UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 4

Science and Ecosystem Support Division
Field Services Branch
980 College Station Road
Athens, Georgia 30605-2720

August 1, 2016

Mr. Jim Bowyer
North Carolina Department of Environmental Quality
Division of Air Quality
Green Square Office Complex
217 West Jones Street
Raleigh, NC 27699-1641

SESD Project Number: QT16-0107

Mr. Bowyer:

We have reviewed the following document you submitted for approval:

Model 42i-Y Trace Level Reactive Oxides of Nitrogen (NOy) Monitoring System, Section 1, Electronic Calibration Branch (ECB) Responsibilities (TLNOy 2.38.1), Revision 1.6, April 21, 2016.

The quality assurance and technical elements within this SOP were compared to EPA regulations and current guidance. The stated procedures appear to be clear, sound, and appropriate as written, to the extent they can be evaluated. EPA approval of this document is granted. Please be aware that approval of this SOP does not constitute a waiver from any regulatory requirements, or the agency's QAPP requirements, that are not addressed within the body of this document. Your agency remains accountable for ensuring that the NOy monitoring procedures implemented adhere to all the applicable requirements detailed in 40 CFR Parts 50, 53, and 58, and that the data generated is of sufficient quality. This SOP should be revised when/if the stated procedures are modified.

If you have any questions, please contact Stephanie McCarthy at 706-355-8745 or via email at mccarthy.stephanie@epa.gov.

Sincerely,

Laura Ackerman, Chief
Superfund and Air Section

MODEL 42*i*-Y TRACE LEVEL REACTIVE OXIDES OF NITROGEN (NOy) MONITORING SYSTEM
Section I

Electronic Calibration Branch (ECB) Responsibilities

Standard Operating Procedure Approval

I certify that I have read and approve of the contents of this revision of 2.38.1 with an effective date of April 21, 2016.

Raleigh Central Office 42*i*-Y Trace Level Reactive Oxides of Nitrogen (TL - NOy) Lead

Carlton Blakley, Environmental Chemist

Signature: Carlton Blakley Date: April 21, 2016

Electronic and Calibration Branch Lead

Mark Yirka, Electronics Tech III

Signature: Mark Yirka Date: 4-26-2016

Projects and Procedures Branch Supervisor

Joette Steger, Environmental Supervisor

Signature: Joette Steger Date: 5-6-2016

Ambient Monitoring Section Chief

Donnie Redmond, Ambient Monitoring Section Chief

Signature: Donnie Redmond Date: 5/6/16

U.S. Environmental Protection Agency

Laura Ackerman, Region 4 SESD

Signature: _____ Date: _____

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2.38.1 Trace Level Oxides of Nitrogen QA Plan: ECB Responsibilities

Note: The following is a list of "significant changes" from Revision 1.5.

1) Addition of permapure dryer change/replacement every five (5) years for all sites.

2) Audit level changes to reflect use of expanded list of audit levels for Annual Performance Evaluation as described in 40 CFR Part 58 Appendix A Section 3.2.2 for all sites.

3) The sample probe inlet (including converter box) must be located at 10-meter height to meet US-EPA requirement for the NCore site only.

4) MDL performed for NCore site only.

5) 146C Audit calibrator purge procedure added.

6) TAPI 701 Zero Air Generator added to network.

7) Audit frequency and level changes to reflect use Annual Performance Evaluation as described in 40 CFR Part 58 Appendix A Section 3.1.2 for all sites.

2.38.1.1 Equipment 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 NOy monitoring equipment and related accessories. Further, ECB is responsible for receipt, assembly, testing (at its facility) and installation of NOy monitors in the field, evaluation of the on-going performances of NOy monitors and related support equipment and scheduled and unscheduled system's maintenance. As a part of its responsibilities, ECB is also expected to maintain a sufficient inventory of monitors, support equipment and replacement parts to minimize loss of NOy ambient monitoring data.

Additionally, ECB staff is also responsible for procuring and maintaining dedicated traceable NOy standards for the certification of all calibrators and for the independent accuracy auditing of the ambient air quality NOy monitors. These trace standards provide a direct link to establish national standards and thus become basis for the collection of the highest quality ambient monitoring NOy data and more so in accordance with current procedures and existing Federal Regulations and Guidelines. The continual accuracy audits performed by the ECB staff provide an ongoing evaluation of NOy monitor's performance and site operator's adherence to DAQ approved operating procedures.

The ECB also maintains permanent records of all NOy 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 NOy monitor and sampler used to analyze ambient air quality in the State of North Carolina. Each major component of

the NOy monitoring system, such as analyzer, calibrator, zero-air supply system, 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. Both permanent records are updated continuously.
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.

2.38.1.2 Ambient Reactive Oxides of Nitrogen Monitoring

The North Carolina Ambient Air Reactive Oxides of Nitrogen Monitoring System must meet or exceed the Reference and Equivalent Method requirements in 40CFR53.1 and 40CFR58 Appendix C. The NC ambient nitrogen monitoring system consists of the following:

- Thermo Environmental (TEI) Model 42*i*-Y TLE NOy analyzer
- Thermo Environmental (TEI) Model 146C Dynamic Gas Calibrator
- Thermo Environmental (TEI) Model 111 Zero Air Generator
- Teledyne-API (TAPI) 701 Zero Air Generator
- Certified and Traceable National Institute of Standards and Testing-Standard Reference Material (NIST-SRM) NO Gas Cylinder
- ESC Model 8832 Data Logger
- Dedicated Site PC
- Wireless Modem / Ethernet

Only the main components of the NOy monitoring system are discussed briefly here for their operational details. For further details of other NOy monitoring system related components refer to the "Model 42*i*-Y NOy Instruction Manual, Chemiluminescence NO-DIF-NOy Analyzer, 20 December, 2007".

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 nitrogen. 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.

2.38.1.3 Receipt, Testing and Inventory

The ECB shall conduct operational tests after receipt and unpacking of each instrument. Following the Model 42*i*-Y Trace Level-Enhanced Instruction Manual (Chapter 2) setup procedures, Section 2.38.2.2 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 approval of the tested unit, the unit shall be added to the fixed asset system. For each monitor, apply an inventory decal and complete an inventory load sheet showing the planned monitor location.

2.38.1.4 TEI Model 42*i*-Y TLE Certification (Pre-Site Installation Checks)

A) Model 42*i*-Y NOy Monitor testing: the NOy Model 42*i*-Y monitor should be tested thoroughly before deployment at the monitoring site. This testing will involve among other things:

- Pre-calibration electronic adjustment
  1) Data logger analog output adjustment
  2) Setting initial calibration factors and adjustment to PMT
- NOT/NO2T/NOyT operational zero/span calibration check and test calibration
  1) Zero /span calibration check (all sites)
     a. Zero calibration check (0 ppb)
     b. SPAN1 – 180 ppb
     c. SPAN2 – 100 ppb
     d. SPAN3 – 10 ppb
  2) Operational test calibration (all sites)
     a. Zero calibration (0 ppb)
     b. SPAN1 calibration (180 ppb)
  3) NO gas phase titration / converter efficiency test (180 ppb, all sites).
  4) Zero Air Audit (NCore site)
  5) The method detection limit (MDL, Section 2.38.1.11) at the NCore site.

The procedural details of each of the above are given in the manufacturer's manual "Model 42*i*-Y NOy Instruction Manual, Chemiluminescence NO-DIF-NOy Analyzer, 20 December, 2007". Further, the ECB staff is expected to follow and fulfill all steps before the monitor is installed at the monitoring site.

Point*	**Calibration Tolerance**	**Converter Efficiency**
Span (90%)	±3%	96 - 104%
Mid (50%)	±3%	
Precision (5%)	±10%	
Zero (O)	±0.5 PPB	
NO2T Span (titration)	±5%	

Point*	**Calibration Check Tolerance**	**Converter Efficiency**
Span (90%)	±6%	96 - 104%
Mid (50%)	±8%	
Precision (5%)	±15%	
Zero (O)	±0.5 PPB	
NO2T Span (titration)	±5%	

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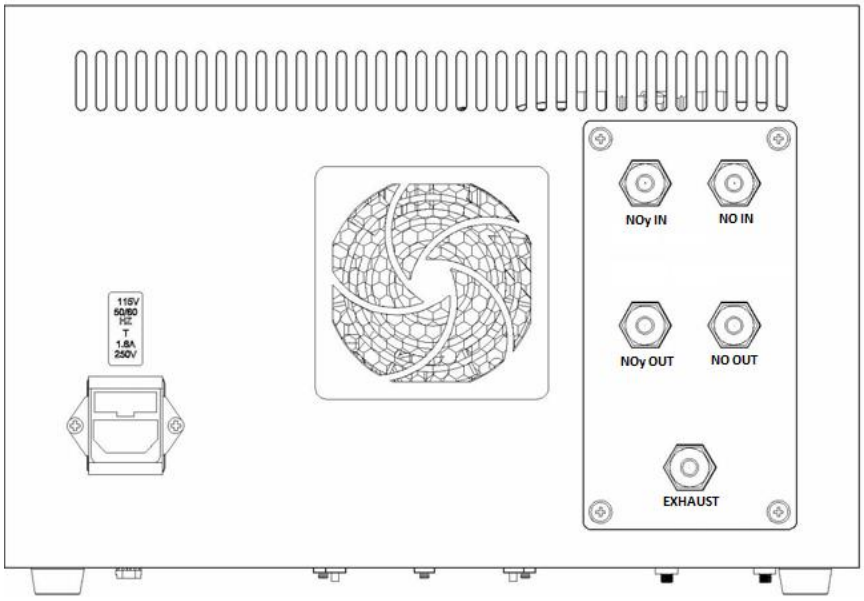
*Nominal or designated value of each point

Leak Test (Bypass Pump)

Use the following procedure to perform leak test:

1. Cap three of the four ports on the rear panel of the bypass pump with leak-tight caps, excluding the exhaust port.
2. Connect a suitable vacuum gauge to the fourth port, excluding the exhaust port.
3. Turn pump on and the pressure reading on the vacuum gauge should drop Below 160 mm Hg.



Bypass Pump Rear Panel

If the pump diaphragm is in good condition and the capillaries are not blocked, it should take less than one minute from the time the inlet is plugged to the time the reading below 160 mm Hg is obtained.

