STATE OF CALIFORNIA

AIR RESOURCES BOARD

AIR MONITORING QUALITY ASSURANCE

VOLUME V

AUDIT PROCEDURES FOR AIR QUALITY MONITORING

APPENDIX AM

PERFORMANCE AUDIT PROCEDURES FOR BGI INCORPORATED PQ100 SAMPLERS FOR SPECIAL PURPOSE MONITORING

MONITORING AND LABORATORY DIVISION

JUNE 2010

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APPENDIX AM

PERFORMANCE AUDIT PROCEDURES
FOR
BGI INCORPORATED PQ100 SAMPLERS
FOR SPECIAL PURPOSE MONITORING

AM.1.0 GENERAL INFORMATION

AM.1.0.1 GENERAL AUDITING PROCEDURES

The primary goal of an auditing program is to identify system errors that may result in suspect or invalid data. Accurate assessment of a total suspended particulate (TSP) matter measurement system may only be made by conducting an audit under the following guidelines:

1. Without special preparation or adjustment of the system to be audited.

2. By an individual with a thorough knowledge of the instrument or process being evaluated, but not by the routine operator.

3. With accurate calibrated National Institute of Standards and Technology (NIST) traceable transfer standards that are completely independent of those used in routine calibration.

4. With complete documentation of audit data for submission to the operating agency. Audit information includes, but is not limited to, types of instruments and audit transfer standards, model and serial numbers, transfer standard traceability, calibration information, and collected audit data.

The audit procedures described here provide quantitative estimates of a TSP sampler's performance, consisting of the flow rate percent difference. The flow rate percent difference indicates the accuracy of the sampler's indicated flow rate by comparing the indicated flow rate measurement with the measurement from an audit transfer standard. The ambient temperature and barometric pressure is also recorded during an audit for reference.

An independent observer should be present during the audit, preferably the routine operator of the sampling equipment. The presence of the operator will both facilitate the overall audit procedure and contribute to its integrity. For example, the operator may offer information that will help the auditor to determine the cause of discrepancies between measured audit data and the sampling equipment response.

AM.1.0.2 PERFORMANCE AUDITS OF THE BGI PQ100 SAMPLER

Audit procedures presented here are applicable to the BGI Incorporated (BGI) model PQ100 sampler (PQ100), which is capable of sampling particulate matter at 10 microns (PM_{10}) or 2.5 microns ($PM_{2.5}$), and TSP. The PQ100 operates at various flow rates between 1 and 25 liters per minute (LPM) depending on the type of media used during sampling.

A calibrated BGI Incorporated TetraCal (TetraCal) is used to measure the sampler's operational flow rate. The sampler's indicated flow rate is then compared with the actual flow rate indicated by the TetraCal.

Since the flow rate of air through the sampler is measured at actual conditions, the audit must also be in terms of actual conditions. The TetraCal's digital screen displays the actual flow along with the actual temperature and barometric pressure.

NOTE: The PQ100 does NOT require a leak test. Cutting off the flow of air by covering or restricting the air flow to the inlet will cause damage to the internal pump and will void the warranty.

AM.1.0.3 AUDIT APPARATUS

All audit transfer standards must be certified against a primary standard traceable to NIST. Audit equipment for flow rate, temperature, and barometric pressure must not be the same as that equipment used for routine site checks/calibrations, but may be traceable to the same primary standard.

In addition to the apparatus listed in the following sections, an audit data worksheet (see Figures AM.1.0.2) is also needed to document audit information. This information includes, but is not limited to, sampler and audit transfer standard type, model, and serial numbers, transfer standard traceability and calibration information, ambient temperature and pressure conditions, and other pertinent audit data.

The following equipment is needed to perform a flow rate audit of the PQ100:

1. Certified (NIST traceable) flow transfer standard TetraCal (2-20 LPM) with the most recent calibration report. The audit transfer standard must be certified against a primary standard traceable to the NIST and shall be within ±2 percent of the NIST traceable standard. The transfer standard shall be calibrated annually with the relative standard deviation within 1.0 percent of the last two calibrations.

2. An audit filter/cassette with appropriate filter media.

AM.1.0.4 AUDIT DATA CALCULATIONS

The TetraCal has built-in, calibrated temperature and pressure sensors so that the flow display on the TetraCal screen is the actual flow in liters per minute (LPM).

1. Determine the percent difference between the sampler indicated flow rates and the audit measured flow rates as:

$$\text{Audit \% Difference} = \frac{Qa(\text{Sampler}) - Qa(\text{Audit})}{Qa(\text{Audit})} \times 100$$

2. Record differences and percent differences as appropriate. Audit flow rate percent differences greater than ±10 percent require an investigation or a recalibration. Upon investigation, the invalidation or correction of all data from the last calibration forward or known date of change (to be determined by the reporting agency) may result.

