Rupprecht and Patashnick 8400N Nitrate
Section I

Electronic Calibration Branch (ECB) Responsibilities

Approval Sign-Off Sheet

I certify that I have read and approve of the contents of the "Rupprecht and Patashnick 8400N Nitrate QA Plan, Section I, Electronic Calibration Branch (ECB) Responsibilities" with an effective date of October 25, 2010. **Sign, date and return to the Ambient Monitoring Section Chief.**

Joette Steger, PPB Supervisor: Joette Steger 1/31/2011

Donnie Redmond, Ambient Monitoring Section Chief: 7/1/11

Frank Stellitano, ECB Supervisor: Per Tech Approval F.R. Stellitano 11/8/10

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2.31.1 R&P 8400 Nitrate QA Plan: ECB Responsibilities

Note: The following is a list of "significant changes" from Revision 2.2.

1) QA updated per QAP/SOP 2.39 "Standard Operating Procedure (SOP) for Preparing Quality Assurance Plans/SOPs".

2) Projects and Procedures updates.

2.31.1.1 Selection and Procurement

The Electronics and Calibration Branch (ECB) of the Ambient Monitoring Section (AMS) of the DAQ is responsible for the selection, evaluation and procurement of the nitrate monitoring equipment and related accessories. Further, ECB is responsible for receipt, assembly, testing (at its facility) and installation of nitrate monitors in the field, evaluation of the on-going performance of nitrate monitors and related support equipment and scheduled and unscheduled system's maintenance. As a part of its responsibilities, ECB is expected to maintain a sufficient inventory of monitors, support equipment and replacement parts to minimize loss of nitrate ambient monitoring data.

Additionally, ECB staff is also responsible for procuring and maintaining dedicated traceable NO standard for the certification and aqueous nitrate standards for the independent accuracy auditing of the ambient air quality nitrate monitors. These standards provide a direct link to established national standards and thus become the basis for the collection of the highest quality ambient monitoring nitrate data possible and more so in accordance with current procedures and existing Federal Regulations and Guidelines.

The ECB maintains permanent records of any standards used in the calibration and auditing of monitors and sampling equipment used in support of DAQ monitoring activities. There are permanent records at ECB for each nitrate monitor and sampler used to analyze ambient air quality in the State of North Carolina. Each major component of the nitrate monitoring system, such as Rupprecht and Patashnick (R & P) pulse generator, R & P pulse analyzer, R & P 8400N pump, and etc. is assigned a dedicated logbook. These logbook records include information related to the performance evaluations and complete records detailing the instruments and equipment placed at each monitoring site.

The ECB is also responsible for evaluating, developing and recommending changes in the equipment and operating parameters to improve the quality of data collected and procedures used in the collection of data.

2.31.1.2 Nitrate Monitoring Instrument, Equipment and Accessories

The nitrate monitoring system includes the following main components:

- R & P Pulse Generator-the main component of the nitrate monitor.

- R & P Pulse Analyzer-the NOx analyzer component of the nitrate monitor.
- R & P Pump to provide vacuum to operate the system.
- N_2 for the nitrogen/zero purge gas supply.
- NO in nitrogen for calibration verification.
- Commercially available aqueous nitrate standard.
- ESC Model 8832 Dataloggers, (Primary, PDL and Secondary, BUDL).
- A Site Dedicated PC and Modem System.
- Telephone Modem.

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

Note: minor components are not specified but included by reference.

The ECB is responsible for ensuring that all components are compatible with the measurement of ambient levels of atmospheric particulate nitrates. The ECB is responsible for the performance of complete system evaluation prior to the field installation and that the system is fully functional at the completion of the installation. On an ongoing basis as needed the ECB provides equipment and instrumentation maintenance and operational support to maximize the collection of the highest quality ambient air pollution data possible in accordance with accepted and approved procedures.

2.31.1.3 Receipt, Testing and Inventory

The ECB shall conduct operational tests after receipt and unpacking of each instrument. Following the R&P 8400N Instruction Manual setup procedures, Section 2.31.2.2 of NC QA/SOP and operator’s calibration section, the instrument must sample calibration gas at atmospheric pressure. After initial setup and instrument checks, the instrument is either approved or returned to the manufacturer if any damage or problems that cannot be fixed are identified.

