

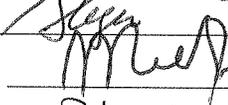
R&P 8400N NITRATE (NO<sub>3</sub>) QA Plan  
Section II

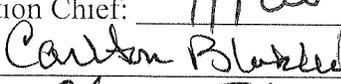
Operator Responsibilities

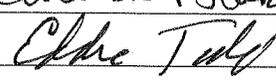
## Approval Sign-Off Sheet

I certify that I have read and approve of the contents of this revision of the "R&P 8400N NITRATE (NO3) QA Plan, Section II, Operator Responsibilities" with an effective date of January 19, 2011.

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## TABLE OF CONTENTS

2.31.2	R&P 8400N Monitoring Site Operation Procedure .....	4
2.31.2.1	Procedures for Site Operation for R&P 8400N Nitrate Monitor .....	4
2.31.2.2	Calibration.....	7
2.31.2.2.1	Operational Checks.....	7
2.31.2.2.2	Analyzer and Multipoint Aqueous Audit.....	9
2.31.2.3	Calibration Check - Weekly & Bi-Weekly.....	12
2.31.2.3.1	Operational Checks.....	12
2.31.2.3.2	Aqueous Standard Span and Zero Check.....	17
2.31.2.3.3	Bi-Monthly Tasks .....	18
2.31.2.3.4	Monthly Tasks .....	18
2.31.2.4	R & P 8400N Nitrate Maintenance.....	20
2.31.2.4.1	Quarterly Tasks.....	20
2.31.2.4.2	Bi-Annual Tasks .....	21
2.31.2.4.3	Annual Tasks .....	21
2.31.2.5	Troubleshooting .....	23
2.31.2.5.1	Status Codes.....	23
2.31.2.6	Site Calls.....	23
2.31.2.7	Data Reporting and Validation for Regional Offices .....	24
2.31.2.8	Quality Assurance Procedures .....	24
2.31.2.9	Monitor Shutdown Procedure.....	25

### List of Tables

Table 1	8400N STATUS CODES .....	26
Table 2	OUTPUT FORMAT AND EXPECTED VALUES FOR 8400N CYCLE DATA .....	27
Table 3	8400N STATUS CODES .....	27

### List of Appendix

Appendix 1	SYSTEM PARAMETERS AND SETTINGS.....	28
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## **2.31.2 R&P 8400N Monitoring Site Operation Procedure**

**Note:** The following is a list of "significant changes" from Revision 2.4.

- 1) QA updated per QAP/SOP 2.39 "Standard Operating Procedure (SOP) for Preparing Quality Assurance Plans/SOPs".
- 2) Project and Procedures Branch updates.
- 3) Site Operator updates.

### **2.31.2.1 Procedures for Site Operation for R&P 8400N Nitrate Monitor**

The Division of Air Quality (DAQ) of the Department of Environment and Natural Resources (DENR) currently operates nitrate monitors at various sites in the State of North Carolina. These sites continuously monitor ground level ambient particulate concentrations of nitrates. This is a major task and thus requires coordinated efforts by both Regional and Headquarters staff to collect quality nitrate data and also meet US-EPA (United States-Environmental Protection Agency) requirements.

The objectives of this document are to establish and deploy common site operations and instrument calibration procedures for generation of quality nitrate particulate data that may be compared and if needed, further extrapolated. Therefore it is critical that the Site Operator strictly follow these protocols and procedures to the last details. Technical assistance is available from the Electronics and Calibration Branch (ECB), Tel No. (919) 715-1761, Raleigh, North Carolina.

All original records including but not limited to: electronic logbook, site logbook must be legible, complete, dated and initialed by the Site Operator and retained as a part of the permanent analyzer calibration record. The Operator's initials in the calibration e-log certifies that the calibration has been performed in accordance with QA/SOP and that the information contained on the form is accurate. All records are to be reviewed and certified by the Regional Chemist and further audited at the Headquarters.

#### **A. Continuous Monitoring Principles for the 8400N Nitrate System-Site**

- Record any unusual events such as power failure, equipment problems, etc.
- The monitoring site is to be inspected for required maintenance such as shelter integrity, condition of vent lines, compressor, filter changes, leak testing, data collection system, ground post connections, etc., with comments recorded in logbook.
- Note that the site building temperature is between 20° - 30° C.
- Verify and record nitrate monitor number and gas cylinders numbers and certification dates. The Site Operator should call the Electronics Calibration Branch (ECB) when the NO<sub>y</sub> in nitrogen cylinder reaches 500 psi and cylinders should be

replaced before pressure reaches 300psi. Record the call to ECB in the site logbook. The operator will notify the ECB for pickup of used cylinder and delivery of new NOy cylinder coordinated with low specialty gas companies (ie Machine Welding & Supply) to deliver N<sub>2</sub> purge gas cylinders. The receipt will be sent to ECB as soon as possible for correct billing purposes.

- The site operator shall visit the monitoring site at least twice-per-week, but perform “calibration check” only once a week and this includes analysis of one blank and one nitrate aqueous standard. Acceptable recovery of nitrate standard spans must be within  $\pm 10\%$ , zero must be within  $\pm 0.8$  ppb. The other site visit is only to ensure that the site is operating satisfactorily by checking on the other related parameters.
- The “calibration check” must be performed before any changes to the nitrate monitoring system are made.
- A “calibration check” is required (analysis of blank and one standard) whenever there is a nitrate monitoring system interruption (due to power failure greater than 2 days, physical removal/replacement of system components or major repair/maintenance).
- A full calibration includes analysis of distilled water (zero) and three different concentrations of nitrate aqueous standards, in triplicate is required at a minimum once-per month or whenever calibration checks fail. A calibration check is also required at the closure of the monitoring site.
- Every year, the operator will call ECB for a routine maintenance of the pulse analyzer (NOy) using the procedure outlined in “Series 8400N Ambient Particulate Nitrate Monitor/Operating Manual”, by Rupprecht and Patashnick (R & P) Company, Albany, New York, 12203, February 2003. This action is recorded in the ECB logbook.

## **B. Nitrate Monitoring Instrument, Equipment and Accessories**

The 8400N nitrate monitoring system includes the following main components:

- R & P pulse generator- the main component of nitrate monitor
- R & P pulse analyzer- the NOy analyzer component of the nitrate monitor
- R & P pump to provide vacuum to operate the system
- Nitrogen/zero purge gas supply and NO in nitrogen for calibration and calibration verification
- Commercially available standard aqueous nitrate solution
- ESC Model 8832 Data logger, Primary (PDL) and R & P8400N internal data logger.
- A site dedicated PC and Modem system

Only the main components of the nitrate monitoring system are briefly discussed here. For further details refer to “Series 8400N Ambient Particulate Nitrate Monitor/Operating Manual”, by Rupprecht and Patashnick (R & P) Company, Albany, New York 12203, February 2003.

### **C. R & P 8400N Ambient Particulate Nitrate Analyzer**

The R & P Series 8400N Ambient Particulate Nitrate Monitor measures the mass concentration of ambient particulate nitrate contained in fine particulate matter (at or below PM<sub>2.5</sub>) in near real time. It measures all forms of inorganic nitrate, with no interference from ammonium salts. The R & P Series 8400N is designed to meet the United States Environmental Protection Agency (USEPA) PM<sub>2.5</sub> speciation monitor requirements for the agency's national PM chemical speciation monitoring/sampling network.

