URS

Quality Assurance Project Plan

KCBX Terminals Company

Chicago, Illinois

Revision 1.1

(October 15, 2014)

Prepared for:

KCBX Terminals Company
3259 East 100th Street
Chicago, IL 60617

Prepared by:

URS Corporation
9400 Amberglen Boulevard
Austin, TX 78729

Statement of Limitations: This document details a quality assurance plan to guide the successful implementation of Ambient Air Monitoring by URS Corporation at the KCBX Terminals Company North and South Terminals in Chicago, IL. The scope of services performed for this work may not be appropriate to satisfy the needs of other users, and any use or re-use of this document or of the findings of this study is at the sole risk of said user.

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Approved by

James Clarke	10/22/2014
(URS Project Manager)	*(Date)*
	22 October 2014
(KCBX Representative)	*(Date)*
(EPA Representative)	*(Date)*
	10/23/14
(URS QA Task Leader)	*(Date)*

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A. PROJECT MANAGEMENT

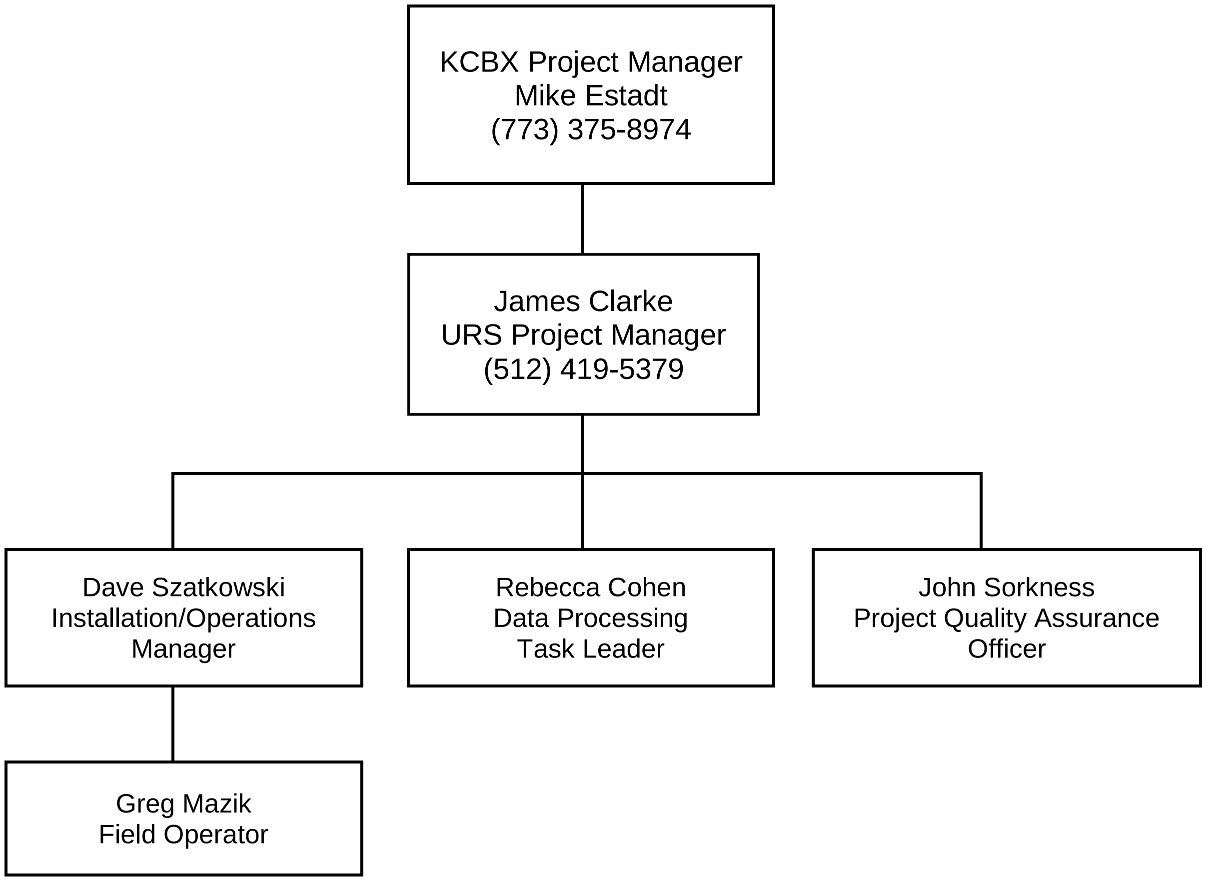
The US Environmental Protection Agency (USEPA) has established guidelines for documenting the policies and procedures used to conduct environmental monitoring programs so that organizations seeking review of a monitoring protocol or acceptance of the resulting data can do so efficiently. In accordance with these guidelines, this Quality Assurance Project Plan (QAPP) describes the sampling and analytical methods that will be used to gather the measurement data, and the procedures employed to assess, control, and document the data quality. This QAPP is in the format specified in the publication, "*EPA Requirements for Quality Assurance Project Plans for Environmental Data Operations*," EPA QA/R-5, March 2001. Following this format, this QAPP is divided into five sections with the following contents:

- **Section A –** Provides a description of the problem and the monitoring project with a presentation of the project organization, the data quality objectives, and the records to be generated;
- **Section B –** Provides a detailed description of all the elements of the monitoring strategy and methods, including the methods for sampling, sample handling, analysis, quality control, and data management;
- **Section C –** Provides a description of the procedures that will be used to assess and report on the QA/QC elements employed in the project;
- **Section D –** Provides a description of the methods that will be used for data review, validation and for reconciling the generated data with all regulatory agency requirements; and
- **Section E –** Provides references to regulatory and method specific documents that form the basis for obtaining the measurement data.

A1 Project/Task Organization

This section presents the organizational structure for the air monitoring program at the KCBX Terminals Company North and South Terminals in Chicago, IL (KCBX) and describes the responsibilities of those within it. This structure is depicted in Figure A-1 showing the key personnel and team roles, including the KCBX project manager, the URS Project Manager, Field Installation/Operations Manager, Data Processing Task Leader, and Project Quality Assurance Officer. The key individuals and their responsibilities are identified below:

Figure A-1. Project Organizational Chart



KCBX Project Manager – The principal contact person for KCBX is Mr. Mike Estadt**.** He provides client supervision and review of the air monitoring program. Any changes to the scope of the monitoring program will be made only with the written approval of the KCBX Project Manager and review by EPA Region 5.

URS Project Manager – Mr. James Clarke is the Project Manager overseeing the day to-day project activities, tracking the project budget, and ensuring the proper execution of the monitoring work. He provides the primary leadership of the URS project team members.

Installation/Operations Manager – Mr. Dave Szatkowski is the Field Installation and Operations Manager. He is responsible for integrating and installing the monitoring equipment, then subsequently directing all data collection, equipment maintenance, and troubleshooting activities. Mr. Szatkowski's overall responsibility is to insure the collection of valid measurement data.

Field Operator – Mr. Greg Mazik of the URS Chicago office provides operations support to the program. He will assist with the equipment installation, conduct routine maintenance on the equipment, collect manual samples, and review raw field data.

Data Processing Task Leader - Ms. Rebecca Cohen serves as Task Leader for data processing. She is responsible for reviewing the unedited data for data validity in accordance with the project data quality objectives, applying appropriate edits (refer to Data Validation Section) to the database values as determined in the data review process, and producing the data deliverables for the client.

Quality Assurance Project Officer – Mr. John Sorkness is the Project QA Officer. He is responsible for conducting routine assessments of the measurement systems for accuracy through periodic audits of field equipment and procedures. He fills no other role with the project to maintain objectivity.

A2 Problem Definition and Background

On November 15, 2013, the United States Environmental Protection Agency (USEPA) issued a Request for Information (RFI) under Section 114(a) of the Clean Air Act. The RFI requires KCBX to install and operate PM_{10} air quality monitors and samplers at its South and North Terminals for a period of one year.

In addition, the request requires a 10-meter meteorological station be operated at one of the sites to characterize wind flow through the area during the study period. KCBX has elected to install two identical meteorological monitoring stations, one at the North Terminal northwest site and one adjacent to South Burley Avenue along the east fence line of the South Terminal. The meteorological monitors will meet the specifications of USEPA meteorological monitoring guidance in Volume IV of the Quality Assurance Handbook and be of sufficient quality for low threshold wind measurements to use in modeling applications if needed. Each station will also be equipped to record data measurements of the following meteorological parameters:

- Wind Speed,
- Wind Direction,
- Ambient Temperature,
- Barometric Pressure, and
- Standard Deviation of Wind Direction (Sigma Theta).

A3 Project/Task Description and Schedule

This project is conducted to provide air quality and meteorological data from ten monitoring sites located around the KCBX North Terminal (4 sites) and South Terminal (6 sites). The selected sites are on KCBX owned or leased property.

The monitoring stations contain pollutant monitors for PM_{10} and are operated to obtain hourly continuous average data. Manual PM_{10} samplers for speciation analyses are operated at the northeast site location for each Terminal. The meteorological conditions are also continuously measured at one site at each Terminal and are stored in an onsite data logger as five-minute averages.

The monitoring station siting survey was conducted in November 2013, and a report was submitted to EPA Region 5 on December 16, 2013. Deliverables for the project include this QAPP and a validated data set in Excel spreadsheet format. A project report reviewing the quality control data and audit results will also be provided to KCBX upon conclusion of the monitoring. Monthly email operational status reports are also required to be provided to KCBX. More detail about the spreadsheet and report content is presented in Section B7.

The project scope of work is divided into tasks, each of which has a designated task leader as shown in Figure A-1. The primary tasks for this project include installation/operations, data management, and quality assurance.

The current schedule is to initiate hardware integration and installation after KCBX receives approval of the proposed air monitoring program documentation (this QAPP) from EPA Region 5. It is anticipated that two weeks will be needed to perform the necessary station assembly, checkout, and installation at the KCBX Terminals. Operations will proceed for a minimum of one year.

A4 Data Quality Objectives and Criteria for Measurement Data

The EPA has developed a Data Quality Objective (DQO) process for use in the planning of environmental measurement projects. URS used the DQO process in the preparation of this QAPP and in the planning for this project. The results of the 7-step DQO process are shown in Figure A-2. The benefits of the DQO process are that it prompts a statement of the problem or issue, identifies the decision(s) to be made and the inputs needed to make the decision(s), and specifies a decision rule.

Following the DQO process, a set of quality criteria is defined for the measurement data. For this project, those criteria are given in Table A-1. These criteria are designed to provide accurate measurements of PM_{10} and sample speciation. The criteria for meteorological data measurements are patterned after the onsite regulatory meteorological monitoring guidance published by EPA.

A5 Documentation and Records

The dataset created for this monitoring program will consist of these components stored for a minimum of five years in the project database:

- The hourly PM_{10} data from each monitoring site;
- The laboratory analyses of manual samples for elemental/organic carbon, select metals, and PM_{10} gravimetric mass; and
- The 5-minute average wind speed, wind direction, ambient temperature, barometric pressure, and sigma theta measurements at each meteorological monitoring site, and the calculated hourly averages from the 5-minute meteorological data.

The following sources of information will support these data:

- Station log books (in electronic form on field operator's computer);
- Calibration and maintenance records for all measurement systems;

- Laboratory reports with quality control results;
- Operational information collected internally by each monitor or sampler;
- Data validation and editing instructions; and
- QA audits of field operations and monitor performance.

Figure A-2. DQO Process for KCBX Project

STEP 1	State the Problem	KCBX has agreed to establish a program to monitor for PM_{10} in real-time at specified locations at or near the fence line to determine on-site or off-site (whether upwind and/or downwind) contributions, if any, to the monitors. Additional manual sampling is needed to provide speciation data for elemental/organic carbon, metals, and PM_{10}.
STEP 2	Identify the Decision	An ambient air monitoring program conducted at the areas identified by predominant wind flow and potential for community impact. The speciation data will be used to assist in possible determination of PM_{10} sources.
STEP 3	Identify the Inputs to the Decision	Measurements of PM_{10} concentrations will be made at nine (9) locations as 1-hour averages. Meteorological data will be collected (wind speed, wind direction, ambient temperature, barometric pressure, Sigma theta) on a 5-minute basis at each Terminal (see Figures B-1 and B-2 of QAPP) at a predominant downwind location. Speciation samples will be obtained at the northeast site of each Terminal.
STEP 4	Define the Study Boundaries	Location and frequency of sampling as defined in Section B of the QAPP document.
STEP5	Develop a Decision Rule	KCBX will use the reported concentration levels and meteorological data to help assess net facility impacts and upwind background.
STEP 6	Specify the Limits of Decision Errors	Calibration of the monitoring equipment will be conducted as specified in EPA guidance documents and quality control limits will conform to guidance. See Table A-1 of the QAPP.
STEP 7	Optimize the Design	If the current system does not conform to the required QA/QC protocols, KCBX will initiate corrective action to bring the program into conformance.

