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

OPERATOR RESPONSIBILITIES

Approval Sign-Off Sheet

I certify that I have read and approve of the contents of this revision of the "MODEL 42*i*-Y TRACE LEVEL REACTIVE OXIDES OF NITROGEN (TLNOy) MONITORING SYSTEM, Section II, OPERATOR RESPONSIBILITIES" with an effective date of November 10, 2011.

Joette Steger, PPB Supervisor: Joette Steger 12/1/2011

Donnie Redmond, Ambient Monitoring Section Chief: 12/15/11

Carlton Blakley, Environmental Chemist: Carlton Blakley 11/10/11

Regional Ambient Monitoring Coordinator: 12/5/2011

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2.38.2 Trace Level NOy Monitoring Site Operation Procedure

Note: The following is a list of "significant changes" from Revision 5.3.

1) Calibration (adjusted calibration) is required every 91 days for the Model 42*i*-Y $TLNO_y$ monitor.

2) Calibration requirements added to Calibration section.

2.38.2.1 Site Operation for Trace Level High Sensitivity Nitrogen Oxide (TLNOy) Monitors

The goals of the United States-Environmental Protection Agency's (US-EPA) National Ambient Air Monitoring Strategy (NAAMS) include improvement of scientific and technical competency of the nation's air monitoring networks and increased value in protecting public health and the environment. Monitoring data are used to characterize air quality and associated health and eco-system impacts, develop emission strategies to reduce impacts, and account for progress over time. In that regard substantial improvements in ambient air quality have been achieved over the last two decades and as a result ambient concentrations of several of the criteria pollutants (such as Pb, CO, SO_2, NO_2, etc.) are now well below the applicable National Ambient Air Quality Standards (NAAQS).

While the obvious problems of widespread elevated concentrations have been largely solved for some of the criteria pollutants, problems related to particulate matter (PM), ozone (O_3) and toxic air pollutants still remain. Further it now has become clear that even very low air pollution levels can be associated with adverse environmental and human health effects. As a result, new approaches in air monitoring are required to measure these low levels and to incorporate these measurements with other related data into compressive assessments of human and environmental health.

One of the major areas of investment in the NAAMS is the use of highly sensitive commercial air pollutant monitors for the characterization of the precursor gases such as CO, SO_2, and total reactive oxides of nitrogen (NO_y) in a new National Core (NCore) monitoring network. These high sensitivity monitors (such as CO, SO_2 and NO_y) are fundamentally the same as those designated as Federal Reference and Equivalent methods, but with modifications to improve sensitivity and accuracy or reduce interferences. The use of such precursor gas analyzers in the NCore network will not only allow determination of compliance with the NAAQS, but will also provide measurements at much lower detection limits than achievable by current monitors. This capability of more accurate measurements at low concentrations will also support long-term epidemiological studies, reduce uncertainties in data for modeling of air pollution episodes, and support source apportionment and observational analysis.

NCore is both a repackaging and an enhancement of existing networks with emphasis on the term ″Core″ reflects a multi-faceted national network that can be complemented by more specific efforts, such as intensive field campaigns to understand atmospheric processes, or personal and indoor measurements to assess human exposure effects.

The precursor gases CO, SO_2 and NO_y play an important role in the formation of atmospheric ozone, air toxics and particulate matter on both local and regional scales. Measurements of ambient nitrogen oxides differ from measurement of CO and SO_2 in that the target air pollutant is <u>not</u> a single chemical but a group of chemicals of different properties. Nitrogen oxides released from emission sources are primarily nitric oxide (NO) with lesser amounts of nitrogen dioxide (NO_2), which collectively are termed as NO_x (i.e. $NO_x = NO + NO_2$). These primary emitted species are converted by atmospheric processes to numerous other inorganic and organic nitrogen oxides, which are collectively called NO_z. The total of all reactive gaseous nitrogen species present in ambient air is called NO_y (i.e. $NO_y = NO_x + NO_z$).

The objectives of this document are to establish and deploy common site operations and instrument calibration procedures for the generation of quality NO_y data that may be compared and if needed, further extrapolated. Therefore, it is critical that the Site Operator strictly follow these protocols and procedures to the last details. Technical assistance is also available from the Electronics and Calibration Branch (ECB), Telephone Number (919) 715-1761.

All original records (electronic logbook, site logbook, etc.) must be legible, complete, dated and signed by the Site Operator and retained as a part of the permanent analyzer record. The Operator's signature on the logbook form certifies that the procedures have been performed in accordance with QA/SOP and that the information contained on the form is accurate. All records are to be reviewed and certified by the Regional Chemist and further audited at the Central Office.

A. Continuous Monitoring Principles for the Model 42*i*-Y NO_y Monitoring System- Site Operator Responsibilities

- Note any unusual events at the site such as power failure, equipment problems, Site building problems, etc.
- The site is to be inspected for required maintenance such as shelter conditions, condition of plumbing/lines, compressor and silica gel condition, filter changes, leak testing, backup data collection, etc.
- Note site temperature.
- Verify instrument and cylinder numbers and certification dates. The Operator should call Electronics and Calibration Branch (ECB) when the cylinder pressure reaches 500 psig and the cylinder should be replaced before it reaches 200 psig. Note the call to ECB in the electronic logbook.

- **An initial adjusted calibration (hereafter referred to, as ″adjusted calibration″ must be performed during the site start-up.**
- **Calibration (adjusted calibration) is required whenever a system's operation is interrupted: more than two days without power, physical removal/replacement of system's components (monitor, calibrator, cylinder, zero air pak, NO_2 – to NO Converter, sample line) or major repairs/maintenance.**
- **Calibration (adjusted calibration) is required whenever a system's operation is offline more than two days.**
- **A calibration (adjusted calibration) is required when a calibration check (i.e. unadjusted calibration) fails. Replace the filter and perform calibration.**
- **The analyzer should also be calibrated (adjusted calibration) at a minimum of once per quarter (91 days), even when properly operating over that time period.**
- Visit the site at least once every 14 days or less and perform a calibration check (unadjusted calibration). A calibration check is to be performed before any changes are made to the monitoring system.
- As a part of calibration check, perform a precision check every 14 days (40 CFR 58 Appendix A).
- A calibration check is required when the span drift on the nightly calibration check is > ± 6% or when the zero drift on the nightly calibration is greater than or equal to ± 2 PPB.
- With a 146C calibrator and/or gas cylinder change (if <u>not</u> done for a problem), a calibration check should be performed before change out to assess any replacement effects. If calibration check passes then perform the calibration. However, if calibration check fails, perform a through investigation of the system to find out reason(s) for the failure and then contact ECB.
- No calibration checks that effects the data are to be made during periods of ambient exceedances or between 6:00 AM and 9:00 AM local time.

B. Monitoring Instrumentation, Equipment and Accessories

- Thermo Electron (TEI) Model 42*i*-Y NOy analyzer
- Thermo Electron (TEI) Model 146C Gas Calibrator
- Certified NO Gas Cylinder
- Thermo Electron (TEI) Model 111 Zero-Air Supply System
- ESC Model 8832 Data loggers (Primary (PDL) and Secondary (BUDL))
- Dedicated Site PC
- Telephone Modem
- Air Compressor

Thermo Environmental Model 42*i*-Y NOy Analyzer System

In general the NOy analyzer system consists of the following components:

- Pneumatic System: This portion of the analyzer consists of a sample inlet incorporating a heated converter, sample inlet line, particulate matter filter, gas phase titration calibration unit, ozone generator, pre-reactor, flow meter, and pump, all used to bring ambient air samples to the analyzer inlet.
- Analytical System: This portion of the analyzer consists of the reaction chamber, photomultiplier, and bandpass filters.
- Electronic Hardware: This portion of the analyzer consists of the electronic components that control the analyzer and process the signals.

Maintenance and Trouble Shooting Documentation

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

Model 111 Zero-Air Supply Systems

The main function of the Model 111 zero-air pack is to supply pollutant-free air (zero-air) for the analyzer zeroing and to provide clean diluent air for use with the 146C calibrators. Because the goal of the NOy analyzer is to detect/quantify NOy concentrations at levels very close to zero, determining the response to the clean air (and hence the baseline of the NOy analyzer) is vital for collecting defensible data in the NCore program. In its operation ambient air is drawn into the system, which removes water vapor, SO_2, NO, NO_2, O_3, CO and hydrocarbons. In reality, zero-air should contain a concentration of NOy that is less than the Lower Detectable Level (LDL) for the analyzer or approximately 0.1 PPB.

The TEI Model 111 Zero Air Supply Systems are currently being used as a constant supply of clean air. Carbon monoxide (CO), SO_2, and NOy are scrubbed from the ambient air using ″Purafil″ (oxidizes NO to NO_2), charcoal (removes NO_2 and SO_2) and ″Carulite″ (removes CO). Water vapor is removed using ″Silica Gel″. The silica gel is changed/replaced as needed (indicated by its color change to pink) while other materials are replaced annually. The delivery pressure should be set to between 30 to 40 psig. A capillary ″bleed″ is installed to allow a constant low flow of air through the scrubbing media.

2.38.2.2 Calibration

- An initial adjusted calibration (hereafter referred to, as ″adjusted calibration″ must be performed during the site start-up.
- Calibration (adjusted calibration) is required whenever a system's operation is interrupted: more than two days without power or offline, physical removal/replacement of system's components (monitor, calibrator, cylinder, NO_2 – to NO Converter, sample line) or major repairs/maintenance.
- A calibration (adjusted calibration) is required when a calibration check (i.e. unadjusted calibration) fails. Replace the filter and perform calibration.

