NOAA Frostpoint Hygrometer Reconditioning Instructions

Version 0.14, 2014-10-20

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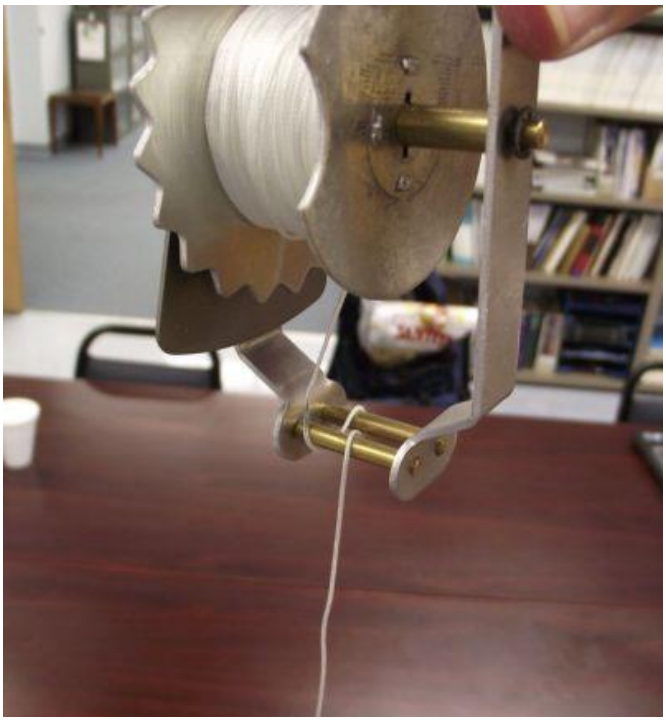
Flight Train Preparation (anytime)

1. Setup the flight train components as shown:

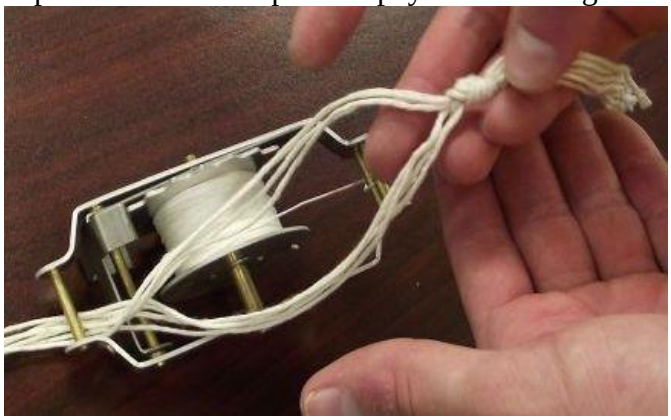
2. Attach the swivel clip to the top of the parachute with a hitch knot:

3. Prepare the payout reel:
    A. Remove the tape to free the end of the string.
    B. Pull the string to unwind from the axel.
    C. Wrap the string into a figure eight configuration around the two friction bars:





4. Attach the parachute to the top of the payout reel using a hitch knot.




   A. Tape or cut off the extra parachute cord so they don't get caught in the unwinder on launch.
5. Attach the bottom clip to the payout reel's cord:

Cryogen Tank Cooling (1 to 4 hours before launch)

1. Purchase 15-20 lbs of dry ice 1 to 4 hours before launch.
2. Place the dry ice on top of the cylinder inside the large white cooler.

NOTE: If you have a -75 deg C freezer at the balloon launch facility you will not need dry ice.

