Barrow Aerosol Measurements

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1. General Description of Aerosol Measurements

The GMD aerosol instruments at the Barrow Observatory measure the aerosol optical, size and chemical properties. The primary instruments are as follows.

- The TSI Nephelometer that measures the aerosol scattering of visible light at 3 wavelengths.
- The CLAP that measures the aerosol absorption of visible light at 3 wavelengths.
- The CPC which counts the aerosol number concentration
- The SMPS that counts the aerosol size distribution from 10 to 800 nm.
- The Aethelometer that measures the aerosol absorption of visible light at 7 different wavelengths.
- The Filter Carousel that collects aerosol samples for later measurement of the aerosol inorganic ion composition.

NOAA GMD manages the general system operation, infrastructure and data logging. NOAA PMEL is responsible for the filter preparation, shipping and sample composition measurements. A group from the Institute for Tropospheric Research in Leipzig, Germany built the SMPS and is responsible for checking its operation. The GMD anemometer also logs data on the aerosol computer.

Guest Instruments: There are frequent guest instruments that use the aerosol sample lines and occasionally the data acquisition system. In 2015 there were two such instruments: The COSMOS, a measure of the aerosol absorption coefficient at high temperatures, operated by Yataka Kondo from the National Institute of Polar Research in Tokyo, Japan; and the SP2, a measure of aerosol black carbon, operated by Ray Bambha and Hope Michelsen of the Remote Sensing and Energetic Materials group at the Department of Energy Sandia Lab in Livermore, CA.

Contact Information:
GMD aerosol group leader: John Ogren, john.a.ogren@noaa.gov
Aerosol system mentor: Anne Jefferson, anne.jefferson@noaa.gov
Backup system mentor: Pat Sheridan, patrick.sheridan@noaa.gov
COSMOS: Dr. Yataka Kondo, kondo@eps.s.u-tokyo.ac.jp
SP2: Ray Bamba, rpbambh@sandia.gov
SP2: Hope Michelsen, hamiche@sandia.gov
PMEL filter sampling: Derek Coffman, derek.coffman@noaa.gov

Photo of front of aerosol rack.
Doesn't include aethelometer or Sandia SP2 rack

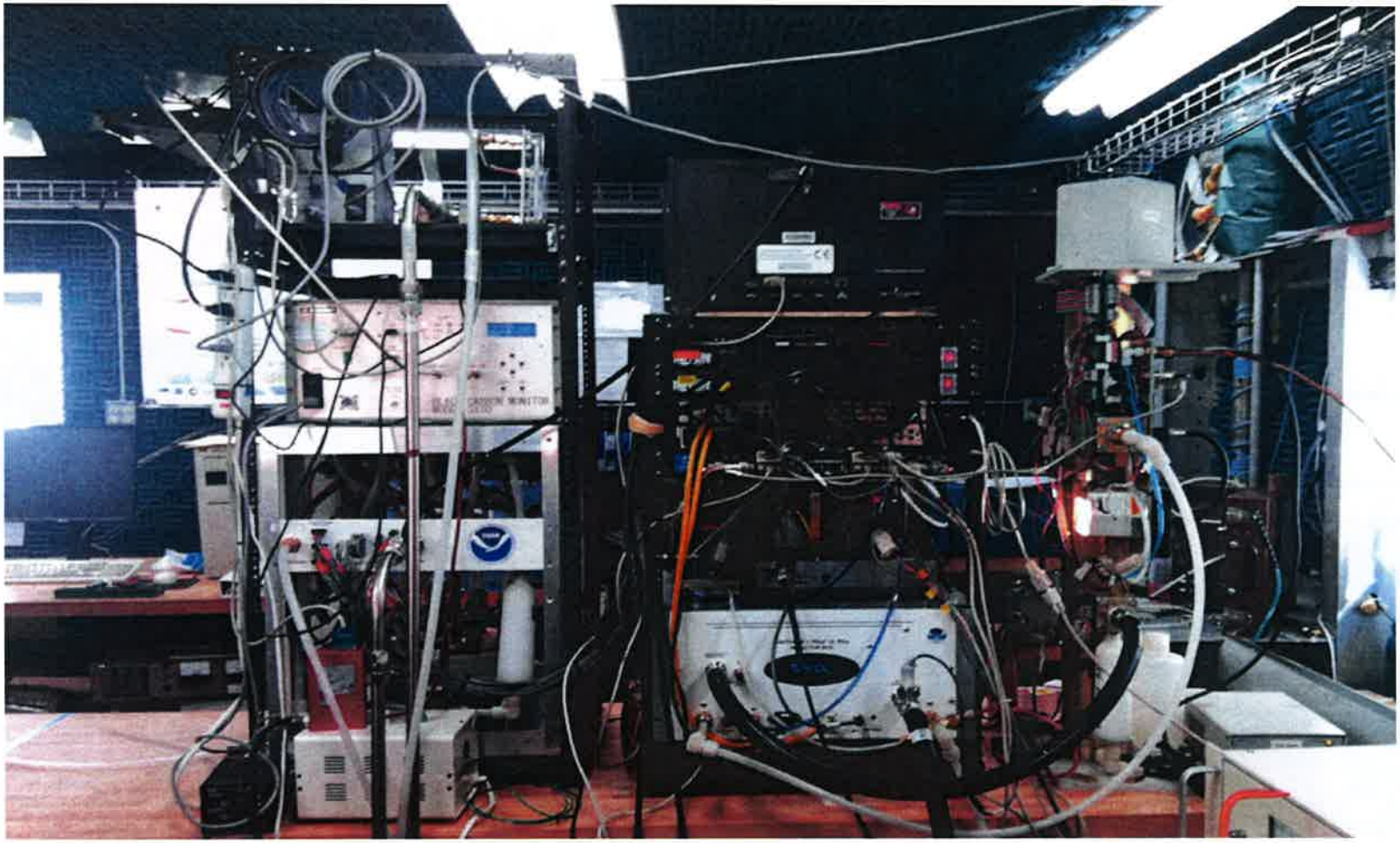
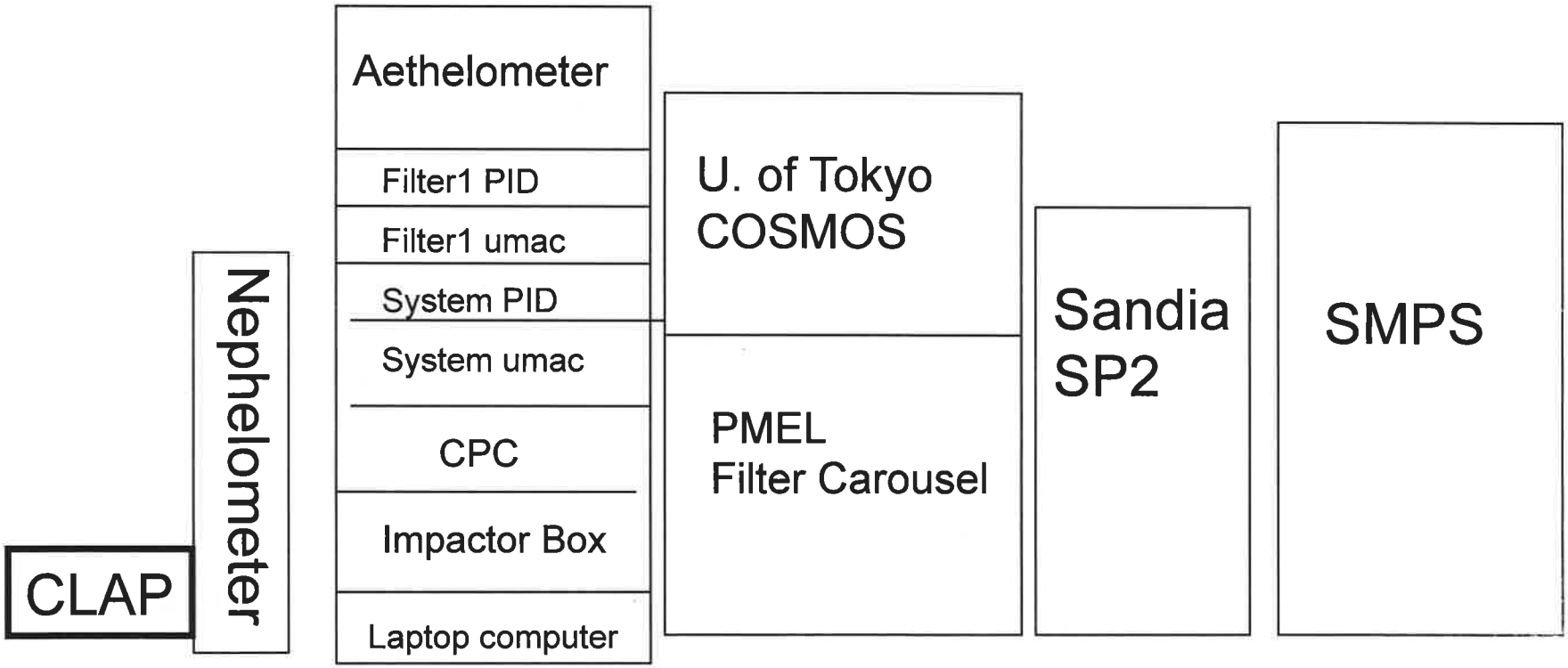
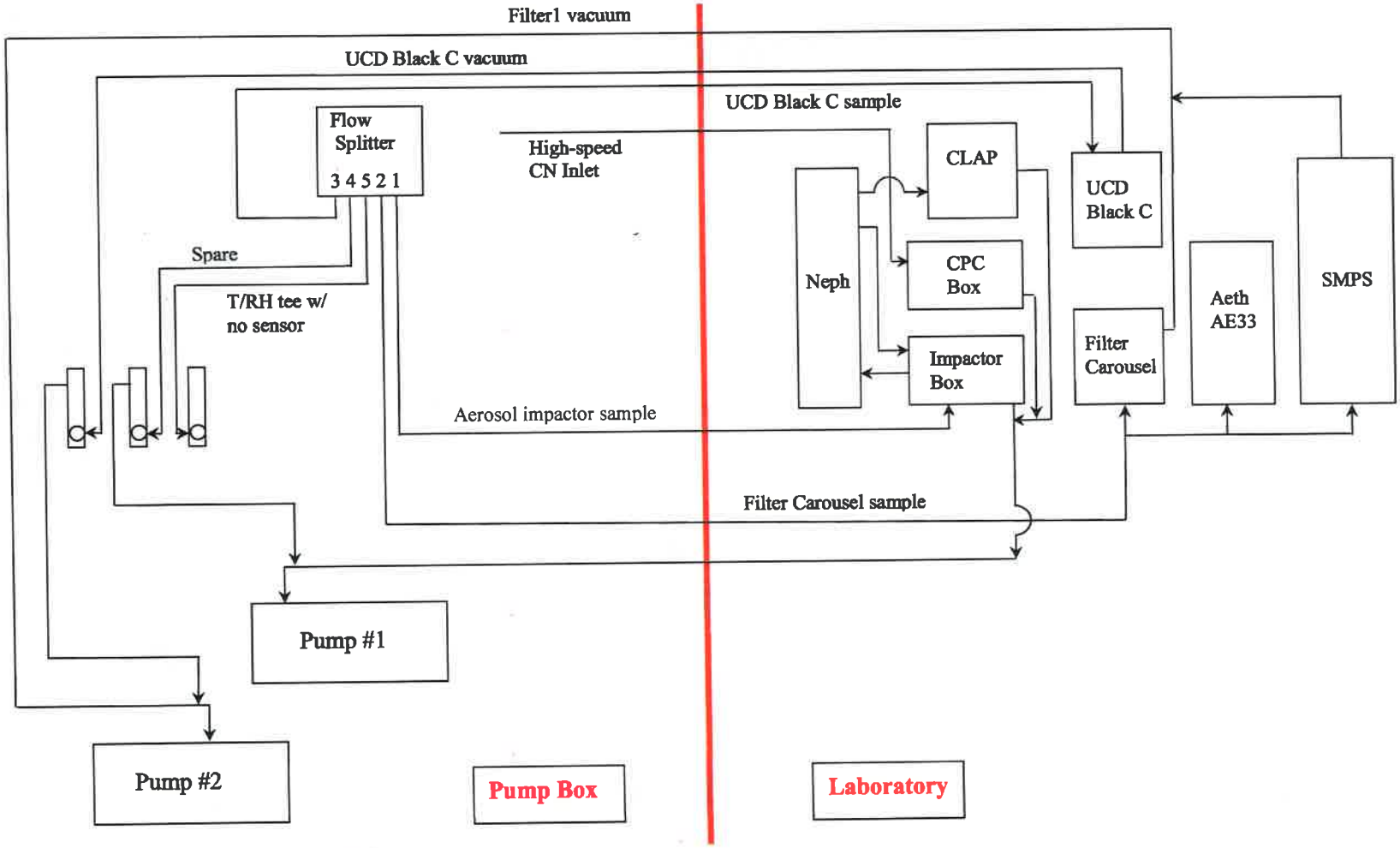


Photo of back of aerosol rack.
Doesn't include SMPS or Sandia SP2 instrument racks



Barrow Aerosol Bench Layout
Front View


Filter1 vacuum
UCD Black C vacuum
UCD Black C sample
Flow Splitter
3 4 5 2 1
High-speed CN Inlet
CLAP
UCD Black C
Neph
CPC Box
Aeth AE33
SMPS
Spare
T/RH tee w/ no sensor
Impactor Box
Filter Carousel
Aerosol impactor sample
Filter Carousel sample
Pump #1
Pump #2
Pump Box
Laboratory

BRW Daily Checklist Aerosol Rack

PID Controller Box

1) Are all PID controllers showing measured values close to their set points?

PID #1 –inlet RH reading <40%
PID#2 Not used
PID#3 not used reading is outside stack RH
PID#4 flow should be close to 30-35 lpm

UMAC-1050 Electronics Box

1) Is the green power indicator light on?
2) Are the yellow Tx and Rx lights blinking, indicating communication with the laptop?

CLAP

1) Check that the flow reading on the front panel of the instrument is about 0.9 lpm, adjust accordingly.
2) There are 8 sample spots on the filter. If the spot number is on 8 for Mon-Thu or 7 for Fri then change the filter.
3) To change the filter **a)** push in the red status light**, b)** open the 4 bolts on the top of the instrument**, c)** clean the inside surface for filter residue, **d)** replace the filter (white side up), **e)** replace the top and tighten the bolts with a torque wrench, **f)** press the red status light and **g)** adjust the flow.
4) Check the software (<ESC>, E) that spot=1, Flags=0000 and there is no lamp or filter error.

CN Box

1) Is the system vacuum gauge in the CN box reading ≥12 in. Hg?
2) Does the CN drier flow rotameter read ≥6 lpm?
3) Is the level of butanol in the CN counter visible through the viewing port? If NO, fill CN counter up to fill line with butanol.

Impactor Box

1) Is one of the two indicator lights lit on the yellow motorized ball valve, indicating that the valve is either in the open or closed position

SMPS

1) Check the CN Box functioning in the "CN Box" section above
2) Check that the Sheath flow is 5.0 lpm and the sample flow is 0.5 lpm
3) Check that there are counts on the screen and that the particle number distribution makes a curved "bell" shape.