Upon receipt of the instrument, if there is any obvious damage to the shipping container, notify the carrier immediately and hold for inspection. Carefully unpack the monitor and its appurtenances. Install the 8400N in the shop on a stable, level surface so that there is easy access to the front and back of the instrument. The contents of the shipping container should contain the analyzer, instrument power cord, ozone scrubber, particulate filters, and instruction manual.

Verify that all items listed on the "Receiving Report" are included. Mark each as "received". Items back-ordered should be marked "B.O.". Missing items should be marked "missing". Sign, date, and return the Receiving Report to the Branch supervisor. For any missing items, call the vendor for an explanation.

Read the instructions thoroughly for each model monitor. Visually inspect the exterior of all items for damage. If there are obvious damages, notify the carrier and hold for inspection.

To inspect the internal chassis of the pulse analyzer and pulse generator, remove the cover of the instrument(s) to expose the internal components and check for loose circuit boards, for loose wires, cables, broken components, or other damages. If necessary, contact the manufacturer for assistance.

Upon approval of the tested monitor, the unit shall be added to the fixed asset system. For each monitor(s), apply an inventory decal and complete an inventory load sheet. Submit the inventory load sheet to the Projects and Procedures Supervisor.

Principle of R & P 8400N Monitor Operation

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

Ambient air samples are pulled through a cyclone operated at 5.5 L/min to remove particles above $PM_{2.5}$. 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 $PM_{2.5}$ 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 temperature. The system outputs nitrate concentration and system operating parameters via a serial communications line at the end of each cycle.

2.31.1.4 R & P 8400N Nitrate Analyzer (Pre-Site Installation Checks)
A) Model 8400N Nitrate Monitor: the monitor should be tested thoroughly before deployment at the monitoring site.

Monitor System Assembly
The ECB staff should read carefully the "Series 8400N Ambient Particulate Nitrate Monitor/Operating Manual", by Rupprecht and Patashnick (R & P) Company, Albany,

New York, 12203, February 2003. Then only try and assemble all components of the nitrate monitoring system for testing at its facility.

In order to operate the Series R & P 8400N ambient particulate nitrate monitor, the following components needs to be set up, such as the pulse generator, pulse analyzer, pump, inlet hood, gas cylinders, in-line filters holder, computer and power cable and humidifier. Refer to above referenced operating manual, Sections 2, 3, 4 and 5 for detailed instructions for the monitor system assembly. For the assembling of each monitor components for further testing at its facility, the ECB staff should follow all the instructions included in the "Series 8400N Ambient Particulate Nitrate Monitor / Operating Manual", by Rupprecht and Patashnick (R & P) Company, Albany, New York, 12203, February 2003. Specifically see Sections 2, 3, 4 and 5 of the R & P operating manual for detailed instructions.

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.

This testing will involve among other things:

Pre-calibration electronic adjustment

1) Datalogger analog output adjustment
2) Operational test calibration check

Nitrate Monitor Testing
After assembly of the complete R & P 8400N monitor, the ECB staff will test its satisfactory operational performance at its facility. The procedural details for testing are given in the "Series 8400N Ambient Particulate Nitrate Monitor/Operating Manual", by

Rupprecht and Patashnick (R & P) Company, Albany, New York, 12203, February 2003. Refer to above referenced manual Sections 2, 3, 4 and 5 for detailed instructions. Specifically, after setting up the monitor, turn “on” the pulse analyzer and pulse generator and perform a primary manual leak check:

Open the door of the Pulse Generator. **IMPORTANT: Ensure that the pump is turned on before performing the manual leak check.** Pull up on the knob of the cell regulator to display the orange strip. Turn the knob to completely open the flow. You will know that the flow is completely open when the regulator knob hits a stop and when the cell vacuum gauge reads around or above 25 inches. Ensure that the sample valve is open. Close the inlet valve. Allow the rotometers to settle. Close the makeup flow valve (located toward the back of the unit) and the sample/bypass flow valve (located near the front of the unit). Wait 1 minute. Open the sample/bypass flow valve. When you open this valve, watch the cell vacuum gauge. If the needle on the gauge moves, there is a leak in the system. If the needle of this gauge remains steady, then there are no leaks in the system. If there are no leaks in the system, open all the valves and turn on the Pulse Generator by pushing the power switch on the front of the unit.

