NOx BOX INSTRUCTIONS and TROUBLESHOOTING TIPS
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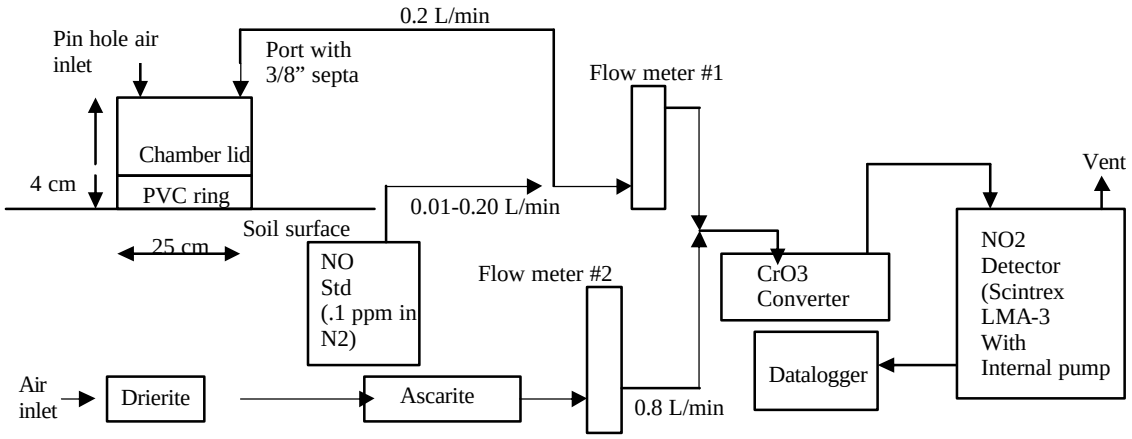
I. Measurement of NO and NO_2 (Nox) using an LMA-3 chemoluminescence detector and converter box (NO to NO2).

The LMA-3 Luminox in Air Monitor uses a chemoluminescence detector to measure NO_2. Air is pumped through a reaction vessel containing a fabric wick that is saturated with luminol II solution (A luminol solution containing additives to enhance reaction and reduce interference from other gases including ozone). For information of the safe handling of Luminol I see the safety section below) When the NO_2 is brought into contact with luminol, the luminol oxidizes and produces chemoluminescence around 425nm. A peristaltic pump is used to keep fresh luminol flowing through the reaction vessel. The photomultiplier tube (PMT) samples the central part of the wick and generates a signal that is directly proportional to the mixing ratio of the NO_2 in the sample air. NO_2 is measured directly (conversion of NO_2 to NO is not necessary). The chemical reaction of luminol and NO_2 is temperature sensitive. To correct for this the LMA3 is equipped with temperature compensation circuitry uniquely designed for the detection of NO2 in the range of 5 C to 40 C; it makes a correction approx. 3%/degree over the 5 C to 40 C range. The correction scheme is actually setThe PMT also compensates for temperatures in the range of 5 C to 40 C producing a changing background current. The LMA-3 is equipped with a drift correction circuit that stablizes the zero to less than 40 ppt V (parts per trillion by volume. (John Drummond faxed that the correction is so small that it may be unreliable and it may be best to turn it off _ need to investigate this further. We've always used it.) Variations in ambient operating pressure are not a problem for normal ground use of the instrument, but adjustments must be made for airborne applications. (The above paragraph was modified from information provided in the Scintrex LMA-3 Operations Manual).

NOx Box Diagram



Path on Tina's computer:
Research\Data,stats,pubs/Docs/chemmethods/NOx

II. Equipment and supplies
A. Equipment
1. NOx box, including tight peristaltic pump tubing, luminol waste and luminol feed bottles.
2. Converter box
3. Battery (Powersonics PS1270, 12V, 7.0AH)
4. Battery to NOx box cable
5. Ascarite in hydropurge, tube 1/4" fitting (Ascarite II, Fisher A183-500; tube Alltech 14625)
6. Drierite in hydropurge tube (Drierite, Fisher ???)
7. Flow meter #1 (0-280 ml/min) (Shielded w/valve No. 11, Port NPT(M) 1/8" Cole-Parmer G-03234-52
8. Flow meter #2 (020-2100 ml/min) (Shielded w/ valve No. 12, Port NPT (M) 1/8", Cole-Parmer G-03234-53
9. NOx backpack, including fitted tarp for bottom
10. NOx backpack flow meter holder
11.Aluminum cage
12.Clear tarp
13. Chamber top, teflon-lined (with inner ridge lightly greased with apiezon) and 25' of teflon tubing
14.Rings,
15. pounder