2.38.1.5 Calibration Standards and System

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 nitrogen monitors at each site. The primary NO standard used must be certified, commercially prepared compressed gas standards with a certified accuracy of no worse than ±2 percent. Standards in the concentration range of ~20 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 NO protocol standard calibration gases must be referenced to a National Bureau of Standards (NBS) nitrogen 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. Calibration standards will be replaced after 3 years for 0.5 to 50 ppm NO in oxygen-free nitrogen standards or when expired for verification of gas stability. (This 36-month period is allowed because NO is somewhat stable as shown by repeated analysis of the same cylinder. 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.

TEI Model 146C Dynamic Gas Calibrator

The 42*i*-Y TLE analyzer is calibrated using a TEI 146C Calibrator, which must have flows certified by ECB and traceable to a primary standard according to the requirements in the QA/SOP 2.3.4 TEI 146C/146*i* Calibrator.

The Model 146C dynamic gas calibrator supplies the required levels of NO to perform zero, precision, span checks and multipoint calibrations. The Model 146C is operated remotely from the data logger to perform zero, precision, and span checks. The calibrator is an accurate mass flow controlled gas dilution system that meets the 40 CFR 50 requirements of ± 2 % accuracy. NO gas (usually in an inert gas such as nitrogen) from a NIST traceable protocol certified cylinder (of ± 2 % accuracy or less) is blended with "zero-air" to provide desired concentration. From the known calibration of the two mass

flow controllers, the exact concentration can be calculated. A typical dilution ratio of 100:1 to 1000:1 is generally used to generate appropriate concentrations.

Model 111 Zero Air Pak and Compressor Checks (non NCore site)
The silica gel in the cartridges located on the back of the Zero Air Pack removes the moisture from the compressed air before the carbon monoxide is removed from the dried air by the internal carulite canister. Silica gel, though, has a limited capacity to effectively remove moisture from the air stream. Because of this limited capacity, the silica gel must be replaced every 14 days or less to insure effective moisture removal in both cartridges. Verify that the silica gel is not spent by color change. When the gel is new it is a dark blue in color. If the gel is spent, it is a lighter blue in color with white crystals. If the gel is spent or it has been 14 days since it was last changed, replace it, and return it to the ECB for regeneration. Check the condition of the Purifill. Fresh Purifill is purple and turns brown when saturated. Replace when purple color is less than 20% of the volume. Remove the cartridge holding the Purifill, unscrew the cap, discard used Purifill, replace with fresh and screw on the cap and replace cartridge. On an annual basis, change all scrubbing medium.

Verify and record that the outlet pressure on the air compressor is reading between 40 and 50 psi. Verify that the ZAP is reading 30 psi. If either pressure reading is outside of these ranges, corrective action is required. Also, check and drain any water from the compressor (do this at every site visit).

Annually
Replace Model 111 zero air pack annually with a certified zero air pack or:
Replace the Purafil. Fresh Purafil is purple. It becomes brown when it is used up. Replace when the purple color represents less than 20% of the volume. To replace, shut off the air supply so that the Model 111 pressure drops to 0.0 psig. Remove the cartridge holding Purafil. Slowly unscrew the cap, allowing any remaining pressure to vent, empty out the used Purafil into a zip lock bag and discard. Replace with fresh Purafil. Screw on cover and replace cartridge.

PURAFIL® media is a non-toxic, non-flammable substance. Filtration of contaminants through PURAFIL® media causes molecular changes within the media to occur, and the resulting product is usually not harmful to the environment and does not require special disposal.

Replace the charcoal. The procedure is the same as replacing Purafil, outlined above. One half of the acrylic canister contains silica gel (allows detection of moisture contamination).

Replace the carulite. The procedure is the same as replacing Purafil, outlined above.

Replace the silica gel. Old silica gel is returned to the ECB for re-drying. If silica is wet, replace carulite and silica.

Leak test canisters at 30 psi with snoop.

Five Year Maintenance
Permapure Dryer. As the permapure dryer deteriorates it causes the flow to be restricted which would impact the operation of the system, change the permapure dryer every 5-years. The inner tube will turn brown when replacement is needed.

Record the chemical change(s) in the site logbook/file. If chemicals are changed in the site zero air pack, the zero air pack must be conditioned 24 hours before use.

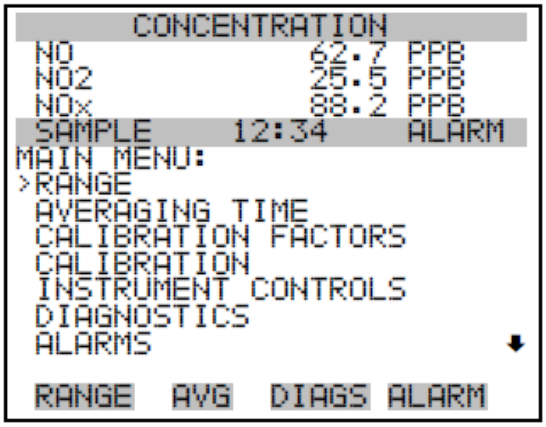
TAPI Model 701 Zero Air Generator (NCore site)

The TAPI Model 701 Zero Air Generator is a pure air generator system that is capable of continuous delivery of up to 20 standard liters per minute (SLPM), 30 pounds per square inch (PSI) of dry, contaminant-free air. The air is suitable for use as: a zero reference calibration gas, ultra-pure combustion air for flame ionization detector, and service air for pneumatically operated valves. The system is capable of delivering air free from water vapor, particulates, sulfur dioxide (SO2), Hydrogen Sulfide (H2S), Oxides of Nitrogen (NO), Nitrogen Dioxide (NO2), Ozone (O3), and Carbon Monoxide (CO).

Model 701 Zero Air Generator Checks:
- The pollution scrubber/converter media should be replaced yearly by ECB.
- Verify that the delivery pressure is set to 30 ± 2 psi. (If the delivery pressure is outside of ± 2 psi range, adjust the pressure using pressure adjust control knob).
- Check the drain from the air generator.

TEI Model 42*i*-Y NOy Analyzer Component Performance

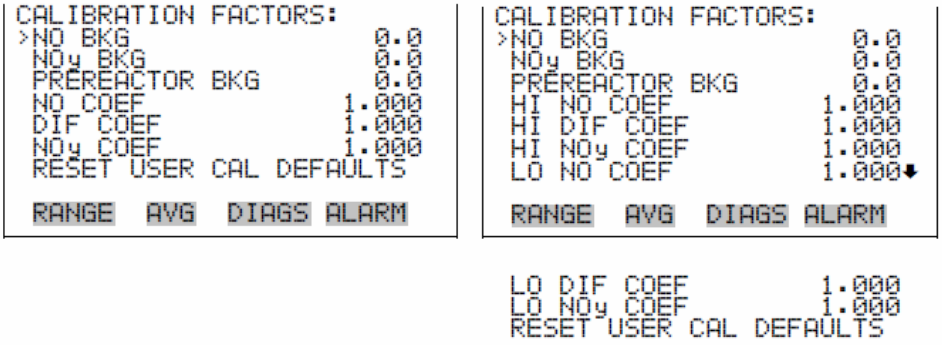
The following Test mode parameter settings are allowed in the TEI 42*i*-Y TLE Analyzer:



42*i*-Y Main Menu

- **Main Menu**, choose ***Range***
  Gas Units PPB
  Range 200

- **Main Menu**, choose ***Averaging Time***
  Currently 60 sec

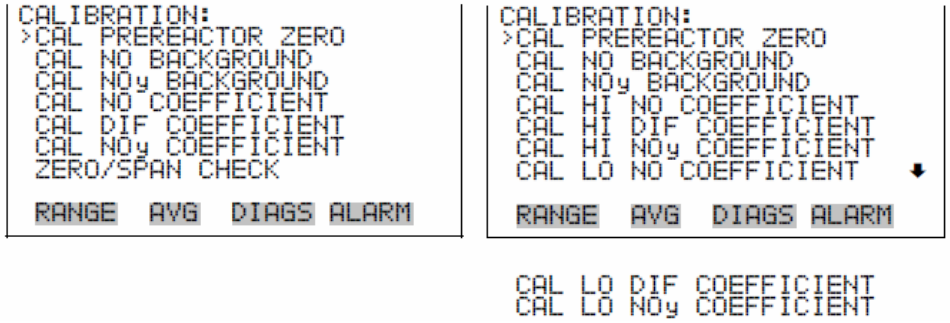


42*i*-Y Calibration Factors Menu

- **Main Menu**, choose ***Calibration Factors > NO*** *or* ***NOx Bkg***
  NO Background:
  NO: 0.0
  NOx Background:
  NOx: 0.0

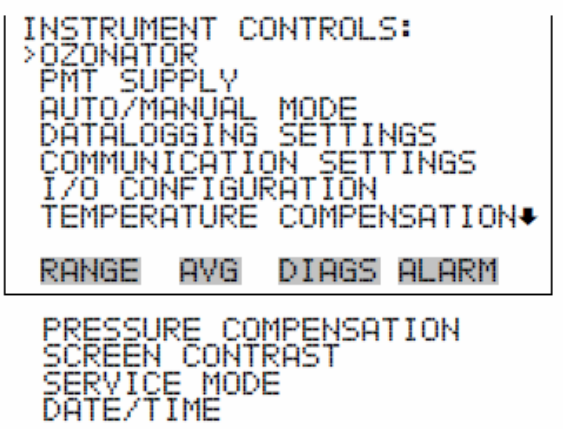
- **Main Menu**, choose ***Calibration Factors > NO, NO2, or NOx Coef***
  NO Coefficient:
  NO: 1.0
  NOx Coefficient:
  NOx: 1.0
  NO2 Coefficient:
  NO2: 0.95

- **Main Menu**, choose ***Calibration Factors > Cal Pressure***
  Pressure: 150 mmHg



42*i*-Y Calibration Menu

- **Main Menu**, choose ***Calibration*** > ***Zero/Span Check***
  Zero/Span Ratio 1:1



42*i*-Y Instrument Controls Menu

- **Main Menu**, choose ***Instrument Controls*** > ***Ozonator***
  Ozonator:
  Currently ON