Filter Carousels

Go into the filter menus ("<ESC> f") and check that there is some volume listed in the far right column. Check that if the system is in the clean sector that there is flow through the filters at 35-45 lpm (check PID controller) and that there is a high, pressure difference on the filter that is being sampled. Check that the pressure differences on the filters not being sampled are all low.

Laptop

1) Does the laptop appear to be communicating with the instruments (i.e., it is not "locked up")?
2) Are any error messages (usually in red boxes) visible on the laptop screen?

Aethelometer

1) On "Home" tab of front screen check
    a. Reported flow = 5 lpm
    b. Tape adv. Left > 10%
    c. Status has green check point and status bit is "0" or"1"
        i. If status bit is >1 then note number and contact mentor
        ii. Check in aethelometer manual page 42 for status bit description

BRW Weekly Checklist

Aerosol Rack

Nephelometer

1) Perform nephelometer span check.
2) Type in <ESC> N" to get to the neph menu the type "M start span check"
3) Follow the instructions. Remember to turn off the CO2 gas tank at the end.
4) If the reported error is more than 10% then repeat the span check.

Impactor Box (every 3 weeks)

1) Clean the impactor plates in the 1-micron and 10-micron impactors
2) Type <Enter> select <Enter log>, type " starting impactor cleaning"
3) Bypass analyzers from "Aerosol" window in computer (<Enter>, "Bypass Status" then "m" "set bypass", m, "Bypass", "yes")
   Remove impactors and clean plates. Spray impaction plate with silicone and grease inlet plate on 10 um impactor
4) Install impactors
5) Unbypass analyzers (ESC, "Bypass Status" then "m" "set bypass",m, "Unbypass","yes")

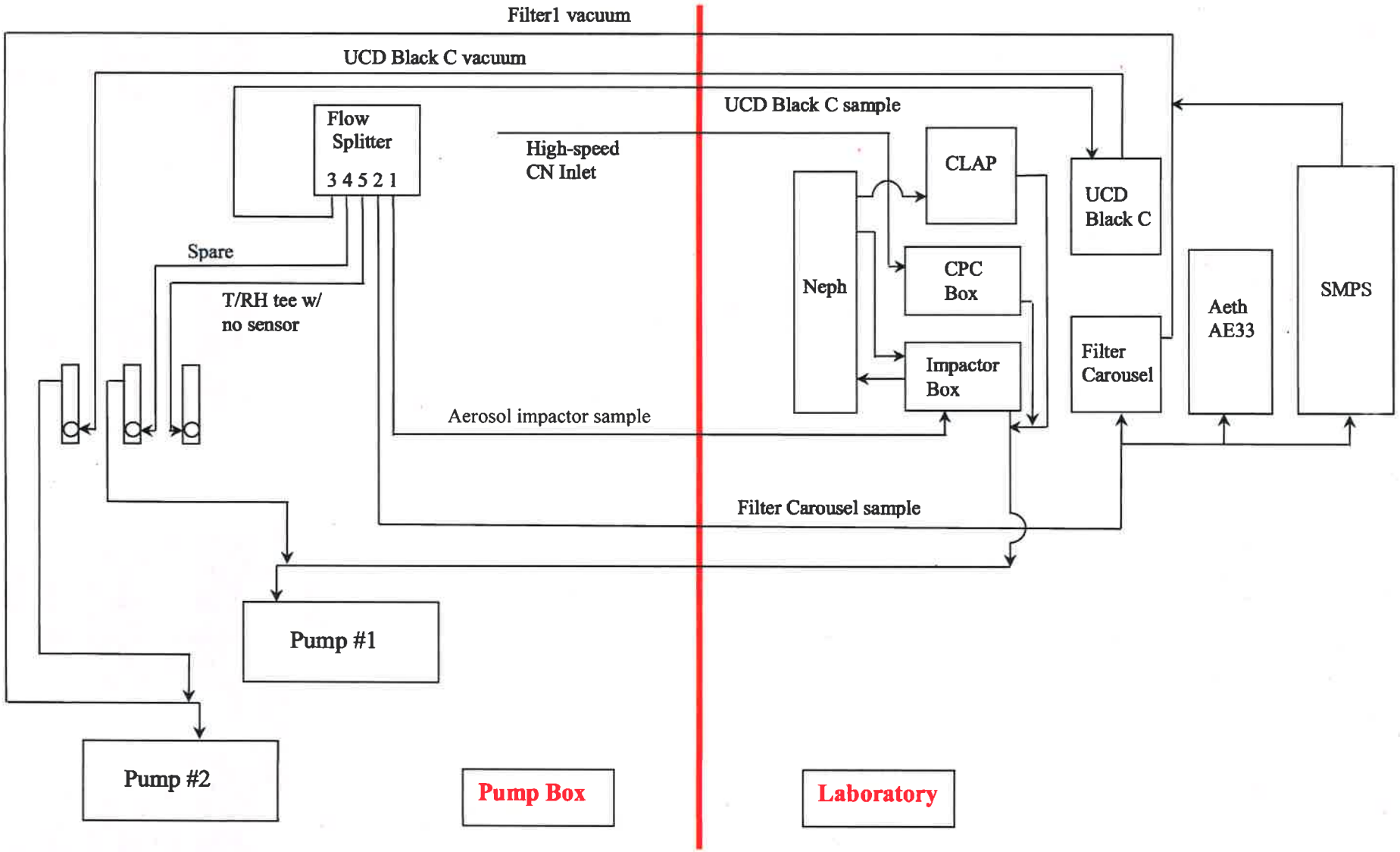
Filter Carousel Change

Do this every 4 weeks
Type in "<Enter> F", "M start filter change" for the PMEL filters
Close the manual valve
Remove the filter carousel and change filters in the glove box
Remember to type "m stop filter change" once the new filter is in place.
Open the manual valve.
Note the pressure and flow changes at the start of the new filter.
Filter #1 is the blank or reference filter. This samples filtered air for only a few seconds before the filter carousel switches to Filter #2.
Ship the used filters back to either PMEL. Send an email to PMEL if you don't have a set of replacement filters within a week of needing to change them.

Barrow Aerosol System
Daily Check Sheet

	MON	TUE	WED	THU	FRI	MON	TUE	WED	THU	FRI
Date (UTC) 2007										
Time (UTC)										
Observer										
From Computer										
Laptop not frozen	☺ ☹	☺ ☹	☺ ☹	☺ ☹	☺ ☹	☺ ☹	☺ ☹	☺ ☹	☺ ☹	☺ ☹
Active filter #/Press. (60-110 hPa)										
Q_stack 700-800 lpm	☺ ☹	☺ ☹	☺ ☹	☺ ☹	☺ ☹	☺ ☹	☺ ☹	☺ ☹	☺ ☹	☺ ☹
Q_CNdrier ~7 lpm	☺ ☹	☺ ☹	☺ ☹	☺ ☹	☺ ☹	☺ ☹	☺ ☹	☺ ☹	☺ ☹	☺ ☹
Neph1 Lamp Voltage:										
Neph1 Lamp Current:										
CLAP Filter Transmission (Change if on filter #8)										
Non-computer stuff:										
PIDs meas'd~setpt 2&4 and 4f	☺ ☹	☺ ☹	☺ ☹	☺ ☹	☺ ☹	☺ ☹	☺ ☹	☺ ☹	☺ ☹	☺ ☹
CLAP Flow 0.9 lpm	☺ ☹	☺ ☹	☺ ☹	☺ ☹	☺ ☹	☺ ☹	☺ ☹	☺ ☹	☺ ☹	☺ ☹
Butanol lvl.	☺ ☹	☺ ☹	☺ ☹	☺ ☹	☺ ☹	☺ ☹	☺ ☹	☺ ☹	☺ ☹	☺ ☹
Both CPC lites?	☺ ☹	☺ ☹	☺ ☹	☺ ☹	☺ ☹	☺ ☹	☺ ☹	☺ ☹	☺ ☹	☺ ☹
CNC Vac. > 12" Hg	☺ ☹	☺ ☹	☺ ☹	☺ ☹	☺ ☹	☺ ☹	☺ ☹	☺ ☹	☺ ☹	☺ ☹
Filter Vac. > 12" Hg	☺ ☹	☺ ☹	☺ ☹	☺ ☹	☺ ☹	☺ ☹	☺ ☹	☺ ☹	☺ ☹	☺ ☹
CO2 valve closed	☺ ☹	☺ ☹	☺ ☹	☺ ☹	☺ ☹	☺ ☹	☺ ☹	☺ ☹	☺ ☹	☺ ☹
UPS	☺ ☹	☺ ☹	☺ ☹	☺ ☹	☺ ☹	☺ ☹	☺ ☹	☺ ☹	☺ ☹	☺ ☹
UMac green light on	☺ ☹	☺ ☹	☺ ☹	☺ ☹	☺ ☹	☺ ☹	☺ ☹	☺ ☹	☺ ☹	☺ ☹
UMac yellow lights blinking	☺ ☹	☺ ☹	☺ ☹	☺ ☹	☺ ☹	☺ ☹	☺ ☹	☺ ☹	☺ ☹	☺ ☹
Impactor: red or yellow lit	R Y	R Y	R Y	R Y	R Y	R Y	R Y	R Y	R Y	R Y
SMPS sample flow 0.5 lpm	☺ ☹	☺ ☹	☺ ☹	☺ ☹	☺ ☹	☺ ☹	☺ ☹	☺ ☹	☺ ☹	☺ ☹
SMPS sheath flow 5.0 lpm	☺ ☹	☺ ☹	☺ ☹	☺ ☹	☺ ☹	☺ ☹	☺ ☹	☺ ☹	☺ ☹	☺ ☹
SMPS CPC butanol lvl.	☺ ☹	☺ ☹	☺ ☹	☺ ☹	☺ ☹	☺ ☹	☺ ☹	☺ ☹	☺ ☹	☺ ☹
SMPS CPC lights?	☺ ☹	☺ ☹	☺ ☹	☺ ☹	☺ ☹	☺ ☹	☺ ☹	☺ ☹	☺ ☹	☺ ☹
CPC1 ~ CPC2										
Periodic Stuff:										
Neph Span Check, set CO2 flow at 8 lpm										
CO2 tank pressure										
Neph error %										
Pump box Rotameters ~30 lpm										
SMPS flow calibration										
Carousel Change Time (Thursday after 0Z)										
Filters Activated?	☺ ☹	☺ ☹	☺ ☹	☺ ☹	☺ ☹	☺ ☹	☺ ☹	☺ ☹	☺ ☹	☺ ☹
Neph Impactor Change Every few mths.										

Notes:


Filter1 vacuum
UCD Black C vacuum
UCD Black C sample
Flow Splitter
3 4 5 2 1
High-speed CN Inlet
CLAP
UCD Black C
Spare
T/RH tee w/ no sensor
Neph
CPC Box
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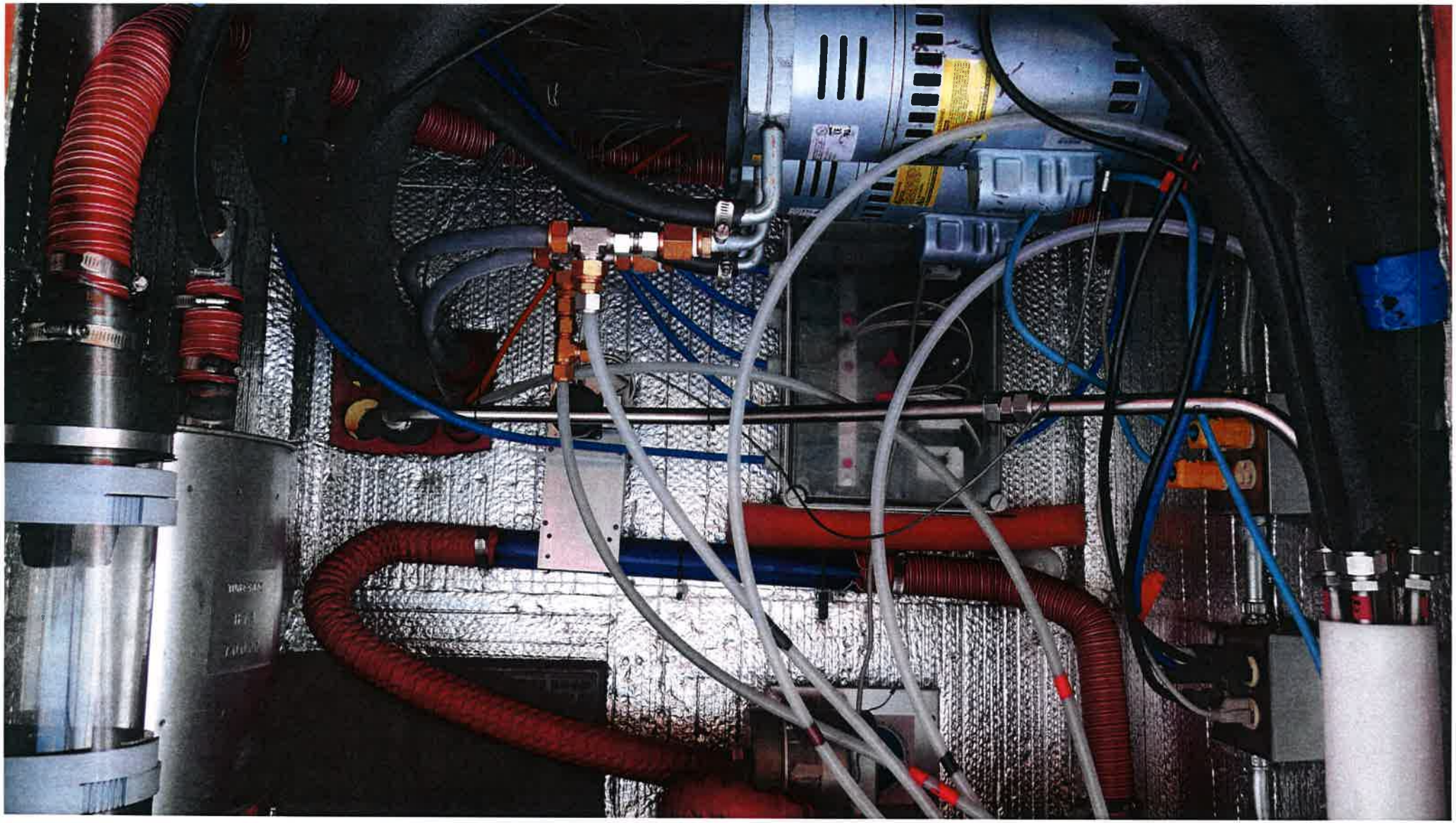
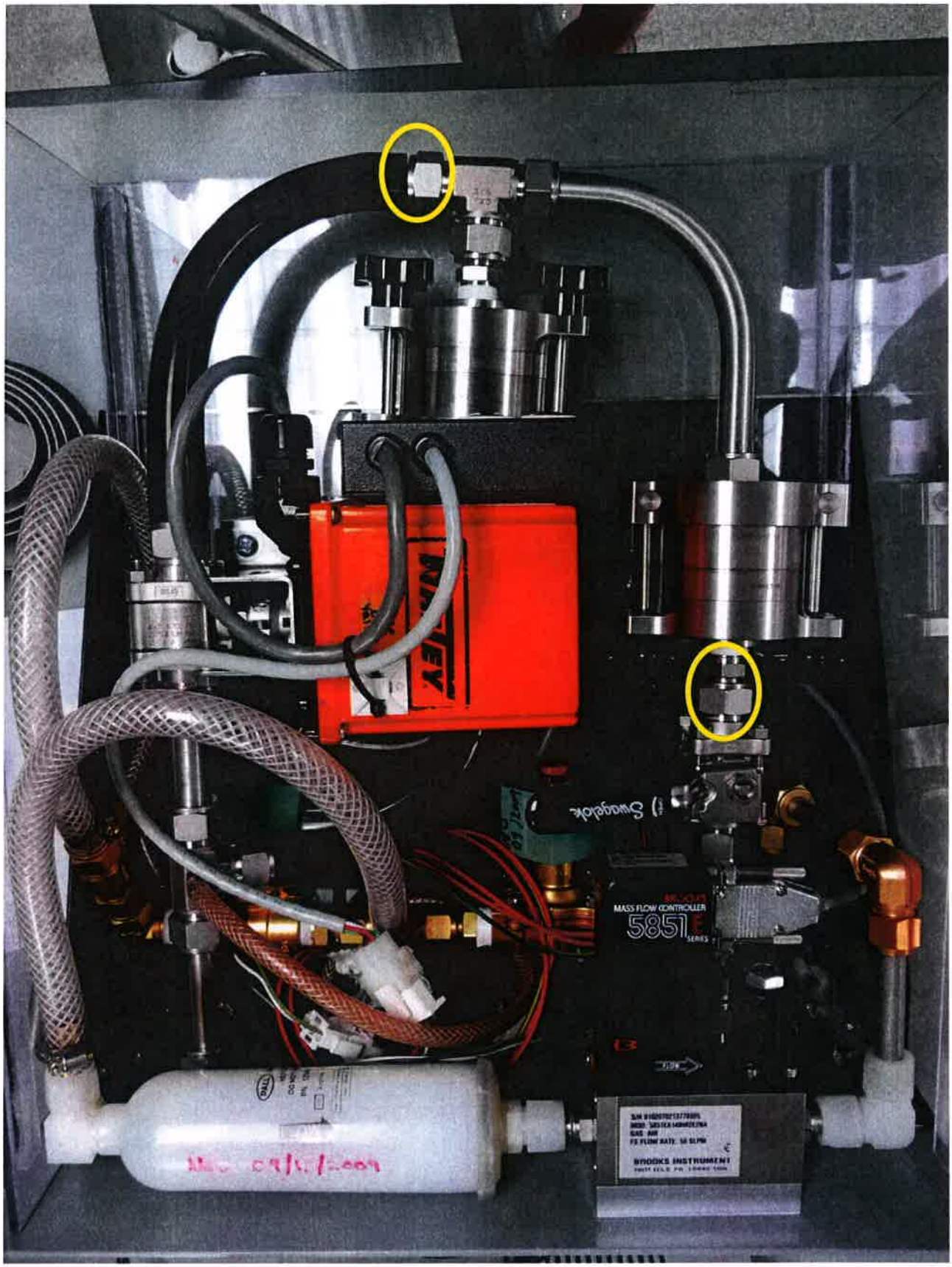
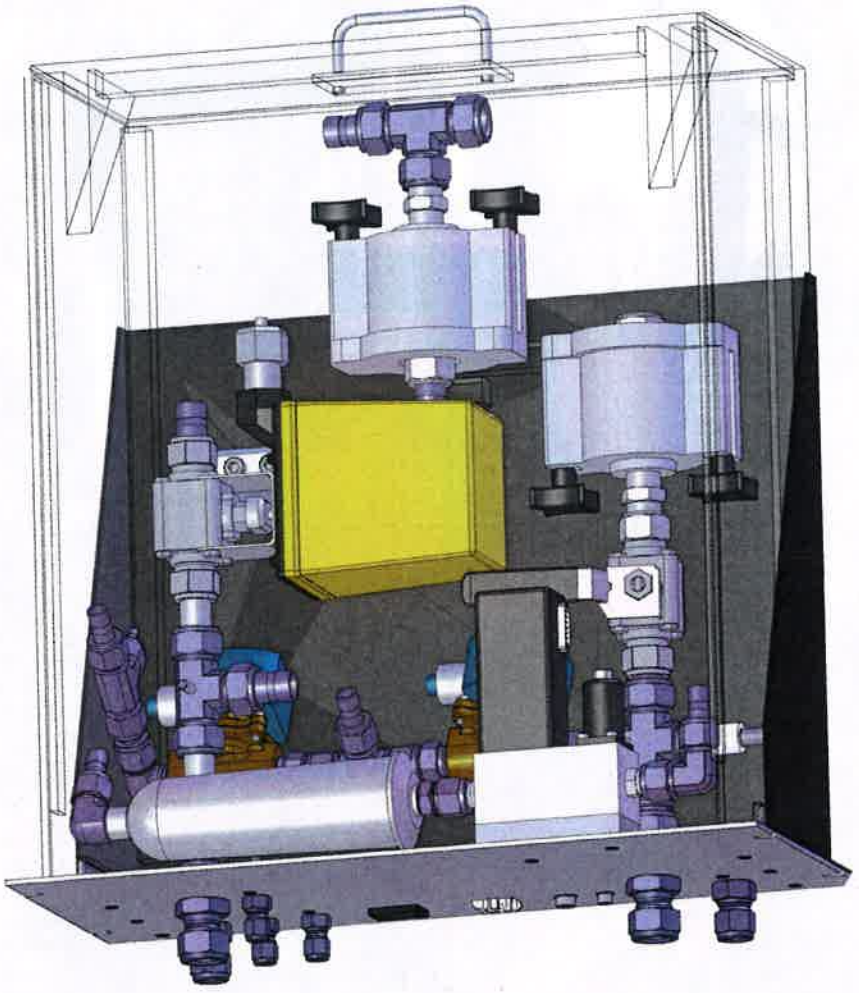
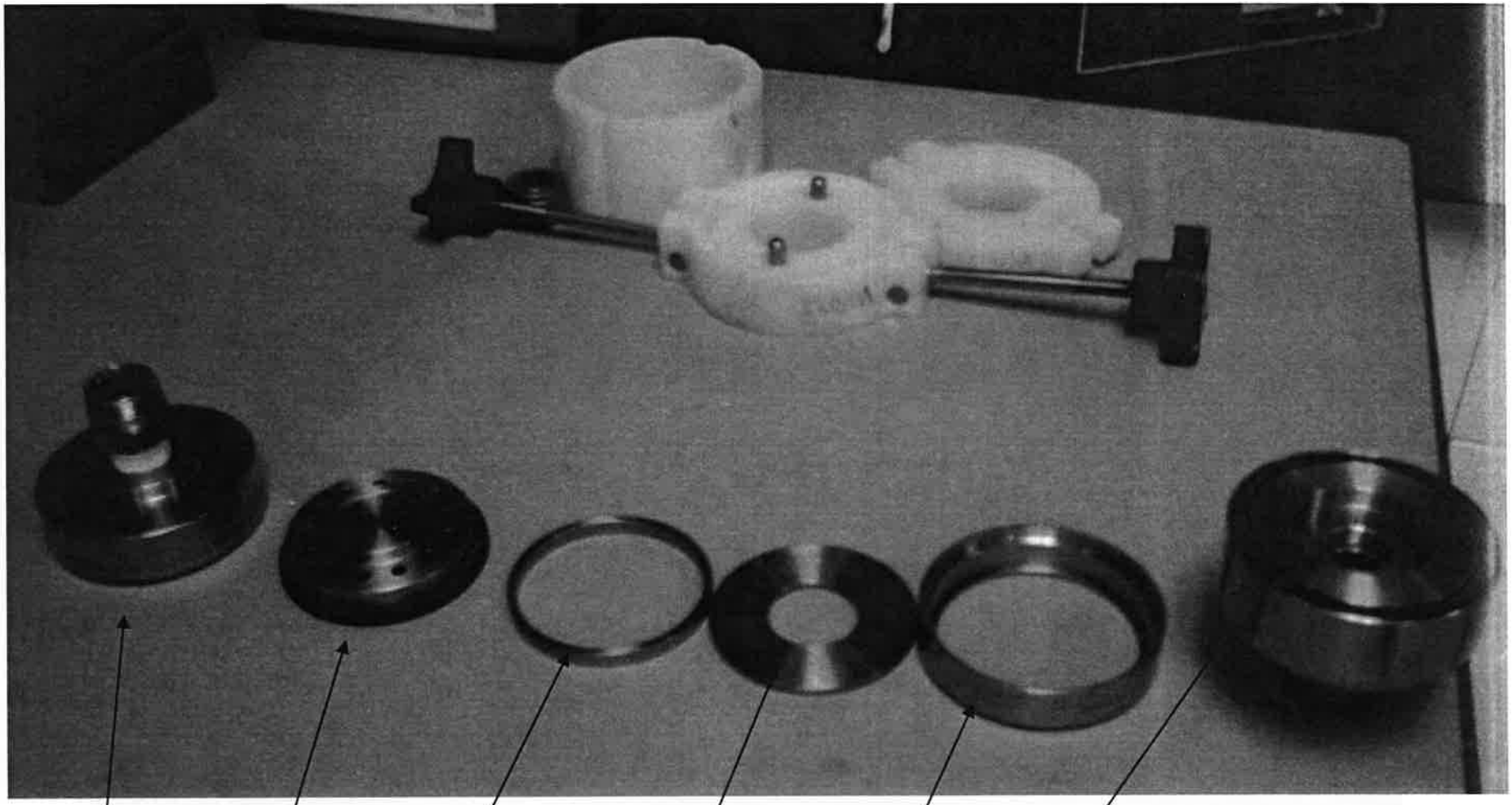
SMPS
Impactor Box
Filter Carousel
Aerosol impactor sample
Filter Carousel sample
Pump #1
Pump #2
Pump Box
Laboratory



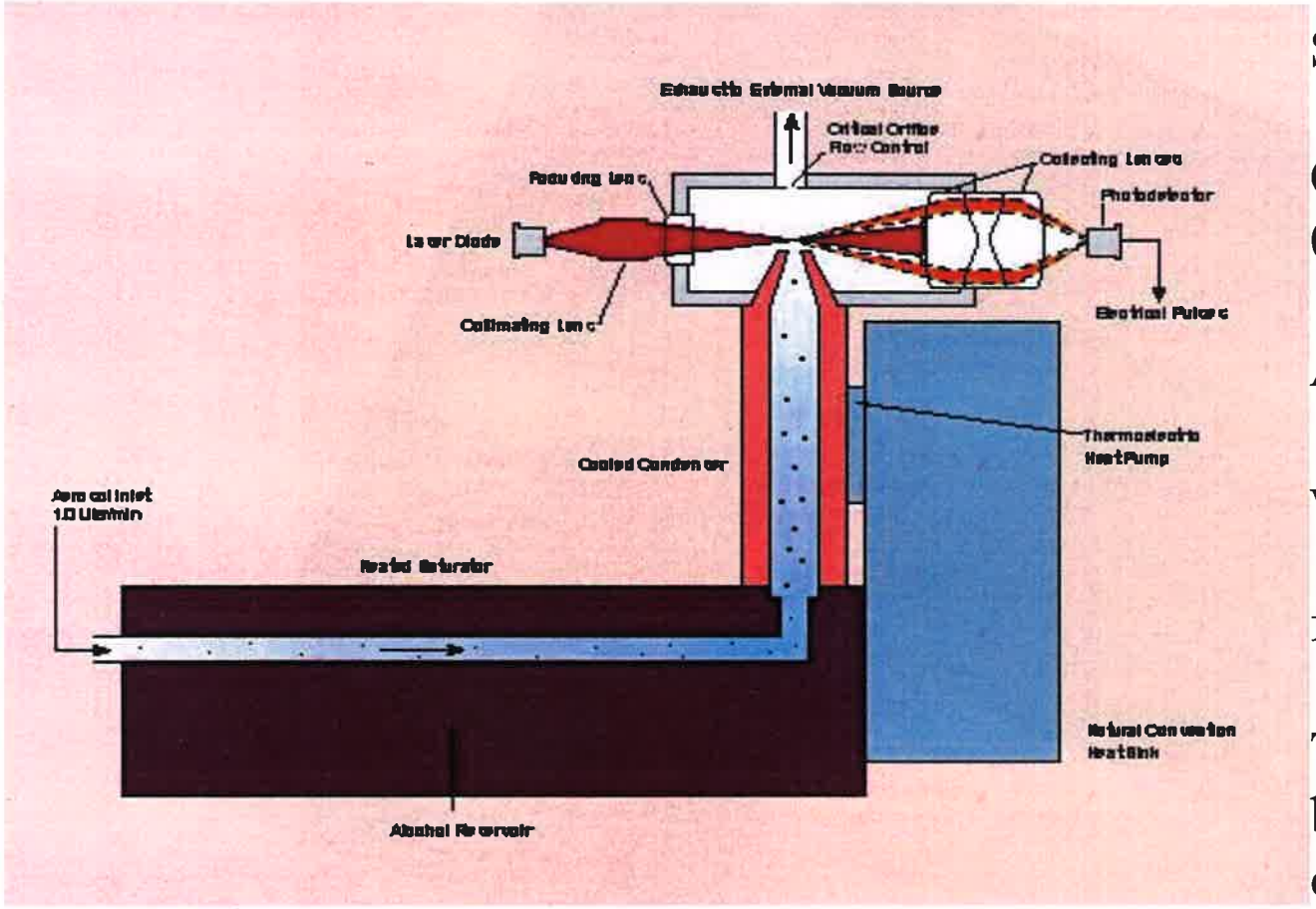

MASS FLOW CONTROLLER
5851
SERIES
BROOKS INSTRUMENT



Back Panel of impactor box


Inlet
Jet plate
Top spacer ring
Impaction plate
Bottom spacer ring
Outlet
Impaction cup

Condensation Particle Counter (CPC)