#### **Principle of R & P 8400N Monitor Operation**

Ambient air samples are pulled through a cyclone operated at 5.5 L/min to remove particles above PM<sub>2.5</sub>. From this, 1 L/min portion of this flow is used for nitrate analysis. The 1L/min nitrate sample flow passes through a carbon honeycomb denuder to remove potential gaseous interferences and a Nafion humidifier to ensure that the particles are wet. Wetted ambient air particles are collected by impaction onto a nichrome strip mounted in a collection and vaporization cell. Typical sample period is 8.5 minute. After sample collection, the system switches from this collection mode to the analysis mode. During analysis step, the sample flow bypasses the collection cell, while maintaining flow through the sample line, denuder and humidifier. The collection and vaporization cell is flushed with nitrogen gas, most of which is introduced at the side of the cell (called cross-flow), but with a portion introduced through the collection orifice (called orifice flow). The nitrogen flows through the cell and into a nitrogen oxide analyzer. The collection substrate is then flash-heated by a current from a battery until reaching an infrared cutoff. Typical heating times are 90-120 ms. Evolved nitrogen oxides are carried in the nitrogen flow to the analyzer, where they are reduced to NO by a molybdenum converter, and assayed by chemiluminescence. The analyzer output is integrated to yield the nitrate concentration. Additionally, the analyzer baseline is read prior to each analysis flash and subsequently removed from the integrated result, to yield the final, corrected sample pulse. At the end of the analysis period, the system returns to sample collection. The PM<sub>2.5</sub> cyclone precut, denuder, humidifier and collection-analysis cell are housed in a box, which is ventilated with outside air to try to maintain sampling temperature close to ambient. The system outputs nitrate concentration and system operating parameters via a serial communications line, at the end of each cycle.

The system is set up to automatically conduct two types of audits: analyzer flow audits and analyzer zero/span audits. The analyzer flow audits are done during sample nitrate collection step, without interruption of the cycle. The analyzer flow audit value is used to set up the cross flow during the analysis step. Analyzer automated zero and span audits take the system off-line for two cycles. Analyzer audits may be done automatically at a preset time of the day, at a frequency of one to seven days, as selected by the Site Operator. Additionally, the system is calibrated manually using aqueous standards applied directly to the collection substrate. For additional operating details refer to the

“Series 8400N Ambient Particulate Nitrate Monitor/Operating Manual”, by Rupprecht and Patashnick (R & P) Company, Albany, New York, 12203, February 2003.

### **2.31.2.2 Calibration**

Perform all of the following checks and adjustments before calibrating the 8400N nitrate monitor and document all checks, instrumental adjustments and the calibrations in the e-log and site logbook. Telephone ECB (919-715-1761) for assistance.

#### **2.31.2.2.1 Operational Checks**

##### **Site Operational Checks**

Record all events in the electronic logbook.

Upon arrival at the site, observe the outside of the sampling building and probe, looking for vandalism or security breaches. Check the probe outside for an intact screen any insect nest inside the probe funnel or sample line. If there is any evidence of vandalism, contact the appropriate Law Enforcement Department (generally this one is the City Police, if the site is within city limits and the County Sheriff, if it is outside city limits) and also inform the Central Office.

**Site Temperature:** Check site temperature. Adjust the site thermostat as necessary to maintain the 20 to 30°C range. If the site temperature is outside of the 20 to 30°C range, notify the Regional Chemist and ECB, the later for correcting the problem(s).

Perform all of the following checks and adjustments before calibrating the 8400N analyzer. Conduct the following operational checks:

##### **8400N Analyzer Operational Checks**

**Power “On”:** Verify and record that the instrument and all its related components have power “on” by observing the display and listening for the pump noise. If the monitor or any of its components do not have power, determine the cause and time of power failure from the data logger. Invalidate nitrate ambient data for the 30-minute period after the power comes back on.

**Check the Fan Filter:** Locate the fan filter in the pulse generator compartment and pull the plastic latch and slide the filter out. Check the filter to make sure that it is clean and undamaged. Slide the filter back into the filter holder and push the plastic latch into the bracket. If cleaned, document in the electronic logbook.

**Check Activated Carbon Denuder:** Locate the activated carbon denuder housing and pull the back hose off the top barb. Hold the bottom of the activated carbon denuder while unscrewing the top of the activated carbon denuder housing. Remove the top part

of the assembly from the activated carbon denuder assembly and make sure that the activated carbon denuder is not damaged and properly positioned in the holder. Screw the top of the activated carbon denuder housing onto the activated carbon denuder and attach the black hose barb.

**Check Nichrome Flash Strip:** Locate the cell assembly and unscrew the knob on the front of the cell assembly. Push the tab to the side to open the cell assembly. Pull the bottom of the cell assembly down to display the Nichrome flash strip. Ensure that the flash strip is undamaged and mounted on both posts. Push the bottom of the cell assembly up and line the tab up so that it holds the assembly together. Tighten the knob and the pulse generator is now ready to be turned “on”.

**Check the Cyclone Assembly:** Locate the cyclone assembly and unscrew the cyclone cup and remove it from the cyclone assembly. Make sure that the inside of the cyclone cup is clean and clean, if needed. Screw the cyclone cup into the cyclone assembly.

**PermaPure Humidifier:** Make sure that the permapure humidifier is filled with de-ionized water. Record the action in the logbook.

**Leak Test Cell and Inlet:** with system in “READY” mode, close the green valve above the cyclone and close the front vacuum valve (below front vacuum gauge). Let the system pump down for several minutes. Then close valve below back vacuum gauge. Watch cell pressure reading on front panel. Drift upward should be less than 0.01 atmospheres / min. If OK, slowly reopen valve above cyclone, and reopen both vacuum valves.

**Cycle Parameter:** verify system and cycle parameter settings are as per **Table 1**.

**Maintenance and Troubleshooting Documentation:**

Document any other site related suspected mechanical problems for preventative and routine maintenance in the electronic and site logbook and notify ECB.

**Setting Computer, PDL Time/Date.**

The times for the PDL and computer must be EASTERN STANDARD TIME. The PDL must have the same NIST time  $\pm 1$  minute. The computer time must be 5 minutes slower than the PDL time.

Check the computer time and date at the lower right hand corner of the computer screen. If the time and date are not correct; click "**START**" button, control panel, date/time or right click computer time on taskbar, select "**Adjust Date/Time**", type in changes and select "**OK**".

Sources for getting the correct time:

1. Call the ECB and ask for the NIST time.
2. Call the NIST Colorado time @ **(303) 499-7111** (long distance).
3. Correct time loaded into cell phone.
4. Correct time website, <http://nist.time.gov/>

**Login to 8832 Data logger:** Sites are equipped with ESC Model 8832 primary and R & P8400N internal data logger. Both are important tools in reviewing monitor/site operations.

The following sequence is used to log onto the PDL and BUDL so that calibrations can be performed via the 8832 data logger:

- Turn on the screen
- Double click on “Shortcut to Splitscreen”
- Open PDL
- Highlight PDL and type 2 letter data logger site code (located on the front of 8832 data logger) and AQM (may have to hit **ESC** several times before typing the site code)
- Select Login "**L**"
- Enter password (xxxxxxxxxx) and this will bring up “Home Menu”
- Can view “Report Current Cal Status” (tells when all Auto Cals are run)

#### **Disable Channels on Data logger**

- While disabled, values are collected but flagged as “invalid data”
- Highlight PDL and scroll using arrow keys to select “**C**” Configuration Menu
- Select “**D**” Configure Data Channels
- Select “**M**” Disable/Mark Channel Offline
- Select "**NO3MC**", "**NO3FD**", "**NO3SF**" or "**NO3**", "**FD8400N**", "**CF8400N**" (these are marked down separately) press <**ENTER**>
- **ESC**, **ESC** to “Home Menu”
- Select “**D**” Real Time-Data Display
- Select “**B**” Display Last Base Avg: This shows the last 1minute average only w/flag
- D: Disabled
- **ESC**, **ESC** to “Home Menu” on PDL

#### **2.31.2.2.2 Analyzer and Multipoint Aqueous Audit**

- Check analyzer readings.

