

***Section IV : HEADQUARTERS***  
**RESPONSIBILITIES FOR THE**  
**TEOM CONTINUOUS MONITOR**

**STANDARD OPERATING PROCEDURE**  
**AND QUALITY ASSURANCE PLAN**

Rupprecht & Patashnick  
TEOM Series 1400a / ab  
Continuous Ambient Particulate PM-10 & PM-2.5 Monitor  
Procedure for Operating a Rupprecht & Patashnick TEOM Series 1400a  
PM-10 / PM-2.5 Continuous Ambient Particulate Monitor

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## **2.27.4 Headquarters Ambient Monitoring Branch Responsibilities and Assignments**

Headquarters personnel will provide an advisory role to the field technicians responsible for TEOM operations. These include various assistance with: the installation of the TEOM and TEOM startup, operations review, data processing, personnel training, system calibrations, audits, and maintenance items.

The success of TEOM operations will require information and status updates between the field technicians and headquarters. This involves scheduling of activities and providing reports of TEOM operations. The Regional office site operator will have the responsibility for reviewing the TEOM operations documentation for accuracy and completeness. It is suggested that the site be polled and the available TEOM channels reviewed three times per week.

This documentation is the quality assurance record and is used for data validation support. This documentation will be filed and managed by the site operators at the regional offices. If there is a problem with the data, the Regional Office should take appropriate action, contacting ECB or headquarters as necessary.

### **2.27.4.1 Data Processing**

TEOM data processing begins with data downloading. The operator downloads the data on a bi-weekly basis. The TEOM download lists eight parameters: raw, 30 minute, 1 hour, and 24-hour concentrations; along with, total mass, main flow, auxiliary flow, and air temperature. Data is also automatically polled every day using EDAS data management software. The EDAS file used for "AIRNow" reporting contains; 1-hour mass concentrations, main flow, and filter loading (percentage). The EDAS software also processes the data into the AQS format, for reports and editing. All data processed using this system is the responsibilities of the headquarters data processing staff. The TEOM data that is downloaded on to a PC during site visits is to be stored as TEOM backup and support data and is to be reviewed monthly by the regional staff.

At the beginning of each month, the Data Management Statistical Services Branch (DMSSB) technician at headquarters will create a file listing the hourly concentrations downloaded for the prior month. The printout will be mailed to the appropriate regional office monitoring staff for review. After the regional staff has reviewed and noted the reasons for missing data and has identified needed changes, the data technician will forward the reviewed forms to the Projects and Procedures Branch (PPB) chemist for final review. The headquarters chemist will review the comments, the data questions, issues of concern and return the revised monthly file listing to the DMSSB technician. The data management technician will make the changes based upon the regional office

staff recommendations and the headquarters chemist recommendations. Once these changes are completed, the data will be prepared for AQS submittal.

The following flags are used to assign validity to the data. If no flag is present it is assumed to be accurate data.

EPA-AQS; Null Value Codes Table

AH	Main flow and/or auxiliary flow outside limits
AN	Equipment malfunctions, disconnected coupling, broken tubing, etc.
AV	Power failures
AX	Precision Check
AZ	Audit
BA	Maintenance and repairs, including filter changes
BJ	Operator errors that produce missing data or invalid data

E-DAS Datalogger Codes Table

<b>H,h</b> or <b>L, l</b>	(AH = equivalent AQS code)	“ <b>H</b> igh high” or “ <b>h</b> igh” alarm, “ <b>L</b> ow low” or “ <b>l</b> ow” alarm, main flow and/or auxiliary flow outside limits
<b>T</b>	(AN = equivalent AQS code)	“ <b>ouT</b> of control” equipment malfunctions
<b>P</b> or <b>B</b>	(AV = equivalent AQS code)	“ <b>P</b> ower failure”, or “ <b>B</b> ad Status”
<b>C</b> or <b>D</b>	(BA = equivalent AQS code)  (AZ = equivalent AQS for audits)	“ <b>C</b> alibrate”, “ <b>D</b> owned” channel for Maintenance and repairs, includes filter changes, precision checks, and audits

### 2.27.4.2 Daily Data Review

The Projects and Procedures Branch (PPB) chemist will review the daily polled data for TEOM sites each workday. This reviewer will initial and date the daily polling hardcopy and provide feedback / makes inquiries to the regions when data questions arise. The polling by the headquarters computer usually occurs in the early morning hours and is available for review at the start of the workday.

- Hourly data is reported in Eastern Standard Time at the start of each hour (1:00-1:59 am is reported as 01:00)
- The field operator accounts for periods of missing or invalid data by identifying the reasons on the appropriate form, generally the monthly data review form. The Regional Chemist II signs, dates, and submits the monthly data review form to Headquarters. It is the Regional chemist’s responsibility to submit the monthly data review.
- The Regions must submit the reviewed monthly data report to headquarters within 15 workdays of the end of the month.

### 2.27.4.3 Training and Support

Training is necessary for site operators to develop the knowledge and skills required to operate the TEOM. The TEOM leader will provide the instructions and exercises needed to train and qualify TEOM operators. Training will consist of reviewing the standard operating procedure and the R&P TEOM series 1400a Operator's Manual and Service Manual. On site TEOM training will be a major element of site operator's development. On site training will include learning the fundamental principals and subsystems that the TEOM uses to sample and measure PM-10 and/or PM-2.5. Operators will be trained on executing the TEOM software and entering commands using the TEOM keypad. The operator will perform all the assigned tasks to acquire the experience and methodology needed for these assignments. Quality assurance fundamentals and proper documentation of site activities will be applied. Support for the TEOM operations will be needed from headquarters. This support will include diagnostic evaluation of TEOM operational problems and clarification of operational procedures.