AM.1.0.5 AUDIT DATA REPORTING

Final verified audit data should be submitted to the operating agency as soon as possible. Delays may result in data loss; a sampler out of audit limits is also out of calibration limits, and the data collected may be invalid. If a sampler exhibits unsatisfactory agreement with the verified audit results, a calibration should be performed before the next run day.

AM.2.0 AUDIT PROCEDURES FOR THE BGI PQ100 SAMPLER

AM.2.0.1 BACKGROUND

The audit of a PQ100 sampler includes a determination of the sampler's flow rate, and notation of the ambient temperature and barometric pressure. A complete audit also includes verifying that the proper sampler maintenance procedures have been performed by the operator **prior** to the audit. Before the audit, verify from the operator that all appropriate maintenance, scheduled calibrations, and flow checks have been performed.

Both the operator and auditor(s) should have read and be familiar with the manufacturer's Instruction Manual as well as any Standard Operating Procedures for the BGI PQ100 that may be available.

AM.2.0.2 AUDIT PROCEDURES

Begin by ensuring that the PQ100 is not sampling and that the previous run completed successfully. If a run is halted for any reason, the PQ100 must be reset to insure that the readings are stored in the proper sequence.

1. Place a clean filter of the type to be used for sampling in the PQ100.

2. Remove the rain shield cover from the filter holder and connect the TetraCal to the top of the filter holder inlet.

3. On the PQ100, press [SETUP] to go to the "Main Idle Display". Ensure that the "Start Date Enable" is OFF. Press [RUN/STOP] to start the pump.

4. Allow a 10 minute warm-up period for the pump and flow readings to stabilize. Observe and record the Qa flow readings from both the TetraCal and the sampler.

5. Record the ambient temperature and barometric pressure at the time of the flow check.

6. Record other pertinent information as noted on the QA Audit Worksheet.

7. Stop the pump by pressing [RUN/STOP].

AM.2.0.3 POST AUDIT CONFIGURATION

1. Remove the audit filter/cassette and TetraCal from the system and re-install the rain shield cover. Allow the operator to return the PQ100 to its appropriate state of operation.

2. Calculate and record the percent difference using the formula shown above (Audit Data Calculations). A Technical Appendix (see Figure AM.3.0.3) can be generated using the Excel Worksheet formatted for the PQ100.

