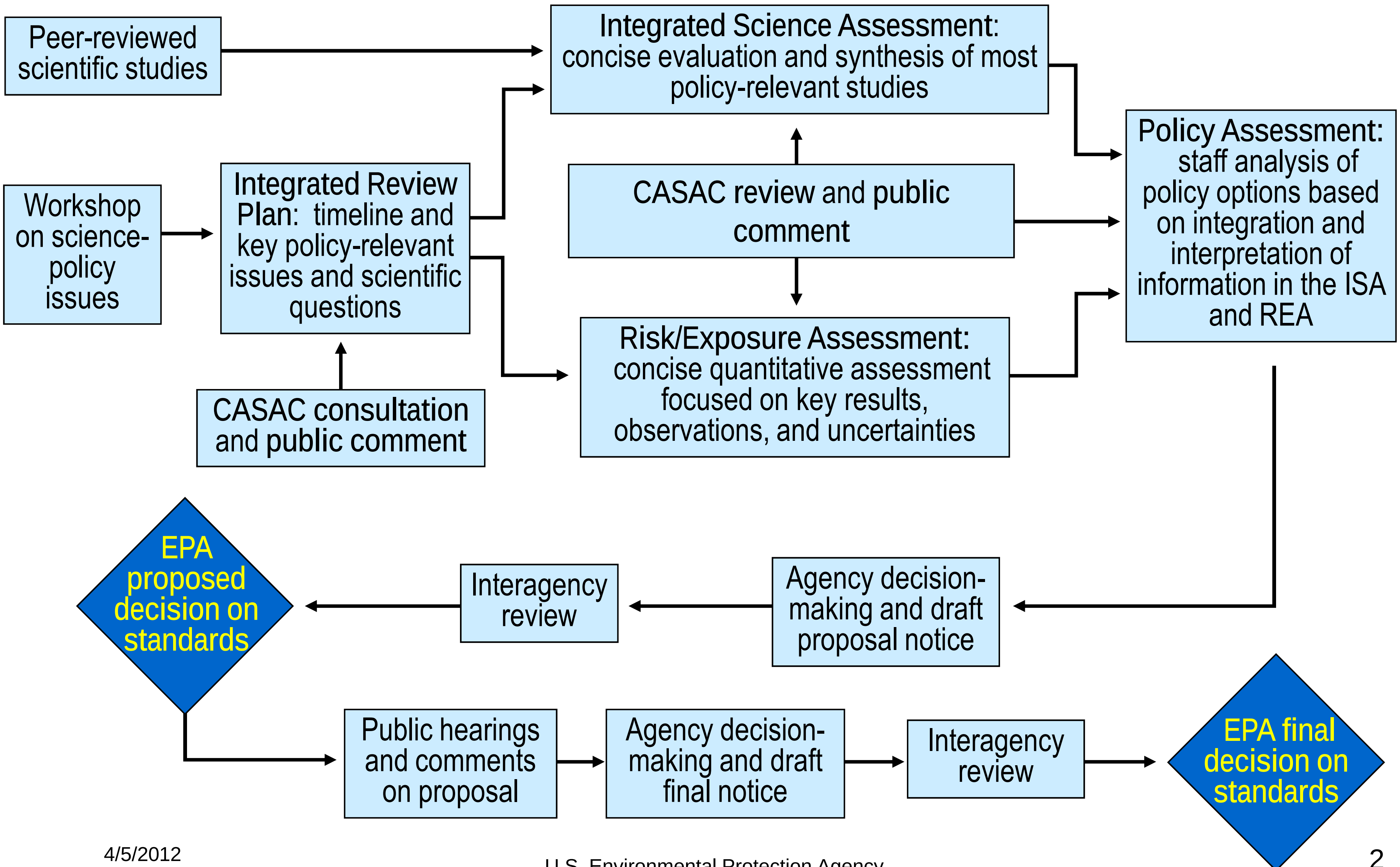
Review of the National Ambient Air Quality Standards for Lead

Updates for Lead NAAQS Review Panel of the Clean Air Scientific Advisory Committee

Staff from the
Offices of Air and Radiation and Research and Development
U.S. Environmental Protection Agency

April 10-11, 2012

Current NAAQS Review Process



Schedule for the Current Review

Major Milestones		Projected Completion Date	Projected CASAC Review Date
Workshop to Discuss Key Policy-Relevant Issues		May 2010	
Integrated Review Plan	Draft Final	March 2011 Nov 2011	May 5, 2011
Integrated Science Assessment	First Draft Second Draft Final	May 2011 Feb 2012 July 2012	July 20-21, 2011 April 10-11, 2012
Risk/Exposure Assessment	Planning Document	June 2011	July 21, 2011
Policy Assessment (PA)	First Draft PA Second Draft PA	Sept 2012 Feb 2013	Oct 2012 March 2013
Rulemaking	Final PA Proposed Rulemaking Final Rulemaking	June 2013 Jan 2014 Nov 2014	

Objectives for OAR/ORD Briefings

Day 1

- Recap Key Considerations/Conclusions in 2008 Decision
- Update CASAC Panel on
  - Monitoring Network and Methods
  - Piston Aircraft Emissions Information

Day 2

- Summarize key aspects of risk/exposure information to be presented in Policy Assessment

