UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
RESEARCH TRIANGLE PARK, NC 27711

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OFFICE OF
AIR QUALITY PLANNING
AND STANDARDS

MEMORANDUM

SUBJECT: Estimates of Precision and Bias for Lead in Total Suspended Particulate (TSP)

FROM: Louise Camalier and Joann Rice (EPA, OAQPS)

TO: Lead NAAQS Review Docket (OAR-2006-0735)

This memo presents findings from an evaluation of precision and bias for current lead (Pb) FRMs (Federal Reference Methods)/FEMs (Federal Equivalent Methods).

Objective of Analysis

This analysis was done to investigate the precision and bias of existing FRMs/FEMs for lead in TSP with high-volume sampling. This information presented provides an estimate of the precision and bias that can be expected from these methods at concentrations considered in the Risk Assessment Report and Staff Paper.

Analysis

The precision of the high-volume lead from TSP samplers was evaluated based on data reported to the EPA Air Quality System (AQS) for collocated samplers. The AQS is EPA's repository for ambient air quality data.

TSP lead precision data were extracted from AQS on November 21, 2007, and analyzed to assess the types of samplers in the national monitoring network and the precision of the available data. The reported precision data comes from collocated TSP lead monitors which are situated across the U.S. There are two types of TSP lead samplers currently in operation: high-volume and low-volume. There are 32 high-volume and 2 low-volume collocated sites in the network. The following assessments were made based on the high-volume sample data because not enough data were available to make any conclusions regarding the low-volume data (nine observations).

It is important to note that 21 percent of the data were below the MDL (0.01 ug/m^3). These data were excluded from the analysis. Table 1 shows the range of observed concentrations

from the precision data pairs. Precision was calculated by relative percent difference in Equation 1, where X and Y are the respective primary and secondary values.

Equation 1

$$d_i = \frac{X_i - Y_i}{(X_i + Y_i)/2} \cdot 100$$

The reference methods for which high-volume TSP lead precision data were reported have an average precision value of 11.7 percent with a standard deviation of 18.6 percent (Table 2). Agreement from high-volume samplers is comparable both between methods and within methods, even across the low range of concentrations. Precision across concentrations is shown in Figure 1, where the red line represents a smoothing spline weighted to fit the data (5 degrees of freedom). The relative flatness of the red line shows that the variance is consistent across the range of concentrations.

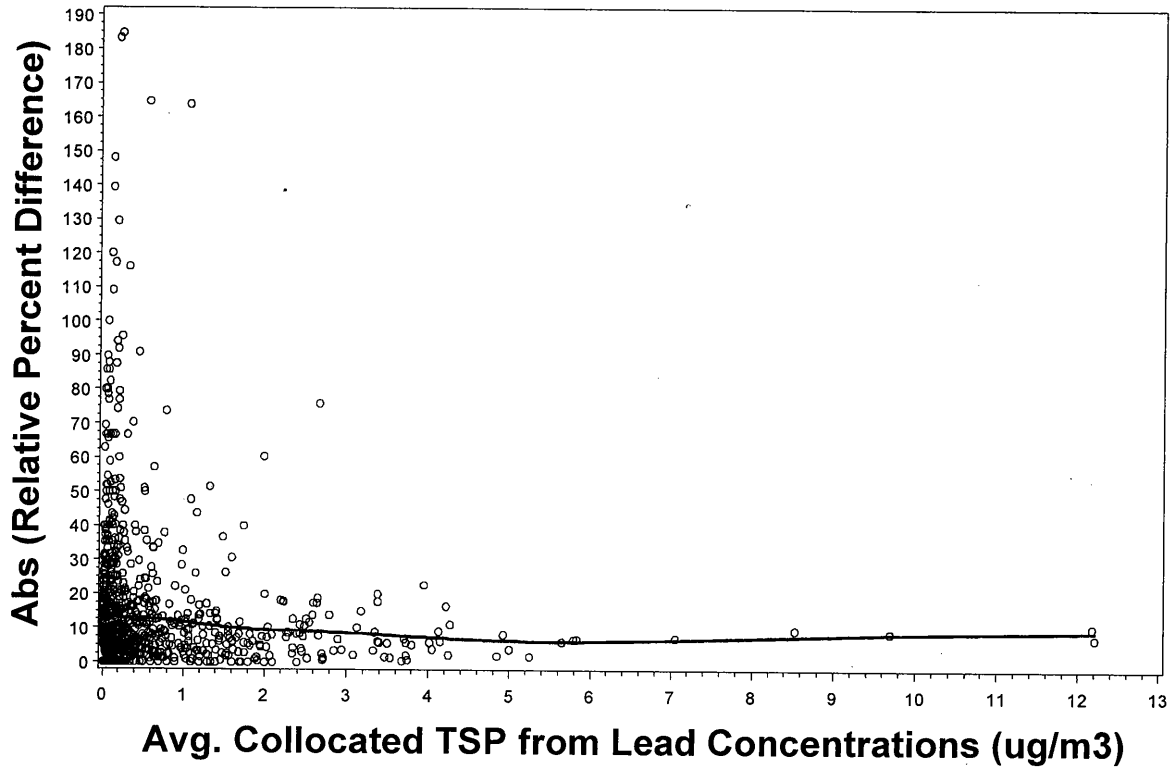
Table 1. Concentrations of TSP Lead Precision