- The analyzer should also be calibrated (adjusted calibration) at a minimum of once per quarter (91 days), even when properly operating over that time period.

2.38.2.2.1 Operational Checks

An initial calibration is performed without doing any prior calibration checks. The filter must be clean. Perform all of the following checks and adjustments before calibrating the 42*i*-Y NOy analyzer. All checks and adjustments will be documented in the electronic logbook.

Site Operational Checks
Upon arrival at the site, observe the outside of the sampling building and probe, looking for any vandalism or security breaches. Document all actions in the site logbook.

If there is any evidence of vandalism, contact the appropriate Law Enforcement Department (generally this one is City Police, if the site is within city limits and the County Sheriff, if it is outside city limits) and also inform the Central Office.

Power On and Sample Line Check: observe the analyzer, calibrator, computer, and data loggers for indications of power failure, and if needed, correct the cause. Verify the instrument "**LCD**" panel is lit and there is an audible sound from the external pump. If the analyzer or calibrator lost power, allow an equilibration period of at least an hour for the instrument(s) to stabilize. Visually inspect the tubing, especially at any bends, to ensure that it has not been accidentally kinked, crimped, cut, or insects are nested in the lines. Particulate matter may also load the sample line ahead of the inlet filter. Such restrictions can usually be determined by disconnecting the inlet line of the sample pump. If pump performance is significantly improved and the inlet filter itself is not loaded with particulate matter, the sample line may require replacement. Record all events in the electronic logbook. Notify supervisor and call the ECB for instructions on length of stabilization period and recycling the data logger if necessary.

Check on Gas Cylinder and 146C Calibrator: verify the gas cylinder and calibrator are in certification (calibrator certification sticker on front panel) and document certification dates in logbook. (If the cylinder pressure **is less than 500 psig** arrange with ECB when the Region will do a calibration check before delivery of the cylinder. Calibrate after the new cylinder is installed per **2.38.2.2 Calibration**. Verify that the 146C has the correct cylinder concentration stored in memory.

146C Calibrator
- Main Menu
- Gas A, <ENTER>
- Tank Conc., <ENTER>

Model 111 Zero Air Pak and Compressor Checks: 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. Record checks in the electronic logbook. 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 and record that the ZAP is reading between 20 and 40 psi. If either pressure reading is outside of these ranges, contact the ECB and record corrective action. Also, check and drain any water from the compressor (do this at every site visit).

TEI 146C Dynamic Gas Calibrator Operational Checks

Check the TEI 146C Run Screen

a. Press the **<MENU>** button on the front of the instrument. (Make sure the 146C is in "**Remote**" mode, the 146C has to be in the REMOTE MODE in order to activate the internal span solenoid inside the 42*i*-Y TLE)

Check for "**Alarm**" on the displays. If no alarms are present, record the "Alarm On" checks in the logbook as "**no**" and continue. If either screen shows an alarm, record the "Alarm On" check as "**yes**" in the logbook for the appropriate instrument(s). **NOTE: Items that are not in alarm status are labeled "OK"**

View the Alarm menu to determine the cause:

b. Use the ↑ or ↓ menu pushbuttons to select the **Alarm Submenu,** <ENTER>
c. Use the ↑ or ↓ menu pushbuttons to select the item that is in Alarm Status.
d. Determine the cause of the alarm. Consult with the ECB prior to performing calibrations or maintenance.
e. Press the <**MENU**> button twice to return to the main menu screen.

The following Alarm Limit is used in the NOy operation of the TEI 146C Calibrators:

Parameter	**Min.**	**Max.**
Internal Temperature	18.5ºC	47ºC

Thermo Environmental Model 42*i*-Y NOy Analyzer Operational Checks

- Verify the analyzer ″**POWER**″ light is lit and there is audible sound from the external pump. Observe the chamber pressure (200 to 450 mm Hg). If the analyzer does not have any power, determine the cause and time of failure. Invalidate data for a 20-minute period after the power comes back. Correct the cause and verify zero and span. Record all events in the electronic logbook and notify Supervisor and the ECB.
- Verify that the NOYT concentration range is set at correct setting i.e. 200 PPB for NOT, NO2T and NOYT by using: **Main Menu**, choose ***Range***
- Verify calibration reactor pressure is between 150 and 300 mmHg. **Main Menu**, choose ***Diagnostics*** **>** ***Pressure***
- NO sample and NOy sample flow readings should be between 0.6 to 0.8 LPM. **Main Menu**, choose ***Diagnostics*** **>** ***Flow***
- The PMT cooler temperature should be between -1º C to -20º C. If not contact ECB. **Main Menu**, choose ***Diagnostics*** **>** ***Temperatures*** **>** ***Cooler***
- The reaction chamber temperature should be between 47º C to 51º C. If not contact ECB. **Main Menu**, choose ***Diagnostics*** **>** ***Temperatures*** **>** ***Chamber***
- Inspect 5 Micron Teflon Particulate Filters: Replace before performing calibration. Unscrew the filter holder and replace the old filter with a new one.

2.38.2.2.2 Filter Conditioning

When changing the filters, touch only its outer edges. Check for leaks associated with the filter holder. Record in the electronic logbook.

Condition the Teflon particulate matter filter before performing a calibration and **monthly**. To replace the filter, unscrew the filter holder and replace the old filter with a new one. While changing the filters, touch only its outer edges.

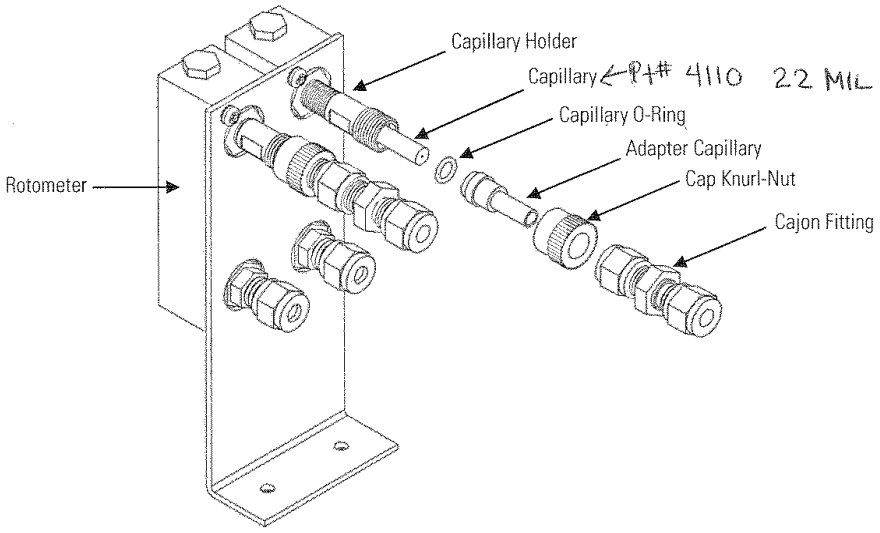
To condition a filter:

1. Click on **PDL Display Screen**
2. Press the **{ESC}** key; Press the **{ESC}** key again.
3. Select ″**C**″ Configure Menu
4. Select ″**C**″ Configure Calibration Menu
5. Select ″**1**″ Start Single Phase Cal
6. Select ″**Level 1**″, press <ENTER>
7. Scroll down and highlight ″**Duration**″.
8. Enter ″**20 Minutes**″.
9. Scroll Down to ″**Start Single Cal (NOW**)″, press <ENTER>

- Run span 1 and if it passes, then this is considered a leak check. Record in the electronic logbook.

- If a problem is observed in obtaining substantial NOT, NO2T and NOYT span levels, there may be a problem due to clogged auxiliary capillaries. There are two capillaries. One for ″NO″ and the other one for ″NOy″ and these two must be cleaned / replaced by the Site Operator.

2.38.2.2.3 Inspection and Replacement of Auxiliary Pump Capillaries



Tools needed:
Phillips head screwdriver
$^{9}/_{16}$ wrench
$^{7}/_{16}$ wrench
$^{1}/_{2}$ wrench

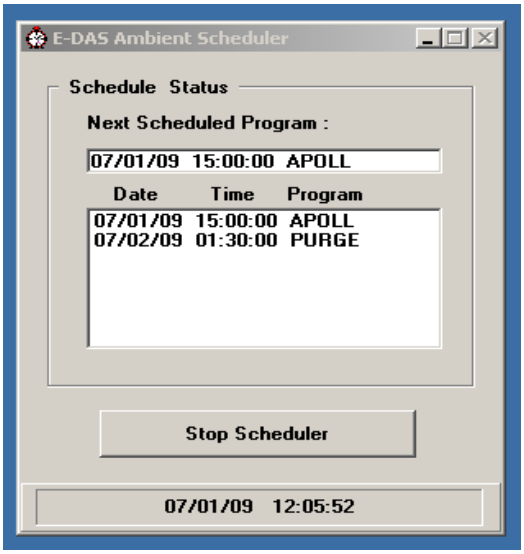
Locate auxiliary pump:

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.
2. Remove the instrument cover.
3. Locate the capillary holders (see figure above).
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.