##### **Perform Analyzer Audit**

- On the pulse generator, press “**RUN/STOP**” and “**F1**” to finish the current cycle.
- If necessary, open the main tank valve and regulator outlet valve on the calibration gas cylinder.
- The cal gas gauge on the 8400N should read  $5 \pm 2$  psi.
- Press “**Menu**”, then “**Enter Service Mode**”, then “**Perform Analyzer Audit**”.

- Press “**Full Audit**”. This starts the audit and will take 15-20 minutes.
- Record audit values in e-log.
- At end of audit, press “**Menu**”, then “**Exit Service Mode**” to get back to the main screen and then <**RUN/STOP**> to resume normal operation.

Alternatively, set the 8400N to run a daily analyzer audit. Follow these steps to set up the automatic analyzer audit:

- When in the Main screen press <**F5: Cycle Setup**> to enter the Cycle Setup screen.
- When in the Cycle Setup screen, press <**F5: Audit Setup**> to enter the Analyzer Audit screen.
- Press <EDIT>.
- Go to “**Perform analyzer audit field**” and press “**1**”. The automatic analyzer audit will occur once a day.
- Press <ENTER>. The unit will perform a “Full Audit” (all seven steps of the audit) at the “Start analyzer audit” time after you press <**RUN/STOP**> to initiate your cycling runs. The unit will not run the automatic analyzer audit if it is not set to run a cycle (if you do not press <RUN/STOP> to run a cycle).

Mode: READY	Cycle Setup	Status: OK
Sample Time: <input type="text" value="515"/> sec Purge Time: 30 sec Baseline Read Time: 10 sec Read 1 Time: 20 sec Read 2 Time: 1 sec (0 = disable)		
Base Start Time: 00:10 Minimum Cycle Length: 598 sec Desired Cycle Length: 600 sec (0 = no delay) Number of cycles: 0 cycles (0 = continuous)		
Perform flow audit: 6 cycles (0 = disable) Start analyzer audit: 04:00 Perform analyzer audit: 1 days (0 = disable)		
		EDIT 2000-Jun-14 22:14:05
		Audit Setup 8400 Setup

#### **Aqueous standards/ water audit**

- On the pulse generator, press <**RUN/STOP**> and “**F1**” to finish the current cycle or “**F2**” to abort the current cycle.
- Go to “**Menu**”>“**Service Mode**”>“**Aqueous Standard**”.
- Press “**Start**” to run one aqueous standard cycle without applying any standard solution to the strip. (This step will remove any residual material from the strip and prepare it for aqueous nitrate standards).
- Open the door of the pulse generator, locate the cell assembly and open the cell.
- Rinse the syringe in de-ionized water, three (3) times.

- Fill the syringe to desired volume (0.5µl) with distilled water. Remove any air gaps in the syringe by drawing and depressing the syringe's plunger several times while the syringe's needle is immersed in the water.
- Apply water to the center of strip by emptying syringe and touching to strip.
- Press, "**Edit**" to enter the "Mass Deposit" value, in nanograms (0) on the pulse generator screen.
- Repeat **water** application two (2) more times.
- Rinse the syringe in de-ionized water, three (3) times
- Fill the syringe to desired volume (e. g. 0.6µl, 0.4µl, 0.2µl, etc.) with the nitrate standard solution. Remove any air gaps in the syringe by drawing and depressing the syringe's plunger several times while the syringe's needle is immersed in the nitrate solution. Further, ensure that no nitrate solution drops are clinging to the outside of the needle and or syringe, by touching to mouth of nitrate standard bottle or container.
- Apply standard nitrate solution to the center of strip by emptying syringe and touching to strip.
- Close the cell of the pulse generator and press, "**Start**" to analyze nitrate standard (the system will wait for 2 minutes and then only start sample analysis).
- Press "**Edit**" to enter the "Mass Deposit" value, in nanograms on the pulse generator screen.
- Record the results on the "Calibration e-Log".
- Press <RUN/STOP> to resume normal operation.
- Rinse syringe thoroughly several times with de-ionized water.
- Calculate the percent difference, while at the site using the following equation:

$$\text{Percent Difference (\%)} = ((\text{Known Standard Conc.} - \text{Observed Conc.}) / \text{Known Standard Conc.}) \times 100$$

If any of the three different zero audit results are not within  $\pm 1.5$  ppb and the three different audit span concentration results (in triplicate) are not within the acceptable range of  $\pm 15\%$  of the expected values then do the following:

- Repeat the zero/three-point calibration, and if no improvement, then contact ECB Supervisor and inform him of the situation (i.e. problems with the three-point calibrations/recoveries).
- The Site Operator will flag all ambient data collected since the last acceptable nitrate standard analysis.
- Further, the Operator and or ECB staff member will (as soon as possible) go to the site, investigate any instrumental operational problem(s), fix the problems and analyze again three (3) nitrate standards in triplicate.
- Start collecting ambient nitrate data after ensuring that the standard recoveries are within acceptable ranges.

Using the data recorded, plot the “mass deposited” readings (x-axis) versus the “measured mass” readings (y-axis). Determine the slope of the line (from e-log) and enter the slope in the “% of theoretical conversion” field in the 8400N setup screen.

**Note:** Ensure that this standard is **not** older than 6 months (from the date of purchase). If it is, make arrangements, through ECB to obtain a newer standard.

### **Enable Channels on PDL**

- Highlight PDL and select “C” Configuration Menu
- Select "D" Configure Data Channels
- Select "E" Enable/Mark Channel Online
- Select "NO3MC", "NO3FD", "NO3SF" or "NO3", "FD8400N", "CF8400N" (these are marked up separately) press <ENTER>

The following sequence is used to logout of the PDL data logger:

- **ESC**, **ESC** to “Home Menu” on PDL
- Use arrow key to select "O" or hit "O" key to logout

Turn off Computer screen. **Note: DO NOT** close the ESC Digitrend Operating Software, **DO NOT** turn off the computer.

### **2.31.2.3 Calibration Verification - Weekly & Bi-Weekly**

Calibration check (every 7 days or less) determines the ongoing accuracy and stability of the site specific nitrate monitoring system. The “calibration check” must be performed before any changes to the nitrate monitoring system are made.

- The NOx monitor can be set to perform automatic zero and span audits as per preset intervals using high purity nitrogen and a 5-PPM calibration gas.
- The time of the day and frequency are selected in the cycle setup window.
- The operator performs an analyzer calibration (zero/span) when a 10% difference is exhibited from the true concentrations.
- Field blanks are to be measured once every 2 weeks by placing a particulate filter between the cyclone and the denuder.

#### **2.31.2.3.1 Operational Checks**

- Turn “On” power to both the pulse generator and pulse analyzer. Allow at least 30 minutes for ozone generator in the pulse analyzer begin operating.
- Re-confirm that all system parameters are set as per **Table 1-** “System Parameters and Settings”.
- Press <RUN/STOP> to begin sampling and analysis. The 8400N is designed for automated operation and will continue sampling and analysis indefinitely, barring further Operator intervention or malfunction.