Size range: 10 nm to >3 um

Concentration range:
0 to 10,0000 particles/cc

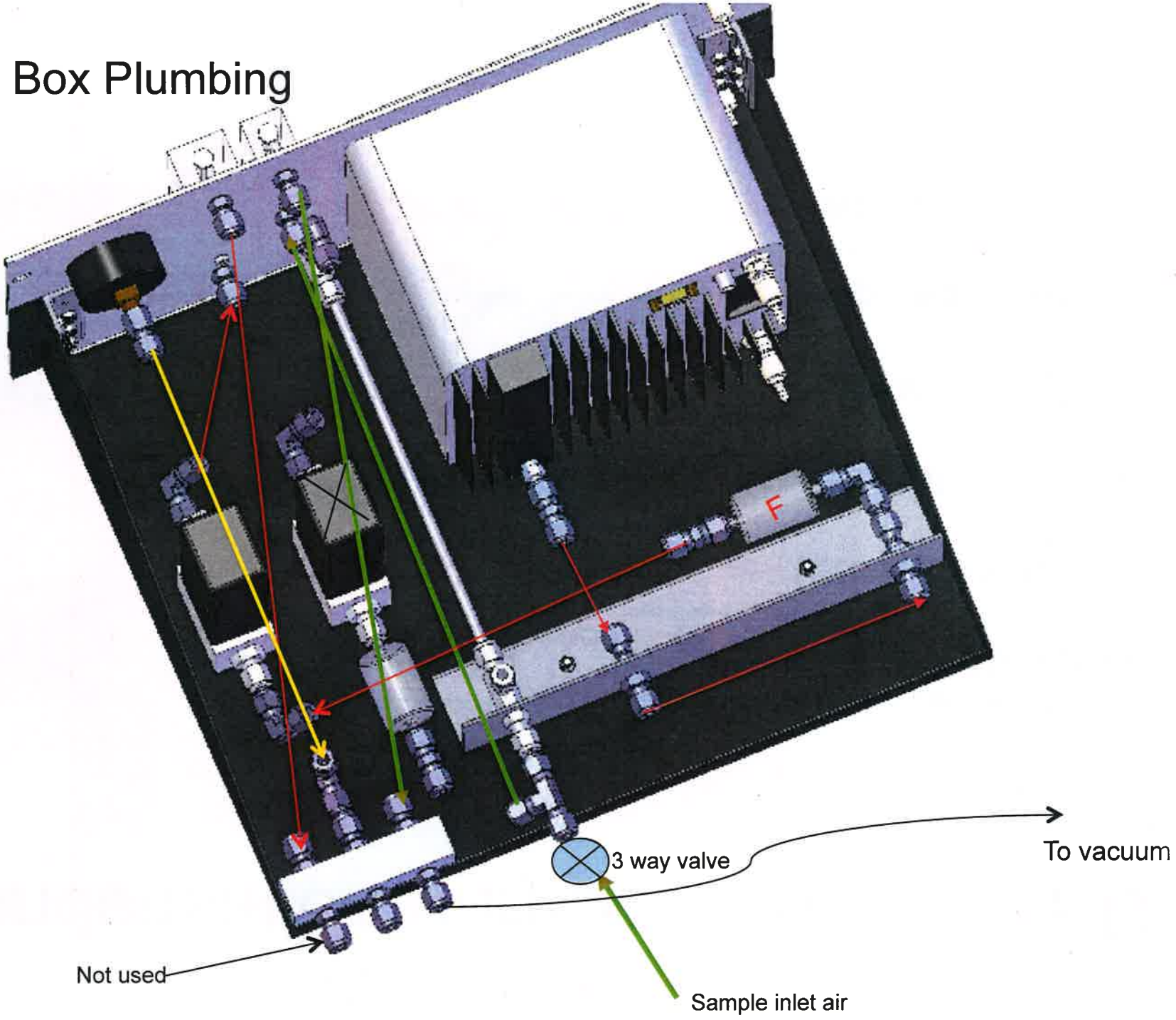
Accuracy: +/- 10%

working fluid: butanol

flow rate: ~ 1.0 lpm

Temperature difference between saturator and condensor : 17 °C

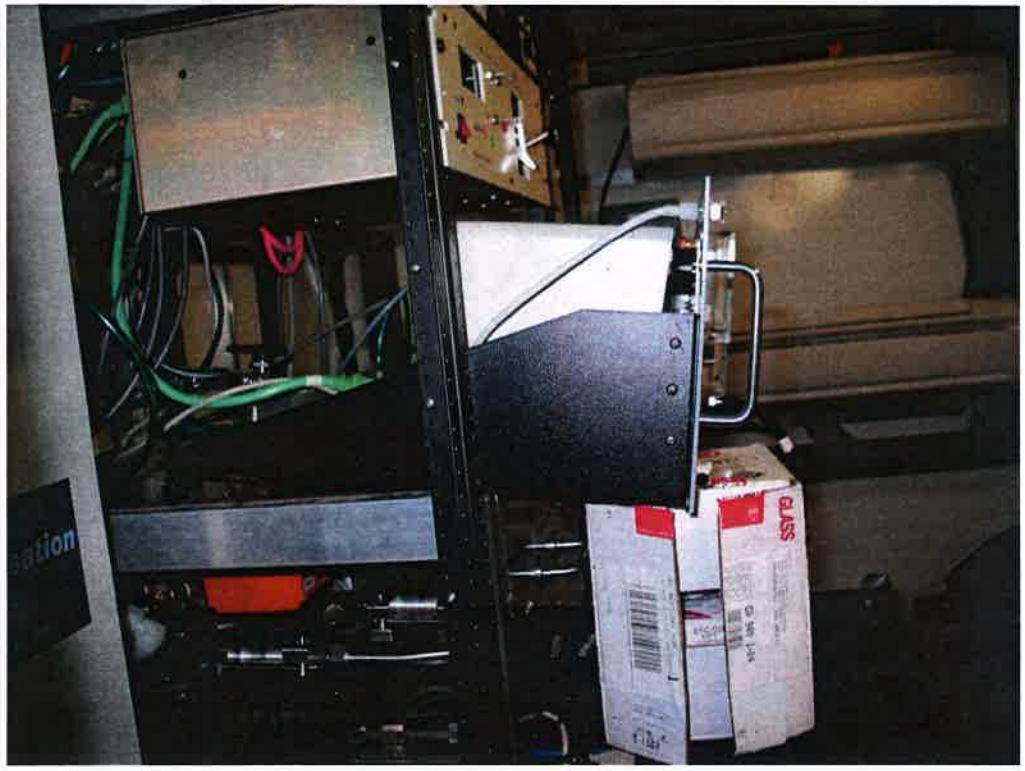
CPC Box Plumbing



Cleaning of the CPC Orifices

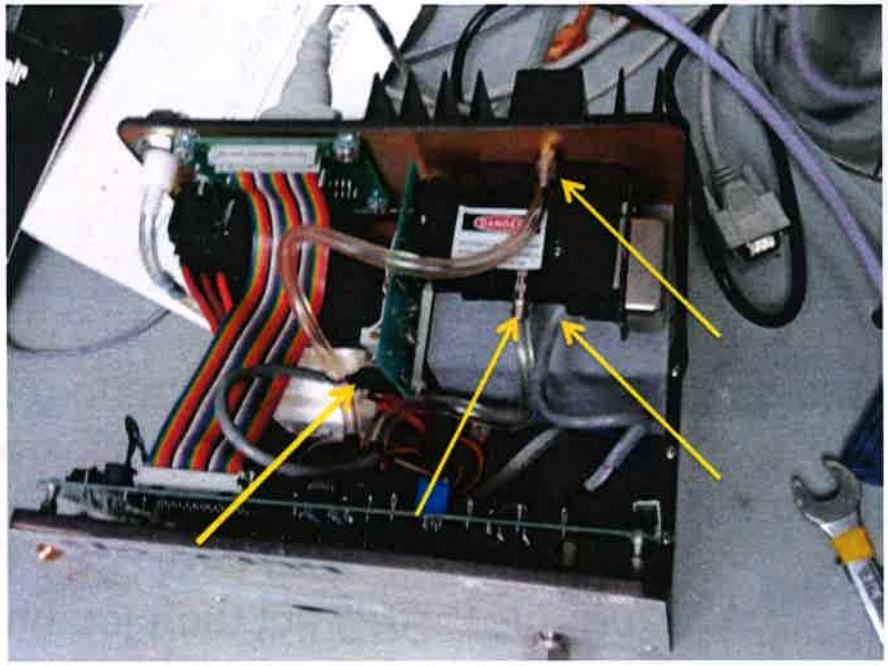
1.

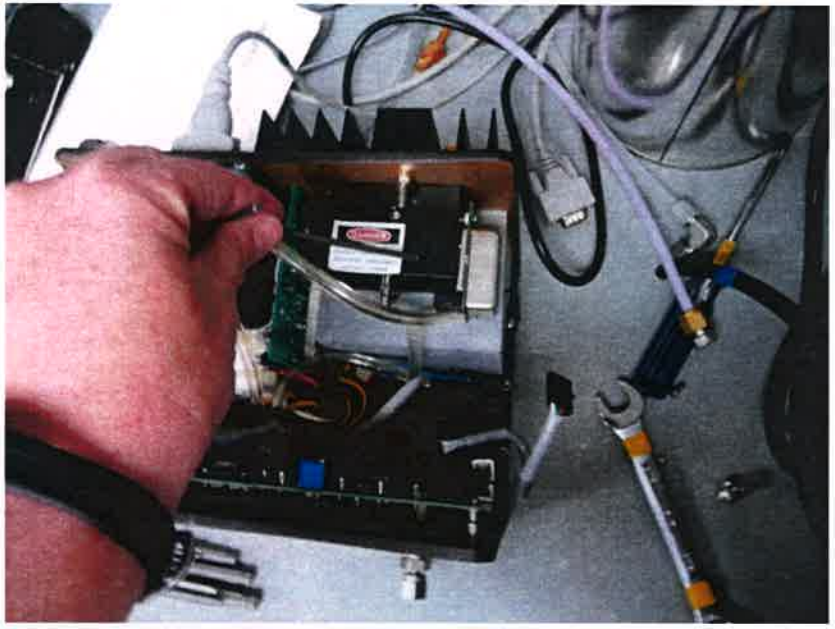
Drain butanol from the CPC
Remove CPC from rack
Disconnect power, comport cable, inlet and outlet, remove butanol tubes.
Plug the vacuum outlet
Tilt rack-mount case forward and lift CPC up out of rack

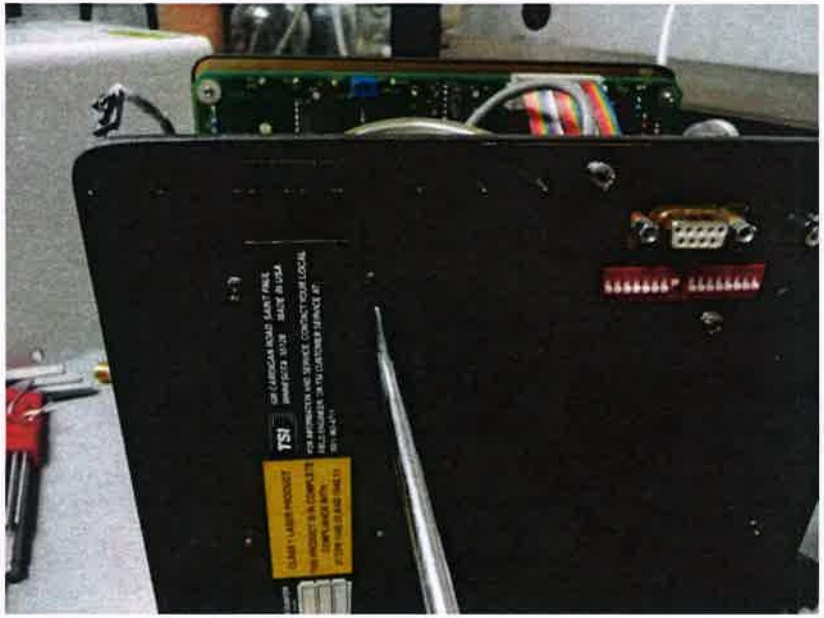


2.

Remove two connectors and two tubes to the pressure sensor
Note the position of the tubes and connectors







3.

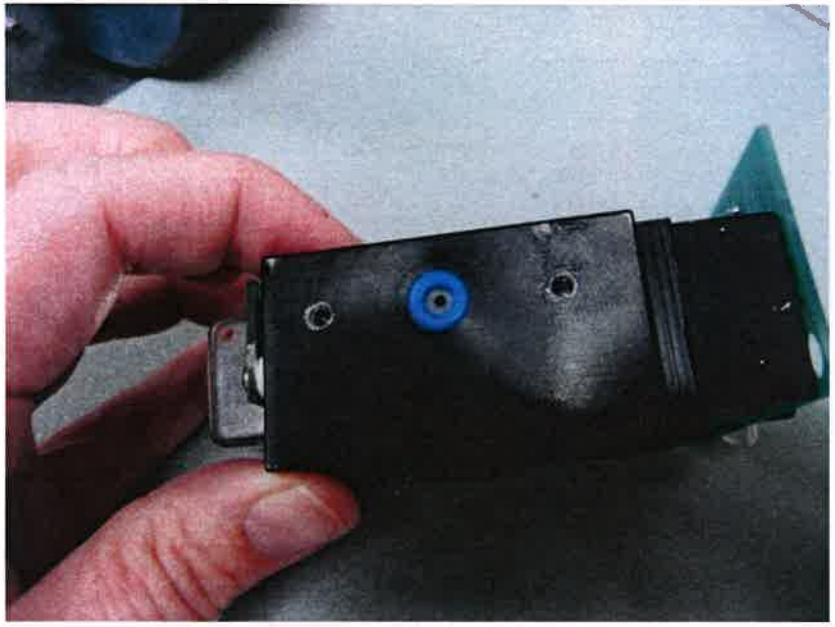
Remove 2 Allen head screws from the top of the optics block

Remove two phillips head screws from the backside of the CPC

4.

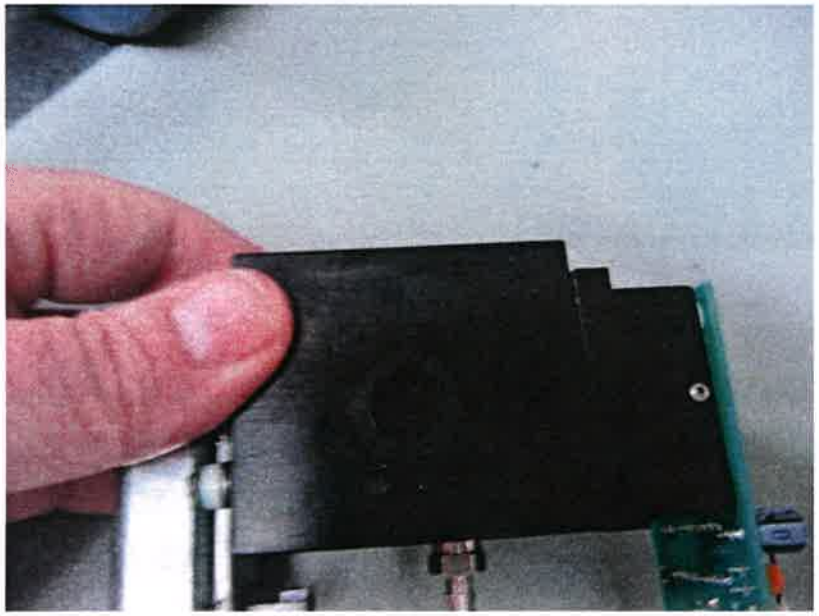
Remove vacuum connection from the back panel

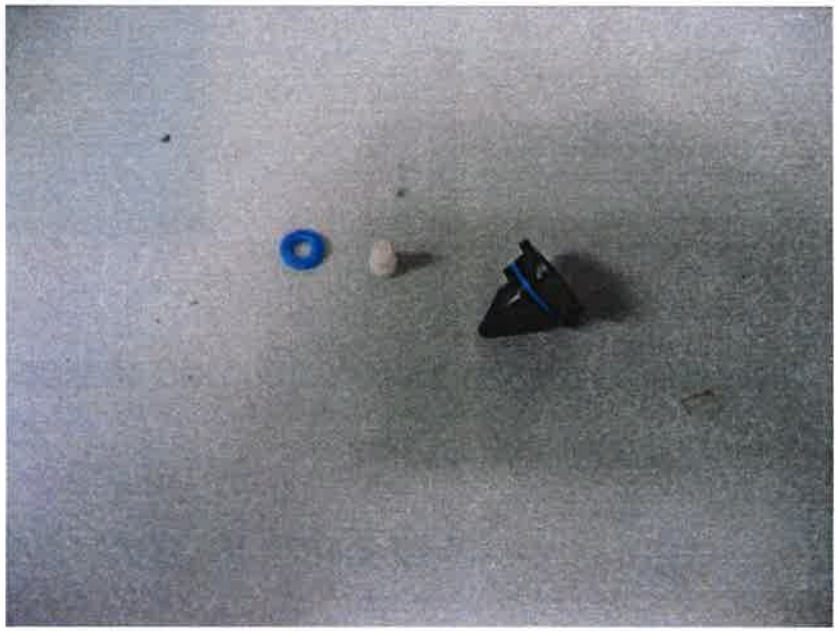
Remove black optics block from the instrument



5

Remove two orifices from the instrument and clean with alcohol and a tooth pick.





