

Appendix A

Quality Assurance Final Report

Southern California Supersite

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Executive Summary

This quality assurance (QA) final report summarizes the QA audits performed in years 2002 and 2003 and three key QA parameters of the data collected at Southern California Supersite, including minimum detection limits (MDL) and data completeness for a variety of instrumentation and analytical endpoints, and accuracy (or bias). The MDLs for the endpoints directly generated by the instruments were compiled from the specifications of instruments. Those for specific analytes were compiled from corresponding analytical methods. Metal MDLs were obtained from the Chester Lab (www.chesterlab.net). Most of the Supersite data were completed in more than 90% of the samplings, except APS, SMPS, meteorological data by Automet, and carbon and nitrate data of ADI (Aerosol Dynamics, Inc). The ~20% incompleteness of APS and SMPS data did not affect the data quality due to the large amount of data generated in 5-minute intervals by the instrumentation. The carbon and nitrate data of ADI were collected for the purpose of prototype development. The high incompleteness of meteorological data for ambient temperature, wind speed and wind direction (68%) was unexpected, due to difficulties encountered using the Automet instrument in the field. Meteorological data from the nearby AQMD monitoring stations was utilized as supplemental data as needed.

Two external QA audits were conducted in November 2002 and May 2003. The audits indicated 85% (29 out of 35) of audit items passed the accuracy test (within $\pm 10\%$ audit criteria or specific criteria, such as $\pm 2^\circ$ for wind direction and $\pm 1^\circ$ for ambient temperature). The audit in November 2002 determined that the accuracy of the BAM ultrafine, wind speed, and wind direction instrumentation fell outside of audit criteria. The problems were corrected immediately. The instruments passed the on further audit in May 2003. The accuracy (~57%) of DataRam did not meet QA criteria, leading to a decision to cease utilizing the instrument for later monitoring. DataRam data were not submitted to NARSTO for permanent archiving. The accuracy (12%) of Harvard HEADS instrument was near the board line of $\pm 10\%$, suggesting a need for extra precautions in the setup of the equipment and in interpreting and using the HEADS data. No duplicated or collocated data were used to assess precision.

In summary, Southern California Supersite successfully implemented QA procedures to assure the data generated in this research center passed QA criteria. Correction was initiated immediately after QA criteria fell outside of the criteria.

Instrument	MDL	Completeness (%)
aethalometer	0.02 ug/m3	92.6
APS	0.001 #/cm3	76.8
SMPS	0.0187 #/cm3	82.6
Automet (010C) - wind speed	0.5 mph (0.22 m/s)	32.2
Automet (020C) - wind direction	0.5 mph (0.22 m/s)	32.2
Carbon - ADI	1.0 ug/m3	56
Nitrate - ADI	1.0 ug/m3	42.6
URG HEADS - nitrate	0.0139 ug/m3	100
URG HEADS - sulfate	0.0208 ug/m3	100
URG HEADS - mass	0.116 ug/m3	99.7
MOUDI - IC nitrate	0.0046ug/m3	100
MOUDI - IC sulfate	0.0069 ug/m3	100
MOUDI - mass	0.116 ug/m3	99.7
MOUDI - EC	see notes 1,2 below	100
MOUDI - OC	see notes 1,2 below	100
MOUDI - Na (see note 3 below)	2.085 ug/filter	99.8
MOUDI - Mg	0.250 ug/filter	99.8
MOUDI - Al	0.111 ug/filter	99.8
MOUDI - Si	0.078 ug/filter	99.8
MOUDI - P	0.067 ug/filter	99.8
MOUDI - S	0.078 ug/filter	99.8
MOUDI - K	0.058 ug/filter	99.8
MOUDI - Ca	0.039 ug/filter	99.8
MOUDI - Ti	0.028 ug/filter	99.8
MOUDI - V	0.019 ug/filter	99.8
MOUDI - Cr	0.019 ug/filter	99.8
MOUDI - Mn	0.031 ug/filter	99.8
MOUDI - Fe	0.025 ug/filter	99.8
MOUDI - Co	0.017 ug/filter	99.8
MOUDI - Ni	0.017 ug/filter	99.8
MOUDI - Cu	0.017 ug/filter	99.8
MOUDI - Zn	0.05 ug/filter	99.8
MOUDI - Ga	0.042 ug/filter	99.8
MOUDI - Ge	0.039 ug/filter	99.8
MOUDI - As	0.033 ug/filter	99.8
MOUDI - Se	0.028 ug/filter	99.8
MOUDI - Br	0.025 ug/filter	99.8
MOUDI - Rb	0.142 ug/filter	99.8
MOUDI - Sr	0.044 ug/filter	99.8
MOUDI - Y	0.042 ug/filter	99.8
MOUDI - Zr	0.05 ug/filter	99.8
MOUDI - Mo	0.070 ug/filter	99.8
MOUDI - Pd	0.142 ug/filter	99.8
MOUDI - Ag	0.150 ug/filter	99.8
MOUDI - Cd	0.153 ug/filter	99.8
MOUDI - Sn	0.267 ug/filter	99.8
MOUDI - Sb	0.214 ug/filter	99.8
MOUDI - Ba	1.668 ug/filter	99.8
MOUDI - La	1.009 ug/filter	99.8
MOUDI - Hg	0.070 ug/filter	99.8
MOUDI - Pb	0.078 ug/filter	99.8
Partisol - IC nitrate	0.0083 ug/m3	100
Partisol - IC sulfate	0.0125 ug/m3	100
Partisol - mass	0.116 ug/m3	99.7
Partisol - Na (see note 3 below)	2.085 ug/filter	99.8

Partisol - Mg	0.250 ug/filter	99.8
Partisol - Al	0.111 ug/filter	99.8
Partisol - Si	0.078 ug/filter	99.8
Partisol - P	0.067 ug/filter	99.8
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Partisol - La	1.009 ug/filter	99.8
Partisol - Hg	0.070 ug/filter	99.8
Partisol - Pb	0.078 ug/filter	99.8
Coarse Teom - mass	0.01ug	83.9

Notes:

1.) Detection Limit of EC (or OC) is the lower bound of the linear working range (in ug/cm²) of the analytical method (Modified NIOSH 5000). The value was converted into a concentration, given a known deposit area of filter and sampling volume, prior to comparison with observed concentrations. (See more details in USER NOTE2).

2.) The method to measure EC/OC in PM was a modified version of NIOSH Method 5000. Linear working ranges for EC & OC are 1-15 and 5-400 (ug/cm²), respectively [Please see the SOP companion file (file name: EC_OC 06.doc) for more details]. These ranges are considered the most reliable working conditions of this method. The upper and lower bounds must be converted into concentration limits (in ug/m³) prior to comparison with actual measurements, as follow: Concentration limits (ug/m³) = Linear working ranges (ug/cm²) * deposited area (cm²) / volume of air sampling (m³). The lower bound represents the detection limit (DL). If a measurement is less than the DL, a flag 'V1' is applied. If a measurement is greater than the upper bound of the concentration limits, a flag 'V4' is given. If a measurement is within the concentration limits, it is a valid observation flagged with 'V0'.

3.) Detection Limits (DL) are reported per filter. DL for XRF (X-ray fluorescence) are listed on the Chester Lab Website: http://www.chesterlab.net/DL_pages_finals.htm. The DL was converted from (ug/filter) to (ug/m³) by dividing by the volume of air sampled for each filter stage when reported to NARSTO.