Adjust the cell vacuum before running a cycle for the first time. Pull up on the knob of the cell regulator to display the orange strip. Turn the knob until the cell vacuum gauge is at 1/2 ATM (roughly 15-16 inches at sea level). When the cell vacuum gauge displays 1/2 ATM, push the knob of the cell regulator down to hide the orange strip.

After turning “on” the pulse generator, allow the unit to run in “ready” mode for at least 14 hours before running the first cycle to charge the internal lead-acid battery.

B) 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. Invalidate nitrate ambient data for the 30-minute period after the power comes back. Record all events in the site logbook and notify Supervisor and the ECB.

Pulse Generator: status light should be off. If "**blinking**" or "**on**", check and note status codes in upper left hand corner. Correct and/or clear using "**reset status**" soft key.

Purge and Cal Pressure: the purge and cal pressure gauges should both read between 4 and 6 psi.

Display: display should show “**RUN**” mode, and is active, show “**Water Reservoir OK**”, and “**Flash Strip OK**”.

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.

Check the 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 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.

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”. Record all actions in 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.

Check NO_x R-Cell Pressure: to check the R-Cell pressure, look for the value in the middle of Pulse Analyzer display. If not displayed, press “**test**” to scroll through parameter list. If not between 4.7 and 5.3 in Hg, then adjust the regulator at the back of analyzer. The data system records the R-Cell value.

C) Model 8400N Monitor Specifications

SYSTEM PARAMETERS AND SETTINGS

Menu	Value	Comments
	Cycle Setup	
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	**note:** 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	
	Audit Setup	
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	85%	
% Theor. Conv.	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	

2.31.1.5 Calibration Standards and System

Gas Calibration Standards

The ECB shall procure certified protocol standards for the Ambient Monitoring Section. Primary NO Standards are used to calibrate and evaluate the ongoing calibration checks and audit performance of the nitrate monitor. The primary NO standard used must be certified, commercially prepared compressed gas standards with a certified accuracy of no worse than ±2 percent. Procedure for the Verification of New Cylinder Concentrations (QA/SOP 2.3.6) will be followed when primary standard calibration gases are purchased / received. Standards in the concentration range of ~5 ppm are suitable choices for dilution to prepare low concentration calibration mixtures.

a. Extreme care must be taken to ensure compatibility for all components. Flow rates and concentration outputs must meet the requirements of the monitor.

b. All primary protocol standard calibration gases must be referenced to a National Bureau of Standards (NBS) nitrogen oxide in Air Standard Reference Material (SRM) or an NBS/EPA approved gas manufacturer's Certified Reference Material (CRM). A written statement of certification should be obtained which provides the following:

   a. a brief description of the certification procedure,
   b. cylinder numbers,
   c. cylinder gas concentrations,
   d. replicate analysis data,
   e. balance gas used,
   f. NBS, SRM numbers used as standards, and
   g. last analysis date.

A copy of this certification should be available to users and should be kept on file in the ECB Unit files.

c. Re-analysis of calibration gas standards shall be performed every 24 months or when expired for verification of gas stability. (This 24 month period is allowed because NO is somewhat stable as shown by repeated analysis of the same cylinder and in accordance with 40CFR50 App. C.3.1. In actual practice most cylinders may be expended sooner)

d. No cylinder gas should be used below a cylinder pressure of 200 psig as shown by the cylinder gas regulator.

e. Each NO gas cylinder shall contain the following minimum traceability information on a label or tag affixed to the cylinder or valve:

a. The concentration of cylinder gas,
b. The last analysis date,
c. The expiration date,
d. The initials of the person performing the analysis,
e. Cylinder number, and
f. Balance gas.