- **Main Menu**, choose ***Instrument Controls Menu*** > ***Communication Settings>Baud Rate***
  Baud rate 9600

- **Main Menu**, choose ***Instrument Controls Menu> Communication Settings> Instrument ID***
  Instrument ID 42

- **Main Menu**, choose ***Instrument Controls Menu*> *Communication Settings*> *Communication Protocol***
  Communication Protocol CLINK

- **Main Menu**, choose ***Instrument Controls Menu*> *Communication Settings*> *RS 232/RS-485***
  RS 232/RS-485 Selection RS 232

- **Main Menu**, choose ***Instrument Controls*** > ***I/O Configuration*> *Output Relay Settings***
  Output Relay Settings:

1	NOP	GEN ALARM
2	NOP	NONE
3	NOP	UNITS
4	NOP	CONC ALARM
5	NOP	NONE
6	NOP	NONE
7	NOP	NO MODE

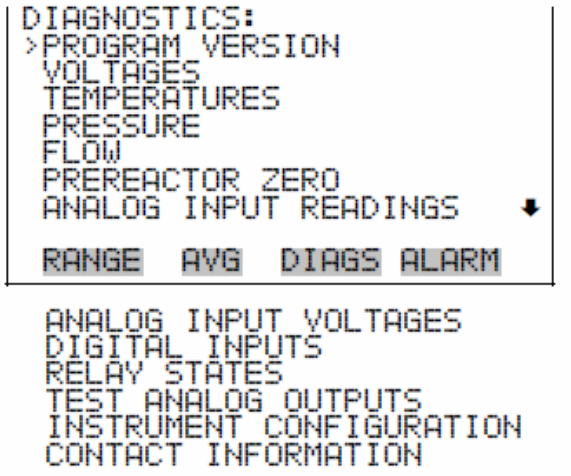
- **Main Menu**, choose ***Instrument Controls*** > ***I/O Configuration*> *Digital Input Relay Settings***
  Digital Input Setting:

1	NOP	NO MODE
2	NOP	NOX MODE
3	NOP	SET BACKGROUND
4	NOP	CAL TO LO SPAN
5	NOP	AOUTS TO ZERO
6	NOP	AOUTS TO FS
7	NOP	NONE

- **Main Menu**, choose ***Instrument Controls*> *Temperature Compensation***
  Comp Temp 30.0
  Currently ON

- **Main Menu**, *choose* **Instrument Controls> Pressure Compensation**
  Comp Pres 150.0 mmHg
  Currently ON

- **Main Menu,** choose ***Instrument Controls*> *Service Mode***
  Currently OFF



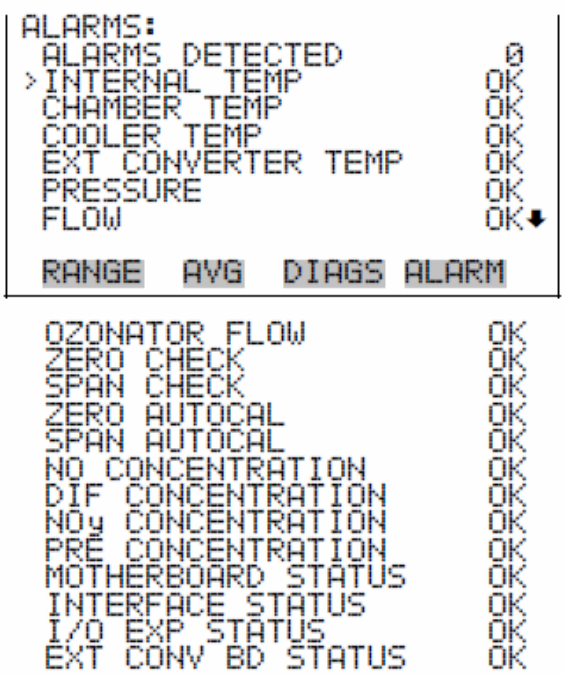
42*i*-Y Diagnostics Menu

- **Main Menu**, choose ***Diagnostics*** > ***Voltages> Motherboard***
  Voltages:

3.3 SUPPLY	3.3 V
5.0 SUPPLY	5.0 V
24.0 SUPPLY	24.1 V
-3.3 SUPPLY	-3.3 V

- **Main Menu**, choose ***Diagnostics*** > ***Interface Board Voltages***
  Voltages:

PMT SUPPLY	785:5 V
3.3 SUPPLY	3:3 V
5.0 SUPPLY	5.0 V
15.0 SUPPLY	15.0 V
P15 SUPPLY	15.0 V
24.0 SUPPLY	24.1 V
-15.0 SUPPLY	-15.0 V



42*i*-Y Alarms Menu

- **Main Menu**, choose ***Alarms***
  Alarms (Choose each parameter to see settings)

	Min	Max
Internal	15.0° C	45.0° C
Chamber	48.0° C	52.0° C
Cooler	-20.0° C	-1.0° C
NO2 Converter	300.0° C	350.0° C
Pressure	200-mmHg	450-mmHg
Flow	0.750 LPM	2.0 LPM
Ozonator Flow	>0.050 LPM	

Note: Adjust the operational parameters as necessary if outside to these ranges. If adjustments are performed the stability of the adjusted parameter(s) must be evaluated and recorded prior to proceeding.

The ECB is responsible for setting the operational parameters of each TEI 42*i*-Y TLE as listed above. Primary Standard operation outside of these settings and limits is non-compliant with the NC QA/SOP for ambient air reactive oxides of nitrogen monitoring and the data will be invalidated.

Yearly and prior to installation at the monitoring site, the ECB must evaluate the condition and performance of each TEI Model 42*i*-Y TLE monitor. The results of the evaluation, findings, and all adjustments are entered into the monitor number specific logbook, dated, and initialed.

- The sample line should be as short as practical and should be PFA Teflon or their equivalent. The sample line should be replaced every two (2) years.

A. Verification of Component Performance

Note: The following recommendations should be followed with the NOy 42*i*-Y monitors to allow them to measure NOy accurately:

- Sample residence time in the inlet should be < 20 seconds.
- A heated molybdenum (325º C) converter.
- Automatic over-range capabilities are used to track rapid changes that may occur in ambient NOy levels.
- Using 1/4" PFA Teflon tubing, plumb the inlet.
- Run two sample lines, calibration line, and thermocouple wire and power cable inside the converter enclosure and secure the conduits to the converter enclosure.
- Connect the sample lines to the bypass pump, filters and analyzer.
- Connect the converter power cable and plug in the instrument, vacuum pump and bypass pump into a grounded power strip that has surge protection.
- Install the NOy analyzer at the site by placing it on a stable, level surface. Install the 146C calibrator, 111 zero-air supply system box, air pump and compressor, data logger unit and interface unit and backup data logger and a solenoid interface box and UPS. The NCore site utilizes a Model 701 zero-air supply system. Conduct operational checks for solenoid and events. Do not obstruct the ozone scrubber vent unit.
- Calibration gas is vented via molyconverter sample inlet.
- Two lines connect to the output port of the calibrator. Connect the output line to the port on the solenoid interface box labeled "Wh/Br COM", Connect the vent line to the port on the solenoid interface box labeled "Blu/Grn COM".
- Thread three 1/4" (5/32" I.D.) Teflon tubing lines through the conduit to the weatherproof sampling box outside the building. Connect first sample line to the sample port on the back of the 42*i*-Y NOy monitor. Connect the filter holder to the stainless tee, which connects to the sampling port. Connect the second sample line to the NOy port on the back of the 42*i*-Y monitor and to the filter holder, which connects to the tube at the top of the converter. Connect the third sample line to the port labeled "Wh/Br COM" on the solenoid interface box and to the open port of the stainless steel tee inside the weatherproof sampling box.
- Be sure that all three Teflon lines go through 1” diameter Rubatex insulation with heat tape to prevent condensation buildup in the lines.
- Unroll the wires connected to the back of the NOy monitor. Thread the brown thermocouple wire through the conduit, into the sampling box, and attach to the appropriate connector. Use fish tape or tubing to thread the gray converter power supply (120v) wire through the conduit, and into the sampling box. Push the pins into the connector body according to the labeling on the plastic plug, and connect to the mating plug inside the sampling box.

- The sample line should be as short as practical and should be PFA Teflon or their equivalent. The sample line should be replaced every two (2) years.

A. Verification of Component Performance

Note: The following recommendations should be followed with the NOy 42*i*-Y monitors to allow them to measure NOy accurately:

- Sample residence time in the inlet should be < 2 seconds.
- A heated molybdenum (325º C) converter.
- Automatic over-range capabilities are used to track rapid changes that may occur in ambient NOy levels.
- Using 1/4" PFA Teflon tubing, plumb the inlet.
- Run two sample lines, calibration line, and thermocouple wire and power cable inside the converter enclosure and secure the conduits to the converter enclosure.
- Connect the sample lines to the bypass pump, filters and analyzer.
- Connect the converter power cable and plug in the instrument, vacuum pump and bypass pump into a grounded power strip that has surge protection.
- Install the NOy analyzer at the site by placing it on a stable, level surface. Install the 146C calibrator, 111 zero-air supply system box, air pump and compressor, data logger unit and interface unit and backup data logger and a solenoid interface box and UPS. The NCore site utilizes a Model 701 zero-air supply system. Conduct operational checks for solenoid and events. Do not obstruct the ozone scrubber vent unit.
- Calibration gas is vented via molyconverter sample inlet.
- Two lines connect to the output port of the calibrator. Connect the output line to the port on the solenoid interface box labeled "Wh/Br COM", Connect the vent line to the port on the solenoid interface box labeled "Blu/Grn COM".
- Thread three 1/4" (5/32" I.D.) Teflon tubing lines through the conduit to the weatherproof sampling box outside the building. Connect first sample line to the sample port on the back of the 42*i*-Y NOy monitor. Connect the filter holder to the stainless tee, which connects to the sampling port. Connect the second sample line to the NOy port on the back of the 42*i*-Y monitor and to the filter holder, which connects to the tube at the top of the converter. Connect the third sample line to the port labeled "Wh/Br COM" on the solenoid interface box and to the open port of the stainless steel tee inside the weatherproof sampling box.
- Be sure that all three Teflon lines go through 1” diameter Rubatex insulation with heat tape to prevent condensation buildup in the lines.
- Unroll the wires connected to the back of the NOy monitor. Thread the brown thermocouple wire through the conduit, into the sampling box, and attach to the appropriate connector. Use fish tape or tubing to thread the gray converter power supply (120v) wire through the conduit, and into the sampling box. Push the pins into the connector body according to the labeling on the plastic plug, and connect to the mating plug inside the sampling box.