Decisions in the 2008 Review

- EPA concluded that 1978 primary standard of 1.5 µg/m^3 (calendar quarter) was not requisite to protect public health with an adequate margin of safety. In revising standard, EPA:
  - Retained indicator as Pb in total suspended particles
    - Reflects evidence that Pb particles of all sizes pose health risks
  - Revised averaging time and form to a maximum (not-to-be-exceeded) rolling three-month period, calculated from three consecutive monthly averages
    - Gives equal weight to all three-month periods and equal weight to each month within each period
    - Yields 12 three-month averages per year to compare to NAAQS (*versus* four averages)
  - Revised level to 0.15 µg/m^3
    - Decision guided by air-related IQ loss framework that integrates evidence for relationships between: Pb in air and Pb in children's blood, and Pb in children's blood and IQ loss
    - Quantitative risk assessment results supportive of framework estimates

➢ Combination of decisions on indicator, averaging time, form and level provides requisite public health protection, including health of sensitive groups, with an adequate margin of safety

2008 NAAQS Review: Summary of Considerations and Decisions on Indicator

Element	Proposed Options	Final Decision
Indicator	-Retain Pb-TSP, but allow Pb-PM_{10}, *Adopt default scaling factor, from within* *1.1-2.0 for source sites, and* *1.0-1.4-1.9 for nonsource sites* *Also, allow site-specific scaling factors* - Revise to Pb-PM_{10}, with corresponding adjustment to level	Retain Pb-TSP, *Allow Pb-PM_{10}, without adjustment, at nonsource sites or where ultracourse particles unlikely*

Pb NAAQS Monitoring: Since the Last Review

Mr. Kevin Cavender,
Office of Air Quality Planning and Standards, OAR

April 10, 2012

Monitoring Conclusions in Last Review

- Network and network design requirements
  - Potential for exceedances of NAAQS limited to areas near Pb sources (existing or recently closed)
  - Revisions to network design requirements needed to:
    - Capture all sources with potential for NAAQS exceedance
    - Allow for use of Pb in PM_{10} in areas where ultracoarse Pb not expected
  - Existing IMPROVE speciated $PM_{2.5}$ monitoring network meets monitoring need and provides adequate data for tracking trends in rural areas
- Sampling and analysis methods
  - Existing Federal Reference Method (FRM) and Federal Equivalent Methods (FEM) for Pb in TSP were found to be adequate to determine compliance with the NAAQS
  - New FRM for Pb in PM_{10} needed
  - Methods improvements needed
    - Need for an improved sampler for ultra-coarse particles
    - The FRM and many FEM needed updating