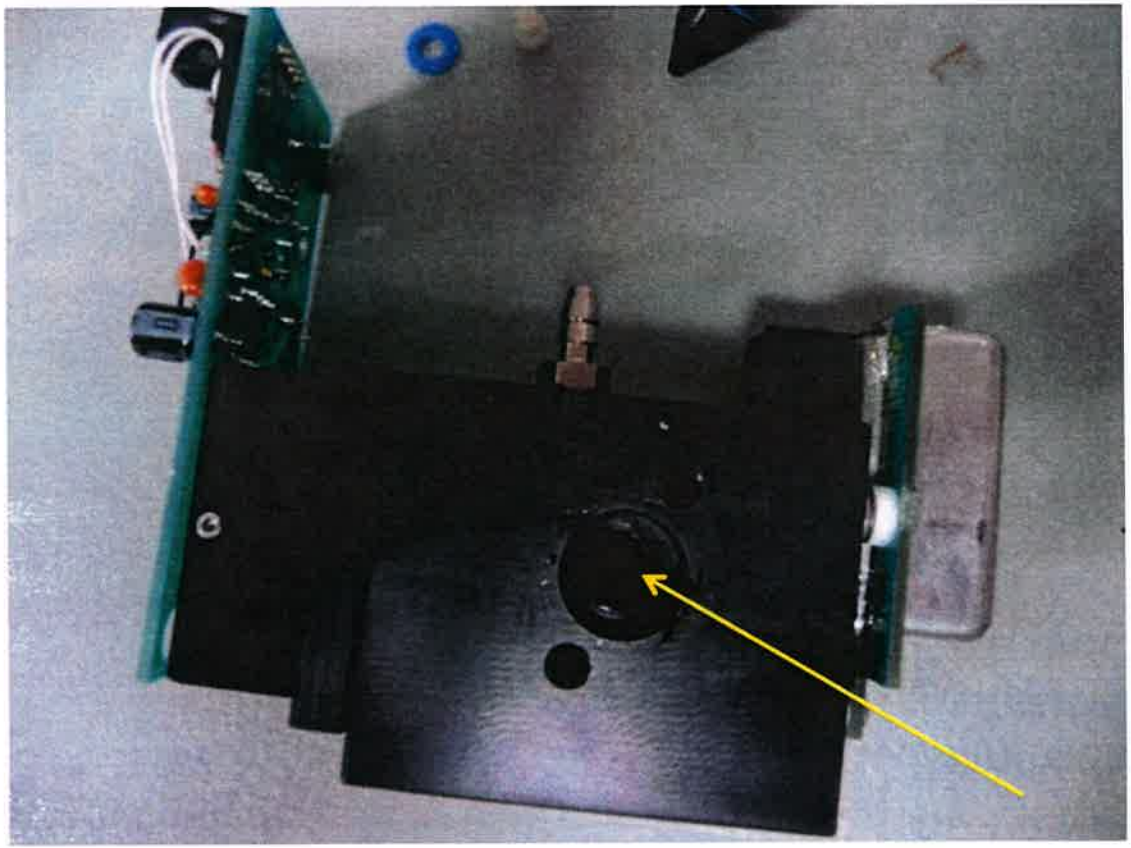
6

Gently clean the inside of the optics cavity with alcohol and a Q-tip

Replace the orifices

Reassemble the unit and put back in the rack

Fill with butanol, plug in comport cable and power cord and start data acquisition



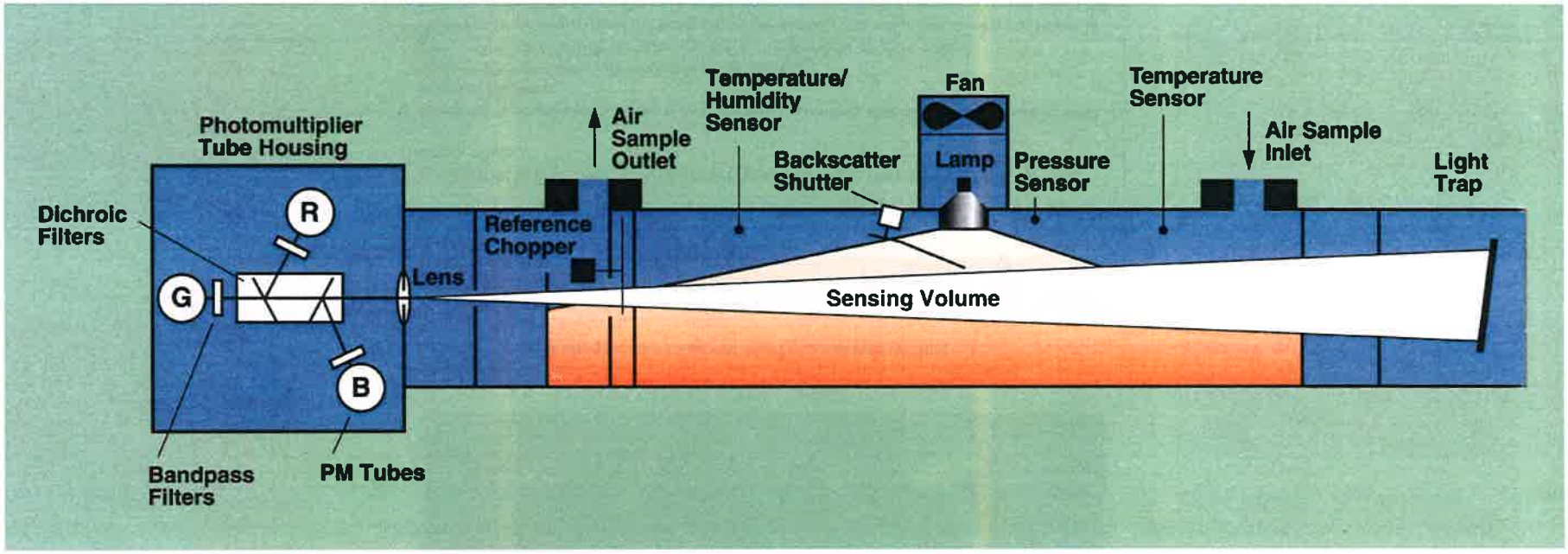
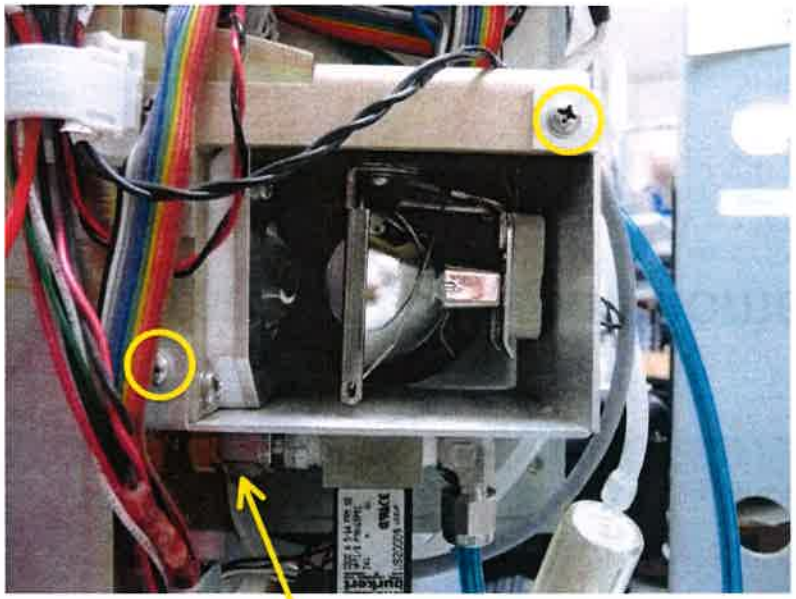


Diagram of TSI Nephelometer

Neph lamp Change



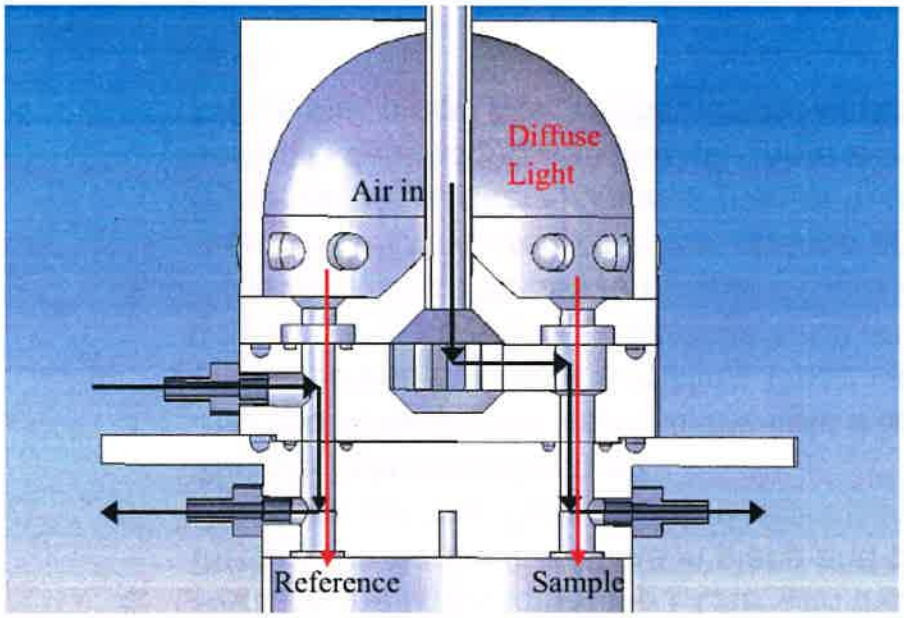
1) Press F12 and make a log entry that you're about to change the lamp

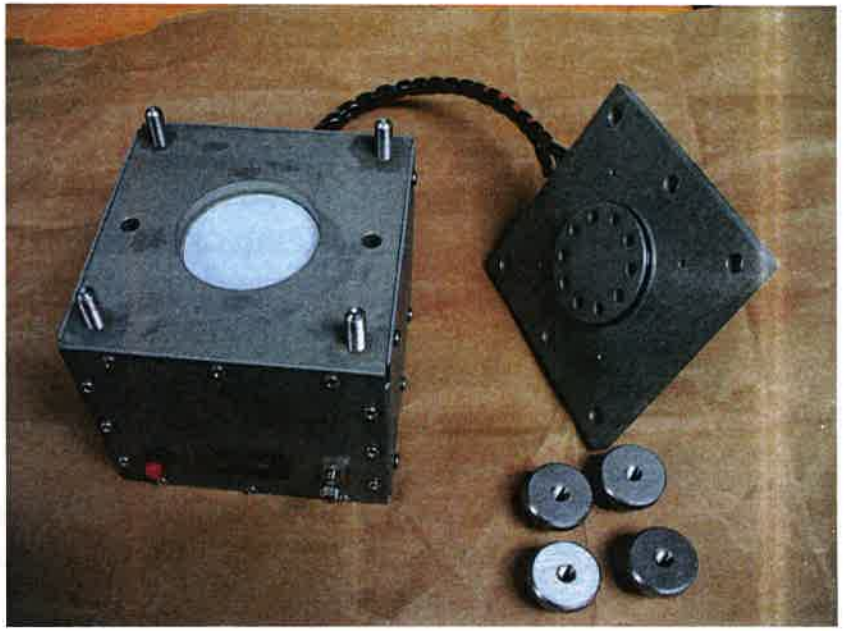
2) Turn off the power to the neph AC/DC power converter. This is located on the backside of the rack. You can trace the black power cord back to the power supply. There is an on/off switch on the power supply. Remove the neph from the rack. Remove the front cover of the neph.
Wait for the lamp to cool down.

3) GE spare lamps: These look like small projector lamps. They are located in the AOS supply boxes.

4) See the attached photo. There is a cover with two screws that has to be removed in order to access the lamp.
Remove 2 screws with yellow circles in the photo.
Remove the nut to which the arrow points. (not a problem on most nephs)
There is a lever arm to push the lamp out of the socket. You will need to use your finger to push the lamp down out of the track as the lever arm isn't strong enough. You can insert the new lamp into the socket, making sure the lever arm is above the lamp.
Replace the lamp cover and the neph cover.
5) Once the lamp is replaced turn back on the neph power. Connect any fittings that were removed.

Continuous Light Absorption Photometer CLAP

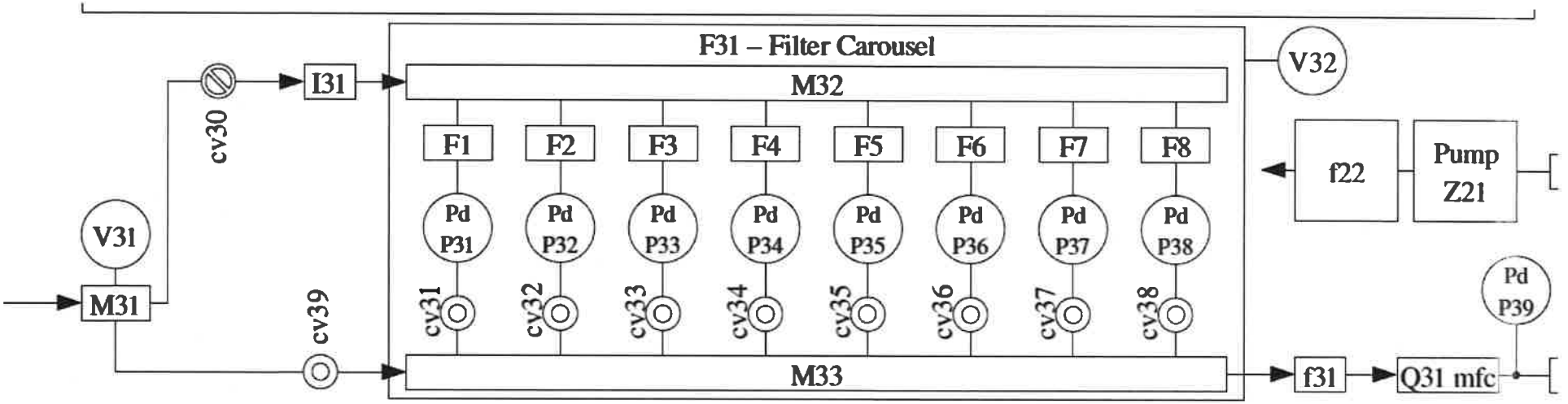




CLAP Filter Change Procedure

1. Press the red button on the front panel of the CLAP to signal the start of a filter change.
2. Unscrew the 4 nuts on top of the panel using the torque driver. Remove the top and lay it carefully on the side or top of the instrument so that filter material doesn't fall into the instrument optics.
3. Remove the filter and clean the top surface with a kimwipe or paper towel and alcohol. Make sure none of the filter material falls into the optics.
4. Using tweezers remove e new filter from the box and place it in the bottom of the CLAP holder. Make sure the white, textured surface faces up and that there aren't multiple filters stuck together.
5. Replace the lid on top of the CLAP with the wires pointing toward the back of the instrument. Screw the 4 nuts in place and tighten them with the torque wrench.
6. Press the red button on the CLAP front panel to signal the end of the filter change. The red light should turn off.
7. The cpd software will wait until the light intensities through the 10 spots have stabilized and then start sampling. Once sampling starts set the CLAP flow to 0.9 lpm by turning the flow adjustment knob on the front of the instrument.
8. If the red light continues to blink or if there are non-zero flags in the CLAP data menu in CPD then redo the filter change or try advancing to the next filter (<m>,<advance filter>).Contact mentor to trouble shoot if these don't work. If the software data acquisition was off, there was a power outage or the CLAP lost power then either a new filter will be needed or the filter will need to be advanced to the net spot.