Supersite QA Accuracy (or Bias) Summary:

Instrument	Company/Model	Date	Audit Flow, Qa (lpm)	Sie Flow, Qm (lpm)	% Accuracy	Audit Criteria	Reference
APS	TSI 3320 S/N 1124	11/22/2002	4.92	5.00	1.63	±10%	Page 5, PIU Audit Report, Nov. 2002
APS	TSI 3320 S/N 1125	5/1/2003	4.98	5.00	0.40	±10%	Page 4, PIU Audit Report, May 1. 2003
SMPS+CPC	TSI SMPS 2080 S/N 809 & TSI 3022A	11/22/2002	1.44	1.50	4.53	±10%	Page 5, PIU Audit Report, Nov. 2002
SMPS+CPC	TSI SMPS 2080 S/N 809 & TSI 3022A	5/1/2003	0.30	0.30	-0.66	±10%	Page 4, PIU Audit Report, May 1. 2003
Aethalometer	Anderson	11/22/2002	4.12	4.00	-2.91	±10%	Page 6, PIU Audit Report, Nov. 2002
Aethalometer	Anderson	5/1/2003	3.94	4.00	1.52	±10%	Page 5, PIU Audit Report, Nov. 2002
Partisol (coarse)	R&P	11/22/2002	1.75	1.65	-5.71	±10%	Page 7, PIU Audit Report, Nov. 2002. Use of low flow rate for the coarse section is intended for measurements of metals by XRF.
Partisol (coarse)	R&P	5/1/2003	1.79	1.66	-7.26	±10%	Page 8, PIU Audit Report, May 1, 2003. Use of low flow rate for the coarse section is intended for measurements of metals by XRF.
Partisol (fine)	R&P	11/22/2002	15.23	15.00	-1.51	±10%	Page 7, PIU Audit Report, Nov. 2002. Use of low flow rate for the coarse section is intended for measurements of nitrate/sulfate by IC.
Partisol (fine)	R&P	5/1/2003	14.86	15.00	0.94	±10%	Page 8, PIU Audit Report, May 1, 2003. Use of low flow rate for the coarse section is intended for measurements of nitrate/sulfate by IC.

Cascade carbon system	ADI	11/22/2002	0.88	0.84	-4.55	±10%	Page 8, PIU Audit Report, Nov. 2002.
Cascade carbon system	ADI	5/1/2003	0.83	0.79	-4.82	±10%	Page 12, PIU Audit Report, May 1. 2003
Cascade nitrate system	ADI	11/22/2002	1.02	1.04	1.96	±10%	Page 9, PIU Audit Report, Nov. 2002.
Cascade nitrate system	ADI	5/1/2003	1.02	1.04	1.96	±10%	Page 13, PIU Audit Report, May 1. 2003
TEOM PM Coarse	R&P 1400A	11/22/2002	2.03	2.00	-1.48	±10%	Page 12, PIU Audit Report, Nov. 2002. Main sample only.
TEOM PM Coarse	R&P 1400A	5/1/2003	1.96	1.99	1.53	±10%	Page 14, PIU Audit Report, May 1. 2003. Main sample only.
Differential TEOM	R&P	11/22/2002	3.15	3.00	-4.92	±10%	Page 13, PIU Audit Report, Nov. 2002. Average flow of samples A & B.
Differential TEOM	R&P	5/1/2003	2.96	2.86	-3.21	±10%	Page 15, PIU Audit Report, May 1. 2003. Average flow of samples A & B.
BAM PM2.5	MetOne 1020	11/22/2002	16.82	16.70	-0.71	±10%	Page 10, PIU Audit Report, Nov. 2002.
BAM PM2.5	MetOne 1020	5/1/2003	15.10	14.90	-1.32	±10%	Page 9, PIU Audit Report, May 1. 2003
BAM Ultrafine	MetOne 1020	11/22/2002	12.95	16.70	28.96	±10%	Page 11, PIU Audit Report, Nov. 2002.
BAM Ultrafine	MetOne 1020	5/1/2003	16.42	16.80	2.31	±10%	Page 10, PIU Audit Report, May 1. 2003
MOUDI	MSP 110	11/22/2002	30.20	31.00	2.65	±10%	Page 14, PIU Audit Report, Nov. 2002.
MOUDI	MSP 110	5/1/2003	30.30	32.00	5.61	±10%	Page 16, PIU Audit Report, May 1. 2003
DataRam PM2.5	MIE	5/1/2003	1.27	2.00	57.48	±10%	Page 6, PIU Audit Report, May 1, 2003, Flow exceeds audit criteria
HEADS	Harvard	5/1/2003	8.93	10.00	11.98	±10%	Page 7, PIU Audit Report, May 1, 2003, Flow slightly exceeds audit criteria

Automet wind speed	MetOne 034-A, S/N: Y2211	11/22/2002	Audit MPH Input (X)	Site MPH DAS (Y)	%		Audit method: RM Young Wind Monitor
			1.70	2.80	64.71		
			2.20	4.00	81.82		
			3.10	4.60	48.39		
			2.90	4.00	37.93		
			2.60	4.40	69.23		
			2.70	4.00	48.15		
			2.40	3.50	45.83		
				Bias (%)=	56.58		Page 15, PIU Audit Report, Nov. 2002. Audit method: RM Young Wind Monitor.
		5/1/2003	0.60	0.60	0.00		
			9.60	9.50	-1.04		
			18.50	18.50	0.00		
			36.40	36.30	-0.27		
				Bias (%)=	-0.33		Page 17, PIU Audit Report, May 1, 2003

Automet wind direction	MetOne 034-A, S/N: Y2211	11/22/2002	Audit Degree DAS (X)	Site Degrees DAS (Y)	Degree Diff. DAS	Audit Criteria	Audit method: RM Young Wind Monitor
			207.00	232.00	25.00		
			250.00	259.00	9.00		
			284.00	240.00	-44.00		
			203.00	207.00	4.00		
			221.00	232.00	11.00		
			203.00	241.00	38.00		
			227.00	303.00	76.00		
			236.00	212.00	-24.00		
			Average diff. =		11.88	±2 degree	Page 16, PIU Audit Report, Nov. 2002. Audit method: RM Young Wind Monitor.
		5/1/2003	135.00	134.00	-1.00		
			225.00	224.00	-1.00		
			315.00	318.00	3.00		
			45.00	44.00	-1.00		
			Average diff. =		0.00	±2 degree	Page 18, PIU Audit Report, May 1, 2003

Ambient Temperature	Vaisala HMP45A	11/22/2002	Audit Deg. C Input	Site Deg C DAS	Deg C Diff.	Audit Criteria	
			25.40	24.40	-1.00		
			26.10	25.50	-0.60		
			27.00	26.60	-0.40		
			24.80	24.60	-0.20		
			Average Deg C Diff =		-0.55	±1.0 degree C	Page 17, PIU Audit Report, Nov. 2002.
		5/1/2003	16.30	16.50	0.20		
			17.70	18.10	0.40		
			Average Deg C Diff =		0.30	±1.0 degree C	Page 19, PIU Audit Report, May 1, 2003

Relative Humidity	Vaisala HMP45A	11/22/2002	Audit R.H. Input	Site R.H. DAS	%		
			23.20	20.90	-9.91		
			23.60	21.20	-10.17		
			22.30	20.00	-10.31		
			39.90	37.60	-5.76		
				Bias (%) =	-9.04		Page 18, PIU Audit Report, Nov. 2002.
		5/1/2003	53.40	50.90	-4.68		
			42.20	39.50	-6.40		
				Bias (%) =	-5.54		Page 21, PIU Audit Report, May 1, 2003

Summary of Quality Assurance Audits

Performance audits were conducted on November 2, 2002 and May 3, 2003 to evaluate the accuracy of the measurements by comparing instrument performance against known standards. NIST-traceable standards were used whenever possible. All standards are maintained independently from standards used at the PIU. Since the majority of the measurements made at the PIU are of particulate matter, the majority of the performance checks consisted of flow measurements using volumetric flow devices. When possible, flow measurements were made both at the sample train inlet and at the inlet to the sampler in order to verify that the sample train was not damaged in any way during relocation. Similarly, during auditing of the meteorological sensors, emphasis was placed on verifying the orientation of the wind direction sensor, as this too can be altered during relocation. Following the verification of the wind direction orientation, a performance audit of the wind speed sensor was conducted using a selectable speed anemometer drive or a collocated wind speed sensor. A performance audit of the wind direction sensor consisted of aligning the wind vane to four known directions. For the audit of ambient temperature/RH and interior temperature/RH, a collocated audit temperature/RH system was placed adjacent to the station temperature and relative humidity sensors. Following the completion of the audit, data were downloaded and compared for reasonableness.