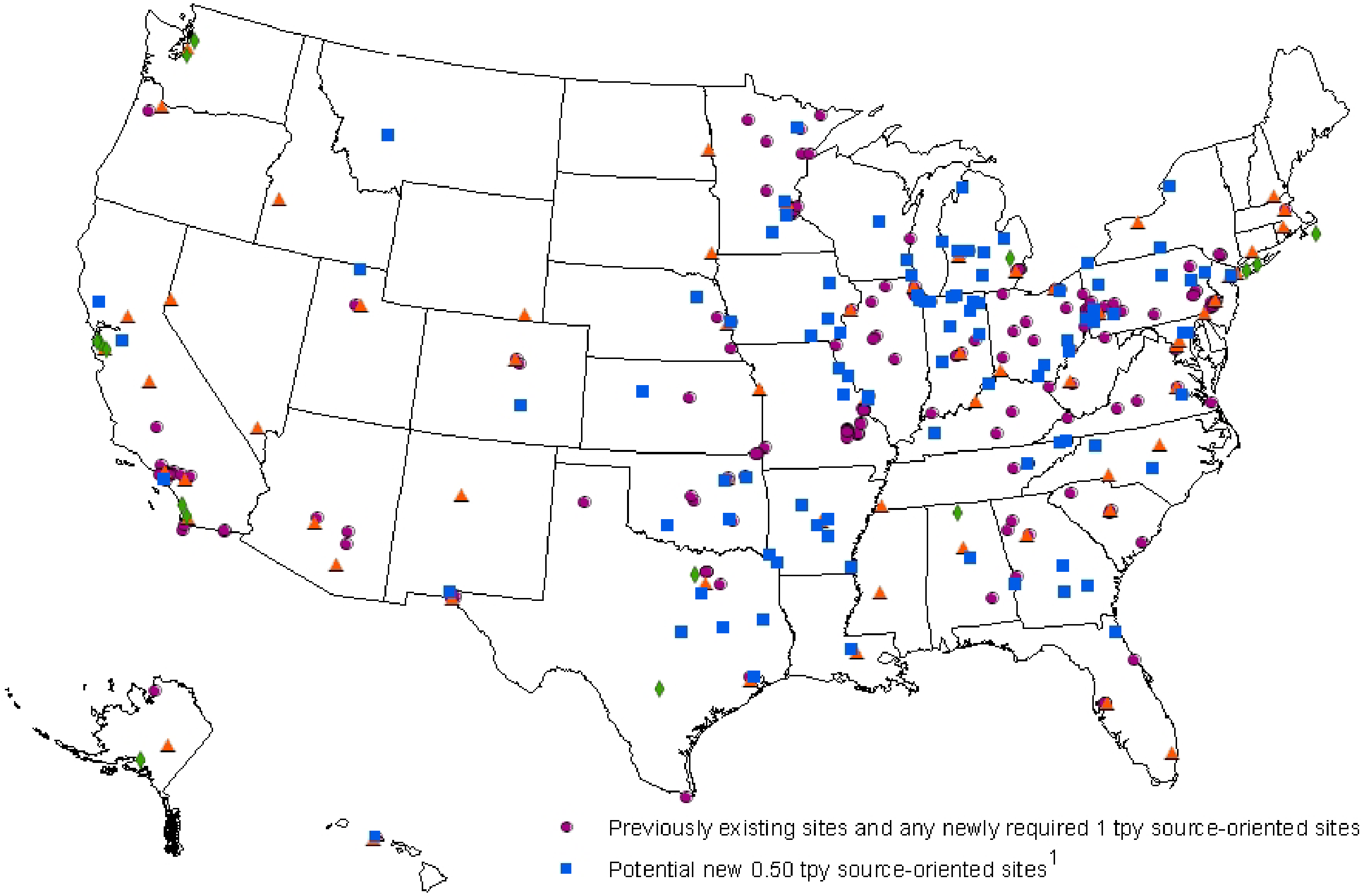
Revisions to Monitoring Requirements

- Required source-oriented monitors at locations of estimated maximum concentration
  - For sources (other than airports) estimated to emit 0.5 tpy or more
    - Sites near sources emitting ≥ 1.0 tpy required to be operational by January 1, 2010
    - Sites near sources emitting ≥ 0.50 tpy but < 1.0 tpy required to be operational by December 27, 2011
    - Waivers allowed if it could be shown that source did not contribute to a concentration > 50% of the NAAQS
    - Approximately 230 sources were identified and reviewed in 2005 National Emission Inventory (NEI) with emissions greater than 0.50 tpy resulting in approximately 130 required source-oriented monitors (after waivers)
  - For airports estimated to emit 1.0 tpy or more
    - Identified 4 sites required to be operational by January 1, 2010
- Required non-source-oriented monitors at NCore sites in Core Based Statistical Areas (CBSA) with a population of 500,000 or more
  - Approximately 60 sites required to be operational by December 27, 2011

Revisions to Monitoring Requirements (continued)

- Require one year of monitoring at 15 specific airports emitting 0.5 – 1.0 tpy
  - Airports selected based on three criteria
    - Pb emissions >= 0.50 tpy
    - Ambient air within 150 meters of runway end or run-up area
    - Meteorology and airport layout that leads to majority of take-offs from one runway end
  - Sites required to be operational by December 27, 2011
  - Sites with concentrations > 50% of the NAAQS required to remain beyond 1-year period
- Allow for Pb in PM_{10} sampling
  - At all non-source-oriented sites and select source-oriented sites (e.g., sources not expected to emit ultracoarse Pb particles)
  - Any site exceeding 75% of the NAAQS required to switch to Pb in TSP sampling
- Promulgated new FRM for Pb in PM10 based on low-volume sampler and X-ray fluorescence (XRF) analysis
- Updates to Quality Assurance (QA) requirements