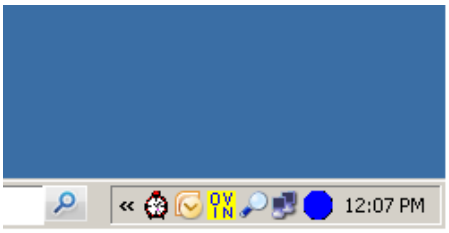
10. Replace capillary in the housing making sure the capillary is in straight.
11. Replace knurl-nut fitting. **Note:** the knurl-nut fitting should be tightened hand tight.
12. Repeat procedure for other capillary.
13. Reconnect NO and NOy tubing to the "T" fitting.
14. Re-install the cover.
15. Re-install the "NOy IN", "NO IN", "NOy Out", and "NO OUT" lines to the auxiliary pump.
16. Connect the power cord and turn the instrument ON.

Maintenance and Trouble Shooting Documentation
Document any other site related suspected mechanical problems for preventive and routine maintenance in the logbook and notify ECB.

Stop Scheduler
Stop the poll editor and scheduler by clicking on the radio button that says "**Stop Scheduler**" to keep from losing data that is being collected on the PDL and the BUDL.

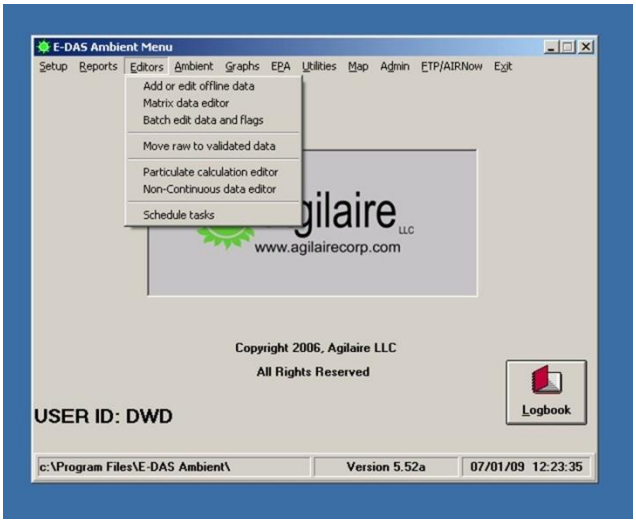


If the scheduler isn't on the screen, there should be a small red alarm clock "**icon**" down in the bottom right hand corner. Any mouse click will bring up the scheduler so that you can stop the scheduler.

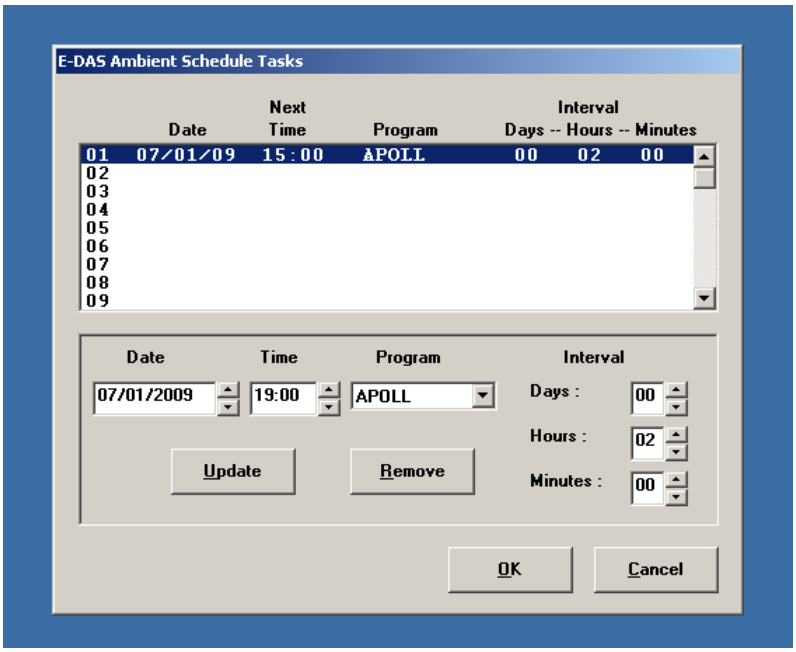


The APOLL task must be set to a later odd hour time after the manual calibration will be completed.

Then open the EDAS and under the ″**Editors**″ pull down menu there is a ″**Schedule tasks**″ button. Click on it…



That will bring up the E-DAS Schedule Tasks window….Highlight the ″**APOLL**″ line in the top half and set the bottom ″**Time**″ for the next odd hour or some odd hour beyond that (two or four hours later today). AND HIT ″**UPDATE**″ TO MAKE THE HILIGHTED LINE REFLECT THESE CHANGES.



Setting computer, PDL, and BUDL time/date.
The times for the PDL, BUDL, and computer must be EASTERN STANDARD TIME. The computer, BUDL, and PDL must have the same NIST time ±1 minute.

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

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

PDL & BUDL time and date:
- Double click "**Shortcut to Splitscreen**"
- Open PDL & BUDL
- Highlight PDL and type 2 letter data logger site code and AQM, (e.g.) "**GR** AQM" (located on front of data logger, may have to hit **{ESC}** a couple of times before typing)
- Select: "**L**" Login
- Type password: **XXXXXXXXXX** (not case sensitive), this brings up Home Menu
- Select: "**C**" configuration menu

- Select: "**S**" configure System Parameters
- Highlight "**Logger Time**"
- Type in correct time in the format of: **HH:MM:SS**
- **{ESC}{ESC}{ESC}**
- Highlight BUDL and type the 2 letter data logger site code and AQM (e.g.) "**UG** AQM", (located on front of data logger, may have to hit **{ESC}** a couple of times before typing)
- Select: "**L**" Login
- Type password: **XXXXX** (not case sensitive), this brings up Home Menu
- Select: "**C**" configuration menu
- Select: "**S**" configure System Parameters
- Highlight "**Logger Time**"
- Type in correct time in the format of: **HH:MM:SS**
- **{ESC}{ESC}{ESC}**

Setup BUDL Analog output

In Service mode, set the BUDL analog output to mirror the PDL digital output to within 30ppb.

2.38.2.2.4 Zero Calibration

In the 42*i*-Y **MAIN MENU**, scroll down to ″**CALIBRATION FACTORS**″ press ↵ and record beginning calibration factors.

Calibrate ″SPAN ZERO″

- Highlight PDL from ″Home Menu″ and select ″**C**″, Configuration Menu
- Select ″**C**″, Configuration Menu
- Select ″**C**″, Configure Calibrations
- Select ″**1**″, start Single Phase Calibration
- Select ″**NOT CAL**″, <ENTER>
- Select ″**SPAN ZERO**″, <ENTER>
- Select phase duration (set to ≥ 1 hour)
- Select ″**Start Single Cal** (**NOW**)″, <ENTER>
- **{ESC}{ESC}** to ″Home Menu″

Monitor Actual Values

- Select ″**D**″, Real Time Display Menu
- 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
- Type in parameters ″**NOT**, **NO2T**, **NOYT**″
- Change # of flags to report from 02 to 03. Use Decimal Positioner.

- Start continuous report: this will show minute averages as they are calculated and keeps all values on screen

NOT, NO2T and NOYT Zero Calibration

- Wait a minimum of 30 minutes for monitor to stabilize. To calibrate zero, press button labeled as ″CAL″ on 42*i*-Y monitor. Scroll to ″CAL″ pre-reactor BKG ↵ set ″PRE″ to ″ZERO″ by pressing ↵. Press ″CAL″ button and scroll to ″CALNO″ background ↵ set ″NO″ to ″ZERO″ by pressing ↵. Press ″CAL″ button and scroll to ″CAL NOY″ background ↵. Set ″NOY″ to ″ZERO″↵. The microprocessor will calculate, apply and store the pre-reactor and zero ″CALIBRATION FACTORS″ for all three channels.
- Enter 5 minutes of averaged NOT, NO2T and NOYT data logger data in the electronic logbook. The data logger and backup data logger should average to zero (O) ± 1 PPB or may be even less for NOT, NO2T and NOYT. (if all three channels are not in this range contact the ECB.
- Wait until calibration is completed before recording ″CALIBRATION FACTORS″.
- Record any adjustments. Press ▸ when ″SPAN O″ adjustment is complete.
- Record 5 consistent consecutive values in the electronic logbook

The BUDL mirrors the activity of the PDL. The instrument calibration control is via the PDL. The BUDL screen is used to view the real time data either as last base average or through the continuous report. Record 5 consistent consecutive 1-minute averages in the electronic logbook.

- Highlight PDL
- {ESC}{ESC} back to ″Home Menu″
- Select ″**C**″, Configuration Menu
- Select ″**C**″, Configure Calibrations
- Select ″**W**″, ″NOTCAL″
- Purge the instrument with span gas for about 5 minutes

2.38.2.2.5 Multi-Point Calibration

Span 1 Calibration

Note: Abort each current SPAN prior to running the next using ″W″ command

- Highlight PDL from ″Home Menu″ and select ″**C**″, Configuration Menu
- Select ″**C**″, Configure Calibrations
- Select ″**1**″, start Single Phase Calibration
- Select ″**NOTCAL**″, <ENTER>
- Select ″**SPAN 1**, (SPAN 2, SPAN 3) ″. Make phase duration for four (4) hours.

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 (30 to 45 minutes)
- Press ▸ when ″Span 1″ is complete
- Calibrate NOT, NOYT. To calibrate Span 1-Press ″CAL″ button, select ″CALNO″ coefficient, edit ″SPAN CONC″ if necessary, press ↵. Press ″CAL″,
- Select ″CALNOY″ coefficient then edit ″SPANCONC″, if necessary for any cylinder impurity.