### 2.27.4.4 Independent Flow Audit - TEOM 2.5

There are three items essential to the quarterly flow audit; temperature, pressure, and flows. The temperature and pressure sensors are calibrated annually and are the basis for calculating mass. The flow audit consists of two measurements, one for through-the-filter sample flow, and the other for the system bypass flow. As with other audit procedures, the measurement device for the audit must be different than the device used for calibrations (and preferably checks).

#### Background:

Meeting *bypass flow* requirements has not been a problem to date. It is unlikely that the window of +/-1.0 Lpm (6.0% of set point) will ever be challenged. The historical issue with flow audits has been the specification window of the *sample flow*. The manufacturer's literature recommends 0.2 liter per minute above or below the set point of 3.0 liters per minute. This window represents a 6.67% margin error. An audit limit of +/- 10% (0.3 Lpm) was originally put in place in the NC DAQ SOP as the limit for data invalidation. As a result of the two different limits, a "grey-area" developed for flows that were greater than +/-0.2 Lpm and less than +/-0.3 Lpm. Two causes for the out-of-spec readings were identified:

1. > The timing of the readings between the audit device and the TEOM unit; and,
2. > The relatively "flat" slope of the original flow transfer standards' calibration curve.

The TEOM mass flow controller is relatively consistent over time. However, due to the design of the instrument, the flows are constantly adjusted relative to the particulate which continuously deposits on the filter (recall the oscillating microbalance is read and adjusted every two seconds). As a result there are moment-to-moment fluctuations in the true flow rate. Because the audit flow reading and the comparative TEOM reading can be read at the opposite 'peak' or 'trough' of this natural oscillation, there were

instances of flow readings being outside of the +/- 0.2 Lpm limit when using the original flow transfer standard (FTS). The shortcoming of these original “flat slope” FTS devices was amplified by limitations in the precision of the electronic manometers used in the field. A single digit change in the manometer reading could result in a change in the calculated flow equal to 3-8% of the total. When paired with the slightly fluctuating flow of the TEOM instrument, the difference can be far above the 6.67% limit. The solution was to replace the orifices in the FTS units to achieve a “sharper” sloped calibration curve. Audits now pass with high regularity.

#### Audit Responsibilities

- The operating region is required to perform flow audits once a quarter, preferably the second month of the quarter (Feb, May, Aug, Nov), and should be returned by the Regional Chemist II to the Project and Procedures Branch at least 15 days prior to the end of the quarter. Upon receipt of the audit data, the PPB supervisor will review the data for acceptability and recommend action if needed (i.e. – repeating the audit, calibration check, etc.)
- The flow transfer standard device should not be the same unit used for regularly scheduled flow checks, and must have a valid calibration (one year).
- The audit specification for the total flow is **16.7** liters per minute +/- **1.0** liter per minute. The audit specification for the main flow rate is **3.00** liters per minute +/- **0.20** liters per minute.
- If the flow rate audit results are outside audit specifications, the site operator will contact headquarters/ECB to request an independent audit to verify the flow rates. If the flow rates are found to be within specifications, the regional chemist and the headquarters TEOM contact will review the audit procedure, the audit data, and the sample data back to the last valid flow check, for validity. If both audits agree and are outside specification limits the TEOM flow controllers must be recalibrated. When a flow rate audit finding is outside the audit control limit, data must be invalidated back to the last satisfactory flow rate verification (flow check).
- A leak test of the system should be conducted following the Audit. The leak test procedure is given in the operator section. When leak testing is performed the **sample filter has to be removed** from the mass transducer. High pressure can damage the sample filter. A leak test is only to be done after the audit. Leak test data is included on the audit form.

(Audit values and information are entered on the flow rate audit log. *figure 5 found in the appendix of this procedure*).

#### **2.27.4.5 Precision Flow Checks - TEOM 2.5**

The site operator is required will do a precision flow rate check every 2 weeks (14 days *or less*) to verify the flow rates of the TEOM units. A “check” is defined as a test of a

sensor using an external standard. The precision check is done using an orifice type flow transfer standard that is accurate to +/- 1%. The device used for the *quarterly audit cannot* be used for this bi-weekly precision flow rate check. All precision check values and information are to be entered on the flow rate form. (See figure 3 found in the appendix of this procedure.)

#### Precision Responsibilities

- The specification for acceptable total flow is **16.7** liters per minute +/- **1.0** liter per minute. The specification for the main flow rate to be acceptable is **3.00** liters per minute +/- **0.20** liters per minute.
- If the precision check flow rate results are outside the specifications the Regional Chemist or the ECB TEOM lead should be contacted by the operator. The Regional Chemist/TEOM lead will review the calculations and if necessary perform an independent check to verify the flow rates. If the flow rates are found to be within specifications, the chemist/TEOM leader will review the operator's precision flow check procedure. If the second check agrees that the flow rate is outside the specification limits the TEOM flow controllers must be recalibrated by the ECB staff.

#### **2.27.4.6 Data Validation and Certification**

Two levels of reporting are required. One level to certify to the EPA that the quality of the data is high and meets QA requirements; and one level for the Ambient Monitoring Section Chief on the status and results of the program.

A Systems Audit will be performed at the end of the calendar year by a PPB chemist. The systems audit will verify the completeness of each site's data, the completeness of the accuracy and precision data (audit and precision flow checks), identification of issues and problems with the regional operators, and possible solutions. During the systems audit each region operating a TEOM will be visited by the PPB chemist (preferably the TEOM site as well) to discuss issues faced during the year.

The PPB chemist will submit the systems audit report(s) to the section chief for review and approval. The PPB chemist will assist the section chief in preparing the EPA letter certifying the quality of the sampling program.