- The Site Operator should check the instrument and complete the weekly (or bi-weekly) e-log form. If any of these parameters are not within the specified limits, contact ECB for guidance.
- Pressing <**RUN/STOP**> again will halt sampling (with an option to abort immediately or finish the current 10 minute cycle)
- Power can then turn off to both the pulse generator and pulse analyzer.

### **Setting Computer, PDL, and Time/Date.**

The times for the PDL and computer must be EASTERN STANDARD TIME. The PDL must have the same NIST time  $\pm 1$  minute. The computer time must be 5 minutes slower than the PDL time.

Check the computer time and date at the lower right hand corner of the computer screen. If the time and date are not correct; click "**START**" button, control panel, date/time or right click computer time on taskbar, select "**Adjust Date/Time**", type in changes and select "**OK**".

Sources for getting the correct time:

1. Call the ECB and ask for the NIST time.
2. Call the NIST Colorado time @ **(303) 499-7111** (long distance).
3. Correct time loaded into cell phone.
4. Correct time website, <http://nist.time.gov/>

**Login to 8832 Data logger:** Sites are equipped with ESC Model 8832 primary data logger. Both are important tools in reviewing monitor/site operations. To ensure the monitor zero/audit levels are within required ranges.

The following sequence is used to log onto the PDL so that calibration checks can be performed via the 8832 data logger:

- Turn on the screen
- Double click on "**Shortcut to Splitscreen**"
- Open PDL
- Highlight PDL and type 2 letter data logger site code (located on the front of 8832 data logger) and AQM (may have to hit ESC several times before typing the site code)
- Select Login "**L**"
- Enter password (xxxxxxxx) and this will bring up "Home Menu"
- Can view "Report Current Cal Status"

### **Disable Channels on Data logger**

- While disabled, values are collected but flagged as "invalid data"
- Highlight PDL and scroll using arrow keys to select "**C**" Configuration Menu
- Select "**D**" Configure Data Channels
- Select "**M**" Disable/Mark Channel Offline

- Select "NO3MC", "NO3FD", "NO3SF" or "NO3", "FD8400N", "CF8400N" (these are marked down separately) <ENTER>
- **ESC, ESC** to "Home Menu"
- Select "**D**" Real Time-Data Display
- Select "**B**" Display Last Base Avg: This shows the last 1 minute average only w/flag D: Disabled
- **ESC, ESC** to "Home Menu" on PDL

### **Weekly or Bi - Weekly Checks**

The 8400N responds to a variety of conditions and malfunctions with status code messages. Current status codes can be viewed by pressing "**Status Codes**" from the main screen, see **Table 2** for codes.

The following checks are straight forward and fast and must be performed at least twice-per-week and recorded in the e-log:

- **Check the Nitrogen Cylinder and 2<sup>nd</sup> Gauge** - Twice-per-month check the pressure of the nitrogen cylinder. Replace the cylinder when the pressure is below 300 psi. and / or when cylinder certification date has expired.
- **Check Calibration Gas Cylinder and 2<sup>nd</sup> Gauge** - Twice-per-month check the pressure of the calibration gas cylinder. Replace the cylinder when the pressure is below 300 psi. and / or when cylinder certification date has expired.
- **Conduct Pulse Analyzer Status** - 1) Verify steady green light of the pulse analyzer. 2) If **no** steady green light, then press "**msg**", note the message and press "**clear**" to reset (you will get message upon any power failure or the ozone generator may not be "On" for 30 minutes).
- **Check NO<sub>x</sub> R-Cell pressure** - 1) Look for a value in the middle of the pulse analyzer display and if not displayed, press "**Test**" to scroll through parameter list. 2) If the value is not between 4.8" and 8.0" Hg, then adjust the regulator which is located at the back of analyzer. (Record in the site logbook and e-log if you have manually adjusted the R-cell value).
- **Check Pulse Analyzer Zero**-1) This is not critical as the system records the zero before each flash. But it is always best to keep the zero within  $\pm 5.0$  ppb.
- **Check Pulse Analyzer Span** -1) If the steady state check differs from the span gas concentration more than  $\pm 10\%$ , you will need to stop and reset the zero and span, follow the instruction included in "Series 8400N Ambient Particulate Nitrate Monitor/Operating Manual", by Rupprecht and Patashnick (R & P) Company, Albany, New York, 12203, February 2003. (This manual is always readily available at the monitoring site).

- **Conduct Manual Analyzer Audit-**1) Press “**RUN/STOP**” and “**F1**” to finish current sample (if necessary, open the main tank valve and regulator outlet valve on the calibration gas cylinder. The cal gas gauge on the 8400N should read  $5 \pm 2$  psi). 2) Press “**Menu**”, then “**Enter Service Mode**”, and then “**Perform Analyzer Audit**”. 3) Press “**Full Audit**” and this starts the audit and will take 15 to 20 minutes. 4) Record the audit value in site logbook and e-log and at the end of the audit, press “**Menu**”, then “**Exit Service Mode**” to get back to the main screen and then “**RUN/STOP**” to resume normal operation.
- **Check and Record Analyzer Audit data** -1) If the 8400N is set to do automatic analyzer audits, then all that is needed is to record the data. With the system running, press “**Data**”, then “**Select Data**”, “**Audit Data**” and record the most recent values in the e-log.
- **Check Pulse Generator-**1) Check that the pulse generator status light is “**Off**”. 2) If blinking or “**On**” check and note status codes in the upper left hand corner. 3) Correct and/or clear using “**Reset Status**” soft key. 4) Display should show “**Run**” mode and is active.
- **Refill Water Reservoir-** 1) Display should show “**Water Reservoir OK**”. 2) if not, open the cap at top of the reservoir water bottle, replenish with de-ionized water. 3) Replace the top loosely (Do not tighten, but allow for air to penetrate the headspace). 4) Check that there appears to be water in the lines to the humidifier. 5) If not and lines are dry, loosen the  $\frac{1}{4}$ " nut on the side of the upper tee of the humidifier and let the humidifier fill from the bottle.
- **Check Flash Strip** -1) Display should show “**Flash Strip OK**”. 2) Check that flash duration is between 90-120 ms with newly installed strips and 90-140 ms in-use flash strips. 3) From the main screen press “**Data**”- the flash duration is the last value listed. 4) Press “**ESE**” to return to main screen, verify and then press in “**Run**” mode.
- **Check Sample Flow-**1) Check sample flow rate when “**CURRENT STEP**” reads “**Sample**”. Flow should be between 0.9 and 1.2 L/min. 2) If “**CURRENT STEP**” reads “**PURGE**”, “**BASELINE**”, “**READ**” or “**WAIT**” then the indicated flow is not the sample flow. 3) Wait for system to enter step labeled “**SAMPLE**” and then read flow. 4) If the flow is lower than above- mentioned range (0.9 and 1.1 L/min), clean the collection orifice as described in “Series 8400N Ambient Particulate Nitrate Monitor/Operating Manual”, by Rupprecht and Patashnick (R & P) Company, Albany, New York, 12203, February 2003. (This manual is always readily available at the monitoring site).
- **Makeup Flow-**1) Open pulse generator front door and check upper rotometer readings-makeup flow should read between 3 and 5 L/min. 2) If not, follow