Flow diagram of filter carousel



Sample flows through manifold (M31) and inlet RH/T sensor (V31)through a solenoid valve (CV30) and an aerosol impactor (I31) into a manifold (M32). When the wind direction is from the clean sector then one of the valves (cv31-cv38) will open and allow air to flow past one of 8 filters (F1-F8). Delta pressure sensors (Pd P31 to Pd P38) record the pressure drop across the filter. Only the sensor with flow should have a large pressure drop. All other Pd values should be low. If more than one Pd value is high this indicates a leak in the flow line. Check that all the quick connect fittings are secure and that all the hoses to the Pd sensors are connected. Air exits the filter into manifold M33, filter f31 and through the mass flow controller Q31 to the vacuum pumps.

PMEL Aerosol Filter Carousel Filter change Procedure

1. Turn on the pump on the top of the filter change glove box and flush for at least 30 min prior to use. *(turn it on before 23:30 for a filter change at 00:00 UTC.)*
2. After the filter has completed its sample cycle, enter the filter menu on the aerosol computer and start a filter change from the submenu.
3. Follow the submenu instructions to close the manual ball valve and then remove the filter carousel with the impactor from the filter box. *(The impactor is attached using a torr fitting behind the main body of the impactor. Loosening the fitting will be clockwise from the front of the filter box. It might help to lift upward on the filter carousel while loosening, check the gasket for wear periodically)*
4. Separate the impactor form the filter carousel.

Filter Change:

1. Insert the filter carousel with a new PVC filter container into the filter change glove box. You should use three sets of gloves. *(an outer set of blue latex gloves over the long gloves attached to filter change box, over some light inner gloves to keep your hand from sticking to the outer gloves)*
2. Open the filter carousel following the knob order engrained on the filter change carousel. *(black first then white)*
3. Open the used PVC filter container and take out the rubber spacers. Place the used filters in the container with a rubber spacer between each filter and also one at each end.
4. Close the white filter container and write the time that you took them offline. Usually the new UTC date and 00:00 UTC.
5. Similarly load the new filters into their appropriate position and make sure they are placed in position 1-8 according to how they are labeled on their sides. Close the filter carousel in the reverse knob order that you opened it with. *(Ex. white first and then black)*
6. With the rubber spacers inside, close the new white PVC filter container and write the approximate time that you think you will be putting the filters online on the side of the new container. Ex: date and 00:45 UTC.

Impactor cleaning: (refer to picture of disassembled impactor)

1. With the impactor and new impactor films in the filter change box, loosen the sides of the two arms holding the impactor together. *(Use the red, cylindrical mount to prop up the impactor during a cleaning to avoid taking the impactor apart on its side and having it all come apart.)*

2. In general you want to clean any and all parts of the impactor that do not appear clean using Kimwipes and alcohol.
3. Remove the top section of the impactor and expose the plate with vacuum grease. If there are particles impacted in grease it should be cleaned and replaced with new grease.
4. Below the vacuum greased impactor plate should be an additional impactor plate with smaller holes around the perimeter. Make sure this plate is clean. Behind it should be a spacer on top of the impactor film and plate. Using the tweezers, remove the impactor film and place it in the its respective Petri dish. (The impactor films are designated by an 'S' for sample and a 'B' for blank).
5. Place the blank 'B' impactor film in place on the impactor, remove it and set it aside in the filter change box for the week. Next, set the sample 'S' film in place and put the impactor back together.

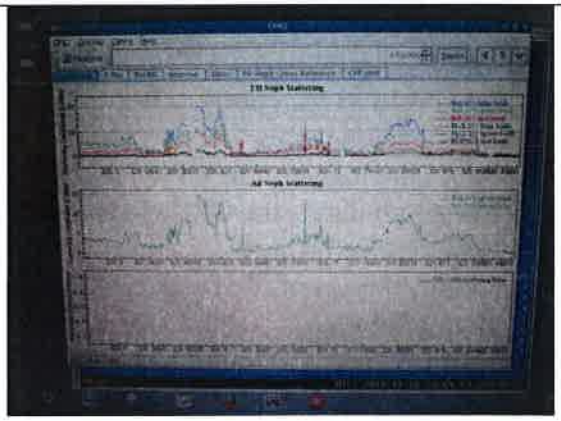
Starting the new samples:

1. Put everything back together as it was when you removed it from the aerosol filter housing.
2. If the filter schedule is changing its sampling frequency *(1 week, 2 week, or 4 weeks)* you will need to reset the CPD program before starting the filter cycle.
3. In the filter submenu, indicate that you have completed the filter change, open the manual ball valve as prompted and begin your filter sampling. *(You should here the solenoid valves pop first from to the filter#1 blank, then onto the filter#2. If winds are in-sector you will be able to see your dP values on your second filter in the appropriate range. If you are out of sector you will see that your status is bypassed)*

Computer Operation

1.0. General

The computer runs a live CD distribution of Linux based on Debian Squeeze. The data acquisition and instrument control is done with a family of programs, collectively referred to as 'cpd', which uses a client-server architecture to separate the continuous operating tasks (acquiring data, writing to disk, controlling instruments) from the user interface tasks. The server is called 'cpd'. There are currently two clients, 'cpd2.cursclient' for text-mode display (i.e., the screen with windows displaying values for different measurement parameters), and 'cpx2' for graphical (stripchart) display. The text-mode client allows the user to issue commands to 'cpd'.



graphical (stripchart) display (CPX2)

cpdclient (text mode) display
also called aerosol data logger window

- Most icons on desktop (rather than in bottom toolbar.)
- Help icon on bottom toolbar pops up menu with useful documents (e.g., this operations manual) and contact info
- All desktop icons require double clicking to activate.

The system clock is set to UTC (7 hours different from Mountain Standard Time in Boulder). The clock is synchronized with a network time server using the 'ntp' protocol. If a network time server is not available, it is possible to use a GPS receiver directly connected to the computer as the time standard. The system clock is displayed in the lower right corner of the Aerosol Data Logger window.

Instruments are connected to the computer via RS-232C ports.

3.1. Startup

This assumes you have a USB stick which is already initialized and a LiveCPD CD. The CD contains everything you need to run CPD on the computer, while the initialized USB stick contains station specific configuration information (e.g., the cpd.ini file) and, depending on configuration, the USB stick is usually the location where data are stored.

Insert USB stick in USB port (either on back of computer or in edgeport module)
Turn on PC.
After a few minutes, the NOAA aerosol data logger window will appear.

There are eight at the bottom left of the screen. The shutdown icon is the ninth icon at the very far right of the screen. Position the mouse over each one to see its function.

Icons for cpd2 desktop

CPD2 desktop functions, left to right
These functions, from left to right, are: 1. Start data logger – the CPD program 2. Stripchart data – the CPX program 3. Send data to NOAA 4. Edit the cpd.conf file (using Nedit) 5. Web browser 7. Icon to bring up a terminal window 8. Stop data logger 9. Shutdown everything!
Click **TWICE** on the icon to activate

During normal operation you should never need to select 1 because the data logger starts up automatically when the computer is turned on. Number 3 also happens automatically, with a frequency between 1 and 4 times per day (an automatic email is generated at GMD detailing what data files have been processed. Occasionally there are some automated warnings based on system parameters in the email as well.

If for some reason you did need to start cpd and the data logger, here's what to do:
To start the data acquisition program, click on the "Start cpd" icon. This will start 'cpd' in a background window, and several seconds later starts 'cpdclient' in the terminal window. To start the graphical client 'cpx', click on the "Stripchart data" icon. This takes a little while to get started so don't keep clicking if it doesn't start right away!! To stop data acquisition and shut everything off, click on the "Shutdown" icon. The "Shutdown" icon will ask whether you want to shut everything down, reboot or cancel the request to shutdown.

These programs can also be started from a command line in a terminal window by typing one of the following commands:
cpd --client → starts the text mode client (blue screen)
cpd.--restart → starts both cpd and text mode client

cpd.--halt → stops cpd and text mode client
cpd --plot → starts the graphical client cpx2
cpd --help → get more command line options

1.1. Shutdown

To cleanly shutdown the computer follow these steps:

- ➔ Click on the "Shutdown" icon on the lower right of the screen
- ➔ This will pop up a small window in the upper left corner saying 'Shutdown', 'Reboot', and 'Cancel'. Choose 'Shutdown' to shutdown.
- ➔ Wait for the computer to display "Power down".
- ➔ Turn off power.

1.2. Archiving and Backing-up Data

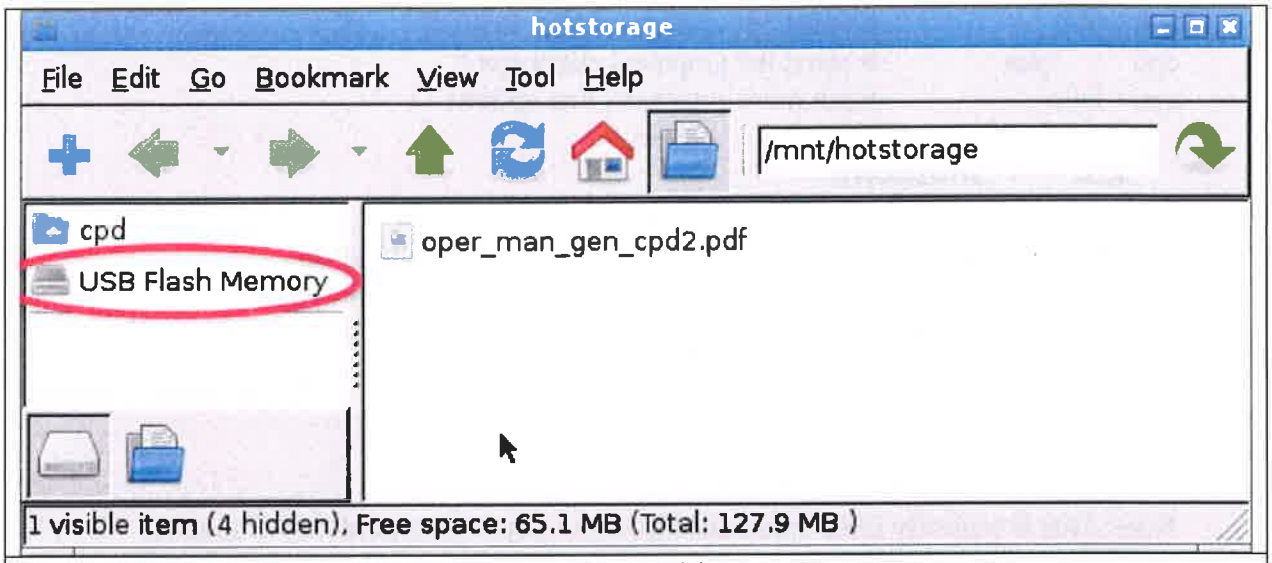
Note: This is typically done automatically, these steps are needed only if manual archiving is required. The data archives are standard "tar.gz" format. The data files are plain ASCII, comma-delimited, with headers.

1.3. Other desktop icons

Two icons at the top-left corner of the desktop start a graphical file manager for browsing the file system. The "Open Tunnel" icon in the top-right corner of the desktop enables remote access to the LiveCPD system for troubleshooting and maintenance.

Clicking on the 'Data' icon opens a window with the file directory in which the current data are being logged (equivalent to /aer/stn/log), while clicking on the 'Storage' icon starts the graphical file manager at the root of the file system.

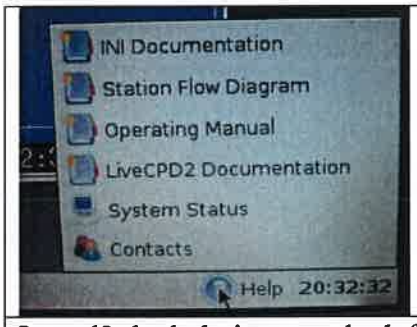
If you need to transfer data or other files from the field computer to another computer, insert a USB flash drive into the USB port on the back of the computer or in the Edgeport adapter. Double-click on the 'Storage' icon, and then click once on the icon for your USB flash drive in the side pane. This will bring up a window with the directory structure of the USB stick. (Note: you may need to refresh the directory window if a different USB stick had previously been inserted.) When you are done with transferring data (or whatever) remove the USB stick – the system will automatically dismount within 30 seconds or so.



File manager window showing icon for USB flash drive

1.4. LiveCPD2 Documentation

There are documents on the desktop explaining how this all works.



In cpd2 the help icon on the left of the bottom toolbar will bring up a menu with links to useful documents.

The "CPD Conf" icon opens a text document that describes all the options that can be put in the configuration file for cpd, cpd.conf. The README icon describes the LiveCPD Linux distribution in detail – how to configure the USB stick, more detailed descriptions of all the icons, etc. This document is called 'LiveCPD2 documentation' in CPD2. The LiveCPD/liveCPD2 documentation also explains the use of the icons in the lower right of the desktop.

