nonroad engines or vehicles, under CAA section 211(c)(1). The CAA defines "motor vehicle," "nonroad engine," and "nonroad vehicle" in section 216 for purposes of part A of title II of the CAA. Part A is also where the authority to regulate fuels under section 211 resides. However, EPA's authority to regulate aircraft resides in

[26] *See* "National Ambient Air Quality Standards for Lead" 73 FR 66970–67007 (Nov. 12, 2008).

[27] *See* "National Ambient Air Quality Standards for Lead" 73 FR 67007–67012 (Nov. 12, 2008).

[28] *See, e.g.,* CAA sections 111(b); 213(a)(2), (4).

[29] *See, e.g.,* 66 FR 5001 (January 18, 2001) (heavy duty engine and diesel sulfur rule).

[30] *See, e.g.,* 67 FR 68242 (November 8, 2002) (snowmobile rule).

[31] *Bluewater Network* v. *EPA,* 370 F.3d 1, 15 (DC Cir. 2004) (For Fairbanks, this contribution was equivalent to 1.2 percent of the total daily CO inventory for 2001).

[32] *NACAA* v. *EPA,* 489 F.3d 1221, 1229–30 (DC Cir. 2007).

part B of title II, and therefore the definitions of section 216 do not apply to aircraft. This means that aircraft are not "nonroad vehicles," and aircraft engines are not "nonroad engines." Consequently, EPA's authority to regulate fuels under section 211 does not extend to fuels used exclusively in aircraft, such as leaded avgas, that are not also used in motor vehicles or nonroad vehicles or engines (excluding fuel used in vehicles exclusively).

Instead, fuels used exclusively in aircraft engines are to be regulated by the FAA. Title 49 (49 U.S.C. 44714) requires that "the Administrator of the Federal Aviation Administration shall prescribe (1) standards for the composition or chemical or physical properties of an aircraft fuel or fuel additive to control or eliminate aircraft emissions the Administrator of the Environmental Protection Agency decides under section 231 of the Clean Air Act (42 U.S.C. 7571) endanger the public health or welfare; and (2) regulations providing for carrying out and enforcing those standards."

E. Federal Actions To Reduce Lead Exposure

The U.S. has made tremendous progress in reducing lead concentrations in the outdoor air. Nationwide, average concentrations of lead in the air have dropped 91 percent between 1980 and 2008.[33] Much of this dramatic improvement occurred as a result of the permanent phase-out of lead in motor vehicle gasoline discussed in this section of the ANPR. However, lead continues to be emitted into the air from many different types of stationary sources and piston-engine aircraft as well as certain high performance engines such as race cars.

Federal programs provide for nationwide reductions in emissions of lead and other air pollutants through several provisions in the CAA. In the early 1970s, EPA issued regulations regarding lead in gasoline in order to accomplish two purposes.[34] First, EPA issued regulations designed to ensure the availability of unleaded gasoline for use in motor vehicles equipped with emission control systems such as catalytic converters. EPA had determined that lead additives would impair to a significant degree the performance of emission control systems. Second, EPA issued regulations designed to gradually reduce the content of lead in leaded gasoline, because EPA found that lead emissions from motor vehicles presented a significant risk of harm to the health of urban population groups, especially children. Children are at a sensitive life stage with regard to the adverse health effects of lead. In 1985, EPA, noting the significant reduction in adverse health effects, mainly among pre-school age children, that would result from reductions in lead content in gasoline, promulgated additional regulations to decrease the allowable concentration of lead in gasoline for motor vehicles to 0.10 grams per gallon.[35] In 1990 Congress added section 211(n) to the CAA which provides that after December 31, 1995, it shall be unlawful to sell any gasoline for use in any motor vehicle which contains lead or lead additives. In 1996, EPA incorporated the CAA statutory ban on gasoline containing lead or lead additives for highway use into the Agency's existing regulations on the lead content of gasoline.[36] In this regulation, it was noted that the petroleum industry may continue to make and market gasoline produced with lead additives for all remaining uses, including use as fuel in aircraft, racing cars, and nonroad engines such as farm equipment engines and marine engines, to the extent otherwise allowed by law.[37]

In fact, there have been no regulatory limits placed on the production and consumption of leaded avgas, and, as noted in Section I.A of this ANPR, emissions of lead from piston-engine aircraft account for an increasing fraction of the lead emissions to air (*e.g.,* accounting for approximately half the national inventory of lead emission in 2005). This is in spite of the decrease in the supply of leaded avgas nationally from 374 million gallons (875 tons of lead) in 1990 to 235 million gallons (550 tons of lead) in 2008.[38] The decrease in fuel consumption is attributed to the decrease in piston-engine aircraft activity over that time period and not due to a shift to unleaded fuel. There are over 200,000 piston-engine aircraft in the U.S. that continue to consume leaded avgas and approximately 2,000 new piston-engine aircraft requiring leaded avgas are manufactured annually. Projected growth for this industry is discussed in Section III.B.

Significant reductions in emission of lead from stationary sources have been achieved between 1985 and 2002, totaling almost 2,000 tons of lead.[39] Regulations promulgated in 1995, 1997 and 1999 controlled emissions of lead from primary and secondary lead smelters, contributing to these reductions.[40 41 42] Currently, metal industry emissions of lead comprise 23% of the national inventory (298 tons). Additional reductions in the emission of lead have been accomplished through controls on waste incineration and other stationary sources.[43 44 45] These standards have been set at "maximum achievable control technology" (MACT) levels, and under CAA sections 112 and 129 EPA must revisit these standards in the future to determine whether they are sufficiently stringent to provide an ample margin of safety to protect public health and prevent an adverse environmental effect.

As lead is a multimedia pollutant, a broad range of Federal programs beyond those that focus on air pollution control provide for nationwide reductions in environmental releases and human exposures. In addition, the U.S. Centers for Disease Control and Prevention (CDC) programs provide for the tracking of children's blood lead levels nationally and provide guidance on levels at which medical and environmental case management activities should be implemented.[46 47] In

[33] *See http://www.epa.gov/airtrends/lead.html.*

[34] "Regulation of Fuels and Fuel Additives" 38 FR 1254 (Dec. 4, 1973).

[35] "Regulation of Fuels and Fuel Additives; Gasoline Lead Content" 50 FR 9386 (March 7, 1985).

[36] "Prohibition on Gasoline Containing Lead or Lead Additives for Highway Use" 61 FR 3832 (Feb. 2, 1996).

[37] "Prohibition on Gasoline Containing Lead or Lead Additives for Highway Use" 61 FR 3834 (Feb. 2, 1996).

[38] These fuel volume estimates are from the Department of Energy Information Administration. *http://tonto.eia.doe.gov/dnav/pet/hist/mgaupus1A.htm.*

[39] U.S. Environmental Protection Agency (2008) EPA's Report on the Environment EPA/600/R–07/045F. Available at: *http://www.epa.gov/roe/.*

[40] "National Emission Standards for Hazardous Air Pollutants From Secondary Lead Smelting" 60 FR 32587 (June 23, 1995).

[41] "National Emission Standards for Hazardous Air Pollutants From Secondary Lead Smelting" 62 FR 32209 (June 13, 1997).

[42] "National Emission Standards for Hazardous Air Pollutants for Primary Lead Smelting" 64 FR 30194 (June 4, 1999).

[43] "Standards of Performance for New Stationary Sources and Emission Guidelines for Existing Sources: Municipal Waste Combustors" 60 FR 65387 (Dec. 19, 1995).

[44] "Emission Guidelines for Existing Sources and Standards of Performance for New Stationary Sources" 62 FR 45124 (Aug. 25, 1997).

[45] "Standards of Performance for New Stationary Sources and Emission Guidelines for Existing Sources: Large Municipal Waste Combustors" 71 FR 27324–27348 (May 10, 2006).

[46] Centers for Disease Control and Prevention (2005) Preventing lead poisoning in young children: a statement by the Centers for Disease Control and Prevention. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service. August.

[47] Advisory Committee on Childhood Lead Poisoning Prevention (2007) Interpreting and managing blood lead levels <10 μg/dL in children and reducing childhood exposures to lead:

1991, the Secretary of the U.S. Department of Health and Human Services (HHS) characterized lead poisoning as the "number one environmental threat to the health of children in the United States." [48] In 1997, President Clinton created, by Executive Order 13045, the President's Task Force on Environmental Health Risks and Safety Risks to Children in response to increased awareness that children face disproportionate risks from environmental health and safety hazards (62 FR 19885).[49] By Executive Orders issued in October 2001 and April 2003, President Bush extended the work for the Task Force for an additional three and a half years beyond its original charter (66 FR 52013 and 68 FR 19931). The Task Force set a Federal goal of eliminating childhood lead poisoning by the year 2010, and reducing lead poisoning in children was identified as the Task Force's top priority.

Federal abatement programs provide for the reduction in human exposures and environmental releases from in-place materials containing lead (*e.g.,* lead-based paint, urban soil and dust, and contaminated waste sites). Federal regulations on disposal of lead-based paint waste help facilitate the removal of lead-based paint from residences (68 FR 36487). Further, in 1991, EPA lowered the maximum levels of lead permitted in public water systems from 50 parts per billion (ppb) to 15 ppb measured at the consumer's tap (56 FR 26460).

Federal programs to reduce exposure to lead in paint, dust, and soil are specified under the comprehensive Federal regulatory framework developed under the Residential Lead-Based Paint Hazard Reduction Act (Title X). Under Title X and Title IV of the Toxic Substances Control Act (TSCA), EPA has established regulations and associated programs with the goal of reducing exposure to lead via lead-based paint. For example, under Title IV of TSCA, EPA established standards identifying hazardous levels of lead in residential paint, dust, and soil in 2001. On March 31, 2008, the Agency issued a new rule (73 FR 21692) to further protect children from lead-based paint hazards resulting from renovation and repair work occurring in housing in which they live.

Programs associated with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA or Superfund) and Resource Conservation Recovery Act (RCRA) also implement abatement programs, reducing exposures to lead and other pollutants. For example, EPA determines and implements protective levels for lead in soil at Superfund sites and RCRA corrective action facilities. Federal programs, including those implementing RCRA, provide for management of hazardous substances in hazardous and municipal solid waste.[50] Federal regulations concerning batteries in municipal solid waste control the collection and recycling or proper disposal of batteries containing lead.[51] Similarly, Federal programs provide for the reduction in environmental releases of hazardous substances such as lead in the management of wastewater.[52]

A variety of Federal nonregulatory programs also provide for reduced environmental release of lead-containing materials through voluntary measures and more general encouragement of pollution prevention, promotion of reuse and recycling, reduction of priority and toxic chemicals in products and waste, and conservation of energy and materials. These include the voluntary partnership between EPA and the National Association for Stock Car Auto Racing (NASCAR) which has achieved the goal of removing alkyl lead (organic forms of lead) from racing fuels used in the Nextel Cup, Busch and Craftsman Truck Series.[53] Other programs include the Resource Conservation Challenge,[54] the National Waste Minimization Program,[55] "Plug in to eCycling" (a partnership between EPA and consumer electronics manufacturers and retailers),[56] and activities to reduce the practice of backyard trash burning.[57]

In addition to the lead control programs summarized above, EPA's research program, with other Federal agencies, identifies, encourages and conducts research needed to locate and assess serious risks and to develop methods and tools to characterize and help reduce risks. For example, EPA's Integrated Exposure Uptake Biokinetic Model for Lead in Children (IEUBK model) and the Adult Lead Methodology are widely used and accepted as tools that provide guidance in evaluating site specific data. More recently, in recognition of the need for a single model that predicts lead concentrations in tissue for children and adults, EPA is developing the All Ages Lead Model (AALM) to provide researchers and risk assessors with a pharmacokinetic model capable of estimating blood, tissue, and bone concentrations of lead based on estimates of exposure over the lifetime of the individual. EPA research activities on substances including lead focus on better characterizing aspects of health and environmental effects, exposure, and control or management of environmental releases.[58]

II. Health and Welfare Effects of Lead

A. Multimedia and Multi-Pathway Exposure Considerations

This section briefly summarizes the information presented in the 2008 NAAQS for Lead,[59] the 2007 Lead Staff Paper [60] and the 2006 Air Quality Criteria Document for Lead (AQCD for Lead).[61] Lead is an unusual pollutant in that the distribution of lead to different environmental media (*e.g.,* air, soil, water) is important for evaluating public health and welfare effects. Lead emitted to the air can result in exposure via multiple pathways (*e.g.,* inhalation, ingestion, dermal absorption). Some key multimedia and multi-pathway considerations for lead include the following:

(1) Lead is emitted into the air from many sources encompassing a wide

Recommendations of CDC's Advisory Committee on Childhood Lead Poisoning Prevention. Morbidity and Mortality Weekly Report. 56(RR–8). November 2, 2007.

[48] Alliance to End Childhood Lead Poisoning (1991) The First Comprehensive National Conference; Final Report. October 6, 7, 8, 1991.

[49] Co-chaired by the Secretary of the HHS and the Administrator of the EPA, the Task Force consisted of representatives from 16 Federal departments and agencies.

[50] *See, e.g.,* 66 FR 58258.

[51] *See, e.g.,* "Implementation of the Mercury-Containing and Rechargeable Battery Management Act" *http://www.epa.gov/epaoswer/hazwaste/recycle/battery.pdf* and "Municipal Solid Waste Generation, Recycling, and Disposal in the United States: Facts and Figures for 2005" *http://www.epa.gov/epaoswer/osw/conserve/resources/msw-2005.pdf.*

[52] *http://www.epa.gov/owm/.*

[53] U.S. Environmental Protection Agency Persistent, Bioaccumulative, and Toxic Pollutants (PBT) Program (2002) PBT national action plan for alkyl-Pb. Washington, DC. Available online at: *http://www.epa.gov/pbt/pubs/Alkyl_lead_action_plan_final.pdf.*

[54] *http://www.epa.gov/epawaste/rcc/index.htm.*

[55] *http://www.epa.gov/epawaste/hazard/wastemin/.*

[56] *http://www.epa.gov/epawaste/partnerships/plugin/index.htm.*

[57] *http://www.epa.gov/epawaste/nonhaz/municipal/backyard/index.htm.*

[58] *http://www.epa.gov/ord/.*

[59] National Ambient Air Quality Standards for Lead 73 FR 66970–67007 (Nov. 12, 2008) Section II.A.

[60] U.S. Environmental Protection Agency Review of the National Ambient Air Quality Standards for Lead: Policy Assessment of Scientific and Technical Information OAQPS Staff Paper (2007) Chapter 2. EPA–452/R–07–013 November.

[61] U.S. Environmental Protection Agency Air Quality Criteria for Lead (2006) Volume I: Chapters 2 & 3. EPA/600/R–5/144aF. October.

variety of stationary and mobile source types. Lead emitted to the air is predominantly in particulate form, with the particles occurring in various sizes. Once emitted, the particles can be transported long or short distances depending on their size, which influences the amount of time spent in the aerosol phase. In general, larger particles tend to deposit more quickly, within shorter distances from emissions points (*e.g.,* kilometers), while smaller particles will remain in the aerosol phase and travel longer distances before depositing (*e.g.,* hundreds to thousands of kilometers).[62] As summarized in the AQCD for Lead, airborne concentrations of lead at sites near sources are much higher than at sites not known to be directly influenced by sources.

(2) Once deposited to surfaces, lead can subsequently be resuspended into the ambient air and, because of the persistence of lead, emissions of this metal contribute to environmental media concentrations for many years into the future as it is cycled within and between environmental media such as soil, air and water. Lead that is a soil or dust contaminant today may have been airborne yesterday or many years ago.[63]

(3) Exposure to lead emitted into the ambient air can occur directly by inhalation, or indirectly by ingestion of lead-contaminated food, water or other materials including dust and soil. This occurs due to the environmental cycling of this persistent metal which, once emitted into the ambient air is distributed to other environmental media and can contribute to human exposures via indoor and outdoor dusts, outdoor soil, food and drinking water, as well as inhalation of air. Atmospheric deposition is estimated to comprise a significant proportion of lead in food (AQCD for Lead, p. 3–48). For example, livestock may be exposed to lead in vegetation (*e.g.,* grasses and silage) and in surface soils via incidental ingestion of soil while grazing (USEPA 1986, Section 7.2.2.2.2).[64] And dietary intake may be a predominant source of lead exposure among adults, greater than consumption of water and beverages or inhalation (73 FR 66971). These exposure pathways are described more fully in Section 8.2.2 of the AQCD for Lead.

(4) Air-related exposure pathways are affected by changes to air quality, including changes in concentrations of lead in air and changes in atmospheric deposition of lead. Further, because of its persistence in the environment, lead deposited from the air may contribute to human and ecological exposures for years into the future as described above.

Additionally, human exposures to lead include pathways that are not related to ambient air concentrations. The pathways of human exposure to lead that are not air-related include ingestion of indoor lead paint,[65] lead in diet as a result of inadvertent additions during food processing, and lead in drinking water attributable to lead in distribution systems, as well as other generally less prevalent pathways, as described in the AQCD for Lead (pp. 3–50 to 3–51).

B. Health Effects Information

In 2008, EPA decreased the level of the primary (health-based) NAAQS for Lead from 1.5 μg/m^3 to 0.15 μg/m^3 in order to provide increased protection for children and other at-risk populations against an array of adverse health effects, most notably neurological effects in children, including neurocognitive and neurobehavioral effects.[66] This section summarizes information provided in the numerous recent documents summarizing health and welfare effects from exposure to lead, including the AQCD for Lead, CDC documents, the EPA Staff Paper[67] and the proposed and final NAAQS for Lead. First, the use of blood lead as a measure of exposure to lead is described followed by a brief summary of the broad array of lead-induced health effects. Particular focus is given here to the effects of lead on the developing nervous system in children since this is among the most sensitive endpoints identified for this toxic metal. The section ends with a description of at-risk populations and life stages.