Aqueous Nitrate Standards and Water

a. Commercially available standard nitrate solution (300 ng KNO_3)

2.31.1.6 Site Monitor Operation / Verification (Site Installation)

After the regional office has obtained permission to use a site from the site owner, and after the DAQ Ambient Monitoring Project and Procedures Supervisor has approved the site, the Electronics and Calibration Branch will install the monitor and its appurtenances. Electrical circuits should be dedicated, properly sized and labeled prior to the installation of the monitor equipment. Inspect the site for integrity and safety.

The ECB staff is responsible for the installation of all State operated nitrate monitoring systems across the State of North Carolina.

The cylinder will need to be switched out every 24 months or before it expires. All procedures should be documented on the 109 Form.

The installation at the monitoring site includes:

- R&P 8400N Nitrate monitor
- Computer, datalogger, and modem system

Note: To ensure the uniform collection of air quality data various sample probe-siting criteria must be followed (see 40 CFR 58 Appendix E for details). These criteria are summarized below for middle neighborhood and urban spatial scales:

- The nitrate monitor and its associated accessories must be installed in a building where room temperature extremes do not fall below 20ºC (68ºF) or exceed 30ºC (86ºF). Check to ensure that the heater and air conditioner are in working order and do indeed maintain the desired temperature range, irrespective of the time of the day and season. Remove the air conditioner filter and clean, if necessary. Check any problems related to the building such as leaks, infestations, etc.
- The sample probe inlet must be located 10 meter above ground level and at least 1 meter from any obstructions.
- The probe should be at least 10 meter from obstructions over a range of 180º.
- The probe inlet should be > 20 meter from the drip line of trees. The probe inlet must be at least 10 meter from the drip line of any tree.
- The distance from the probe inlet to any obstacles such as buildings must be at least twice the height the obstacle protrudes above the probe inlet.
- There must be unrestricted airflow 270º around the probe inlet or 180º if the probe inlet is on the side of a building.
- The spacing from the sample probe inlet to the edge of the nearest traffic lane is dependent on the traffic flow. Consult the table in 40 CFR 58 Appendix E to determine the proper siting distance.
- The sample line should be 5/16’ OD (outer diameter) made of 316 stainless steel housed inside a 3” aspirated duct, both of which should extend approximately 2 meters above the rooftop. There should be an aluminum clamp to hold the tubing within the screened inlet hat. Make sure you have an inlet hat that is not painted.
- Install the pulse generator and pulse analyzer as per instructions in Sections 2 and 3 of the “Series 8400N Ambient Particulate Nitrate Monitor/Operating Manual”, by Rupprecht and Patashnick (R & P) Company, Albany, New York, 12203, February 2003. The pulse analyzer may be placed either alongside or underneath the pulse generator provided it is within 24 inches of the outlet located at the left-hand bottom rear of the main unit. If located underneath, it is best to construct separate shelf so that the pulse analyzer can be removed easily without disturbing the pulse generator.
- Ensure that the analyzer filter is in place prior to starting the flow to the pulse analyzer.
- Insulate the indoor portion of the 3" aspirated duct with flexible insulation such as Reflectix or fiberglass.
- With the supplied serial cable ensure that the RS-485 port on the 8400N is connected to the pulse generator with the pulse analyzer.
- Ensure that the RS-232 port on the 8400N is connected with the supplied serial cable to a code-operated switch and then to the modem, for remote communication with the pulse generator.
- Next, the datalogger must be configured and initialized by following the instructions included in the manufacturer’s manual. Turn the main power “on” of all system components and ensure that components power lights are on.

- Configure the modem as per manual instructions to auto answer on the first ring and to operate at 2400bps. Check modem operability by calling the ECB and having someone call back the site.