1.5. Graphical Client Program (cpx2)

The graphical client is a work in progress. Please send suggestions for improvement to John.A.Ogren@noaa.gov. Documentation for cpx2 can be viewed by clicking on the "Help" item on the cpx2 menu bar. This graphical interface allows you to see what's happening with the data over time, so, for example, you could use it to watch

CN counts get much lower when you put the leak test filter on the stack. To start cpx2 double click on the CPX icon in the lower part of the screen

1.6. *Aerosol Data Logger Program*

1.6.1. General Operation

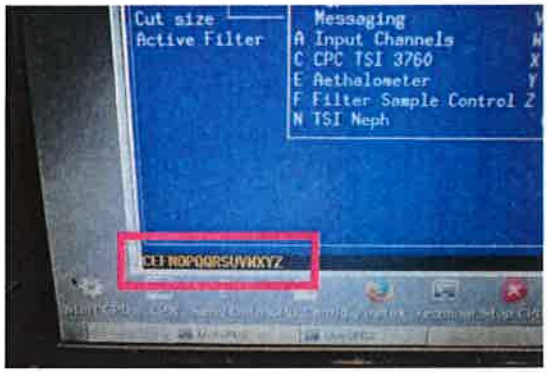
Press <enter> to access menus, <Esc> to abort from any menu or entry box without any changes, a second <Enter> to accept the current entry or highlighted item. Any instrument window can be displayed by the shortcut key <Enter><X>, where "X" is the code letter for the desired instrument. Windows are closed by pressing the <esc> key. Pressing the <Tab> key cycles the view among all the active windows. Windows can be repositioned on the screen using the arrow keys. Menu entries can be selected with the arrow keys or pressing the numerical digit for the desired selection.

The program will request an access code if you select a menu item that will result in a change to the data being logged to disk, in order to prevent inadvertent changes. The access code is 'cmdl' (lowercase is necessary).

Keystrokes	**Action**
<enter>	Shows root menu
<esc>	Shows root menu and hides any active menu
<Enter><X>	Selects root menu entry 'X' when root menu is not focused (X can be A,B,C,D,F,G,H,L,M,N,O,S,U,V,W or others depending on the station)
<enter><enter>	Online log entry (message window)
<F12>	Online log entry (message window)
<control><E>	Toggles red error window (if present)
<control><C>	Quit cpdclient
<M>	Shows menu for active window
<esc>	Closes active window
<tab>	Cycles through open windows
Arrow keys (in menu)	Move thru menu list
Number/letter (in menu)	Quick select on menu list
Keystrokes	**Action**
<enter> (in menu/dialog box)	Chooses or toggles selected item
<enter> (dialog box)	Begins 'enter input' mode, text will be bolded; pressing <enter> again will end input mode
<esc>	Exits menu/dialog box without applying changes
<enter> (with bottom entry selected in dialog box)	Closes dialog box and applies all changes
<enter><enter>	Brings up message window

1.6.2. Display

The "base" display consists of a "root" window for displaying current values for ambient measurements and a status line at the bottom left of the screen.



←status line location (in pink box) in root window

←example status line

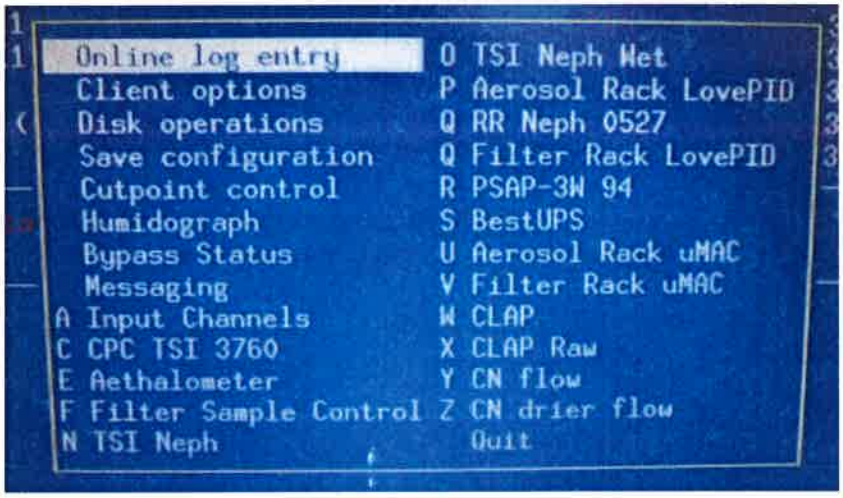
The bottom status line gives the code letters of the active instruments and the system date and time. If the code letter for an instrument is absent, then that instrument is not present or not responding.

The code letters are assigned in cpd.conf, and vary from station to station. Status windows for specific instruments can be displayed by pressing <enter> plus the code letter for that instrument. Note: the code letters are can be assigned to any instrument, however we try to be (mostly) consistent. Common assignments for code letters are:

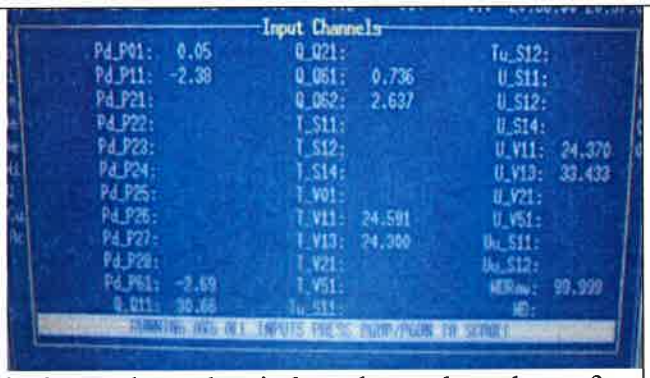
A – Analog signals (e.g., flows, Ts, RHs, Ps, wind speed/direction)
B – Best UPS
C – CN
D – CCN
E -- CLAP
F – Filters
G – GPS
M- contamination
N – nephelometer (reference/dry) active
P – PID Box – this is box with T/RH and flow control
R – could be PSAP (esp. if it's a 3-w PSAP), or for second PID box
T – TSI mass flow meter
U - μMAC1050 A/D I/O subsystem
V - μMAC1050 A/D I/O subsystem

1.6.3. Root Menu *<enter> or <esc>*

Pressing <Esc> or <enter> brings up the root menu, with the following choices (shortcut keys are in the left column). Use the arrow keys to highlight the desired action and then press <Enter>:
(Not all stations have all of these options – it depends what instruments are deployed.)

→	Online log entry	allows the user to make an entry in the system log file. Think of this as an on-line logbook, and use it liberally. Each entry can be at most 8192 characters long, and each entry is recorded with a time stamp. Please make an entry for any deviations from normal operation, such as exceptions that you note on the daily checksheets. These logbook entries will be sent to the GMD aerosol group by email shortly after the data are sent to Boulder.
→	Client Options	controls some features of the client program.
→	Disk operations	allows the user to flush any buffered data to disk, and to change to a new set of data files
→	Save configuration	Saves layout of windows if you have a cpdclient set-up you like
→	Cutpoint Control	Allows to change size cut or disable cutpoint scanning
→	Humidograph	Allows to change humidograph setpoints or disable humidograph scanning
→	Bypass status	Allows to bypass/unbypass analyzers (e.g., during impactor service)
→	Messaging	Starts Instant Messenger
A	Activate the analog signal window	 Example root menu. Note: two Q items – that will not work!
C	Activate the CNC status window (shows current concentration)	
D	Activate the CCN status window	
E	Activate Aethalometer status window	
F	Activate the filter status window	
G	Activate the GPS status window (Filter#2 at BRW)	
L (or R)	Activate the PSAP status window (L or R depends on your system, only one will work)	
N	Activate the nephelometer status window (Typically this is the 'dry' or 'reference' neph.)	
O	Activate the second neph status window (Typically this is a 'wet' or 'humidified' neph.)	
P	Activate the PID box status window. (PID box controls T/RH/flow)	
U	Activate the umac status window (This is the main umac.)	
V	Activate the 2nd umac status window (This is the umac that typically controls the filter carousel.)	
W	Activate CLAP	
→	Quit	Quit cpd client

1.6.4. Input Channels Status Window and Monitor Menu <enter><A><M>



The input channels window shows the values of monitoring parameters like temperatures, humidities, pressures, flows and wind speed/dir.

The input channels menu allows you to look at all the signals or just select signal types (temperatures and RH (T and U), pressures (P) , flows (Q)) by toggling through them. You can also display running averages or the last average value.

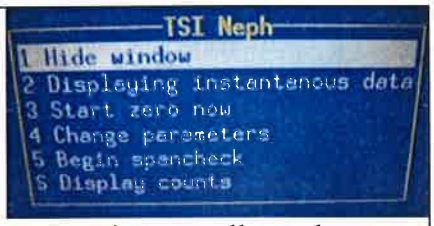
Window hide/Window unhide <1> changes visibility of status window

Averages <A> context-sensitive function to display averages, running averages or instantaneous values of analog input signals

Toggle <D> context-sensitive function to switch between screens with all parameters or screens with just one type of parameter (e.g., only pressures or only flows)

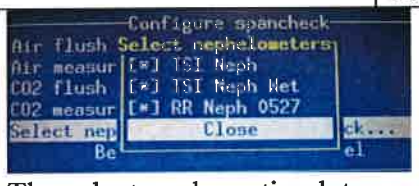
1.6.5. Nephelometer Status Window and Menu <enter><N><M> or <enter><O><M>

This window shows the current state of the nephelometer, including measured light scattering and back scattering at 3 wavelengths, neph monitoring parameters like temperature and voltage and neph state.



The neph menu allows the user to do a span check and change neph parameters.

The change parameters menu lets the user talk directly to the neph



The select nephs option lets you choose which neph(s) to do a span check on.

The configure span check option allows you to change span check parameters.

Window hide/Window unhide <1> changes visibility of status window

Display instantaneous/last average data <2> toggles between displaying 1-s data or running averaged data

Start Neph zero <3> starts neph zero

Change parameters <4> Activates a menu for sending selected commands to the nephelometer. Not normally used except for troubleshooting.

Span Check /Abort Span Check <5> context-sensitive menu to start/abort a CO_2 span check.

Display counts <S> toggles between nephelometer photon counts and nephelometer scattering

1.6.6. CLAP Menu <enter> <L> <M> or <enter><R><M>

Window hide/Window unhide <1> changes visibility of status window

Start filter change/ End filter change <2> Context-sensitive menu to start/end a filter Use this function to prevent data logging during a CLAP filter change, and to generate automatic log file entries when PSAP filters are changed. The protocol is to use this function to indicate the start of the filter change but to let the CLAP autodetect feature figure out when the filter change is done.

Start white filter check <3> This feature (run only when you've started a new box of filters or some sort of servicing has been done to the instrument) determines the characteristics of a white filter. One puts a new filter into the CLAP and then begins this check. During this check the flow is zero and the red light is lit. The white filter check will **not** automatically end, you must select this command a second time ("End white filter check") to terminate the white filter measurements and begin normal sampling.

Advance spot <4> This feature allows you to move to a different spot on the filter. I.e., if you are on filter spot#6 and want to move to filter spot#7. Note: this is probably more useful for field campaigns than day-to-day operations

Various display options <D> this feature has seven possible display modes you can cycle through in order. They are:
→display intensities - These are the raw intensities of all spots for all four sample modes (red, green, blue, and dark) as reported by the instrument.
→display intensities relative standard deviation (RSD) – The RSD of the raw intensities over the"normalization" period (normally 60 seconds, but can be changed in the configuration file).
→display normalized intensities – This is the ratio of each sample spot and its corresponding reference spot. For example, the first normalized intensities is the second raw spot over the last raw spot, both with the respective dark value subtracted before division.

→display normalized intensities RSD – The RSD of the above over the normalization period.
→display white filter ratios – The ratio of the current normalized intensities over the normalized intensities of the last white filter. This is similar to the transmittance relative to the last white filter (the difference being that the white filter normalized intensities do not account for filter flexing due to flow). At the end of a white filter check, with no flow, all these will be 1.0.
→display filter start ratio – The ratio of the current normalized intensities over the normalized intensities from the end of the last filter change. This is similar to the transmittance except that it does not acount for filter flexing due to flow (this can often be seen by there being a distortion away from 1.0 on unsampled spots for all the even or odd channels, depending on what reference is currently in use). With no flow, all unsampled spots would nominally be 1.0, and sampled spots would be their last transmittance.
→standard display (this is the typical display mode with flows and transmittances, etc)
To move among these you would select <M> then <D> until you get the desired display mode.

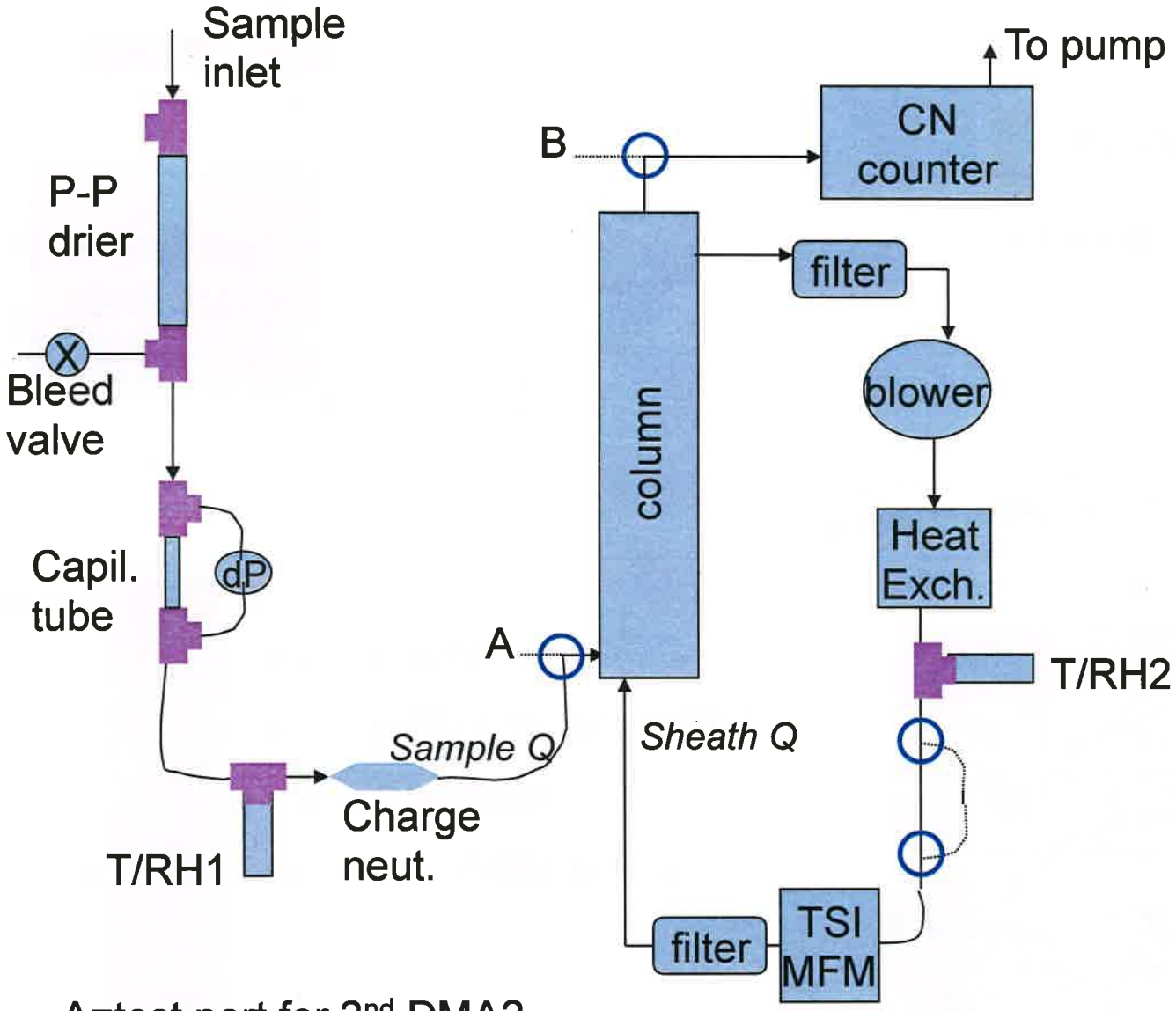
1.6.7. Filters Menu <enter> <F> <M>

Window hide/Window unhide <1> changes visibility of status window

Filter change <2> context-sensitive function to notify system that the filters will be changed. Changes to "Filter start" when changing.