It should be noted that the audit flow devices measured volumetric flow rates in liters per minute (lpm). Flow rates for most samplers were reported in volumetric units. However, there were cases where the operating manual and/or the technicians indicated that the reported sampler flow rates were in standard liters per minute (slpm). In these cases, the audit volumetric flow rates were converted to standard flow rates by using the ambient temperature and pressure and the ideal gas law. Samplers using standard flow rates were as follows:

- Andersen Aethelometer
- R&P 5400 Carbon Analyzer
- ADI Cascade Carbon System
- ADI Cascade Nitrate System

In general, the operation of the PIU appeared good, with only relatively minor issues noted. Whenever possible, problems were investigated and resolved at the time of the audit.

The following issues potentially had an effect on data quality:

General

- Wind speed and wind direction data will be representative of only the immediate area around the site. Nearby buildings and structures over 30 meters tall obstructed the wind flow, especially winds from the north, east and west directions.
- Mounting the temperature/RH sensor at least 2 meters above the trailer was recommended to minimize artificial temperature effects that are produced from the top of the trailer.

- During both audits, leak checks conducted on the BAM (Ultra Fine) sampler indicated leaks within the system. In addition, the impactor was secured loosely to the sampler by way of bungee chords. It was recommended that the impactor be secured to the sampler using fittings that provide a more positive seal.

November 2, 2002

- The alignment of the wind direction sensor was 7° low from 180° True. The technician corrected the orientation prior to the audit. It was recommended that data prior to the audit be adjusted by subtracting 7° to account for the misalignment (and add 360° to the result if the value is less than zero).
- When tested separately, the inlet flow rate for the condensation particle counter (CPC) was measured at 1.5 lpm. However, when the SMPS was placed in series with the CPC, the flow into the system dropped by about 7% to 1.37 lpm. Disconnecting the line between the SMPS and the CPC produced a noticeable hiss, revealing a significant vacuum in the line connecting the two instruments. The problem appeared to be related to a problem with the CPC being stuck in the high flow mode, which was also noted during the audit. The CPC was removed for repair soon after the audit. Data for several weeks prior to the audit appear to have been affected by the problem.
- Sampler flow rates for the BAM (Ultra Fine) did not meet the audit criteria of $\pm 10\%$. In addition, low flows were initially noted for the differential TEOM, though audit activities apparently caused the flow to shift back to the design flow rate.

May 3, 2003

- Sampler flow rates for the DataRam, HEADS, and TEOM (PM_{coarse}) did not meet the audit criteria of $\pm 10\%$.
- A leak check conducted on the BAM $PM_{2.5}$ sampler indicated a leak within the system. The leak check value was 12.9 lpm, which is very high for this test. Further investigation revealed that the mechanism providing the seal to the sample tape had not properly positioned itself and was causing the leak. Once the mechanism was properly positioned, a leak was not evident. However, the measured flow rate changed significantly, deviating by 27% from the instruments reported flow rate. It was recommended that data obtained from this sampler should be carefully reviewed.

QUALITY ASSURANCE AUDIT REPORT

for the

SOUTHERN CALIFORNIA PARTICLE CENTER AND SUPERSITE PARTICLE INSTRUMENTATION UNIT

LOS ANGELES (USC), NOVEMBER 2002

Prepared for

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JANUARY 2003

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SCPCS AUDIT REPORT

SUPERSITE MEASUREMENTS

Site: Particle Instrumentation Unit (Los Angeles (USC))

Audit Dates: November 22, 2002

Instrumentation Audited: SMPS, APS, Aethalometer (2 wv), Partisol, BAM (PM_{2.5}), BAM (PM_{Ultra Fine}), TEOM, Differential TEOM, MOUDI, Nitrate Sampler, Carbon Sampler, Interior Temperature/RH, Ambient Temperature/RH, Wind Speed, Wind Direction

Key Person(s): Bill Grant/Peter Jaques

Auditor: David Bush/David Yoho

The purpose of this summary is to provide a report of significant audit findings. The audits were conducted November 22, 2002 while the PIU was at the Los Angeles (USC) location. Results of the performance audit comparisons are included.

AUDIT PROCEDURES

The audits consisted of both a system and a performance component. A technical systems audit was conducted to verify that procedures are being followed according to established SOPs. The audit was conducted using a systems audit checklist. The checklist was completed during the March/April 2001 audit. Therefore, the system audit consisted of a review of the previously completed checklist, concentrating on any changes in procedures and equipment since the last audit. A siting audit was also conducted to evaluate the representativeness of the site location, checking probe exposures and local sources.

Performance audits were conducted to evaluate the accuracy of the measurements by comparing instrument performance against known standards. NIST-traceable standards were used whenever possible. All standards are maintained independently from standards used at the PIU. Since the majority of the measurements made at the PIU are of particulate matter, the majority of the performance checks consisted of flow measurements using a Gilibrator 2 automated optical bubble flow meter. When possible, flow measurements were made both at the sample train inlet and at the inlet to the sampler in order to verify that the sample train was not damaged in any way during relocation. Similarly, during auditing of the meteorological sensors, emphasis was placed on verifying the orientation of the wind direction sensor, as this too can be altered during relocation. Following the verification of the wind direction orientation, an independent audit data logging system consisting of wind speed/wind direction, ambient temperature and relative humidity sensors were collocated adjacent to the site

meteorological sensors. Meteorological data from the site and audit systems were collected over several hours and were compared for reasonableness.

In general, the operation of the PIU appears to be going smoothly, with only the relatively minor issues noted below. Problems noted during the audit were discussed with key PIU operating personnel at the time of the audit. Whenever possible, problems were investigated and resolved at the time of the audit.

KEY SITING AUDIT FINDINGS

- Wind speed and wind direction data will be representative of only the immediate area around the site. Nearby buildings and structures over 30 meters tall will obstruct the wind flow, especially winds from the north, east and west directions.

KEY SYSTEM AUDIT FINDINGS

No problems noted.

KEY SURFACE METEOROLOGY AUDIT RESULTS

Unless otherwise noted, all instruments were operating within the recommended criteria.

- The alignment of the wind direction sensor was 7° low from 180° True. The technician corrected the orientation prior to the audit. It is recommended that data prior to the audit be adjusted by subtracting 7° to account for the misalignment (and add 360° to the result if the value is less than zero).
- The model of wind sensor used at the PIU is not conducive to testing with a constant RPM motor without disassembling the sensor and jeopardizing the calibration of the wind vane. However, it was possible to collocate an independent wind sensor adjacent to the site sensor and collect data over the duration of the audit. Following the audit, the audit and site wind speed and wind direction data were compared for reasonableness. Although some comparisons exceed the recommended audit criteria, wind conditions at the time of the audit were relatively low and variable, making it difficult to accurately assess the reasonableness of the data. There appears to be no problems with the wind sensors.
- Mounting the temperature/RH sensor at least 2 meters above the trailer is recommended to minimize artificial temperature effects that are produced from the top of the trailer.
- The station interior temperature sensor was reading 1.8° C low and exceeds the recommended audit criteria of $\pm 1.0^{\circ}\text{C}$. While the station temperature reading is not critical, it is unclear whether or not the system is operating correctly. The system should be recalibrated, and repaired if necessary.

KEY AIR QUALITY AUDIT FINDINGS

Unless otherwise noted, all instruments were operating within the recommended criteria.