Monitor Actual values

- From ″Home Menu″
- Select ″**D**″, Real-Time Display Menu
- 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
- Type parameters ″**NOT**, **NO2T**, **NOYT**″
- Change # of flags from 02 to 03, <ENTER>
- Start continuous report: This will show the minute averages as they are calculated and keeps all values on screen.

- Record five stable consecutive 1 minute NOT and NOYT averages in the electronic logbook from PDL and BUDL
- Record ending Calibration Factors: BKG's and COEF's
  Main Menu, choose ***Calibration Factors > NO BKG & NOx BKG***
  Main Menu, choose ***Calibration Factors > NO COEF, NO2 COEF & NOx COEF***

Calculate actual NOT/NOYT concentrations of approximately 90% of full-scale range (180 PPB) using the equation below. Record the ″**NOT**″ and ″**NOYT**″ spans in the electronic logbook.

Obtain $F_{NO} + F_{zero}$ from 146C display by pushing ″**Run**″ button
$[NO]_{ca} = [F_{NO} / (F_{NO} + F_{zero})] \times [NO_{std}]$
$[NOy]_{ca} = [F_{NO} / (F_{NO} + F_{zero})] \times [NO_{std}] + [NO2_{imp}]$
Where: $F_{NO} + F_{zero}$ = Calibrated flows in sccm
$[NO2_{imp}]$ = NO2 impurity in cylinder (see certification sheet)
$[NO_{std}]$ = Certified NO gas concentration

Note: Multiply litres by 1000 to convert to sccm; multiply PPM by 1000 to convert to PPB

i.e. if $[NO_{std}]$ = 5.44 PPM, F_{NO} = 79.99 sccm and F_{zero} = 9797 sccm (9.797 lpm) then [NO] = 0.04405 PPM (44.05 PPB)

2.38.2.2.6 Titration

While the Span 1 event is running and stabilized:

- On 146C press ″**Menu**″ button, press <ENTER> until 146C is in ″Local″ mode
- On 146C press ″**Run**″ button to bring up ″**Run 1**″ screen
- Use ↓↑ arrows to select GAS option, select ″**GAS A**″
- 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**″, <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 that you recorded as noted above, if not phone ECB for guidance.

Allow the 42*i*-Y monitor to stabilize (about 1 hour) and record NO and NOY responses as NOT, NOYT original. Once the GPT original phase is completed, use the ↑or ↓ arrows to adjust the O_3 ″Level″ (percent ozonation) to 30%, allow reading to stabilize.

On 146C Main Menu press ↓ 4 times to ″Ozonator″, press <ENTER>, press ↓ to ″Manual Adjustment %″, and then ″Ozonator Manual Level″ <ENTER>. Starting from 30% 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. Once set, the O_3 level will work with future calibrations unless something changes such as a gas cylinder, 146C calibrator or an ozonator lamp.

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 the example below, 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. Wait until the actual concentration is stable on the data logger. If the concentrations measured on the data logger are within ± 5% of the actual concentration, enter 5 minutes averaged NOT, NO2T, and NOYT data logger and backup data logger data into the calibration section of the electronic logbook.

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

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

If the NO2T concentration measured on the data logger is not within ± 5% of the actual $[NO2]_{Ca}$ concentration, press ″Cal Button″, use down arrow ↓ to ″CAL DIFCOEFFICIENT″ then press ↵ using cursor, edit SPAN Conc. to actual NO2 concentration. Then press the ″**ENT**″ button. Wait for the microprocessor to stabilize, and enter 5 minutes averaged NOT, NO2T, and NOYT data logger and backup data logger readings into the calibration section of the logbook.

When the titration finishes, do the following:

- Place 146C back into ″Remote″
- Abort ″**NOT SPAN 1**″, C, C, W
- Once completed and stabilized, record 5 minutes of consistent readings in the electronic logbook
- The converter efficiency should be between 96-104%

Check SPAN 2 / SPAN 3

- Make no adjustments to SPAN 2 or SPAN 3
- Highlight PDL from ″Home Menu″ and select ″**C**″, Configuration Menu
- Select ″**C**″, Configure Calibrations

- Select ″**1**″, start Single Phase Calibration
- Select ″**NOTCAL**″, <ENTER>
- Select SPAN 2. Make phase duration for > one (1) hour.
  Start continuous report: This will show minute averages as they are calculated and keeps all values on the screen.
- Start SPAN 2 and let it stabilize (30 to 35 minutes)
- Record 5 consecutive one-minute averages
- Abort SPAN 2 using ″W″ command
- Repeat all above steps for SPAN 3

Percent Tolerance Across <u>all</u> Full Scale (FS) Ranges (50, 100, 200 PPB)

<u>Point*</u>	**<u>Calibration Tolerance</u>**	**<u>Converter Efficiency</u>**
Span (90%)	±3%	96 - 104%
Mid (50%)	±3%	
Precision (18%)	±10%	
Zero (O)	±1 PPB	
NO2T Span	±5%	

*Nominal or designated value of each point

If any of the points are greater than the calibration tolerance for the full-scale range, the calibration is unacceptable. If the calibration is unacceptable after two (2) tries, contact ECB. All points on the calibration must meet their respective calibration tolerance.
<u>Adjustments to the 42*i*-Y should be based on the 42*i*-Y NOT meeting the tolerance criteria.</u>

If the calibration is <u>acceptable</u>, proceed to ″logout″.

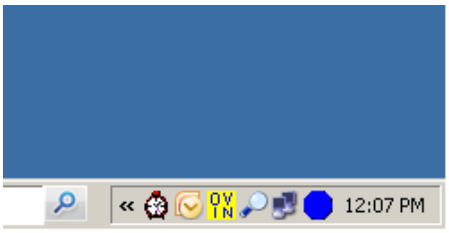
Enable Channels on PDL and BUDL

- Highlight PDL and select ″**C**″, Configuration Menu
- Select ″**D**″, Configure Data Channels
- Select ″**E**″ Enable/Mark Channel Online
- Select ″**NOT**, **NO2T**, **NOYT**″ and press <ENTER>
- Highlight BUDL and follow the above instructions for enabling the 3 channels

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

- {ESC}{ESC} to ″Home Menu″ on both PDL and BUDL
- Use arrow key to select "**O**" or hit "**O**" key to logout
- Repeat for BUDL

The Scheduler must be restarted
Restart the poll editor and scheduler by clicking on the Scheduler Icon scheduler.

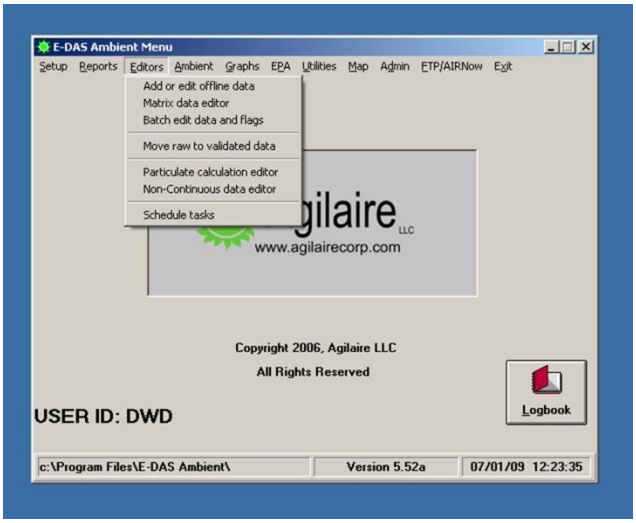


If the scheduler isn't on the screen, there should be a small red alarm clock "**icon**" down in the bottom right hand corner. Any mouse click will bring up the scheduler so that you can start the poll editor and scheduler.

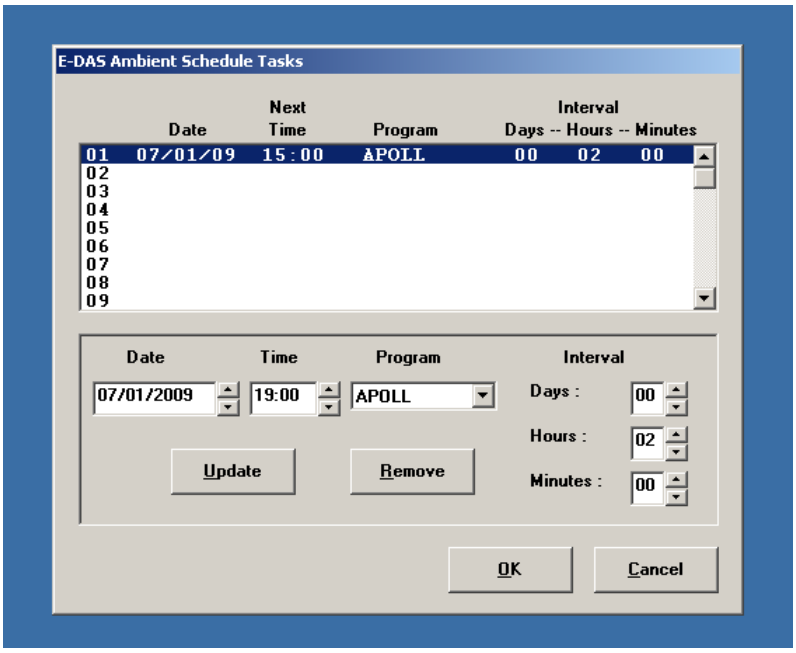
You can bring the scheduler back up and see that it's going to run 4 hours down the road.