- instructions included in “Series 8400N Ambient Particulate Nitrate Monitor/Operating Manual”, by Rupprecht and Patashnick (R & P) Company, Albany, New York, 12203, February 2003. 3) Close door and verify that system is on main screen and in “RUN” mode. (A copy of this manual is always readily available at the monitoring site).
- **Check Orifice Flow** -1) Open the pulse generator front door and check lower rotometer readings. The orifice flow rotometer is the lower of the two rotometers, located inside the pulse generator cabinet. 2) Orifice flow should read 3-5 cc/min. x 100 during analysis (“PURGE”, “BASELINE” or “READ 1” steps), if not, follow instruction in “Series 8400N Ambient Particulate Nitrate Monitor/Operating Manual”, by Rupprecht and Patashnick (R & P) Company, Albany, New York, 12203, February 2003. 3) Orifice flow should read “0” during “SAMPLE”, if not, follow instructions given in “Series 8400N Ambient Particulate Nitrate Monitor/Operating Manual”, by Rupprecht and Patashnick (R & P) Company, Albany, New York, 12203, February 2003. (A copy of this manual is always readily available at the monitoring site). 4) Close door and verify that the system is “ON” main screen and in “RUN” mode.
  - **Check Vacuum Gauges**-1) Open the pulse generator front door and if any readings are out of range, record their values before changing and then adjust and note value after adjustment. 2) Front vacuum gauge should read between -15 and -17” Hg., and if not, follow instructions included in “Series 8400N Ambient Particulate Nitrate Monitor/Operating Manual by Rupprecht and Patashnick (R & P) Company, Albany, New York, 12203, February 2003. 3) Back makeup flow vacuum gauge should read between -20” and -30” Hg., and if not, follow instruction included in “Series 8400N Ambient Particulate Nitrate Monitor/Operating Manual”, by Rupprecht and Patashnick (R & P) Company, Albany, New York, 12203, February 2003. (A copy of this manual is always readily available at the monitoring site). 4) Close door and verify that system is “On” main screen and in “RUN” mode.
  - **Check Pressure Gauges**-1) The pressure gauge should read between 3 and 5 psi. 2) Purge pressure gauge is read during “PURGE”, “BASELINE” or “READ”. If any readings are out of range, record their values before changing. Then adjust and note value after adjustment. 2) If purge pressure is less than 3 then follow instructions in “Series 8400N Ambient Particulate Nitrate Monitor/Operating Manual”, by Rupprecht and Patashnick (R & P) Company, Albany, New York, 12203, February 2003. 3) If purge pressure is greater than 5 then follow instructions in “Series 8400N Ambient Particulate Nitrate Monitor/Operating Manual”, by Rupprecht and Patashnick (R & P) Company, Albany, New York, 12203. (A copy of this manual is always readily available at the monitoring site).

- **Check Cyclone-**1) If it has just rained, then dry the cyclone and unscrew the bottom, dry and replace. 2) Note the time and check while the system is running. 3) Also note if a lot of water is present.

#### 2.31.2.3.2 Aqueous Standard Span and Zero Check

1) On the pulse generator, press <RUN/STOP> and “F1” to finish the current cycle or “F2” to abort the current cycle. 2) Go to “Menu”>“Service Mode”>“Aqueous Standard”. Press “Start” to run one aqueous standard cycle without applying any standard solution to the strip. (This step will remove any residual material from the strip and prepare it for aqueous nitrate standards). 3) Open the door of the pulse generator, locate the cell assembly and open the cell. 4) Rinse the syringe in de-ionized water, three (3) times. 5) Fill the syringe to desired volume (0.5µl) with distilled water. Remove any air gaps in the syringe by drawing and depressing the syringe’s plunger several times while the syringe’s needle is immersed in the water. Apply water to the center of strip by emptying syringe and touching to strip. 6) Close the cell of the pulse generator and press, “Start” to analyze the water (the system will wait for 2 minutes and then only start sample analysis). Press, “Edit” to enter the “Mass Deposit” value, in nanograms (0) on the pulse generator screen. Repeat **water** application two (2) more times. 7) Fill the syringe to desired volume (0.4µl) with the nitrate standard solution. Remove any air gaps in the syringe by drawing and depressing the syringe’s plunger several times while the syringe’s needle is immersed in the nitrate solution. Further, ensure that no nitrate solution drops are clinging to the outside of the needle and or syringe, by touching to mouth of nitrate standard bottle or container. 8) Apply standard nitrate solution to the center of strip by emptying syringe and touching to strip. 9) Close the cell of the pulse generator and press, “Start” to analyze nitrate standard (the system will wait for 2 minutes and then only start sample analysis). 8) Repeat 0.4µl application two (2) more times. 10) Press, “Edit” to enter the “Mass Deposit” value, in nanograms on the pulse generator screen. 11) Record the results on the “Calibration e-Log”. 12) Rinse syringe thoroughly several times with de-ionized water. 13) Press “RUN/STOP” to resume normal operation. 14) Calculate the zero criteria, span percent difference and slope from the e-log while at the site using the following equation:

$$\text{Percent Difference (\%)} = ((\text{Known Standard Conc.} - \text{Observed Conc.}) / \text{Known Standard Conc.}) \times 100$$

If any of the three different zero audit results are not within  $\pm 1.5$  ppb and the different audit span concentration (0.6µl) results (in triplicate) are not within the acceptable range of  $\pm 15\%$  of the expected values then do following:

- **Note Corrective Actions taken-**1) Note in the logbook any corrective actions taken in the e-logbook, specifically if cell orifice was cleaned or flash strip was replaced or semi-monthly tests were run.

- **Note if Weekly or Bi-Weekly Checks** -1) Note in the e-logbook if weekly or bi-weekly checks were conducted in the site logbook.

### 2.31.2.3.3 Bi-Monthly Tasks

The 8400N responds to a variety of conditions and malfunctions with status code messages. Current status codes can be viewed by pressing “Status Codes” from the main screen, see **Table 2** for codes.

These following checks must be performed at least once every 2 weeks and recorded in the e-log:

- **Measure Field Blank** -1) Press <RUN/STOP> and “F1” to finish current sample. 2) Open pulse generator front door and connect Ballston particulate filter in line to the top of the black tubing above denuder. 3) Go to “Cycle Setup” and adjust “Based Start Time” to “Immed”. 4) Press “ESC” to return to main screen and push <RUN/STOP> to run for two cycles. 5) Record values in e-logbook and re-enter “Cycle Setup” and adjust “Base Start Time” back to “00:10”. 6) Remove filter, reconnect sample line, press <RUN/STOP> to resume normal operation.
- **Conduct Sample Flow Audit** -1) While the unit is in sample mode, attach a flow measuring device (e. g. Dry Cal) to black tubing above the activated carbon denuder. 2) Record the front panel “Sample Flow” and dry cal readings (If dry cal reading differs from the front panel reading more than 10%, the sample flow meter needs to be calibrated).
- **Check the Cyclone Assembly**: Locate the cyclone assembly and unscrew the cyclone cup and remove it from the cyclone assembly. Make sure that the inside of the cyclone cup is clean and clean, if needed. Screw the cyclone cup into the cyclone assembly.

### 2.31.2.3.4 Monthly Tasks

The 8400N responds to a variety of conditions and malfunctions with status code messages. Current status codes can be viewed by pressing “Status Codes” from the main screen, see **Table 2** for codes.