Table A-1. Quality Criteria for Measurement Data

1. Measurements of PM_{10} using EPA Federal Equivalent Method (FEM) Monitor (BAM-1020)	
Sensitivity	Lower Detection Limit <4.8 µg/m^3 2σ, 1-hour average
Accuracy	Meets EPA Class III FEM Standard for additive and multiplicative bias; flow rate measurement accuracy ±4% at 16.7 LPM
Range	1 – 1000 µg/m^3
Completeness	80% or better quarterly for each monitor at each site (with the exception of Acts of God, loss of power, scheduled calibration/audit events, or other situations over which neither KCBX nor their monitoring contractor have control)
Cycle Time	One hour
2. Measurements of Elemental/Organic Carbon (EC/OC) using EPA speciation network SOP (TO/FID)	
Accuracy	±16.7% at 23 µg/m^3
Precision	0.085 at 23 µg/m^3
Completeness	80% or better quarterly for each sampler (with the exception of Acts of God, loss of power, or other situations over which neither KCBX nor their monitoring contractor have control)
3. Measurements of Metals using EPA Method IO-3.5 (ICP-MS)	
Accuracy	±20% for analytical results above the reporting limit
Precision	±10% for analytical pairs above the reporting limit
Completeness	80% or better quarterly for each sampler (with the exception of Acts of God, loss of power, or other situations over which neither KCBX nor their monitoring contractor have control)
4. Measurements of PM_{10} using EPA Federal Reference Method (FRM) Sampler (2025i PartisolPlus)	
Accuracy	Flow rate measurement accuracy ±4% at 16.7 LPM
Precision	Assessed by comparing sample data with 24 hour FEM average measurements; least squares slope within 10% for sample pairs ,<60 µg/m^3 on a quarterly basis for each NE monitoring site
Completeness	80% or better quarterly for each sampler (with the exception of Acts of God, loss of power, or other situations over which neither KCBX nor their monitoring contractor have control)
3. Measurements of Meteorological Parameters using weather instruments (MetOne)	
System Accuracy	±0.2 m/s (WS), ±5 degrees (WD), ±1.0°C (TMP), ±5 mmHg (BP)
Precision	EPA methodology does not provide for assessment of measurement precision
Completeness	90% or better quarterly for meteorological data based on hourly averages with a minimum 75% completeness of 5-minute data to construct a valid hourly average (with the exception of Acts of God, loss of power, scheduled calibration/audit events, or other situations over which neither KCBX nor their monitoring contractor have control)

B. MEASUREMENT DATA ACQUISITION

B1 Sampling Process Design

Consistent with the requirements of the Section 114(a) request, KCBX will establish monitoring sites at its North and South Terminals as indicated previously in Section A3. The source environment and monitoring site descriptions are presented in the following sections.

B1.1 Source Environment Description

The location of the KCBX North and South Terminals are in south Chicago, Illinois, near the southern tip of Lake Michigan along the Calumet River. The elevation of the area is approximately 590' above sea level and terrain is relatively flat. The suburbs of Chicago, Illinois surround the area and several neighborhoods are adjacent to portions of each Terminal fence line.

The local land use categories include refining and heavy industry, with a significant presence of residential housing immediately adjacent to and surrounding the western and eastern boundaries of the North Terminal and along the eastern boundary of the South Terminal. Minor river ports and canals are present in the area and provide access to Lake Michigan.

The climate of the area where the Terminals are located is characterized by cold winters and warm summers with occasional heat waves. The average temperature in January is 22º F and the average temperature in July is 73.3º F although 90º summer days are not uncommon. The annual average snowfall in winter is 37.5" and the annual average precipitation total is about the same. The proximity of KCBX to Lake Michigan's southernmost tip brings wind effects year-round. Annual wind roses for the area indicate a strong NW component as well as a strong SW component, based on the season.

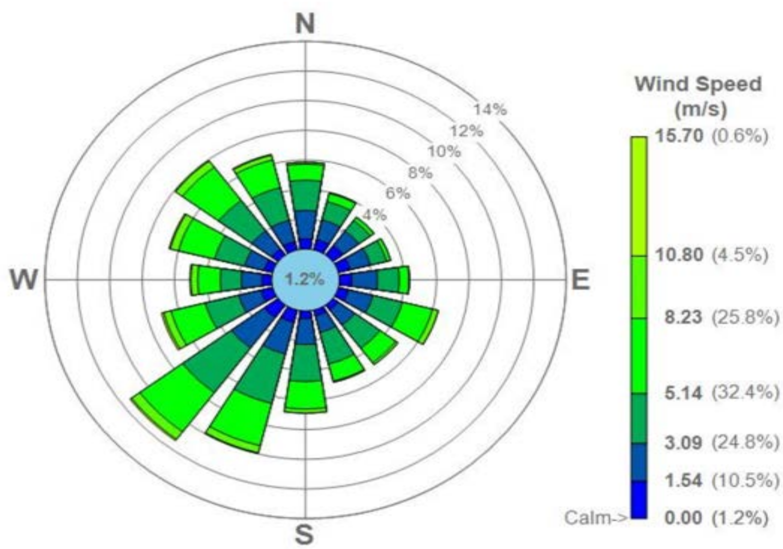
B1.2 Monitor Site Description

Figures B-1 and B-2 (yellow pins) indicate the locations at which KCBX will operate monitoring stations as part of this program. The blue lines indicate approximate property boundaries. An example historical wind rose plot from Chicago is shown in Figure B-3. The predominant winds appear to be seasonally trimodal with very few winds directly from the East. Table B-1 lists the monitoring network configuration by site.

Figure B-1. Monitoring Site Locations for the KCBX North Terminal

Figure B-2. Monitoring Site Locations for the KCBX South Terminal

Figure B-3. Wind Rose Plot for Chicago Area



B2 Sampling Methods Requirements

Sample collection methods are presented in this section as are sample documentation and control requirements that are applicable to the network. Three types of sampling methods have been identified for the KCBX network.

B2.1 Sample Collection Methods

BAM-1020 FEM PM_{10}

The PM_{10} continuous monitors collect ambient particulate matter samples through a size-selective inlet that is designed to allow only particles with an aerodynamic diameter <10 µm to pass through to the measurement apparatus. PM_{10} is measured using the MetOne Instruments Model BAM-1020 (EPA designated Class III Federal Equivalent Method EQPM-0798-122). Specifications for the BAM-1020 are provided in Table B-2. The operation of the BAM unit is described in Section 3, of Revision K, of the MetOne BAM-1020 manual, along with calibration procedures (Section 5), and maintenance procedures (Section 7). The network technician has a copy of this manual for reference and an electronic copy is available to all project team members in the project management folder of the URS Austin server. The sample inlet height will be approximately 2 meters, within the 2-7 meter inlet height specification.

Table B-1. KCBX Monitoring Network Configuration by Site

Site ID	Approximate Location	Monitoring Equipment
#NT-NW	Northwest North Terminal 41 42.744 N 87 32.911 W	BAM-1020 monitor for $PM_{10;}$ Meteorological monitors (MetOne 010C WS, 020C WD, 060A-2 TMP, Vaisala PTB110 BP)
#NT-NE	Northeast North Terminal 41 42.797 N 87 32.952 W	BAM-1020 monitor for $PM_{10;}$ PartisolPlus 2025i samplers for EC/OC, metals, PM_{10} mass
#NT-SW	Southwest North Terminal 41 42.573 N 87 33.013 W	BAM-1020 monitor for PM_{10}
#NT-SE	Southeast North Terminal 41 42.576 N 87 32.708 W	BAM-1020 monitor for PM_{10}
#ST-NW	Northwest South Terminal 41 41.936 N 87 33.066 W	BAM-1020 monitor for PM_{10}
#ST-N	North South Terminal 41 41.921 N 87 32.864 W	BAM-1020 monitor for PM_{10}
#ST-NE	Northeast South Terminal 41 41.954 N 87 32.744 W	BAM-1020 monitor for $PM_{10;}$ PartisolPlus 2025i samplers for EC/OC, metals, PM_{10} mass
#ST-M	East boundary South Terminal 41 41.854 N 87 32.746 W	Meteorological monitors (MetOne 010C WS, 020C WD, 060A-2 TMP, Vaisala PTB110 BP)
#ST-CE	East boundary South Terminal 41 41.673 N 87 32.756 W	BAM-1020 monitor for PM_{10}
#ST-SW	Southwest South Terminal 41 41.608 N 87 33.070 W	BAM-1020 monitor for PM_{10}

Table B-2. BAM-1020 Specification

Range	1 – 1000 µg/m^3
Sensitivity Std Deviation (σ; 1 hr)	<2.4 µg/m^3
Flow Rate	16.7 liters/ minute (LPM)
Beta Source	Carbon-14; 60µCi ±15 µCi
Operating Temperature	0º to 50ºC
Humidity Control	Active control inlet heater; 35% RH setpoint
Analog Output	0-1 VDC std; selectable voltage and current ranges
Memory	182 days @ 1 record/hour

PartisolPlus 2025i FRM PM_{10}

The PM_{10} samplers collect ambient particulate matter samples through a size-selective inlet that is designed to allow only particles with an aerodynamic diameter <10 µm to pass through to the measurement apparatus. PM_{10} is measured using the Thermo Environmental Instruments Model 2025i PartisolPlus sequential sampler (EPA designated Federal Reference Method RFPS-1298-127). Specifications for the Model 2025i are provided in Table B-3. The operation of the unit is in accordance with the May 26, 2011 revision of the Thermo Environmental Instruments 2025i manual. Specific procedures are provided in Chapter 7 (Sampler Operation), Chapter 8 (Calibration), and Chapter 10 (Preventative Maintenance). The network technician has a copy of this manual for reference and an electronic copy is available to all project team members in the project management folder of the URS Austin server. The sample inlet height will be approximately 2 meters, within the 2-7 meter inlet height specification.

Table B-3. PartisolPlus 2025i Specification

Range	1 – 1000 µg/m^3
Sample capacity	16 filter cassettes
Flow Rate	16.7 liters/ minute (LPM)
Operating Temperature	-30º to 50ºC
Data Output	selectable voltage ranges; RS-222; Ethernet
Memory	86 days @ 1 record/ 5 minutes

Meteorological Measurements

Two 10 meter meteorological towers will be installed as part of this program. The first will be located near the northwest boundary of the North Terminal, and the second near the east boundary of the South Terminal. The towers will be outfitted with wind speed, wind direction, ambient temperature, and barometric pressure sensors. The data reported from the meteorological system will include vector resultant wind direction, scalar wind speed, vector wind direction standard deviation (aka Sigma Theta), ambient temperature, and barometric pressure for each five-minute and hourly collection period. Additional measurements of ambient temperature and barometric pressure will be collected from each BAM unit using onboard sensors, which enable them to calculate the correct flow rates for PM_{10} monitoring. Sensors will be sited according to EPA guidelines. Table B-3 lists the performance specifications for each sensor type. A brief description of the meteorological sensors follows.

The Met One Model 020C wind direction sensor is a standard vane-type assembly. The vane is directly coupled to a single precision potentiometer. A built-in electronics module provides a voltage source for the potentiometer and amplifies the output signal. The voltage output is applied to a Campbell data logger for processing and storage of averages. The Met One Model 010C wind speed sensor contains a three-cup anemometer directly coupled to a slotted disc chopper wheel. The chopper rotates and interrupts the light path of an optical link. The signal is amplified and produces a pulsed frequency output proportional to wind speed. This output is applied to a Campbell data logger for processing and storage of averages. Each wind sensor is equipped with an internal heater to provide positive pressure to minimize internal dust accumulation and provide protection against light icing conditions. If extensive icing is encountered, external sleeve heaters may be employed to minimize downtime.

The Met One Model 060A-2 temperature sensor consists of a solid state electronic resistance element. The sensor is housed in a fan-aspirated radiation shield mounted at 2 meters height. The resistance output is applied to a Campbell data logger for processing and storage of averages. The Vaisala Model PTB 110 is an electronic pressure transducer. Its output is applied to a Campbell data logger for processing averages of ambient barometric pressure. It is mounted near the data logger at less than 2 meters height.

Shelters

Environmentally controlled shelters with a minimum insulation rating of R11 will be installed at each monitoring site. The commercial grade climate control systems in each shelter will generally control the inside temperature within the range of 20 – 30º C for satisfactory instrument performance and maintain a slight positive pressure. All internal electrical wiring conforms to National Electrical Code (NEC). Each shelter is configured with a sample inlet

Table B-4. Specifications for Meteorological Sensors

Wind Speed	
Starting Speed	0.22 m/s
Calibrated Range	0 to 50 m/s
Accuracy	± 1% or 0.07 m/s
Temperature Range	- 50 to +65°C
Response (Distance Constant)	< 3 feet to reach 63% of rate
Wind Direction	
Operating Range (Azimuth)	0 to 360 degrees
Starting Threshold	0.22 m/s
Linearity	± 0.5% of full scale
Accuracy	± 3 degrees
Damping Ratio	0.4 to 0.6
Delay Distance	Less than 3 feet
Ambient Temperature	
Range:	- 50° to +50° C
Accuracy:	± 0.1° C ambient
Barometric Pressure	
Range:	375-825 mmHg
Accuracy:	± 0.8 mmHg

flange through which the BAM-1020 inlet tubing is routed. Figure B-4 shows the EKTO dual unit cabinets which will be installed at the northeast sites at each Terminal (only one BAM unit will be installed for this monitoring network), and the single unit cabinet which will be installed at the remaining continuous PM_{10} monitoring sites. The single unit cabinets are from ShelterOne (white exterior) and EKTO (tan interior), but are the same basic configuration.