- The flow measured at the inlet for the particle counters was significantly lower than the sum of the sampling flows for the particle counters, indicating a leak in the system. Upon further investigation, it was determined that the leak occurred in the sample can above the trailer roof. Ambient readings were therefore not affected. However, it is recommended that the leak be repaired.
- When tested separately, the inlet flow rate for the condensation particle counter (CPC) was measured at 1.5 lpm. However, when the SMPS was placed in series with the CPC, the flow into the system dropped by about 7% to 1.37 lpm. Disconnecting the line between the SMPS and the CPC produced a noticeable hiss, revealing a significant vacuum in the line connecting the two instruments. It is recommended that this issue be investigated further to determine if this is a problem.
- While the indicated sample flow rate for the CPC was correct (5.0 cm³/s or 0.30 lpm), the actual sample flow could not be measured, as the system would not drop into the "low" flow mode in order to check the flow. As stated above, the CPC inlet flow remained at 1.50 lpm. It should be noted that in both of the previous two audits, the inlet flow into the CPC was 0.30 lpm. The currently higher flow rate of 1.50 lpm may explain the observations in the comment above, as the SMPS may have difficulty pulling 1.5 lpm rather than 0.3 lpm through its system. The CPC should be checked and the 0.30 sample flow rate verified. In verifying the CPC sample flow rate, it should also be determined whether the noted inlet vacuum and corresponding reduced inlet flow rate affects the sample flow rate in any way.

This issue was further investigated by the site operators. Discussion with the Instrument Manufacturer's (TSI, Inc) Technical Assistance Support revealed that continuous use of the CPC for more than a period of 6 months can typically result in its pump sticking in the high flow mode (1.5 lpm). Since the data acquisition software is not aware of this, it thinks the instrument is operating at its programmed flow of 0.3 lpm, thereby consistently reporting particle number concentration high by a factor of 5. Evaluation of the cumulative daily average number concentration for the SMPS suggests that the number concentration increased by about a factor of 5 above typical daily averages between November 5 and the day of the audit (November 22). The CPC was immediately returned to TSI for maintenance, and they responded by immediately providing a loaner (same model) to allow for a minimum break in data acquisition. On January 24, 2003, the repaired CPC was returned and reconnected for routine PIU sampling.

- At the time of the audit, the R&P carbon sampler was not operating. Therefore an audit of the sampler was not conducted.

ADDITIONAL AUDIT FINDINGS

The following comments refer to instrumentation outside of normal Supersite operations, and concern instrumentation of a prototype or special study nature that have been installed at the PIU to take advantage of the array of collocated measurements.

- The audit the BAM (Ultra Fine) sampler inlet flow rate was measured to be 12.95 lpm, which exceeds the recommended $16.7 \text{ lpm} \pm 10\%$ audit criteria. Also, a leak check indicated a significant leak within the system. In addition, the impactor was secured loosely to the sampler by way of bungee chords. It is recommended that the impactor be secured to the sampler using the appropriate fittings.
- When initially checked, the inlet flow for the differential TEOM was measured at 10.4 lpm, significantly lower than the expected $16.7 \text{ lpm} \pm 10\%$. After disassembling the sample system to measure the other critical flows (all of which were within criteria), the inlet flow was rechecked, and measured at 17.56 lpm. The reason for the change is unknown. It is recommended that the flow rates for this sampler be monitored to determine if this problem reappears.

T&B SYSTEMS
PARTICULATE SAMPLERS

Date: 11/22/02
Start: 9:45 PST
Finish: 9:55 PST
Audited By: David Bush/David Yoho
Witness: Bill Grant

Site name: PIU
Operator: UCLA
Project: SCPCS

Sampler: Carbon
Sampler ID: 262:17H9

Make: Andersen
Model: Aethalometer (2 wv)
Last cal.: NA

Amb. Press: 29.82 In Hg
Amb. Temp.: 23.5 Deg C

Flowmeters
Gilibrator II

Audit Flow (slpm)		Site Flow (slpm)		% Diff.
4.12		4.00		-2.9

Audit Criteria: $\pm 10\%$

Comments: Leak check using HEPA filter: BC= 0.0, UV= -0.2

T&B SYSTEMS
PARTICULATE SAMPLERS

Date: 11/22/02
Start: 11:40 PST
Finish: 11:55 PST
Audited By: David Bush/David Yoho
Witness: Bill Grant

Site name: PIU
Operator: UCLA
Project: SCPCS

Sampler: Cascade Carbon System
Sampler ID: NA

Make: ADI
Model: Prototype
Last cal.: 10/06/02

Amb. Press: 29.81 in. Hg
Amb. Temp.: 26.0 deg. C

Flowmeters
Gilibrator II

Audit Flow (slpm)		Site Flow (slpm)		% Diff.
0.88		0.84		-4.5

Audit Criteria: +/- 10%

Comments: The site rotameter agreed with the audit flow of 0.88 lpm. The SOP indicates flows should be 0.9 - 1.1 lpm.

T&B SYSTEMS
PARTICULATE SAMPLERS

Date: 11/22/02
Start: 11:40 PST
Finish: 11:55 PST
Audited By: David Bush/David Yoho
Witness: Bill Grant

Site name: PIU
Operator: UCLA
Project: SCPCS

Sampler: Cascade Nitrate System
Sampler ID: NA

Make: ADI
Model: Prototype
Last cal.: 10/06/02

Amb. Press: 29.81 in. Hg
Amb. Temp.: 26.0 deg. C

Flowmeters
Gilibrator II

Audit Flow (slpm)		Site Flow (slpm)		% Diff.
1.02		1.04		2.0

Audit Criteria: $\pm 10\%$

Comments: No problems noted.

T&B SYSTEMS
PARTICULATE SAMPLERS

Date: 11/22/02
Start: 10:25 PST
Finish: 10:35 PST
Audited By: David Bush/David Yoho
Witness: Bill Grant

Site name: PIU
Operator: UCLA
Project: SCPCS

Sampler: BAM PM2.5
Sampler ID: NA

Make: MetOne
Model: 1020
Last cal.: NA

Amb. Press: 29.82 in. Hg
Amb. Temp.: 24.0 deg. C

Flowmeters
Gilibrator II

Audit Flow (lpm)		Site Flow (lpm)		% Diff.
16.82		16.70		-0.7

Audit Criteria: +/- 10%; Inlet 15.0 - 18.4 lpm

Comments: No problems noted. Leak check: 0.3 lpm.

T&B SYSTEMS
PARTICULATE SAMPLERS

Date: 11/22/02
Start: 10:25 PST
Finish: 10:35 PST
Audited By: David Bush/David Yoho
Witness: Bill Grant

Site name: PIU
Operator: UCLA
Project: SCPCS

Sampler: BAM Ultra Fine
Sampler ID: NA

Make: MetOne
Model: 1020
Last cal.: NA

Amb. Press: 29.82 in. Hg
Amb. Temp.: 24.0 deg. C

Flowmeters
Gilibrator II

Audit Flow (lpm)		Site Flow (lpm)		% Diff.
12.95		16.70		29.0

Audit Criteria: +/- 10%; Inlet 15.0 - 18.4 lpm

Comments: Upon arrival to the site the ultra fine BAM impactor was secured with bungee chords to secure it to the sampler. A leak check indicated a leak of 16.7 lpm within the system. Additionally, a flow check of 12.95 lpm exceeds the recommended criteria of 16.7 lpm $\pm 10\%$. It is recommended to repair or use the appropriate fittings to secure the impactor to the sampler.