The following monthly checks must be performed and recorded in the e-log:

- **Clean Sample Collection Orifice**-1) Check that the front vacuum gauge reads between -15 and -17" Hg and if less than -15" Hg then re-adjust and check sample flow reading during the “Sample” step. 2) If the flow is still low then the orifice needs cleaning. 3) Stop the running cycle by pressing <RUN/STOP> and **F1** and open the cell and unscrew the orifice using yellow handled nut driver and large socket. 4) Clean the orifice with de-ionized water using a squirt bottle, dry with portable air and re-install, while assuring the orifice is tight, so that the O-ring provides a vacuum seal. 5) Press <RUN/STOP> to resume normal operation.

- **Replace Flash Strip-** The site operator needs to check flash duration times and change the strip if the flash duration is greater than 140 ms. For changing the strip- 1) Press <**RUN/STOP**> and **F1** to finish current cycle and open cell and unscrew the strip using yellow handled nut driver and small socket. 2) Remove the nuts, the washers and the strip and replace a new formed nichrome strip on the posts, with the loop facing up. 3) Put the washers and nuts back on the posts and go to “**Menu**”> “**Service**”> “**FlashIR Setup**”. 4) Press “**Reset Flash Fault**” and then press “**Test Flash**” and make sure the flash looked even and no sparks were seen. 5) Close the cell and check the flash duration (should be between 90-125 ms). 6) If OK then exit the service mode and press <**RUN/STOP**> to resume normal operation. Also, if the flash strip is replaced, a full three-point aqueous standard calibration must be performed 24 hours after a flash strip change.
- **Check Make-Up Flow Filter -** Open pulse generator front door and check upper rotometer readings-makeup flow should read between 3 and 5 L/min. 2) If not, follow instructions included in “Series 8400N Ambient Particulate Nitrate Monitor/Operating Manual”, by Rupprecht and Patashnick (R & P) Company, Albany, New York, 12203, February 2003. 3) Close door and verify that system is on main screen and in “**RUN**” mode. (A copy of this manual is always readily available at the monitoring site).
- **Check Analyzer Flow Filter-**1) This task should be performed every four (4) months. 2) Unscrew the filter holder mounted on the back of the pulse generator and carefully remove the 25 mm Teflon filter and place a new 25 mm Teflon filter between the black O-ring and the filter screen inside the holder. 3) Screw the filter holder back together and tighten until leak tight.
- **Leak Check-** 1) With system running in “**READY**” mode, close the green valve above the cyclone and close the front vacuum valve below the vacuum gauge. 2) Let the system pump down for several minutes and then close valve below back vacuum gauge. 3) Watch cell pressure reading on front panel and make sure that the drift should be less than 0.01 atms/min. 4) If Ok, slowly reopen valve above cyclone and reopen both vacuum valves.
- **Verify Ambient Temperature-**1) Insert reference thermometer in probe in temperature shield and verify that ambient temperature displayed on the main screen is within  $\pm 2^{\circ}\text{C}$ . 2) if not follow instruction included in “Series 8400N Ambient Particulate Nitrate Monitor/Operating Manual”, by Rupprecht and Patashnick (R & P) Company, Albany, New York, 12203, February 2003. (A copy of this manual is always readily available at the monitoring site).
- **Verify Ambient Pressure-**1) Using NIST-referenced barometer, determine the current ambient pressure in mm Hg and verify that the ambient pressure in the

main screen is within  $\pm 10$  mm Hg. 2) if not, follow instruction included in “Series 8400N Ambient Particulate Nitrate Monitor/Operating Manual”, by Rupprecht and Patashnick (R & P) Company, Albany, New York, 12203, February 2003. (A copy of this manual is always readily available at the monitoring site).

- **PVC Rain Cap**-1) Inspect and clean the PVC rain cap once a month or as necessary. 2) Be sure to install the inlet tubing through the centering hole in the rain cap. For additional information refer to “Series 8400N Ambient Particulate Nitrate Monitor/Operating Manual”, by Rupprecht and Patashnick (R & P) Company, Albany, New York, 12203, February 2003. (A copy of this manual is always readily available at the monitoring site).

### **Enable Channels on PDL**

- Highlight PDL and select “**C**” Configuration Menu
- Select “**D**” Configure Data Channels
- Select “**E**” Enable/Mark Channel Online
- Select “**NO3MC**”, “**NO3FD**”, “**NO3SF**” or “**NO3**”, “**FD8400N**”, “**CF8400N**” (these are marked up separately) <ENTER>

The following sequence is used to logout of the PDL data logger:

- **ESC**, **ESC** to “Home Menu” on the PDL
- Use arrow key to select “**O**” or hit “**O**” key to logout

Turn off Computer screen. **Note: DO NOT** close the ESC Digitrend Operating Software, **DO NOT** turn off the computer.

## **2.31.2.4 R & P 8400N Nitrate Maintenance**

### **Preventive Maintenance**

#### **2.31.2.4.1 Quarterly Tasks**

The 8400N responds to a variety of conditions and malfunctions with status code messages. Current status codes can be viewed by pressing “Status Codes” from the main screen, see **Table 2** for codes.

These following checks must be performed and recorded in the e-log:

- **Pulse Generator Battery**-Clean any corrosion on the battery terminals of the pulse generator on quarterly basis
- **Pulse Generator Fan Filter**-Clean or replace fan filter on the pulse generator. For additional details refer “Series 8400N Ambient Particulate Nitrate Monitor/Operating Manual”, by Rupprecht and Patashnick (R & P) Company,

Nitrate Monitoring System-Section 2.31.2 Revision 2 January 21, 2008 Page 20 of 24 Albany, New York, 12203, February 2003. (A copy of this manual is always readily available at the monitoring site).

#### **2.31.2.4.2 Bi-Annual Tasks**

The 8400N responds to a variety of conditions and malfunctions with status code messages. Current status codes can be viewed by pressing “Status Codes” from the main screen, see **Table 2** for codes.

These following checks must be performed and recorded in the e-log:

- **Carbon Denuder**-Replace or recharge (by baking out absorbed material) the carbon denuder every six (6) months, or as necessary. Further details are included in “Series 8400N Ambient Particulate Nitrate Monitor/Operating Manual”, by Rupprecht and Patashnick (R & P) Company, Albany, New York, 12203, February 2003. (A copy of this manual is always readily available at the monitoring site).
- **Aluminum Inlet Line**-Clean or replace the aluminum inlet line every six (6) months.
- **Calibrate Sample Flow Sensor**- Instructions included in “Series 8400N Ambient Particulate Nitrate Monitor/Operating Manual”, by Rupprecht and Patashnick (R & P) Company, Albany, New York, 12203, February 2003. (A copy of this manual is always readily available at the monitoring site).
- **Calibrate Cross Flow Sensor**- Instructions included in “Series 8400N Ambient Particulate Nitrate Monitor/Operating Manual”, by Rupprecht and Patashnick (R & P) Company, Albany, New York, 12203, February 2003. (A copy of this manual is always readily available at the monitoring site).

#### **2.31.2.4.3 Annual Tasks**

The 8400N responds to a variety of conditions and malfunctions with status code messages. Current status codes can be viewed by pressing “Status Codes” from the main screen, see **Table 2** for codes.

These following checks must be performed and recorded in the e-log:

- **Clean Reaction Cell**- It is ECB’s responsibility to clean and re-build the reaction cell inside the pulse analyzer every 2 (two) years, or as necessary. Make sure that the site operator calls ECB. Also note the call date and time in site logbook. The ECB will follow instructions included in “Series 8400N Ambient Particulate Nitrate Monitor/Operating Manual”, by Rupprecht and Patashnick (R & P) Company, Albany, New York, 12203, February 2003. . (A copy of this manual is always readily available at the monitoring site).