The APOLL task must be set to a later odd hour time after the manual calibration will be completed.

Then open the EDAS and under the ″**Editors**″ pull down menu there is a ″**Schedule tasks**″ button. Click on it…

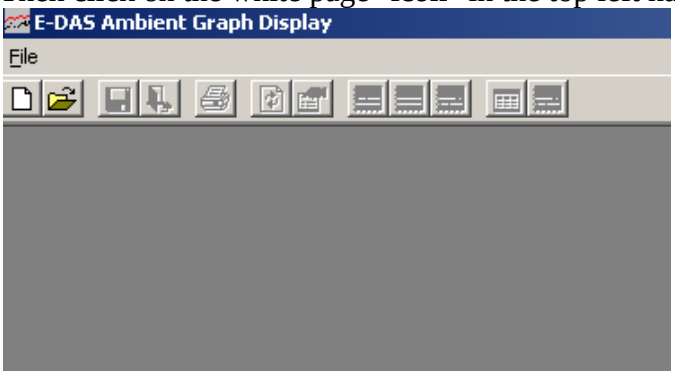


That will bring up the E-DAS Schedule Tasks window….Highlight the ″**APOLL**″ line in the top half and set the bottom "**Time**" for the next odd hour or some odd hour beyond that (two or four hours later today). AND HIT ″**UPDATE**″ TO MAKE THE HILIGHTED LINE REFLECT THESE CHANGES.

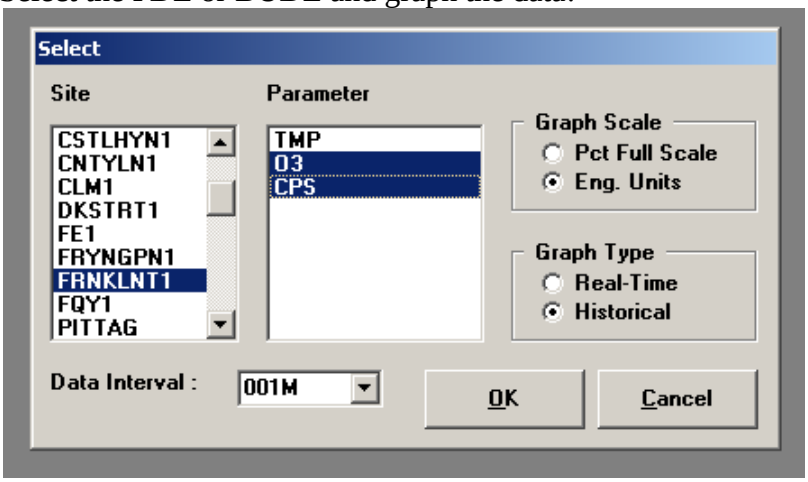


Check to ensure that the data logger is storing minute data on the computer.
Check to make sure that we can collect the data from the data logger and store it on the computer. Check to see IF it has actually happened. Minute data only resides in the data logger for about 3 days, beyond that the minute data is overwritten and is lost FOREVER. It's real easy to see this data, just open up the graph "**icon**".

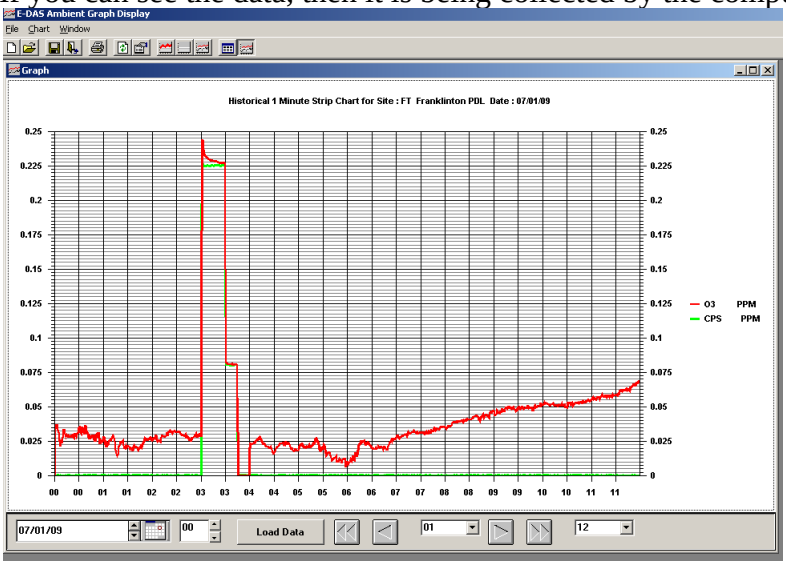
Then click on the white page "**icon**" in the top left hand corner to open the data file area.



Select the PDL or BUDL and graph the data!



If you can see the data, then it is being collected by the computer.



If you can't see the data after hitting load data….there is a problem. Call the ECB for instructions.

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

2.38.2.3 Calibration Check

Note: Make no monitor adjustments during calibration check

- A bi-monthly calibration check (every 14 days or less) including converter efficiency calculation determines the ongoing accuracy and stability of the site-specific NOy monitoring system.
- As a part of calibration check, perform precision check every 14 days.
- A calibration check is to be performed before any changes are made to the monitoring system.
- A calibration is required when the span drift on the nightly calibration check is > ± 6% or when the zero drift on the nightly calibration is greater than or equal to ± 2 PPB.
- A calibration is required when a calibration check (i.e. unadjusted calibration) fails. Replace the filter and perform calibration.
- With a 146C calibrator and/or gas cylinder change (if not done for a problem), a calibration check should be performed before and after change out to assess any replacement effects. If calibration check passes then perform the calibration. However, if calibration check fails, perform a thorough investigation of the system to find out reason(s) for the failure and then contact ECB.
- No calibration checks that affect the data are to be made during periods of ambient exceedances or between 6:00 AM and 9:00 AM local time.

2.38.2.3.1 Operational Checks

Upon arrival at the site, observe the outside of the sampling building and probe, looking for any vandalism or security breaches. Document all actions in the site logbook. If there is any evidence of vandalism, contact the appropriate Law Enforcement Department (generally this one is City Police, if the site is within city limits and the County Sheriff, if it is outside city limits) and also inform the Central Office.

Power On and Sample Line Check: observe the analyzer, calibrator, computer, and data loggers for indications of power failure, and if needed, correct the cause. Verify the instrument "**LCD**" panel is lit and there is an audible sound from the external pump. If the analyzer or calibrator lost power, allow an equilibration period of at least an hour for the instrument(s) to stabilize. Visually inspect the tubing, especially at any bends, to ensure that it has not been accidentally kinked, crimped, cut, or insects are nested in the lines. Particulate matter may also load the sample line ahead of the inlet filter. Such restrictions can usually be determined by disconnecting the inlet line of the sample pump. If pump performance is significantly improved and the inlet filter itself is not loaded with particulate matter, the sample line may require replacement. Record all events in the electronic logbook. Notify supervisor and call the ECB for instructions on length of stabilization period and recycling the data logger if necessary.

Check on Gas Cylinder and 146C Calibrator: verify the gas cylinder and calibrator are in certification (calibrator certification sticker on front panel) and document certification

dates in logbook. (If the cylinder pressure **is less than 500 psig** arrange with ECB when the Region will do a calibration check before delivery of the cylinder. Calibrate after the new cylinder is installed per **2.38.2.1 Calibration**. Verify that the 146C has the correct cylinder concentration stored in memory.

146C Calibrator

- Main Menu
- Gas A, <ENTER>
- Tank Conc., <ENTER>

Model 111 Zero Air Pak and Compressor Checks: 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. Record checks in the electronic logbook. 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 and record that the ZAP is reading between 20 and 40 psi. If either pressure reading is outside of these ranges, contact the ECB and record corrective action. Also, check and drain any water from the compressor (do this at every site visit).

TEI 146C Dynamic Gas Calibrator Operational Checks

Check the TEI 146C Run Screen

a. Press the ″**MENU**″ button on the front of the instrument. (Make sure the 146C is in "**Remote**" mode, the 146C has to be in the ″REMOTE" mode in order to activate the internal span solenoid inside the 42*i*-Y TLE)

Check for "**Alarm**" on the displays. If no alarms are present, record the "Alarm On" checks in the logbook as "**no**" and continue. If either screen shows an alarm, record the "Alarm On" check as "**yes**" in the logbook for the appropriate instrument(s). **NOTE: Items that are not in alarm status are labeled "OK"**

View the Alarm menu to determine the cause:

b. Use the ↑ or ↓ menu pushbuttons to select the **Alarm Submenu,** <ENTER>

c. Use the ↑ or ↓ menu pushbuttons to select the item that is in Alarm Status.
d. Determine the cause of the alarm. Consult with the ECB prior to performing calibrations or maintenance.
e. Press the <**MENU**> button twice to return to the main menu screen.