- Make the remaining connections to the monitor, calibrator, wireless modem, data logger and interface boxes as per the manual instructions.
- Connect all instruments and support equipment power cords to a grounded surge suppressor which is connected to an 115v AC, 60Hz grounded receptacle.

External Converter Box of 42*i*-Y NOy Analyzer

The ECB staff will be intimately involved in the installation, operation, maintenance and all related repairs of the converter box of the 42*i*-Y NOy analyzer. The converter box will be placed at 10-meter height to meet US-EPA requirement for the NCore site only. The analyzer will be sited as per criteria in 40 CFR 58, Appendix E.

To meet the above stated requirement (of US-EPA), ECB staff will supervise the installation of a 10-meter meteorological tower at the monitoring site.

The **Figure 1** illustrates the external converter hardware components. For further details and functioning of each component, refer to manufacturer's instructional manual "Model 42*i*-Y NOy Instruction Manual, Chemiluminescence's NO-DIF-NOy Analyzer, 20 December, 2007" and in particular Chapter 8.

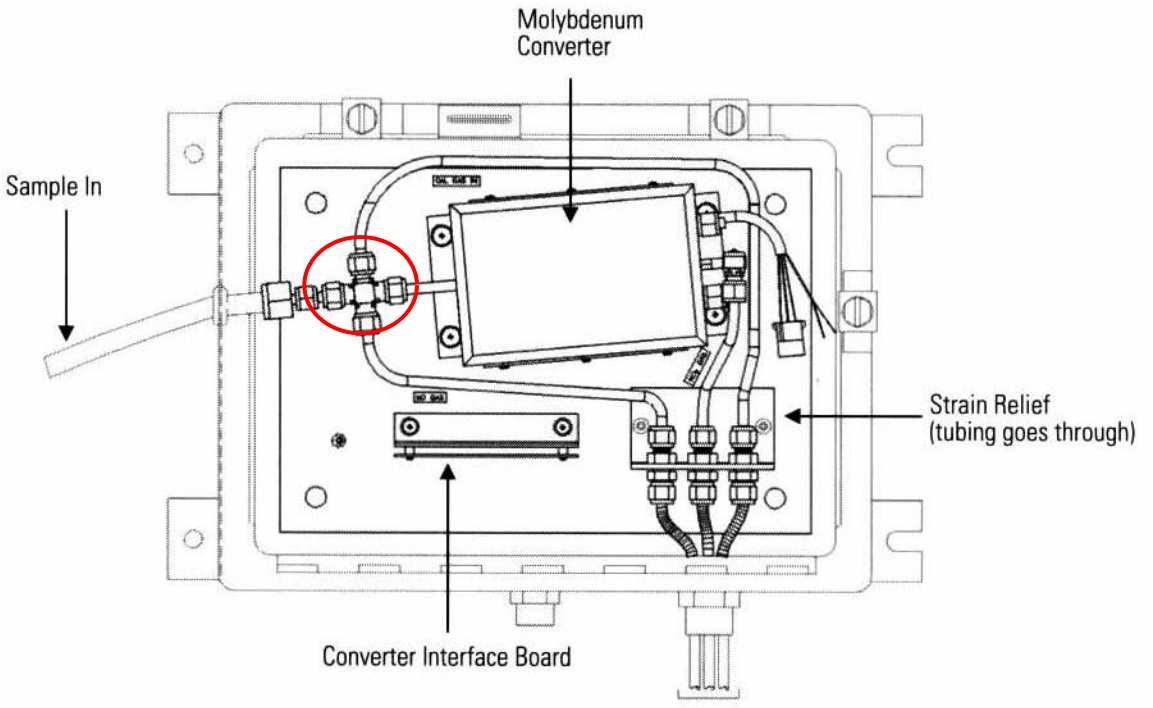


Figure 1 External Converter Hardware Components

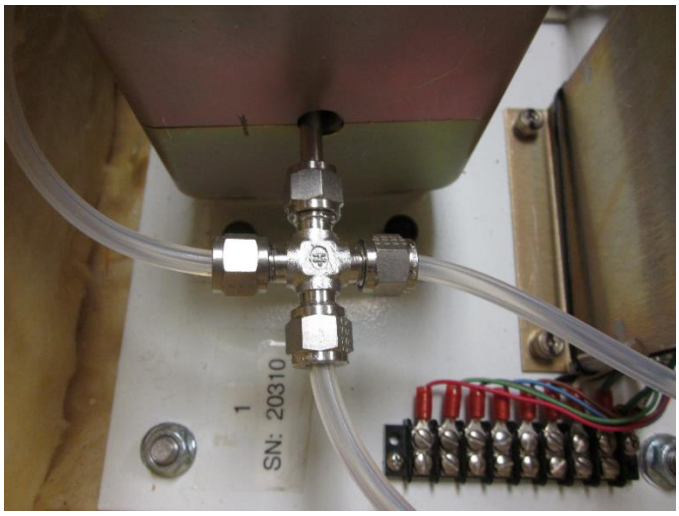


Figure 2 Factory 4 Way Stainless Steel Union

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 and 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.

- Conduct operational checks for zero / span solenoid and diagnostics / alarms events.
- Document actions on the 109 Form.
- A MDL (Section 2.38.1.11) test will be performed within 30 days of a part/monitor change and site installation (NCore site only).

Note: the compressor must be plugged into a wall socket and not a surge suppressor (non-NCore site).

B. Data Logger System, Modem and Computer (all sites)

Following the installation of components of the NOy monitoring system, the ECB staff should verify the performance and proper functioning of each component.

a. The data logger must be configured and initialized by following the instructions included in the manufacturer's manual. Adjust data logger (Z1 and S1) to be close to correct value (±5). Turn the main power "on" of all system components and ensure that components power lights are on.
b. Site Polling - manually poll the data logger to review data and edit flags if needed.
c. Make sure poll editor and scheduler is set to poll the correct site at the next odd hour.
d. The times for the data logger, computer, and AV-Trend must be EASTERN STANDARD TIME. Also, must be synched to the NIST time provider in Colorado (± 1 minute). A task scheduler can be created in AV-Trend to sync the data logger and computer time. This task is accomplished by clicking on the date and time in the lower right corner of the computer screen. Select "**Change date and time settings**". Select "**Internet Time**" tab, and "**Change settings**". Check the box that states "**Synchronize with an Internet time server**". From the Server drop down menu, select "**time.nist.gov**". Press "**Update Now**". Select "**OK**" twice to exit.

   If the data logger time is not within 1 minute of NIST time but it matches the computer time, then there is a problem with the computer time. Either the computer is not synchronizing properly with the NIST time or the clock is drifting too much and needs to be synchronized more often or the computer needs to be replaced. Call the ECB and they will help identify the issue and tell you what to do to correct it.

   If the data logger time is not within 1 minute of NIST time and it does not match the computer time and the computer matches NIST time, then there is a problem with the synchronization of the data logger time with the computer.

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

- Select the AV-Trend icon, enter the username followed by the password, hit "**OK**"
- Select: "**Utilities**"
- Select: "**Link to Logger**"
- From the drop down menu, locate the site
- Select: "**Connect**"
- Select: "**L**", to log onto the site data logger (use site password)

Disable Channels on Data Logger
- Press {**ESC**} {**ESC**} to return to the Home Menu
- Select: "**C**", Configuration Menu
- Select: "**D**", Configure Data Channels
- Select: "**M**", Enable/Mark Channel Online
- Select: "**NOT**", <ENTER>

- Select: "**M**", Enable/Mark Channel Online
- Select: "**NO2T**," <ENTER>
- Select: "**M**", Enable/Mark Channel Online
- Select: "**NOYT**,"<ENTER>

The monitor control is via the data logger as last base average or through the continuous report.

Next, allow the analyzer to sufficiently warm-up and activate the zero event. After the zero event has stabilized, set the data logger digital output to within 1ppb. Next activate the spans and perform a Gas Phase Titration (GPT) check.

Span Zero Check Procedure
- Press **{ESC}{ESC}** to return to the Home Menu
- Select: "**C**", Configuration Menu
- Select: "**C**" Configure Calibrations
- Select: "**1**", start Single Phase Calibration
- Select: "**NOTCAL**", <ENTER>
- Select: "**SPAN ZERO**", <ENTER>
- Scroll down and highlight "**Phase Duration**", set to 1 hour, <ENTER>
- Scroll down and select: "**Start Single Cal** (**NOW**)", <ENTER>

Monitor Actual values
- Press{**ESC**}{**ESC**} to return to the Home Menu
- Select: "**D**", Real Time Display
- Select: "**C**", Continuous Average Report
- Type in parameters "**NOT**", and "**NOYT**" <ENTER>
- Change # of flags to report from "**02**" to "**03**", <ENTER> (the "**<**", "**D**", and "**C**" flags will show)
- Use decimal Positioner?: "**Y**", <ENTER>
- Start continuous report: <ENTER> (this will show the minute averages as they are calculated and keeps all values on screen).

Abort SPAN Zero
- Press{**ESC**}{**ESC**} to return to the Home Menu
- Select: "**C**" Configure Calibration
- Select: "**C**", Configuration Menu
- Select: "**W**", Abort Calibration
- Select: "**NOTCAL**", <ENTER>

Span Check Procedure
- Press{**ESC**}{**ESC**} to return to the Home Menu
- Select: "**C**", Configuration menu
- Select: "**C**", Configuration Calibrations
- Select: "**1**", start Single Phase Calibration, <ENTER>
- Select: "**NOTCAL**", <ENTER>
- Select: "**SPAN1**", <ENTER>

- Scroll down and highlight "**Phase Duration**", set to 4 hours, <ENTER>
- Scroll down and select: "**Start Single Cal** (**NOW**)", <ENTER>
- Start SPAN 1 and let it stabilize (about 30 to 45 minutes)
- Press ▸ when "Span 1" is complete

Monitor Actual values

- Press{**ESC**}{**ESC**} to return to the Home Menu
- Select: "**D**", Real Time Display
- Select: "**C**", Continuous Average Report
- Type in parameters "**NOT**", "**NO2T**", and "**NOYT**" <ENTER>
- Change # of flags to report from "**02**" to "**03**", <ENTER> (the "**<**", "**D**", and "**C**" flags will show)
- Use decimal Positioner?: "**Y**", <ENTER>
- Start continuous report: <ENTER> (this will show the minute averages as they are calculated and keeps all values on screen).