- **CPU Battery-** Replace the 3v Lithium CPU battery every year. Instructions are included in “Series 8400N Ambient Particulate Nitrate Monitor/Operating Manual”, by Rupprecht and Patashnick (R & P) Company, Albany, New York, 12203, February 2003. (A copy of this manual is always readily available at the monitoring site).
- **Data Backup battery-** Replace 3v Lithium battery every year. Instructions are included in “Series 8400N Ambient Particulate Nitrate Monitor/Operating Manual”, by Rupprecht and Patashnick (R & P) Company, Albany, New York, 12203, February 2003. (A copy of this manual is always readily available at the monitoring site).
- **Replace/Rebuild Pump-** The pump of the nitrate monitor has a lifetime of about 12 months. If the pump performance deteriorates, it should be re-built (ECB may be asked for help on this task) or replaced with a new pump.

### **Corrective Maintenance**

All corrective maintenance aspects of the R & P 8400N nitrate monitoring system have not been fully addressed by the system’s manufacturer. However, it is expected that related issues will be experienced and added to this list, upon further extended field deployment of the system.

### **Routine Maintenance**

As a part of routine maintenance and or during any site visits, perform and document readings in the e-log:

- Document the day, time and reason for the site visit in the Site Logbook.
- Check that the site building temperature is between 20°C and 30°C.
- Check that the probe and sample line are connected and secure.
- Check air conditioner, heater and lines for proper functions.
- Check that the site building is secure. Vandalism is to be reported to the Law Enforcement Officials and ECB Supervisor.
- Check the site building for any problems (e. g. leaks, infestations, etc.).
- Check that the heat tape is working and the site insulation is adequate.
- Check that all nitrate monitoring system’s components such as the pulse generator, pulse analyzer, R & P 8400N pump, etc., are operating within the prescribed ranges.
- Every year, ECB staff will perform routine maintenance of the pulse analyzer (NOx) using the procedures outlined in “Series 8400N Ambient Particulate Nitrate Monitor/Operating Manual”, by Rupprecht and Patashnick (R & P) Company, Albany, New York, 12203, February 2003. This action is recorded in the ECB logbook.

## **2.31.2.5 Troubleshooting**

### **2.31.2.5.1 Status Codes**

The 8400N responds to a variety of conditions and malfunctions with status code messages and these can be viewed by pressing "Status Codes" from the main screen. Every data code record contains a representation of these codes in a hexadecimal number called the "OP" code. See **Table 2** for a list of "OP" codes, status codes and their description.

### **2.31.2.6 Site Calls**

(See **Section III: Regional Office Responsibilities: EDAS set-up; Retrieval, Review, Correction and Storage of Data; Report Submission**, for site operator's duties between visits.)

To minimize travel some site operational checks must be made by telephone. Site calls are recommended every working day. Calls to a site can be made at any time; however an effort to avoid calling during the first 5 minutes of an hour should be made in order to avoid conflict with the calls made by the automated polling process of the Data Management and Statistical Services Branch (DMSSB) headquarters computer. At a minimum request, yesterday's data and today's data. If calling on a Monday, retrieve the data for Friday, Saturday, and Sunday as well.

**Note:** Make sure the modem speed (BAUD rate) is set correctly for the corresponding site (i.e. if set to 300 BAUD it will not work usually on a 2400 BAUD). If you are uncertain as to what speed modem your site is operating, call the ECB or DMSSB for assistance. Often times a site operator can call a site if it is set to the incorrect BAUD rate and the site will NOT respond. This is a common problem and can easily be avoided by making sure the rate(s) correspond.

### **Review the Reports For Flagged Data.**

Flags are assigned to data to indicate its validity. If no flag follows a value, the data is assumed accurate and valid. These data are used in all appropriate averages. Compare any flagged data with what is expected to occur such as nightly auto-calibrations. If any of the flagged data appears unusual make a note to check the back-up data collected during the next site visit. If several values are invalid, a site visit may be needed.

If a channel is incorrectly marked "D" (down) the data may be valid and you will need to notify headquarters of any valid data to be reported.

Compare the monitor zero results to the zero for each day. Compare the monitor span results to the known calibrator output for each day. Review the power failure report. Review the log for temperature inside the building. See "**Section III: Regional Office Responsibilities**" on "polling" for complete flag and review procedures.

**2.31.2.7 Data Reporting and Validation for Regional Offices**  
(See *Section IV: Continuous Monitor QA Plan Section, Headquarters Responsibilities.*)

**Data Validation for Regional Offices:** The regional office is responsible for data validity.

Verify that all periods of missing or invalid data have been accounted for, and the reasons have been identified for missing or invalid data on the Monthly File Listing or on an AQ-42 in remarks.

The operator must review all AQ-42s for unusually high or low concentrations.

The operator signs, dates, and submits the completed AQ-42s to the DMSSB in Ambient Monitoring in Raleigh. Each month, the DMSSB initiates a data review by printing a raw data report for each field office. Each month, the Regional Offices will be requested to send selective sets of BUDL data that are needed beyond what is already needed by DMSSB for verifying the missing value imputations supplied by the field office. DMSSB requested backup data logger files should be FTP'd to the DMSSB within 5 working days.

All monthly data should be submitted to headquarters within 10 working days from the end of the collection month.

All data, including logbooks and supporting printouts must be kept for five years.

**2.31.2.8 Quality Assurance Procedures**

The Quality Assurance Program requires strict adherence to approved procedures including the performance of specific tasks and activities. The determination of adherence to the approved procedures and the quality of ambient air data collected at each site includes the bi-monthly aqueous audits performed by the site operators and a complete systems audit performed by the staff of the Ambient Monitoring Section of the Division of Air Quality of each monitoring site and the ECB. This approach provides the essential ongoing and independent evaluation of data quality and reliability for the entire ambient air quality data set collected at each site and statewide.

**Strict adherence to the established approved procedures is required to enable the Division of Air Quality to certify that the data collected is true and representative of the ambient levels of oxides of nitrogen in the State of North Carolina.** Certain information must be available to the auditor.

### **Site Operator Responsibilities**

The critical part of the site operator's role in the Quality Assurance Program is the adherence to approved operating procedures, performing the required multipoint analysis, and maintaining accurate records of all monitoring site activities. It is the site operator's responsibility to notify the Regional Air Quality Chemist of the performance of each nitrate monitoring system during and/or immediately following each monitoring site visit. The site operators and the Regional Air Quality Chemist are jointly responsible for timely data validation and reporting.

**Bi-Monthly** Every two (2) weeks (**EVERY 14 DAYS OR LESS**), the zero and aqueous nitrate multipoint audits must be performed on the nitrate analyzer as part of the Calibration Check procedures and the results are to be reported to the DMSSB at the end of each quarter. Data validation must be conducted by the operator on a routine basis according to section **2.31.2.7** of this QA plan.

The Regional Ambient Monitoring Coordinator should verify that all site visits and aqueous zero/span audits are conducted as required.

### **Accuracy Auditing**

The ECB does not perform any nitrate monitoring site accuracy audits.

### **Interagency Auditing**

Interagency audits do not take place between the DAQ.

### **Data Verification**

The Regional Ambient Monitoring Coordinator is responsible for all data verification activities.