The following Alarm Limit is used in the NOy operation of the TEI 146C Calibrators:

Parameter	**Min.**	**Max.**
Internal Temperature	18.5ºC	47ºC

Thermo Environmental Model 42*i*-Y NOy Analyzer Operational Checks

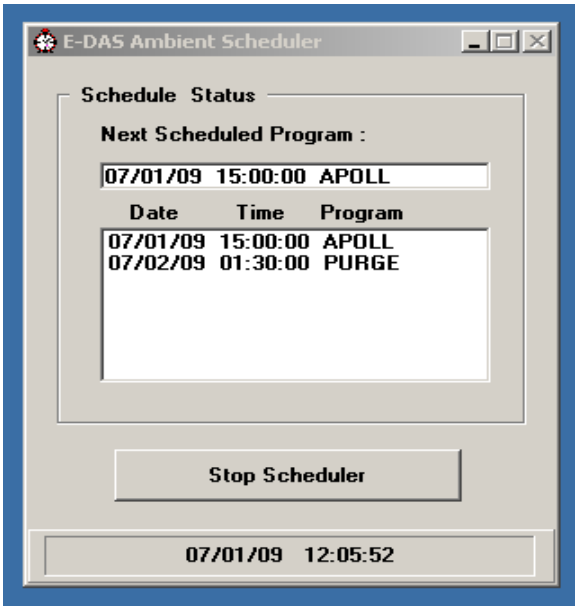
- Verify the analyzer ″**POWER**″ light is lit and there is audible sound from the external pump. Observe the chamber pressure (200 to 450 mm Hg). If the analyzer does not have any power, determine the cause and time of failure. Invalidate data for a 20-minute period after the power comes back. Correct the cause and verify zero and span. Record all events in the electronic logbook and notify Supervisor and the ECB.
- Verify that the NOYT concentration range is set at correct setting i.e. 200 PPB for NOT, NO2T and NOYT by using: **Main Menu**, choose ***Range***
- Verify calibration reactor pressure is between 150 and 300 mmHg. **Main Menu**, choose ***Diagnostics*** **>** ***Pressure***
- NO sample and NOy sample flow readings should be between 0.6 to 0.8 LPM. **Main Menu**, choose ***Diagnostics*** **>** ***Flow***
- The PMT cooler temperature should be between -1º C to -20º C. If not contact ECB. **Main Menu**, choose ***Diagnostics*** **>** ***Temperatures*** **>** ***Cooler***
- The reaction chamber temperature should be between 47º C to 51º C. If not contact ECB. **Main Menu**, choose ***Diagnostics*** **>** ***Temperatures*** **>** ***Chamber***
- If a problem is observed in obtaining substantial NOT, NO2T and NOYT span levels, there may be a problem due to clogged capillaries. There are two capillaries. One for ″SAMPLE″ and the other one for ″OZONE″ and these two must be cleaned / replaced by the Site Operator.

2.38.2.3.2 Inspection and Replacement of Auxiliary Pump Capillaries
(see page 11)

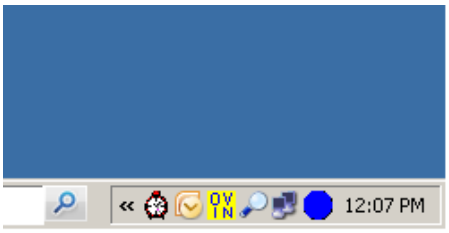
Maintenance and Trouble Shooting Documentation
Document any other site related suspected mechanical problems for preventive and routine maintenance in the logbook and notify ECB.

Stop Scheduler

Stop the poll editor and scheduler by clicking on the radio button that says "**Stop Scheduler**" to keep from losing data that is being collected on the PDL and the BUDL.

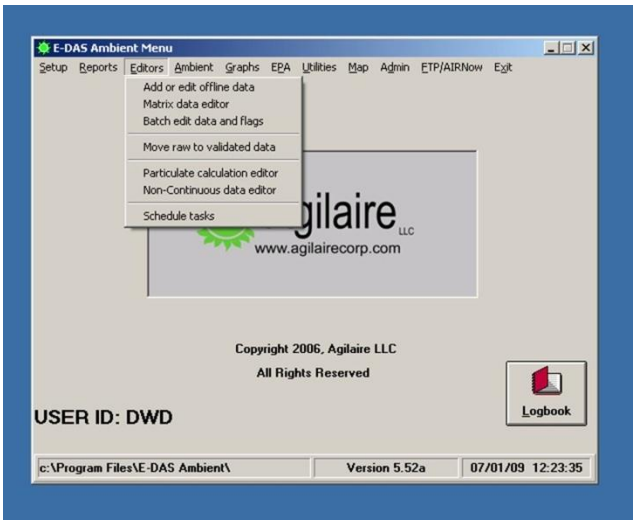


If the scheduler isn't on the screen, there should be a small red alarm clock "**icon**" down in the bottom right hand corner. Any mouse click will bring up the scheduler so that you can stop the scheduler.

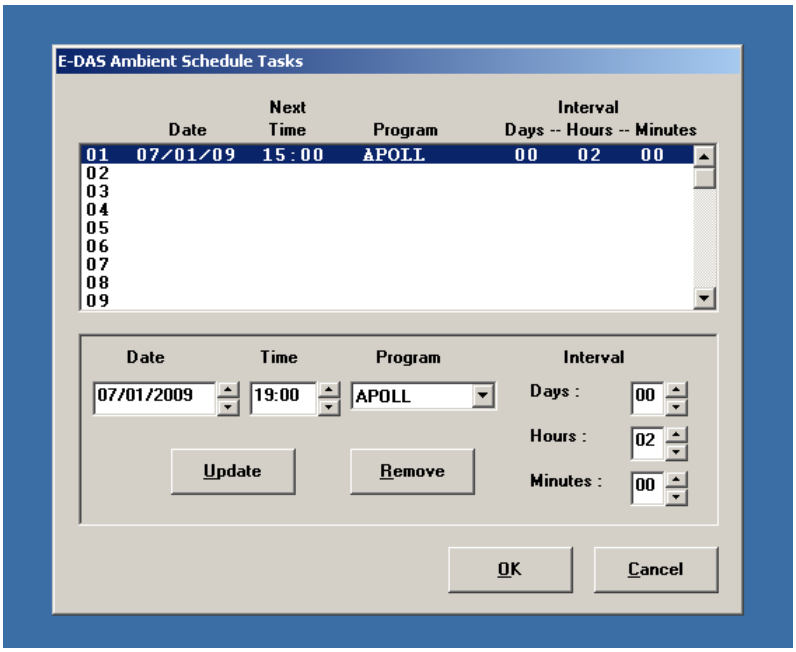


The APOLL task must be set to a later odd hour time after the calibration check will be completed.

Then open the EDAS and under the "**Editors**" pull down menu there is a "**Schedule tasks**" button. Click on it…



That will bring up the E-DAS Schedule Tasks window….Highlight the ″**APOLL**″ line in the top half and set the bottom "**Time**" for the next odd hour or some odd hour beyond that (two or four hours later today). AND HIT ″**UPDATE**″ TO MAKE THE HILIGHTED LINE REFLECT THESE CHANGES.



Setting computer, PDL, and BUDL time/date.
The times for the PDL, BUDL, and computer must be EASTERN STANDARD TIME. The computer, BUDL, and PDL must have the same NIST time ±1 minute.

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

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

PDL & BUDL time and date:

- Double click "**Shortcut to Splitscreen**"
- Open PDL & BUDL

- Highlight PDL and type 2 letter data logger site code and AQM, (e.g.) "**GR** AQM" (located on front of data logger, may have to hit **{ESC}** a couple of times before typing)
- Select: "**L**" Login
- Type password: **XXXXXXXXXX** (not case sensitive), this brings up Home Menu

- Select: "**C**" configuration menu
- Select: "**S**" configure System Parameters
- Highlight "**Logger Time**"
- Type in correct time in the format of: **HH:MM:SS**
- **{ESC}{ESC}{ESC}**
- Highlight BUDL and type the 2 letter data logger site code and AQM (e.g.) "**UG** AQM", (located on front of data logger, may have to hit **{ESC}** a couple of times before typing)
- Select: "**L**" Login
- Type password: **XXXXX** (not case sensitive), this brings up Home Menu
- Select: "**C**" configuration menu
- Select: "**S**" configure System Parameters
- Highlight "**Logger Time**"
- Type in correct time in the format of: **HH:MM:SS**
- **{ESC}{ESC}{ESC}**

2.38.2.3.3 Span Zero Calibration Check

- Highlight PDL from ″Home Menu″
- Select ″**C**″, Configuration Menu
- Select ″**C**″ Configure Calibrations
- Select ″**1**″, start Single Phase Calibration
- Select ″**NOTCAL**″, <ENTER>
- Select ″**SPAN ZERO**″, <ENTER>
- Under phase duration (set to ≥ 1 hour)
- Select ″**Start Single Cal (NOW)**″, <ENTER>
- **{ESC}{ESC}** to ″Home Menu″

Monitor Actual Values

- 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
- Type in parameters: ″**NOT**, **NO2T**, **NOYT**″
- Change # of flags to report from 02 to 03. Use Decimal Positioner.
- Start continuous report: this will show minute averages as they are calculated and keeps all values on screen

The BUDL mirrors the activity of the PDL. The calibration check control is via the PDL. The BUDL screen is used to view the real time data either as last base average or through the continuous report. Record five consistent consecutive 1-minute averages in the electronic logbook.