1. Blood Lead

Lead enters the body most commonly via the respiratory system and/or gastrointestinal tract, from which it is quickly absorbed into the blood stream and distributed throughout the body.[68] Less commonly, lead, particularly organic forms of lead such as alkyl lead, can be absorbed through the skin (AQCD for Lead, page 4–12). Blood lead levels are extensively used as an index or biomarker of exposure by national and international health agencies, as well as in epidemiological (AQCD for Lead, Sections 4.3.1.3 and 8.3.2) and toxicological studies of lead health effects and dose-response relationships (AQCD for Lead, Chapter 5). The U.S. CDC, and its predecessor agencies, has for many years used blood lead level as a metric for identifying children at risk of adverse health effects and for specifying particular public health recommendations.[69] Most recently, in 2005, with consideration of a review of the evidence by their advisory committee, CDC revised their statement on Preventing Lead Poisoning in Young Children.[70] CDC specifically recognized the evidence of adverse health effects in children with blood lead levels below 10 μg/dL,[71] the data demonstrating that no "safe" threshold for blood lead had been identified, and emphasized the importance of preventative measures.[72]

Since 1976, the CDC has been monitoring blood lead levels in multiple age groups nationally through the National Health and Nutrition Examination Survey (NHANES).[73] The

[62] U.S. Environmental Protection Agency (2004) Air quality criteria for particulate matter. Research Triangle Park, NC: Office of Research and Development, National Center for Environmental Assessment; EPA report no. EPA–600/P–99/0028aF.

[63] National Ambient Air Quality Standards for Lead 73 FR 66971 (Nov. 12, 2008), AQC for Lead, Section 2.5.

[64] U.S. Environmental Protection Agency (1986) Air quality criteria for lead. Research Triangle Park, NC: Office of Health and Environmental Assessment, Environmental Criteria and Assessment Office; EPA report no. EPA–600/8–83/028aF–dF. 4v. Available from: NTIS, Springfield, VA; PB87–142378.

[65] Weathering of outdoor lead paint may also contribute to soil lead levels adjacent to the house.

[66] National Ambient Air Quality Standards for Lead 73 FR 66965 (Nov. 12, 2008).

[67] U.S. Environmental Protection Agency (2007) Review of the National Ambient Air Quality Standards for Lead: Policy Assessment of Scientific and Technical Information, OAQPS Staff Paper. EPA–452/R–07–013. Office of Air Quality Planning and Standards, Research Triangle Park.

[68] Additionally, lead freely crosses the placenta resulting in continued fetal exposure throughout pregnancy, with that exposure increasing during the latter half of pregnancy (AQC for Lead, Section 6.6.2).

[69] Centers for Disease Control (1991) Preventing lead poisoning in young children: a statement by the Centers for Disease Control. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service; October 1. Available online at: *http://wonder.cdc.gov/wonder/prevguid/p0000029/p0000029.asp.*

[70] Centers for Disease Control and Prevention (2005) Preventing lead poisoning in young children: a statement by the Centers for Disease Control and Prevention. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service. August.

[71] As described by the Advisory Committee on Childhood Lead Poisoning Prevention, "In 1991, CDC defined the blood lead level (BLL) that should prompt public health actions as 10 μg/dL. Concurrently, CDC also recognized that a BLL of 10 μg/dL did not define a threshold for the harmful effects of lead. Research conducted since 1991 has strengthened the evidence that children's physical and mental development can be affected at BLLS <10 μg/dL" (ACCLPP, 2007).

[72] Advisory Committee on Childhood Lead Poisoning Prevention (2007) Interpreting and managing blood lead levels <10 μg/dL in children and reducing childhood exposures to lead: Recommendations of CDC's Advisory Committee on Childhood Lead Poisoning Prevention. Morbidity and Mortality Weekly Report. 56(RR–8). November 2, 2007.

[73] This information documents a variation in mean blood lead levels across the various age groups monitored. For example, mean blood lead

NHANES information has documented the dramatic decline in mean blood lead levels in the U.S. population that has occurred since the 1970s and that coincides with regulations regarding leaded motor vehicle fuels, leaded paint, and lead-containing plumbing materials that have reduced lead exposure among the general population (AQCD for Lead, Sections 4.3.1.3 and 8.3.3).

While blood lead levels in the U.S. general population, including geometric mean levels in children aged 1–5 have declined significantly, levels have been found to vary among children of different socioeconomic status (SES) and other demographic characteristics (AQCD for Lead, p. 4–21), as well as by age.[74] Racial/ethnic and income disparities in blood lead levels in children persist. For example, blood lead levels for lower income and African American children are higher than those for the general population.

The spectrum of health effects discussed in the following section is relevant for all forms of lead that enter the blood stream. Once in the blood stream, lead bioaccumulates in the body, with the bone serving as a large, long-term storage compartment. Soft tissues (*e.g.,* kidney, liver, brain, *etc.*) serve as smaller compartments, in which lead may be more mobile (AQCD for Lead, Sections 4.3.1.4 and 8.3.1). During childhood development, bone represents approximately 70% of a child's body burden of lead, and this accumulation continues through adulthood, when more than 90% of the total lead body burden is stored in the bone (AQCD for Lead, Section 4.2.2). Lead in bone can be mobilized during critical periods including pregnancy and lactation (AQCD for Lead, Section 5.8.6).

2. Health Effects

Lead, as with mercury and arsenic, has no known biological function.[75] Lead has been demonstrated to exert "a broad array of deleterious effects on multiple organ systems via widely diverse mechanisms of action" (AQCD for Lead, p. 8–24 and Section 8.4.1). This array of health effects includes effects on heme biosynthesis and related functions; neurological development and function; reproduction and physical development; kidney function; cardiovascular function; and immune function. The weight of evidence varies across this array of effects and is comprehensively described in the AQCD for Lead. There is also some evidence of lead carcinogenicity, primarily from animal studies, together with limited human evidence of suggestive associations (AQCD for Lead, Sections 5.6.2, 6.7, and 8.4.10). The U.S. EPA has listed lead under current EPA guidelines as a probable human carcinogen based on the available animal data (AQCD for Lead, p. 6–195).[76] Inorganic lead has been classified as a probable human carcinogen by the International Agency for Research on Cancer (inorganic lead compounds), based mainly on sufficient animal evidence,[77] and classified as reasonably anticipated to be a human carcinogen by the U.S. National Toxicology Program (lead and lead compounds) (AQCD for Lead, Section 6.7.2).[78] [79]

As described in the AQCD for Lead, the key effects associated with individual blood lead levels in children and adults in the range of 10 µg/dL and lower include neurological, hematological and immune[80] effects for children, and hematological, cardiovascular and renal effects for adults (AQCD for Lead, Tables 8–5 and 8–6, pp. 8–60 to 8–62). As evident from the discussions in Chapters 5, 6 and 8 of the AQCD for Lead, "neurotoxic effects in children and cardiovascular effects in adults are among those best substantiated as occurring at blood lead concentrations as low as 5 to 10 µg/dL (or possibly lower); and these categories are currently clearly of greatest public health concern" (AQCD for Lead, p. 8–60).[81] [82] The AQCD for Lead states, "There is no level of lead exposure that can yet be identified, with confidence, as clearly not being associated with some risk of deleterious health effects" (AQCD for Lead, p. 8–63).

While adults are susceptible to lead effects at lower blood lead levels than previously understood (*e.g.,* AQCD for Lead, p. 8–25), among the wide variety of health endpoints associated with lead exposures, there is general consensus that the developing nervous system in children is among the, if not the, most sensitive. Blood lead levels in U.S. children have decreased notably since the late 1970s. Studies evaluating current blood lead levels in children have reported associations with neurodevelopment effects (AQCD for Lead, Chapter 6). Functional manifestations of lead neurotoxicity during childhood include sensory, motor, cognitive and behavioral impacts. Numerous epidemiological studies have reported neurocognitive, neurobehavioral, sensory, and motor function effects in children with blood lead levels below 10 µg/dL (AQCD Lead, Sections 6.2 and 8.4).

Cognitive effects associated with lead exposures that have been observed in epidemiological studies have included decrements in intelligence test results, such as the widely used IQ score, and in academic achievement as assessed by various standardized tests as well as by class ranking and graduation rates (AQCD for Lead, Section 6.2.16 and pp 8–29 to 8–30). As noted in the AQCD for Lead with regard to the latter, "Associations between lead exposure and academic achievement observed in the above-noted studies were significant even after adjusting for IQ, suggesting that lead-sensitive neuropsychological processing and learning factors not

levels in 2001–2002 for ages 1–5, 6–11, 12–19 and greater than or equal to 20 years of age, are 1.70, 1.25, 0.94, and 1.56 µg/dL, respectively (AQC for Lead, p. 4–22).

[74] Axelrad, D., U.S. EPA (November 4, 2009) E-mail message to Marion Hoyer, U.S. EPA. Available in docket number EPA–HQ–OAR–2007–0294.

[75] U.S. Environmental Protection Agency (2007) Framework for Metals Risk Assessment. Office of the Science Advisor. EPA 120/R–07/001.

[76] U.S. Environmental Protection Agency, Integrated Risk Information System (IRIS) (1993) IRIS Summary for Lead and compounds (CASRN 7439–92–1), Available online at: *http://www.epa.gov/ncea/iris/subst/0277.htm.*

[77] International Agency for Research on Cancer (IARC) (2006) Inorganic and organic lead compounds. Lyon, France: International Agency for Research on Cancer. IARC monographs on the evaluation of the carcinogenic risk of chemicals to humans: volume 87. Available online at: *http://monographs.iarc.fr/ENG/Monographs/vol87/index.php.*

[78] National Toxicology Program (2003) Report on carcinogens background document for lead and lead compounds. Research Triangle Park, NC: U.S. Department of Health and Human Services. Available online at: *http://ntp.niehs.nih.gov/ntp/newhomeroc/roc11/Lead-Public.pdf.*

[79] National Toxicology Program. (2004) Lead (CAS no. 7439–92–1) and lead compounds. In: Report on carcinogens, eleventh edition. Research Triangle Park, NC: U.S. Department of Health and Human Services. Available online at: *http://ntp.niehs.nih.gov/ntp/roc/eleventh/profiles/s101lead.pdf.*

[80] At mean blood lead levels, in children, on the order of 10 µg/dL, and somewhat lower, associations have been found with effects to the immune system, including altered macrophage activation, increased IgE levels and associated increased risk for autoimmunity and asthma (AQC for Lead, Sections 5.9, 6.8, and 8.4.6).

[81] With regard to blood lead levels in individual children associated with particular neurological effects, the AQC for Lead states "Collectively, the prospective cohort and cross-sectional studies offer evidence that exposure to lead affects the intellectual attainment of preschool and school age children at blood lead levels <10 µg/dL (most clearly in the 5 to 10 µg/dL range, but, less definitively, possibly lower)." (p. 6–269)

[82] Epidemiological studies have consistently demonstrated associations between lead exposure and enhanced risk of deleterious cardiovascular outcomes, including increased blood pressure and incidence of hypertension. A meta-analysis of numerous studies estimates that a doubling of blood-lead level (*e.g.,* from 5 to 10 µg/dL) is associated with ~1.0 mm Hg increase in systolic blood pressure and ~0.6 mm Hg increase in diastolic pressure (AQC for Lead, p. E–10).

reflected by global intelligence indices might contribute to reduced performance on academic tasks" (AQCD for Lead, pp 8–29 to 8–30).

With regard to potential implications of lead effects on IQ, the AQCD for Lead recognizes the "critical" distinction between population and individual risk, identifying issues regarding declines in IQ for an individual and for the population. The AQCD for Lead further states that a "point estimate indicating a modest mean change on a health index at the individual level can have substantial implications at the population level" (AQCD for Lead, p. 8–77).[83] A downward shift in the mean IQ value is associated with both substantial decreases in percentages achieving very high scores and substantial increases in the percentage of individuals achieving very low scores (AQCD for Lead, p. 8–81).[84] For an individual functioning in the low IQ range due to the influence of developmental risk factors other than lead, a lead-associated IQ decline of several points might be sufficient to drop that individual into the range associated with increased risk of educational, vocational, and social failure (AQCD for Lead, p. 8–77).

Other cognitive effects observed in studies of children have included decrements in attention, executive functions, language, memory, learning and visuospatial processing (AQCD for Lead, Sections 5.3.5, 6.2.5 and 8.4.2.1), with attention and executive function effects associated with lead exposures indexed by blood lead levels below 10 μg/dL (AQCD for Lead, Section 6.2.5 and pp. 8–30 to 8–31). The evidence for the role of lead in this suite of effects includes experimental animal findings (discussed in the AQCD for Lead, Section 8.4.2.1; p. 8–31), which provide strong biological plausibility of lead effects on learning ability, memory and attention (AQCD for Lead, Section 5.3.5), as well as associated mechanistic findings.

The persistence of such lead-induced effects is described in the AQCD for Lead (*e.g.,* AQCD for Lead Sections 5.3.5, 6.2.11, and 8.5.2). The persistence or irreversibility of such effects can be the result of damage occurring without adequate repair offsets or of the persistence of lead in the body (AQCD for Lead, Section 8.5.2). It is additionally important to note that there may be long-term consequences of such deficits over a lifetime. Poor academic skills and achievement can have "enduring and important effects on objective parameters of success in real life," as well as increased risk of antisocial and delinquent behavior (AQCD for Lead, Section 6.2.16).

The current evidence reviewed in the AQCD for Lead with regard to the quantitative relationship between neurocognitive decrement, such as IQ, and blood lead levels indicates that the slope for lead effects on IQ is nonlinear and is steeper at lower blood lead levels, such that each μg/dL increase in blood lead may have a greater effect on IQ at lower blood lead levels (*e.g.,* below 10 μg/dL) than at higher levels (AQCD for Lead, Section 6.2.13; pp. 8–63 to 8–64; Figure 8–7). As noted in the AQCD for Lead, a number of examples of non- or supralinear dose-response relationships exist in toxicology (AQCD for Lead, pp. 6–76 and 8–38 to 8–39). With regard to the effects of lead on neurodevelopmental outcomes such as IQ, the AQCD for Lead suggests that initial neurodevelopmental effects at lower lead levels may be disrupting very different biological mechanisms (*e.g.,* early developmental processes in the central nervous system) than more severe effects of high exposures that result in symptomatic lead poisoning and frank mental retardation (AQCD for Lead, p. 6–76). The AQCD for Lead describes this issue in detail with regard to lead (summarized in AQCD for Lead at p. 8–39). Various findings within the toxicological evidence, presented in the AQCD for Lead, provide biologic plausibility for a steeper IQ loss at low blood lead levels, with a potential explanation being that the predominant mechanism at very low blood lead levels is rapidly saturated and that a different, less-rapidly-saturated process becomes predominant at blood lead levels greater than 10 μg/dL.

3. At-Risk Populations and Life Stages

Individuals potentially at risk from exposure to environmental pollutants include those with increased susceptibility and vulnerability. The terms "susceptibility" and "vulnerability" have been used to characterize those with a greater likelihood of an adverse outcome given a specific exposure in comparison with the general population. This increased likelihood of response to a pollutant can result from a multitude of factors, including genetic or developmental factors, life stages (*i.e.,* childhood or old age), gender differences, or preexisting disease states. In addition, new attention has been paid to the concept of some population groups having increased responses to pollution-related effects due to factors including socioeconomic status (SES) (*e.g.,* reduced access to health care, poor nutritional status) or particularly elevated exposure levels.

EPA uses the term "life stage" to refer to a distinguishable time frame in an individual's life characterized by unique and relatively stable behavioral and/or physiological characteristics that are associated with development and growth. To recognize the rapid changes that occur during childhood related to physiology, metabolism, anatomy and behavior that can impact exposure and risk to environmental hazards, EPA now views childhood as a sequence of life stages, from conception through fetal development, infancy, and adolescence. EPA published several exposure and risk assessment guidance documents beginning in 2005,[85] [86] [87] in which we emphasized the importance of considering the potential for increased sensitivity of different life stages or age groups in addition to that of groups that form a fixed portion of the population based on characteristics such as pre-existing disease, gender, socioeconomic status, geographical location, culture/ethnicity, or genetic make-up.

Physiological, behavioral and demographic factors contribute to increased risk of lead-related health effects. Children are at increased risk of lead-related health effects due to various factors that enhance their exposures (*e.g.,* via the hand-to-mouth activity that is prevalent in very young children, AQCD for Lead, Section 4.4.3) and susceptibility. While children are considered to be at a period of maximum exposure around 18–27 months, the current evidence has found even stronger associations between blood lead levels at school age and IQ at school age. The evidence "supports the idea that lead exposure continues to be toxic to children as they reach school age, and [does] not lend support to the interpretation that all the damage is done by the time the child reaches 2 to

[83] As an example, the AQC for Lead states "although an increase of a few mmHg in blood pressure might not be of concern for an individual's well-being, the same increase in the population mean might be associated with substantial increases in the percentages of individuals with values that are sufficiently extreme that they exceed the criteria used to diagnose hypertension" (AQC for Lead, p. 8–77).

[84] For example, for a population mean IQ of 100 (and standard deviation of 15), 2.3% of the population would score above 130, but a shift of the population to a mean of 95 results in only 0.99% of the population scoring above 130 (AQC for Lead, pp. 8–81 to 8–82).

[85] U.S. EPA (2005) Guidance on Selecting Age Groups for Monitoring and Assessing Childhood Exposure to Environmental Contaminants. EPA/630/P–03/003F.

[86] U.S. EPA (2006) A Framework for Assessing Health Risks of Environmental Exposures to Children. EPA/600/R–05/093A.

[87] U.S. EPA (2008) Child-Specific Exposure Factors Handbook. EPA/600/R–06/096F.

3 years of age" (AQCD for Lead, Section 6.2.12). Physiological factors that can affect risk of lead-related effects in children include genetic polymorphisms and nutritional status. Children with particular genetic polymorphisms (*e.g.,* presence of the δ-aminolevulinic acid dehydratase-2 [ALAD–2] allele) have increased sensitivity to lead toxicity, which may be due to increased susceptibility to the same internal dose and/or to increased internal dose associated with the same exposure (AQCD for Lead, p. 8–71, Sections 6.3.5, 6.4.7.3 and 6.3.6). Some children may have blood lead levels higher than those otherwise associated with a given lead exposure (AQCD for Lead, Section 8.5.3) as a result of nutritional status (*e.g.,* iron deficiency, calcium intake), as well as genetic and other factors (AQCD for Lead, Chapter 4 and Sections 3.4, 5.3.7 and 8.5.3).