– Skip if sonde is New – Reconditioning Hygrometer (days before launch)

1. Clean up the instrument package after recovery or when it is returned.
    A. Remove and discard all tape from the instrument package.
    B. Take off the radiosonde.
    C. Remove the battery foam box from the hygrometer.
    C. Replace the hygrometer batteries in the 3 C cell battery holder and tape it back up using electrical tape. Measure the voltage with a voltmeter to make sure they are above 9.0V.
    D. Replace the double sided tape on the battery box along the long edges of the box.
    E. Remove the intake tubes. Curved needle nose pliers are helpful in this task. Be careful not to twist the instrument too much which could cause the seal to break between the Dewar and cold finger.
    F. Clean the sensor housing, mirror, and lens area getting rid of all dirt and left-over glue. An X-acto knife is handy to scrap any residual epoxy left on the sensor housing.
    G. Check the Dewar for leaks by filling with water. If it leaks you might be able to repair with silicon RTV glue. If not, please send the instrument back to so we can replace the Dewar.
    H. Check to see that the ozonesonde box is not damaged and replace if need be.
2. Check the hygrometer circuit board to make sure it still works properly.
    A. Open “Hygro Control” and attach the UART cable to the FPH circuit board UART0 (selecting the right com port if necessary)
    B. If it fails to connect to the port, disconnect then reconnect the usb cable to the level converter, then select the proper com port again from “Hygro Control’s” menu.
    C. Plug in the instrument using a bench power supply with 8.6V. The led should blink. The current draw shouldn’t be larger than 0.5 amps. Unplug the instrument if the current meter is above 0.5 amps and clean the entire sensor housing again.
    D. If the error value is below 32767 on “Hygro Control” you will need to adjust the trimpot on the board so that the error value reads above 32767 (ideally 41418 +/-50 ADC counts).
    E. If you are unable to adjust the error value to around 41418 ADC counts after cleaning please unplug and ship the instrument back to Boulder to get refurbished. Please don’t keep the instrument plugged in for long periods of time when the error value is below 32767 as the mirror

heater will be on. We have a safety limit built into the code that won't allow the mirror heater to heat the mirror warmer than ~ +35C but we still like to minimize the potential damage if we can.

3. Once the error value is set to 41418, continue to check all of the fields on "Hygro Control" to make sure they all are reading numbers that make sense. The important fields to check are listed below.

A. The *Error* value needs to read above 32767. Anything above this number is good but try and set it to 41418 +/- 50ADC counts.

B. *Corrected error* will report the *Error* value with the *Sun* value subtracted off.

C. Any ambient light will be seen in the *Sun* value. This should be less than 120 counts.

D. We want to see the *Mirror PWM* value be 0.

E. Check that the *Pressure* is within 3mb of room pressure. The pressure sensor temperature (*PTemp*) should read between room temperature and the optics block setpoint temperature.

F. Next, the *Battery Voltage* should read close to the voltage you are supplying the instrument with. Anything between 8.1 and 9.0V will work with 8.6V being optimal.

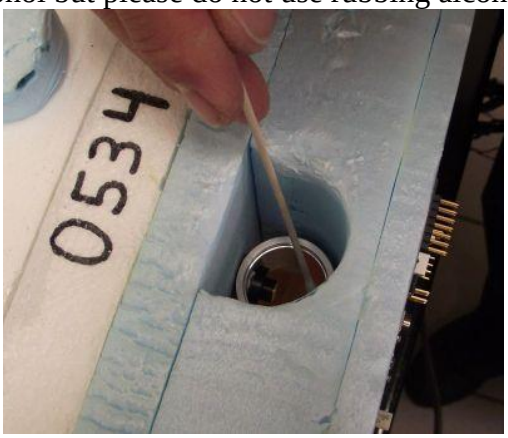
G. The *Optics Block Temperature* will hopefully stabilize at 31.99C. We typically see this value stable within +/- 0.01C.

H. The *Mirror/Thermistor Calibration* box should display the hygrometer number that matches the number written on the foam with sharpie. Select the correct mirror number if it doesn't.