Data Systems and Software

The BAM-1020 units have onboard data logging capability of up to six months, so data values and diagnostic information are readily accessible. AirPlus software is used to communicate with the BAM-1020. The PartisolPlus samplers have capability for onboard storage of up to 90 days and the Thermo iPort software is used to communicate with the 2025i; each unit will be connected to the cellular aircard and router via Ethernet. Each meteorological monitor is wired into a Campbell Scientific CR-10X data logger with a network interface module at each meteorological tower and the CR-10X has at least six months of data storage capacity.

LoggerNet is the software program used to communicate with Campbell data loggers. Data will be acquired via cellular aircards and a router using each of these software products for file transfer protocol from the sites to the URS office in Austin, Texas each business day.

Figure B-4. Shelter Configurations

All datalogger, monitor, and sampler time settings will be set within ±60 seconds of the site technician's reference time obtained from a local cell phone network.

B2.2 Sample Documentation and Control Requirements

Field operation records include site visit and maintenance logs, checklists, chain of custody forms, continuous monitor calibration documents, and meteorological calibration documents. All of these records are in electronic form, as spreadsheets or text files. All field operation records are returned at least monthly to the URS data management task leader for inclusion in the project files. The automatic data polling systems are password protected and only URS team members have access. Examples of the checklists and calibration documents are presented in Appendix A and an example chain of custody form for laboratory samples is presented in Appendix B. The chain of custody protocol will follow the general guidance of Section 8 of Volume II of the EPA QA Handbook and sample specific requirements for storage and handling in each applicable analytical method, as well as Chapter 3 of the 2025i manual.

B3 Analytical Methods Requirements

The monitoring program will collect 24-hour PM_{10} filter samples that will later be analyzed for heavy metals and elemental carbon/organic carbon (EC/OC). Since one sample filter cannot be used for both types of analyses, URS will operate two Thermo Environmental Instruments Model 2025i PM_{10} samplers at the northeast sites of each terminal. These samplers will operate from midnight to midnight, every three days, according to EPA's 3-day sampling schedule. The first sample date is projected to be February 19, 2014. Particulate matter is collected on pre-fired 47mm quartz fiber filters for EC/OC analysis, and on pre-weighed 47mm Teflon filters for mass and metals analysis. Samples will be collected weekly, after every 2-3 sample events and stored cold (<4°C) until a batch of filters is returned to the lab biweekly.

The exposed Teflon filters from each Terminal will be sent to Research Triangle Institute's (RTI's) laboratory in Research Triangle Park, North Carolina for analysis. RTI will initially perform a gravimetric analysis of the filters to determine its PM_{10} mass concentration using EPA Method IO-2.1. The mass concentrations produced should provide a general indication of measurement agreement between the PartisolPlus samplers and BAM monitors at each northeast site.

Following gravimetric analysis, these filters will be prepared and extracted for heavy metal analysis using EPA Method IO-3.1, followed by Method IO-3.5 (ICP-MS). The estimated Method Detection Limit (MDL) for each of the target metals is listed below.

	Estimated MDL
Metal	**nanograms per cubic meter (ng/m^3)**
Arsenic	0.52
Barium	0.52
Cadmium	0.10
Chromium	0.26
Copper	0.10
Iron	0.26
Lead	0.10
Manganese	0.26
Nickel	0.52
Selenium	0.52
Silver	0.10
Vanadium	0.52
Zinc	0.26

Quartz fiber filters collected on the second PartisolPlus sampler located at each Terminal will be sent to RTI for EC/OC analysis. Filters will be prepared and analyzed using an application of NIOSH Method 5040, per the PM coarse speciation network SOP developed by

RTI. The carbon analysis is a Thermal Optical method. A small punch (0.5 cm^2) from the quartz filter is exposed to a laser beam under helium atmosphere and temperature is raised to 540^0 C. All the organic carbon is determined where the carbon is oxidized to CO_2 by oxidation and reduced to methane by oxidation and reduction catalysts. Subsequently it is measured by a flame ionization detector. When organic carbon evolves at 540^0 C, oxygen is introduced and the temperature is raised to 740^0 C. Elemental carbon is determined by the same principle. Several peaks according to the boiling points will be shown in the thermogram, which are called different fractions such as OC1, OC2, etc. A list of carbon species targeted for this analysis and associated MDLs are provided below.

Carbon Species	Estimated MDL micrograms per cubic meter (μg/m^3)
Organic Carbon 1	0.005
Organic Carbon 2	0.008
Organic Carbon 3	0.013
Organic Carbon 4	0.015
PCR	0.033
Elemental Carbon 1	0.009
Elemental Carbon 2	0.012
Elemental Carbon 3	0.013
OCR	0.038
Total Carbon	0.038

Laboratory records include sample cassette IDs imprinted on the filter support screens, chain-of-custody forms matching cassette ID to sample ID, raw data files from the analysis, QC check data, analysis reports, and electronic data files for transmittal to the project database. The laboratory is responsible for maintaining these records, and long-term archival of records is accomplished using a well-defined laboratory procedure. Each time that the lab receives field samples, sample login e-mail verification is sent to the data management task leader, as a scanned Adobe Acrobat file of the chain-of custody form.

An important consideration of the analytical work is the treatment of data at low concentrations near the method detection limit for the laboratory. Each laboratory has two boundaries within its KCBX reporting protocol: the Method Detection Limit (MDL) and the Reporting Limit (RL). Each target compound on the KCBX list has a unique MDL and RL. The RL is typically five times higher than the MDL, and results reported within this concentration range between MDL and RL are flagged as such. The precision and accuracy specifications are applicable to measurement data at or above the RL, and lower concentration data are possibly outside the quality specifications and should be treated accordingly by data users. The laboratory analysis conditions, such as sample or digestate volume can vary slightly from sample to sample, so these numbers are not absolute. The estimated MDLs provided above are based on a nominal sample volume of 24 cubic meters of air.

The subcontract analytical laboratory has published SOPs that describe the basic procedures and quality indicators used by the lab to demonstrate adherence to the EPA methods. There are no special analytical requirements for this project outside of the EPA method or the laboratory SOPs. The SOPs may be reviewed upon request to the laboratory.

B4 Quality Control Requirements

This section describes the quality control methods employed in the network. All field related information is presented in Section B4.1 and lab related information is presented in Section B4.2.

B4.1 Field Quality Control

Field quality control encompasses several areas of concern. The tasks required of the field technician to promote quality are as follows (calibration tasks are discussed in Section B5):

- Documentation – The operator will maintain a file of site information that will include site visit and maintenance logs, operator checklists and calibration data. Copies of this documentation will be forwarded to the project team at least monthly, and these items will be retained in the project files. Submittal via electronic mail is acceptable. Examples of the calibration data sheets and operator checklists are presented in Appendix A.
- PM_{10} Monitor Checks – A leak check, flow rate check, and temperature/pressure transducer check will be performed biweekly, or after any major maintenance, as recommended in the BAM-1020 manual. Additional maintenance checks are listed on the monthly QC spreadsheet used for this project (an example is shown in Appendix A).
- PM_{10}/Speciation Sampler Checks – Appendix B contains example chain of custody form for the subcontractor laboratory participating in this monitoring effort. PartisolPlus sampler operating checks will be performed at least weekly and recorded on a QC spreadsheet, and will include a leak check and operating flow rate test. Additional maintenance checks are listed on the monthly QC spreadsheet used for this project (an example is shown in Appendix A).
- Meteorological Equipment Checks – The field technician will visually inspect the meteorological equipment at each visit (weekly at a minimum) for signs of deterioration or damage. With every site visit, he will review recent data and compare it to reported National Weather Service conditions for the area.

The meteorological sensors will be calibrated with traceable secondary instruments, which will either place the sensor in a known condition or make a comparative measurement.

All sensors are initially calibrated and certified by the instrument manufacturer and then compared to a traceable standard under ambient conditions every six months when deployed to the field.

The wind vane sensor will be aligned with landmarks of known orientations and the readings from the Campbell data acquisition system will be used to assess system accuracy. Orientation will be established relative to true north (subject to the local magnetic declination value of -3° 46' W), based on initial alignment conducted with a surveyor's transit. The wind speed anemometer shaft will be rotated with a traceable constant velocity motor at rates corresponding to four known wind speeds. Readings from the data acquisition system will be used to assess the correct anemometer response to a known motor velocity. These checks will be conducted every six months as part of the meteorological system calibration.

The ambient temperature and barometric pressure sensor outputs will be compared to traceable temperature and pressure standards of known accuracy every six months with the meteorological system calibration. The monthly check for the onboard temperature and pressure sensors for the BAM is documented on the BAM QC form, since the temperature and pressure readings are critical to subsequent PM_{10} mass calculations. A summary of service checks is proved in the BAM manual (refer to Section 7 of the manual). The other quality control checks for the meteorological hardware in this project include:

- Visually inspecting (from ground level) the meteorological sensor and tower system during each site visit;
- Inspecting the anemometer and wind vane for any damage if the data appear suspect;
- Visually inspecting the wind direction alignment for reasonableness during each site visit;
- Checking the temperature aspirator fans for proper operation;
- Inspecting the BAM temperature and barometric pressure sensor housing for evidence of damage or airflow blockage; and
- Comparing the current conditions to local weather reports and against measurements from other monitoring sites in the area as available.

B4.2 Laboratory Quality Control

The following lists present some of the common quality control procedures required by the methods for each type of analysis. Specific quality control measures are provided in the laboratory SOP documents.

Laboratory quality control for elemental/organic carbon analyses includes the following:

- Quartz fiber filters must be prepared in a low temperature asher for 2-3 hours or in a muffle furnace for 1-2 hours at 800º C.
- Analyze replicate samples. For up to 50 samples, analyze 10 percent, and for over 50 samples, analyze 5 percent.
- Use three quality control spikes and three analyst spikes to check the instruments calibration prior to testing.
- Adjust analyzer settings according to manufacturer's recommendations.
- Double check calculations while determining EC/OC concentrations.

Refer to NIOSH Method 5040 and the RTI SOP for more detailed requirements for the EC/OC quality control measures.

Laboratory quality control for metals analyses includes the following:

- Use at least two calibration standards, and one calibration blank while performing initial calibration.
- While performing calibration verification checks, use calibration standards from a different vendor.
- Analyze a calibration blank before each run.
- Run interference check standards though the analyzer.
- Use continuing calibration standards to check the response of the instrument, as required, depending on the number of filters in a batch.
- A reagent blank should be tested.
- Laboratory control spikes should be used after each batch of samples.
- Analyze a matrix spike during each run.
- Test a duplicate or spike duplicate after testing a group of samples.

Refer to EPA Method IO-3.4 for more detailed requirements for a metals laboratory's quality control program.

Laboratory quality control for gravimetric mass analyses includes the following:

- Use media that meet the requirements for sampling presented in IO Method IO-3.1 Section 4.
- Equilibrate media under the temperature and humidity control requirements of the Method before weighing.
- Use the same microbalance for pre- and post-sampling weighing events.
- Calibrate the microbalance using Class S standard weights.

- After every tenth weighing, re-zero the balance and perform a standard weight check.
- Reweigh 10% of the samples using a different analyst.

Refer to EPA Method IO-3.1 for more detailed requirements for a mass laboratory's quality control program.

URS will be using the following method to create unique sample identification (ID) designations for each field sample collected during this study. Samples will be identified using the following format:

XX-DDMMYY-ZV

Where:
XX is the collection location; NT for North Terminal and ST for South Terminal (both are northeast site)
DDMMYY is the sample day, month, and year
Z is the sample type; C for EC/OC and M for metals and mass samples
V is the type of sample; R indicates a routine sample and B indicates a field blank

For example, NT-021914-CB represents a field blank for carbon species collected on February 19, 2014 at the North Terminal northeast site.

B4.3 Equipment Testing, Inspection, and Maintenance

Specific tasks for periodic testing, inspection, and maintenance are required for the air sampling and monitoring equipment to provide sufficient quality control to remain within the manufacturer's operating specifications and ensure that the project quality goals are met. Initial testing of each piece of equipment is conducted in the URS air quality instrumentation lab for operation within the manufacturer's specifications, then some operational checks are repeated during installation, before initial calibration and use for field measurements. These operational checks are described in Section B4.1. The maintenance tasks are summarized for each type of equipment below.