- Highlight PDL
- {ESC}{ESC} back to ″Home Menu″
- Select ″**C**″, Configuration Menu
- Select ″**C**″, Configure Calibrations
- Select ″**W**″, ″NOTCAL″
- Purge the instrument with span gas for about 5 minutes

2.38.2.3.4 Span Calibration Check

- Highlight PDL from ″Home Menu″ and select ″**C**″, Configuration Menu
- Select ″**C**″, Configure Calibrations
- Select ″**1**″, start Single Phase Calibration
- Select ″**NOTCAL**″, <ENTER>
- Select ″**SPAN 1**, (SPAN 2, SPAN 3) ″. Make phase duration for four (4) hours. 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)
- Press ▸ when ″Span 1″ is complete
- Calibrate NOT, NOYT. To calibrate ″SPAN 1″- press ″CAL″, select ″CALNO″ coefficient and edit ″SPAN CONC″, if necessary, press ↵. Press ″CAL″, select ″CALNO″ coefficient then edit ″SPANCONC″, if necessary for any cylinder impurity.

Monitor Actual values

- From ″Home Menu″
- Select ″**D**″, Real-Time Display Menu
- 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
- Type parameters ″**NOT**, **NO2T**, **NOYT**″
- Change # of flags from 02 to 03, <ENTER>
- Start continuous report: This will show the minute averages as they are calculated and keeps all values on screen
- Record five (5) 1 minute averages in the electronic logbook

Calculate actual NOT/NOYT concentrations of approximately 90% of full-scale range (180 PPB) using the equation below. Record the ″**NOT**″ and ″**NOYT**″ spans in the electronic logbook.

Obtain $F_{NO} + F_{zero}$ from 146C display by pushing ″**Run**″ button

$[NO]_{ca} = [F_{NO} / (F_{NO} + F_{zero})] \times [NO_{std}]$

$[NOy]_{ca} = [F_{NO} / (F_{NO} + F_{zero})] \times [NO_{std}] + [NO2_{imp}]$

Where: $F_{NO} + F_{zero}$ = Calibrated flows in sccm

$[NO2_{imp}]$ = NO2 impurity in cylinder (see certification sheet)
$[NO_{std}]$ = Certified NO gas concentration

Note: Multiply litres by 1000 to convert to sccm; multiply PPM by 1000 to convert to PPB

i.e. if $[NO_{std}]$ = 5.44 PPM, F_{NO} = 79.99 sccm and F_{zero} = 9797 sccm (9.797 lpm)
then [NO] = 0.04405 PPM (44.05 PPB)

2.38.2.3.5 Titration

Use the following procedure to check the converter efficiency:

While the Span 1 event is running and stabilized:

- On 146C press ″**Menu**″ button, press <ENTER> until 146C is in ″Local″ mode
- On 146C press ″**Run**″ button to bring up ″**Run 1**″ screen
- Use ↓↑ arrows to select GAS option, select ″**GAS A**″
- 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″, <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 that you recorded as noted above, if not phone ECB for guidance.

Allow 42*i*-Y monitor to stabilize (about 1 hour) and record NO and NOY responses as NOT, NOYT original. Once the GPT original phase is completed use the ↓↑ arrows to adjust the O_3 ″Level″ (percent ozonation) to 30%, allow reading to stabilize.

146C Main Menu press ↓ 4 times to ″Ozonator″, press <ENTER>, press ↓ to ″Manual Adjustment %″, and then ″Ozonator Manual Level″ <ENTER>. Starting from 30% 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. Once set, the O_3 level will work with future calibrations unless something changes such as a gas cylinder, 146C calibrator or an ozonator lamp.

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 the example below, 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. Wait until the actual concentration is stable on the data logger. If the concentrations measured on the data logger are within ± 5% of the actual concentration, enter 5 minutes averaged NO2T data logger and backup data logger data into the calibration section of the electronic logbook.

$$[NO2]_{Ca} = [NO]_{orig} - [NO]_{rem} + [F_{NO} / (F_{NO} + F_{zero})] \times [NO2_{imp}]$$

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

Where: $[NO2]_{Ca}$ = NO2 concentration at the output manifold, 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 certification sheets (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.

Note: To convert liters to sccm, multiply liters by 1000. To convert PPM to PPB multiply by 1000.

Enter 5 minutes averaged NOT, NO2T, and NOYT data logger readings into the calibration check electronic logbook.

When the titration finishes, do the following:

- Place 146C back into ″Remote″
- Abort ″**NOT SPAN 1**″, C, C, W

- Once completed and stabilized, document 5 minutes of consistent readings in the electronic logbook
- The converter efficiency should be between 96-104%.

2.38.2.3.6 Check SPAN 2/ SPAN 3

- Make no adjustments to SPAN 2 or SPAN 3
- Highlight PDL from ″Home Menu″ and select ″**C**″, Configuration Menu
- Select ″**C**″, Configure Calibrations
- Select ″**1**″, start Single Phase Calibration
- Select ″**NOTCAL**″, <ENTER>
- Select SPAN 2. Make phase duration for > one (1) hour.
  Start continuous report: This will show minute averages as they are calculated and keeps all values on the screen.
- Start SPAN 2 and let it stabilize (30 to 35 minutes)
- Record 5 consecutive one-minute averages
- Abort SPAN 2 using ″W″ command
- Repeat all above steps for SPAN 3

2.38.2.3.6 Filter Conditioning

Replace and condition the Teflon particulate matter filter after performing a calibration check. To replace the filter, unscrew the filter holder and replace the old filter with a new one. While changing the filters, touch only its outer edges. To condition a filter:

1. Click on PDL Display Screen
2. Press the **{ESC}** key; Press the **{ESC}** key again.
3. Select ″**C**″, Configure Menu
4. Select ″**C**″, Configure Calibration Menu
5. Select ″**1**″, start Single Phase Calibration
6. Select ″**Level 1**″, press <ENTER>
7. Scroll Down and Highlight ″**Duration**″
8. Enter ″**20 Minutes**″
9. Scroll Down to ″**Start Single Cal (NOW**)″, press <ENTER>

Run span 1 and if it passes, then this is considered a leak check. Record results in the electronic logbook.

Review Calibration Check and End

Percent Tolerance Across <u>all</u> Full Scale (FS) Ranges (50, 100, 200 PPB)

Point*	**Calibration Check Tolerance**	**Converter Efficiency**
Span (90%)	±6%	96 - 104%
Mid (50%)	±8%	
Precision (18%)	±15%	
Zero (O)	±2 PPB	
NO2T Span	±5%	

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*Nominal or designated value of each point

If any of the points are greater than the calibration tolerance for the full-scale range, the calibration is unacceptable. If the calibration is unacceptable after two (2) tries, contact ECB. All points on the calibration must meet their respective calibration tolerance. **Adjustments to the 42*i*-Y should be based on the 42*i*-Y NOT meeting the tolerance criteria.**

If the calibration is acceptable, proceed to document the operational checks and then ″logout″.

Enable Channels on PDL and BUDL

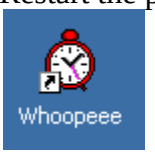
- Highlight PDL and select ″**C**″, Configuration Menu
- Select ″**D**″, Configure Data Channels
- Select ″**E**″ Enable/Mark Channel Online
- Select ″**NOT**, **NO2T**, **NOYT**″ and press <ENTER>
- Highlight BUDL and follow the above instructions for enabling the 3 channels

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

- {ESC}{ESC} to ″Home Menu″ on both PDL and BUDL
- Use arrow key to select "**O**" or hit "**O**" key to logout
- Repeat for BUDL

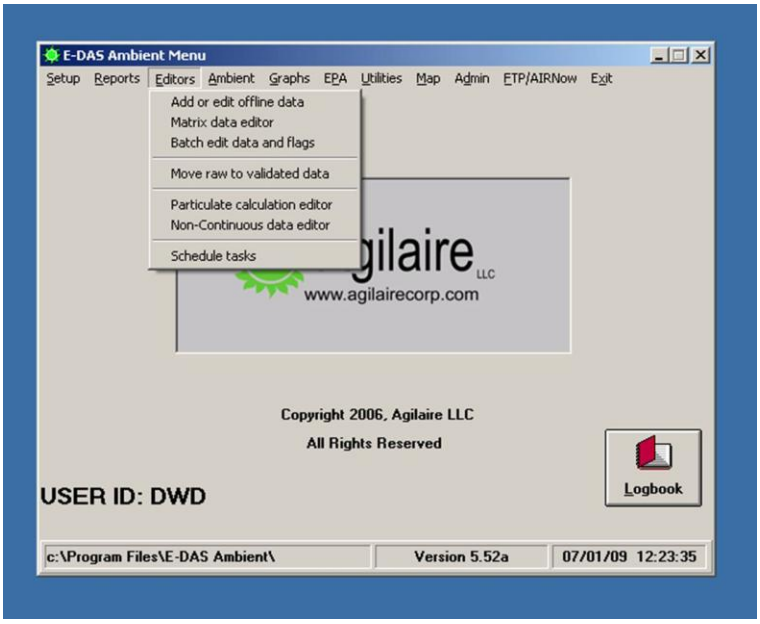
The Scheduler must be restarted

Restart the poll editor and scheduler by clicking on the ″**Scheduler Icon**″.