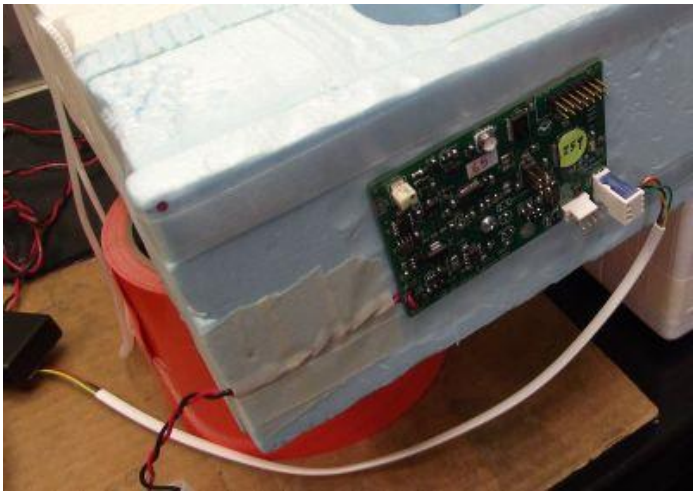
I. Finally, the *Frostpoint Temperature* is the most important field. It should be reading near room temperature unless the mirror heater has warmed the mirror recently.

Hygrometer Preparation (day of launch)

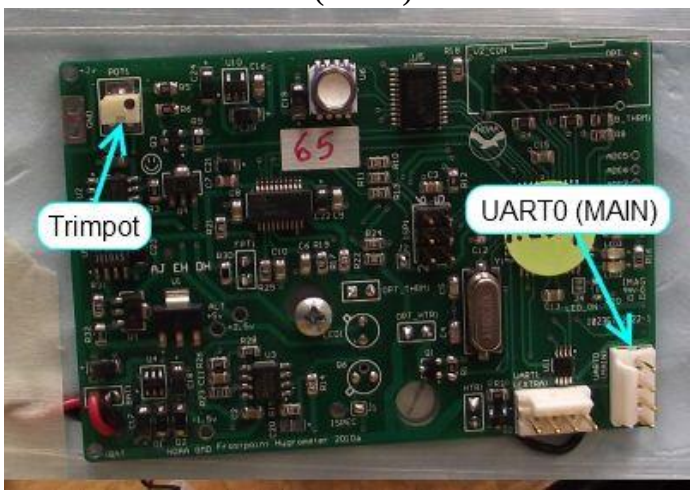
1. While powered off, clean the hygrometer mirror with a cotton swab and methanol (or use 195-200 proof alcohol but please do not use rubbing alcohol).