- Continuous Monitor Maintenance – Each monitor has manufacturer-recommended maintenance schedules that are found in the operating manuals provided at the station. These must be followed at a minimum, or in response to an identified decrease in analyzer performance. For the PM_{10} monitor, the filter tape should be inspected weekly (usual life time is 2 months before replacement). The sample inlet hardware for PM monitors should be disassembled and cleaned monthly, including the PM_{10} nozzle assembly, and the sample pump and tubing should be inspected. Section 7 of the BAM manual provides details.

- Manual Sampler Maintenance – Maintenance of the PartisolPlus 2025i samplers will be performed according to the procedures presented in the manual (Section 10). A large part of preventative maintenance of the PartisolPlus samplers is keeping the PM_{10} head inlet system and filter cassette O-rings and seals clean from dirt. The PM_{10} head and inlet parts should be cleaned a minimum of once a month, or more frequently, if required. Rain hoods and air screens are scheduled to be cleaned every six months. However, experience has shown that insects find these areas a good place to build a nest, requiring more frequent cleaning. O-rings and seals should be inspected monthly and kept pliable with an application of silicone grease. A sharp rise in internal and external leak check results is likely an indication of a potential future leak.
- Meteorological System Maintenance – The field technician must perform an inspection of the tower and equipment and perform maintenance activities with each visit. The inspection should include verifying that the wind vane and anemometer cups/propellers are intact and operable and verifying that the temperature/pressure aspirator fin set is free from debris. An inspection of the signal cables and fastening hardware should be conducted at three-month intervals, during either a system calibration or audit.

These activities must be documented in the site visit logbook. The field operations task leader should provide a schedule for all activities and checklists to the field technician. A limited number of common consumable parts are maintained in the field technician's possession. Additional parts may be obtained from the operations task leader. URS maintains an equipment cost center in Austin, Texas that serves approximately 50 air quality monitoring sites. The equipment used for this project is commonly in stock in the cost center, and spare parts are readily available to deliver to the field via overnight air express, if needed.

B4.4 Acceptance Requirements for Supplies and Consumables

Field equipment supplies and consumables are obtained either directly from the original equipment vendor, or from a scientific equipment/ materials vendor whose products are proven to be equivalent in quality, or are commonly available (silicone grease is an example). The equipment manager for the Austin cost center should be consulted if any question arises regarding suitability for intended use. Such supplies and consumables include but are not limited to: vacuum pump rebuild kits, silicone grease, filter tape, wind sensor bearing assemblies, and BAM nozzle cleaning supplies.

B5 Instrument Calibration and Frequency

This section describes the calibration protocols for each type of measurement conducted in the KCBX network and the prescribed frequency.

B5.1 Calibration Procedures for BAM-1020

Each BAM-1020 unit deployed to the field must undergo a zero background test before taking data. This test is performed using a zero calibration filter kit supplied by MetOne and is placed in place of the sample inlet head. The unit is then operated for a minimum of 72 hours to determine the true zero background of the unit at the given location conditions. The unit's background constant value is then updated in the operating software before sampling can commence. This check will be repeated as needed, usually at six month intervals or after major maintenance or repair.

Calibration of the PM_{10} monitor consists of two levels of activity. First is a semi-annual calibration as described in Section 5 of the BAM manual. This calibration involves testing the flow controller at three flow rates, then setting the operating flow rate at 16.7 liters per minute (LPM). A leak check is performed, and then a flow meter traceable to a NIST primary standard (BGI DeltaCal or equivalent) is installed in place of the sample inlet head to independently measure the flow rate. The temperature and pressure transducers are tested and adjusted, and this is also accomplished using a traceable standard. The results are documented in a spreadsheet.

Second, a biweekly verification check is conducted. This check tests the ability of the sampler mass flow controller to operate at ±4% measurement accuracy, and maintain the design flow rate of 16.7 LPM within ±5%. This procedure is similar to the semi-annual calibration, and a spreadsheet is also used to document the results. A leak check is performed and the flow rate reading should drop to below 0.5 LPM; if this cannot be met, the nozzle should be cleaned and the check repeated. The ambient temperature and pressure transducers are also checked. The acceptance criteria for these calibration checks are ±2.0 °C and ±10 mmHg; if these levels are not met maintenance and adjustment is required. An example of the spreadsheets used for PM_{10} semi-annual calibration and biweekly calibration check activities are included in Appendix A.

B5.2 Calibration Procedures for PartisolPlus 2025i

Calibration of the PartisolPlus 2025i samplers should be performed at least quarterly, or after any maintenance activity that has the potential to alter the response of the instrument. Similar to the BAM-1020 calibration procedures, the PM_{10} sampling head is removed, and the mass flow controller tested over three points against an NIST primary standard (BGI DeltaCal or equivalent). Acceptable results should be ±4% of the flow reading of the primary standard for each point. During calibration, ambient temperature, compartment temperature, filter temperature, and barometric pressure are checked against a certified transfer standard. Allowable ranges for these calibration checks are ±2.0 °C for temperature measurements and ±10 mmHg for pressure readings. Both internal and external leak checks are performed as part of the calibration. Leak check results reported by the instrument should be ±25 mmHg. Readings above that level will require inspecting the O-rings and seals for cracks or other leaks within the flow system. Finally, the internal clock is compared to the time displayed by a cell phone, or other device of known accuracy. The internal clock should be ±60 seconds of the known time (always Central Standard Time). Any results not meeting the acceptance criteria above will require immediate adjustment or corrective action until those criteria are met.

In addition to quarterly flow rate calibrations, monthly flow checks will be performed. These checks are similar to calibrations, but verify only one flow point, instead of three. During each check sampler temperatures, barometric pressure, and the internal clock will be compared to certified transfer standards. Internal and external leak checks will be conducted. As with calibrations, any parameters found to be outside allowable limits will be adjusted or corrected before sampling resumes. Refer to Appendix A for examples of calibration check forms.

B5.3 Calibration Procedures for Meteorological Monitors

Meteorological sensors will be calibrated at program startup and on a scheduled semi-annual basis thereafter. Unscheduled calibrations will be performed following any sensor repair or replacement. The calibrations will occur in monitoring quarters where meteorological sensor audits are not scheduled so that an assessment is performed each quarter, whether a QC check or an audit. Monthly checks of the ambient temperature and barometric pressure sensors onboard the BAM and PartisolPlus units are also conducted as part of the monthly QC procedures for those items.

All calibration methods used will conform to EPA guidelines for calibration of meteorological systems. The specific procedures to be used for the wind instruments are described in Tables B-5 and B-6 and the procedure for temperature is described in Table B-7. Table B-8 describes the barometric pressure sensor calibration check. Meteorological calibrations will be performed twice a year or more frequently if major maintenance or repair is required on any sensor.

Table B-5. Calibration Procedure for Wind Direction Sensors

Required Equipment: **Surveyor's Transit, Tripod, Small Hose Clamp, Linearity Device, Screwdriver**
1. Begin by making a note in the station logbook of the time/date of the calibration. Lower the meteorological tower so that the wind direction sensor is accessible, noting the start time at the top of the audit form. Examine the sensor for damage or loose parts. Install the small hose clamp over the shaft and the vane collar, align the sensor benchmarks, and tighten the clamp, making sure that the benchmarks remain aligned.
2. Check the station data system's instantaneous wind direction readout. A reading of 180º should be indicated. If the reading is not quite 180º, adjust the vane and retighten the clamp until 180º is indicated. Enter this value under "Test Angle" on the bottom of the calibration form. Raise the tower.
3. Set up the surveyor's transit and tripod at a point along the imaginary axis created by the vane at a distance of approximately 35 yards, either to the north or south of the sensor. Level the transit and set the outer vernier to 0º. Align the compass needle to 0º, then lock the lower stage and unlock the upper stage (vernier).
4. Sight the vane with the telescope, making sure that the axis of the vane is square in the cross-hairs. Read the degree value from the vernier to the nearest tenth, e.g., 6.3º East. Compare the value obtained to the known magnetic declination value for the area; the values should agree within ±2º. Note the value observed in the station logbook and on the calibration form. If the vane alignment is out of tolerance, see that corrective action is initiated. Upon completion of the alignment check, lower the tower, remove the clamp, install the linearity device, and set at 180º. Proceed to rotate the vane in 30º increments clockwise and record the sensor output for a full rotation. Once back at 180º rotate counterclockwise down to 0º and record each output.
5. When calibration activities are complete, raise the tower and note the time on the calibration form and in the station logbook.

Table B-6. Calibration Procedure for Wind Speed Sensors

Required Equipment: Allen Key Set, Tygon or Rubber Tubing, Tie-Wraps, Selectable Speed Synchronous Motor Drive, Motor Drive Mounting Arm, Torque Measurement Device
1. Begin by making a note in the station logbook of the time/date of the calibration. Lower the tower so that the sensor is accessible and record the start time in the station notebook. Remove the sensor from its mount and examine the anemometer cups for damage or loose parts. Remove the anemometer cups from the sensor shaft.
2. Connect the shaft of the sensor to the shaft of the motor using Tygon or similar tubing, making sure that no slippage of the tubing is possible around either shaft. A custom mounting arm is provided for this step.
3. Check the station data system instantaneous readout for wind speed. A reading of 0.0 m/s should be indicated as the zero value. Record this value on the calibration form. Set the motor to 60-rpm, selecting clockwise rotation, and record the stable instantaneous output value from the data system. The value should be within 0.2 m/s of 1.9 m/s. Switch the motor to counter-clockwise rotation and verify that the value obtained is the same as in the clockwise rotation position.
4. Set the motor output to 160, 300 and 600-rpm and repeat the above procedure. The value obtained should be within 0.2 m/s of each expected output shown on the spreadsheet.
5. Remove the tubing from the sensor shaft and detach the mounting arm. Attach the torque measurement device and balance the device with the sensor in a horizontal position (all holes in the torque measurement disk should be horizontal). Place a 0.1-gram screw in the hole at a 3-cm radius horizontal from the center. Observe the disk for rotational movement away from horizontal, indicating acceptable bearing condition.
6. Replace the anemometer cups and remount the sensor. Raise the tower and note the time on the audit form.

Table B-7. Calibration Procedure for Temperature Sensors

Required Equipment: National Institute of Standards and Testing (NIST) Traceable Temperature Device
1. Remove the 2 meter sensor from the aspirator housing and place in a water bath at 0° C with a NIST traceable temperature device in close proximity, out of direct sunlight. Allow a minimum of 15 minutes equilibration.
2. Record the temperature from the NIST traceable device(s) and the corresponding readings of the station temperature from the data logger.
3. Repeat the reading three times at intervals of at least three minutes each to verify stabilized results. Verify that the temperature is within 1.0 degrees C. Repeat the process using water baths at ambient conditions and at least 15° above ambient temperature. Replace the sensor if outside specification at any temperature level.
4. Record the results on the calibration form and in the station logbook and return to normal sampling operations.

Table B-8. Calibration Procedure for Barometric Pressure Sensors

Required Equipment: Traceable Calibration Standard Barometer
1. Place the site sensor and traceable calibration sensor in close proximity.
2. Record the readings of the two sensors as five minute averages for at least three different iterations.
3. Verify that the sensors agree within ±2.3 mmHg. Replace the sensor if outside specification.
4. Record the results on the calibration form and in the station logbook and return to normal sampling operations.