Titration Procedure

While the Span 1 event is running and stabilized:

- On 146C push "**Menu**" button press <ENTER>, <ENTER>, <ENTER> until 146C is in "Local"
- Push "**Run**" button
- Press →Turn GAS A "**On**" by pressing, <ENTER>. Press ↓, press → press <ENTER> to turn SPAN 1 "**On**", then press ↓, press →, press <ENTER>
- Set bottom line to "**OZONE**" Manual
- From 146C main menu, press down arrow (↓) to "**Ozonator**", press <ENTER>
- Go to "**Manual**"**,** press <ENTER>
- Verify that the ozonator level is set to 0.0%
- Note your "GPT" zero air and "GPT" gas flows by pressing "**RUN**" button twice on 146C while you are running the "GPT". The flows should be approximately equal to **Span 1** zero air and gas flows.

  Allow the 42*i*-Y monitor to stabilize (about 1 hour) and record NO and NOY responses as NOT, NO2T and NOYT. Once the GPT original phase is completed, use the ↑↓ arrows to adjust the O_3 "Level" (percent ozonation) to 25%, allow reading to stabilize. From 146C main menu, press down arrow (↓) to "Ozonator" then <ENTER>, ↓ "Manual Adjustment %", and then "Ozonator Manual Level". The stable NOYT readings should agree with the original NOYT span value, if the right amount NO2T is being converted to NOYT. Starting from 25% ozonation, slowly increase the O_3 level until the NOT readings drop to 10-20% of the span value (e. g. if the NOT span is 180 PPB, increase the percent O_3 level slowly until the monitor stabilizes at an NOT reading of approximately 18-36 PPB). Usually, an O_3 level set between 20-40% accomplishes the required NOT reduction.

  Important: During the "GPT", the NOT reading must not be allowed to decrease by more than 90% of its original full scale span value so that adequate NOT is available

for the NOT/O_3 reaction and enough NOT remains for accurate NO2T Calculations. If the NOT reading drops by more than 90%, reduce the output of the calibrator until an acceptable NOT reading is achieved. For example, 18 PPB for a NOT full scale response of 180 PPB.

Wait approximately 45 to 60 minutes for the NO2T trace to stabilize.
After the appropriate time period, look for a stable NO2T trace of about 10 minutes' data logger duration. Calculate the actual concentration of the NO2T span using the equation below. The converter efficiency should be between 96-104% range.

$[NO2]_{Ca} = [NO]_{orig} - [NO]_{rem} + [F_{NO} / (F_{NO} + F_{zero})] \times [NO2]_{imp}$

i.e. $[NO2]_{Ca} = 180 \text{ PPB} - 20 \text{ PPB} + 0.7 \text{ PPB} = 160.7 \text{ PPB}$

Where: $[NO2]_{Ca}$ = NO2 concentration at the output, PPB

$[NO]_{orig}$ = Original NO concentration before titration with the O_3, PPB

$[NO]_{rem}$ = NO concentration after titration with O_3, PPB

$[NO2]_{imp}$ = NO2 impurity in cylinder

NO2 impurity in cylinder = NOy – NO values on the cylinder certification (i.e. 0.7 PPM = 11.7 PPM - 11 PPM or 700 PPB = 11,700 – 11,000 PPB)

F_{NO} = NO flow rate, sccm

F_{zero} = Zero air flow rate, sccm

D = Dilution ratio $F_{NO} / (F_{NO} + F_{zero})$

Note: NO2 impurity may be listed as an additional factor in certified protocol NO gas received from the manufacturer. If so, this additional NO2T must be included when calculating the total NOT concentration generated during gas phase titration.

Abort SPAN1

- Press {**ESC**}{**ESC**} to return to the Home Menu
- Select: "**C**" Configure Calibration
- Select: "**C**", Configuration Menu
- Select: "**W**", Abort Calibration
- Select: "**NOTCAL**", <ENTER>

Check SPAN2 / SPAN3

Make no adjustments to SPAN2 or SPAN3

- Press {**ESC**}{**ESC**} to return to the Home Menu
- Select: "**C**", Configuration Menu
- Select: "**C**", Configure Calibrations
- Select: "**1**", start Single Phase Calibration, <ENTER>
- Select: "**NOTCAL**", <ENTER>
- Select: "**SPAN2**", <ENTER>
- Scroll down and highlight "**Phase Duration**", set to ≥ 1 hour, <ENTER>
- Scroll down and select: "**Start Single Cal** (**NOW**)", <ENTER> and let it stabilize (30 to 35 minutes)
- Abort SPAN2 using "**C**", "**C**", "**W**", "**NOTCAL**", <ENTER>

- Repeat all above steps for SPAN3
- Abort SPAN3 using "**C**", "**C**", "**W**", "**NOTCAL**", <ENTER>
- Leave expendable supplies (e.g. silica gel, etc) at the site.
- Leave channel down for calibration.
- Turn off computer screen. **Note: DO NOT** close the AV-Trend software, **DO NOT** turn off the computer.

A calibration check should also be performed by the ECB, following any one of the activities listed below:

- A new site installation
- A monitor replacement
- A calibrator replacement
- Any repairs that may affect the calibration of the instrument such as particulate filters or capillaries, pump, and ozone lamp replacements

2.38.1.7 Equipment Identification

The Model 42*i*-Y TLNOy Analyzer and converter, the Model 146C Gas Calibrator, the Model 111 / Model 701 Zero Air Supply System, data logger and computer identification numbers will be documented / logged on the 109 Form.

2.38.1.8 TLNOy Monitoring System Maintenance

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

- Preventive Maintenance
- Corrective Maintenance
- Routine Maintenance

Note: ECB staff must document any and all maintenance activities, irrespective of type in the instrument logbook.

Preventive Maintenance
Included here are the periodic maintenance procedures for some of the main components of the monitoring system that must be performed by the ECB staff to ensure proper operation. For details of any other system components maintenance procedures refer to the manufacturer's instructional manual "Model 42*i*-Y NOy Instruction Manual, Chemiluminescence NO-DIF-NOy Analyzer, 20 December, 2007".

a. Inspection and Replacement of Bypass Auxiliary Capillaries

Tools needed:
Phillips head screwdriver
9/16-inch wrench
7/16-inch wrench

1/2-inch wrench
Capillary 0.022-inch ID (P/N 4110)
Capillary 0.008-inch ID (P/N 4119)

1. Down the associated channels.
2. Turn the instrument OFF and unplug the power cord.
3. Label and remove the "NOy IN", "NO IN", "NOy Out", and "NO OUT" lines from the auxiliary pump.
4. Remove the instrument cover.
5. Locate the capillary holders (see **Figure 3**, **Figure 4** pg.26).
6. Disconnect NO and NOy sample lines from the "T" fitting.
7. Unscrew knurl-nut fitting(s) from the rotometer (one line at a time) using your fingers being careful not to lose the O-ring.
8. Remove the glass capillaries and O-ring. Inspect O-ring for cuts or abrasion, and replace as necessary making sure the O-ring is around the capillary evenly before inserting it into the body.
9. Check capillary for particulate deposits. Replace as necessary.
10. Replace capillary in the housing making sure the capillary is in straight.
11. Replace knurl-nut fitting. **Note:** the knurl-nut fitting should be tightened hand tight.
12. Repeat procedure for other capillary.
12. Reconnect NO and NOy tubing to the "T" fitting.
13. Re-install the cover.
14. Re-install the "NOy IN", "NO IN", "NOy Out", and "NO OUT" lines to the auxiliary pump.
15. Connect the power cord and turn the instrument ON.