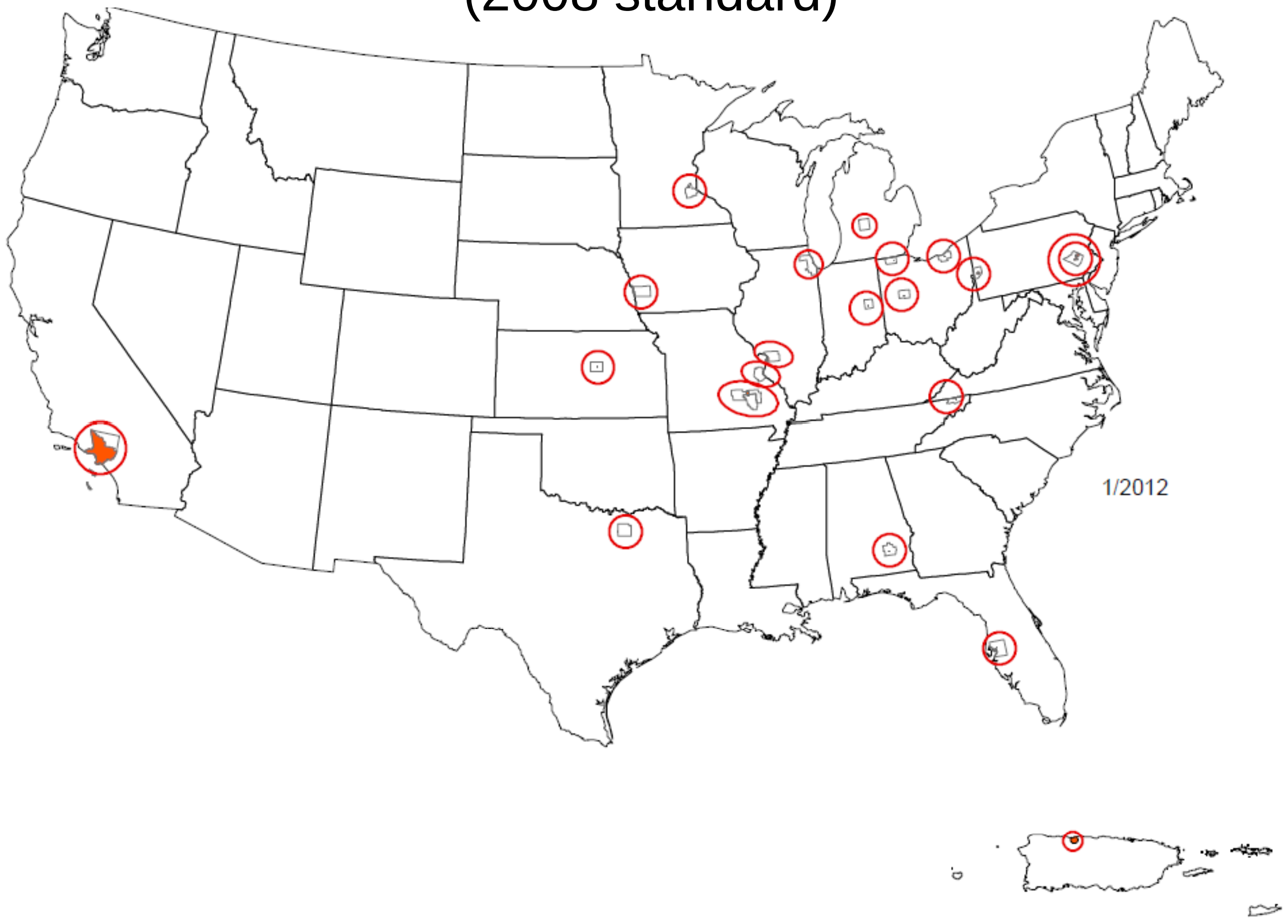
Lead NAAQS Monitoring Network



[1]Based on 2005 National Emission Inventory lead emission estimates

Counties Containing Nonattainment Areas

(2008 standard)



Nonattainment areas are orange areas within circled counties

http://www.epa.gov/air/oaqps/greenbk/map/maplead2008.pdf

Update on Federal Reference Method Research Activities

Briefing for
Lead NAAQS Review Panel of the
Clean Air Scientific Advisory Committee

Dr. Robert Vanderpool, Office of Research and Development
U.S. Environmental Protection Agency

April 10, 2012

Presentation Outline

- Updates on new FEM designations for Pb analysis
- Development of a new FRM for TSP filter analysis using ICP-MS
- Summary of 2008 FRM sampling techniques (TSP and PM_{10})
- Specifications and uncertainties associated with current Pb NAAQS sampling methods
- Discussion of research initiatives to address limitations of current Pb sampling methods

Summary of Pb NAAQS Sampling and Analytical Techniques

The two different sampling FRMs (Pb-TSP and Pb-PM_{10}) have correspondingly different analytical FRMs associated with them

Hi-Vol TSP Sampling (~ 50 cfm)

- Sampling at source-oriented sites
- Analytical FRM involves extraction of Pb on 8" x 10" glass fiber filters using acid extraction followed by flame AA analysis

PM_{10} Sampling (16.7 Lpm)

- Sampling at non-source-oriented sites and at selected source-oriented sites where ultra-coarse emissions are expected to be minimal
- Analytical FRM involves XRF analysis of Pb on 46.2 mm diameter teflon filters

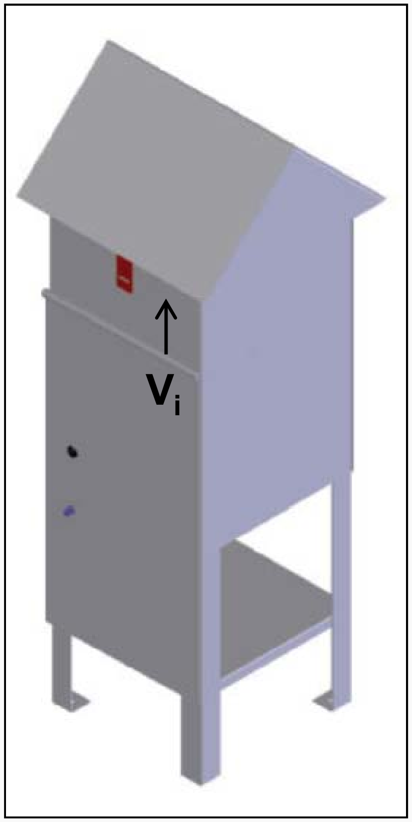
Recent Method Designations (2010-2012)

Metric	Applicant	Designation	Extraction	Analysis
TSP	Inter-Mountain Laboratories	EQL-0310-189	Hot plate w/ HNO_3	ICP-MS
TSP	EPA/OAQPS	EQL-0510-191	Heated ultrasonic w/ HCL/HNO_3	ICP-MS
TSP	EPA/Region 9	EQL-0710-192	Hot block w/ HNO_3	ICP-MS
TSP	EPA/OAQPS	EQL-0311-196	Heated w/ HCL/HNO_3	ICP-AES
TSP	ERG	pending	Heated w/ $HCL/HNO_3/H_2O_2$	ICP-MS
PM_{10}	ERG	pending	Heated w/ $HCL/HNO_3/H_2O_2/HF$	ICP-MS

Proposed New Analytical FRM for Pb in TSP

- Designed to meet lower detection limit requirements of new Pb NAAQS
- Based on two recently designated FEMs (EQL-0510-191 and EQL-0710-192)
- Extraction options: Heated ultrasonic with HCl/HNO_3 or hot block with HNO_3
- Applicable to glass fiber, quartz, and teflon filters
- Interlaboratory results from RTI, ERG, ORIA, and ORD are favorable for precision and comparability