T&B SYSTEMS
 PARTICULATE SAMPLERS

Date: 11/22/02
 Start: 10:00 PST
 Finish: 10:15 PST
 Audited By: David Bush/David Yoho
 Witness: Bill Grant

Site name: PIU
 Operator: UCLA
 Project: SCPCS

Sampler: TEOM PM Coarse
 Sampler ID: NA

Make: R&P
 Model: 1400A
 Last cal.: NA

Amb. Press: 29.81 in. Hg
 Amb. Temp.: 26.0 deg. C

Flowmeters
 Gilibrator II

Sample	Audit Flow (lpm)		Site Flow (lpm)		% Diff.
Main	2.03		2.00		-1.7
Aux	NA		NA		NA

Audit Criteria: +/- 10%

Comments: Leak check: Main = 0.05 lpm, Aux = 0.0 lpm. The flow rate of the auxillary flow was set to 50 lpm, which exceeds the measuring capabilities of the audit flow standard.

T&B SYSTEMS
 PARTICULATE SAMPLERS

Date: 11/22/02
 Start: 12:30 PST
 Finish: 13:05 PST
 Audited By: David Bush/David Yoho
 Witness: Bill Grant

Site name: PIU
 Operator: UCLA
 Project: SCPCS

Sampler: Differential TEOM
 Sampler ID: NA

Make: R&P
 Model: Prototype
 Last cal.: NA

Amb. Press: 29.81 in. Hg
 Amb. Temp.: 26.0 deg. C

Flowmeters
 Gilibrator II

Sampler	Audit Flow (lpm)		Site Flow (lpm)		% Diff.
A	3.06		2.99		-2.2
B	3.24		3.00		-7.5
Bypass	11.45		10.65		-7.0
Total	17.56		16.64		-5.2

Audit Criteria: +/- 10%; Total 15.0 - 18.4 lpm

Comments: Sample A zero: < 0.35 lpm, Sample B zero: < 0.2 lpm. Initial inlet reading was measured low at 10.4 lpm. Later during audit, inlet was measured at 17.56 lpm, which is correct. Reason for change is unknown.

T&B SYSTEMS
PARTICULATE SAMPLERS

Date: 11/22/02
Start: 12:00 PST
Finish: 12:10 PST
Audited By: David Bush/David Yoho
Witness: Bill Grant

Site name: PIU
Operator: UCLA
Project: SCPCS

Sampler: MOUDI
Sampler ID: NA

Make: MSP
Model: 110
Last cal.: NA

Amb. Press: 29.81 in. Hg
Amb. Temp.: 26.0 deg. C

Flowmeters
Gilibrator II

Audit Flow (lpm)		Site Flow (lpm)		% Diff.
30.20		31.00		2.6

Audit Criteria: $\pm 10\%$

Comments: Site flow obtained using rotameter designated for MOUDI flow rates.

T&B SYSTEMS
 HORIZONTAL WIND SPEED

Date: 11/22/02
 Start: 12:30 PST
 Finish: 14:30 PST
 Audited By: David Bush/David Yoho
 Witness: Bill Grant

Site Name: PIU
 Operator: UCLA
 Project: SCPCS

Manufacturer: Met One
 Serial No.: Y2211
 K factor: 3.6
 Range: 100 MPH

Model: 034-A
 Sensor Ht.: 10 meters
 Starting torque #N/A gm cm
 Starting thresho #N/A MPH

Last calibration date Oct-02

	Cal. Factors
	<u>Chart</u> <u>DAS</u>
Slope:	1.000 1.000
Int.:	0.000 0.000

WS Audit Point	Audit MPH Input		Site MPH DAS	MPH Diff. DAS
1245	1.7		2.8	1.1
1300	2.2		4.0	1.8
1315	3.1		4.6	1.5
1330	2.9		4.0	1.1
1345	2.6		4.4	1.8
1400	2.7		4.0	1.3
1415	2.4		3.5	1.1

Average Difference:	1.4
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Comments: Sensor not designed for use of conventional constant speed motor for performance auditing. The audit method used an RM Young Wind Monitor collocated next to the site sensor. Light and variable winds at the time of the audit made it difficult to accurately assess the reasonableness of the wind speed data. There appears to be no problems with the sensor.

T&B SYSTEMS
 HORIZONTAL WIND DIRECTION

Date: 11/22/02
 Start: 12:30 PST
 Finish: 14:30 PST
 Audited By: David Bush/David Yoho
 Witness: Bill Grant

Site Name: PIU
 Operator: UCLA
 Project: SCPCS

Manufacturer: Met One
 Serial No.: Y2211
 K factor: 29.8
 Range: 360 Deg
 Crossarm: 181 Deg true

Model: 0-34A
 Sensor Ht.: 10 meters
 Starting torque: #N/A gm cm
 Starting threshold: #N/A m/s

Last calibration date Oct-02
 Slope: 1.000
 Int.: 0.0

Chart DAS

WD Audit Point	Audit Degrees DAS		Site Degrees DAS	Diff. Degrees DAS
1245	207		232	25
1300	250		259	9
1315	284		240	-43
1330	203		207	4
1345	221		232	11
1400	203		241	38
1415	227		303	76
1430	236		212	-24

Average Difference:	12
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Audit Criteria ± 2 degrees (orientation)

Comments: The sensor orientation was measured to be 173°, which exceeds the criteria of $\pm 2^\circ$. The sensor orientation was corrected to 181° prior to the audit. The audit method used a collocated RM Young Wind Monitor as the audit standard and was mounted next to the site sensor. The relatively large differences in wind direction between the audit and site data are likely due to the light and variable winds observed at the time of the audit. There appears to be no problems with the wind direction sensor.

T&B SYSTEMS
 AMBIENT TEMPERATURE

Date: 11/22/02
 Start: 10:00 PST
 Finish: 11:45
 Audited By: David Bush/David Yoho
 Witness: Bill Grant

Site Name: PIU
 Operator: UCLA
 Project: SCPCS

Manufacturer: Vaisala
 Serial No.: V1130024
 Lower Range: -30 Deg C
 Upper Range: 50 Deg C

Model: HMP45A
 Sensor Ht.: 1 meter above roof

Last calibration date: NA

Cal. Factors

	<u>Chart</u>	<u>DAS</u>
Slope:	1.000	1.000
Int.:	0.000	0.000

Temperature Audit Point	Audit Deg C Input		Site Deg C DAS	Deg C Diff. DAS
1100	25.5		24.4	-1.1
1200	26.1		25.5	-0.6
1300	27.0		26.6	-0.4
1400	24.8		24.6	-0.2

Audit Criteria: $\pm 1.0^{\circ}\text{C}$

Comments: No problems noted. Mounting the temperature sensor
 >2 meters above the top of the trailer is recommended
 to minimize artificial temperature effects produced
 from the rooftop.

T&B SYSTEMS
 RELATIVE HUMIDITY

Date: 11/22/02
 Start: 11:00 PST
 Finish: 14:00 PST
 Audited By: David Bush/David Yoho
 Witness: Bill Grant

Site Name: PIU
 Operator: UCLA
 Project: SCPCS

Manufacturer: Vaisala
 Serial No.: V1130024

Model: HMP45A
 Sensor Ht.: 1 meter above roof

Last calibration date: NA

Cal. Factors

	<u>Chart</u>	<u>DAS</u>
Slope:	1.000	1.000
Int.:	0.00	0.00

R.H. Audit Point	Audit R.H. Input		Site R.H. DAS	R.H. Diff. DAS
1100	23.2		20.9	-2.3
1200	23.6		21.2	-2.4
1300	22.3		20.0	-2.3
1400	39.9		37.6	-2.3

Audit Criteria: NA

Audit Equivalent Dew Point	Audit Deg C Input		Site Deg C DAS	Deg C Diff. DAS
1100	3.0		1.5	-1.5
1200	3.7		2.2	-1.5
1300	3.7		2.1	-1.5
1400	10.3		9.4	-0.9

Audit Criteria: $\pm 1.5^{\circ}\text{C}$

Comments: No problems noted. Mounting the relative humidity sensor >2 meters above the top of the trailer is recommended to minimize artificial effects produced from the rooftop.