Gas Regulator Attachment

1. Connect the regulator to the cylinder and connect the line that will feed the mass flow controller to a vacuum pump.
2. With the cylinder valve tightly closed, open the regulator valve and vacuum the regulator for two minutes.
3. Close the regulator valve and open the cylinder valve. Increase the pressure to 100 psig.
4. Close the cylinder valve.
5. Repeat steps 2 – 4 an additional 4 times. During the last run, drop the regulator pressure to the normal operating level (usually 20-30 psig).
   Do not close the cylinder valve after the last run.
6. Disconnect the line from the vacuum pump and open the regulator valve to allow a very low flow to prevent ambient air from entering the dilution system.
7. Connect the tubing to pollutant mass flow controller in the dynamic dilution system.
8. Fully open the regulator valve.

B. Computer Datalogger System and Modem

Following the installation of components of the nitrate particulate monitoring system, the ECB staff should verify the performance and proper functioning of each component. Set the computer, primary and secondary datalogger's time. The times for the PDL and computer must be Eastern Standard Times (EST).

Note: The PDL must have the NIST time ± 1 minute; the computer time must be 5 minutes slower than PDL/BUDL.

Sources for setting the correct time

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

Login to 8832 Datalogger: Sites are equipped with ESC Model 8832 primary and backup dataloggers.

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

- Turn on the screen
- Double click on "Shortcut to Splitscreen"
- Open the PDL

- Highlight PDL and type 2 letter datalogger site code (located on the front of 8832 datalogger) and AQM (may have to hit "**ESC**" several times before typing the site code)
- Select Login "**L**"
- Enter password (xxxxxx) and this will bring up "Home Menu"
- Can view "Report Current Cal Status" (tells when all Auto Cals are run)

Disable the PDL channel:

- Select "**D**", real time display
- Select '**B**", display last base average: shows the last 1 minute average only w/flag, "D", disabled and "C" calibration
- Select "**C**", continuous average report
- Select "**NO3MC**", "**NO3FD**", "**NO3SF**" or "**NO3**", "**FD8400N**", "**CF8400N**" (these are marked down separately) <**ENTER**>
- Change # of flags to report from 02 to 03
- Start continuous report: this will show minute averages as they are calculated and keeps all values on screen

- **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.

- **Pulse Generator**: status light should be off. If blinking or on, check and note status codes in upper left hand corner. Correct and/or clear using "reset status" soft key.

- **Purge and Cal Pressure**: the purge and cal pressure gauges should both read between 4 and 6 psi.

- **Display**: display should show "**RUN**" mode, and is active, show "**Water Reservoir OK**", and "**Flash Strip OK**".

- **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.

- **Check the 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 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.

- **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 NO_x R-Cell Pressure**: to check the R-Cell pressure, look for the value in the middle of Pulse Analyzer display. If not displayed, press "**test**" to scroll through parameter list. If not between 4.7 and 5.3 in Hg, then adjust the regulator at the back of analyzer. The data system records the R-Cell value.

- **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.

- Verify system and cycle parameter settings using the table given in section **2.31.1.4 C)**.

- Perform analyzer audit: 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 ± 2 psi. Press "**Menu**", then "**Enter Service Mode**", then "**Perform Analyzer Audit**". Press "**Full Audit**". This starts the audit and will take 10 minutes. 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. Close the calibration tank valve and cal gas regulator outlet valve if a leak is suspected.

- Turn on the power to the pulse analyzer and give about 30 minutes for the ozone generator in the pulse analyzer to begin operating.

- Press "**RUN/STOP**" to begin sampling and analysis. The 8400N is designed for automated operation and will continue sampling and analysis indefinitely barring operator intervention or component(s) malfunction.

- Pressing "**RUN/STOP**" again will halt sampling (with an option to abort immediately or finish the current 10 minute cycle).

- Power then can be turned off to both pulse generator and pulse analyzer.

Enable Channels on PDL

- Press **{ESC}** Home Menu on PDL
- 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 datalogger:

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

Remote Polling - check to make sure the telephone is in working order (dial tone). Call back to the ECB and request a site poll, if necessary.

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

2.31.1.7 Equipment Identification

ECB personnel, using Form 109 will document and log all components of the nitrate monitoring system.

2.31.1.8 R & P 8400N Nitrate Monitoring System Maintenance

ECB is also intimately involved in the overall system maintenance to ensure optimum continual high data quality collection. The following are three important aspects of system maintenance ECB is involved:

- Preventive maintenance.
- Corrective maintenance.
- Routine Maintenance.