B6 Data Acquisition Requirements

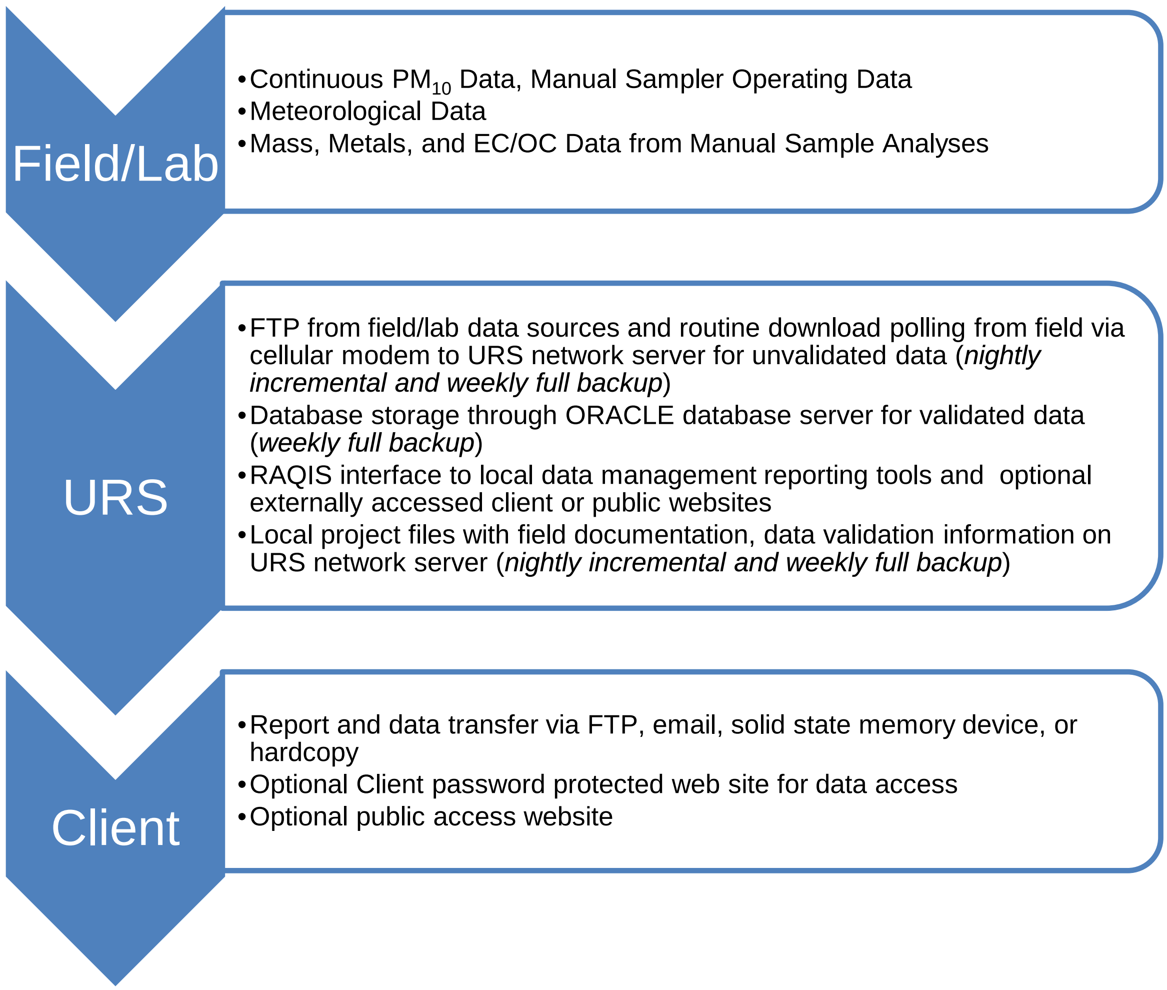
All data acquisition will employ the onboard data logging capability of the BAM-1020 monitor and PartisolPlus samplers for PM_{10} and a Campbell Scientific CR-10X data logger for meteorology. The PM_{10} measurement cycle is one hour for the BAM-1020, and the PartisolPlus stores sampler operating conditions at 5 minute intervals. The Campbell logger will sample each sensor input once per second and average the inputs to 5-minute data intervals. From these 5-minute intervals hourly averages may be calculated.

B7 Data Management

Figure B-5 presents the data flow path for collecting, storing, and managing all data generated in the network. The data logging units on the BAM-1020, PartisolPlus, and the Campbell units store averages as ASCII format data. An automated daily polling routine is initiated from the URS air monitoring data processing center to collect continuous PM_{10} data, manual sample PM_{10} operating data, and meteorological data. Data are transmitted from the sites via cellular wireless networks for Internet access. Each of these data sets is transferred to the Radian Air Quality Information System (RAQIS) database using a custom data file loader program. All raw continuous and manual sampler data from the field are retained in the database. The data management task leader and other team members with authorization to

.

Figure B-5. Data Management Tasks for KCBX Network



access RAQIS then may obtain data for preliminary review and validation. The operations task leader and network field technician also periodically connect to the monitoring sites using remote PCs to review the operating status of the equipment. Monitor calibration data are transferred in Excel spreadsheets to the data management task leader, who then loads all of the file information to the KCBX network site on the server. URS network servers have an incremental backup performed nightly, and once a week a full backup is performed. All data are still in an unedited, non-validated form at this point and have received a screening for gross errors or anomalies only.

When a month of data is complete and present on the server, the hourly data are imported into an Oracle® database for reporting and validation tasks; this database is fully backed up weekly. An air quality scientist reviews the data, calibration files, and logbooks and creates a set of edit instructions for the data. Any edit instructions that are required for the continuous pollutant or meteorological data are sent to the project data management task leader for application.

Once the edits have been completed the task leader saves an "edited" version of the data, and then notifies the project manager that the data are ready for final approval. The edited version of the data is then reviewed and approved. The project manager (or designee) then either approves the edits or requests further action. When the final edits are complete and the monthly data are considered validated, the database is updated to contain the edited version only (unedited data are recoverable from the server). The record of edit instructions is stored in the project files as hardcopy and is available for further review if necessary. All documentation is retained for a minimum of five years.

Client reports may be accomplished through several means: an electronic file transfer of data may be obtained (via FTP or e-mail), data may be copied onto a CD-ROM, or a hardcopy report script can be used to generate reports. Additionally, reports of averages, trends, individual sample results, and wind rose distribution plots can be generated from the intranet site that allows URS project team members access to the database as a Windows-based application.

Monthly status reports will be forwarded to KCBX within 14 days of the end of each month via email. These reports will briefly describe the progress of the monitoring efforts; discuss any issues of significance to data collection including extended downtime, present a summary table of the five highest hourly average PM_{10} concentrations for the month at each terminal, and present a summary table of 24-hour average PM_{10} data from each site. URS will also provide KCBX with copies of site visit and maintenance logbooks, operations checklists, and calibration forms generated each month.

A project data summary is required to be submitted to EPA on a monthly basis. The continuous monitor, filter sample speciation, and meteorological data set will be submitted as an Excel spreadsheet file as ASCII comma delimited hourly average values, with single header rows by variable. Copies of QC checks and QA audits conducted during the month will also be provided. This summary is required to be submitted via email attachment and is due 20 business days after the conclusion of each month of monitoring.

C. ASSESSMENT AND OVERSIGHT

C1 Assessment and Response Actions

The URS project team includes a quality assurance specialist whose duties are solely in the area of independent assessment of the measurement effort. This individual is part of the same corporate organization as the project team, but holds no duties or interests in the operation of any of the monitoring sites and networks that he audits. To promote objectivity and independence, the specialist maintains designated audit equipment in a separate location from the operations center, and has access to the Austin General Engineering Department QA Officer for assistance in promoting the quality objectives of the company. The QA Officer is also available to assist in resolution of project issues related to quality. Assessments conducted for this project fall into two categories: Technical Systems Audits and Performance Evaluation Audits. Both provide vital information regarding the status of the project team operation and how well the measurement data adhere to the quality specifications of the QAPP. All performance and technical systems audits are conducted following the guidance documents in the "EPA Quality Assurance Handbook" series, Volumes I, II, and IV. Additional method-specific quality guidance is provided by the applicable sections of the manufacturer operating manuals, in the absence of an EPA guidance document specific to the application of an equipment-specific measurement.

C1.1 Technical Systems Audits

Technical systems audits for the field operation have several areas of focus. The audit is conducted employing a checklist as a guide to the major topics to be assessed, and the auditor is free to allot greater amounts of time to any particular area as needed. A checklist is prepared in advance of the audit and is based on information presented in the QAPP and in general, the guidance of the EPA QA Handbook series.

The field technical systems audit includes a review of overall equipment siting and exposure, site visit logs, continuous analyzer and meteorological operating procedures and documentation, and any site maintenance activities. From this assessment the auditor is able to determine the quality requirements for the monitoring effort from the QAPP, and then report on the level of adherence to the specifications. This review includes traceability documentation for standards and test equipment used to conduct quality control checks on pollutant and meteorological monitors. Where the specification appears incomplete or inadequate, the auditor should be able to apply EPA guidance document information and personal experience in assessing whether the quality of the monitoring activity will produce defensible data. Technical Systems Audits are conducted quarterly for the network field operation. Some example TSA field checklists are presented in Figure C-1.

Figure C-1. Example TSA Field Checklist

AIR MONITORING SYSTEMS AUDIT CHECKLIST

Site PECO Round Rock
Date March 31, 2011

Response (Y, N or Unknown. Indicate NA if question does not apply to operation under review)	Operational Function		Comments
	I. System Equipment Inspection		
	Sample Manifold and Inlet System		
Y	Is the sample inlet manifold clean and properly assembled?		
Y	Are unused manifold ports plugged?		
Y	Is the manifold material chemically inert? (Glass or Teflon)		
Y	Is the manifold blower motor working?		
Y	Is the manifold flow rate monitored? (How?)		
Y	Are manifold parts and sample inlet lines dry?		
Y	Are sample inlet lines 1/4" FEP Teflon?		
Y	Are all analyzers operational?		
Y	Do autocal data indicate "in control" conditions?		
Y	Are inlet filters used? Specify date of last change.	March 23, 2011	
	Auxiliary Equipment		
Y	Is the A/C unit maintaining temperature between 70-80 F?		
Y	Does the telephone/modem system work?		
Y	Is the data system time and date accurate(to 5 minutes)?		
	Wind direction / Wind speed		
Y	Are all sensors operational?		
Y	Are wind Sigma values calculated and recorded?		
Y	Are wind vector and scalar values recorded?		
Y	Is the instrument tower plumb and the base secured?		
Y	Are instrument mountings level?		
Y	Is tower winch assembly secure and easy to operate?		
Y	Are all signal cables and connections in good shape?		
	Temperature and or Differential Temepratures		
Y	Sensor(s) operational?		
Y	Aspiration fan(s) operational?		
Y	Instrument mounting(s) level?		
Y	Signal cable(s) and connection(s) in good shape?		
NA	***Precipitation***		
	Is the sensor operational?		
	Is the sensor level?		
	Is the signal cable in good shape?		
NA	***Relative Humidity***		
	Is the sensor operational?		
	Is the aspiration fan operational?		
	Is the instrument level?		
	Is the signal cable in good shape?		
NA	***Barometric Pressure***		
	Is the sensor operational?		
	Is the insturment level?		
	Is the signal cable in good shape?		
NA	***Radiation Sensor***		
	Is the sensor operational?		
	Is the sensor level?		
	Is the signal cable in good shape?		
	Are values at night zero for solar radaition?		
	Are values at night negative for net radaition?		
	Gas Chromatography		
Y	Is the analyzer operational?		
Y	Were the GC file names changed to reflect an audit?		
Y	Is the date/time correct on the GC software?		
Y	Are downstream variable rotometers set to the recommended level?		
Y	Are downstream flow controllers set to the recommended level?		
Y	Are daily calibration and blank checks performed?		
	$NO_X/NO/NO_2$ Analyzer		
Y	Is the analyzer operational?		

Figure C-1. (continued)

N		Are there any error / status conditions on the display?	
		SO_2 Analyzer	
Y		Is the analyzer operational?	
Y		Are there any error / status conditions on the display?	Low flow warning
NA		***O_3 Analyzer***	
		Is the analyzer operational?	
		Are there any error / status conditions on the display?	
NA		***H_2S Analyzer***	
		Is the analyzer operational?	
		Are there any error / status conditions on the display?	
		Is the converter temperature above 325 F?	
NA		***Particulate Matter Samplers***	
		Are collocated samplers operated at this site?	
		Are the samplers between 2 and 5 meters apart?	
		Are sampler gasket materials in good condition?	
		Are chart recorder traces normal?	
		Are sample elapsed time records normal? How measured?	
		If present, are stagnation pressure ports capped?	
		Are sample inlets clean? Specify date of last cleaning.	
	II.	**Operational Procedures**	
		Recordkeeping and Safety	
N		Is a bound, document-controlled station logbook used?	Electronic form
Y		Do logbook entries show arrival/departure time and date?	
Y		Are any events that affect status noted (calibrations, "down" times)?	
Y		Is the authorship of each entry noted?	
NA		Are incorrect entries marked out with a single line?	
Y		Are the most recent calibration data completed and posted?	
Y		Is the station calibrator flow rate measurement data posted?	
Y		Is the configuration listing for the data system posted?	
Y		Are Material Safety Data Sheets (MSDS) posted?	
Y		Is an operational fire extinguisher in the shelter?	
Y		Is the site address posted, with emergency numbers (if not 911)?	
		Calibrations	
Y		Is the site technician trained to perform valid calibrations?	
Y		Are certified, traceable gas standards used? Specify.	SO2/NO Protocol Blend; Benzene NIST Standard
		(Specify all cylinders used.)	
Y		Are certified, traceable flowrate standards used?	
NA		PM10 orifice?	
Y		Are automated zero/spans performed daily?	
Y		Are precision checks performed biweekly at 16-20% of full scale?	
Y		Are calibrations performed before and after analyzer adjustments?	
	III.	**Data Chain-of-Custody**	
Y		Are hourly averages from the data system periodically retrieved?	
NA		Is a data shipment package sent from the field periodically?	
NA		Are duplicate copies of all written records kept on-site?	
NA		Are data shipment custody forms used?	
NA		Are particulate matter C-O-C filter envelope forms complete?	
NA		Is a copy of the shipping bill of lading kept for tracking purposes?	
	IV.	**Maintenance**	
Y		Is a schedule for preventative maintenance available?	
Y		Are adequate parts and tools available for maintenance?	
Y		Are maintenance activities recorded in a logbook?	Kept with site visit log spreadsheet
Y		Are maintenance procedures consistent with project expectations?	
	V.	**Overall Observations**	
Y		Does the field operation meet project expectations?	
Y		Are the current readings consistent with ambient conditions?	
Y		Are all data system recording channels on-line? Note date/time.	March 31, 2011

AUDITOR: John Smith

Notes: Informed site operator about SO2 low flow warning

URS
February 1, 2010

C1.2 Performance Evaluation Audits

Continuous PM_{10} monitor and sampler performance is audited quarterly, and consists of a leak check, a flow rate measurement accuracy check, and verification of the temperature and pressure transducer measurement accuracy. The leak check must demonstrate a flow rate less than 1 LPM, the flow rate accuracy check must be within ±4%, the temperature measurement accuracy must be within ±2.0° C, and the pressure measurement accuracy must be within ±10 mmHg.