Demographic factors that can affect risk of lead-related effects in children include residential location, poverty, and race. As noted in previous EPA actions on lead, situations of elevated exposure, such as residing near sources of ambient lead, as well as socioeconomic factors, such as reduced access to health care or low socioeconomic status can also contribute to increased blood lead levels and increased risk of associated health effects from air-related lead.[88] Additionally, as described in the NAAQS for Lead, children in poverty and black, non-Hispanic children have notably higher blood lead levels than do economically well-off children and white children, in general.[89]

C. Welfare Effects

Lead is persistent in the environment and accumulates in soils, aquatic systems (including sediments), and some biological tissues of plants, animals and other organisms, thereby providing long-term, multi-pathway exposures to organisms and ecosystems. In 2008, EPA established a secondary lead standard of 0.15 ug/m^3. This standard is intended to protect the public welfare from known or anticipated adverse effects associated with the presence of lead in the ambient air. This section provides a summary of information regarding welfare effects of lead, focusing on terrestrial and aquatic ecosystems. This information is largely drawn from the 2006 AQCD for Lead, Chapter 6 of the Office of Air Quality Planning and Standards Staff Paper on Lead (SP) [90] and the Lead NAAQS.

1. Terrestrial Ecosystems

Lead is removed from the atmosphere and deposited on soil and other surfaces via wet or dry deposition. In soils, most lead is retained via the formation of stable solid phase compounds, precipitates, or complexes with organic matter. Thus, terrestrial ecosystems remain primarily sinks for lead but amounts retained in various soil layers vary based on forest type, climate, and litter cycling (AQCD for Lead, Section 7.1). Once in the soil, the migration and distribution of lead is controlled by a multitude of factors including pH, precipitation, litter composition and other factors, which in turn, govern the rate at which lead is bound to organic materials in the soil (AQCD for Lead, Section 2.3.5, and Section AX 7.1.4.1).

Lead exists in the environment in different forms which vary widely in their ability to cause adverse effects on ecosystems and organisms. Many forms of lead in the ambient air are quite insoluble and thus not easily leached to underground water once deposited to surfaces. However, leaching may occur under acidic conditions, where lead concentrations are extremely high, or in the presence of substances (*e.g.,* soluble organic matter, high concentrations of chlorides or sulfates) that form relatively soluble complexes with lead (AQCD for Lead, Section 2.3.5).

Plants take up lead via their foliage and through their root systems. The rate of plant uptake from soil varies by plant species, soil conditions, and lead species. Most lead in plants is stored in roots, and very little is stored in fruits. Metals that are applied to soil as salts (usually as sulfate, chloride, or nitrate salt) are accumulated more readily than the same quantity of metal added via sewage sludge, flue dust, or fly ash (AQCD for Lead, Section 2.3.7).

Surface deposition of lead onto plants may represent a significant contribution to the total lead in and on the plant, as has been observed for plants near smelters and along roadsides (AQCD for Lead, page E–19). Atmospheric deposition of lead also contributes to lead in vegetation as a result of contact with above-ground portions of the plant (AQCD for Lead, pp. 7–9 and AXZ7–39; USEPA, 1986, Sections 6.5.3 and 7.2.2.2.1). Wildlife may subsequently be exposed to lead in vegetation (*e.g.,* grasses and silage) and in surface soils via incidental ingestion of soil while grazing (USEPA 1986, Section 7.2.2.2.2).[91]

By far, the majority of air-related lead found in natural terrestrial ecosystems was deposited in the past during the use of lead additives in motor vehicle gasoline. Many sites receiving lead predominantly through long-range transport of gasoline-derived small particles have accumulated large amounts of lead in soils (AQCD for Lead, p. AX7–98). There is little evidence that terrestrial sites exposed as a result of this long range transport of lead have experienced significant effects on ecosystem structure or function (AQCD for Lead, Section AX7.1.4.2 and p. AX7–98). Strong complexation of lead by organic matter in soil may explain why few ecological effects have been observed (AQCD for Lead, p. AX7–98). Studies have shown decreasing levels of lead in vegetation, which appears to correlate with decreases in atmospheric deposition of lead resulting from the removal of lead additives to motor vehicle gasoline (AQCD for Lead, Section AX 7.1.4.2).

The deposition of gasoline-derived lead into forest soils has produced a legacy of slow moving lead that remains bound to organic materials despite dramatic reductions in the use of leaded additives to motor vehicle fuels. Current levels of lead in soil vary widely depending on the source of lead but in all ecosystems lead concentrations exceed natural background levels. For areas influenced by point sources of air lead, concentrations of lead in soil may exceed by many orders of magnitude the concentrations which are considered harmful to laboratory organisms. Adverse effects in terrestrial organisms associated with lead include neurological, physiological and behavioral effects which may influence ecosystem structure and functioning (73 FR 67008).

2. Aquatic Ecosystems

Atmospheric lead enters aquatic ecosystems primarily through deposition (wet and dry) and the erosion and runoff of soils containing lead. While overall deposition rates of atmospheric lead have decreased dramatically since the removal of lead additives from motor vehicle gasoline,

[88] U.S. Environmental Protection Agency (2007) Review of the National Ambient Air Quality Standards for Lead: Policy Assessment of Scientific and Technical Information, OAQPS Staff Paper. EPA–452/R–07–013. Office of Air Quality Planning and Standards, Research Triangle Park.

[89] *See* 73 FR 66973 (November 12, 2008).

[90] U.S. Environmental Protection Agency (2007) Review of the National Ambient Air Quality Standards for Lead: Policy Assessment of Scientific and Technical Information, OAQPS Staff Paper. EPA–452/R–07–013. Office of Air Quality Planning and Standards, Research Triangle Park.

[91] U.S. Environmental Protection Agency (1986) Air quality Criteria for Lead. Research Triangle Park, NC: Office of Health and Environmental Assessment, Environmental Criteria and Assessment Office; EPA report no. EPA–600/8–83/028aF–dF. 4v. Available from: NTIS, Springfield, VA; PB87–142378.

lead continues to accumulate and may be re-exposed in sediments and water bodies throughout the United States (AQCD for Lead, Section 2.3.6).

Several physical and chemical factors govern the fate and bioavailability of lead in aquatic systems. A significant portion of lead remains bound to suspended particulate matter in the water column and eventually settles into the substrate. Species, pH, salinity, temperature, turbulence and other factors govern the bioavailability of lead in surface waters (AQCD for Lead, Section 7.2.2). Lead can bioaccumulate in the tissues of aquatic organisms through ingestion of food and water, and adsorption from water, and can subsequently lead to adverse effects if tissue levels are sufficiently high.[92] The accumulation of lead is influenced by pH and decreasing pH favors bioavailability and bioaccumulation. Organisms that bioaccumulate lead with little excretion must partition the metal such that it has limited bioavailability, otherwise toxicity will occur if a sufficiently high concentration is reached.[93] The general symptoms of lead toxicity in fish include production of excess mucus, lordosis, anemia, darkening of the dorsal tail region, degeneration of the caudal fin, destruction of spinal neurons, aminolevulinic acid dehydratase (ALAD) inhibition, growth inhibition, renal pathology, reproductive effects, growth inhibition, and mortality.[94] Toxicity in fish has been closely correlated with duration of lead exposure and uptake.[95]

Lead exists in the aquatic environment in various forms and under various chemical and physical parameters which determine the ability of lead to cause adverse effects either from dissolved lead in the water column or lead in sediment. Current levels of lead in water and sediment vary widely depending on the source of lead. Conditions exist in which adverse effects to organisms and thereby ecosystems may be anticipated given experimental results. It is unlikely that dissolved lead in surface water constitutes a threat to ecosystems that are not directly influenced by point sources. For lead in sediment, the evidence regarding the effects is less clear. It is likely that some areas with long-term historical deposition of lead to sediment from a variety of sources as well as areas influenced by point sources have the potential for adverse effects to aquatic communities. The long residence time of lead in sediment and its ability to be resuspended by turbulence make lead likely to be a factor for consideration regarding potential risk to aquatic systems for the foreseeable future (73 FR 67008).

III. Lead Emissions From Piston-Engine Aircraft

Currently, lead emitted by piston-engine aircraft operating on leaded avgas is the largest source of lead to the air, contributing about 50% of the National Emission Inventory in 2005. This section describes the draft 2008 avgas lead inventory which is currently undergoing review by State, local and Tribal air agencies. We describe and request comment on input data used to derive airport-specific lead inventories. This section ends with a summary of data forecasting the potential growth of the industry using leaded avgas.

A. Inventory of Lead From Piston-Engine Powered Aircraft

Every three years, the EPA prepares a National Emissions Inventory (NEI) of air emissions of criteria pollutants and hazardous air pollutants with input from numerous State, local, and Tribal air agencies and from industry.[96] For the purposes of this ANPR, EPA is describing piston-engine aircraft lead information provided in the draft 2008 NEI as well as information from the final 2005 NEI. We have chosen to describe the draft 2008 NEI for the following reasons: (1) This is the first version of the NEI that will include airport-specific lead inventories that use our most recently developed methods for estimating lead (described below); (2) this inventory is the first NEI to include approximately 20,000 airport facilities in the U.S.; and (3) to increase awareness of the opportunity for State, local, and Tribal governments and industry to review this draft NEI and provide information that could improve airport lead inventories. Comments and data can be supplied to EPA for the 2008 NEI until mid-2010. While we are describing the draft 2008 NEI for piston-engine aircraft emissions of lead, we do not have draft inventory estimates for 2008 for all sources of lead. The 2008 NEI will be final in 2010.

1. National Emissions of Lead From Piston-Engine Aircraft

To calculate the national avgas lead inventory, the volume of leaded avgas produced in a given year is multiplied by the concentration of lead in the avgas and by the fraction of lead emitted from a combustion system operating on leaded fuel (to account for the lead that is retained in the engine, engine oil and/or exhaust system). For example, the volume of avgas produced in the U.S. in 2008 according to DOE was 235,326,000 gallons.[97] The concentration of lead in avgas ([Pb] in the equation below) can be one of four levels (ranging from 0.14 to 1.12 grams of lead per liter or 0.53 to 4.24 grams of lead per gallon) as specified by the American Society for Testing and Materials (ASTM). By far the most common avgas supplied is "100 Low Lead" or 100LL which has a maximum lead concentration specified by ASTM of 0.56 grams per liter or 2.12 grams per gallon.[98] [99] A fraction of lead is retained in the engine, engine oil and/or exhaust system which we currently estimate at 5%.[100]

For 2008, using DOE fuel volume estimates, the national estimate of lead emissions from the consumption of avgas is 522 tons as calculated according to the following equation:

$$\frac{(235{,}326{,}000\text{ gal})(2.12\text{ g Pb/gal})(0.95)}{907{,}185\text{ g/short ton}} = 522\text{ short tons Pb}$$

[92] AQC for Lead I. 7–24: (Vink, 2002; Rainbow, 1996).

[93] AQC for Lead AX7.2.3.1.

[94] AQC for Lead page 232, Annex 7.

[95] AQC for Lead page 232, Annex 7.

[96] *http://www.epa.gov/air/data/neidb.html.*

[97] DOE Energy Information Administration. Fuel production volume data obtained from *http://tonto.eia.doe.gov/dnav/pet/hist/mgaupus1A.htm* accessed November 2006.

[98] ChevronTexaco (2006) Aviation Fuels Technical Review. FTR–3. Available online at: *http://www.chevronglobalaviation.com/docs/aviation_tech_review.pdf.*

[99] ASTM International (2007) Standard Specification for Aviation Gasolines D910–06.

[100] U.S. Environmental Protection Agency (2008) Lead Emissions from the Use of Leaded Aviation Gasoline in the United States, Technical Support Document. EPA420–R–08–020. Available online at: *http://www.epa.gov/otaq/aviation.htm.*

As described in the Overview section of this ANPR, DOT's FAA also provides estimates of annual avgas fuel consumption. For 2008, DOT estimates 351,000,000 gallons of avgas were consumed. Consumption of this volume of avgas equates to a national lead emissions estimate for this source of 779 short tons. DOT fuel volume data are derived from FAA estimates of piston-engine activity annually.[101] We are working to identify the source(s) of the information used to derive DOE fuel volume estimates. In the draft 2008 NEI, we are using DOT fuel volume estimates.

We currently cannot estimate the fraction of total lead emissions these estimates comprise since the inventories for all other sources of lead to air are not yet in the draft 2008 NEI. In 2005, lead from avgas comprised about 50% of the national lead inventory for emissions to air. As point source emissions of lead have decreased, lead emissions from piston-engine aircraft have become the largest single source of lead to air (Figure 2). These lead emissions estimates do not include evaporative losses of lead and minimal military aircraft data. Few military aircraft are piston-engine powered and consume leaded avgas.[102] Military aircraft data are supplied by States, and data provided to EPA during the 2008 NEI review will be included in the final 2008 inventory.

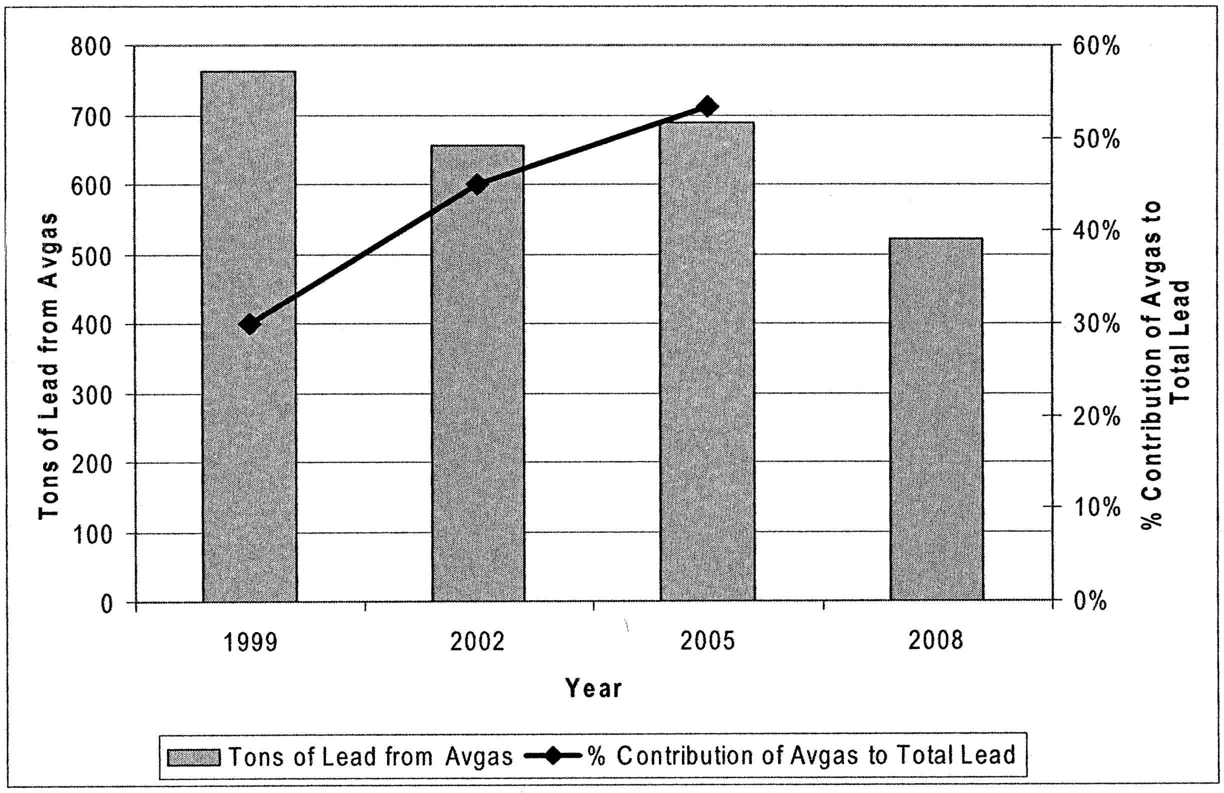

Figure 2. The Increasing Contribution of Lead from Aviation Gasoline to the Total Inventory of Lead Emissions to Air Annually (the total lead inventory for 2008 will be available in 2010). Fuel volume data is from DOE's Energy Information Administration.

2. Airport-Specific Emissions of Lead From Piston-Engine Aircraft

Aircraft gaseous and particulate matter (PM) emissions are calculated through the FAA's Emissions and Dispersion Modeling System (EDMS).[103] This modeling system was designed to develop emission inventories for the purpose of assessing potential air quality impacts of airport operations and proposed airport development projects. Lead emissions from piston-engine aircraft are not included in EDMS. To estimate airport-specific lead inventories we use engine data and other attributes of general aviation (GA) and air taxi (AT) that are used in EDMS for GA and AT and we use methods similar to those in EDMS that are described in an EPA Technical Support Document (TSD) and briefly

[101] U.S. Department of Transportation Federal Aviation Administration Aviation Policy and Plans. FAA Aerospace Forecast Fiscal Years 2009–2025. p.81. Available at: *http://www.faa.gov/data_research/aviation/aerospace_forecasts/2009-2025/media/2009%20Forecast%20Doc.pdf.* This document provides historical data for 2000–2008 as well as forecast data.

[102] ChevronTexaco (2006) Aviation Fuels Technical Review p. 44. Available online at: *http://www.chevronglobalaviation.com/docs/aviation_tech_review.pdf.*

[103] EDMS is available online at: *http://www.faa.gov/about/office_org/headquarters_offices/aep/models/edms_model/.*

summarized here.[104] The data required to estimate airport-specific lead inventories includes the landing and take-off (LTO) activity of piston-engine aircraft at a facility; fuel consumption rates by these aircraft during the various modes of the landing and take-off cycle; the time spent in each mode of the LTO (taxi/idle-out, takeoff, climb-out, approach, and taxi/idle-in); the concentration of lead in the fuel; and the retention of lead in the engine and oil. The equation used to calculate airport-specific lead emissions during the LTO cycle is below, followed by a description of each of the input parameters.

$$\text{LTO Pb (tons)} = \frac{\text{(piston-engine LTO)(avgas gal/LTO)([Pb])(1-Pb retention)}}{\text{907,185 g/short ton}}$$

Piston-engine LTO: Most piston-engine aircraft fall into the categories of either GA or AT. Some GA and AT activity is conducted by turboprop and turbojet aircraft which do not use leaded avgas. There are no national databases that provide airport-specific LTO activity data for piston-engine aircraft separately from turbojet and turboprop aircraft. The fraction of GA and AT aircraft that use piston engines will vary by airport. However, in the absence of airport-specific data, EPA calculated a national default estimate using FAA's GA and AT Activity (GAATA) Survey.[105] The 2005 GAATA Survey reports that approximately 72% of all GA and AT LTOs are from piston-engine aircraft which use avgas, and about 28% are turboprop and turbojet powered which use jet fuel, such as Jet A.[106] Lead is not added to jet fuel. Therefore, to calculate piston-engine aircraft LTO as input for this equation, the total GA plus AT LTOs are multiplied by 0.72.