16. mallet
17. First Aid kit
18. NOx standard tank, (.1ppm Nitric oxide in nitrogen)
19. Regulator, 2 stage, SS (Scott-Marrin NO. 2SS75-660)

B. Supplies

1. **Tubing, including**
2. **Tubing for the following connections (Teflon PTFE 1/4" OD, Cole-Parmer G-06407-44):**

: Drierite to Ascarite
Ascarite to Flow meter #2
Flow meter #2/Flow meter#1 junction to Converter IN
Converter OUT to NOx Box IN
Flow meter#1 to NOx top

3. **Supply kit (extra Drierite, screwdriver, forceps, extra air pump, soil thermometer, ruler, duct tape, tubing fittings, 22g needles, chamber septa (3/8" for chamber port), extra back ferrules for chamber port**
4. **Rite-in-the-Rain data notebook and pencil**
5. **Personal supplies such as sunscreen, water, and hat**
6. **Portable chair (optional)**

III. Setup and Chamber Measurements

A. Parts and definitions

1. **Fittings:** The NOx box uses two types of fittings: Swagelock metal to metal, and teflon to teflon. Diagrams of proper fitting set up is below
2. **Peristaltic pump and tubing: The peristaltic pump (Scintrex 350332) draws liquid into the reaction chamber using a roller assembly that operates at approx. 2.4 rpm.** Inside the NOx box are two types of peristaltic tubing. The light colored, narrower one feeds luminol from the feed bottle through one side of the pump to the top fitting on the wick plate Tubing, C-Flex, ColeParmer, H-06424-13, Scintrex 856205) Feed tubing should be cut to 3.5 inches. The clear, wider tubing (Masterflex L/S thinwalled, Cole Palmer 96400-16, 25'/roll or Scintrex 856019 - pre-cut) moves luminol from the fitting at the bottom of the wick plate to the other side of the pump and then to the waste bottle. New waste tubing should be cut to 3.75 inches (Scintrex documentation).
3. **Luminol II:** Luminol should always be kept refrigerated! Make sure any luminol carried to the field is insulated in a small cooler with blue ice. The only time this solution is not keep refrigerated is when it is in use in the LMA-3.
4. **Drierite:** Drierite is a dessicant and removes moisture from the air entering the NOx box because water interferes with the chemoluminescent reaction. Use a combination of blue ("indicating" drierite, turns from blue to light purple, more expensive) and white ("non-indicating", cheaper) drierite in the tube. Pack the

drierite tightly within the tube. Gently tap the full tube on a hard surface to settle the contents and make space to add more. The drierite should be packed firmly, but should not be forced. Leave room to pack both ends of the tube with glass wool. Always use gloves when handling glass wool! Hand screw on the ends until they are tight. Old drierite can be regenerate once or twice by drying in a 428?F oven for 1 hr (check temp and duration in fisher catalog).

5. **Ascarite:** Ascarite (sodium hydroxide coated silica) is used to scrub the incoming bulk air of NO and NO_2 (also removes CO2, but doesn't matter). Ascarite is "indicating", turning from light brown to white when it is no longer functional, and should be replaced when it becomes moist and brown. Retarded flow rates are an indication that ascarite should be replaced, however, a visual check should always be done prior to sampling. Also check the date of the last ascarite change. When in doubt, change the ascarite. To replace ascarite, open tube using two crescent wrenches and remove the wet plug of ascarite, or if necessary, replace the entire contents of the tube. Always use gloves! Pour out the used ascarite into a plastic bag for proper disposal (not in the trash!). Pour in new ascarite, pack like drierite, and put glass wool in the ends of the tube. Record date of ascarite change on tape and attach tape to ascarite tube.

6. **Converter Box:** This silver box contains two filters: the scrubber (lead sulfite) converts NO to NO_2, and the chromium trioxide (CrO_3) scrubs all NO and NO_2 out of the air. Each filter has a handle on the outside of the converter box that controls whether air passes through the filters or not. Normal operating procedure assumes filters ON (all NO to NO_2) and CrO_3 ON.