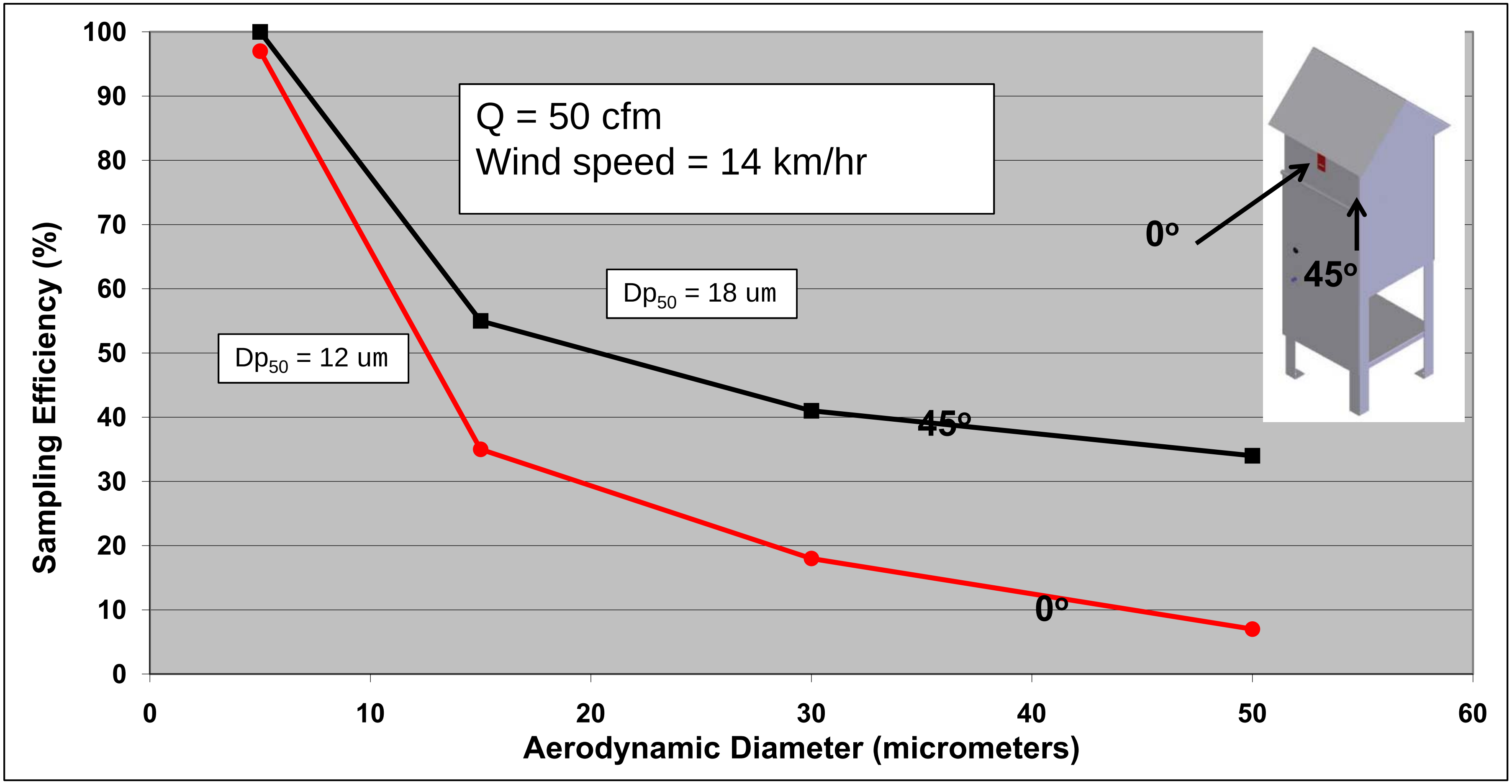
Appendix B to Part 50: Design Specifications of the Hi-Vol TSP Sampler



- Roof shape: gabled, rectangular
- Sampling flow rate: 39 to 60 cfm
- Inlet velocity (V_i): 20 to 35 cm/sec
  (25 cm/sec recommended but not required)
- No inlet dimensions specified
- Filter: glass fiber, 8” x 10”
- Timer accuracy: ± 30 min