Avgas use (gal/LTO): Piston-engine aircraft can have either one or two engines. EDMS version 5.0.2 contains information on the amount of avgas used per LTO for some single and twin-engine aircraft. The proportion of piston-engine LTOs conducted by single- versus twin-engine aircraft was taken from the FAA's GAATA Survey for 2005 (90% of LTOs are conducted by aircraft having one engine and 10% of LTOs by aircraft having two engines). Since twin-engine aircraft have higher fuel consumption rates than those with single engines, a weighted average LTO fuel usage rate was established to apply to the population of piston-engine aircraft as a whole. For the single-engine aircraft, the average amount of fuel consumed per LTO was determined from the six types of single piston-engine aircraft within EDMS.[107] This was accomplished by averaging the single-engine EDMS outputs for fuel consumed per LTO using the EDMS scenario property of ICAO/USEPA Default—Times in Mode (TIM), with a 16 minute taxi-in/taxi-out time according to EPA's *Procedures for Emission Inventory Preparation, Volume IV: Mobile Sources,* 1992.[108] This gives a value of 16.96 pounds of fuel per LTO (lbs/LTO). Next, the average single-engine consumption rate was divided by the average density of 100LL avgas, 6 pounds per gallon (lbs/gal), producing an average fuel usage for single-engine piston aircraft of 2.83 gallons per LTO (gal/LTO). This same calculation was performed for the two twin-engine piston aircraft within EDMS, producing an average LTO fuel usage rate for twin-engine piston aircraft of 9.12 gal/LTO.

Using these single- and twin-engine piston aircraft fuel consumption rates, a weighted average fuel usage rate per LTO was computed by multiplying the average fuel usage rate for single-engine aircraft (2.83 gal/LTO) by the fleet percentage of single-engine aircraft LTOs (90%). Next, the twin-engine piston aircraft average fuel usage rate (9.12 gal/LTO) was multiplied by the fleet percentage of twin-engine aircraft LTOs (10%). By summing the results of the single- and twin-engine aircraft usage rates, the overall weighted average fuel usage rate per LTO of 3.46 gal/LTO is obtained.

Concentration of lead in fuel, [Pb]: The maximum lead concentration specified by ASTM for 100LL is 0.56 grams per liter or 2.12 grams per gallon. This amount of lead is normally added to assure that the required lean and rich mixture knock values are achieved. As noted above, 100 Octane (containing 1.12 grams of lead per liter or 4.24 grams of lead per gallon) is used by a small number of piston-engine aircraft. We currently do not include estimates of lead emissions using 100 Octane and we are requesting comment on the airport facilities where 100 Octane is used and the LTO activity associated with the use of this fuel.

Retention of lead in engine and oil (1–Pb Retention): Recent data collected from aircraft piston engines operating on leaded avgas suggests that about 5% of the lead from the fuel is retained in the engine and engine oil.[109] Thus the emitted fraction is 0.95.

Multiplying the lead concentration in 100LL avgas by the weighted average fuel usage rate produces an overall average value of 7.34 grams of lead per LTO (g Pb/LTO) for piston engines: 3.46 gal/LTO × 2.12 g Pb/gal = 7.34 g Pb/LTO. The denominator is a unit conversion factor used to express the lead inventory in units of short tons.

Applying these parameters in the equation above yields the following equation:

[104] U.S. Environmental Protection Agency (2008) Lead Emissions from the Use of Leaded Aviation Gasoline in the United States, Technical Support Document. EPA420–R–08–020. Available online at: *http://www.epa.gov/otaq/aviation.htm.*

[105] The FAA GAATA is a database collected from surveys of pilots flying aircraft used for general aviation and air taxi activity. For more information on the GAATA, *see* Appendix A, online at: *http://www.faa.gov/data_statistics/aviation_data_statistics/general_aviation/.*

[106] There are about 194,000 piston-engine aircraft in the U.S. general aviation and air taxi fleet (175,000 single-engine and 19,000 twin-engine aircraft) according to FAA's 2005 GAATA Survey.

[107] EPA understands that EDMS 5.0.2 has a limited list of piston engines, but these are currently the best data available.

[108] U.S. Environmental Protection Agency (1992) Procedures for Emission Inventory Preparation, Volume IV: Mobile Sources, EPA–450/4–81–026d (Revised).

[109] The information used to develop this estimate is from the following references: (a) Todd L. Petersen, Petersen Aviation, Inc, *Aviation Oil Lead Content Analysis,* Report Number EPA 1–2008, January 2, 2008, available at William J. Hughes Technical Center Technical Reference and Research Library at *http://actlibrary.tc.faa.gov/* and (b) E-mail from Theo Rindlisbacher of Switzerland Federal Office of Civil Aviation to Bryan Manning of U.S. EPA, regarding lead retained in engine, September 28, 2007.

$$\text{Pb (tons)} = \frac{(\text{piston-engine LTO})(7.34 \text{ g Pb/LTO})(0.95)}{907{,}185 \text{ g/short ton}}$$

which simplifies to: Pb = (piston-engine LTO) (7.7×10^{-6} short tons) or 7 grams of lead per LTO where piston-engine LTO = (GA LTO + AT LTO)(0.72). EPA used similar methods to estimate lead emissions from piston-engine powered helicopters which are described separately.[110] We currently estimate there are 6 grams of lead emitted by piston-engine helicopters per LTO.

Lead emitted during the LTO cycle is assigned to the airport facility where the aircraft operations occur.[111] FAA's Office of Air Traffic provides a complete listing of operational airport facilities in the National Airspace System Resources (NASR) database.[112] In 2008, there were 19,896 airport facilities in the U.S., the vast majority of which are expected to have activity by piston-engine aircraft that operate on leaded avgas. There are seven types of airport facilities: airports, balloonports, seaplane bases, gliderports, heliports, stolports,[113] and ultralight facilities. Among these, balloonports are the only facilities not expected to have piston-engine aircraft activity.

Preparing airport-specific lead inventories requires information regarding LTO activity.

These activity data are reported to the FAA for only a small subset of the approximately 20,000 facilities in the U.S. EPA obtains LTO information for approximately 3,400 facilities from FAA's Terminal Area Forecast (TAF) database that is prepared by FAA's Office of Aviation Policy and Plans.[114] The TAF database currently includes information for airports in FAA's National Plan of Integrated Airport Systems (NPIAS), which identifies airports that are significant to national air transportation. For airports not listed in the TAF, operations data are obtained from the NASR database, where available. Operations data provided by the NASR database may be self-reported by airport operators through data collection accomplished by airport inspectors who work for the State Aviation Agency, or operations data can be obtained through other means.[115]

We are using the January 15, 2009 version of the NASR database to evaluate airport lead emissions inventories for 2008. Using the TAF database as the primary source of LTO information and the NASR as a secondary source, we have LTO activity data for approximately 5,600 airport facilities. There are approximately 14,000 facilities in the NASR database for which there are no LTO activity data.[116] We developed methods based on previous work conducted by the FAA to estimate LTO activity at the remaining airport and heliport facilities. We are requesting comment on these methods which are described here briefly. The details regarding the method described here are available in the docket.[117]

The FAA has used regression models to estimate operations at facilities where operations data are not available.[118] [119] In this work and other work, FAA identified characteristics of small towered airports for which there were statistically significant relationships with operations at these airports.[120] Regression models based on the airport characteristics were then used to estimate general aviation operations for a set of non-towered airports. The airport characteristics identified by the FAA and used to estimate general aviation operations at small airports include: the number and type of aircraft based at the facility (*i.e.,* "based aircraft"), population in the vicinity of the airport, airport regional prominence, per capita income, region of the country, and the presence of certificated flight schools. We were able to obtain data from the NASR and the U.S. Census Bureau to evaluate relationships between several airport characteristics and LTO activity. LTO estimates were derived using different models depending on data availability.

The number of based aircraft and county population in which the airport is located were the most highly significant and positive regressors to LTO activity that our analysis provided.[121] The regression equation for based aircraft and county population is: LTOs = 1248 + 203.04*Aircraft + 0.0019*County Population with an R^2 = 0.64. For approximately 7,800 facilities that do not report LTO activity to FAA, we used based aircraft and county population to estimate activity. We request comment on the method we are using to estimate LTO activity at these airport facilities.

To estimate LTO activity at the airport facilities that do not report based aircraft, we used a regression equation based on county population and region of the country. The regression equation using county population and regression of the country is: LTOs = 6200.2 + 0.0087*county population—175.07*West State − 5567.3*Alaska + 854.83*Northeast with an R^2 = 0.15. This equation has a low correlation coefficient and we are exploring additional options for estimating LTO activity at these facilities for which very little information is reported to the FAA. We request comment on applying the regression equation above and alternative methods to estimate LTO activity at these facilities.

For heliports, which comprise approximately 5,500 facilities in the NASR database, we had insufficient information on which to develop a regression equation and are currently using the median of activity (141 LTOs/year) at heliports for which we have LTO activity data. Nationally, 25% of helicopters are piston-engine powered and therefore use leaded avgas. The FAA and EPA have limited information

[110] U.S. EPA (March 2010) Memorandum from Meredith Pedde to docket EPA–HQ–OAR–2007–0294, titled, "Calculating Aviation Gasoline Lead Emissions in the 2008 NEI." pp.8–9.

[111] An aircraft operation is defined as any landing or take-off event, therefore, to calculate LTOs, operations are divided by two. Most data sources from FAA report aircraft activity in numbers of operations which, for the purposes of calculating lead emissions using the method described in the TSD, need to be converted to LTO events.

[112] An electronic report can be generated from the NASR database and is available for download from the Internet at the following Web site. *http://www.faa.gov/airports_airtraffic/airports/airport_safety/airportdata_5010/*. This database is updated every 56 days.

[113] Stolport is an airport designed with STOL (Short Take-Off and Landing) operations in mind, normally having a short single runway.

[114] *http://aspm.faa.gov/main/taf.asp.*

[115] In the absence of updated information from States, local authorities or Tribes, we are using the LTO data provided in the FAA database.

[116] No Commuter, GA Itinerant, GA Local, or Air Taxi operations data.

[117] U.S. EPA (March 2010) Memorandum from Meredith Pedde to docket EPA–HQ–OAR–2007–0294, titled, "Calculating Aviation Gasoline Lead Emissions in the 2008 NEI."

[118] Federal Aviation Administration, Office of Aviation Policy and Plans, Statistics and Forecast Branch. (July 2001) Model for Estimating General Aviation Operations at Non-Towered Airports Using Towered and Non-towered Airport Data. Prepared by GRA, Inc.

[119] Hoekstra, M. (April 2000) Model for Estimating General Aviation Operations at Non-Towered Airports. Prepared for FAA Office of Aviation Policy and Plans.

[120] GRA, Inc. "Review of TAF Methods," Final Report, prepared for FAA Office of Aviation Policy and Plans under Work Order 45, Contract No. DTFA01–93–C–00066, February 25, 1998.

[121] U.S. EPA (March 2010) Memorandum from Meredith Pedde to docket EPA–HQ–OAR–2007–0294, titled, "Calculating Aviation Gasoline Lead Emissions in the 2008 NEI."

regarding the specific heliports that have activity by piston-engine helicopters. We are requesting information regarding heliport facilities at which piston-engine powered aircraft operate and the activity of these aircraft.

The draft 2008 NEI is the first inventory for which we are implementing the use of LTO-based lead estimates at almost 20,000 airport facilities and we are expecting State, local and Tribal air agency review of these data to improve our current estimates. The specific information on which we are requesting data include: (1) The fraction of GA and AT LTO activity reported to FAA that is conducted by piston-engine versus jet-engine powered aircraft, (2) airport-specific LTO activity for single- versus twin-engine piston-powered aircraft, (3) fuel consumption rates for the piston-engine aircraft operating at each airport, (4) the time spent in each mode of operation including run-up checks conducted by piston-engine aircraft prior to take-off, and (5) the concentration of lead in fuel delivered to individual airports. Methods for providing information to EPA as part of the review process involved in finalizing the 2008 NEI are available.[122]

The discussion above pertains only to lead emissions during the LTO cycle. Lead emitted outside the LTO cycle occurs during aircraft cruise mode and portions of the climb-out and approach modes. This part of an aircraft operation emits lead at various altitudes as well as close to and away from airports. We are developing methods to estimate lead emissions outside the LTO cycle which we anticipate will be available in 2010.

B. Projections for Future Growth

The FAA publishes an annual forecast of the number of piston-engine powered aircraft, hours flown, the consumption of avgas, the numbers of pilots and student pilots.[123] The most recent forecast is for the years 2009 through 2025. The General Aviation Manufacturers Association (GAMA) reproduces the FAA forecast in their annual statistical databook.[124] According to the GAMA summary, the number of active single-engine piston-powered aircraft is projected to increase annually at a 0.5% growth rate, with the aircraft population increasing from 144,220 in 2008 to 157,400 in 2025. The number of active twin-engine piston-powered aircraft is projected to decrease 0.9% annually, with aircraft population decreasing from 18,385 in 2008 to 15,650 in 2025. The piston-powered helicopter population is expected to grow 4.7% annually from a population of 3,970 in 2008 to 8,295 in 2025.

The FAA forecast predicts the number of hours flown in single-engine piston-powered aircraft is projected to increase 0.5% yearly from 2008 to 2025); the number of hours flown in twin-engine piston-powered aircraft is projected to decrease 1.5% annually and the number of hours flown in piston-powered rotocraft is projected to increase 3.9% annually. The changes in numbers of piston aircraft and hours flown is generally reflected in the consumption of leaded avgas. For the years 2008 through 2025, DOT's FAA estimates no change in the volume of leaded avgas consumed by single-engine aircraft in the U.S. (204 million gallons in 2008 and 2025), a 1.9% decrease in leaded avgas consumed by multi-engine aircraft (from a baseline of 108 million gallons in 2008 to 78 million gallons in 2025), and a 3.8% annual increase in the volume of leaded avgas consumed by piston-powered helicopters (from a baseline of 13 million gallons in 2008 to 24 million gallons in 2025). For 2025, the forecast volume of leaded avgas is 348 million gallons. Consumption of this volume of fuel would release 773 tons of lead to the air in 2025.

The number of active pilots flying general aviation aircraft (excluding air transport pilots) is projected to be slightly over half a million in 2025, representing a yearly increase of 0.7% over the forecast period.[125] The student pilot population is forecast to increase at a slightly higher rate of 1.0% yearly for a 2025 total slightly over 100,000. Private pilots and sport pilots are also projected to increase yearly (0.2% yearly increase in the number of private pilots). EPA is requesting comments on the forecast information presented in this section and on the uncertainty in these projections.

IV. Lead Concentrations in the Vicinity of Airports

This section summarizes information regarding the chemical and physical properties of lead emitted by piston-engine aircraft and monitoring and modeling studies regarding ambient and soil lead concentrations in the vicinity of airports where piston-engine aircraft operate.

A. Chemical and Physical Properties of Lead Emitted by Piston-Engine Aircraft

Information regarding lead emissions from engines operating on leaded fuel is summarized in prior AQCDs for Lead.[126] [127] The chemical form of lead added to avgas (*i.e.,* tetraethyl lead) and the lead scavenger, ethylene dibromide, are the same compounds used in leaded gasoline for motor vehicles in the past. Therefore, the summary of the science regarding emissions of lead from motor vehicles presented in the 1997 and 1986 AQCD for Lead are relevant to understanding some of the properties of lead emitted from piston-engine aircraft. In addition, the Swiss Federal Office of Civil Aviation (FOCA) published a study of piston-engine aircraft emissions including measurements of lead.[128]

When leaded avgas is combusted, the lead is oxidized to form lead oxide. In the absence of a lead scavenger in the fuel, lead oxide can collect on the valves and spark plugs and if the deposits become thick enough, the engine can be damaged. Ethylene dibromide reacts with the lead oxide, converting it to brominated lead and lead oxybromides. These halogenated forms of lead are volatile at the high temperatures experienced under combustion conditions and are therefore exhausted from the engine along with the other combustion by-products.[129] Upon cooling to ambient temperatures these brominated lead compounds are converted to particulate matter. In addition to lead halides, ammonium salts of lead halides were also emitted by motor vehicles.[130] Lead halides

[122] All documentation for use in preparing 2008 emission inventories can be found on the NEI/EIS Implementation Web site: *http://www.epa.gov/ttn/chief/net/neip/index.html.*

[123] FAA Aerospace Forecast Fiscal Years 2009–2025. Available online at: *http://www.faa.gov/data_research/aviation.*

[124] General Aviation Manufacturers Association (2008) General Aviation Statistical Databook and Industry Outlook, pp.51–55. Available online at: *http://www.gama.aero/files/2008_general_aviation_statistical_databook__indust_499b0dc37b.pdf.*

[125] Except for sport pilots, an active pilot is a person with a pilot certificate with a valid medical certificate. Source: FAA 2008–2025 Aerospace Forecast.

[126] U.S. Environmental Protection Agency (1977) Air Quality Criteria for Lead. Research Triangle Park, NC: Office of Health and Environmental Assessment, Environmental Criteria and Assessment Office; EPA report no. EPA–600/8–77–017. Available at: *http://www.epa.gov/ttn/naaqs/standards/pb/s_pb_pr.html.*

[127] U.S. Environmental Protection Agency (1986) Air Quality Criteria for Lead. Research Triangle Park, NC: Office of Health and Environmental Assessment, Environmental Criteria and Assessment Office; EPA report no. EPA–600/8–83/028aF–dF. 4v. Available at: *http://www.epa.gov/ttn/naaqs/standards/pb/s_pb_pr.html.*

[128] Federal Office of Civil Aviation Environmental Affairs (2007) Aircraft Piston Engine Emissions Summary Report. *33–05–003 Piston Engine Emissions_Swiss FOCA_Summary. Report_070612_rit.* Available online at: *http://www.bazl.admin.ch.*

[129] ChevronTexaco (2006) Aviation Fuels Technical Review pp. 64–65. Available online at: *http://www.chevronglobalaviation.com/docs/aviation_tech_review.pdf.*

[130] U.S. Environmental Protection Agency (1986) Air Quality Criteria for Lead. Volume 2 Section

undergo compositional changes upon cooling and mixing with the ambient air as well as during transport; the water-solubility of these lead-bearing particles increases with a shift toward smaller mean particle size (USEPA 1977, Section 6.2.2.1). Lead halides from automobile exhaust break down rapidly in the atmosphere, via redox reactions in the presence of atmospheric acids (AQCD for Lead, page E–17).