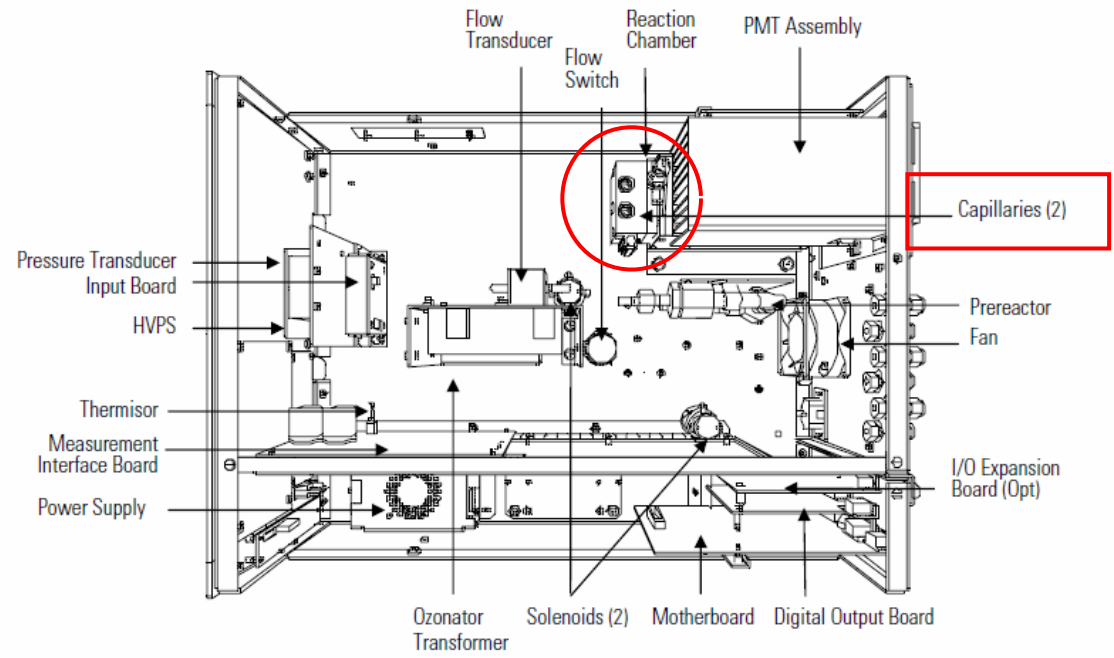


Figure 3 Analyzer Component Layout

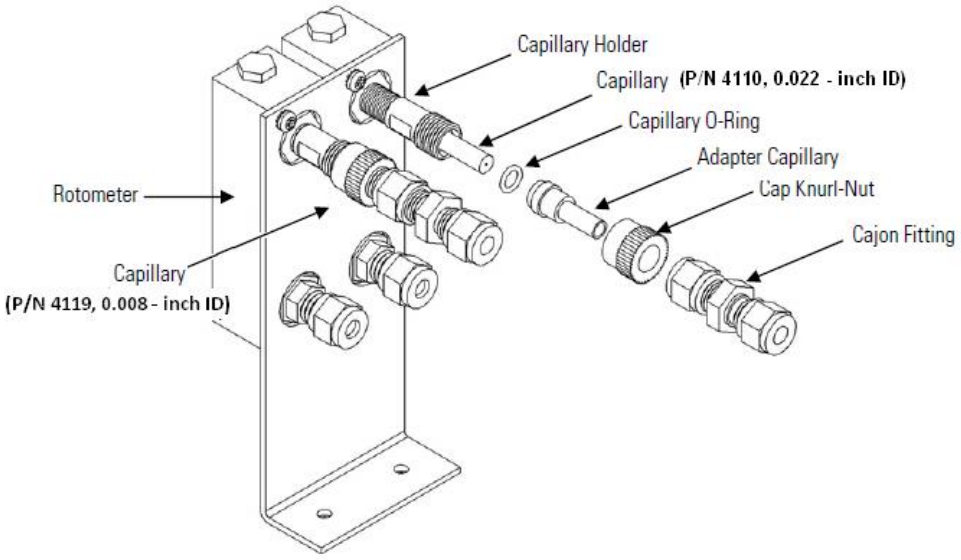


Figure 4 Bypass Auxiliary Capillaries

b. **Inspection and Cleaning of Thermoelectric Cooler Fins**

1. Remove cover of the instrument.
2. Locate PMT cooler.
3. Using clean-pressured air, blow off cooler fins.
4. If necessary, employ a small brush to remove residual particulate matter accumulation.

Note: It may be more convenient for the user to vacuum the cooler fins. In either case, make sure that any particulate matter accumulation between the fins has been removed.

5. Replace instrument cover

c. **Sample Filters Inspection and Replacement**

The Teflon particulate filters should be inspected and, if necessary replaced. A filter that does not interact with NO or NO_2 in air should be utilized. A suitable filter should have 5 or 2-micron pore size. The filter should be replaced on a regular maintenance schedule (**monthly**) to prevent the absorption of sample gas by trapped material on the filter.

d. **Bypass Pump Rebuilding**

1. Turn instrument "Off", unplug the power cord, and remove the cover.
2. Loosen the fittings and remove both lines going to the pump.
3. Remove the four screws from the top plate; remove top plate, flapper valve, and the bottom plate.
4. Remove the screw securing the diaphragm to piston and remove diaphragm.
5. Assemble the pump by following the previous steps in reverse, making sure the Teflon (white) side of the diaphragm is facing up and that the flapper valves cover the holes of the top and bottom plate.

6. Perform the "**Bypass Leak Test**" procedure described in section **2.38.1.4**.

e. **Vacuum Pump Rebuilding**

1. Turn instrument "Off", unplug the power cord, and disconnect the pump plumbing from the instrument.
2. Note the orientation of the pump head top plate for later reassembly. Using a 3 mm "Allen" wrench, remove the eight socket head screws and washers securing the pump head top plate.
3. Discard the old Teflon gasket.
4. Note the orientation of the diaphragm head for later reassembly. Remove the diaphragm head. Using a 4 mm "Allen" wrench, remove the four socket head screws, securing the diaphragm head to the pump body.
5. Insert the tip of blunt needle nose pliers in the dimples of the clamping disk, then loosen and remove the clamping disk.
6. Remove and discard the old Teflon gasket.
7. Insert the clamping disk into the new Teflon diaphragm (three pieces) and screw the clamping disk into the pump. Do not over tighten.
8. Remove the screw and nut securing the flapper valves and remove and discard old flapper valves.
9. Install the new flapper: check that the screw head and not the washer is on, the smooth side of the pump, and check that the flappers are completely flat and straight.
10. Align the diaphragm head correctly as noted in the Step 2, and secure with the four socket head screws.
11. Place the new Teflon gasket over the pump head so that the eight screws are aligned.
12. Replace the top plate and secure with the eight screws and washers being sure that the Teflon gasket stays in place.
13. Reconnect the plumbing to the instrument and plug in the pump power cord.
14. Check that the reaction chamber pressure reads between 150 and 300 mm Hg.

Corrective Maintenance

Caution: <u>All power should be turned off on the instrument before any electrical maintenance is performed.</u>

The following are step-by-step procedures to be used by the ECB staff to replace the subassembly modules in the monitoring system (see manufacturer's instructional manual "Model 42*i*-Y NOy Instruction Manual, Chemiluminescence NO-DIF-NOy Analyzer, 20 December, 2007" for other related details and or for replacement of any other subassembly modules of the NOy monitoring system).

a. **Photomultiplier Cooler Replacement**

Parts required:

Photomultiplier Cooler Assembly (P/N 101020-00)

1. Disconnect two-pin (reaction chamber thermistor) connector from the temperature control board.
2. Remove cooler fan guard at rear panel.
3. Remove four screws from cooler shroud and remove shroud.
4. Remove plumbing connections to reaction chamber.
5. Unplug signal cable to input board, high voltage cable to PMT power supply and four-pin connector to DC power supply. Pull cables through divider panel,
6. Remove four screws holding cooler to floor plate.
7. Lift cooler assembly and reaction chamber up and slide forward to remove.
8. Install new cooler by following above procedure in reverse.

b. **Replacement of Photomultiplier Tube (PMT)**

Parts required:
Photomultiplier Tube (PMT) (P/N 9367)

1. Turn instrument OFF, unplug the power cord, and remove the cover.
2. Disconnect the high voltage cable from the PMT power supply and unplug the BNC cable from the Input Board.
3. Remove six external screws holding PMT cover plate and the four screws holding the PMT shroud to the panel and remove the PMT cover plate. If the cooler fan is attached, unplug the fan power cord if necessary.
4. Remove the three retaining screws holding PMT base assembly to the cooler using a 5/16-inch nut driver.

Note: Do not point the photomultiplier tube at a light source. This can permanently damage the tube.

5. Pull the PMT and PMT base from cooler assembly by twisting it slightly back and forth.
6. To install PMT, follow previous steps in reverse making sure to backfill the cooler with dry air or nitrogen prior to replacing the PMT.
7. Perform a photomultiplier tube calibration.

c. **Reaction Chamber Cleaning and/or Removal**

1. Remove PMT cooler as described in the manual.
2. Disconnect all plumbing connections from the reaction chamber.
3. Remove the three socket head screws fastening front of reaction chamber to rear. This exposes the inner surfaces of both sections of the reaction chamber and the quartz window. To clean these surfaces, use cotton swabs and methanol.
4. To continue removing rear of reaction chamber remove the three socket head screws holding it to cooler, being careful to keep quartz window and red filter in cooler body.
5. To reinstall reaction chamber, follow previous steps in reverse, making sure to backfill the cooler with dry air or nitrogen prior to installing reaction chamber.
6. Re-install the measurement bench.

d. **NO_2 – to NO Converter Replacement**

Parts required:
External Converter Assembly (P/N 101009-00), Molybdenum Converter Cartridge (P/N 9269)

1. Turn instrument OFF, unplug the power cord, and remove the cover.
2. Allow converter to cool to room temperature to prevent contact with heated components.
3. Disconnect plumbing at converter inlet and outlet.
4. Disconnect thermocouple leads and heater connector from temperature control board.
5. Loosen the four captive screws holding converter housing to floor plate.
6. Remove the six screws holding the top housing assembly to the bottom half.
7. Remove the converter cartridge/heater assembly from the bottom housing assembly.
8. Loosen the heater clamp, pry heater apart no wider than necessary and remove the converter cartridge noting the proper orientation of heater wires and thermocouple probe.
9. Loosen the heater clamp, pry heater apart no wider than necessary and remove the converter cartridge noting the proper orientation of heater wires and thermocouple probe.
10. To replace converter, follow previous steps in reverse. **Note:** Be sure to wrap the O_3 converter tube snugly around the heater.

e. **Solenoid Valve Replacement**

Parts required:
Solenoid Valve (P/N 101390-00)

1. Refer to "Removing the Measurement Bench and Lowering the Partition Panel" in the manual to lower the partition panel, proceed to the next step below.
2. Disconnect solenoid from the Measurement Interface board (NO/NO_x connector). **Note electrical connections to facilitate re-connection.**
3. Remove plumbing from solenoid. Note plumbing connections to facilitate re-connection.
4. Pull solenoid valve from mounting clip.
5. To replace solenoid, follow previous steps in reverse.
6. Re-install the measurement bench.

f. **Ozonator Replacement**

Parts required:
Ozonator (P/N 9973)

1. Refer to "Removing the Measurement Bench and Lowering the Partition Panel" in the manual to lower the partition panel, proceed to the next step below.
2. Carefully disconnect the plumbing at the glass inlet and outlet of the ozonator.
3. Disconnect the stainless steel tubing from the flow transducer.