3. Complete a Preliminary Quality Assurance Report and deliver a copy to the station operator.

FIGURES

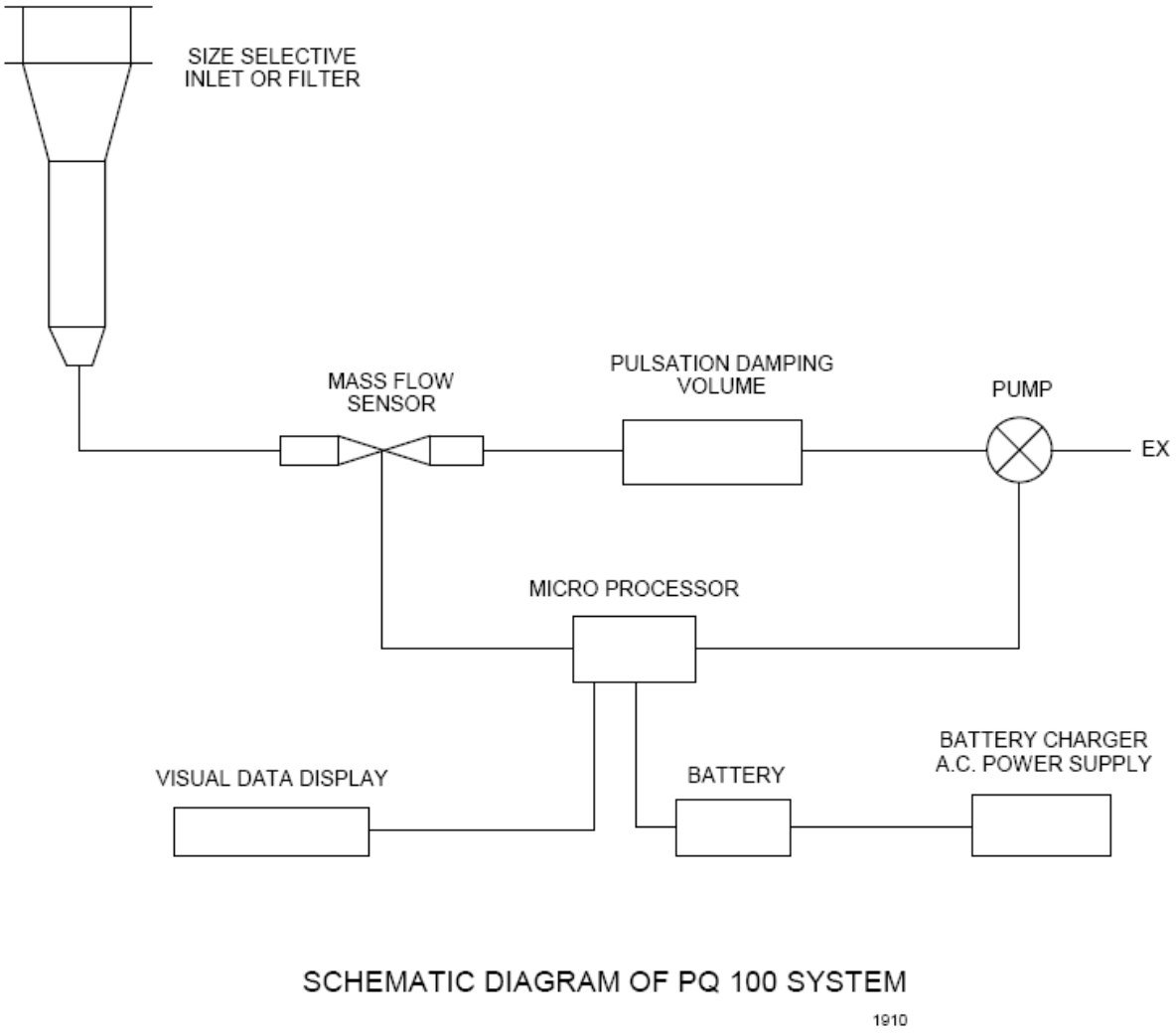

Figure AM.3.0.1
Schematic Diagram of the PQ100 System

QA AUDIT WORKSHEET
BGI PQ100

Site Name:_____ Auditors:_____

Operator:_____ Date:_____

Collocated Yes [ ] No [ ] Primary Yes [ ] No [ ]

TSP	PM10	PM2.5

Sampler Information

Make	Model	ID Number	Last Cal Date	Cal Equip Cert Date

Inlet Cleaning Schedule:_____

Inlet Last Cleaned:_____

Filter Size/Material: _____

Sampler Target Flow Rate: _____

Dates of Last Two Flow Checks

1:
2:

Audit Temperature: _____

Audit Pressure: _____

Measured Flow Rates:

Audit Flow	Station Flow

Collocated Yes [ ] No [ ] Secondary Yes [ ] No [ ]

TSP	PM10	PM2.5

Sampler Information

Make	Model	ID Number	Last Cal Date	Cal Equip Cert Date

Inlet Cleaning Schedule:_____

Inlet Last Cleaned:_____

Filter Size/Material: _____

Sampler Target Flow Rate: _____

Dates of Last Two Flow Checks

1:
2:

Audit Temperature: _____

Audit Pressure: _____

Measured Flow Rates:

Audit Flow	Station Flow

Data recorded and verified by: _____

State of California Air Resources Board

QAS-PQ100 (Rev. 6/21/2010)

Figure AM.3.0.2
Quality Assurance Audit Worksheet

Technical Appendix - BGI PQ100 - Special Purpose Monitoring

Audit Information

QA Data Audit MFM Display	QA Data Actual Flow (Qa) (LPM)	QA Data Standard Flow (Qs) (SLPM)	Station Data Indicated Flow (LPM)	Percent Difference (Audit LPM vs. Station LPM)
11.90	11.90	12.24	12.00	0.8%

Failures and Warnings

The flow rate failure limit for TSP samplers is ±10% difference.
A warning occurs at a flow rate of ±7% difference.

All audit parameters are within specified limits!

Audit Calculations

Actual Flow = (Audit MFM Display * Slope) + Intercept
Standard Flow = (Qa * (298.13 / Ambient Temperature) * (Ambient Pressure / 760))

TetraCal slope = 1.000 intercept = 0.000

Ambient Pressure (mmHg) = 759.0 Ambient Temp. (°C) = 16.4
Ambient Temp. (°K) = 289.55

Instrument/AIRS Information

ARB Number	12345	AIRS Number	06XXXXXXX
Audit Date	5/7/2010	Instrument	BGI PQ100
Quarter	2	Serial Number	20001234
Van	E	Last Calibration	1/14/2010

General Comments

* Sample Technical Appendix

Figure AM.3.0.3
Quality Assurance Technical Appendix