A small fraction of uncombusted alkyl lead was measured in the exhaust of motor vehicles operating with leaded gasoline and is therefore likely to be present in the exhaust from piston-engine aircraft.[131] Alkyl lead is the general term for organic lead compounds and includes the lead additives tetramethyl lead and tetraethyl lead. Tetraethyl lead is a highly volatile compound and therefore, a portion of tetraethyl lead in fuel exposed to air will partition into the vapor phase. Tetraethyl lead can enter the atmosphere from avgas distribution systems, refueling operations, fuel check pre-flight procedures and evaporative losses from the aircraft.[132] Tetraethyl lead has an atmospheric residence time ranging from a few hours to a few days. Tetraethyl lead reacts with the hydroxyl radical in the gas-phase to form a variety of products that include ionic trialkyl lead, dialkyl lead and metallic lead. Trialkyl lead is slow to react with the hydroxyl radical and is quite persistent in the atmosphere (AQCD for Lead, page 2–5).

Particles emitted by piston-engine aircraft are in the submicron size range (less than one micron in diameter). The Swiss FOCA reported the mean particle diameter of particulate matter emitted by one single-engine piston-powered aircraft ranged from 0.049 to 0.108 microns under different power conditions. The particle number concentration ranged from 5.7×10^6 to 8.6×10^6 particles per cm^3 and using a specific density for soot of 1.2, the authors estimated the mass concentration of particulate emissions as approximately 10,000 μg/m^3. The authors noted that these particle emission rates are comparable to those from a typical diesel passenger car engine without a particle filter (FOCA, Section 2.2.3.a).

A significant fraction of particles in the submicron size range are deposited and retained in the lower respiratory system of humans and animals (AQCD for PM, page 6–108).[133] The 1986 AQCD for Lead concludes that lead deposited in the lower respiratory tract is totally absorbed (USEPA 1986, page 10–2).

Due to their small size (*i.e.,* typically less than one micron in diameter), lead-bearing particles emitted by piston engines may disperse widely in the environment. However, lead emitted during LTO, particularly during ground-based operations such as start-up, idle, preflight run-up checks, taxi and take-off may deposit to the local environment. Meteorological factors (*e.g.,* wind speed, convection, rain, humidity) will influence local deposition rates. As discussed in the overview section of this ANPR, many airports in the country have been home to piston-engine operations for decades, including years when lead concentrations in avgas were twice as high as current levels. We seek comment on the chemical and physical form of lead emissions from piston-engine aircraft as well as dispersion and deposition patterns that may influence the risk for local-scale impacts.

B. Summary of Airport Lead Monitoring and Modeling Studies

Lead concentrations in ambient air have been reported for samples collected on or near five airports: the Santa Monica municipal airport in Santa Monica, CA, the Van Nuys airport in Van Nuys, CA, the Chicago O'Hare airport in IL, the Toronto Buttonville municipal airport in Ontario, Canada, and the Destin airport in Destin, FL.[134] [135] [136] [137] [138] Air quality modeling of lead emissions from piston-engine aircraft has been conducted as part of EPA's National Air Toxics Assessment and in one study.[139] [140] As discussed in Section VI.A of this ANPR, State and local agencies are initiating lead monitoring at four airports in 2010 that will provide additional information regarding the air quality impact of lead emissions from piston-engine aircraft.

1. Summary of Airport Lead Monitoring Studies

The ambient air monitoring studies reporting lead concentrations on and near airport property served many purposes and therefore used different criteria for determining sample locations, sample durations, sample collection methods, and collection of important metadata (*e.g.,* activity of piston-engine aircraft and aircraft engine type). This section summarizes results from these studies.

Ambient monitoring studies at and near airports indicate that lead levels in ambient air at or near airports with piston-engine activity are higher than lead levels in areas not directly influenced by a lead source. The study at the Santa Monica Airport[141] is the only study to date in which a lead monitor was sited at an area of anticipated maximum concentration for a period of time that provides ambient concentrations relevant for comparison to the Lead NAAQS.[142] In this study where monitors were placed in

Chapters 5 & 6. Research Triangle Park, NC: Office of Health and Environmental Assessment, Environmental Criteria and Assessment Office; EPA report no. EPA–600/8–83/028aF–dF. 4v. Available from: NTIS, Springfield, VA; PB87–142378.

[131] U.S. Environmental Protection Agency Persistent, Bioaccumulative, and Toxic Pollutants (PBT) Program (2002) PBT national action plan for alkyl-Pb. Washington, DC. Available online at: *http://www.epa.gov/pbt/pubs/Alkyl_lead_action_plan_final.pdf.*

[132] U.S. Environmental Protection Agency Persistent, Bioaccumulative, and Toxic Pollutants (PBT) Program (2002) PBT national action plan for alkyl-Pb. Washington, DC. p. 12. Available online at: *http://www.epa.gov/pbt/pubs/Alkyl_lead_action_plan_final.pdf.*

[133] U.S. Environmental Protection Agency (2004) Air Quality Criteria for Particulate Matter (AQCD). Volume II Document No. EPA600/P–99/002bF. Washington, DC: U.S. Environmental Protection Agency. Available online at: *http://cfpub.epa.gov/ncea/cfm/recordisplay.cfm?deid=87903.*

[134] South Coast Air Quality Management District (2007) Community-Scale Air Toxics Monitoring—Sun Valley Neighborhood and General Aviation Airports. Presented by Dr. Philip Fine at the U.S. EPA Air Toxics Data Analysis Workshop—Chicago, IL. October 2–4, 2007.

[135] Illinois Environmental Protection Agency Bureau of Air (2002) Chicago O'Hare Airport Air Toxic Monitoring Program June–December, 2000.

[136] Environment Canada (2000) Airborne Particulate Matter, Lead and Manganese at Buttonville Airport. Toronto, Ontario, Canada:Conor Pacific Environmental Technologies for Environmental Protection Service, Ontario Region.

[137] Tetra Tech, Inc. (2007) Destin Airport Air Sampling Project Executive Summary. Prepared for City of Destin, Florida.

[138] Tetra Tech, Inc. (2008) Destin, Florida Airport Sampling Report. October 2008. Prepared for City of Destin, Florida.

[139] Piazza, B for the Los Angeles Unified School District Environmental Health and Safety Branch (1999) Santa Monica Municipal Airport: A Report on the Generation and Downwind Extent of Emissions Generated from Aircraft and Ground Support Operations. Report Prepared for The Santa Monica Airport Working Group. Available online at: *http://yosemite.epa.gov/oar/CommunityAssessment.nsf/6ce396ab3fa98ee485256db0004acd94/$FILE/Santa_Monica.pdf*

[140] U.S. Environmental Protection Agency (2009) 2002 National-Scale Air Toxics Assessment (NATA). Available online at: *http://www.epa.gov/ttn/atw/nata2002/index.html.*

[141] South Coast Air Quality Management District (2007) Community-Scale Air Toxics Monitoring—Sun Valley Neighborhood and General Aviation Airports. Presented by Dr. Philip Fine at the U.S. EPA Air Toxics Data Analysis Workshop—Chicago, IL. October 2–4, 2007. This presentation includes lead monitoring data collected at and near the Santa Monica Airport and the Van Nuys Airport.

[142] As with other lead sources, source-oriented monitors for airports should be sited in ambient air at the location of predicted maximum lead concentration. Typically, the location of maximum lead concentration will be downwind of the take off strip near the "blast fence." *http://www.epa.gov/ttnamti1/files/ambient/pb/NetworkDesignQA.pdf.*

locations to identify the gradient in lead concentrations with distance from piston-engine activity, ambient lead increased with increasing proximity to the airport. Lead monitors were located at seven sites around the Santa Monica Airport for two three-month periods, in Spring 2006 and Winter 2006–2007. At the monitor placed near the runway blast fence (*i.e.,* the maximum impact site) on the Santa Monica Airport property, the quarterly average concentrations of lead in total suspended particulate matter (TSP) were 0.08 (winter) and 0.10 (spring) μg/m³.[143] The maximum quarterly average concentration of lead in total suspended particulate matter (TSP) was 0.10 μg/m³, 67% of the 2008 Lead NAAQS of 0.15 μg/m³. This suggests that ambient air lead concentrations at similar airports with more piston-engine activity than the Santa Monica Airport may be higher, and could further approach or exceed 0.15 μg/m³. At a neighborhood site, 70 meters in the prevailing downwind direction from the maximum impact site, quarterly average concentrations of lead in TSP were 0.02 μg/m³ (winter) and 0.03 μg/m³ (spring).[144] At a distance of one kilometer in the prevailing downwind direction from the maximum impact site, lead concentrations were 0.004 μg/m³ and 0.008 μg/m³ in winter and spring, respectively (these concentrations are considered the background lead concentration). The study conducted at the Santa Monica Airport reported concentrations of ambient lead that were highest at on- and near airport areas downwind from the emissions of piston-engine aircraft. These data suggest that piston-engine activity can increase ambient lead concentrations in downwind neighborhood sites, resulting in levels that are four to five times higher than background levels and maximum impact site concentrations that are up to 25 times higher than background lead levels.[145]

As with other emissions from internal combustion engines, lead emitted by piston-engine aircraft are largely in the submicron and even ultrafine size fraction; therefore, analogies to gradients in ultrafine PM are relevant. As summarized in EPA's 2009 Integrated Science Assessment for Particulate Matter, ultrafine particulate number counts decrease exponentially with distance from roadways.[146] A recent study at the Santa Monica Airport reported increased ultrafine PM in a neighborhood downwind from aircraft operations that were conducted by jet and piston-engine aircraft.[147] The EPA is conducting modeling and monitoring studies to further evaluate the gradient in lead concentrations with distance from airports (*see* Section VI.B of this ANPR).

At the Van Nuys Airport, lead monitoring in ambient air was conducted at six sites for two three-month periods. Lead monitoring for this study included locations of ambient air on airport property. However, monitors were not sited in the area anticipated to experience the maximum impact from piston-engine aircraft emissions. The monitoring site that was in closest proximity to the maximum impact area was more than one kilometer downwind from the maximum impact site.[148] The highest quarterly concentration of lead observed at the Van Nuys Airport was at the monitor located over one kilometer away from the maximum impact site and the lead concentration at this site was 0.03 μg/m³ which was four-fold higher than the regional background level of 0.008 μg/m³ measured during the same time period at a site over 2.5 kilometers from the north end of the Van Nuys Airport.

At the Toronto Buttonville Municipal Airport, ten 24-hour PM_{10} samples were collected at four sites at the airport (as close as 15 meters from the runway) and one urban background site in downtown Toronto (located about 10 kilometers west, southwest of the airport). PM_{10} is particulate matter less than ten microns in aerodynamic diameter. The average lead concentration among the airport monitors (which includes three samples that were taken for less than a 12-hour period), was 0.03 μg/m³ and the maximum 24-hour lead concentration was 0.13 μg/m³. One sample, collected for 11 hours, measured 0.30 μg/m³. The maximum concentration observed over a 24-hour period at the airport during this study (0.13 μg/m³) was 11 times higher than the lead concentration reported for the downtown Toronto, Canada background site during the same time period (0.012 μg/m³).[149] The average lead concentration reported for the downtown Toronto site was 0.007 μg/m³. The total particulate matter mass in PM_{10} was also measured in this study, and at the airport, the average mass of lead in PM_{10} was 0.15% of the total PM_{10} mass. At the downtown Toronto site, the average mass of lead in PM_{10} was 0.04% of the total PM_{10} mass. The study reported that the use of leaded avgas at the airport was evident in enhanced airborne lead levels.

Lead and other hazardous air pollutants were measured at sites upwind and downwind of the Chicago O'Hare Airport on sixteen days during the period from June through December, 2000. In order to assess the potential impact of airport operations on ambient concentrations of lead and other pollutants in areas adjacent to airport property, two monitoring sites were deployed on different sides of the airport: one in Bensenville, IL and the other in Schiller Park, IL. For five days during the sampling campaign, the prevailing wind direction provided samples that were collected simultaneously upwind and downwind of the airport. Lead concentrations measured at the downwind site on these five days were, on average, 88% higher than lead concentrations measured at the upwind site. Lead concentrations at the upwind site over the five days averaged 0.016 μg/m³ and downwind concentrations averaged 0.030 μg/m³. This study demonstrates the potential for operations on airport property to impact ambient lead concentrations downwind.

Lead TSP samples were collected for four days in April 2007 and for three days in July 2008 near the Destin Airport in Destin, FL. Twelve-hour TSP samples (AM and PM) were collected at four residential locations ranging from 200 meters to 400 meters from the runway at the Destin Airport and at two urban background locations which were 1.4 kilometers and 2.7 kilometers from the airport.[150] The average lead concentration among the four residential locations was 0.004 μg/m³ and 0.005 μg/m³ in April and July, respectively, and the average urban

[143] A low-volume sampler was used at this site which EPA expects would yield comparable results to a high-volume sampler, the latter of which is the current method used to collect samples for comparison with the Lead NAAQS.

[144] These distances were measured using Google Earth Pro software.

[145] EPA notes that additional information regarding this study at the Santa Monica Airport may become available. If additional information does become available, EPA will take this information into account in the NPRM.

[146] U.S. Environmental Protection Agency (2009) Integrated Science Assessment for Particulate Matter. Second External Review Draft. EPA/600/R–08/139B. p. 3–110. Available online at: *http://cfpub.epa.gov/ncea/cfm/recordisplay.cfm?deid=210586.*

[147] Hu, S., Fruin, S., Kozawa, K., Mara, S., Winer, A.M., Paulson, S.E. (2009) Aircraft Emission Impacts in a Neighborhood Adjacent to a General Aviation Airport in Southern California. Environ. Sci. Technol. 43:8039–8045.

[148] These distances were measured using Google Earth Pro software. Prevailing wind direction, which determines the direction in which the majority of aircraft depart, is provided in the SCAQMD presentation of these data.

[149] Average concentrations reported in this study include three days of short-duration sampling so the average is not used for comparison here.

[150] These distances were measured using Google Earth Pro software.

background lead concentration was 0.003 and 0.004 μg/m³ in April and July, respectively.

In addition to these airport-specific studies, authors evaluating ambient lead concentrations collected as part of the Interagency Monitoring of Protected Visual Environments (IMPROVE) network and the National Oceanic and Atmospheric Administration (NOAA) monitoring sites reported a weekend increase in ambient lead that the authors attributed to weekend increases in piston-engine powered general aviation activity.[151] At some airports, piston-engine aircraft activity conducted for recreational purposes can increase greatly on weekends and can also change seasonally with weather conditions. These peaks in activity are important to capture because they may have a strong influence on long-term average concentrations in an area. However, the current database for ambient lead concentrations at maximum impact sites at airports is severely limited and does not allow us to quantitatively evaluate the influence of this variability in activity on ambient lead concentrations.

We have identified no studies evaluating the potential contribution of piston-engine aircraft emissions on vegetation. We have identified only one study that reports soil concentrations on airport property where piston-engine aircraft are active. The air monitoring study conducted at the Toronto Buttonville airport in Ontario, Canada reported lead concentrations in soil samples collected at eight locations at the airport and two locations at the urban background site. Soil samples that were collected at the Toronto Buttonville airport had lead concentrations ranging from 22–46 μg/g which was not substantially higher than the lead concentrations in soil samples at the two urban background sites (29 and 31 μg/g). We are seeking comments on the potential for piston-engine aircraft emissions to impact local soil lead concentrations.

2. Summary of Airport Lead Modeling Studies

Lead emissions from piston-engine aircraft at 3,410 airports were included in the recently released 2002 National Air Toxics Assessment (NATA) as nonroad sources of lead.[152] Ambient lead concentrations and exposures to lead are modeled for area, point and nonroad sources. Nonroad sources include only lead emissions from piston-engine aircraft. Lead emission rates are based on the lead concentration in fuel and not direct emission measurements. For the NPRM we will summarize modeling results from the 2005 NATA which will incorporate all 20,000 airport facilities discussed in Section III of this ANPR.

As discussed in Section VI of this ANPR, the EPA has conducted a study to develop a modeling approach to evaluate the local-scale variability in ambient lead concentrations attributable to piston-engine activity at a case study airport. This project includes collection of air monitoring data for use in evaluating model performance. In the NPRM, we will describe the results of the modeling study with NATA results for this airport and previous modeling work.[153]

We are requesting comment on the availability of additional monitoring or modeling studies that evaluate the air quality impact of lead emissions from piston-engine aircraft as well as potential impacts on soil, house dust, surface water or other environmental media. We also request comment on the availability of studies that assess the potential public health and welfare impacts of lead emissions from piston-engine aircraft.

V. Exposure to Lead From Piston-Engine Aircraft and Potential for Impacts

The continued use of lead in avgas by piston-engine aircraft is a significant source of current lead emissions to the environment. Piston-engine aircraft emissions of lead occur at ground level as well as at flying altitude. Lead from this source is thus concentrated near airports and is also deposited over a large geographic area potentially contributing to higher ambient concentrations in many communities. Numerous groups within the population may be at risk of exposure to lead in fresh emissions from piston-engine aircraft, resuspended dust or other routes. Further, lead accumulates in the environment posing a potential risk to future generations

In this section we discuss a variety of exposure pathways and scenarios by which the general population and environment may experience an increase in lead exposure from emissions of lead by piston-engine aircraft. This section also describes the potential for public health and welfare effects from exposure to compounds associated with the continued use of tetraethyl lead in fuel, such as the contribution of lead to ambient particulate matter, emissions of ethylene dibromide and non-exhaust exposure to tetraethyl lead. We are seeking comments and information on these exposure scenarios as well as additional exposure pathways and scenarios.

A. Exposure to Lead Emissions From Piston-Engine Aircraft

Piston-engine aircraft emissions of lead occur at ground level as well as at altitudes, resulting in areas of more concentrated ambient air exposure, as discussed in Section IV, and can also be distributed over large geographic areas due to in-flight emissions. Lead particles can deposit to soil, water, vegetation and other surfaces or remain airborne for some time following emissions. In this section we discuss potentially exposed populations which include people living or attending schools near airports and pilots. Additional pathways by which people and animals could be exposed to lead emissions from piston-engine aircraft are those associated with agricultural applications of these aircraft and piston-engine activity at seaport and inland waterways.

Lead from aviation gasoline has been identified as a potential source of contamination for local communities.[154] As described below, many general aviation airports are located in densely populated areas. GA airport facilities were typically built in sparsely populated areas, many of which are now heavily populated or are experiencing increased residential development. This development includes dense residential neighborhoods, schools, businesses, and recreational facilities.