Performance audits for meteorological sensors are conducted semi-annually, in coordination with the meteorological calibration events (either a calibration or an audit is conducted every three months). The performance audits are accomplished by either direct comparison with an audit standard of known quality, or an artificial field test in which the instrument response is predicted. For the wind direction sensor, the output of the sensor with the vane turned to a series of known directions is assessed, as is the orientation of the vane with respect to true north. The wind speed sensor is tested using a traceable certified motor drive unit for which the rotational speed inputs have a predicted result. The condition of the wind instrument bearings is also checked to ensure that the starting threshold is within specification. The ambient temperature and barometric pressure audits are conducted using collocated audit standards. A digital thermistor unit with certified traceability is used for temperature and a traceable barometer is used to test the site pressure transducer. Table C-1 presents the audit objectives for the meteorological measurements.

Table C-1. Performance Audit Specifications for Meteorological Measurements

Measurement	Audit Activity	Specification
Wind Direction	True North Alignment	± 2°
	Sensor Linearity	± 3°
Wind Speed	Starting Threshold	≤ 0.3 gm-cm
	Artificial Field Input	± 0.22 m/s
Temperature	Collocated Transfer Standard	± 1.0° Celsius
Barometric Pressure	Collocated Transfer Standard	± 2.3 mm Hg

C2 Reports to Management

Reports for field performance and technical systems audits conducted by URS include a statement of the scope of the audit, summary presentation of results, and a listing of specific observations or findings related to the specifications under review. Also, the field data and traceability documents for each audit standard employed are included. The auditor should always provide the field technician and/or the operations task leader a list of preliminary findings and recommendations during a debriefing meeting held at the conclusion of the audits. If significant deficiencies are determined that impact the ability of the system to properly function, the URS Project Manager will be notified immediately. He in turn will notify the KCBX Project Manager of the situation and advise them of the response actions being undertaken to restore the systems to full operational status. A formal report should be provided to the project team within two weeks of completion of the audits. If there are no corrective action items, the auditor may close the audit. If further action is required, the audit will be classified as open pending verification that the corrective action was completed and the audit specification is being met. This information will be supplied to EPA as part of the monthly reporting effort.

Responsibility for follow-up on audit recommendations belongs to everyone on the project team, but usually one person is designated after each audit to provide a written response to the findings and communicate the outcome of the corrective action effort. This is typically the operations task leader for the field network or the subcontract laboratory manager. If the auditor does not receive a response or the response is inadequate, he must communicate the situation to the project manager, who has the ultimate responsibility for the technical execution of the project. The URS Austin General Engineering QA Officer is also available to assist in obtaining a resolution to problems related to corrective action.

A formal Corrective Action Report (CAR) system is available to document audit findings and track corrective actions undertaken by the project team, if warranted. The CAR system is a database-driven program that contains formal documentation that outlines the nature of an identified deficiency, system or systems that are affected by the deficiency, proposed corrective action, actions taken by the responsible party, and the follow-up verification of the resolution of the deficiency. The URS Austin ambient air monitoring QA group administers the CAR system, and most action items are resolved at the project team level.

Accuracy, precision, and completeness statistics are also computed on a quarterly and annual basis for each measurement as applicable, per the quality assurance guidance in 40 CFR Part 58, Appendix A. A quarterly review of laboratory detection limits will be conducted to ensure that the reported limits meet the nominal values stated in this QAPP. The computations for flow rate measurement accuracy are as described in Volume II and the computations for meteorological measurement accuracy are as described in Volume IV of the EPA QA Handbook. Precision of PM_{10} measurements between the two methods that are employed is evaluated by quarterly least squares regression slope comparison of FEM and FRM PM_{10} data for sample data pairs $<60 \mu g/m^3$ at each NE site where those measurements are collocated. Laboratory analysis precision is compared to the method requirements for analytical duplicate analyses. Completeness is calculated as the ratio of valid samples or hours of data compared to the total planned number of samples or operational hours of data attempted to be collected, expressed as a percentage.

Accuracy data are generated each quarter by the audit staff, as the spreadsheet results from measurement audits. Precision data are generated by the data management staff, in the form of statistics created from precision check data, or QC data from the subcontract laboratory as required by the analytical method. Completeness data are also generated by the data management staff, using an automated reporting script integrated into the RAQIS database.

D. DATA VALIDATION AND USABILITY

D1 Data Review, Validation, and Verification Requirements

Data review, validation, and verification procedures are presented in this section. Three types of data are collected for this project: continuous hourly data from PM_{10} monitors, speciation data from manual samplers, and continuous 5-minute data from meteorological sensors. The five-minute data are averaged into hourly values, which is the format for final reporting. Daily data review is the responsibility of the data management task leader for the project, in parallel with operations staff. The task leader also performs the routine monthly review and validation functions or delegates and supervises them.

In the event that the daily data review indicates a potential unusual or elevated result the reviewer (this can be the site operator, operations supervisor, or data analysis specialist, as all perform routine data review tasks) notifies the project manager and data management task leader. The data editor gathers all pertinent QC data for the date and time of the result of interest and reports to the project manager regarding the validity of the measured values. This typically occurs within 24 hours of first discovery of the situation. If the measurements are valid, the project manager immediately notifies the client and provides associated meteorological data so that the client may investigate any potential events or sources that could have contributed to the result of interest.

The meteorological data are also retrieved via cellular aircard and router, and subjected to manual data review by an experienced air quality scientist every business day throughout each month. Screening tests, such as those recommended by EPA in the *"On-Site Meteorological Program Guidance for Regulatory Modeling Applications"* are performed using an automated script to aid in identifying data that require further investigation.

Analytical laboratory reports for speciation of manual samples will be forwarded in electronic format and loaded into the database using a custom loading script. The data management task leader is responsible for ensuring that the data are properly loaded and the supporting documentation is in the central project file.

Data will be declared invalid whenever documented evidence exists demonstrating that a continuous monitor or meteorological sensor was not collecting data under representative conditions or was malfunctioning. In rare cases where a consistent offset in continuous measurements can be verified, a factor may be applied to the averages in a data set with clear identification of the affected data. The project data documentation files will contain the supporting documentation of the use of and justification for the factor.

Data validation will be performed or supervised for each monthly data set by the data management task leader, with internal peer review per URS project management policy. The

data management task leader will verify that the continuous monitor data and the meteorology measurement data are complete for the month, and then initiate the validation process. The task leader will inform the project manager when the complete data set is ready for peer review.

The activities involved in validation of the data in general include the following:

- Reviewing all site visit logs, calibration data, audit data, and project memoranda for indications of malfunctioning equipment or instrument maintenance events;
- Reviewing each laboratory report for speciation;
- Reviewing all available BAM-1020 and PartisolPlus performance data from on-board diagnostic data files; and
- Examining the hourly continuous PM_{10} and 5-minute meteorological data for spikes in the data, unusual persistence, unusually high rates of change, or measurement values that seem incongruous with normal measurement ranges and/or diurnal variations.

All continuous air quality analyzer data files are obtained via modem during the daily automated network call up routine. These data are validated using the universal calibration method, as described in EPA's *"Quality Assurance Handbook for Air Pollution Measurement Systems"*, Volume II, Section 12.8. With this method of data reduction, the on-site data system records data in conventional engineering units based on the raw instrument signal voltages, converted to full scale instrument ranges. No further calibration curve is accounted for in reporting the data since the output is sufficiently linear to meet project measurement performance goals (the zero offset is measured and coded into the BAM-1020 software at the completion of the 72-hr zero background test). Each monthly data set is manually reviewed and edited.

Data are never declared invalid solely because they are unlikely to occur in nature, but may be flagged as suspect and be subjected to further review until the cause for the apparent anomaly is determined. The results from all quality control and quality assurance checks are evaluated to determine if the data quality objectives for each measurement are being met. Evidence of overwhelming measurement bias, external influences on the representativeness of the data, or lack of reproducibility of the measurement data may be cause for the data to be judged invalid.

After the edit and validation review is complete, the editor returns a set of instructions to the data manager for application to the data set. The final edited version of the data is then produced and peer reviewed to ensure that the edits were properly applied and that the validation process was consistent with project requirements and URS standard procedures. A record of the edit instructions is retained in the project files, as is the final data product. Once the project manager has reviewed and approved the edited data set, it is released and reported to the client.

D2 Reconciliation with Data Quality Objectives

Periodically throughout the data collection effort, it is the project QA officer and project manager's responsibility to evaluate the project's progress in meeting the client's goals for the measurement data. This evaluation will occur at a minimum on an annual basis. Two areas will be reviewed: the performance of the project in respect to the quality goals specified in the QAPP and the limitations (if any) on the measurement data for their intended use. The results of this evaluation will be reported to KCBX.

D2.1 Assessment of Measurement Performance

As part of the annual review the performance of the monitoring network will be assessed to determine to what extent the measurement data meet the requirements of the data user (client and/or regulatory agency). In the data quality objectives section a discussion of the key indicators was presented in relation to precision, accuracy, completeness, representativeness, and comparability goals for the monitoring effort. Specific quantitative measures of precision, accuracy, and completeness were defined for use in estimating the quality of the data set. These measures will be calculated and compared to the goals for the project.

D2.2 Data Quality Assessment

If any of the data quality measures indicate performance outside the desired objective (e.g., an audit result outside the project specification or a monthly completeness average less than the project goal) the data associated with that result are not considered useless. The burden is on the project team to determine the extent to which a quality issue affects the related data, and ultimately how the issue impacts the fitness for use of the data.

Most often a single isolated incident in which the performance objective is not met does not automatically render the data useless, but rather slightly reduces the confidence that the measurement is reliable, and indicates that increased quality control measures are needed. Any such data for which there is a question of confidence will be appropriately flagged in the data base. The data quality objectives are assessed periodically throughout the monitoring effort. A month in which the completeness statistic for a given site is below the objective is cause for concern and corrective action, but if the other months are within the objective the confidence in the complete data set should remain high.

Any potential limitations of the validated data set will be identified and communicated. The project team will present all known or potential limitations on the data with each data submittal, and will clearly flag any such data so that users may determine if the data should be used for a particular conclusion or decision.