Preventive Maintenance

All preventive maintenance aspects of R & P 8400N nitrate monitoring system have not been fully addressed at this time. **Note**: In terms of preventive maintenance at present time, the ECB staff needs to insure that they have sufficient spare parts of the nitrate monitoring system in stock such as carbon denuders, fan filters, etc., so that they can, upon specific request from the site operator, arrange to send them, on an as needed basis.

Corrective Maintenance

All corrective maintenance aspects of 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.

Factory Calibration Procedure

The Factory Cal procedure balances the PMT, preamp, and software gain factors so the instrument has optimum noise, linearity, and dynamic range. It should be used when you are unable to zero or span the instrument, when the slope and offset values are outside of the acceptable range, or when other more obvious reasons for problems have been eliminated. Factory Calibration Procedure: **NOTE In this procedure a range of 20000 ppb and a span gas concentration of 5000 ppb is used as an example. Other values can be used.**

1. On the Preamp board, set S1 and S2 to 8. Turn R19 20 turns clockwise, then 3 turns counter-clockwise.

2. Set RANGE MODE to SNGL by SETUP-RNGE-MODE-SNGL to select single range operation.

3. Set the RANGE to 20000 ppb by SETUP-RNGE-SET and key in 5000, then press **ENTER**.

4. Input Zero gas into the sample port, and Scroll to the TEST function labeled PMT. Typical reading should be less than 50 mV. Readings above 150 mV indicate a pneumatic leak, light leak, contaminated reaction cell, bad zero gas, or wet air coming into the ozone generator. If readings are greater than ±150 mV, the instrument will not zero or span properly. Allow the instrument to sample zero gas for at least 20 minutes to re-fill the internal data filters and autozero filter with zero readings. Then zero the instrument by CAL-ZERO- ENTR.

5. Set the expected span concentration to 400ppb. Enter the expected NOx concentration of 400 ppb by pressing CAL-CONC-NOX. Then press CAL-CONC-NO, to enter the expected NO concentration of 400 ppb. Then press EXIT to return to the CAL menu.

6. Input 400 ppb of NO span gas in the sample inlet port.

7. Scroll to the NORM_PMT - TEST function.

8. Calculate the expected NORM PMT mV reading. For ranges up to 2000 ppb, multiply the expected span value by 2 to get the mV reading. For ranges 2001 to 20000 ppb, multiply the expected span value by .2 to get the mV reading. In this example the expected span gas concentration is 5000 ppb and therefore the expected voltage is 1000 mV. As an alternate method, the voltage can be determined from the graph in **Table 1**.

On the Y-axis find the calibration concentration in ppb, then determine the expected voltage from the X-axis.