Airports can function as a center of many forms of activity in a community. In EPA's initial research, EPA has found that airports are often surrounded by a variety of land uses including recreational sport facilities (*e.g.,* baseball diamonds, soccer fields, golf courses, and swimming pools) and residential communities that take

[151] Murphy, D.M., Capps, S.L., Daniel, J.S., Frost, G.J., and White, W.H. (2008) Weekly patterns of aerosol in the United States. Atmos. Chem. Phys., 8, 2729–2739.

[152] U.S. Environmental Protection Agency (2009) 2002 National-Scale Air Toxics Assessment (NATA). Available online at: *http://www.epa.gov/ttn/atw/nata2002/tables.html.*

[153] Piazza, B for the Los Angeles Unified School District Environmental Health and Safety Branch (1999) Santa Monica Municipal Airport: A Report on the Generation and Downwind Extent of Emissions Generated from Aircraft and Ground Support Operations. Report Prepared for The Santa Monica Airport Working Group. Available online at: *http://yosemite.epa.gov/oar/CommunityAssessment.nsf/6ce396ab3fa98ee485256db0004acd94/$FILE/Santa_Monica.pdf.*

[154] Levin, R.; Brown, MJ; Kashtock, ME; Jacobs, DE; Whelan, EA; Rodman, J; Schock, MR; Padilla, A; Sinks, T. (2008) Lead Exposures in U.S. Children, 2008: Implications for Prevention. Environ. Health Perspec. 116:1285–1293.

advantage of the ease of transport and pilot training/recreation offered by quick access to an airport. Many airports offer on-site tours to the general public, educational classes, and recreational opportunities that can present near-source exposure scenarios. Airports are especially attractive to young children, and programs at some airports are focused on this population and provide outdoor observation facilities and picnic facilities for families to observe aircraft operations. Many general aviation airports offer instructional flying and/or clubs where children 14 years of age and older as well as adults can learn to fly in rental aircraft. Airport facilities also host community-friendly activities such as antique sales, fireworks displays, air shows and community meals. Many airport facilities provide activities which bring people from the general public in close proximity to lead emissions from piston-engine aircraft and piston-engine helicopters. EPA is requesting information regarding national databases that provide information regarding recreational fields and community gardens in close proximity to airports.

1. Population Residing Near Airports

To evaluate the number of people who might be exposed to elevated lead levels due to emissions from piston-engine aircraft, EPA calculated the number of people that live within one kilometer of the centroid of an airport.[155] The centroid of the airport is defined here as the latitude and longitude coordinate provided by airports to FAA.[156] These coordinates typically identify a location in the center of the runway or runway area. For some airports, nearby residences are outside the one kilometer distance from the airport centroid. This is the case for residences near airports that have runways that are longer than two kilometers and for residences near large airports such as those servicing primarily commercial aircraft activity. For airport facilities with one runway that is approximately one kilometer in length, this method will generally include people residing within approximately 500 meters from the ends of the runway and may include residences up to approximately 900 meters from the sides of the runway. The limited ambient lead monitoring data near airports presented in Section IV of this ANPR suggests that for some airports this analysis will underestimate the actual number of people potentially exposed to elevated levels of ambient lead from piston-engine powered aircraft. This is because the analysis will include very little of the nearby population for airports that have a large footprint. We plan to revise this analysis for the NPRM using a graphical interface system that will allow us to evaluate the number of people living within uniform distances of aircraft activity.

Using 2000 U.S. Census Data[157] at the block level, EPA estimates that 16 million people live within one kilometer of the centroid of the 19,896 airport facilities which includes airports, seaplane bases, heliports, stolports, ultralight facilities and glider ports. There are currently 5,567 heliports in this analysis, which can be in densely populated areas. Fourteen of the 16 million people living within one kilometer of the centroid of an airport facility live within one kilometer of a heliport. We currently have limited information regarding which heliport facilities have piston-engine activity and we are seeking comment on piston-engine activity at heliports.

There are several pathways by which people may be exposed to lead associated with the use of piston-engine aircraft. These include inhalation of ambient airborne lead as well as incidental ingestion of ambient lead through contact with indoor or outdoor surfaces to which ambient lead has deposited. Additionally, ambient lead deposited to outdoor soil can be tracked into interior spaces. There is also the potential for ingestion of lead emitted by piston engine aircraft emissions to deposit on edible plants and produce being cultivated in locations near airports. Consequently, there is the potential for exposure to lead emitted by piston-engine aircraft via ingestion for those consuming vegetables grown near airports that service piston-engine aircraft. In addition to personal gardens, community gardens are sometimes sited near airports as these areas can have undeveloped available land. We do not have information on the potential significance of this exposure pathway and we are seeking comment on information and analyses that could inform this issue.

In some cases, pilots and their families choose to live in close proximity to an airstrip. These communities intentionally placed near airports are known as airport communities, fly-in communities or residential airparks. Some residential airparks are private while others have public services and facilities. Some residential airparks are specifically designed as airport communities with driveways leading from aircraft hangars or tie-downs onto the airstrip, while other residential airparks allow apartments to be built in the airplane hangar. Other residential airparks are developed by the addition of a neighborhood immediately adjacent to a commercial airport. FAA terms this a "through-the-fence" operation.[158] Homes are required to be at least 45 meters from the runway centerline and can be built along one or both sides of the runway.[159] Some residential airparks provide taxiways for access to the runway, some provide streets separate from taxiways, and some share automobile and aircraft traffic on the same thoroughfares. A variety of resources list the location and services offered by residential airparks in the U.S. and estimates of the number of residential airparks range from 300 to 600.[160] [161]

In some cases, records are maintained only for those residential parks that have five or more homes or lots.

Exposure modeling at the EPA indicates that, for the 20 highest air emission sources, local emissions are significantly related to local blood lead levels.[162] We are aware of no studies evaluating blood lead levels among people who live in close proximity to airports with piston-engine activity or those for whom lead emissions from piston engines may elevate their exposure via other exposure pathways. As noted in Section II.B.2, the current evidence indicates that the slope for

[155] U.S. EPA (March 2010) Memorandum from Meredith Pedde to docket EPA–HQ–OAR–2007–0294, titled, "Evaluation of People Living Within 1 km of U.S Airport Facilities."

[156] Federal Aviation Administration. Airport Data (5010) & Contact Information, Airport Facilities Data. Retrieved on August 13, 2009 from: *http://www.faa.gov/airports/airport_safety/airportdata_5010/menu/index.cfm.*

[157] Obtained from: *http://www.epa.gov/ttn/fera/human_hem_censusandmet.html.*

[158] FAA officially defines "through-the-fence" as those activities permitted by an airport sponsor through an agreement that permits access to the public landing area by independent entities or operations offering an aeronautical activity or to owners of aircraft based on land adjacent to, but not part of, the airport property. The obligation to make an airport available for the use and benefit of the public does not impose any requirement for the airport sponsor to permit ground access by aircraft from adjacent property. (*http://www.aopa.org/whatsnew/region/airportOps0712.pdf*).

[159] ASTM International (2005) ASTM F2507–05 Standard Specification for Recreational Airpark Design

[160] *http://www.airparks.com* maintains a list of airparks that have five or more homes/lots. The list can be updated by the public and as of July 31, 2009, lists 326 residential airparks.

[161] *http://livingwithyourplane.com/about/* has a directory of over 600 residential airparks.

[162] U.S. Environmental Protection Agency (2007) Pilot Study of Targeting Elevated Blood Lead Levels in Children (Draft Final Report). Washington DC: U.S. EPA Office of Pollution Prevention and Toxics. *http://cfpub.epa.gov/si/si_public_record_report.cfm?dirEntryId=195303.*

lead effects on IQ is nonlinear and is steeper at lower blood lead levels, such that each µg/dL increase in blood lead may have a greater effect on IQ at lower blood lead levels (*e.g.,* below 10 µg/dL) than at higher levels (AQCD for Lead, Section 6.2.13; pp. 8–63 to 8–64; Figure 8–7). We are therefore seeking comment and information regarding blood lead concentrations in children living near airports and the extent to which these emissions cause or contribute to any increases in blood lead levels.

2. Children Attending School Near Airports

As noted in Section II.B.2 of this ANPR, while adults are susceptible to lead effects at lower blood lead levels than previously understood (*e.g.,* AQCD for Lead, p. 8–25), there is general consensus that the developing nervous system in children is among the, if not the, most sensitive health endpoints. Also, as noted in Section II.B.3, while children are considered to be at a period of maximum exposure around 18–27 months, the current evidence has found even stronger associations between blood lead levels at school age and IQ at school age. The evidence "supports the idea that lead exposure continues to be toxic to children as they reach school age, and [does] not lend support to the interpretation that all the damage is done by the time the child reaches 2 to 3 years of age" (AQCD for Lead, Section 6.2.12). Accordingly, school-age children are an at-risk population for lead exposures. This section discusses potential exposures of children at school to lead associated with piston-engine aircraft.

During the school year, students spend many hours a day at school, which usually includes time on school playgrounds and on school athletic fields. Those children attending schools in close proximity to piston-engine activity may have increased exposure to lead. Using data from the U.S. Department of Education's National Center for Education Statistics, EPA calculated that there are 8,637 schools located within one kilometer of the centroid of an airport in the U.S., at which over 3 million children are in attendance (Table 1).[163] [164] These children represent 6% of the total U.S. student population.

TABLE 1—NUMBERS OF PUBLIC AND PRIVATE SCHOOLS AND SCHOOL CHILDREN ATTENDING SCHOOLS LOCATED WITHIN ONE KILOMETER OF THE CENTROID OF AN AIRPORT SERVICING PISTON-ENGINE AIRCRAFT

	Number of schools within 1 km of an airport	Number of students who attend schools within 1 km of an airport
Private Schools	2,185	420,824
Public Schools	6,452	2,869,939
All Schools	8,637	3,290,763

Section II.B.1 notes that children in poverty and black, non-Hispanic children have notably higher blood lead levels than do economically well-off children and white children, in general. To evaluate potential ethnic and economic disparities among children attending schools close to airports compared with the general population, we used data from the Department of Education that provides this information. These data indicate that minorities are overrepresented at schools that are located within one kilometer from the centroid of an airport. For example, Hispanic students represent 23% of students at schools located within one kilometer of an airport, whereas Hispanic students represent 19% of students in all U.S. schools (Table 2). Black students represent 18% of students at schools located within one kilometer of an airport, whereas black students represent 16% of the student population in the U.S. (Table 2).

TABLE 2—RACIAL DISTRIBUTION AT SCHOOLS WITHIN ONE KILOMETER OF THE CENTROID OF AN AIRPORT AND THE RACIAL DISTRIBUTION AT ALL U.S. SCHOOLS

		American Indian/Alaskan Indian	Asian/Pacific Islander	Black, Non-Hispanic	Hispanic	White, Non-Hispanic	Total students*
All Schools within 1 km of an airport.	Number	46,861	154,408	597,223	764,704	1,646,882	3,290,763
	Percent	1%	5%	18%	23%	50%	
All U.S. Schools	Number	632,237	2,581,822	8,696,565	10,525,763	30,664,231	54,271,986
	Percent	1%	5%	16%	19%	57%	

* This table includes only those children that identify as one of the five races/ethnicities. A small fraction of students identify as mixed race or 'other' and they are not included here, therefore the percent of students does not total 100%.

In general, housing and income data suggest that people living in close proximity to major transportation sources (*i.e.,* major roadways, airports, ports, railyards) are likely to have lower income than the general population.[165] To evaluate the socioeconomic status of students who attend schools near airports, EPA evaluated the number of students who are eligible for the U.S. Department of Agriculture's free or reduced school lunch program. Children

[163] U.S. EPA (March 2010) Memorandum from Meredith Pedde to docket EPA–HQ–OAR–2007–0294, titled, "Identification of Schools Within 1 km of U.S Airport Facilities."

[164] Public School Data available for 2006–2007: *http://nces.ed.gov/ccd/bat/;* Private School Data available for 2007–2008: *http://nces.ed.gov/surveys/pss/pssdata.asp.*

[165] U.S. Environmental Protection Agency (2007) Regulatory Impact Analysis for the Regulation to Control Hazardous Air Pollutant Emissions from Mobile Sources. Chapter 3, p. 3–122.

from families with incomes at or below 130 percent of the poverty level are eligible for free meals. Those with incomes between 130 percent and 185 percent of the poverty level are eligible for reduced-price meals.[166] Free and reduced lunch eligibility is only tracked by the U.S. Department of Education's National Center for Education Statistics for students who attend public schools. At public schools that are located within one kilometer of the centroid of an airport, 47% of students are eligible for either free or reduced lunches, whereas nationally, 41% of students at public schools are eligible for either free or reduced lunches. As this analysis demonstrates, those living in the vicinity of airports are more likely to be low-income households and minority residents.

We are aware of no studies evaluating blood lead levels among children attending school in close proximity to airports with piston-engine activity. We are seeking comment and information regarding blood lead concentrations in children who attend schools in close proximity to airports and the extent to which these emissions cause or contribute to any increases in blood lead levels.

3. Agricultural Activities

Piston-engine aircraft are used in a variety of agricultural activities that may introduce lead into the human diet as well as contribute to lead in the environment. The FAA conducts the General Aviation and Air Taxi Activity (GAATA) Survey annually to obtain information on the general aviation and air taxi fleet, the number of hours flown, and the reasons people use general aviation and air taxi aircraft.[167] [168] According to the results of the 2007 GAATA Survey (the most recent), aerial application in agriculture and forestry represented 5% of all hours flown by general aviation aircraft in 2007. Of the total aerial application hours flown in 2007 (1.41 million hours), 60% of the hours were flown by piston-engine aircraft. Aerial application activity includes crop and timber production, which involve fertilizer and pesticide application and seeding cropland. The National Agricultural Aviation Association estimates that there are approximately 3,200 aerial application professional operators and pilots in the United States.[169]

As discussed in Section II.C.1, surface deposition of lead onto plants may represent a significant contribution to the total lead in and on the plant. Lead halides, the primary form of lead emitted by engines operating on leaded fuel, are slightly water soluble. They therefore may be more readily absorbed by plants than other forms of inorganic lead. Atmospheric deposition of lead also contributes to lead in vegetation as a result of contact with above-ground portions of the plant (AQCD for Lead, pp. 7–9 and AXZ7–39; USEPA, 1986, Sections 6.5.3 and 7.2.2.2.1). Livestock may subsequently be exposed to lead in vegetation (*e.g.,* grasses and silage) and in surface soils via incidental ingestion of soil while grazing (USEPA 1986, Section 7.2.2.2.2).[170] The lead concentration of plants ingested by animals is primarily a result of atmospheric deposition of lead particles onto plant surfaces rather than the uptake of soil lead through plant roots. Some of the highest levels of lead exposure among livestock have been attributed to grazing near major sources such as smelters (AQCD for Lead, Section 2.3.8). Atmospheric deposition is estimated to comprise a significant proportion of lead in food (AQCD for Lead, p. 3–48) and dietary intake may be a predominant source of lead exposure among adults (greater than consumption of water and beverages or inhalation (73 FR 66971)).

Depending on wind conditions, an aircraft involved in aerial application may fly only 4 inches to 12 feet above the crops.[171] [172] [173] The low flying height is needed to minimize the drift of the fertilizer and pesticide particles away from their intended target. An unintended consequence of this practice is that exhaust emissions of lead have a substantially increased potential for directly depositing on vegetation and surrounding soil. We have not identified any data or analyses regarding the contribution of piston-engine aircraft lead emissions to lead concentrations in or on plant tissues, in livestock or the dose that this might deliver to the human population. We are seeking comments on the potential significance of this exposure pathway.

4. Pilots, Student-Trainees, Passengers

Pilots, student-trainees, and passengers are all potentially exposed to lead emissions from piston-engine aircraft that use leaded avgas. General aviation passengers and pilots access their aircraft in areas that are typically in close proximity to runways. Therefore, these individuals walk near and breathe the air near locations where aircraft are idling, conducting run-up checks, taxiing, taking off, and landing.

In the U.S., general aviation aircraft fly over 27 million hours and carry 166 million passengers annually.[174] Approximately 36 percent of the hours flown by general aviation are for personal transportation, 19 percent are instructional flight hours, 11 percent are corporate flight hours, 11 percent are for business, eight percent are air taxi and air tours and the remainder include hours spent in other applications such as aerial observation and aerial application.[175] According to the 2008 General Aviation Statistical Databook & Industry Outlook report by the General Aviation Manufacturers Association (GAMA) there were 578,541 pilots in the United States in 2008.[176] Among the pilot population, 75,382 were student pilots, comprising 13% of the total pilot population. The majority of initial pilot training is conducted in piston-engine aircraft.[177] There is no age minimum for

[166] United States Department of Agriculture: Food and Nutrition Service, National School Lunch Program Fact Sheet. Obtained from: *http://www.fns.usda.gov/cnd/Lunch/AboutLunch/NSLPFactSheet.pdf,* August 3, 2009. For the period July 1, 2008, through June 30, 2009, 130 percent of the poverty level is $27,560 for a family of four; 185 percent is $39,220.

[167] The FAA GAATA is a database collected from surveys of pilots flying aircraft used for general aviation and air taxi activity. For more information on the GAATA, *see* Appendix A at *http://www.faa.gov/data_statistics/aviation_data_statistics/general_aviation/.*

[168] National Agricultural Aviation Association: "Help the Aerial Application Industry by completing the 2008 General Aviation Activity Survey." Retrieved from: *http://www.agaviation.org/2008%20GenAvnSurvey.htm* on August 13, 2009.

[169] National Agricultural Aviation Association: "History." Retrieved from: *http://www.agaviation.org/history.htm* on August 13, 2009.

[170] U.S. Environmental Protection Agency (1986) Air Quality Criteria for Lead. Research Triangle Park, NC: Office of Health and Environmental Assessment, Environmental Criteria and Assessment Office; EPA report no. EPA–600/8–83/028aF-dF. 4v. Available from: NTIS, Springfield, VA; PB87–142378.