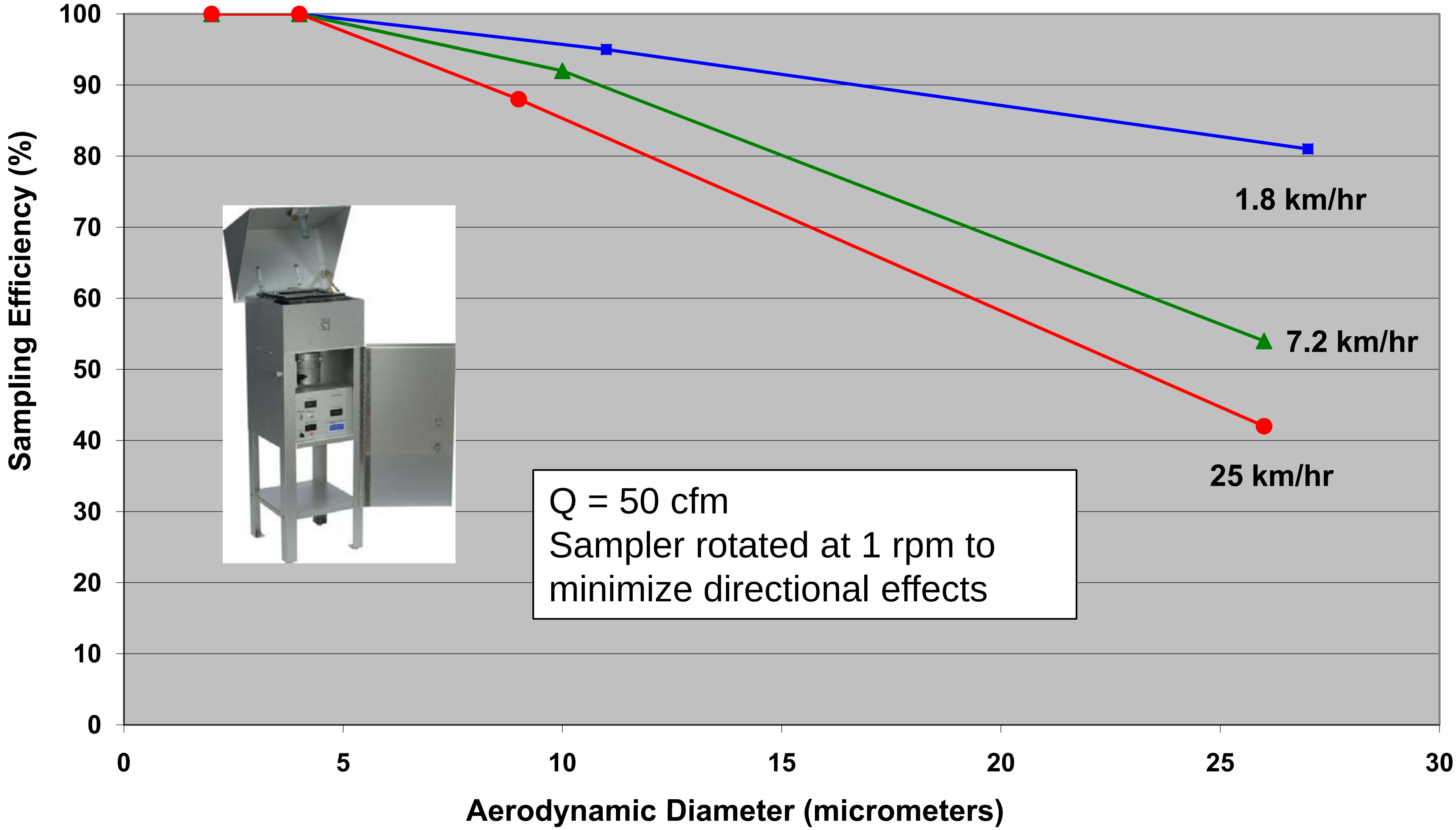
Issue: The size selective performance (i.e., aspiration efficiency versus aerodynamic particle size) of ambient samplers is a strong function of sampling flow rate and inlet dimensions

High-Vol TSP Sampling Efficiency vs Wind Direction
Source: Wedding et al. (1977)



The angle at which airborne particles approach the Hi-Vol TSP sampler strongly affects the efficiency with which they are collected.

High-Vol TSP Sampling Efficiency vs Wind Speed
Source: McFarland, et al. (1979)



The Hi-Vol TSP sampler displays notable decreases in particle collection efficiency at increasing ambient wind speeds.

Limitations of the High-Vol TSP

- Wide range of allowed flow rates (39 to 60 cfm) – there have been no wind tunnel tests versus flow rate
- Wide range of allowed air inlet velocities (20 to 35 cm/sec) – there have been no wind tunnel tests versus inlet velocity
- No fixed inlet dimensions
- Limited wind tunnel evaluations have demonstrated there's strong dependence of particle collection characteristics versus ambient wind speed and direction
- Evidence of aerosol collection during non-sampling periods
- Design does not enable sequential, multiple-event sampling
- Large filter size is not readily amenable to gravimetric or XRF analysis

Features of the Pb-PM_{10} Sampler

- Inlet specifications (dimensions, tolerances, materials, and finishes) fully specified in *Federal Register* using 17 design drawings
- Sampler operates at a fixed 16.7 aLpm flow rate independent of ambient conditions
- Inlet's omnidirectional design avoids measurement bias due to wind direction
- Method's low flow rate and use of 46.2 mm diameter filters enables adaption to sequential, multi-event design and multiple analytical techniques
- Inlet design minimizes rain and insect intrusion
- Strong interlaboratory test results have been obtained during wind tunnel studies of size-selective performance

Performance of the Low-Vol Pb-PM_{10} Inlet

Reference	Inlet Model	Cutpoint (µm)		
		2 km/hr	8 km/hr	24 km/hr
McFarland and Ortiz (1984)	SA 246B	9.9	10.2	10.0
VanOsdell and Chen (1989)	SA 246B	9.8	10.0	9.9
VanOsdell (1991)	R&P 10 µm	9.8	-	9.6
Tolocka et al. (2001)	Louvered	9.9	10.3	9.7