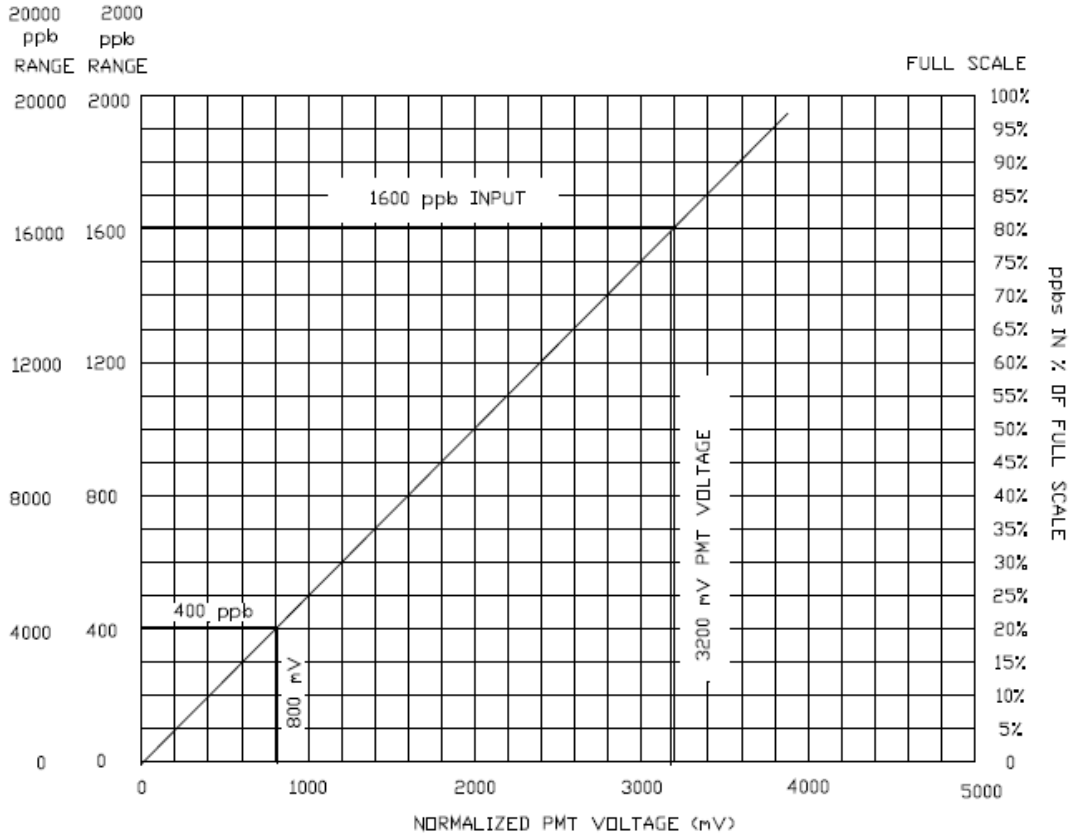

Table 1 NORM PMT mV Reading

Example: Cylinder conc. 5.236 ppm (NO), 0.189 ppm (NOx)

5.236
0.189 5.425 X 0.2 = 1.085 x 1000 = 1085 mv
5.425 ppm

9. Adjust S2, the HVPS coarse adjustment, on the preamp board to the setting that produces a signal that is closest to 800 mV. Adjust S1, the HVPS fine adjustment, to the setting that produces a signal that is closest to 1000 mV. Use R19 to trim the reading to 1000 ± 50 mV. The readings will periodically go to zero as the AutoZero circuit operates, ignore the zero readings.

10. Allow the instrument to sample span gas for 30 minutes. Then do a span calibration by CAL-SPAN-ENTR. After the span is completed, do the analyzer audit procedure. This

procedure is extremely important to assure that the instrument will operate with optimum noise, linearity, and dynamic range.

Electric Test (ET) Procedure:
1. To adjust ET press SETUP-MORE-DIAG, then scroll to ELEC TEST and press **ENTER**.
2. Scroll the TEST functions until PMT is displayed.
3. Adjust R27 until 2000 mV ± 100 is displayed.
4. Press **EXIT** to return to SAMPLE mode.

Optic Test (OT) Procedure:
1. To adjust OT press SETUP-MORE-DIAG, then scroll to OPTIC TEST and press **ENTER**. 2. Scroll the TEST functions until PMT is displayed.
3. Adjust R25 until 2000 mV ± 100 is displayed.
4. Press **EXIT** to return to SAMPLE mode.

Routine Maintenance
As a part of routine maintenance and or during any site visit, ECB will perform:

- Document the day, time and reason for the site visit in the Site Logbook.
- Check that the site building temperature is between 20ºC and 30ºC.
- 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 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
- Checks 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.
- Down any channels for nitrate monitor's component(s) repaired, replaced during the repair, replacement.
- Up any channels for nitrate monitor's component(s) repaired, replaced during the repair, replacement.
- If appropriate, time duration wise change the probe every 2 years.
- Every two years, ECB staff will perform routine maintenance of the pulse analyzer (NOx) using the procedures outlined in the "Series 8400N Ambient Particulate Nitrate Monitor/Operating Manual", by Rupprecht and Patashnick (R & P) Company, Albany, New York, 12203, February 2003.

2.31.1.9 Accuracy Audits

The Electronics and Calibration Branch does not audit the nitrate monitor.