		Concentration - TSP Lead Precision Data (ug/m^3)					
Flow Rate	n (pairs)	mean	std	median	p95	min	max
hi-vol	2108	0.34	0.82	0.07	1.61	0.011	12.21

Table 2. Precision of TSP Lead

		Precision - TSP Lead (%)					
Flow Rate	n (pairs)	mean	std	median	p95	min	max
hi-vol	2108	11.7	18.6	5.3	42.9	0.0	184.7

Figure 1. Lead Precision versus Concentration



We also evaluated sampling and analysis bias from audit results gathered through EPA's National Performance Audit Program (NPAP). The available audit results were compiled from years 1998 through 2005. An estimate of sampling bias was determined from in-field high-volume sampler flow rate audits (Table 3). The average sampling bias based on flow audits was -0.7 percent with a standard deviation of 4.2 percent. An estimate of laboratory analysis bias was determined from the laboratory analysis of lead-spiked filter strips. The average laboratory analyses bias was -1.1 percent with a standard deviation of 5.5 percent. The average total bias, which includes bias from both sampling and analysis, was estimated by totaling the bias for only those locations (locations identified in Tables 3 and 4 below) with both sampling and analysis bias values and then taking the average. The standard deviation of the total bias was determined from the same locations. The average total bias was -1.7 percent with a standard deviation of 3.4 percent.

The precision of low-volume lead PM_{10} samplers was evaluated based on data reported to AQS; however, there were not enough observations (18 paired data points for one site) to make any conclusions on the precision of lead in PM_{10} with this sampler.

Table 3. National Performance Audit Program (NPAP) sampling flow rate audit results

		Average Flow Bias by Year				
Site	**State**	**1998**	**1999**	**2001**	**2004**	**Average**
01-109-0003[a]	AL	5.8	-3.1			1.4
06-029-0014[a]	CA	-1.5	-0.5			-1.0
06-077-1002	CA	-5.8				-5.8
08-001-3001	CO	1.9				1.9
08-031-0015	CO		1.7			1.7
36-071-3001	NY		0.5			0.5
45-079-0006	SC	2.5				2.5
48-085-0007	TX	7.4	-0.9			3.3
12-031-0084[a]	FL		-0.7			-0.7
12-057-1066[a]	FL	-0.4	-0.3			-0.3
12-103-3005[a]	FL		1.5			1.5
48-141-0002[a]	TX	-16.9		-9.5	-10.2	-12.2
29-093-0027[a]	MO	-1.2				-1.2
Overall Average						**-0.7**
Standard Deviation						**4.2**

[a] Values used in average total sampling and analysis bias calculations

Table 4. National Performance Audit Program (NPAP) laboratory analysis audit results

		Average Bias by Year							
Site	**State**	**1998**	**1999**	**2001**	**2002**	**2003**	**2004**	**2005**	**Avg.**
01-109-0003[a]	AL	-11.1	-6.5	-11.9	-5.0	-5.6		-21.0	-10.2
06-029-0014[a]	CA					-1.6	-0.4		-1.0
08-001-3001	CO	-1.2	-2.0	-1.7	-2.5		-0.9		-1.7
17-031-6003	IL	-5.3	-2.1	2.3	-3.0	2.7	-5.7	-5.4	-2.3
18-089-2011	IN	-5.7	-1.2	-16.6		-5.7		1.5	-5.5
26-163-0033	MI			-6.1			-4.2		-5.1
27-037-0001	MN	-4.6	1.4	-1.5	-0.7	-0.4	-6.9	4.2	-1.2
45-025-0001	SC	-3.1	-1.6	-2.0	-1.8	4.3	-3.4		-1.3
49-011-0001	UT	-7.0	8.3	-8.8	-3.7		-8.6	3.7	-2.7
06-037-4002	CA	-5.2	-2.6	1.2	19.2	36.5	12.2	9.9	10.2
12-031-0084[a]	FL	-7.4	-6.8		11.3				-1.0
12-057-1066[a]	FL	-2.8	-1.8	-4.7	-1.9	0.1	0.1	5.8	-0.7
12-103-3005[a]	FL	-4.1	-3.8		-0.2	-0.9		2.2	-1.3
35-001-1014	NM	-5.7							-5.7
48-141-0002[a]	TX	5.8	54.5	-0.3	0.2	7.4			13.5
29-093-0016[a]	MO	-2.3	-5.4	-6.1	-7.2				-5.3
29-099-0005	MO		-3.2			3.7			0.3
47-187-0100	TN	-2.5		-4.7	0.4	12.2			1.4
Overall Average									**-1.1**
Standard Deviation									**5.5**

[a] Values used in average total sampling and analysis bias calculations