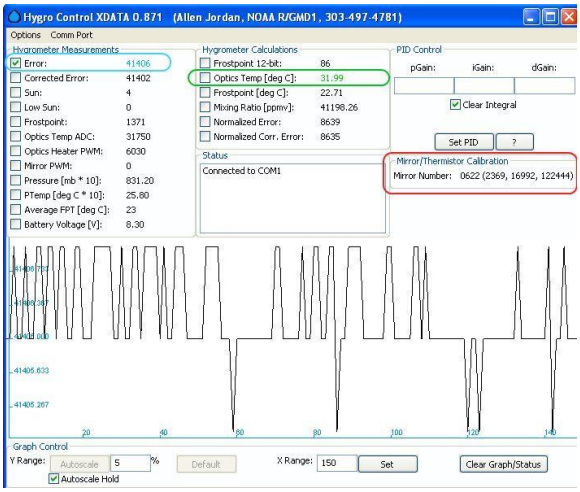


2. Attach the 4-wire xdata cable from the level converter to the hygrometer board's "UART0 (MAIN)" header.



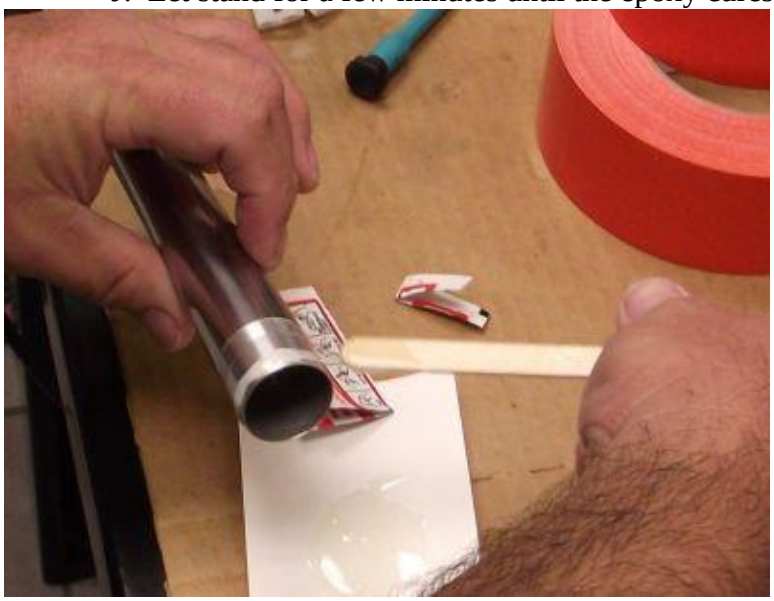
3. Plug the hygrometer into the power supply set to +8.6V DC (or use the test batteries). You will see the onboard LED blink once for each 100 millibars of ambient room pressure.
4. Open "Hygro Control" (selecting the right com port if necessary)
    A. If it fails to connect to the port, disconnect then reconnect the usb cable to the level converter, then select the proper com port again from "Hygro Control's" menu.
5. Monitor the "Optics Temp [deg C]" field, waiting until the value becomes green at 31.99 deg C.
6. With the optics temp stable in its green temperature range, examine the "Error" field which shows the frost coverage of the mirror.
    A. Using the trimpot screwdriver, adjust the hygrometer's timpot until the error value becomes blue around 41418 (+/- 50).





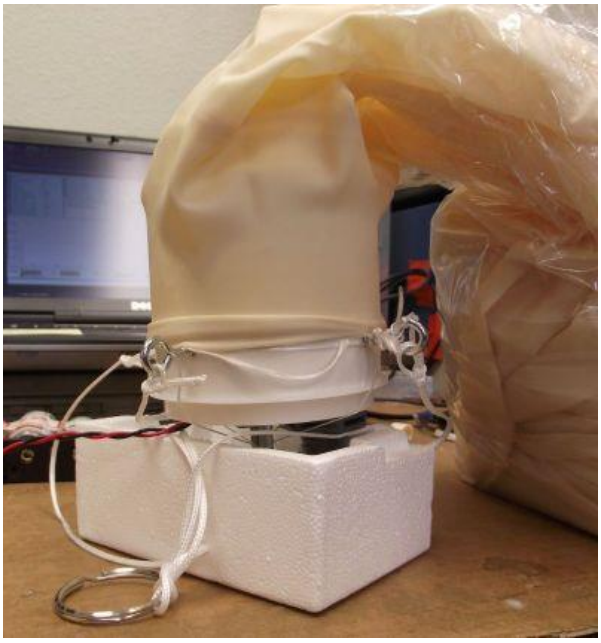
7. Double check the "Mirror Number" field in the "Mirror/Thermistor Calibration" section, making sure the leftmost number matches the hygrometer's instrument number (written on the foam hygrometer package with sharpie marker).
8. Check the "Frostpoint [deg C]" field. It should be reading approximately room temperature.
9. Close "Hygro Control" and gently remove the xdata cable from the hygrometer board.
10. Unplug the hygrometer from the power supply or test batteries.
11. Attach hygrometer intake tubes with the 5 minute quick setting epoxy:
    A. Flip the hygrometer upside down on a table to prepare for inserting the lower tube.
    B. Locate the two hygrometer intake tubes and one or two packets of "double bubble 5 minute epoxy," along with a mixing stick and disposable piece of paper to mix on.

C. Squeeze one packet of epoxy onto the mixing paper and mix thoroughly with the stick.
D. Apply epoxy all the way around the stiff aluminum end of one tube, keeping the glue approximately 1 mm away from the end. Be careful not to get any epoxy inside the tube.
E. Stick the epoxy-coated end of the tube into the hygrometer housing, making sure it seats properly. Put two pieces of tape between the tube and the foam to keep it from falling out later on. See photo below.
F. Flip the hygrometer over (avoid bumping the tube) and hang it up.
G. Apply epoxy to the second tube in a similar fashion (if the epoxy is dry or too hard, make another batch of epoxy first).
H. Stick the second epoxy-coated tube into the hygrometer housing.
I. Visually align the tubes while looking down through both of them. Adjust as necessary, making sure the tubes are still seated properly.
J. Let stand for a few minutes until the epoxy cures.