7. **Air Pump and Tubing**: Air is draw into the LMA-3 using an air pump assembly (scintrex 856044) in PFA **Teflon (Need more info. on tubing sections including ORDER INFo)** air tubing with a Teflon compression fitting. Two traps are present in the air line to prevent liquid from the reaction assembly and particulates from the sample air from reaching the air pump. The liquid trap is a fragile round glass chamber. The particle filter/trap is a disposable air filter located beneath the liquid trap. This trap should be changes every 3 weeks at tropical sites to avoid mold growth.

B. Connections and startup

1. Metal to metal fittings (ascarite to drierite tubing, one end of ascarite to flowmeter #2 tubing) must be tightened with two crescent wrenches. Carefully use one crescent wrench to tighten the fitting, and the second to steady the attached nut (i.e. you don't want to inadvertently unscrew another fitting while tightening your fitting). Teflon to teflon fittings should be hand tightened. Make sure tubing is cut flat and pushed flush with the opening before tightening fittings!
2. Place the loose tubing across the peristaltic pump when ready to operate. Make sure tubing is tight and will not slip.
3. Fill feed bottle 0.25 inch full with luminol. Place feed and waste bottles in proper holes in NOx box. Connect tubing. Important: tubing must be in the correct configuration to move the luminol through the Nox box in the waste bottle.

4. Connect the battery cord from the battery to the NOx box EXTERNAL BATTERY port. Battery should already be charged. For battery clips, red on red, Black (or blue, in our case!) on black. Connecting the cables in reverse (+ to - and - to +) will damage charging circuit (even if the power is not on). Without the charging circuit the internal battery can not be recharged, but the external battery can be used. Cover the battery connections with duct tape to keep them dry. Make sure the battery connection to the back of NOx box is secure. In the past, this connection has been loose. If it is loose, carefully widen the pin in the female end of the connection with a screwdriver. Be careful not to break the pin!
5. When all tubing and cables (exterior and interior) are properly connected and tightened, turn on the POWER switch. The NOx box should make a quiet humming sound and the peristaltic pump should turn. NOx Box #1 (S/N 8904237) has a BACKFLUSH button next to the Air Pump switch. This BACKFLUSH button is actually a FORWARD FLUSH; i.e., when pressed, the peristaltic pump increases in speed and pushes luminol at a rapid rate through the box. Use this button once or twice to speed the luminol through the tubes and into the NOx box. Let the luminol cycle for at least 15 minutes. Once the luminol has pumping for an adequate amount of time and is flowing into the waste bottle, take the NOx box OUTSIDE (out of a closed room) for warm up.
Nox Bow #2 (??????) does or does not have a functioning backflush? Contact folks in mex.
6. Check that flow meter #2 is all the way OPEN. Flow meter #1 should open to about 1.5 ticks. Make sure the ratio of dry air to chamber air is 6:1. Check that there are no kinks in any of the lines. On the silver box, check that filters are ON and handle is pointed to CrO_3 (chromium trioxide). Check that hole in end of drierite tube is clear.
7. Turn the air pump ON. The NOx box will make a louder humming sound, but pump should not sound strained. As of 5/96, flows have been running at around 250/1650. If flow meter #2 is significantly lower than this, find out why and where airflow is restricted. Check for constrictions in tubing, and blockages in drierite and ascarite tubes.
8. Let NOx box warm up >1hour, if possible., Scintrex recommends 2 hours (leave running overnight if the detection limit is being pushed to <100ppt V.). Baseline should rise to about 20 to 30 points on the NOx box readout.

C. STANDARD CURVE
The standard routinely used for standard curves is a NIST certified .1ppm (concentration v/v) Nitric Oxide (NO) in oxygen-free nitrogen in a Size 30 cylinder made by Scott-Marrin, Riverside CA. (See Order Info. section for details). IMPORTANT NOTE: IT ROUTINELY TAKES 12 WEEKS TO MAKE, SO PLAN AHEAD! Running several curves one after the other can saturate the converter reducing sensitivity. A solution to remedy severe loss of sensitivity in the converter is to run air through it for about 12 hours, since the converter also can be regenerated by running ozone through it and the ozone concentration in a

rural area can be high enough to regenerate the converter. A good general practice, given the high concentration of our standard, is to do the curve as far in advance of the sample as is reasonable (45 min or so) and run air until samples are taken.