E. REFERENCES

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Appendix A

Example Calibration Data Spreadsheets and Operator Checklists

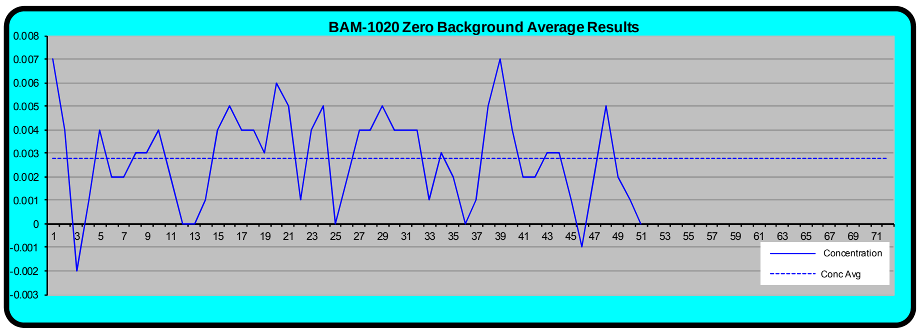
BAM-1020 72-Hr Background Test

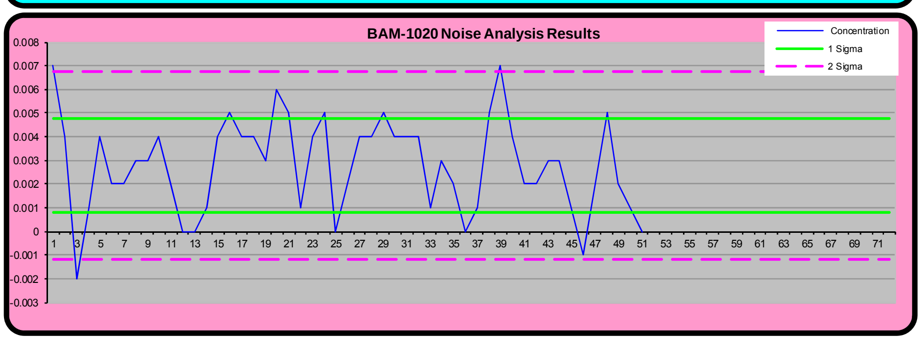
Rev A Jan 2010
Met One Instruments

Time	Concentration
8/2/2011 12:00	0.007
8/2/2011 13:00	0.004
8/2/2011 14:00	-0.002
8/2/2011 15:00	0.001
8/2/2011 16:00	0.004
8/2/2011 17:00	0.002
8/2/2011 18:00	0.002
8/2/2011 19:00	0.003
8/2/2011 20:00	0.003
8/2/2011 21:00	0.004
8/2/2011 22:00	0.002
8/2/2011 23:00	0
8/3/2011 0:00	0
8/3/2011 1:00	0.001
8/3/2011 2:00	0.004
8/3/2011 3:00	0.005
8/3/2011 4:00	0.004
8/3/2011 5:00	0.004
8/3/2011 6:00	0.003
8/3/2011 7:00	0.006
8/3/2011 8:00	0.005
8/3/2011 9:00	0.001
8/3/2011 10:00	0.004
8/3/2011 11:00	0.005
8/3/2011 12:00	0
8/3/2011 13:00	0.002
8/3/2011 14:00	0.004
8/3/2011 15:00	0.004
8/3/2011 16:00	0.005
8/3/2011 17:00	0.004
8/3/2011 18:00	0.004
8/3/2011 19:00	0.004
8/3/2011 20:00	0.001
8/3/2011 21:00	0.003
8/3/2011 22:00	0.002
8/3/2011 23:00	0
8/4/2011 0:00	0.001
8/4/2011 1:00	0.005
8/4/2011 2:00	0.007
8/4/2011 3:00	0.004
8/4/2011 4:00	0.002
8/4/2011 5:00	0.002
8/4/2011 6:00	0.003
8/4/2011 7:00	0.003
8/4/2011 8:00	0.001
8/4/2011 9:00	-0.001
8/4/2011 10:00	0.002
8/4/2011 11:00	0.005
8/4/2011 12:00	0.002
8/4/2011 13:00	0.001
8/4/2011 14:00	0

Test Records	
BAM-1020 Serial Number:	
Test Performed By:	
Test Start Date:	
Test End Date:	
Previous BKGD Value:	
BKGD Value During Test:	0.0000

Dataset Statistics (milligrams)		
Zero Average	0.0028	Within Bounds!
Hourly Standard Deviation (σ)	0.0020	Within Bounds!
Hourly Detection Limit (2σ)	0.0040	Within Bounds!
Background (BKGD)	**-0.0028**	Set this value in the BAM-1020





Test Instructions

1) The BAM-1020 should be completely installed and operational at its field site before starting a zero test.
2) Allow the BAM-1020 to warm up for several hours before starting a zero test, or plan on discarding the first 4 hours.
3) Perform a leak check, nozzle and vane cleaning, and flow check on the unit. See manual section 5.
4) In the SETUP > CALIBRATE menu, record the existing BKGD value, then set the BKGD to 0.0000 mg.
5) Remove the PM10 inlet and install the BX-302 zero filter. Run the BAM for at least 72 hours with the zero filter.
6) Download the data from the BAM-1020 serial port in .csv format. See manual Section 9.4.
7) Copy the 72 hourly concentration data points into this sheet and analyze the results.
8) The negative of the zero average is the correct BKGD (background) setting. Enter it into the BAM-1020.
9) Remove the BX-302 zero filter and resume normal BAM operation.
10) Save the results of this test. The test may be performed annually to audit the performance of the BAM.

BAM-1020 PARTICULATE MATTER (PM) MONITOR
Calibration Data

SITE NAME: KCBX NT-NE
AQS Site Code: N/A
DATE: 13-Feb-14
TIME: 16:00

CLIENT: Koch
SAMPLER ID: BAM-1020
Model Number: 1020
Serial Number: P21274

FLOW RATE AND LEAK CHECK Calibration Data

Leak Check[1]: 0.3 LPM

1. Acceptance Criteria: < 0.5 LPM

Clock/Timer Verification[2]:

BAM-1020 : not recorded
Reference Time: not recorded

2. Acceptance Criteria: within 60 sec. of Reference Time

Flow Rate Calibration Device: BGI
Model Number: deltaCal
Serial Number: 1377
Certification Expiration: 01/21/15

	Sampler Indicated Flow Rate (LPM)	Calibration Flow Rate (Qstd) (LPM)	Percent Difference[3] (Sampler vs. Calibration)	Percent Difference[4] (Calibration vs. Design)
	16.70	16.60	0.6%	-0.4%

3. Acceptance Criteria: ± 4.0%
4. Acceptance Criteria: ± 5.0%

TEMPERATURE Calibration Data

Calibration Device: BGI Model Number: deltaCal	Sampler Sensor Temperature (T_a) (°C)	Calibration Sensor Temperature (T_a) (°C)	Temperature Difference[5] (Sampler - Calibration) (°C)
Serial Number: 1377	-0.9	-1.1	0.2
Certification Expiration: 01/21/15	-0.9	-1.1	0.2
	-0.9	-1.1	0.2

5. Acceptance Criteria: ± 2.0 °C

PRESSURE Calibration Data

Calibration Device: BGI Model Number: deltaCal	Sampler Sensor Pressure (P_a) (mm Hg)	Calibration Sensor Pressure (P_a) (mm Hg)	Pressure Difference[6] (Sampler - Calibration) (mm Hg)
Serial Number: 1377	736.0	734.0	2.0
Certification Expiration: 01/21/15	736.0	734.0	2.0
	736.0	734.0	2.0

6. Acceptance Criteria: ± 10.0 mm Hg

Calibration Tech: Greg Mazik

Notes: BKGD set to 0.0 from -0.0038, zero filter installed at 17:00

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PARTISOL PARTICULATE MATTER (PM) SAMPLER
Calibration Data

SITE NAME: KCBX NT-NEQ (EC/OC sampler)
AQS Site Code: N/A
DATE: 3-Jun-13
TIME: 0955-1020

CLIENT: Koch
SAMPLER ID: PartisolPlus
Model Number: 2025i
Serial Number: 20704

TEMPERATURE Calibration Data			
Calibration Device: BGI **Model Number:** deltaCal	**Sampler Sensor Temperature (T_a) (°C)**	**Calibration Sensor Temperature (T_a) (°C)**	**Temperature Difference[1] (Sampler - Calibration) (°C)**
Serial Number: 579	24.7	24.0	0.7
Certification Expiration: 09/10/13	24.7	23.8	0.9
	24.8	24.0	0.8

1. Acceptance Criteria: ± 2.0 °C

PRESSURE Calibration Data			
Calibration Device: BGI **Model Number:** deltaCal	**Sampler Sensor Pressure (P_a) (mm Hg)**	**Calibration Sensor Pressure (P_a) (mm Hg)**	**Pressure Difference[2] (Sampler - Calibration) (mm Hg)**
Serial Number: 579	760.0	755.0	5.0
Certification Expiration: 09/10/13	760.0	755.0	5.0
	760.0	755.0	5.0

2. Acceptance Criteria: ± 10.0 mm Hg

COMPARTMENT TEMPERATURE Calibration Data			
Calibration Device: BGI **Model Number:** deltaCal	**Sampler Compartment Temperature (T_a) (°C)**	**Calibration Sensor Temperature (T_a) (°C)**	**Temperature Difference[3] (Sampler - Calibration) (°C)**
Serial Number: 579	24.7	24.0	0.7
Certification Expiration: 09/10/13	24.7	23.8	0.9
	24.8	24.0	0.8

3. Acceptance Criteria: ± 2.0 °C

LEAK CHECK, TIME, AND FLOWRATE Calibration Data

External Leak Check[4] 8.0 mmHg

4. Acceptance Criteria < 25 mm Hg

Clock/Timer Verification[5]:

Partisol : 9:49:20
Reference Time: 9:49:10

5. Acceptance Criteria: within 60 sec. of Reference Time

Calibration Device: BGI **Model Number:** deltaCal	**Sampler Indicated Flow Rate (LPM)**	**Calibration Flow Rate (Qstd) (LPM)**	**Percent Difference[6] (Sampler vs. Calibration)**	**Percent Difference[7] (Calibration vs. Design)**
Serial Number: 579	14.93	14.71	1.5%	-1.9%
Certification Expiration: 09/10/13	16.62	16.44	1.1%	-1.4%
	18.32	18.20	0.7%	-1.1%

A three point flow check is required quarterly and a single point operating flow rate check is required monthly

6. Acceptance Criteria: ± 4.0%
7. Acceptance Criteria: ± 5.0%

Calibration Tech: John Smith

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WIND DIRECTION SENSOR
Calibration Data

SITE NAME: KCBX NT-SW
AQS Site Code: N/A
DATE: 06/03/13
TIME: 1030-1057

CLIENT: Koch
Sensor ID: MetOne
Model Number: 020C
Serial Number: J1399

WIND DIRECTION Calibration Data

Alignment Test at:	180	Deg	**Transit ID:**	Lietz 115A
Area Declination:	-3.5	Negative is West, Positive is East	**Transit SN:**	34786
Measured Declination:	-3.7			
Difference[1]:	0.2	*1. Acceptance Criteria: < 2 Deg*		

Degree Wheel SN: 185AAM	**Input CW (Deg)**	**Sensor Response (Deg)**	**Difference**	**Hysteresis**	**Normalized**	**Avg. Diff.**
	180	180.8	0.8		0.8	
	210	211.0	1.0		1.0	
	240	240.9	0.9		0.9	
	270	271.2	1.2		1.2	
	300	301.1	1.1		1.1	
	330	331.5	1.5		1.5	
	360	358.7	-1.3	1.9	1.3	0.9
	30	28.80	-1.2	2.3	1.2	1.1
	60	58.70	-1.3	2.0	1.3	1.0
	90	89.20	-0.8	1.2	0.8	0.6
	120	119.50	-0.5	0.6	0.5	0.3
	150	149.90	-0.1	0.2	0.1	0.1
	180	180.50	0.5	1.3	0.5	0.6
	Input CCW (Deg)	**Sensor Response (Deg)**	**Difference**	**Hysteresis**	**Normalized**	**Avg. Diff.**
	150	149.9	-0.1	0.2	0.1	0.1
	120	119.9	-0.1	0.6	0.1	0.3
	90	89.6	-0.4	1.2	0.4	0.6
	60	59.3	-0.7	2.0	0.7	1.0
	30	28.9	-1.1	2.3	1.1	1.1
	0	0.6	0.6	1.9	0.6	0.9
		Mean:	0.00	1.35		
				Max[2]:	1.50	

2. Acceptance Criteria: < 3 Deg

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CalibrationTech: Jason Balsano

WIND SPEED SENSOR
Calibration Data

SITE NAME: KCBX NT-SW
AQS Site Code: N/A
DATE: 06/03/13
TIME: 1030-1057

CLIENT: Koch
Sensor ID: MetOne
Model Number: 010C
Serial Number: J1392

WIND SPEED Calibration Data

Zero Check[1]: 0.0
1. Acceptance Criteria < 0.2 m/s

Bearing Condition[2]: 0.3
2. Acceptance Criteria < 0.4 gm-cm

Calibration Device: RM Young Model Number: 18810	Input CCW (RPM)	Calibration Input (M/S)	Sensor Response (M/S)	Difference[3]
Serial Number: CA01953 **Certification Expiration:** 09/10/13	60	1.88	1.90	0.02
	160	4.55	4.60	0.05
	300	8.25	8.30	0.05
	600	16.25	16.10	-0.15
	Input CW (RPM)	**Calibration Input (M/S)**	**Sensor Response (M/S)**	**Difference[3]**
CCW = Counter Clockwise CW = Clockwise	60	1.88	1.90	0.02
	160	4.55	4.60	0.05
	300	8.25	8.30	0.05
	600	16.25	16.15	-0.10

3. Acceptance Criteria: ± 0.22 m/s

Calibration Tech: Jason Balsano

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TEMPERATURE SENSOR
Calibration Data

SITE NAME:	KCBX NT-SW	**CLIENT:**	Koch
AQS Site Code:	N/A	**Sensor ID:**	MetOne
DATE:	06/03/13	**Model Number:**	060A-2
TIME:	1030-1057	**Serial Number:**	F4539

TEMPERATURE Calibration Data			
Calibration Device: Vaisala **Model Number:** HM-34F	**Site Sensor Temperature (ºC)**	**Calibration Sensor Temperature (ºC)**	**Temprature Difference[1] (Sampler - Calibration) (ºC)**
Serial Number: G1023 **Certification Expiration:** 09/10/13	-0.1	0.0	-0.1
	22.4	22.5	-0.1
	35.5	35.4	0.1

1. Acceptance Criteria: ± 1.0 ºC

degF to degC conversion

Temperature	**Units**	**Input**	**Output**
	degF	75.0	
	degC		23.9

Clock/Timer Verification[2]:

Data Logger :	9:49:20
Reference Time:	9:49:10

2. Acceptance Criteria: within 60 sec. of Reference Time

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Calibration Tech: John Smith

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BAROMETRIC PRESSURE SENSOR
Calibration Data

SITE NAME: KCBX NT-SW
AQS Site Code: N/A
DATE: 06/03/13
TIME: 1030-1057

CLIENT: Koch
Sensor ID: Vaisala
Model Number: PTB110
Serial Number: 2356

PRESSURE Calibration Data			
Calibration Device: Vaisala **Model Number:** HM-34F	**Site Sensor Pressure (P_a) (mm Hg)**	**Calibration Sensor Pressure (P_a) (mm Hg)**	**Pressure Difference[1] (Sampler - Calibration) (mm Hg)**
Serial Number: G1023 **Certification Expiration:** 09/10/13	760.0	761.0	-1.0
	760.0	761.5	-1.5
	760.0	761.0	-1.0

1. Acceptance Criteria: ± 2.3 mm Hg

inHg to mmHg conversion

Pressure	Units	Input	Output
	inHg	29.92	
	mmHg		759.97

hPa to mmHg conversion

Pressure	Units	Input	Output
	hPa	1005	
	mmHg		755.64

Calibration Tech: John Smith

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KCBX TERMINALS CO NORTH	SITE VISIT DATE							
	8/12/2013	8/19/2013	8/25/2013					
Meteorological Station								
Arrival time:	10:05 AM	9:35 AM	9:15 AM					
Is the temperature aspirator fan running?	Y	N	Y					
Are all signal cables secured and intact?	Y	Y	Y					
Are wind vane/ anemometer cups intact and operational?	Y	Y	Y					
Is datalogger date/time correct within 60 sec?	N	Y	Y					
Are conditions shown on logger consistent with ambient observations?	Y	Y	Y					
BAM-1020 PM_{10} Monitors								
Arrival time:	10:20 AM	9:50 AM	9:25 AM					
Any status error flags showing?	N	N	N					
Are all monitor dates/times correct within 60 sec?	Y	Y	Y					
Are all filter transport systems operational?	Y	Y	Y					
Are hourly data being collected?	Y	Y	Y					
Is sampler inlet and downtube clean?	Y	N	Y					
Is water collection bottle clean?	Y	N	Y					
Are O-rings in good condition?	Y	N	Y					
Comments section								

On 8/12, reset met station time (63 seconds fast).

On 8/19 found aspirator fan not running; replaced.

On 8/19, NT-SE site inlet removed and cleaned, o rings lubricated.

Site ID List:

NT-NW = Northwest BAM site (Meteorological monitors)
NT-NE = Northeast BAM site (Partisol samplers)
NT-SE = Southeast BAM site
NT-SW = Southwest BAM site

MAINTENANCE LIST FOR METEOROLOGICAL STATION

Each Visit:	Inspect sensors and cables for signs of deterioration or damage and replace as needed
Monthly:	Inspect temperature aspirator and remove dust accumulation
	Inspect tower for plumb, and verify that all fasteners are intact and tight
Biannually:	Perform calibration check on sensors
	Check wind sensor bearings
Annually:	Replace wind sensor bearings

MAINTENANCE LIST FOR BAM-1020

Each Visit:	Inspect filter tape and replace when needed (~2 months/roll; run SELF-TEST function in the TAPE menu).
	Inspect filter tape for pinholes and irregular PM deposits
Monthly:	Perform flow rate and leak check
	Clean BAM nozzle and vane
	Clean inlet hardware, capstan shaft and pinch roller
Quarterly:	Verify BAM settings file
	Flow system Calibration
	Disassemble and clean inlet
Biannually:	Check pump muffler and tubing and replace as needed
	Test filter RH and Temperature sensors
	Test smart heater function
Annually:	Perform zero background test
	Clean internal debris filter
	Remove and check membrane span foil
	Beta detector count rate and dark count test
	Rebuild vacuum pump
	Replace nozzle o-ring

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KCBX TERMINALS CO SOUTH	SITE VISIT DATE							
	8/12/2013	8/19/2013	8/25/2013					
Meteorological Station								
Arrival time:	10:05 AM	9:35 AM	9:15 AM					
Is the temperature aspirator fan running?	Y	N	Y					
Are all signal cables secured and intact?	Y	Y	Y					
Are wind vane/ anemometer cups intact and operational?	Y	Y	Y					
Is datalogger date/time correct within 60 sec?	N	Y	Y					
Are conditions shown on logger consistent with ambient observations?	Y	Y	Y					
BAM-1020 PM_{10} Monitors								
Arrival time:	10:20 AM	9:50 AM	9:25 AM					
Any status error flags showing?	N	N	N					
Are all monitor dates/times correct within 60 sec?	Y	Y	Y					
Are all filter transport systems operational?	Y	Y	Y					
Are hourly data being collected?	Y	Y	Y					
Is sampler inlet and downtube clean?	Y	N	Y					
Is water collection bottle clean?	Y	N	Y					
Are O-rings in good condition?	Y	N	Y					
Comments section								

On 8/12, reset met station time (63 seconds fast).

On 8/19 found aspirator fan not running; replaced.

On 8/19, ST-SW site inlet removed and cleaned, o rings lubricated.

Site ID List:

ST-NW = Northwest BAM site
ST-N = North BAM site
ST-NE = Northeast BAM site (Partisol samplers)
ST-M = Meteorological Monitoring Site
ST-CE = Center East BAM site
ST-SW = Southwest BAM site

MAINTENANCE LIST FOR METEOROLOGICAL STATION

Each Visit: Inspect sensors and cables for signs of deterioration or damage and replace as needed
Monthly: Inspect temperature aspirator and remove dust accumulation
Inspect tower for plumb, and verify that all fasteners are intact and tight
Biannually: Perform calibration check on sensors
Check wind sensor bearings
Annually: Replace wind sensor bearings

MAINTENANCE LIST FOR BAM-1020

Each Visit: Inspect filter tape and replace when needed (~2 months/roll; run SELF-TEST function in the TAPE menu).
Inspect filter tape for pinholes and irregular PM deposits
Monthly: Perform flow rate and leak check
Clean BAM nozzle and vane
Clean inlet hardware, capstan shaft and pinch roller
Quarterly: Verify BAM settings file
Flow system calibration
Disassemble and clean inlet
Biannually: Check pump muffler and tubing and replace as needed
Test filter RH and Temperature sensors
Test smart heater function
Annually: Perform zero background test
Clean internal debris filter
Remove and check membrane span foil
Beta detector count rate and dark count test
Rebuild vacuum pump
Replace nozzle o-ring

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KCBX TERMINALS CO NORTH (NT-NE)	SITE VISIT DATE							
	8/12/2013	8/19/2013	8/25/2013					
PartisolPlus 2025i Metals/Mass Sampler								
Arrival time:	10:05 AM	9:35 AM	9:15 AM					
Any status flags on main screen?	Y	N	N					
Is sampler date/time correct within 60 sec?	N	Y	Y					
Have data from last run been collected?	Y	Y	Y					
Has sampled filter magazine been collected?	N	N	Y					
Has COC form for retrieved samples been filled out?	N	N	Y					
Have samples been packed for shipping?	N	N	Y					
Haves samples been shipped to lab?	N	N	Y					
Have sample data been sent to Austin staff?	N	N	Y					
Is cassette magazine in good condition?	Y	Y	Y					
Are cassettes available in feed magazine for next sample?	Y	Y	Y					
Is sampler inlet and downtube clean?	Y	Y	Y					
Is water collection bottle clean?	Y	Y	Y					
Are O-rings in good condition?	Y	Y	Y					
PartisolPlus 2025i Carbon Sampler								
Arrival time:	10:20 AM	9:50 AM	9:25 AM					
Any status flags on main screen?	N	N	N					
Is sampler date/time correct within 60 sec?	N	Y	Y					
Have data from last run been collected?	Y	Y	Y					
Has sampled filter magazine been collected?	N	N	Y					
Has COC form for retrieved samples been filled out?	N	N	Y					
Have samples been packed for shipping?	N	N	Y					
Haves samples been shipped to lab?	N	N	Y					
Have sample data been sent to Austin staff?	N	N	Y					
Is cassette magazine in good condition?	Y	Y	Y					
Are cassettes available in feed magazine for next sample?	Y	Y	Y					
Is sampler inlet and downtube clean?	Y	Y	Y					
Is water collection bottle clean?	Y	Y	Y					
Are O-rings in good condition?	Y	Y	Y					
Comments section								
On 8/12, reset metals and mass sampler time (65 seconds slow).								
Shipped Samples on 8/20								

MAINTENANCE LIST FOR 2025i

Each Visit:	Inspect filter cassettes and magazines; discard damaged cassettes, and lubricate cassette seals as needed
Weekly:	Perform external leak check
Monthly:	Perform internal leak check
	Clean PM_{10} inlet
Biannually:	Change the large in-line filter
	Clean the rain hoods and air screens
Annually:	Check and rebuild pump if needed

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KCBX TERMINALS CO SOUTH (ST-NE)	SITE VISIT DATE							
	8/12/2013	8/19/2013	8/25/2013					
PartisolPlus 2025i Metals/Mass Sampler								
Arrival time:	10:05 AM	9:35 AM	9:15 AM					
Any status flags on main screen?	N	N	N					
Is sampler date/time correct within 60 sec?	N	Y	Y					
Have data from last run been collected?	Y	Y	Y					
Has sampled filter magazine been collected?	N	N	Y					
Has COC form for retrieved samples been filled out?	N	N	Y					
Have samples been packed for shipping?	N	N	Y					
Haves samples been shipped to lab?	N	N	Y					
Have sample data been sent to Austin staff?	N	N	Y					
Is cassette magazine in good condition?	Y	Y	Y					
Are cassettes available in feed magazine for next sample?	Y	Y	Y					
Is sampler inlet and downtube clean?	Y	Y	Y					
Is water collection bottle clean?	Y	Y	Y					
Are O-rings in good condition?	Y	Y	Y					
PartisolPlus 2025i Carbon Sampler								
Arrival time:	10:20 AM	9:50 AM	9:25 AM					
Any status flags on main screen?	N	N	N					
Is sampler date/time correct within 60 sec?	N	Y	Y					
Have data from last run been collected?	Y	Y	Y					
Has sampled filter magazine been collected?	N	N	Y					
Has COC form for retrieved samples been filled out?	N	N	Y					
Have samples been packed for shipping?	N	N	Y					
Haves samples been shipped to lab?	N	N	Y					
Have sample data been sent to Austin staff?	N	N	Y					
Is cassette magazine in good condition?	Y	Y	Y					
Are cassettes available in feed magazine for next sample?	Y	Y	Y					
Is sampler inlet and downtube clean?	Y	Y	Y					
Is water collection bottle clean?	Y	Y	Y					
Are O-rings in good condition?	Y	Y	Y					
Comments section								
On 8/12, reset metals and mass sampler time (65 seconds slow).								
Shipped Samples on 8/20								

MAINTENANCE LIST FOR 2025i

Each Visit:	Inspect filter cassettes and magazines; discard damaged cassettes, and lubricate cassette seals as needed
Weekly:	Perform external leak check
Monthly:	Perform internal leak check
	Clean PM_{10} inlet
Biannually:	Change the large in-line filter
	Clean the rain hoods and air screens
Annually:	Check and rebuild pump if needed

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APPENDIX B

EXAMPLE CHAIN OF CUSTODY FORM

Q237133X

PM 2.5 CSN CUSTODY AND FIELD DATA FORM

c. White (return to lab)
c. Yellow (site retains)
c. Pink (lab)

A. CUSTODY RECORD (Name, Date)

Bin ID: B33015 **Set:** 6

1. Laboratory, Out Jim [illegible] 1/4/11 3. Site, Out ______
2. Site, In ______ 4. Lab, In ______

B. SITE AND SAMPLER INFORMATION

1. Site AIRS Code NA
2. Sampler S/N
3. Sampler Type BGI
4. Sampler POC
5. Site Name Station A (1)
6. Intended date of use Monday, January 03, 2011
7. Date of Sampler set-up ______
8. Operator's name ______

C. SAMPLER CHANNEL COMPONENT

Channel	Component ID No.	Component Description
1	I13019S	PQ200-10

D. START, END, AND RETRIEVAL TIMES

Channel	Start date	Start time	End date	End time	Retrieval date	Retrieval time
1						

E. SAMPLER CHANNEL INFORMATION (Post-Sampling)

Channel	Run Time	Run Time; Flag	Sample Volume (m3)	Avg. flow (L/min)	Avg. flow CV (%)	Avg. ambient T (° C)	Max. ambient T (° C)	Min. ambient T (° C)
1								

Channel	Δ T Flag	Avg. Filter T (° C)	Max. Filter T (° C)	Min. Filter T (° C)	Avg. BP (mm Hg)	Max. BP (mm Hg)	Min. BP (mm Hg)
1							

F. Comments ______