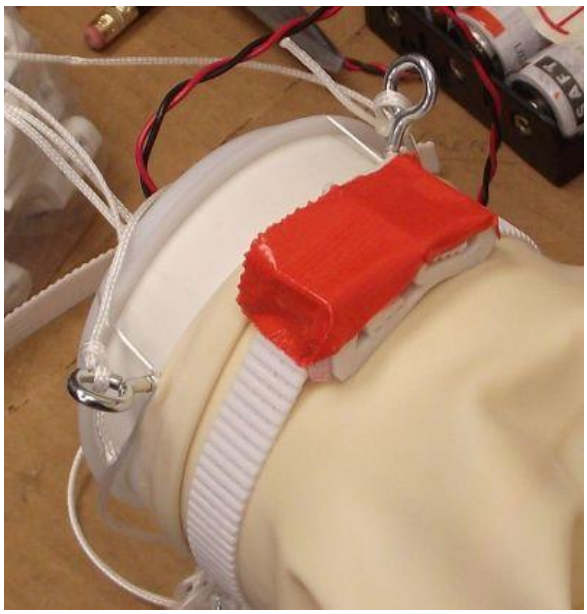


Prepare the Balloon and Valve (day of launch)

1. Open the bag containing the balloon and remove just the neck portion.
2. Place the balloon valve upside down on the foam stand, with the bare PVC end facing up.
3. The balloon needs to be stretched over the valve.
    A. If you are using a Totex (Japanese/Kaymont) 1500g balloon the neck is too small and will need to be trimmed.
    B. Cut off the least amount possible from the neck to allow tight stretching over the valve by two people (usually this takes several attempts to get the right cut).
    C. If you are using one of the Hwoyee (Chinese) 1200g balloons you will not have to trim the neck of the balloon and can proceed to stretch the neck over the valve.
4. Using two people, stretch the balloon over the PVC valve until it is close to or touching the four eyelet screws.

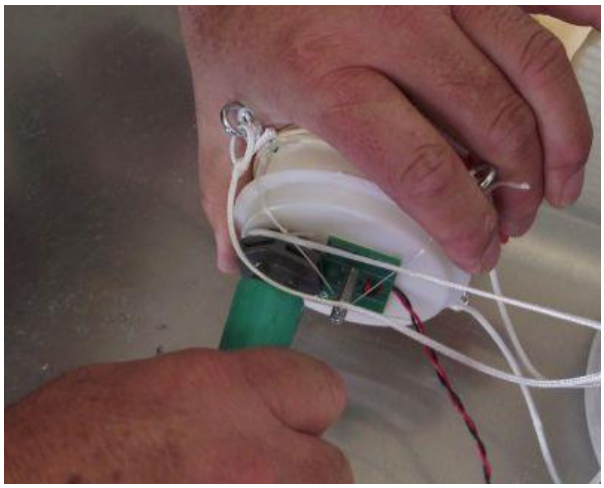



5. Cut off enough banding material to wrap around the valve with some extra for cinching (about 15 inches total or 38cm).
6. Stick one end of the banding into the Q-clip side that dead-ends internally. Wrap the banding around the valve and stretched balloon and stick the other end into the Q-clip.
    A. Push the banding through the Q-clip until several inches protrude from the other side.
    B. Hand-tighten the banding around the stretched balloon area making sure the harness string is out of the way and won't get trapped in the banding.
    C. Use the banding tool to tighten it further.
7. Cut off most of the extra banding material (leave less than 1 inch sticking out), and wrap some tape around the end to cover the sharp edges.