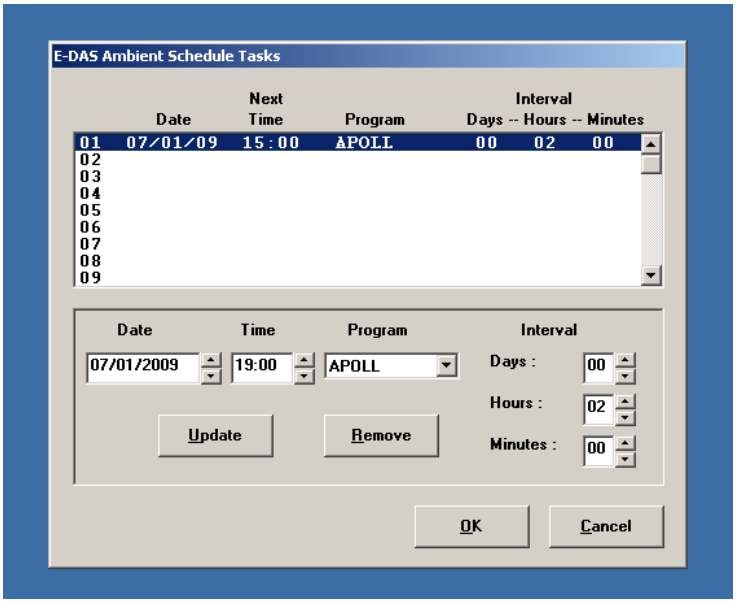


You can bring the scheduler back up and see that it’s going to run 4 hours down the road.

The APOLL task must be set to a later odd hour time after the calibration check will be completed. To do this, we open the EDAS menu and under the ″**Editors**″ pull down menu there is a ″**Schedule tasks**″ button. Click on it…



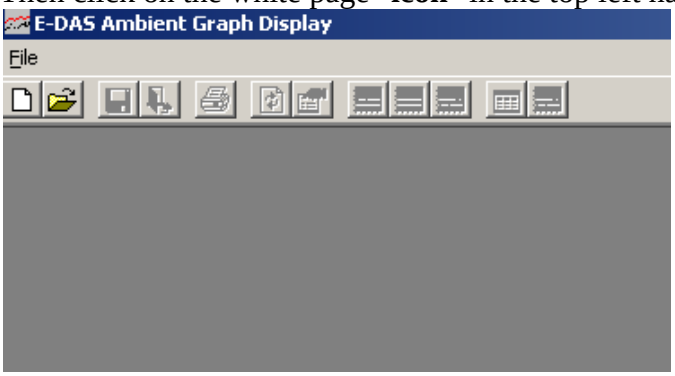
That will bring up the E-DAS Schedule Tasks window….Highlight the ″**APOLL**″ line in the top half and set the bottom "**Time**" for the next odd hour or some odd hour beyond that (two or four hours later today). AND HIT ″**UPDATE**″ TO MAKE THE HILIGHTED LINE REFLECT THESE CHANGES.



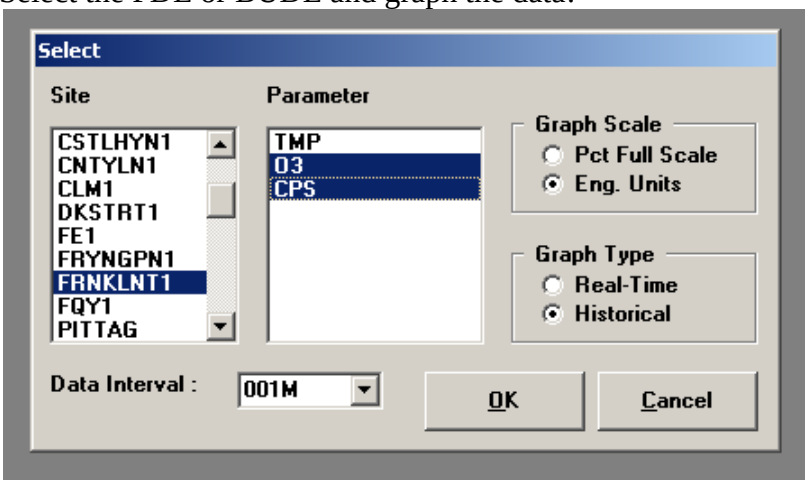
Check to ensure that the data logger is storing minute data on the computer.

Check to make sure that we can collect the data from the data logger and store it on the computer. Check to see IF it has actually happened. Minute data only resides in the data logger for about 3 days, beyond that the minute data is overwritten and is lost FOREVER. It's real easy to see this data, just open up the graph "**icon**".

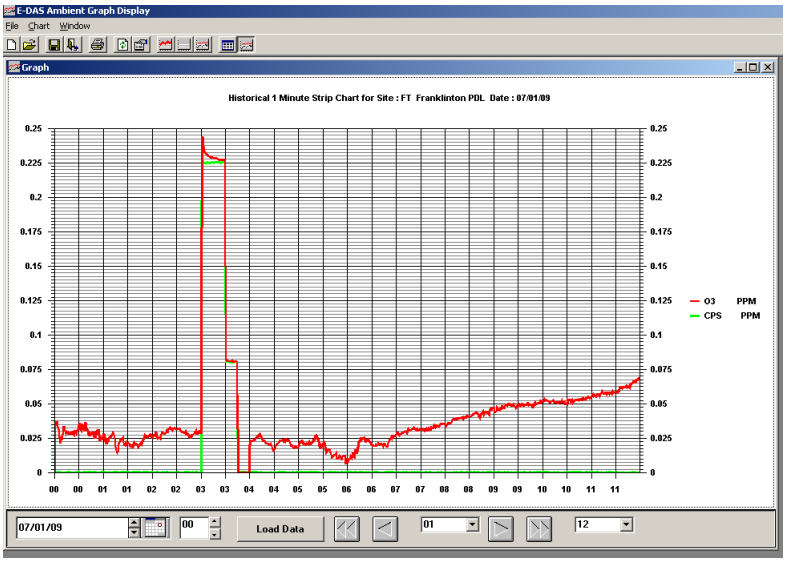
Then click on the white page "**icon**" in the top left hand corner to open the data file area.



Select the PDL or BUDL and graph the data!



If you can see the data, then it is being collected by the computer.



If you can't see the data after hitting load data….there is a problem. Call the ECB for instructions.

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

2.38.2.4 Site Calls

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

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

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

Review the Reports For Flagged Data.

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

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

2.38.2.5 Data Reporting and Validation for Regional Offices

(See **Section IV: Continuous Monitor QA Plan Section, Headquarters Responsibilities.**)

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

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

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

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

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

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

2.38.2.6 Quality Assurance Procedures

The Quality Assurance Program requires strict adherence to approved procedures including the performance of specific tasks and activities. The determination of adherence to the approved procedures and the quality of ambient air data collected at each site includes the biweekly precision point analysis performed by the site operators, the monitor accuracy audits performed independently by the ECB, and a complete systems audit performed by the staff of the Ambient Monitoring Section of the Division of Air Quality of each monitoring site and the ECB. This approach provides the essential ongoing and independent evaluation of data quality and reliability for the entire ambient air quality data set collected at each site and statewide. **Strict adherence to the established approved procedures is required to enable the Division of Air Quality to certify that the data collected is true and representative of the ambient levels of reactive oxides of nitrogen in the State of North Carolina.** Certain information must be available to the auditor. Even though this information can be provided through access to the instrument logbook, use a Continuous Monitor Quality Assurance Report form (AQ121 / CMQAR) to give a better overview of each audit. (See Appendix B for the CMQAR example.)

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

Precision Point Analysis Every two weeks **(EVERY 14 DAYS OR LESS)**, the precision point analysis must be performed on each TL-NOy analyzer as part of the Calibration Check procedures. The results of this precision point analysis are required to be reported to the DMSSB at the end of each quarter. Data validation must be conducted by the operator on a routine basis according to **Section IV** of this QA plan.

The Regional Ambient Monitoring Coordinator (RAMC) should verify that all site visits and precision analysis are conducted as required.

Accuracy Audits
The ECB performs all TLNOy monitoring sites accuracy audits. The operator shall assist if requested by ECB auditor in conducting accuracy audits.

Interagency Auditing
Interagency audits may take place between the DAQ and Local Programs. Also, U.S.E.P.A. Region IV may schedule audits for various parameters, including TLNOy, throughout the year.

Audit Evaluation and Corrective Action
For the precision audit and the accuracy audit, corrective action should be initiated by the Project and Procedures Branch supervisor, and documented at the bottom of the AQ121 Audit Form. An investigation must be undertaken to determine the cause of unusually poor audit results when any result exceeds a ± 10% difference. Documentation of the correction will be provided to the Section Chief, with the QA report.

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

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

2.38.2.7 Monitor Shutdown Procedure

1. Down the associated parameter.
2. Disable the associated calibrations on the PDL by selecting "**Configure Calibrations, Change Old Cal Program**". From the list choose "**NOTCAL**" for TLNOy. Change the dates of the next auto cal on the Starting Time to a future date.
3. Turn the TLNOy monitor power off. Pull the power plugs out for protection from lightning.
4. Shut off the cylinder valve and the outlet valve on the regulator.
5. Contact ECB, PPB and DMSSB Supervisor to acknowledge site shutdown.

Sign-Off Sheet

I certify that I have read, understand and agree to follow the contents of Revision 5.4 of the "MODEL 42*i* TRACE LEVEL REACTIVE OXIDES OF NITROGEN (TL-NOy) MONITORING SYSTEM, Section II, OPERATOR RESPONSIBILITIES" QAP/SOP with an effective date of November 10, 2011. **Sign, date and return to the Ambient Monitoring Section Chief.**

Debbie Manning, Regional Ambient Monitoring Coordinator: _____

Eddie Todd, Regional Ambient Monitoring Coordinator: Eddie Todd 11/21/2011

Site Operator: _____ 12-6-2011

Site Operator: _____ 11-15-2011

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