1. Once the NOx box has warmed up and has been safely transported to the field site, run a standard curve. Begin by checking that the NOx box reads 0.00 mV when the NO/NO_2 scrubber is on . (Scrubber removes NO and NO2 from air.). The scrubber is turned on (in-line) when the converter (silver box) handle is turned to "zero". Wait several minutes until the read out settles.

2. If the read out is not zero, unlock "zero" knob on the front of the NOx box and adjust to bring the readout to 0.00 mV. Once the box is zeroed, re-lock the knob and turn the handle back to the left to CrO_3 (chromium trioxide, converts NO to NO_2).

3. Make sure flow meter #1 is open to about 1, and flow meter #2 is all the way open.

4. STANDARD TANK OPERATION:

You never want ambient air to enter the NOx tank. You can avoid this by always making sure pure NOx is flowing through from the tank to the second stage.

<u>If there is already pressure in the second stage:</u> 1) turn on main valve all the way plus one half turn back. The pressure reading on the main gauge should be 100 kPa, should be marked on the regulator dial. You are now ready to attach the tubing.

<u>If there is no pressure in the second stage:</u> 1) open the main valve, slightly, until you hear a hiss. Then, IMMEDIATELY close off the second stage. Pressure should build up in the valve. Open the main valve all the way, then turn one half turn back. You are now ready to attach the tubing.

5. Hand-screw the tubing fitting on to the NOx tank regulator fitting. Make sure that the teflon tube and cone fitting inside are flush with the NOx tank opening when you are screwing the fitting on. Once the fitting is hand tightened, use two crescent wrenches to further tighten the fitting (see above instructions on using 2 crescent wrenches). Attach the other end of the teflon tubing to flowmeter #1 (for chamber air).

6. Turn flow meter #1 down to about 1. This is to prevent too much NOx from entering the NOx box and maxing it out! CAREFULLY, and SLOWLY, open the second stage of the NOx regulator so that only about 5 psi is flowing from the standard tank. If the NOx box starts to strain, turn flow meter #1 down further!

7. Turn flow meter #1 valve so that the ball is floating at 290 ml/min. Flow meter #2 should be about 1600. Because the air pump is is operating at a constant rate, when we open meter #1 all the way, #2 flow should go down. The reverse is also true: when we close #1 down, #2 flow should go up.

8. NOx box read out should be at about 90 to 120.00 when flow meter #1 is at 290. Wait until the read out is somewhat stable. Record meter #1 (ml/min), meter #2 (ml/min), and then take the NOx box reading.

9. Turn meter #1 down to about 250. Meter #2 should go up slightly. Wait a few seconds before you take the NOx reading. Before you record anything, check the flows again to see if they have slipped. If they have, this is okay! Record whatever the flows are on #1 and #2, then take the NOx reading.

10. Continue to turn down flow meter #1 until you have about 10 to 12 points along meter #1. Try to take readings at a regular interval (to standardize time of it takes to record a reading as the ball slips down!)

11. When you are at the last point (0 on meter #1), you can close the NOx tank valve. Turn off the second stage first, then turn off the main regulator valve. This will allow pressure to build up in the second stage.

12. Take your readings with flow meter #1 all the way closed (at 0). You might have to wait a few seconds for the NOx box reading to settle.

13. Your standard curve should look something like this:

#1	#2	NOx
290	1600	118.62
250	1600	109.08
200	1650	89.11
155	1685	73.45
100	1720	52.75
70	1775	40.80
35	1800	26.60
15	1800	20.45
2	1810	16.54
0	1825	15.70

14. Remove the pump tubing from the NOx tank with 2 crescent wrenches. Always make sure that you replace the NOx tank cap!

15. Open #1 all the way! This is to let any NOx gas escape the chamber line. When you are opening meter #1, make sure you don't inadvertently unscrew the

entire valve from the flow meter! When the read out has settled down to a stable baseline, turn meter one to about 250 (or the 6:1 ratio).

16. Attach the chamber tubing to the chamber port by hand tightening.

17. To obtain a baseline reading, hold the chamber top up over your head and wave it around so that your baseline isn't affected by soil NOx emissions!