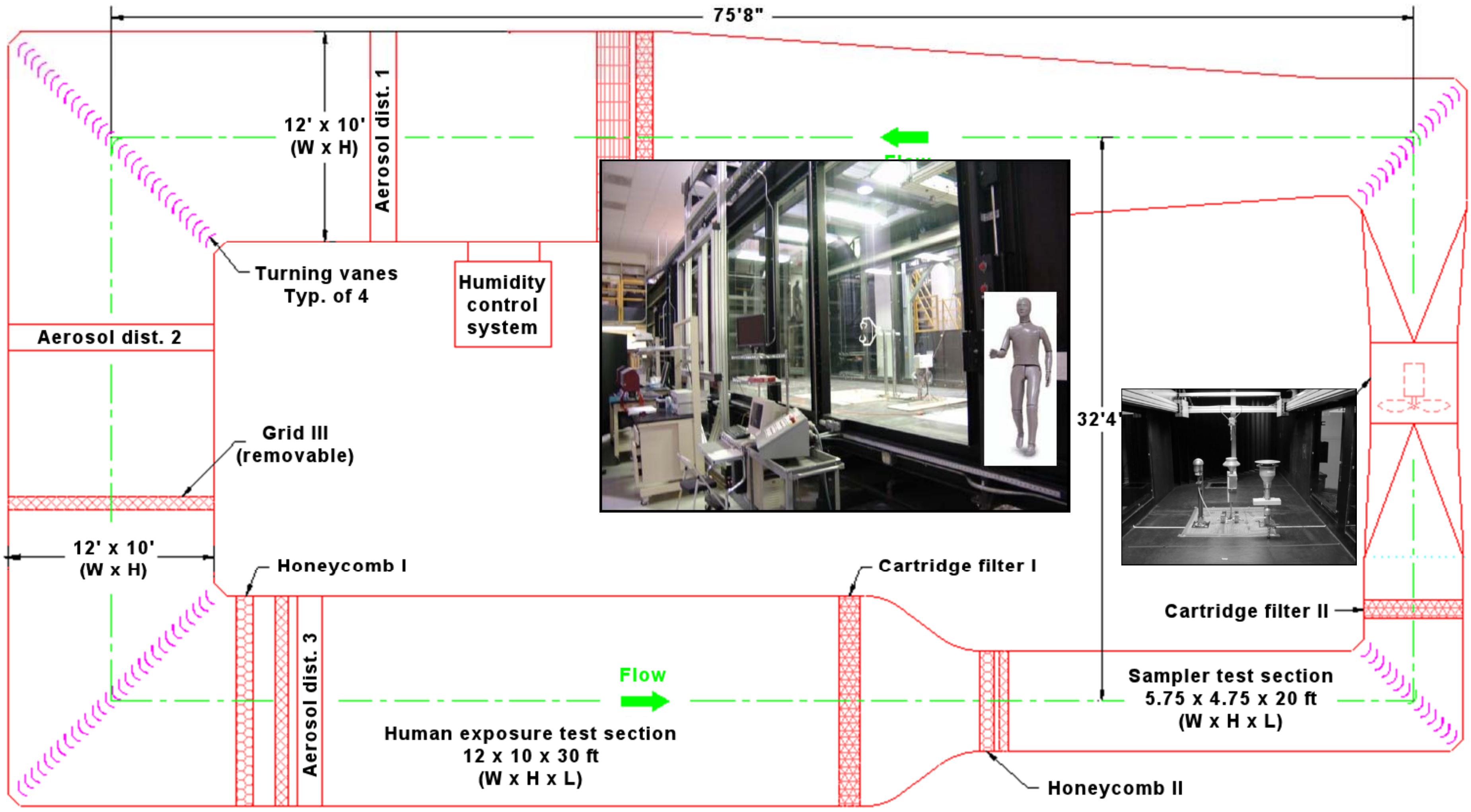
Design Features for a New Pb FRM Sampler

- Fixed inlet dimensions with all components explicitly specified by design
- Fixed inlet flow rate controlled volumetrically at ambient temperature and pressure conditions
- Omnidirectional inlet design to eliminate measurement bias due to wind direction effects
- Inlet design would minimize rain and insect intrusion
- Acceptable variation in size selective performance as a function of ambient wind speeds (2 to 24 km/hr)
- Cutpoint in the 18 to 20 µm size range would quantify all Pb-bearing particles currently measured by the Pb-PM_{10} FRM while accounting for a portion of Pb-bearing particles above 10 µm
- Low to medium flow rate to leverage existing, commercially-available flow systems, enable adaption to sequential, multi-event designs, and amenable to both ICP and XRF analysis
- Favorable inter-manufacturer and intra-manufacturer sampler precision

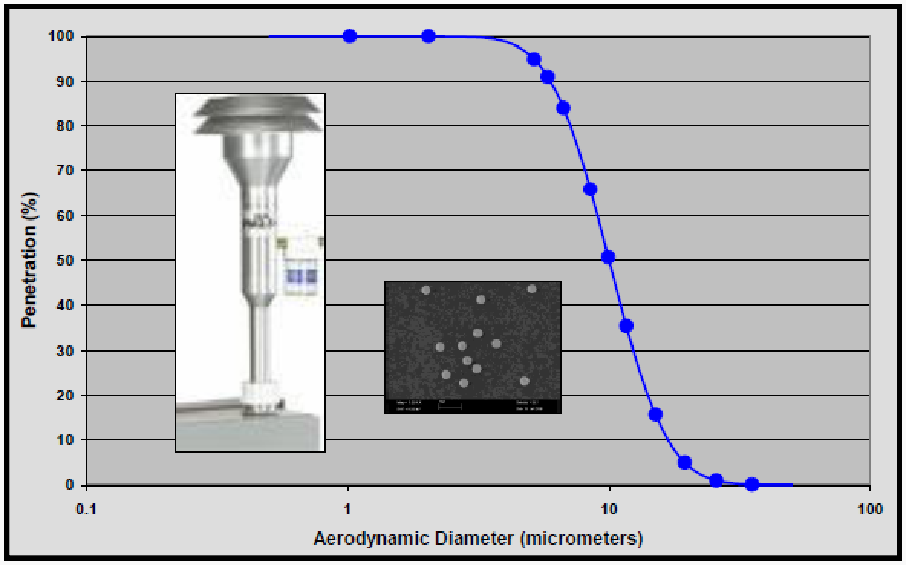
Developmental Approach

- Develop and validate techniques for generation, transport, and measurement of large aerodynamic particles
- Optimize EPA's ATF wind tunnel for conducting size-selective experiments (2, 8, 24 km/hr)
- Conduct size-selective evaluation of EPA's PM_{10} inlet to validate generation and measurement techniques
- Conduct survey of commercially available low-flow rate inlets and test viable candidates
- As needed, design and evaluate new prototype inlets
- Conduct limited field evaluation of final inlet design to determine inherent precision and to compare results with collocated Pb-TSP and Pb-PM_{10} samplers