Filling the Balloon (day of launch)

1. Spread the balloon out in the filling area, being careful not to touch it barehanded, with the valve easily accessible.
2. Attach the 4000 gram payoff weight to the valve harness split ring.
3. Attach a second weight to the cord of the 4000g payoff weight to prevent the balloon from rising to the ceiling when full.
4. Attach the hose to the helium tank
    A. Open then close the tank for a quick blast to clear out the hose (or keep the hose end covered when not in use)
5. Press the hose about ¾ the way onto the balloon valve's inlet.




6. Fill the balloon until the payoff weight starts to float, then stop filling.
7. While holding a cork, carefully remove the hose while bracing the valve lid. Temporarily plug the balloon inlet with your thumb and then press the cork in tightly.

Attach the Cutter (day of launch)

1. Open up the valve cutter foam box. Plug in both CR-123 batteries into the board making sure they are inserted in the correct orientation.
    A. The board should blink once for every 100 millibars of surface pressure.
2. Shut the lid, making sure the cable is sticking out.
3. Wrap tape around the cutter and attach it to the cords of the balloon valve, leaving several inches of clearance below the valve lid.
4. Plug in the cutter wire to the valve wire and tape the connector to the cutter's foam box.

Flight Train Attachment (day of launch)

1. Open up the parachute of the now-assembled flight train. Remove any paper labels if still attached.
2. Grab the parachute cords near the payout reel and whip it around to fill the chute with air.
3. Attach the swivel clip to the balloon valve's split ring.

Instrument Package Assembly (day of launch)

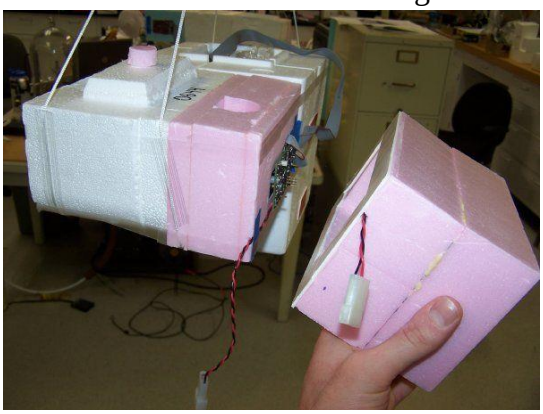
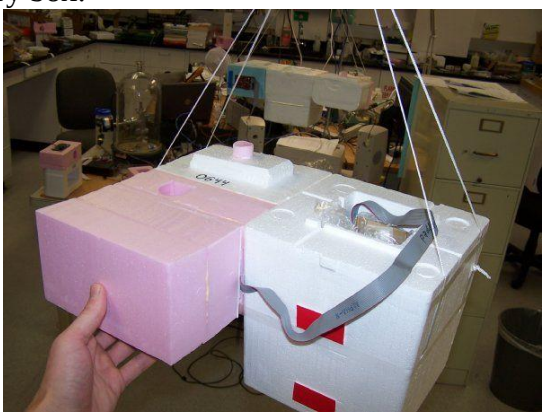
1. With the hygrometer hanging up, locate the iMet radiosonde.
2. Apply two vertical strips of double-sided foam tape down the edges of the radiosonde on the opposite side from the temperature/humidity boom.
3. Stick the iMet radiosonde to the ozonesonde box as shown in the picture below.
    A. Place L-shaped pieces of duct tape between the iMet and the ozonesonde box to secure it further.
4. Attaching the ozonesonde:
    A. Locate an ozonesonde that has been through the checkout procedure. Make sure a new battery pack is taped to the sonde. Make sure the intake tube and the tube leading to the cell are securely pressed into the white Teflon pump.
    B. Remove the metal cover.
    C. If it has a "V2" (vaisala rs-80) circuit board, remove it and replace with a "V7" (iMet) board. The thermistor, cell, pump, and power connections are the same.
    D. Snap off the top face of the metal cover to allow cable access to the board. Place tape over the sharp edge of the remaining cover.
    E. While holding the ozonesonde above its foam packaging, connect the xdata cable from the radiosonde to the V7 board's header labeled "radiosonde." Also attach a loose 16 inch XDATA cable (shipped with the hygrometer) to the "ext comms" header on the V7 ozonesonde board.
    F. Reattach the metal cover and carefully lower the ozonesonde into the foam packaging making sure not to dislodge the intake tube