18. If the baseline is stable, you are ready to take your first reading.

D. CHAMBER MEASUREMENTS

1. Place the NOx box flat on the ground. If terrain is uneven, manipulate the backpack around so that the box is level.

2. Hold chamber in the air for a few minutes until baseline is stable.

3. Write down baseline reading and time of reading. You are ready to put the chamber top on the ring.

4. Place the chamber top on the ring gently, making sure not to push down too hard. Make sure there is a secure seal all around the chamber by Gently pressing in on the ring with your fingers while cinching the chamber top down with your thumbs. This is a delicate procedure! If too much force is use gas can be forced out of the soil causing an irregular spike in the Nox reading. If this happens, continue with readings until a gradual increase occurs or the reading settle down indicating little or not flux.

E. Daily Shutdown Procedure for the Nox Box

1. Open the top of the Nox box, remove the luminol feed bottle, and pour remaining luminol into a waste bottle. Rinse feed bottle with deionized water a couple of times and fill 1/2 way with deionized water.
2. Re-cap feed bottle and press the back flush button. Remember that the backflush on the Nox box in Hawaii is incorrectly labelled. (The backflush on the Nox box in Mexico may function properly, i.e. cause reverse flow, but confirm before using). It actually speeds up the flow through the Nox box. This allows the deionized water to flush more quickly in the evening, and, if desired, to get the luminol flowing more quickly in the morning.

IV. Using a Datalogger with the NOx box

A. **Datalogger (Rustrak Ranger II) Protocol**

This datalogger is much more reliable (knock on wood!) than the old ECD dataloggers, which gave a paper print out (which was vulnerable to changing weather conditions) at the same time as they stored data in their memory

cache. The Rustrak Ranger II was purchased from Cole Palmer (Modular Datalogger w/ 256K memory, H-23150-10 with recharger, H-23150-90). It requires an Isolated single input module, (Cole-parmer H-23150-40) and a Serial Interface module (Cole-parmer, H-23150-82). This datalogger stores data points in its 256k memory cache, and displays of the time, date, current data reading, and battery voltage. Pronto software is used to download data to the computer. Current version is 3.51 and needs to be upgraded.

Before going out into the field, make sure that datalogger battery is fully charged (voltage will be displayed when you turn on the datalogger, and should read about 3.9 V). Once the voltage drops to around 3.7 V, the battery must be recharged because at this level it will no long save data.

The leads from the datalogger are color coded, and should be connected to the same colored terminals on the NOx Box (note: there are two datalogger output ports on the NOx box; use the one on the back of the machine, as the one on the front, where the display is, is broken). Make sure the leads are securely tightened into the terminals, as loose leads will give faulty readings.

To turn on the datalogger, press both control buttons on its front panel simultaneously. You will get an opening display of vital statistics about the datalogger, and then you will get the beginning of a dialog, which reads:

Log for 8hrs
Next Start

You can scroll through the dialog, getting 5 more screens in succession, before returning to the opening screen:

Playback
Next Start

Display
Next Start

Set Up
Next Start

Review
Next Start

Power
Next Start

The datalogger is currently set up to read data points (in mV) at 10 second intervals, and continue the reading session for 8hrs, or until you tell it to stop by pressing both control buttons at once. If this setup is OK with you, press the button below <Start>, and you're off and running. To overwrite/erase the previous data session, press "No" (left button) at "start" prompt, and then press "yes" (right button) at the "overwrite/erase" prompt and session will begin. If the setup is not OK, you can change the recording parameters by working your way through the dialog (see Quick Reference guide below). The one drawback of this system, which doesn't have any auditory cues (like a moving print head) as to when it is reading the data point, is that you must keep track of the start and end times of the chamber reading with a wristwatch. So, at the beginning of a session, make sure to synchronize your watch with the datalogger. If, at any time during a run, you do not see a display, do not panic. It turns off after 30 minutes of no control button activity, and can be accessed by pressing either one (but not both) of the control buttons. While you are recording data from the NOx box, the datalogger displays the mV reading from the NOx box. You can call up the datalogger's clock by pressing the left control button to scroll through the display screens until you get to the one that shows time. Once you have finished your recording session, press one of the control keys to get the display (if it is not already up), and then press both of them simultaneously to end the session. Once the session is ended, you will see the prompt:

Playback
Next Start

If your notebook computer is at hand, you can dump data right now (see Quick Reference guide below for using the PRONTO (v. 3.51) software (NEED TO UPGRADE SOFTWARE). If you just want to shut the datalogger off, and dump the data later, scroll through the dialog by repeatedly pressing <Next> until you see a screen that reads:

Power
Next Off

Select <Off> , and you're done. It's a good idea to dump data once a day, inspite of fact that the datalogger has a pretty large memory buffer. At different sampling rates, the datalogger can run for varying lengths of time before it starts overwriting data points in the memory cache (it will let you know before it starts doing this). At a 30 second sampling interval, with one channel operating, the Rustrak Ranger can run for 10 days continuously, whereas at a 10 second sampling interval, it can run for 3 days continuously before overwriting. Table 1-1 on page 1-6 of the datalogger manual gives complete information about maximum recording times at different sampling rates.

If you want to start another recording session, but have not dumped data yet, the datalogger will automatically begin a new session and retain the old one in its memory buffer. It is important to keep track of which session number refers

to which data set, so that you can retrieve the proper data when you are in the Pronto program.

Note: It was noticed that the datalogger was giving measurements that were a factor of ten larger than those given by the NOx box, so it was programmed so that Channel 9 be the output of Channel 1 multiplied by 0.1. Only this corrected information is going into the memory cache at the present time. If you want to read directly from Channel 1, or get rid of channel 9 altogether, see the Quick Reference section below for How to Set Up Channels.

Survey sessions: To survey the sessions recorded scroll through the menu by pressing "next" (left button). At "review", press "yes" (right button). Press left button. At "measurements" prompt, press "yes" (right button) and screen with list sessions. Use the left button to scroll through sessions.

Return to the main menu: To return to the main menu, press both buttons together until you see "review".

Power: To turn off power scroll through main menu (using left button) until you reach "Power" and press "off" (right button).

B. Rustrak Ranger II Quick Reference:

- To **turn datalogger on**, press both control buttons at once.

- To **scroll through opening menu**, press control button directly below <Next>.

- To **turn datalogger off**, scroll through opening menu until you get to the Power menu, and select <Off>.

- To **change sampling intervals**, scroll through opening menu to:

Set Up
Next Yes

Select <Yes>, and you will get a *Set Clock* screen. Scroll past *Set Clock*, *Set Storage Mode*, *Set Record Time*, to *Set Sample Rate*. Press <Yes>, and you will see: Interval 10 secs
Select Accept

To change the sampling interval, press <Select> to scroll through the options.. These are: 62.5 mS, 125 mS, 250 mS, 500 mS, 1 sec, 2 sec, 5 sec. 10 sec, 30 sec, 1 min, 2 min, 5 min, 10 min, 15 min, 30 min, 1 hr, 2 hrs, 3 hrs, 4 hrs, 8 hrs, 12 hrs. Once you have the interval that you want, press <Accept>.

- To **return to the opening menu**, press both control buttons at once until "Review" appears.
- To **turn off power** scroll through main menu (using left button) until you reach "Power" and press "off" (right button).
- : To survey the sessions recorded scroll through the menu by pressing "next" (left button). At "review", press "yes" (right button). Press left button. At "measurements" prompt, press "yes" (right button) and screen with list sessions. Use the left button to scroll through sessions.
- To turn off power scroll through main menu (using left button) until you reach "Power" and press "off" (right button).
- To **begin recording data**, get to the opening menu screen that reads

Log every 10 Sec {flashes from this to *for 8 hrs*}
Next Start

Select <Start>, and the datalogger will begin recording.

- To **make the time display visible** while recording, press the left control button repeatedly until the time appears.
- To **make note of an event** during a recording session, press the right control button. An event marker will show up as a vertical dotted line when you plot your data using the Plot command within PRONTO.
- To **Set Up Channels**, scroll to the *Set Up* menu, and press <Yes>. If you want to turn a channel on or off, press <Next> until you see the *Channels On/Off* menu. Press <Yes>, and you will see:

Ch 1: 395 off
Change Accept

If you want Channel 1 to become active (i.e. stored in the memory cache), press <Change>, and the display will change to "Ch 1: 395 on". Then press <Accept>, and the screen will advance to the same dialog about Channel 9 (which you'll want to turn off if you've just turned Ch 1 on). Once you've changed the channel set up, return to the main menu by pressing both control buttons at once.