EPA's Aerosol Wind Tunnel

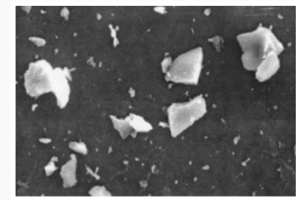


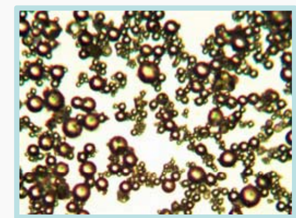
Aerosol Generation Initiatives



Size-selective calibrations using monodisperse aerosols typically provide quality test results but are time-consuming and expensive, especially during inlet development efforts where extensive design modifications and retesting may be required

Schenck Dust Dispenser





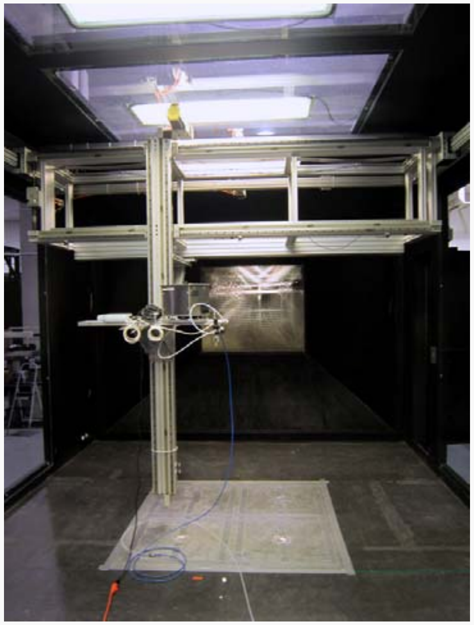
$$D_a = D_p (\rho_p / K \rho_a)^{0.5}$$

Multisizer IV Coulter Counter

Use of polydisperse calibration aerosols generated from bulk materials (e.g., Arizona Test Dust, glass beads) potentially enables more rapid determination of inlet size selective performance than can be achieved using monodisperse calibration aerosols

Aerosol Generation Initiatives (cont)

Apparatus used for dispensing, aerosolizing, and charge neutralizing calibration material into the aerosol wind tunnel



Upstream view of aerosol generation equipment mounted on movable traverse

Isokinetic nozzles (114 Lpm, 90 mm filter) designed for determination of reference concentrations

Survey of Low-Volume Inlets

Comparative Sizes of 16.7 Lpm Inlets

Efficiency is proportional to Inlet Diameter/(Wind Speed x Dp^2)

Status of Research Initiatives

- Draft of a new analytical FRM for Pb in Hi-Vol TSP (completed)
- Develop generation and measurement techniques for polydisperse calibration aerosols (ongoing)
- Optimization of EPA's aerosol wind tunnel for upcoming size selective tests (ongoing)
- Calibration of the louvered PM_{10} inlet to validate newly developed wind tunnel experimental protocols
- Evaluation of commercially available low-vol TSP inlets
- As needed, develop, wind tunnel evaluate, and finalize design of a new candidate inlet for the Pb FRM
- Conduct any necessary field evaluation of the proposed Pb FRM

Lead Emissions from Piston-Engine Aircraft

Dr. Marion Hoyer
Office of Transportation and Air Quality, OAR

April 10, 2012

EPA is Evaluating Lead Emissions from Piston-engine Aircraft

- In April 2010, EPA issued an Advance Notice of Proposed Rulemaking (ANPR) on lead emissions from piston-engine aircraft that use leaded aviation gasoline (avgas).
- We issued the ANPR in response to a 2006 petition from the environmental group, Friends of the Earth.
  - This petition asked EPA to either evaluate the potential for adverse effects on public health and the environment from lead emitted by piston aircraft ("endangerment"), and if we find endangerment the petitioners have asked EPA to regulate the emissions, or
  - If insufficient information exists to make a finding, to commence a study.

Overview of the ANPR

- The ANPR described available data and requested comment on issues related to piston aircraft lead emissions and exposure.
  - Described the inventory for lead emissions to air and the contribution of emissions from aircraft using avgas
  - Summarized the few studies on lead concentrations in air near airports and described potential exposure scenarios.
  - Requested information on lead emissions, ambient air concentrations, soil concentrations, house dust concentrations and blood lead levels for those residing in close proximity to airports where these aircraft operate.
- We did not receive data or publications of which we had not previously been aware.
- The ANPR described the analyses we are conducting and other data being collected to evaluate exposure.

Next Step
Evaluating the Question of Endangerment

- We are performing additional analyses as described in the ANPR:
  - o Demographic analysis
    - o We will have this information in the Policy Assessment
  - o Model piston-engine emissions of lead at airports to evaluate the impact on local air quality and exposure to lead.
    - o We expect this work to be completed by the end of 2013 or early 2014
  - o Evaluate the data from lead monitors at airports
    - o Certified data from the 15 airport study expected by the end of 2013.