4. Loosen the four captive screws securing the ozonator bracket to the floor plate.
5. Remove the two screws securing the ozonator to the ozonator bracket.
6. Unplug the ozonator from the ozonator transformer by lifting the ozonator straight up.
7. To install the ozonator, follow the previous steps in reverse.
8. Re-install the measurement bench.

g. **Replacement of Ozone Transformer**

Parts required:
Ozone Transformer (P/N 101419-00)

1. Turn instrument OFF, unplug the power cord, and remove the cover.
2. Remove the ozonator assembly as described in "Ozonator Assembly Replacement" section in the manual.
3. Disconnect the plug connecting the ozonator transformer to the measurement interface board (OZONATOR connector).
4. Remove the four screws holding the ozonator transformer to the ozonator bracket and remove the ozonator transformer.
5. To install the ozonator transformer, follow the previous steps in reverse.
6. Re-install the measurement bench. Refer to "Removing the Measurement Bench and Lowering the Partition Panel" in the manual.

h. **DC Power Supply Replacement**

Parts required:
DC Power Supply Assembly (P/N 101681-00)

1. Turn instrument OFF, unplug the power cord, and remove the cover.
2. Disconnect all the power supply electrical connections. Note connector locations to facilitate re-connection.
3. Loosen the captive screw securing the power supply to the chassis plate and lift out the power supply.
4. Turn the power supply upside down and remove the four retaining screws securing the power supply to the power supply plate and remove the power supply.
5. To install the DC power supply, follow the previous steps in reverse.

Routine Maintenance

As a part of routine maintenance and or during any (including during site audit) site visit, ECB will perform following:

1. Document the time and reason for the site visit in the site logbook.
2. Check that site-building temperature is between 20ºC and 30ºC.
3. Check that the probe and sample line are connected and secure.
4. Check air conditioner, heater and lines for adequate/proper function
5. Check that the building is secure. Vandalism is to be reported to the ECB Supervisor.
6. Check site building for any problems (e. g. leaks, infestations, etc.).

7. Check that the heat tape is working and the site insulation is adequate
8. Check that all monitoring systems are operating within normal ranges (unless the reason is for site start-up).
9. Down any channels for monitors being repaired, replaced or audited during the repair, replacement or audit.
10. Up any channels after monitors are repaired, replaced or audited after the repair, replacement or audit.
11. If appropriate, time duration wise change the sample probe and funnel every 2 years.

Caution: All power should be turned off on the instrument before any electrical maintenance is performed.

As a part of routine maintenance, see manufacturer's instructional manual "Model 42*i*-Y NOy Instruction Manual, Chemiluminescence's NO-DIF-NOy Analyzer, 20 December, 2007" for other related details and or for replacement of any other subassembly modules of the NOy monitoring system.

2.38.1.9 Accuracy Audits and Reporting

Accuracy audits for continuous gaseous monitors are performed and reported to the Section Chief by ECB staff using an AQ 121 form. Each 42*i*-Y NOy Trace Level monitor in the network must be audited at least once each a year with an effective date of April 27, 2016.

- One point must be within two to three times the method detection limit of the instruments within the PQAOs network.
- The second point will be less than or equal to the 99th percentile of the data at the site or the network of sites in the PQAO or the next highest audit concentration level.
- The third point can be around the primary NAAQS or the highest 3-year concentration at the site or the network of sites in the PQAO.

For the continuous NOy trace level monitors, the ECB must not perform checks or audits between 6:00 AM and 9:00AM "Local Standard Time". The cylinders and calibrators used for auditing must be a different one than the calibrator and cylinder used for calibration and spanning. The 146C "audit calibrator" must be certified one and one half quarters (18 weeks, not to exceed 126 days between consecutive certifications) and the "field calibrator" certifications are good for 12 months. The auditor must not be the same operator as the one who conducts the routine monitoring, calibrations, and analysis. The monitor must operate in its normal sampling mode, and the audit gases must pass through the existing particulate filter.

During the site visit for audit, ECB staff will:
1. Check site temperature.
2. Check that the probe/sample lines are connected.
3. Check that the funnel is clean and in place.

4. Check that the building is secured.
5. Check that all components of the monitoring system are operating adequately.
6. Conduct the accuracy audit, titration, and calculate percent differences while at the site.

- Click on the AV-Trend icon, enter the username followed by the password, hit "**OK**"
- Select: "**Utilities**"
- Select: "**Link to Logger**"
- From the drop down menu, locate the site
- Select: "**Connect**"
- Select: "**L**", to log onto the site data logger (use site password)

Disable the data logger channel: While disabled, values are collected but flagged as invalid data.

- Press **{ESC}{ESC}** to "Home Menu" on the data logger
- Select: "**C**", Configuration Menu
- Select: "**D**", Configure Data Channels
- Select: "**M**", Enable/Mark Channel Online
- Select: "**NOT**", <ENTER>
- Select: "**M**", Enable/Mark Channel Online
- Select: "**NO2T**," <ENTER>
- Select: "**M**", Enable/Mark Channel Online
- Select: "**NOYT**,"<ENTER>

For all sites, ECB activates the certified audit calibrator using: "**ZERO**" (± .0005 ppm), (**Level 1**, 0.0003 - 0.0029 ppm), (**Level 6**, 0.0500 - 0.0999 ppm), and (**Level 7**, 0.100 - 0.2999 ppm) calibration points.

For all sites, ECB activates the certified audit calibrator and conducts a converter efficiency check at the Span 1-180 ppb concentration and completes the AQ 121 and AQ 109 report form, reviews the report and forwards the information to the Section Chief of Ambient Monitoring ***within 5 workdays*** of conducting the audit (acceptance criteria = 96-104%).

If audit results are not within the acceptable range; Zero - ± 0.5 ppb, Level 1 - ± 1.5 ppb, Level 6 & 7 - ± 10% of the expected values, the reviewer will print out the last auto-calibration, calculate percent differences and contact the ECB Supervisor. The ECB Supervisor immediately will investigate the audit results and determine the problem(s). If the problem is with the ECB equipment, the ECB Supervisor fixes the problem with the audit equipment and notifies the staff to repeat the audit. However, if the problem(s) is determined to be with site equipment, then the ECB Supervisor takes appropriate steps to either make arrangement to repair or replace the site equipment. In this case, the ECB Supervisor informs the site operator of his action(s). If the problem is a major site operation problem, the ECB Supervisor informs the site operator, the Regional Ambient Monitoring Coordinator, and the Projects and Procedures Supervisor.

1. Connect the TEI 146C audit calibrator as per manufacturer's instruction. Secure a separate certified Protocol II cylinder of NO gas, connect and purge regulator as per manufacturer's instructions.

2. Follow the TEI 146C audit calibrator procedures.

3. At least three (3) concentrations must be introduced to the analyzer being audited and these (concentrations) must be between the following ranges:

Audit Level	Acceptance Criteria
a. Zero	± 0.5 ppb
b. Level 1 - 2.9 ppb	± 1.5 ppb
c. Level 6 - 90 ppb	± 10%
d. Level 7 - 250 ppb	± 10%

4. Plug in the audit calibrator, turn the power "on" and allow audit calibrator to equilibrate till the alarm disappears.

5. **Begin a Zero:** Follow instructions in the manufacturer's manual to accomplish this task.

6. **Start the Span and Clear the Zero Mode:** Use the procedure included in "Operator Responsibilities for Model 42*i*-Y Trace Level Oxides of Nitrogen (NOy) Monitoring System, Section II, Rev. 5.5, February 10, 2016".

   ECB activates the certified audit calibrator for "**SPAN1, SPAN2** and **SPAN3**.
   - Press {**ESC**}{**ESC**} to return to the Home Menu
   - Select: "**C**", Configuration menu
   - Select: "**C**", Configuration Calibrations
   - Select: "**1**", start Single Phase Calibration
   - Select: "**NOTCAL**", <ENTER>
   - Select "**SPAN1**", make phase duration for four (1) hour. Start continuous report: This will show minute averages as they are calculated and keeps all values on screen
   - Start SPAN 1 and let it stabilize (about 30 to 45 minutes)
   - Record 20-25 consecutive one-minute averages
   - Press ▸ when "SPAN1" is complete
   - Abort SPAN 1 using "**C**", "**C**", "**W**", "**NOTCAL**", <ENTER>
   - Repeat procedures to check SPAN2 and SPAN3
   - Abort SPAN3 using "**C**", "**C**", "**W**", "**NOTCAL**", <ENTER>

8. ECB completes the AQ 109 and AQ 121 forms;
   - The audit measured values are within ± 0.5 ppb for zero, the lowest audit level – Level 1 (the goal is ± 1.5 ppb), and 10 % of the expected values for the higher audit levels.
   - For all the sites, document that the gas phase titration efficiency is in the acceptable range (96 to 104%),

- Reviews the report and submits it to the Section Chief of Ambient Monitoring within 15 workdays of conducting the audit.

10. **Up the data logger channel:**
    - Press{**ESC**}{**ESC**} to return to the Home Menu
    - Select: "**C**", Configuration Menu
    - Select: "**D**", Configure Data Channels
    - Select: "**E**", Enable/Mark Channel Online
    - Select: "**NOT"**, <ENTER>
    - Select: "**E**", Enable/Mark Channel Online
    - Select: "**NO2T"**, <ENTER>
    - Select: "**E**", Enable/Mark Channel Online
    - Select: "**NOYT**", <ENTER>

The following sequence is used to logout of the data logger:
- Press{**ESC**}{**ESC**} to return to the Home Menu
- Use arrow key to select "**O**" or hit "**O**" key to logout
- Turn off computer screen. **Note: DO NOT** close the AV-Trend software, **DO NOT** turn off the computer.

2.38.1.10 Model 701 Zero Air Audit (NCore Site)

Audits for the Model 701 Zero Air Pak (QA/SOP 2.3.5) for the NCore site is performed bi-annually and reported to Headquarters' by ECB staff using an AQ 121C form.

2.38.1.11 Method Detection Limit (MDL)

The Method Detection Limit (MDL) refers to the lowest concentration of a substance that can be reliably determined by a given procedure. **Note:** The Method Detection Limit is performed on the NCore equipment only.

To perform the MDL test:
1. Ensure that the poll editor and scheduler has been edited to not interfere with monitor/calibrator during the MDL study.
2. Check and record previous nightly zero auto-calibration in the MDL e-log.
3. Run zero air through the monitor and establish an acceptable zero.
4. Dilute pollutant gas to the targeted concentration (one to five times the estimated noise per instrument manual) and collect 30 one-minute observations. Repeat this two times per 24-hour period over the course of 5 to 14 days. Average the concentration from the 30 readings and enter them into the MDL e-log. Calculate the standard deviation (S) of the average readings and compute the MDL. The MDL is then calculated as the standard deviation of the response values times the Student's t-value for the number of test measurements (40 CFR Part 136, Appendix B). The results (raw data and spreadsheets) from the MDL study will be retained with the instrument logbook/file. The results for MDL studies conducted after the monitor is installed at the site will also be reported to the DMSSB for entry into the Air Quality System (AQS).