- To **dump data**: (see Pronto user's manual Section 9 for more detail)

1) End your recording session by pressing both control buttons at once.
2) Connect one end of the phone line to the Ranger (must pop open the hood on the side that says "Rustrak" and plug into the jack), and the other end (9-pin) to the notebook computer.
3) Turn on the computer,(ignore the "bad or missing" warnings if present), and at the C prompt, type "cd\Pronto" <enter>
4) At the PRONTO> prompt, type "Pronto"
5) You'll get an opening screen that says "Rustrak Ranger" in large letters, and then (after a few moments) you will see a page with menu options. Press F2 to call up the *Data File* option. Press return.
6) Use the arrow keys to select "*Playback*", and press "enter". In the Playback utility each session will be displayed consecutively. Pronto will automatically wake up the datalogger, and transfer the data points to the computer.

7) When the data has all been transferred, you will get a screen that says "*File Specification*" at the top. You can now save and name the file (s) (the numbers after the period in the name refer to the session # and channel #, respectively). If you don't want to save a file, choose "Ignore" from the *Playback* menu, and the dialog will move on to the next session. It's recommended that the file name contain the date and session number (e.g., 11240001.dta). Pronto will assign the extension and save the file in the "Data" subdirectory "transfer" in the Pronto directory.
8) When you finish dealing with each of the sessions in the datalogger memory, Pronto will automatically enter the "Quick Plot (Save)" mode. Within Quick Plot (save), files are saved to *.PRN (asci) files by choosing the "Database" command. Once you have the "Database " screen, choose "Go", and Pronto will automatically create database prn files from the binary files. (More details if needed-- Or in "Database', select "headings" and deselect "e-time" by presing return on "time" and return on "e-time". Press the escape key to go back to "time". Next, deselect all check marks with a return EXCEPT "value" (which is Volts), and "event". Press escape to exit the menu. Now check "interval" and toggle seconds until 10 seconds is selected (or whatever time interval was sampled). Select "go" and the files will be saved as *.prn (ascii).
9) **Important**: In order open data files with Excel, the file must be converted to a text or asci (.PRN) file in "database" {see Section 9-11, Section 11-4, of Pronto user's manual for more detailed instructions}.
10) PRN files will be stored in the PRONTO directory on the C drive of the notebook. To copy them to a floppy, press F10 to exit to DOS, pop a floppy into the drive, type "b:\", and at the B prompt, type "copy C:\PRONTO\ <filename.prn> ".
11) Eject the disk, turn off the computer, disconnect the leads, and you're done.

B. Records to note in the NOx field book:

1. Datalogger session number and session start time.
2. Chamber number
3. Starting baseline.
4. Time chamber top is placed on the ring or time event button is pressed.
5. Flow rates of flow meters #1 and #2 after chamber top is placed on ring.
6. Flux measurements (if a backup is desired).
7. Time chamber top is taken off.
8. Ending baseline.
9. Air (in the shade) and soil temperatures (at 2 mm depth).

V. To Calculate fluxes:

A. General guidelines Note: if the two standard curves for a sampling period are similar (i.e., within 10% of each other), use the first one. If there is >10% difference in slope, but have good regression seem to be ok, use both using

interpolation. If one is bad (external or internal problems described above), ignore it.

B. Basic Template (ambient air assumed to contain 0 ppb NOx).

1. Open "fluxtplt.xls" template and paste in datalogger data for the chamber. Paste in mV and time. Enter the slope and the y intercept from the standard curve.

2. Next, enter the cells for the leading and trailing baseline mV. You will find these in the NOx book. Enter temperature and chamber height.

3. Now pull down the Formula menu, select "define name" and click on "yvalue". Enter the cell numbers for the beginning of the flux ([NOx] in column C) and the end of the flux. Deciding on the beginning and the end of the flux is tricky. For now, the best way might be to look in the book for the first and last time points taken by the box reader. After changing values, click on add. Now click on "xvalue" and enter the times corresponding to the values for the beginning and end of the flux (time, column A).

4. Save the file as the date and chamber number. Do not overwrite the template.

5. Check out the graph and regression statistics associated with the flux. Check for linearity and note baseline problems, high zero from impact, spike from exhaust, odd shape (sigmoidal), plateau etc.