T&B SYSTEMS
 INTERIOR TEMPERATURE

Date: 11/22/02
 Start: 15:00 PST
 Finish: 15:05 PST
 Audited By: David Bush/David Yoho
 Witness: Bill Grant

Site Name: PIU
 Operator: UCLA
 Project: SCPCS

Manufacturer: Vaisala
 Serial No.: V090002
 Lower Range: -30 Deg C
 Upper Range: 50 Deg C

Model: HMW70Y

Last calibration date:

	Cal. Factors	
	<u>Chart</u>	<u>DAS</u>
Slope:	1.000	1.000
Int.:	0.000	0.000

Temperature Audit Point	Audit Deg C Input		Site Deg C DAS	Deg C Diff. DAS
1	23.4		21.6	-1.8

Audit Criteria: $\pm 1.0^{\circ}\text{C}$

Comments: Response is slightly low.

T&B SYSTEMS
 INTERIOR RELATIVE HUMIDITY

Date: 11/22/02
 Start: 15:05 PST
 Finish: 15:15 PST
 Audited By: David Bush/David Yoho
 Witness: Bill Grant

Site Name: PIU
 Operator: UCLA
 Project: SCPCS

Manufacturer: Vaisala
 Serial No.: V0920002

Model: HMW70Y
 Sensor Ht.: Interior

Last calibration date: NA

Cal. Factors

	<u>Chart</u>	<u>DAS</u>
Slope:	1.000	1.000
Int.:	0.00	0.00

R.H. Audit Point	Audit R.H. Input		Site R.H. DAS	R.H. Diff. DAS
1	44.1		42.4	-1.7

Audit Criteria: NA

Equivalent Dew Point	Audit Deg C Input		Site Deg C DAS	Deg C Diff. DAS
1	9.6		9.0	-0.6

Audit Criteria: $\pm 1.5^{\circ}\text{C}$ equivalent dew point

Comments: None

SOUTHERN CALIFORNIA PARTICLE CENTER & SUPERSITE

AUDIT REPORT

Site: Particle Instrumentation Unit (Los Angeles (USC))

Audit Dates: May 1, 2003

Instrumentation Audited: SMPS, APS, Aethalometer (2 wv), Partisol, BAM (PM_{2.5}), BAM (PM_{Ultra Fine}), TEOM, Differential TEOM, MOUDI, Nitrate Sampler, Carbon Sampler, HEADS, DataRam, Interior Temperature/RH, Ambient Temperature/RH, Wind Speed, Wind Direction

Key Person(s): Bill Grant/Peter Jaques

Auditor: David Bush/David Yoho

The purpose of this summary is to provide a report of significant audit findings. The audits were conducted May 1, 2003 while the PIU was at the Los Angeles (USC) location. Results of the performance audit comparisons are included.

AUDIT PROCEDURES

The audits consisted of performance audits of the PIU instrumentation. A technical systems and siting audit was conducted previously on November 22, 2002.

Performance audits were conducted to evaluate the accuracy of the measurements by comparing instrument performance against known standards. NIST-traceable standards were used whenever possible. All standards are maintained independently from standards used at the PIU. Since the majority of the measurements made at the PIU are of particulate matter, the majority of the performance checks consisted of flow measurements using a Gilibrator 2 automated optical bubble flow meter or a Kimmon dry test meter. When possible, flow measurements were made both at the sample train inlet and at the inlet to the sampler in order to verify that the sample train was not damaged in any way during relocation. Similarly, during auditing of the meteorological sensors, emphasis was placed on verifying the orientation of the wind direction sensor, as this too can be altered during relocation. Following the verification of the wind direction orientation, a performance audit of the wind speed sensor was conducted using a selectable speed anemometer drive. A performance audit of the wind direction sensor consisted of aligning the wind vane to four known directions. For the audit of ambient temperature/RH and interior temperature/RH, a collocated audit Hobo temperature/RH logger was placed adjacent to the station temperature and relative

humidity sensors. Following the completion of the audit, data were downloaded and compared for reasonableness.

In general, the operation of the PIU appears to be going smoothly, with only the relatively minor issues noted below. Problems noted during the audit were discussed with key PIU operating personnel at the time of the audit. Whenever possible, problems were investigated and resolved at the time of the audit.

KEY SITING AUDIT FINDINGS

The following key siting audit findings were noted at the time of the November 22, 2002 audit.

- Wind speed and wind direction data will be representative of only the immediate area around the site. Nearby buildings and structures over 30 meters tall will obstruct the wind flow, especially winds from the north, east and west directions.
- Mounting the temperature/RH sensor at least 2 meters above the trailer is recommended to minimize artificial temperature effects that are produced from the top of the trailer.

KEY SURFACE METEOROLOGY AUDIT RESULTS

Unless otherwise noted, all instruments were operating within the recommended criteria.

- The station interior temperature sensor was reading 3.3° C high and exceeds the recommended audit criteria of $\pm 1.0^{\circ}\text{C}$. While the station temperature reading is not critical, it is unclear whether or not the system is operating correctly. The system should be recalibrated, and repaired if necessary.

KEY AIR QUALITY AUDIT FINDINGS

Unless otherwise noted, all instruments were operating within the recommended criteria.

- A leak check conducted on the BAM (Ultra Fine) sampler indicated an audible leak and a measured leak of 2.3 lpm within the system. In addition, the impactor was secured loosely to the sampler by way of bungee chords. While the noted leak did not appear to have a major effect on the sample rate, it is recommended that the impactor be secured to the sampler using fittings that provide a more positive seal.
- A leak check conducted on the BAM PM_{2.5} sampler indicated a leak within the system. The leak check value was 12.9 lpm, which is very high for this test. Further investigation revealed that the mechanism providing the seal to the sample tape had not properly positioned itself and was causing the leak. Once

the mechanism was properly positioned, a leak was not evident. However, the measured flow rate changed significantly, deviating by 27% from the instruments reported flow rate. This problem should be investigated and repairs conducted as necessary. Data obtained from this sampler should be questioned.

- An audit of the DataRam sampler had a measured flow rate that exceeds audit criteria. It is recommended that the problem be investigated and repairs conducted as necessary.
- An audit of the HEADS sampler showed a 12% difference between the audited flow rate and the flow rate measured by the site flow meter. Part of the problem is likely due to the flow meter used at the site, which is a small 0 to 30 lpm rotameter with limited resolution that is not much more accurate than $\pm 10\%$ at the 10 lpm range. It is recommended that a more appropriate flow meter be used to monitor the flows for this sampler.
- An audit of the TEOM (PM coarse) auxiliary flow rate sampler had a measured flow rate that deviated by slightly over 10% from the expected flow rate of 50 lpm. In addition, the coarse flow is not controlled, and the flow rate is rarely checked. While it is understood that the coarse flow rate is not critical, it is recommended that the flow rate be checked on a regular basis to verify operation.

T&B SYSTEMS
PARTICULATE SAMPLERS

Date: 05/01/03
Start: 7:30 PST
Finish: 7:50 PST
Audited By: David Bush/David Yoho
Witness: Bill Grant

Site name: PIU
Operator: UCLA
Project: SCPCS

Sampler: Carbon
Sampler ID: 262:17H9

Make: Andersen
Model: Aethalometer (2 wv)
Last cal.: NA

Amb. Press: 29.81 In Hg
Amb. Temp.: 18.2 Deg C

Flowmeters
Gilibrator II S/N 010213-S

Audit Flow (slpm)		Site Flow (slpm)		% Diff.
3.94		4.00		1.5

Audit Criteria: $\pm 10\%$

Comments: Leak check using HEPA filter: BC= 0.0, UV= 0.0

T&B SYSTEMS
PARTICULATE SAMPLERS

Date: 05/01/03
Start: 8:10 PST
Finish: 8:15 PST
Audited By: David Bush/David Yoho
Witness: Bill Grant

Site name: PIU
Operator: UCLA
Project: SCPCS

Sampler: PM2.5
Sampler ID: 2525

Make: MIE
Model: DataRAM
Last cal.: NA

Amb. Press: 29.81 in. Hg
Amb. Temp.: 18.2 deg. C

Flowmeters
Gilibrator II S/N 010213-S

Audit Flow (lpm)		Site Flow (lpm)		% Diff.
1.27		2.00		56.9

Audit Criteria: $\pm 10\%$

Comments: Flow exceeds audit criteria.