[171] Xiong, Chao. (9–23–2007) "Future for Crop Dusters is up in the Air". The Star Tribune. Retrieved on August 12, 2009 from: *http://www.startribune.com/local/11606661.html.*

[172] Harpole, T. (3–1–2007) "That Old-Time Profession" Air & Space Magazine. Retrieved on August 12, 2009 from: *http://www.airspacemag.com/history-of-flight/old_time_profession.html.*

[173] Petersen, R. "So you want to be a spray pilot". AgAir Update. Retrieved on October 9, 2009 from: *http://www.agairupdate.com/aau/wannabe/pilot.html.*

[174] General Aviation Manufacturers Association (2008) General Aviation Statistical Databook and Industry Outlook. Available at: *http://www.gama.aero/files/2008_general_aviation_statistical_databook_indust_499b0dc37b.pdf.*

[175] General Accounting Office Report to Congressional Requesters (2001) General Aviation Status of the Industry, Related Infrastructure, and Safety Issues. GAO–01–916.

[176] GAMA 2008 General Aviation Statistical Databook & Industry Outlook report. Retrieved on August 17, 2009 from: *http://www.gama.aero/files/2008_general_aviation_statistical_databook_indust_499b0dc37b.pdf.*

[177] *See http://flighttraining.aopa.org/.*

pilots to begin taking flying lessons.[178] The minimum age for conducting a solo flight is 16 years and a pilot certificate cannot be issued until 17 years of age. According to the 2008 General Aviation Statistical Databook & Industry Outlook report by the GAMA, there are 190 student pilots in the 14–15 year old age group and 11,562 student pilots in the 16–19 years old age group. GAMA reports that in 2008 there are 3,846 private pilots in the 16–19 years old age group. According to the FAA there are more than 500 flight training schools.[179] [180] The requirement for a private pilot certificate is 40 hours in a non-approved school, and 35 hours in an approved school. However, most people obtain 60 to 75 hours of training before earning their pilot certificate.

The general public for whom flying is a recreational activity may be the most highly exposed population to lead emissions from piston-engine activity. In addition to their inhalation exposure to engine exhaust emissions, pilots can be exposed to evaporative emissions of TEL during aircraft fueling, and fuel sump checks during preflight inspections.

5. Bioaccumulation of Lead in Aquatic Organisms

As discussed in Section II.C.2 of this ANPR, lead bioaccumulates in the tissues of aquatic organisms through ingestion of food and water. Because of the potential for significant deposition of lead compounds to water bodies, EPA researches and reports on the atmospheric deposition of lead compounds to the Great Waters (the Great Waters include the Great Lakes, Lake Champlain, Chesapeake Bay and many U.S. coastal estuaries).[181] Alkyl lead, in particular, has been identified by EPA as a Level I Persistent, Bioaccumulative, and Toxic (PBT) pollutant. Level I substances are targeted for virtual elimination through pollution prevention and other incentive-based actions that phase out their use, generation or release in a cost-effective manner within the most expedient timeframe. In 2002, EPA issued the PBT National Action Plan for Alkyl-lead to promote further voluntary reductions of use and exposure to alkyl lead compounds, including leaded avgas.[182]

We are interested in the potential for lead emissions from piston-engine aircraft to be a source of lead pollution to aquatic organisms. Among the approximately 20,000 airport facilities in the United States there are 448 seaplane facilities. Landing and take-off activity by aircraft at these facilities provides a direct pathway for emission of organic and inorganic lead to the air near/above inland waters and ocean seaports where these aircraft operate. In addition to seaplane facilities, many airports and heliports are located very close to rivers, lakes and streams, which can provide a direct pathway for emission of organic and inorganic lead to the air near/above inland waters. Lead emissions from seaplane facilities as well as airports and heliports near water bodies can enter the aquatic ecosystem by either deposition from ambient air or runoff of lead deposited to surface soils. As noted in Section IV.A, lead halides (the primary form of lead emitted by engines operating on leaded fuel) are slightly water-soluble and may be more readily dissolved into water than other inorganic forms of lead.

The EPA Office of Water maintains a database of the National Listing of Fish Advisories (NLFA) which is made available on the Internet to provide information regarding locally-issued fish advisories and safe eating guidelines.[183] States, territories, and Tribes (collectively referred to here as "States") provide this information to EPA every year. The most recent year for which data are available is 2008. States provide information regarding contaminant levels of bioaccumulative toxins measured in fish including lead, mercury, polychlorinated biphenyls (PCBs) and dioxin. Based on these data states issue fish consumption advisories that provide information regarding water bodies for which fish tissue concentrations of these pollutants are found by the State criteria to be safe or unsafe for consumption. The EPA recommends that if fish are detected as having any measureable level of accumulated lead in their tissues that this is cause for concern for all consumers, but especially for children and pregnant or nursing women, and that issuing an advisory is prudent.

The 2008 NLFA database includes data on lead concentrations in over 23,000 fish from over 1,000 lakes and streams. Among these fish, lead concentrations were above the analytical detection limit in 1,000 fish samples [184] and among the fish in which measureable lead concentrations were reported, the concentrations of lead ranged from 5 ppb to 60,400 ppb.[185] States do not provide information regarding the source of contamination in water bodies where fish tissue concentrations of lead are above detection limits. Lead concentrations in fish tissue samples declined from mean concentrations of 0.28 ppm in 1976 to 0.11 ppm in 1984.[186] The decrease in mean lead concentrations was attributed primarily to reductions in the lead content of motor vehicle gasoline. Sources of contamination of lead to waterways frequently noted include lead gunshot, lead sinkers, and Superfund sites.[187] Lead emissions from piston-engine aircraft may contribute to fish tissue lead concentrations in water bodies that are in close proximity to piston-engine aircraft activity. In one case, a State reported lead contaminated fish in a lake on airport property. Piston-engine aircraft emissions of lead also have the potential to contribute to fish tissue lead concentrations at water bodies throughout the U.S. due to the emission of lead in-flight. These in-flight emissions are greatly dispersed in the environment and have been providing a source of lead to the environment for over 80 years.

The Fond du Lac Band of Lake Superior Chippewa, the Leech Lake Band of Ojibwe and the Mille Lacs Band of Ojibwe submitted comments to the Lead NAAQS docket noting the importance of fish consumption in their diet.[188] The Fond du Lac Band of Lake

[178] Federal Aviation Administration (FAA). "Become a Pilot—Student Pilot's Certificate Requirements." Retrieved on August 17, 2009 from: *http://www.faa.gov/pilots/become/student_cert/.*

[179] Federal Aviation Administration (FAA). "Types of Pilot Schools & Choosing a Pilot School". Retrieved on August 17, 2009 from: *http://www.faa.gov/training_testing/training/pilot_schools/.*

[180] Federal Aviation Administration (FAA). "Pilot Schools—Search". Retrieved on August 17, 2009 from: *http://av-info.faa.gov/PilotSchool.asp.*

[181] U.S. Environmental Protection Agency, "The Great Waters Program." Retrieved on August 17, 2009 from: *http://www.epa.gov/air/oaqps/gr8water/.*

[182] U.S. Environmental Protection Agency Persistent, Bioaccumulative, and Toxic Pollutants (PBT) Program (2002) PBT national action plan for alkyl-Pb. Washington, DC. Available online at: *http://www.epa.gov/pbt/pubs/Alkyl_lead_action_plan_final.pdf.*

[183] U.S. Environmental Protection Agency, "The National Listing of Fish Advisories." Retrieved on August 17, 2009 from: *http://www.epa.gov/waterscience/fish/advisories/.*

[184] In some instances States supply individual fish tissue sample results and in some instances States supply averages of multiple fish tissue sample results.

[185] State-specific fish advisories for lead can be downloaded from: *http://oaspub.epa.gov/nlfwa/nlfwa.bld_qry?p_type=advrpt&p_loc=on.*

[186] U.S. Environmental Protection Agency (2000) Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories. Volume 1: Fish Sampling and Analysis. EPA 823–B–00–007. p. 4–59. Available online at: *http://www.epa.gov/waterscience/fish/advice/volume1/index.html.*

[187] U.S. Environmental Protection Agency, "Lead Fishing.". Retrieved on August 17, 2009 from: *http://www.epa.gov/owow/fish/animals.html.*

[188] *See* Docket ID Number EPA–HQ–OAR–2006–0735. The Tribes that submitted comments were:
Continued

Superior Chippewa also noted in their comments, "As a reservation with a municipal airport within its exterior boundaries with two schools and Tribal housing in close proximity to the airport (one half mile), leaded aircraft fuel is a concern." The Leech Lake Band of Ojibwe noted in their comments, "Along with the concerns over the emission inventory, the Tribes have great concern regarding the amount of lead from "small" prop engine airports. On or very near the Leech Lake Reservation there are seven prop plane airports with many private air strips scattered throughout the area." EPA is requesting comment on any information regarding the potential impact of lead emissions from piston-engine aircraft on aquatic environments.

B. Related Exposures of Concern

While the subject of this ANPR is focused on the emissions of lead from piston-engine aircraft, the use of tetraethyl lead in fuel contributes to additional public health and welfare issues that are also of concern to the Agency. Among these issues are: (1) The contribution of lead emissions to ambient PM, especially in areas in nonattainment with the $PM_{2.5}$ NAAQS; (2) the emissions of ethylene dibromide to the environment; and (3) the evaporative emissions of tetraethyl lead.

1. Lead Contribution to Ambient Particulate Matter

As discussed in Section IV.A of this ANPR, lead emitted by piston engines is expected to be predominantly in the particle phase and will contribute to ambient PM. There are two U.S. National Ambient Air Quality Standards (NAAQS) for $PM_{2.5}$: an annual standard (15 μg/m³) and a 24-hour standard (35 μg/m³). As of March 4, 2009 there are 39 1997 $PM_{2.5}$ nonattainment areas. Area designations for the 2006 24-hour $PM_{2.5}$ NAAQS were promulgated in 2009 for 31 areas.[189] All of these nonattainment areas have at least one airport servicing aircraft using leaded avgas and most nonattainment areas have several airport facilities. The Los Angeles-South Coast Air Basin has 343 airport facilities which have a cumulative lead inventory of 15.0 tons. The contribution of PM-lead to these nonattainment areas ranges from 0.001 to 0.7% of the mobile source $PM_{2.5}$ inventory in these areas. In each of four areas designated as nonattainment with the $PM_{2.5}$ annual standard, there is at least one lead monitor at which design values for 2006–2008 are greater than the 2008 Lead NAAQS and two of these counties have $PM_{2.5}$ concentrations exceeding the 24-hour $PM_{2.5}$ NAAQS. Reductions in lead emissions in these counties would help bring the area into attainment.

2. Ethylene Dibromide

As noted in Section IV.A, ethylene dibromide (1,2-dibromoethane) is added to leaded avgas to scavenge lead in order to prevent the deposition of lead oxide to valves and spark plugs. Emissions of ethylene dibromide are a concern to the EPA. Ethylene dibromide is classified in EPA's Integrated Risk Information System database as likely to be carcinogenic to humans, and a number of chronic noncancer effects have been observed in animals and humans exposed to ethylene dibromide by inhalation and ingestion.[190] EPA developed an inhalation reference concentration, ingestion dose and cancer unit risk estimates for inhalation and ingestion of ethylene dibromide.[191] Evidence of nasal tumors, hemangiosarcomas and mesotheliomas in rodents was used by EPA to develop inhalation unit risk estimates (central tendency estimates and 95% upper bound estimates) of 3×10^{-4} to 6×10^{-4} per μg/m³. Evidence of forestomach tumors, hemangiosarcomas, thyroid follicular cell adenomas or carcinomas was used by EPA to develop drinking water unit risk estimates (central tendency estimates and 95% upper bound estimates) of 3×10^{-5} to 6×10^{-5} per μg/L assuming consumption of 2 L of water per day by a 70 kg human. EPA developed a reference concentration for chronic inhalation of 9 μg/m³ based on the critical effect of nasal inflammation and a reference dose for chronic ingestion of 9 μg per kg per day based on the critical effects of testicular atrophy, liver peliosis, and adrenal cortical degeneration. The National Toxicology Program listed ethylene dibromide as "reasonably anticipated to be a human carcinogen" in the Eleventh Report on Carcinogens in 2005.[192] The International Agency for Research on Cancer (IARC) has classified ethylene dibromide as a Group 2A carcinogen: probably carcinogenic to humans. –

In the additive package used to dose fuel with lead, ethylene dibromide is added to achieve a lead-to-bromine atom ratio of 1:2 and a bromine-to-lead weight ratio of 1:2.[193] The concentration of ethylene dibromide in leaded avgas is listed as less than 4 milliliters per gallon (<9 grams per gallon).[194] Since ethylene dibromide was measured in the exhaust and evaporative emissions from light-duty vehicles in the U.S. when they were operated on leaded fuel containing ethylene dibromide we anticipate piston-engine aircraft are currently a source of ethylene dibromide to air.[195] Measurements of ethylene dibromide have not been made that would allow estimation of the exhaust and evaporative emissions from piston-engine aircraft as well as the emissions associated with refueling and pre-flight fuel checks.

In addition to contributing to ambient concentrations, ethylene dibromide may also enter underground aquifers via leaking underground storage tanks or fuel spills. Studies demonstrate that ethylene dibromide may persist for long periods of time in certain groundwater environments.[196] The EPA established a Maximum Concentration Level (MCL) of 0.05 μg/L for ethylene dibromide, which is 100-fold lower than the MCL for benzene and 300-fold lower than the MCL for lead. The MCL is the highest level of a contaminant that is allowed in drinking water and is an enforceable drinking water standard.[197]

The EPA Office of Underground Storage Tanks (OUST) and Office of Research and Development's National Risk Management Research Laboratory (NRMRL) in association with the Association of State and Territorial

The Bad River Band of Lake Superior Tribe of Chippewa Indians, The Quapaw Tribe of Oklahoma, The Leech Lake Band of Ojibwe, The Lone Pine Paiute-Shoshone Reservation, The Fond du Lac Band of Lake Superior Chippewa, and The Mille Lacs Band of Ojibwe.

[189] *http://www.epa.gov/pmdesignations/.*

[190] U.S. Environmental Protection Agency (2004) Integrated Risk Information System (IRIS), IRIS Summary for 1,2-dibromoethane CASRN 106–93–4. Available online at: *http://www.epa.gov/ncea/iris/subst/0361.htm.*

[191] U.S. Environmental Protection Agency (2004) Integrated Risk Information System (IRIS), Toxicological Review of 1,2-dibromoethane in support of summary information on the Integrated Risk Information System. Available online at: *http://www.epa.gov/ncea/iris/toxreviews/0361tr.pdf.*

[192] National Toxicology Program (NTP) (2005) 11th Report on Carcinogens. Public Health Service, U.S. Department of Health and Human Services, Research Triangle Park, NC. Available from: *http://ntp-server.niehs.nih.gov.*

[193] Thomas VM; Bedford JA; Cicerone RJ. (1997) Bromine emissions from leaded gasoline. Geophys Res Letters 24(11):1371–1374.

[194] Chevron Material Safety Data Sheet for aviation gasoline. Available online at: *http://www.chevronglobalaviation.com/docs/aviation_gas.doc.*

[195] Sigsby, J.E.; Dropkin, D.L.; Bradow, R.L.; Lang, J.M. (1982) Automotive Emissions of Ethylene Dibromide. SAE Technical Paper Series 820786.

[196] U.S. Environmental Protection Agency Office of Research and Development (2008) Natural Attenuation of the Lead Scavengers 1,2–Dibromoethan (EDB) and 1,2–Dichloroethane (1,2–DCA) at Motor Fuel Release Sites and Implications for Risk Management, Chapter 2. EPA 600/R–08/107. Available online at: *http://www.epa.gov/ada.*

[197] U.S. Environmental Protection Agency, "Drinking Water Contaminants" Available online at: *http://www.epa.gov/safewater/contaminants/index.html.*

Solid Waste Management Officials (ATSWMO) have formed a team to evaluate the potential for public health and welfare effects attributable to ethylene dibromide from past or present fuel leaks and spills.[198] Among the goals of the EPA/ATSWMO team is to develop information on the distribution of ethylene dibromide in groundwater at leaking underground storage tank sites in States that do not routinely monitor this contaminant. Water samples for this study were provided by State agencies to EPA between October 2005 and July 2007. Of the 802 groundwater samples provided from 102 sites, ethylene dibromide was detected in 54 samples, 43 of which had ethylene dibromide concentrations above the MCL.[199] These sites did not include analysis of groundwater at airports.

While not the focus of this ANPR, ethylene dibromide exposure from inhalation or ingestion pathways is an ongoing concern for EPA, and reduction in the use of leaded gasoline containing ethylene dibromide may reduce exposure and risk to public health and welfare from ethylene dibromide.

3. Non-Exhaust Exposure to Tetraethyl Lead

Tetraethyl lead is a volatile component of leaded avgas. The largest source of tetraethyl lead exposure is expected to originate from evaporative emissions associated with fuel production, fuel distribution, aircraft refueling, pre-flight fuel checks, accidental spills, and fuel tank venting. Pilots check fuel for contaminants by draining a small amount of fuel from each tank sump before flight and after refueling. This fuel is frequently deposited onto the tarmac after the fuel check. EPA is interested in data regarding this practice and any estimates of lead emitted to the air by evaporation of the alkyl lead in the fuel deposited on the tarmac. Alkyl lead becomes oxidized in the atmosphere by direct photolysis, reaction with ozone, and by reaction with hydroxyl compounds. Therefore, depending on ambient conditions, alkyl lead may exist in the atmosphere for hours to days.

Pilots, aviation fuel attendants and mechanics are likely to be among the most highly exposed population to alkyl lead. These populations are at risk due to both inhalation and possible dermal exposure. Absorption of inhaled alkyl lead into the bloodstream is higher than that for inorganic lead compounds which are generally in particulate form (AQCD for Lead, Section 4.2.1). In addition to exposure to lead in the exhaust emissions from piston-engine aircraft, the PBT National Action Plan for Alkyl-lead[200] noted that aviation fuel attendants and mechanics are potentially exposed to alkyl lead emissions due to inhalation of alkyl lead compounds released to the air during fueling, via evaporative emissions from spills, or via evaporative emissions from unused gasoline remaining in the engine or fuel tanks. Further, these populations are also at risk because of possible dermal absorption of gasoline containing alkyl lead compounds. Due to the lipophilic nature of alkyl lead and its ability to permeate biological membranes, alkyl lead is absorbed rapidly and extensively through the skin (AQCD for Lead, page 4–12). In addition to direct human exposure, runoff and deposition of alkyl lead to waterways would increase the amount of lead available for uptake by aquatic plants and animals (*see* Section V.A.7 of this ANPR for more information).