### **Systems Auditing**

The Regional Ambient Air Monitoring Staff shall participate and assist in the Annual Systems Audit performed by the Ambient Monitoring Section. All records and documentation must be available for review.

#### **2.31.2.9 Monitor Shutdown Procedure**

1. Highlight PDL and scroll using arrow keys to select "C" Configuration Menu
2. Select "D" Configure Data Channels
3. Select "M" Disable/Mark Channel Offline
4. Select "NO3MC", "NO3FD", "NO3SF" or "NO3", "FD8400N", "CF8400N" (these are marked down separately)
5. Turn the nitrate monitor power off. Pull the power plugs out for protection from lightning.
6. Shut off the cylinder valve(s) and the outlet valve on the regulator(s).
7. Contact ECB, PPB and DMSSB Supervisor to acknowledge site shutdown.

**Table 1 8400N STATUS CODES**

<b>OP Codes</b>	<b>Status Code</b>	<b>Description</b>
00000000	OK	No Status Condition
00000001	Y	System Reset
00000002	Z	Power failure
00000004	H1	A/D Failure
<b>00000008</b>	<b>S1</b>	<b>Ambient Temperature Out of Range</b>
00000010	S2	Ambient Pressure Out of Range
00000020	S3	Cell Comp Temp Out of Range
00000040	E	Electronics Temp Out of Range
<b>00000080</b>	<b>W</b>	<b>Check H<sub>2</sub>O Reservoir</b>
<b>00000100</b>	<b>X</b>	<b>Flask Failure</b>
<b>00000200</b>	<b>FS</b>	<b>Sample Flow Sensor Failure</b>
00000400	FC	Cross Flow Sensor Fail
<b>00000800</b>	<b>C1</b>	<b>Cross Flow Control Fail</b>
00001000	P1	Abs Pressure Out of Range
00002000	C2	Abs Pressure Control Fail
00004000	P2	Sample Pressure Out of Range
00008000	D	Cell dp Out of Range
00010000	R	Cycle Aborted
<b>00020000</b>	<b>A1</b>	<b>Analyzer Warning</b>
00040000	A2	Analyzer Communication Failure
00080000	A3	Analyzer Data Capture Start
00100000	A4	Analyzer Data Capture Checksum
00200000	A5	Analyzer Data Capture Incomplete
00400000	A6	Analyzer Data Capture Timeout
00800000	U	Amb Temp Sensor Not Used

• **NOTE:** 1) This hexadecimal system for “OP” codes is used so that combinations of status codes can be easily identified. 2) **Bold** entries are for the critical codes that affect data quality. 3) Codes and for their remedies refer to “Series 8400N Ambient Particulate Nitrate Monitor/Operating Manual”, by Rupprecht and Patashnick (R & P) Company, Albany, New York, 12203, February 2003. (A copy of this manual is always readily available at the monitoring site).

**Table 2 OUTPUT FORMAT AND EXPECTED VALUES FOR 8400N CYCLE DATA**

Name (Data Sys.)	Name (8400N)	Units	Accept. Range
Date	Record Date	None	
Time	Record Time	(PST)	
Tamb	Amb. Temp.	(°C)	
Ramb	Amb. Pres	(atm)	
RHCond	Cond % RH	(%)	70-100
Tbox	Cell Comp T	(°C)	Tamb ±10
Qsmpl	Sample Flow	(L/m)	0.9-1.1
Qxflo	Cross Flow	(L/m)	80± 5% of Qanal
Qanal	Analyzer Flow	(L/m)	0.7-1.0
Psmpl	Ave. Sam. Pres	(atm)	0.35-0.5
DPanal	Cell dp	(in H <sub>2</sub> O)	-6 to -10, change < ±1
Pricell	Rcell Pres	(in Hg-A)	4.7-5.3
tsmp	Sample Time	(s)	Set Value (515 at LR)
tread1	Read 1 Time	(s)	20
Noxamb	Average NOx	(PPB)	0-300
BslnArea	Baseline Area	(PPB*s)	<100
FlsArea	Pulse 1 Area	(PPB*s)	
ThConvFact	Conv Fac	(PPB*s/ng)	20-30
CalFact	Theor Conv %	(%)	>70
DtFls	Flash Dur	(ms)	90-140
NO3	Nitrate Conc	(µg/m <sup>3</sup> )	0-100
OP	None	None	000000

**Table 3 8400N STATUS CODES**

OP Codes	Status Code	Description
00000000	OK	No Status Condition
00000001	Y	System Reset
00000002	Z	Power failure
00000004	H1	A/D Failure
<b>00000008</b>	<b>S1</b>	<b>Ambient Temperature Out of Range</b>
00000010	S2	Ambient Pressure Out of Range
00000020	S3	Cell Comp Temp Out of Range
00000040	E	Electronics Temp Out of Range
<b>00000080</b>	<b>W</b>	<b>Check H<sub>2</sub>O Reservoir</b>
<b>00000100</b>	<b>X</b>	<b>Flask Failure</b>
<b>00000200</b>	<b>FS</b>	<b>Sample Flow Sensor Failure</b>
00000400	FC	Cross Flow Sensor Fail
<b>00000800</b>	<b>C1</b>	<b>Cross Flow Control Fail</b>
00001000	P1	Abs Pressure Out of Range
00002000	C2	Abs Pressure Control Fail

00004000	P2	Sample Pressure Out of Range
00008000	D	Cell dp Out of Range

**Appendix 1 SYSTEM PARAMETERS AND SETTINGS**

<u>Menu</u>	<u>Value</u>	<u>Comments</u>
<b>Cycle Setup</b>		
Sample Time	515 sec	These parameters determine timing of cycle steps
Purge Time	30 sec	
Baseline Read	10 sec	
Read Time	20 sec	
Read Time	1 sec	
Base Start Time	0.10	Will start even 10 min past hour
Minimum Cycle Length		Calculated value
Desired Cycle Length	600	
Number of Cycles	0	Runs routinely
Perform Flow Audit	6	<b>note:</b> Flow audits does not stop sample time of the day for automatic analyzer audit with cal gas frequency of analyzer audit in days
Start Analyzer Audit	00:00	
Perform Analyzer Audit	1	
<b>Audit Setup</b>		
Steady state Check	240	These parameters determine timing of audit steps
Read NOx 1	30	
Flow Balance Check	180	
Read NOx 2	30	
Line Purge	600	
Read NOx 3	30	
NOx Pulse Read	30	

**8400N Setup**

Conv. Fact. Calc.

Auto

These are calibration  
and control factors for  
nitrate analysis

Conv. Fact.

Anal. Cross Flow

% Theor. Conv.

85%

85.00%

Depends on aqueous  
standards results

**System Setup**

**RS-232 Setup**

Protocol

CycleDat

For automatic  
download of cycle  
data to computer

Baudrate

9600

Com Para 1

52

Com Para 2

75048

Com Para 3

13010

Com Para 4 0

## Sign-Off Sheet

I certify that I have read, understand and agree to follow the contents of Revision 2.5 of the "R&P MODEL 8400N NITRATE (NO3) QA PLAN, Section II, OPERATOR RESPONSIBILITIES" with an effective date of January 19, 2011. **Sign, date and return to the Ambient Monitoring Section Chief.**

Debbie Manning, Regional Ambient Monitoring Coordinator: \_\_\_\_\_

Eddie Todd, Regional Ambient Monitoring Coordinator: Eddie Todd 1/26/2011

Site Operator: Tim D. FORD 1/25/11

Site Operator: \_\_\_\_\_