T&B SYSTEMS
PARTICULATE SAMPLERS

Date: 05/01/03
Start: 13:25 PST
Finish: 13:40 PST
Audited By: David Bush/David Yoho
Witness: Bill Grant

Site name: PIU
Operator: UCLA
Project: SCPCS

Sampler: HEADS
Sampler ID: NA

Make: Harvard
Model: HEADS
Last cal.: NA

Amb. Press: 29.81 in. Hg
Amb. Temp.: 18.1 deg. C

Flowmeters
Gilibrator II S/N 009603-H

Audit Flow (lpm)		Site Flow (lpm)		% Diff.
8.93		10.00		12.0

Audit Criteria: $\pm 10\%$

Comments: Response exceeds criteria.

T&B SYSTEMS
 PARTICULATE SAMPLERS

Date: 05/01/03
 Start: 13:45 PST
 Finish: 14:05 PST
 Audited By: David Bush/David Yoho
 Witness: Bill Grant

Site name: PIU
 Operator: UCLA
 Project: SCPCS

Sampler: Dichotomous sampler
 Sampler ID: NA

Make: R&P
 Model: Partisol
 Last cal.: NA

Amb. Press: 29.80 in. Hg
 Amb. Temp.: 22.0 deg. C

Flowmeters
 Gilibrator II S/N 010213-S
 Gilibrator II S/N 009603-H

	Audit Flow (lpm)		Site Flow (lpm)	% Diff.
Total	16.62		16.66	0.2
Coarse	1.79		1.66	-7.3
Fine	14.86		15.00	0.9

Audit Criteria: $\pm 10\%$; Total 15.0 - 18.4 lpm

Comments: Leak checks OK. No problems noted.
 Ambient T = 20.0°C vs audit value of 22.0°C.
 Filt1/Filt2 26.1°C/25.8°C - appropriate for ambient temperature.
 Pressure = 756 mm Hg vs audit value of 757 mm Hg.
 RH = 38% vs audit value of 36%.

T&B SYSTEMS
PARTICULATE SAMPLERS

Date: 05/01/03
Start: 8:25 PST
Finish: 8:35 PST
Audited By: David Bush/David Yoho
Witness: Bill Grant

Site name: PIU
Operator: UCLA
Project: SCPCS

Sampler: BAM PM2.5
Sampler ID: 4982

Make: MetOne
Model: 1020
Last cal.: NA

Amb. Press: 29.80 in. Hg
Amb. Temp.: 17.6 deg. C

Flowmeters
Gilibrator II S/N 009603-H

Audit Flow (lpm)		Site Flow (lpm)		% Diff.
15.10		14.90		-1.3

Audit Criteria: $\pm 10\%$; Inlet 15.0 - 18.4 lpm

Comments: Leak check: 12.9 lpm. Fiddled with filter mechanism. Leak dropped to 1.9 lpm; however, measured flow increased to 18.4 lpm, with analyzer indicating 14.5 lpm. Temp sensor: site - 21.9 C, audit - 21.9 C

T&B SYSTEMS
PARTICULATE SAMPLERS

Date: 05/01/03
Start: 8:40 PST
Finish: 8:50 PST
Audited By: David Bush/David Yoho
Witness: Bill Grant

Site name: PIU
Operator: UCLA
Project: SCPCS

Sampler: BAM Ultra Fine
Sampler ID: 1137

Make: MetOne
Model: 1020
Last cal.: NA

Amb. Press: 29.80 in. Hg
Amb. Temp.: 19.1 deg. C

Flowmeters
Gilibrator II S/N 009603-H

Audit Flow (lpm)		Site Flow (lpm)		% Diff.
16.42		16.80		2.3

Audit Criteria: $\pm 10\%$; Inlet 15.0 - 18.4 lpm

Comments: Leak check: 2.3 lpm. Audable leak noted at head impactor. Audit flow went up and down about 0.1 lpm when impactor was moved. Temp sensor: site - 22.0 C, audit - 22.0 C.

T&B SYSTEMS
PARTICULATE SAMPLERS

Date: 05/01/03
Start: 10:05 PST
Finish: 10:00 PST
Audited By: David Bush/David Yoho
Witness: Bill Grant

Site name: PIU
Operator: UCLA
Project: SCPCS

Sampler: Carbon
Sampler ID: 203160206

Make: R&P
Model: 5400
Last cal.: NA

Amb. Press: 29.81 in. Hg
Amb. Temp.: 18.2 deg. C

Flowmeters
Gilibrator II S/N 009603-H

Audit Flow (slpm)		Site Flow (slpm)		% Diff.
16.33		15.80		-3.2

Audit Criteria $\pm 10\%$

Comments: No problems noted.

T&B SYSTEMS
PARTICULATE SAMPLERS

Date: 05/01/03
Start: 13:00 PST
Finish: 13:10 PST
Audited By: David Bush/David Yoho
Witness: Bill Grant

Site name: PIU
Operator: UCLA
Project: SCPCS

Sampler: Cascade Carbon System
Sampler ID: NA

Make: ADI
Model: Prototype
Last cal.: NA

Amb. Press: 29.82 in. Hg
Amb. Temp.: 24.0 deg. C

Flowmeters
Gilibrator II S/N 010213-S

Audit Flow (slpm)		Site Flow (slpm)		% Diff.
0.83		0.79		-4.8

Audit Criteria $\pm 10\%$

Comments: The SOP indicates flows should be 0.9 - 1.1 lpm.

T&B SYSTEMS
PARTICULATE SAMPLERS

Date: 05/01/03
Start: 11:40 PST
Finish: 11:55 PST
Audited By: David Bush/David Yoho
Witness: Bill Grant

Site name: PIU
Operator: UCLA
Project: SCPCS

Sampler: Cascade Nitrate System
Sampler ID: NA

Make: ADI
Model: Prototype
Last cal.: NA

Amb. Press: 29.81 in. Hg
Amb. Temp.: 26.0 deg. C

Flowmeters
Gilibrator II S/N 010213-S

Audit Flow (slpm)		Site Flow (slpm)		% Diff.
1.02		1.04		2.0

Audit Criteria: $\pm 10\%$

Comments: No problems noted.

T&B SYSTEMS
 PARTICULATE SAMPLERS

Date: 05/01/03
 Start: 9:00 PST
 Finish: 9:25 PST
 Audited By: David Bush/David Yoho
 Witness: Bill Grant

Site name: PIU
 Operator: UCLA
 Project: SCPCS

Sampler: TEOM PM Coarse
 Sampler ID: NA

Make: R&P
 Model: 1400A
 Last cal.: NA

Amb. Press: 29.80 in. Hg
 Amb. Temp.: 18.0 deg. C

Flowmeters
 Gilibrator II S/N 010213-S
 Hastings MFM S/N 17259

Sample	Audit Flow (lpm)		Site Flow (lpm)		% Diff.
Main	1.96		1.99		1.5
Aux	60.6		52.0		-14.2

Audit Criteria: ± 10%

Comments: Leak check OK. Auxillary flow exceeds audit criteria.