VI. Additional Information Available for the NPRM To Evaluate the Potential for Public Health and Welfare Impacts and Considerations Regarding Engine Emission Standards

As noted in the Overview section of this ANPR, in this action we are describing information currently available and information being collected that will be used by the Administrator to subsequently exercise her judgment regarding whether aircraft lead emissions from avgas use cause or contribute to air pollution which may reasonably be anticipated to endanger public health or welfare. These additional data will come from lead monitoring being planned to satisfy requirements of the Lead NAAQS, air quality modeling planned at EPA that is described below and any information submitted to EPA during the comment period for this ANPR.

A. The Lead NAAQS and Lead Emissions From Piston-Engine Aircraft

On November 12, 2008, when EPA promulgated revisions to the Lead NAAQS, EPA also adopted revisions to ambient air monitoring requirements for lead, described the approach for implementing the revised standards, and provided an implementation timeline. We describe each of these activities as well as more recent activities below. This section also discusses the most current information available regarding how implementation of the Lead NAAQS may provide additional data on the potential for lead emissions from piston-engine aircraft to cause or contribute to ambient air concentrations that exceed the 2008 Lead NAAQS.

Acknowledging that the existing monitoring network for lead is not sufficient to determine whether many areas of the country would meet the 2008 Lead NAAQS, the EPA re-designed the nation's lead monitoring network to allow assessment of compliance with the revised lead standard. Lead monitoring requirements promulgated in 2008 stipulate that, at a minimum, monitoring agencies must place monitors at maximum impact areas where lead emissions are greater than or equal to one ton or more per year. We refer to these monitors as source-oriented monitors. EPA Regional Administrators may waive the source-oriented monitoring requirements if the monitoring agency can demonstrate that emissions from the source will not contribute to maximum air lead concentrations greater than 50 percent of the revised standard, or 0.075 ug/m^3. EPA estimated that approximately 135 facilities emit lead at levels over the one ton emission threshold, making them subject to the lead monitoring requirements. Lead monitors are operating at a small number of these sources (described in Section VI.A.2 below). For the remainder, source-oriented monitors are to be operational by January 1, 2010.

EPA also required monitors to be operated in each of the 101 urban areas with populations greater than 500,000 in order to gather information on the general population's exposure to lead in air. We refer to these monitors as population-oriented monitors.

Following promulgation of the 2008 Lead NAAQS and monitoring requirements, the Natural Resources Defense Council, the Missouri Coalition for the Environment Foundation, Physicians for Social Responsibility, and the Coalition to End Childhood Lead Poisoning (Petitioners) petitioned

[198] U.S. Environmental Protection Agency Office of Research and Development (2008) Natural Attenuation of the Lead Scavengers 1,2–Dibromoethan (EDB) and 1,2–Dichloroethane (1,2–DCA) at Motor Fuel Release Sites and Implications for Risk Management. p.3. EPA 600/R–08/107. Available online at: *http://www.epa.gov/ada.*

[199] U.S. Environmental Protection Agency Office of Research and Development (2008) Natural Attenuation of the Lead Scavengers 1,2–Dibromoethan (EDB) and 1,2–Dichloroethane (1,2–DCA) at Motor Fuel Release Sites and Implications for Risk Management. p.4. EPA 600/R–08/107. Available online at: *http://www.epa.gov/ada.*

[200] U.S. Environmental Protection Agency Persistent, Bioaccumulative, and Toxic Pollutants (PBT) Program (2002) PBT national action plan for alkyl-Pb. Washington, DC. Page 14. Available online at: *http://www.epa.gov/pbt/pubs/Alkyl_lead_action_plan_final.pdf*

EPA for reconsideration of the lead emission rate at which we required monitoring (the "emission threshold," currently 1.0 tpy).[201] EPA granted the petition to reconsider aspects of the monitoring requirements and proposed revisions to lead ambient air monitoring requirements in December 2009 (74 FR 69050).

Also as part of promulgating the 2008 Lead NAAQS, EPA described the approach for implementing the revised standards and provided an implementation timeline. EPA will use county boundaries as the presumptive boundaries for nonattainment areas, and adjustments to boundaries will be made on case-by-case bases. States in which there is sufficient monitoring data made recommendations for areas to be designated attainment, nonattainment, or unclassifiable in October 2009. States update their recommendations to EPA in October 2010 using any additional monitoring data available from the increased source-oriented monitoring network described above. Final designations of all attainment, nonattainment and unclassifiable areas will be effective no later than January 2012. Where data are sufficient from the currently existing lead monitoring network, we expect that initial designations will be effective January 2011. States are directed to submit State Implementation Plans (SIPs) no later than eighteen months after designation, outlining how they will reduce pollution to meet the lead standards. States are required to attain the standards no later than five years after designation. Additional information regarding the lead standard implementation is available at *http://www.epa.gov/air/lead/actions.html* and in the 2008 Lead NAAQS (73 FR 67030–67043).

1. Monitoring Lead at Airports To Evaluate Ambient Concentrations to Which Lead Emissions From Piston-Engine Aircraft Contribute

Among the estimated 135 source-oriented lead monitoring sites, there are four airports where we expect lead monitoring to begin in January 2010. These airports are the Van Nuys Airport in Van Nuys, CA; the Phoenix Deer Valley Airport in Phoenix, AZ; the Centennial Airport in Englewood, CO; and the Daytona Beach International Airport in Daytona Beach, FL. In each of these areas, we will, as data becomes available, evaluate the impact of lead emissions from piston-engine aircraft on air quality.

2. Evaluating the Contribution of Lead Emissions From Piston-Engine Aircraft to Areas Approaching or Exceeding the Lead NAAQS

In this section we discuss available information and information that will become available in 2010 that can be used to evaluate the potential for lead emissions from piston-engine aircraft to contribute to ambient concentrations in areas exceeding the Lead NAAQS. This evaluation may include the following: (1) Areas currently out of attainment or designated as maintenance with the 1978 Lead NAAQS; (2) areas with current lead monitors that are out of attainment with the 2008 Lead NAAQS; and (3) locations that will have new lead monitors to meet the 2008 Lead NAAQS source-oriented monitoring requirements. In each of these areas, we will, as data become available, evaluate the contribution of lead emissions from piston-engine aircraft to lead inventories and air quality.

The EPA is retaining the 1978 Lead NAAQS until one year after designations for the 2008 Lead NAAQS, except in current nonattainment areas. In those areas, EPA will retain the 1978 standard until the area submits, and EPA approves, attainment and/or maintenance demonstrations for the new standards. Only two areas, East Helena, MT (including Lewis and Clark counties), and part of Jefferson County in Herculaneum, MO, are designated nonattainment with the 1978 Lead NAAQS. The industrial facility causing nonattainment with the Lead NAAQS in the East Helena area closed in 2001. Eleven areas are designated as maintenance areas, only three of which currently have lead monitors. These three locations (Iron County, MO, Dakota County MN, and Collin County, TX) have lead monitors with design value concentrations exceeding the 2008 Lead NAAQS. The design value is the highest "rolling" three month average over a three-year period that is relevant for comparison to the level of the 2008 Lead NAAQS.

Implementation of the 2008 Lead NAAQS is underway, and we have not yet designated areas under it. When EPA promulgated the 2008 Lead NAAQS, EPA provided a list of 18 counties with design values exceeding the 2008 lead standard of 0.15 μg/m³. Using more recent data from EPA's Air Quality System, there are 14 sites at which design values exceed the 2008 Lead NAAQS (Table 3). Over 4.6 million people live in the counties where design values are greater than the 2008 Lead NAAQS. After EPA designates areas that currently have sufficient lead monitoring data, no later than October 15, 2010, we will evaluate the contribution of lead emissions from piston-engine aircraft to lead inventories in nonattainment, maintenance and in some cases, unclassifiable areas, depending on the presence of point sources of lead and the status of ambient lead monitoring in those areas.

TABLE 3—COUNTIES WITH MAXIMUM ROLLING QUARTERLY AVERAGE LEAD CONCENTRATIONS EXCEEDING THE 2008 LEAD NAAQS

County, state	EPA region	County population (2000 Census)	Design value, 2006–2008 (μg/m³)
Jefferson, MO	7	198,099	2.89
Iron, MO	7	10,697	2.46
Delaware, IN	5	118,769	2.16
Hillsborough, FL	4	998,948	1.77
Collin, TX	6	491,675	1.26
Pike, AL	4	29,605	1.21
Dakota, MN	5	355,904	0.70
Fulton, OH	5	42,084	0.69
Berks, PA	3	373,638	0.36
Madison, IL	5	258,941	0.28
Logan, OH	5	46,005	0.27

[201] The petition is available at: *http://www.epa.gov/air/lead/pdfs/OAR.09.000.7687.pdf.*

TABLE 3—COUNTIES WITH MAXIMUM ROLLING QUARTERLY AVERAGE LEAD CONCENTRATIONS EXCEEDING THE 2008 LEAD NAAQS—Continued

County, state	EPA region	County population (2000 Census)	Design value, 2006–2008 (μg/m³)
Sullivan, TN	4	153,048	0.26
Beaver, PA	3	181,412	0.20
Cuyahoga, OH	5	1,393,978	0.17

Lead emissions from piston-engine aircraft operating at airports outside nonattainment areas can also contribute to lead measured in the nonattainment area. In addition, other sources of lead that do not, by themselves, exceed the lead emission monitoring threshold may be located near airports. For example, at some airports in the U.S., race track venues are located immediately adjacent to runways where piston-engine aircraft operate. We are seeking information regarding ambient concentrations of lead that can result from the combined emissions of leaded fuel used in some race vehicles, lead emissions from piston-engine aircraft and other sources of ambient lead.

The EPA intends to conduct modeling analyses to evaluate the contribution of these lead emissions to nonattainment areas and areas that may be approaching nonattainment concentrations. Lead emitted by piston-engine aircraft flying through nonattainment areas may also contribute to lead measured in the nonattainment area. These emissions would be potentially challenging to quantify, although a series of scoping analyses could be conducted. We seek comment on characterizing the contribution of lead emissions from piston-engine aircraft flying through areas that are not attaining the 2008 Lead NAAQS and the potential contribution of piston-engine lead emissions that may be transported into lead nonattainment areas.

As noted above, approximately 135 new lead monitors will begin collecting ambient lead samples starting in January 2010 in order to satisfy the source-oriented monitoring requirements of the 2008 Lead NAAQS. In the NPRM we will discuss the potential contribution of lead from piston-engine aircraft to these areas where the ambient data suggest lead concentrations are close to or exceeding the 2008 Lead NAAQS of 0.15 μg/m³.

B. Additional Information EPA Is Collecting To Evaluate Ambient Lead Concentrations Attributable to Emissions From Piston-Engine Aircraft

In 2008 EPA initiated a study to provide information regarding the local-scale gradient in lead concentrations on- and near airport facilities with piston-engine powered aircraft activity.[202] This study focused mainly on developing an approach for modeling lead emissions from piston-engine aircraft using the Meteorological Society (AMS)/EPA Regulatory Model (AERMOD), and evaluating it using air quality measurements. For purposes of local-scale dispersion modeling, AERMOD is EPA's preferred model.[203] The approach developed includes apportioning lead emitted during landing and take-off to different altitudes in order to characterize emissions during these modes of operation in a realistic manner. In addition, this modeling study includes analysis of the spatial and temporal emissions from piston-engine aircraft during the other modes of aircraft operation (*e.g.,* taxi, run-up check, take-off, landing). The modeling results include an evaluation of the relative contributions of all known sources of lead to the local ambient air, including piston-engine aircraft, local traffic, resuspended road dust, and industrial sources within 20 km of the airport selected for our case study. The EPA study at the Santa Monica Airport was recently completed.[204]

As part of this work, we collected air, soil and house dust samples for lead analysis in order to conduct a model-to-monitor evaluation, and to evaluate the potential for lead emissions from piston-engine aircraft to create a gradient in air, soil and house dust concentrations of lead in proximity to the airport activities.

[202] U.S. EPA (March 2010) Memorandum from Marion Hoyer to the docket EPA–HQ–OAR–2007–0294, titled, "Work Plan for Air Quality Modeling and Monitoring of Lead Emissions from Piston-Engine Powered Aircraft." Docket number EPA–HQ–OAR–2007–0294.

[203] The EPA provides modeling guidance for AERMOD at *http://www.epa.gov/ttn/scram/guidanceindex.htm* and *http://www.epa.gov/scram001/dispersion_prefree.htm#aermod.* A post-processor for AERMOD that reads model output and calculates rolling 3-month averages for the period modeled to provide lead concentrations that can be compared with the Lead NAAQS is available online at: *http://www.epa.gov/ttn/amtic/files/ambient/pb/leadpost.zip.*

[204] The report from this study is posted at *http://www.epa.gov/otaq/aviation.htm.*

We selected the Santa Monica municipal airport for this study because of the data available from the monitoring study conducted by the SCAQMD in 2005–2007 discussed in Section IV.B of this ANPR. In addition, there are no major point sources of lead in close proximity to the airport, simplifying the model development and interpretation of monitoring results.

EPA intends to use this modeling approach to evaluate potential for exceedance of the Lead NAAQS on airport property and surrounding areas, as well as providing an approach to characterize the contribution of lead emissions from piston-engine aircraft to areas with ambient lead concentrations currently exceeding the 2008 Lead NAAQS. This modeling approach will also allow us to quantify the changes in ambient lead concentrations following the implementation of different piston-engine control strategies. The application of this modeling approach to a case-study airport could also be used as input to conduct a risk assessment evaluating the potential contribution of lead from piston-engine emissions on blood lead levels and IQ deficits for those living near or attending school near general aviation activity.

We request comment on all information EPA is collecting to evaluate ambient lead concentrations attributable to emissions from piston-engine aircraft and risk posed by emissions of lead from piston-engine aircraft.

C. Considerations Regarding Engine Emission Standards

A positive endangerment and cause or contribute finding with respect to the emissions of lead from general aviation aircraft would trigger EPA's duty to set emission standards. In considering emission standards, EPA would consider controlling emissions from piston engines using aviation gasoline in aircraft. In cooperation with FAA, EPA would evaluate the technical feasibility of a possible phase-down or elimination of leaded aviation gasoline. One option to consider, for example, could be an emissions standard (established under 40 CFR 87) that would require all newly-manufactured general aviation piston engines to be able to operate with appropriate reliability and durability on unleaded aviation gasoline by some future date. Such a standard might require that new engines used in aircraft would have to receive an FAA type certificate that reflects achievement of these requirements under FAA regulations set forth at 14 CFR parts 33/34.

Beyond this, EPA recognizes that there is a big challenge in dealing with the in-use fleet. Converting in-use aircraft/engines to operate on unleaded aviation gasoline would be a significant logistical challenge, and in some cases a technical challenge as well. In many cases, the implementation of this concept might depend upon efforts and actions of aircraft and engine manufacturers in identifying the necessary modifications and developing hardware as necessary. Depending on timing, these engines might need to be able to operate on either leaded or unleaded aviation gasoline, or a blend thereof. EPA recognizes that in many cases these modifications could trigger the need for FAA regulatory approval of the modifications for both the engines and airframes. Given the potentially large number of affected aircraft and the potential complexities involved, a program affecting in-use aircraft engines would need careful consideration by both EPA and FAA and the two agencies would need to work together in considering any potential program affecting the in-use fleet.

EPA requests comment on this outline of approaches for transitioning the fleet to unleaded aviation gasoline, as well as potential implementation dates, if EPA were to trigger the duty to set emission standards. Comment is also requested on how a program could be best structured to assure that conversions conducted by engine manufacturers (OEMs), independent shops, and in the field by certified power plant mechanics are performed to fully meet the intent of a possible program without compromising the safety of those aircraft and engines. EPA also asks for comment on potential problems with this approach including suggested modifications, improvements, or other approaches. EPA is requesting comment on potential implications for international import and export of piston engines and aviation fuel, as well as potential impacts on international transport. Finally, EPA requests comment on how market incentives might be developed to encourage modification to run on unleaded aviation gasoline as part of a regulatory requirement.

As part of the responses to the **Federal Register** notice EPA published in November 2007 entitled "Petition Requesting Rulemaking to Limit Lead Emissions from General Aviation Aircraft," EPA received a number of comments addressing both technology and fuel-based options as potential measures to reduce or eliminate lead in avgas.[205] In addition to these comments, EPA is aware of completed and ongoing work done under the auspices of the Coordinating Research Council and more recent viewpoints and efforts put forth by industry trade associations, airframe/engine manufacturers, specialty vendors, aviation user groups, and other innovators. The work and perspectives of these groups on technology and avgas fuel quality options are important, and EPA asks for further comment reflecting any new data on technology developments, fuel formulation approaches, or other technical viewpoints.

According to Department of Energy data, annual demand for aviation gasoline is very small in comparison to motor gasoline yet its use is as geographically widespread. This of course creates challenges for supply, distribution, and storage. EPA asks for comment on the avgas refining locations and practices, supply (including imports and exports, if any), details on distribution to terminals and airports, and storage practices for avgas at terminals and airports across the country. EPA is also interested in comments on progress and timeframes for developing alternatives to current leaded avgas and how these might be integrated into the fuel supply and distribution system.

[205] 72 FR 64570 (Nov. 16, 2007); EPA Docket EPA–HQ–OAR–2007–0294.

VII. Statutory and Executive Order Reviews

Under Executive Order 12866, entitled *Regulatory Planning and Review* (58 FR 51735, October 4, 1993), this is a "significant regulatory action" because of the cross-agency nature of this issue. Accordingly, EPA submitted this action to the Office of Management and Budget (OMB) for review under Executive Order 12866 and any changes made in response to OMB recommendations have been documented in the docket for this action. Because this action does not propose or impose any requirements, other statutory and Executive Order reviews that apply to rulemaking do not apply. Should EPA subsequently determine to pursue a rulemaking, EPA will address the statues and Executive Orders as applicable to that rulemaking.

Nevertheless, the Agency welcomes comments and/or information that would help the Agency to assess any of the following: Tribal implications pursuant to Executive Order 13175, entitled *Consultation and Coordination with Indian Tribal Governments* (65 FR 67249, November 6, 2000); environmental health or safety effects on children pursuant to Executive Order 13045, entitled *Protection of Children from Environmental Health Risks and Safety Risks* (62 FR 19885, April 23, 1997) and human health or environmental effects on minority or low-income populations pursuant to Executive Order 12898, entitled *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations* (59 FR 7629, February 16, 1994). The Agency will consider such comments during the development of any subsequent rulemaking.

Dated: April 20, 2010.

Lisa P. Jackson,

Administrator.

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