

STATE OF CALIFORNIA  
AIR RESOURCES BOARD

AIR MONITORING QUALITY ASSURANCE

VOLUME V

AUDIT PROCEDURES MANUAL  
FOR  
AIR QUALITY MONITORING

APPENDIX K

PERFORMANCE AUDIT PROCEDURES  
FOR  
PARTICULATE MATTER (PM<sub>10</sub>) IONS LAB AUDITS

MONITORING AND LAB DIVISION

APRIL 2008

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**FOR**  
**PARTICULATE MATTER (PM<sub>10</sub>) IONS LAB AUDITS**  
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APPENDIX K.1

PERFORMANCE AUDIT PROCEDURES  
FOR  
PARTICULATE MATTER (PM<sub>10</sub>) IONS LAB AUDITS

MONITORING AND LABORATORY DIVISION

APRIL 2008

## **K.1.0 INTRODUCTION**

### **K.1.0.1 GENERAL INFORMATION**

Performance Audits for PM<sub>10</sub> (particulate matter of 10 micrometers in diameter) ions are conducted for the Inorganics Laboratory Section (laboratory) of the Air Resources Board's (ARB) Monitoring and Laboratory Division (MLD). The Quality Assurance Section (QAS) purchases a standard spiked ion sample filter set (filter set) with known amounts of ammonium (NH<sub>4</sub>), potassium (K), sulfate (SO<sub>4</sub>), nitrate (NO<sub>3</sub>), and chloride (Cl) for the laboratory to analyze by ion chromatography.

The purpose of the PM<sub>10</sub> ions laboratory performance audit is to assess the accuracy of the laboratory's standard operating practices and procedures.

The laboratory follows Standard Operating Procedures (SOP) MLD 007 and 023 for processing and analysis. The audit filter set is analyzed by the laboratory to determine the amounts of NH<sub>4</sub>, K, SO<sub>4</sub>, NO<sub>3</sub>, and Cl. The laboratory returns the results to QAS for review. QAS calculates the percent difference to determine the laboratory's accuracy. QAS forwards the results to the Inorganics Laboratory Section.

**K.1.1      **AUDIT PROCEDURES****

**K.1.1.1      INITIATION OF AUDIT**

Upon receiving the audit filter set from a vendor, QAS will document receipt of the filters and accompanying data forms. The filter set, along with an audit initiation memorandum (Fig. K.1.1.1), are sent to the laboratory for analysis.

**K.1.1.2      STANDARD OPERATING PROCEDURES**

The laboratory uses SOP's MLD 007 and 023 for analysis and processing of the audit filter set.

**K.1.1.3      COMPLETION OF AUDIT**

The laboratory completes the PM<sub>10</sub> Ions Audit Datasheet (Figure K.1.1.1) and provides the information to QAS.



**Linda S. Adams**  
Secretary for  
Environmental Protection

## Air Resources Board

**Robert F. Sawyer, Ph.D., Chair**  
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Sacramento, California 95812 • www.arb.ca.gov



**Arnold Schwarzenegger**  
Governor

### MEMORANDUM

**TO:** Michael Poore, Chief  
Northern Laboratory Branch

**THROUGH:** Jeff Cook, Chief /s/  
Quality Management Branch

**FROM:** Merrin Bueto, Manager /s/  
Quality Assurance Section

**DATE:** May 7, 2007

**SUBJECT:** 2007 PM10 ION LABORATORY PERFORMANCE AUDIT

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Thank you for participating in the upcoming PM10 ion laboratory performance audit for 2007. In an effort to conserve resources, PM10 ion laboratory performance audits will be conducted on an annual basis. The audit materials have been delivered to Roxana Walker. Please follow your standard operating procedures when analyzing the samples and return the results to the Quality Assurance Section by Friday, June 29, 2007. Thank you for your participation in the program. If you have any questions, please contact Laura Niles at 324-1149, or via email at lniles@arb.ca.gov.

cc: Cliff Popejoy  
Roxanna Walker  
Laura Niles

Figure K.1.1.1  
PM<sub>10</sub> Ions Audit Initiation Memorandum

## **K.1.2 POST AUDIT CALCULATIONS**

### **K.1.2.1 CALCULATION OF PERCENT DIFFERENCE**

QAS shall calculate the percent difference between laboratory's measured results and the vendor's assigned results using the following equation (results are recorded in micrograms (ug) /filter):

$$\text{Percent Difference} = \frac{(\text{Measured Concentration} - \text{Assigned Concentration})}{\text{Assigned Concentration}} \times 100$$

### **K.1.2.2 FINAL AUDIT REPORT**

QAS will forward the Final Results Report Sheet (see Figure K.1.2.1) with a cover letter to the laboratory. In the event that the percent difference exceeds  $\pm 10$  percent, the laboratory will be asked to investigate the cause.



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### MEMORANDUM

**TO:** Michael Poore, Chief  
Northern Laboratory Branch

**THROUGH:** Jeff Cook, Chief /s/  
Quality Management Branch

**FROM:** Merrin Bueto, Manager /s/  
Quality Assurance Section

**DATE:** August 28, 2006

**SUBJECT:** 2006 PM10 ION LABORATORY PERFORMANCE AUDIT RESULTS

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The following table represents audit results for the 2006 particulate matter (PM10) ion performance audit. The performance audit was conducted using vendor-manufactured filters (CARB-DISK-SET-2BB, series A) spiked with nitrate (NO<sub>3</sub>), sulfate (SO<sub>4</sub>), chloride (Cl), ammonium (NH<sub>4</sub>), and potassium (K) ions traceable to National Institute of Standards and Technology. The Inorganics Laboratory Section utilized ion chromatography (Methods 007 and 023) to determine the concentrations of the ion-spiked filters. The laboratory results are as follows (concentrations are micrograms per filter):

Ion	Sample No.	Reported Values	Reference Values	Percent Difference*
NO <sub>3</sub>	1A	<LOD	0	-
	2A	147	181	-18.8
	3A	334	334	0.0
	4A	952	983	-3.2
SO <sub>4</sub>	1A	<LOD	0	-
	2A	430	427	0.7
	3A	909	899	1.1
	4A	2644	2595	1.9
Cl	1A	<LOD	0	-
	2A	135	141	-4.3
	3A	277	283	-2.1
	4A	502	515	-2.5
NH <sub>4</sub>	1A	<LOD	0	-
	2A	92	151	-39.1
	3A	406	404	0.5
	4A	570	650	-12.3
K	1A	<LOD	0	-
	2A	150	155	-3.2
	3A	304	311	-2.3
	4A	540	566	-4.6

$$\text{*Percent Difference} = \frac{(\text{Reported Values} - \text{Reference Values})}{\text{Reference Values}} \times 100$$

The targeted +/- 20% control limits established for the audit procedure were achieved for all compounds except Sample No. 2A of NH<sub>4</sub>. This indicates a potential contamination. QAS has an additional set of filters which, upon analysis, may help determine the cause of the high discrepancy for the NH<sub>4</sub>. QAS intends to use the remaining set of filters in next years' audit.

Thank you for your participation in the program. If you have any questions, please contact Dustin Goto at 327-4757 or via email at [dgoto@arb.ca.gov](mailto:dgoto@arb.ca.gov).

cc: Dustin Goto  
 Cliff Popejoy  
 Roxana Walker