T&B SYSTEMS
 PARTICULATE SAMPLERS

Date: 05/01/03
 Start: 13:25 PST
 Finish: 13:35 PSt
 Audited By: David Bush/David Yoho
 Witness: Bill Grant

Site name: PIU
 Operator: UCLA
 Project: SCPCS

Sampler: Differential TEOM
 Sampler ID: NA

Make: R&P
 Model: Prototype
 Last cal.: NA

Amb. Press: 29.80 in. Hg
 Amb. Temp.: 21.1 deg. C

Flowmeters
 Gilibrator II S/N 010213-S
 Gilibrator II S/N 009603-H

Sampler	Audit Flow (lpm)		Site Flow (lpm)		% Diff.
A	2.97		2.99		0.7
B	2.94		2.73		-7.0
Bypass	11.01		10.65		-3.3
Total	17.07		16.37		-4.1

Audit Criteria: ± 10%; Total 15.0 - 18.4 lpm

Comments: Sample A zero: 0.96 lpm, Sample B zero: -1.22 lpm.

T&B SYSTEMS
PARTICULATE SAMPLERS

Date: 05/01/03
Start: 9:40 PST
Finish: 10:05 PST
Audited By: David Bush/David Yoho
Witness: Bill Grant

Site name: PIU
Operator: UCLA
Project: SCPCS

Sampler: MOUDI
Sampler ID: NA

Make: MSP
Model: 110
Last cal.: NA

Amb. Press: 29.80 in. Hg
Amb. Temp.: 19.7 deg. C

Flowmeters
Gilibrator II S/N 009603-H

Audit Flow (lpm)		Site Flow (lpm)		% Diff.
30.30		32.00		5.6

Audit Criteria: $\pm 10\%$

Comments: Site flow obtained using rotameter designated for MOUDI flow rates. Audit flow obtained using a dry test meter. No problems noted.

T&B SYSTEMS
 HORIZONTAL WIND SPEED

Date: 05/01/03
 Start: 12:45 PST
 Finish: 13:15 PST
 Audited By: David Bush/David Yoho
 Witness: Bill Grant

Site Name: PIU
 Operator: UCLA
 Project: SCPCS

Manufacturer: Met One
 Serial No.: Y2211
 K factor: 3.6
 Range: 100 MPH

Model: 034-A
 Sensor Ht.: 10 meters
 Starting torque: #N/A gm cm
 Starting threshold: #N/A MPH

Last calibration date: NA

Cal. Factors

	<u>Chart</u>	<u>DAS</u>
Slope:	1.000	1.000
Int.:	0.000	0.000

WS Audit Point	Audit MPH Input		Site MPH DAS	MPH Diff. DAS
1	0.6		0.6	0.0
2	9.6		9.5	-0.1
3	18.5		18.5	0.0
4	36.4		36.3	-0.1

Comments: Bearings felt free. No problems noted.

T&B SYSTEMS
 HORIZONTAL WIND DIRECTION

Date: 05/01/03
 Start: 12:45 PST
 Finish: 13:15 PST
 Audited By: David Bush/David Yoho
 Witness: Bill Grant

Site Name: PIU
 Operator: UCLA
 Project: SCPCS

Manufacturer: Met One
 Serial No.: Y2211
 K factor: 29.8
 Range: 360 Deg
 Crossarm: N/A Deg true

Model: 0-34A
 Sensor Ht.: 10 meters
 Starting torque: #N/A gm cm
 Starting threshold: #N/A m/s

Last calibration date: Oct-02
 Slope: 1.000
 Int.: 0.0

Chart DAS
 1.000 1.000
 0.0 0.0

WD Audit Point	Audit Degrees DAS		Site Degrees DAS	Diff. Degrees DAS
1	135		134	-1
2	225		224	-1
3	315		318	3
4	45		44	-1

Audit Criteria ± 5 degrees
 ± 2 degrees (orientation)

Comments: Orientation - data logger read 180 deg when vane was pointing 182 deg.
 Bearings felt free. No problems noted.

T&B SYSTEMS
 AMBIENT TEMPERATURE

Date: 05/01/03
 Start: 9:00 PST
 Finish: 12:00 PST
 Audited By: David Bush/David Yoho
 Witness: Bill Grant

Site Name: PIU
 Operator: UCLA
 Project: SCPCS

Manufacturer: Vaisala
 Serial No.: V1130024
 Lower Range: -30 Deg C
 Upper Range: 50 Deg C

Model: HMP45A
 Sensor Ht.: 1 meter above roof

Last calibration date: NA

Cal. Factors

	<u>Chart</u>	<u>DAS</u>
Slope:	1.000	1.000
Int.:	0.000	0.000

Temperature Audit Point	Audit Deg C Input		Site Deg C DAS	Deg C Diff. DAS
1000	16.3		16.5	0.2
1100	17.7		18.1	0.4

Audit Criteria: $\pm 1.0^{\circ}\text{C}$

Comments: No problems noted. Mounting the temperature sensor >2 meters above the top of the trailer is recommended to minimize artificial temperature affects produced from the rooftop.

T&B SYSTEMS
 INTERIOR TEMPERATURE

Date: 05/01/03
 Start: 10:45 PST
 Finish: 11:00 PST
 Audited By: David Bush/David Yoho
 Witness: Bill Grant

Site Name: PIU
 Operator: UCLA
 Project: SCPCS

Manufacturer: Vaisala
 Serial No.: V090002

Model: HMW70Y

Lower Range: -30 Deg C
 Upper Range: 50 Deg C

Last calibration date:

Cal. Factors

	<u>Chart</u>	<u>DAS</u>
Slope:	1.000	1.000
Int.:	0.000	0.000

Temperature Audit Point	Audit Deg C Input		Site Deg C DAS	Deg C Diff. DAS
10:45 - 11:00 PST	22.9		26.2	3.3

Audit Criteria: $\pm 1.0^{\circ}\text{C}$

Comments: Response is high.

T&B SYSTEMS
 RELATIVE HUMIDITY

Date: 05/01/03
 Start: 08:00 PST
 Finish: 10:00 PST
 Audited By: David Bush/David Yoho
 Witness: Bill Grant

Site Name: PIU
 Operator: UCLA
 Project: SCPCS

Manufacturer: Vaisala
 Serial No.: V1130024

Model: HMP45A
 Sensor Ht.: 1 meter above roof

Last calibration date: NA

Cal. Factors

	<u>Chart</u>	<u>DAS</u>
Slope:	1.000	1.000
Int.:	0.00	0.00

R.H. Audit Point	Audit R.H. Input		Site R.H. DAS	R.H. Diff. DAS
900	53.4		50.9	-2.5
1000	42.2		39.5	-2.7

Audit Criteria: NA

Audit Equivalent Dew Point	Audit Deg C Input		Site Deg C DAS	Deg C Diff. DAS
900	6.8		6.1	-0.7
1000	4.7		3.8	-0.9

Audit Criteria: $\pm 1.5^{\circ}\text{C}$

Comments: No problems noted. Mounting the relative humidity sensor >2 meters above the top of the trailer is recommended to minimize artificial affects produced from the rooftop.

T&B SYSTEMS
 INTERIOR RELATIVE HUMIDITY

Date: 05/01/03
 Start: 10:45 PST
 Finish: 11:00 PST
 Audited By: David Bush/David Yoho
 Witness: Bill Grant

Site Name: PIU
 Operator: UCLA
 Project: SCPCS

Manufacturer: Vaisala
 Serial No.: V0920002

Model: HMW70Y
 Sensor Ht.: Interior

Last calibration date: NA

Cal. Factors

	<u>Chart</u>	<u>DAS</u>
Slope:	1.000	1.000
Int.:	0.00	0.00

R.H. Audit Point	Audit R.H. Input		Site R.H. DAS	R.H. Diff. DAS
10:45 - 11:00 PST	33.27		30.0	-3.3

Audit Criteria: NA

Equivalent Dew Point	Audit Deg C Input		Site Deg C DAS	Deg C Diff. DAS
10:45 - 11:00 PST	5.9		4.4	-1.5

Audit Criteria: $\pm 1.5^{\circ}\text{C}$ equivalent dew point

Comments: None