Filters bypass/Filters unbypass <3> context sensitive function to allow manual bypassing of filter samples

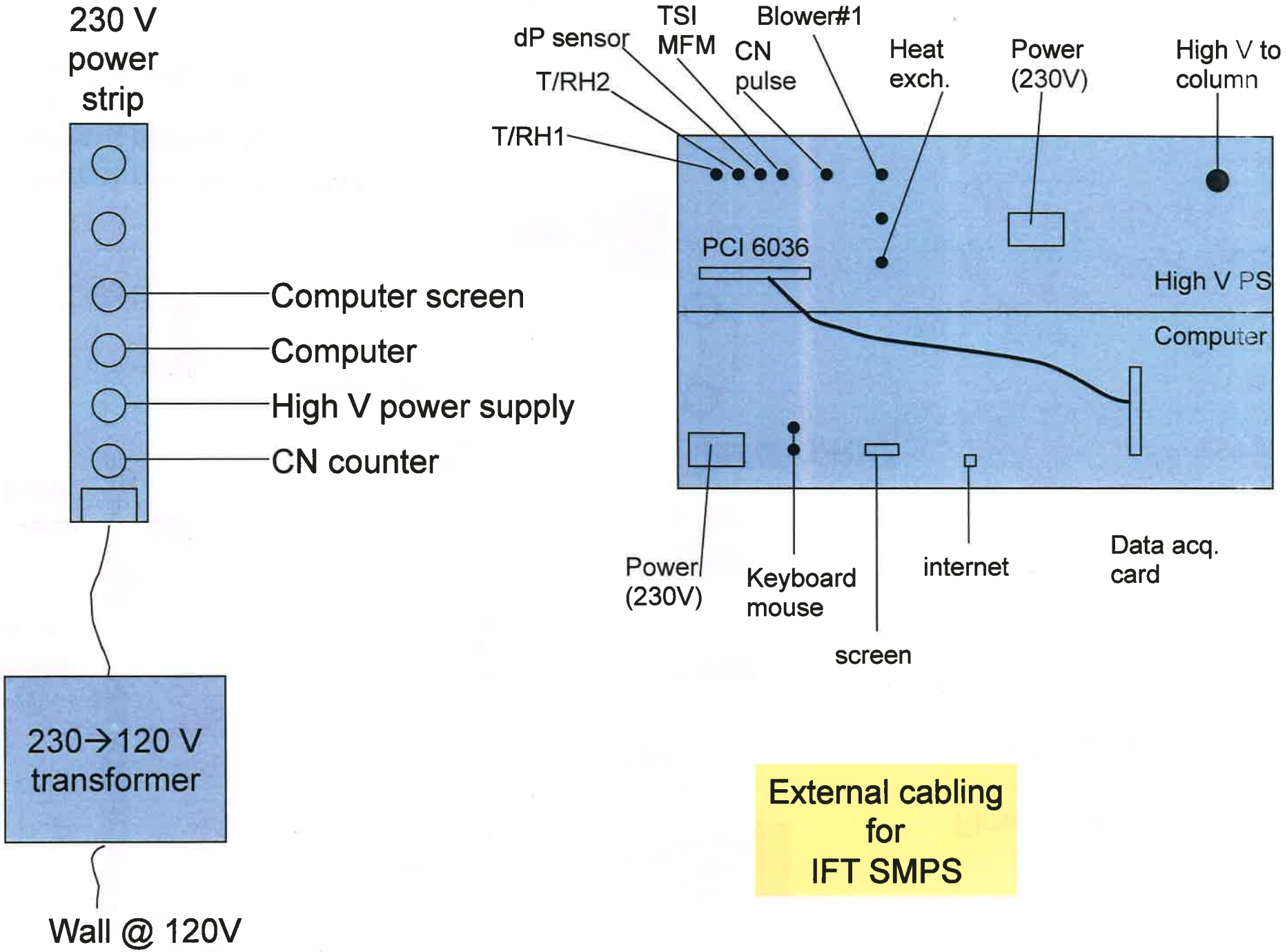
NOTE: to cycle through filters to be sure they are all changing, a parameter in cpd.conf file needs to be adjusted. Talk to station scientist to figure this out.



Flow Schematic for IFT SMPS

A=test port for 2nd DMA?
B=test port for CN counter

○ = 3-way valve



External cabling
for
IFT SMPS

Barrow SMPS Monthly Checks (2013)

Note: Perform Checks in order or you may get anomalous results. Ex: after checking the sheath air flow (check#3) elevated levels of sheath air counts may occur due to arcing of DMA at high voltages!

- Enter a message in both the SMPS log and the aerosol computer log that you are doing the monthly SMPS checks. The SMPS logbook.vi program is located on the computer desktop and automatically opens during start up.
- Press [stop] symbol and close scan.vi program for duration of checks.

1.) Zero-Check (checks for leaks/problems with CPC):

- Turn the *zero/flowcheck valve* above the sheath column upwards (fig 1). Make sure that a zero filter is attached to the other end of the air line connected to the top of the column.

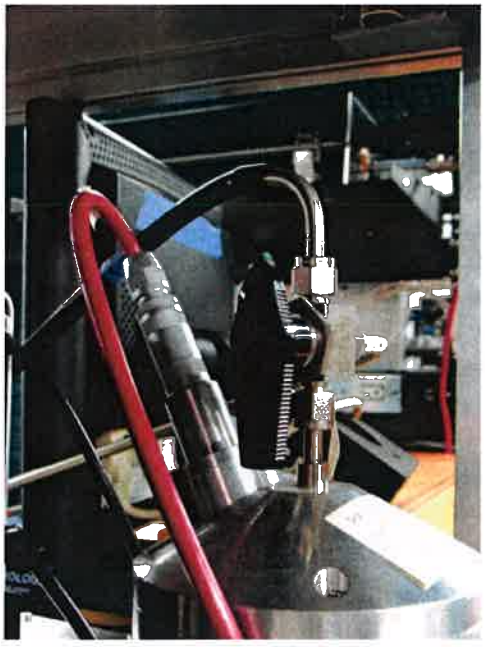


Figure 1 – zero/flowcheck valve (zero position)

Figure 2 – zero filter

- Wait 15 min. to flush out particles.
- Make sure the CPC concentration counts are displayed in PT/CM^3. Toggle by pushing [display] on the CPC.
- Observe concentrations. Counts should be less than 1.0 PT/CM^3

2.) Aerosol Flow Check

- The *zero/flowcheck* valve should remain in the zero position (fig 1).
- Connect the air line to the gilibrator outlet instead of the zero air filter. (fig 3)

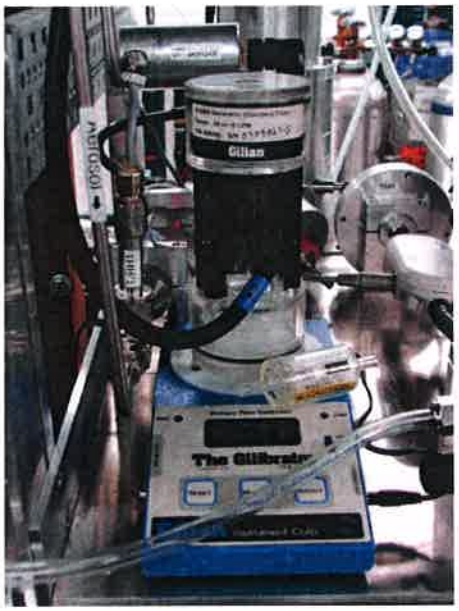


Figure 3 – Gilibrator during aerosol flow check,

Figure 4 – aerosol flow adjustment needle valve

- Add a small amount of soap solution (not pure soap!) to the lower nipple of the gilibrator using the fill bottle.

Gilibrator Notes:

1.) The gilibrator measures in cc/m. (1000cc/m = 1 LPM)
2.) Start by adding enough soap to cover the base of the gilibrator, add solution as needed to produce bubbles rising in the column.
3.) Bubbles will not rise in column unless there is correct flow.
4.) To get a correct reading you will need to need to have single, clean level bubbles rise through the column. Consecutive bubbles are not a problem.
5.) You will need to reset the averages on the gilibrator several times, after mal-formed bubbles appear or after flow adjustments are made.
6.) When finished, the gilibrator needs to be cleaned. (At the very least, flush with water enough to avoid soap build up)

- Check flows using the gilibrator. Push the black button on the bottom of the gilibrator to produce bubbles rising in the column. Make a note of the original aerosol flow measured by the gilibrator.
- Regulate the aerosol flow to 0.50 LPM +/- 0.01 LPM using the needle valve located on the rear outlet of the CPC (fig 4). After each adjustment made to the needle valve, check the flow. Repeat until adjusted to within range.

- Record the original and final aerosol flows to the SMPS system log (logbook.vi).

Note: A reading different form the 0.5 LPM does not affect measurements. We only need to know what is indicated (stored in the diagnostic data files).

3.) Sheath Air Flow Check

- The *zero/flowcheck valve* remains in the zero check position.
- Switch the *sheath air valves* to the sheath air flow check position (fig 5).
- Connect the clear tubing attached to the sheath air valves to the inlet and outlet of the gilibrator as shown (fig5).

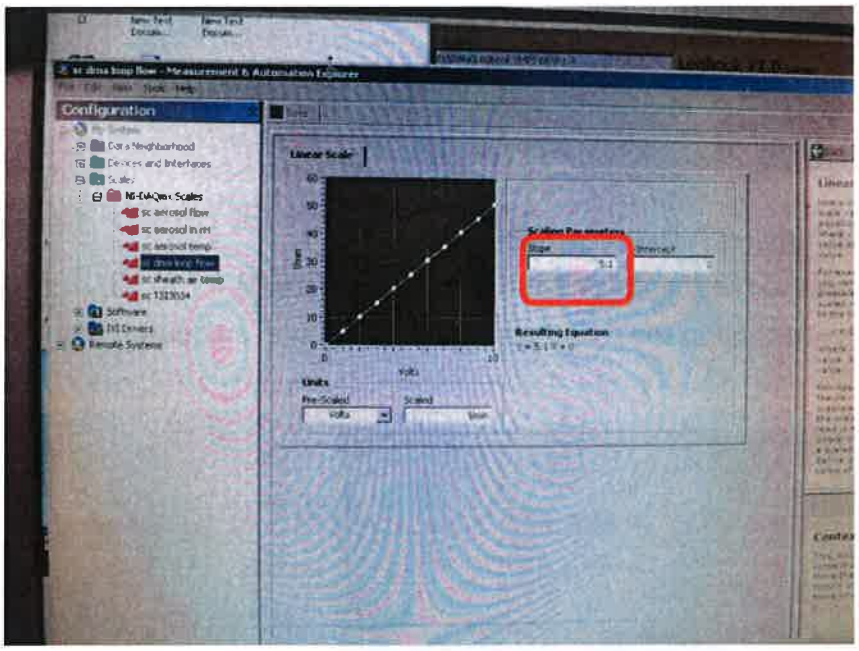
Figure 5 - sheath air valves in sheath air flowcheck position

- Open the setflow.vi program on the desktop. Ensure that blower is on (green light in lower right corner of scan.vi window)
- Wait for stabilization of sheath air flow mean value (number labeled 'mean' in scan.vi)
- Measure flow using the gilibrator, attached as in picture above. (consecutive bubbles are OK but you don't want mal-formed bubbles, reset averages as needed to get correct readings)
- If the flow is outside of the 5.0 +/- 0.1 LPM range the sheath flow needs to be adjusted.

Flow Meter Adjustment

- Open the *Measurement and Automation* program (shortcut on the desktop).

Figure 6 - Measurement and Automation Program



- Navigate through the configuration menu.
  - ➔ Scales
    - ➔ NI-DAQmx scales
      - ➔ sc dma loop flow
- Click on 'sc dma loop flow'
- Modify scaling parameters by entering the measured sheath flow from the gilibrator in the box marked "slope" (.
- Press save, this will adjust the flow meter reading.
- Go back to the seflow.vi program and click the [->] arrow to run. Wait until the setflow.vi has completed its calibration cycle and adjusted the blower voltage.
- Again, measure the flow rate in the gilibrator and repeat the adjustment process for changing the slope in the Measurement and Automation program until the sheath flow is within the range of 5.0 LPM +/- .1 LPM as measured by the gilibrator.
- Once a correct sheath flow is established, you can close the Measurement and Automation program, and prepare the system to return to running scans.

Finishing Up

- Stop the setflow.vi program. (click stop sign, close program)

- Return the *zero/flowcheck* valve to downward sampling position (fig 8).
- Switch *sheath air* valves back to regular operating position, pointing inwards (fig 7).
- The CPC should remain in concentration display.
- Restart scan.vi program with shortcut on desktop. Scans should automatically commence.
- Make a note in the SMPS log that the monthly checks are complete.

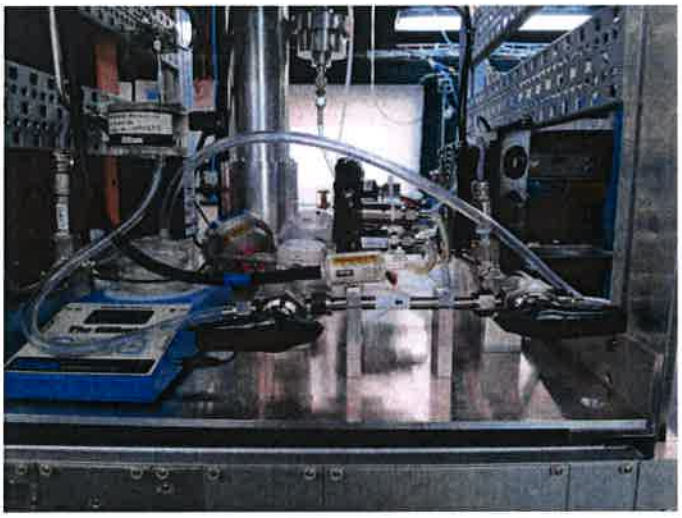


figure 7 – sheath flow valves, regular operation

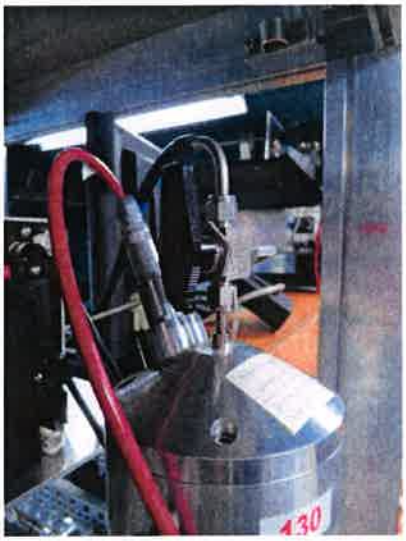


figure 8 – zero flowcheck, downward position