5. Ensure that the scheduler has been engaged for normal operation after the MDL study is completed.

The MDL should be done after the following situations:

1) Procurement,
2) Determined/established by the ECB staff at the monitoring site, during the site monitoring initiation,
3) After any major servicing of the analyzer,
4) Annual monitor audit.

Determination of Lower Detection Limit (LDL) NCore Site Only

The Lower Detection Limit (LDL) is the minimum NO concentration that produces a signal of twice the noise level. To determine the LDL, ECB staff will sample zero-air and the noise level of the reading is determined according to 40 CFR 53.23(b). The LDL (should be 0.10 PPB or less over an averaging time of no more than 5 minutes) for high sensitivity NOy analyzers should be: 1) determined/established by the ECB staff at the monitoring site, during site monitoring initiation, 2) after any major servicing of the analyzer and 3) every year.

2.38.1.12 146C Audit Calibrator Purge Procedure

At the ECB, connect the 146C calibrator to a source of zero air. Run the GAS and AIR at 50% of MFC's scales for an **hour** with zero air. Run the 146C in Ozonator On (MANUAL) at 0% lamp drive to flush that path also.

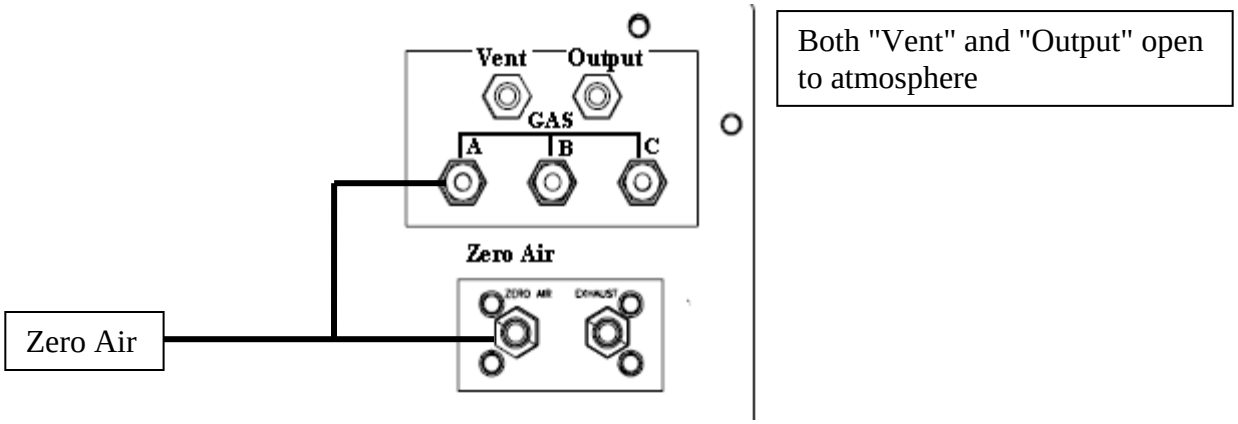


Figure 5 146C Zero Air Purge Diagram

- From the 146C Main Menu, select "**MODE**", press ↓↑ pushbutton until "LOCAL" mode is reached, <ENTER> press Menu [MENU] button 1X to return to the main menu
- From the 146C Main Menu, select: "**GAS A**", "**GAS B**" or "**GAS C**" (dependent on gas used) <ENTER>
- In the GAS menu, use down ↓ arrow to select "**Manual**", <ENTER>
- Select "**ZERO AIR SCCM**", <ENTER> (press ↓↑ to 50%) <ENTER>, press Menu [MENU] button 1X to return to the Manual menu
- Use down ↓ arrow to select "**GAS SCCM**", <ENTER> (press ↓↑ to 50%)
- Press Run [RUN] button to return to the RUN 1 screen
- Use down ↓ arrow to select "**GAS A**", "**GAS B**", or "**GAS C**" (dependent on gas used), <ENTER>
- Use down ↓ arrow, select
- Right arrow → to "**Manual?**"
- Down ↓ arrow
- Right arrow → to "**Ozone Man?**", <ENTER>

When purge is finished, place 146C back in "**Remote**" mode

MODEL 701 ZERO AIR VERIFICATION and CERTIFICATION

REGIONAL SUPERVISOR		REGIONAL CHEMIST	

STATION #		SITE:		REG:	RARO	QTR:		YR:	
AUDIT CYL TYPE:		UHP	AUDIT CYL SN:			AUDIT CYL EXP. DATE:			N/A
SITE 701 ZAP TBV #		Model 701	701 ZAP TBV SN:		NEXT TBV DATE			TBR DATE	
TBR 701 ZAP TBC #		Model 701	701 ZAP TBC SN:		NEXT TBV DATE			TBR DATE	
AUDITORS:	Mark Yirka / Sahid Thomas				REVIEWED BY:				
					DATE PERFORMED:				

TBC= TO BE CERTIFIED
TBR= TO BE RENEWED (Replaced unit or scrubber chemicals renewed)
TBV= TO BE VERIFIED

701 ZERO AIR VERIFICATION

				DATE	START	END
CALIBRATOR AUDIT FLOW TBV MODEL 701	COT=	2000 SCCM	DATE PERFORMED:			
	SO2T=	2000 SCCM	DATE PERFORMED:			
	NOT / NOYT=	6000 SCCM	DATE PERFORMED:			

				DATE	START	END
CALIBRATOR AUDIT FLOW UHP CYL.	COT=	2000 SCCM	DATE PERFORMED:			
	SO2T=	2000 SCCM	DATE PERFORMED:			
	NOT / NOYT=	6000 SCCM	DATE PERFORMED:			

	Site 701 ZAP To Be Verified 30 Min Run/5 Min Avg				UHP Cylinder Response 30 Min Run/5Min Avg			
POINT	COT ZERO READING (ppb)	SO2T ZERO READING (ppb)	NOT ZERO READING (ppb)	NOYT ZERO READING (ppb)	COT ZERO READING (ppb)	SO2T ZERO READING (ppb)	NOT ZERO READING (ppb)	NOYT ZERO READING (ppb)

Zero Criteria	
Model 48i TLE COT	± 35.000 ppb
Model 43i TLE SO2T	± 2.000 ppb
Model 42i TLE NOT	± 0.200 ppb
Model 42i TLE NOYT	± 0.200 ppb

Absolute Value of Diff.		UNITS	Passed/Fail
Model 48i TLE COT	0.000	ppb	PASSED
Model 43i TLE SO2T	0.000	ppb	PASSED
Model 42i TLE NOT	0.000	ppb	PASSED
Model 42i TLE NOYT	0.000	ppb	PASSED

701 ZERO AIR CERTIFICATION

				DATE	START	END
CALIBRATOR AUDIT FLOW TBC MODEL 701	COT=	2000 SCCM	DATE PERFORMED:			
	SO2T=	2000 SCCM	DATE PERFORMED:			
	NOT / NOYT=	6000 SCCM	DATE PERFORMED:			

				DATE	START	END
CALIBRATOR AUDIT FLOW UHP CYL.	COT=	2000 SCCM	DATE PERFORMED:			
	SO2T=	2000 SCCM	DATE PERFORMED:			
	NOT / NOYT=	6000 SCCM	DATE PERFORMED:			

	Site 701 ZAP To Be Certified 30 Min Run/5 Min Avg				UHP Cylinder Response 30 Min Run/5Min Avg			
POINT	COT ZERO READING (ppb)	SO2T ZERO READING (ppb)	NOT ZERO READING (ppb)	NOYT ZERO READING (ppb)	COT ZERO READING (ppb)	SO2T ZERO READING (ppb)	NOT ZERO READING (ppb)	NOYT ZERO READING (ppb)

Zero Criteria	
Model 48i TLE COT	± 35.000 ppb
Model 43i TLE SO2T	± 2.000 ppb
Model 42i TLE NOT	± 0.200 ppb
Model 42i TLE NOYT	± 0.200 ppb

Absolute Value of Diff.		UNITS	Passed/Fail
Model 48i TLE COT	0.000	ppb	PASSED
Model 43i TLE SO2T	0.000	ppb	PASSED
Model 42i TLE NOT	0.000	ppb	PASSED
Model 42i TLE NOYT	0.000	ppb	PASSED

AUDITOR REMARKS: _____

AUDIT RESULTS: GOOD _____ NOT ACCEPTABLE _____ INDICATE ACTION TAKEN BELOW:
_____ ADDITIONAL OPERATIONAL CHECKS (SPECIFY): _____
_____ PREVENTIVE ACTION (DESCRIBE) _____
REMARKS: _____
EVAL. DATE: _____ EVALUATOR: _____

AIR QUALITY SECTION
MAINTENANCE ORDER

Region: _____ Site: _____ Date of Service: _____

Requested By: _____

Action Requested: Repair _____ Supply _____ Maintain _____ Audit _____ Installation _____ Removal _____

Requested Action: _____

Shop Use Only - Action Taken: _____

Removed Cylinders:

Cylinder: Type _____ PPM _____ SN _____ PSI _____ Expires _____

Cylinder: Type _____ PPM _____ SN _____ PSI _____ Expires _____

Cylinder: Type _____ PPM _____ SN _____ PSI _____ Expires _____

Installed Cylinders:

Cylinder: Type _____ PPM _____ SN _____ PSI _____ Expires _____

Cylinder: Type _____ PPM _____ SN _____ PSI _____ Expires _____

Cylinder: Type _____ PPM _____ SN _____ PSI _____ Expires _____

Travel Time: Departed: _____ AM PM Returned: _____ AM PM

Vehicle #: _____ Vehicle #: _____

Logbook(s) Updated: YES NO N/A T Drive Updated: YES NO N/A

Site Temperature	OK _____	Corrected	_____
Probe / Sample Line Connected	OK _____	Corrected	_____
Funnel Clean and In Place	OK _____	Corrected	_____
Building Security	OK _____	Corrected	_____
All Monitoring Systems Operating	OK _____	Corrected	_____

Remarks / Parts Used: _____

Date Signed: _____ Technician(s): _____