C. Template modifed to correct for NOx conc. in ambient air and baseline drift.

D. Template using Fick's Law (plus corrections for NOx in ambient air and baseline drift).

E. Dealing with messy fluxes:

1. If the R^2 value is low (<0.8) but the flux is high, see if you can throw out a weird point (see figure 1), an exhaust spike (figure 2), or a plateau (figure 3). Do this by cutting and pasting, and going back to step 3. If you can't improve the R^2, call the flux NA.
2. If the R^2 value is low and the flux is low (<1 ng cm^-2 h^1), try removing weird points. If the R^2 does not improve, the flux is probably 0 (<+/- 1ng) (figure 4). Slightly negative fluxes are possible and should be accepted. More negative fluxes should be recorded as NA.
3. Near perfect flux (see figure 5).
4. If your baseline increases appreciably (<10 mV) between leading and trailing timepoints, you need to adjust the flux for drift by subtracting the slope of the baseline from the slope of the flux. Do this by a two point interpolation for the baseline and subtract. To calculate ppb and ng cm^-2 h^1, you need to change the flux slope cell by hand. (Template may include this correction.)

Figure 1. You could throw out the weird point.

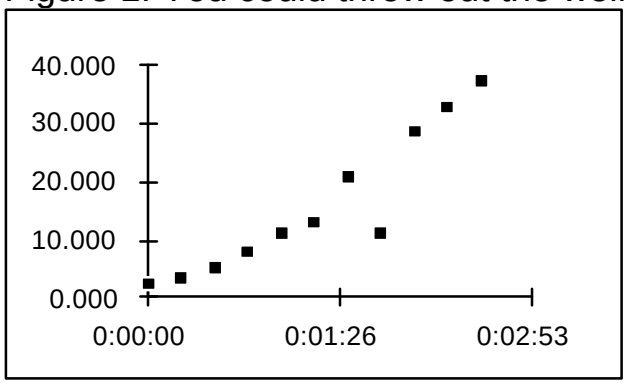


Figure 2: An exhaust spike

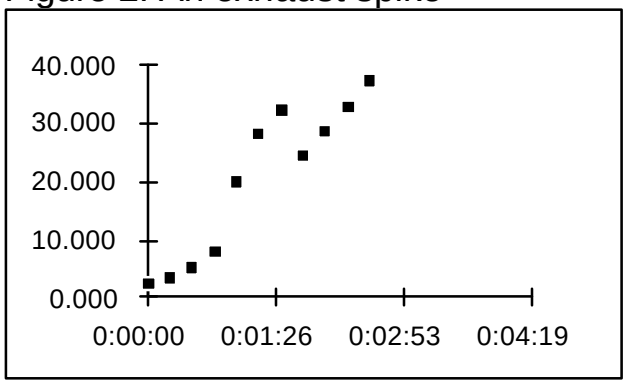


Figure 3: A plateau that could be cut out.

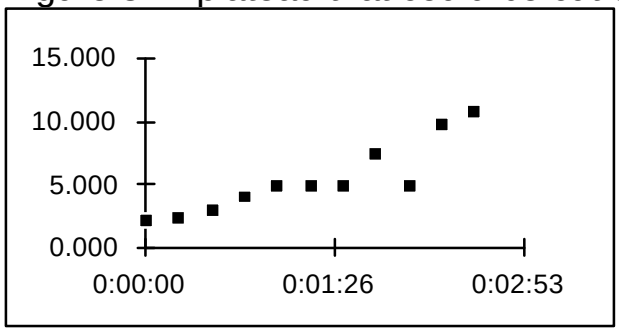


Figure 4. This flux is probably zero after the exhaust spike is removed.

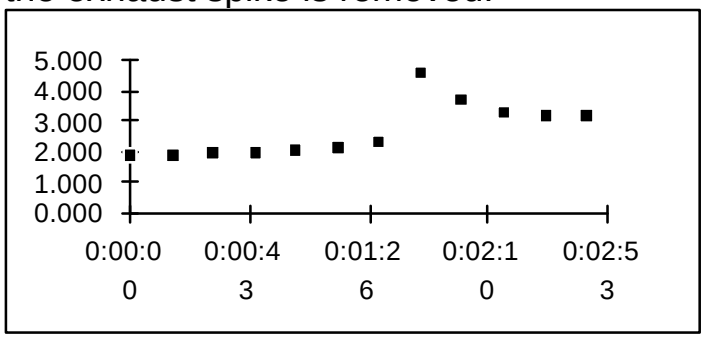


Figure 5. The (almost) perfect flux