G. Tape down the loose cables as shown below (but leave the ozone intake tube untapped).

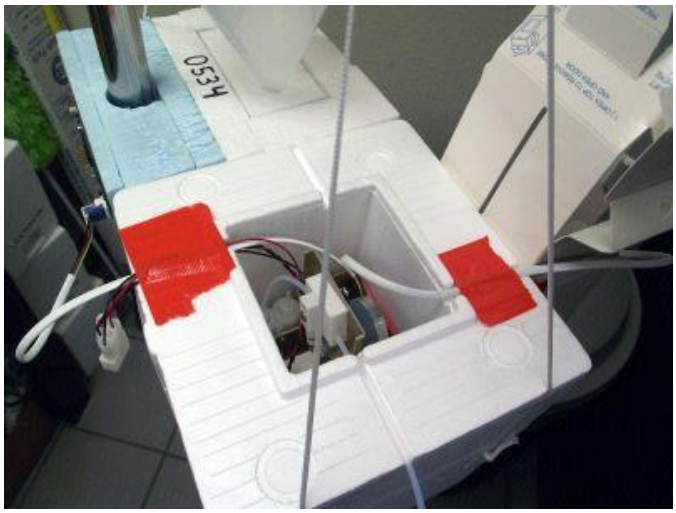
5. Plug the other end of the xdata cable from the ozonesonde's ext comms header into the "UART0 (MAIN)" header of the hygrometer circuit board.

6. Remove the backing from the two long pieces of tape on the hygrometer battery box. Leave the backing on the shorter pieces of tape (helps to prevent wires from being yanked out if reopened).

7. Align the battery box over the hygrometer circuit board with the side marked "up or top" facing up (keeping the power wires sticking out of the same side) and press to stick on. Make sure the edges of the hygrometer circuit board are not hitting the battery box.

8. While squeezing the two pieces together tightly, wrap strapping tape around the hygrometer and battery box. There should not be any gaps between the battery box and the instrument.

Preflight Instrument Setup (day of launch)

1. Plug the audio cable from the receiver to the computers microphone port if using the audio modem.

A. If you are using the older 1200 baud modem unplug the iMet modem's audio cable, leaving the usb cable attached (this is to avoid a glitch in Windows XP that mistakes USB COM ports as serial mice).

2. Start the SkySonde Server program, making sure the COM port option matches the modem (audio or the correct com port).

A. If you are using the 1200 baud modem and are having trouble connecting to the port, close the program, unplug the USB cable, plug back in the cable, and start the program again. You might have to go to the device manager to determine which com port the modem is using.

B. Plug the audio cable back into the iMet modem.

C. If you have continued trouble with the modem, call Emrys or Allen.

3. Open the iMet radiosonde foam door for access to the battery/switch inside. Turn on the receiver and tune to the correct frequency plus about 0.04 MHz (i.e. 402.04 MHz).

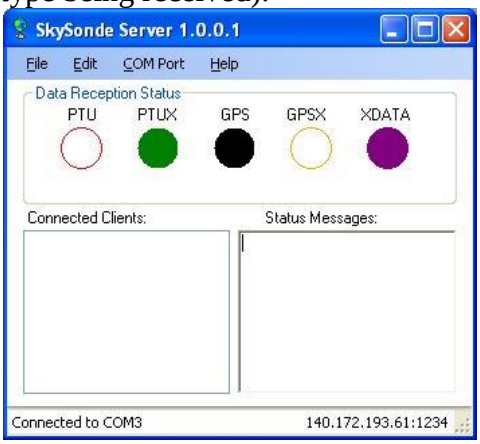
A. Plug the battery into the board, with the red wire facing up (it only plugs in one direction).

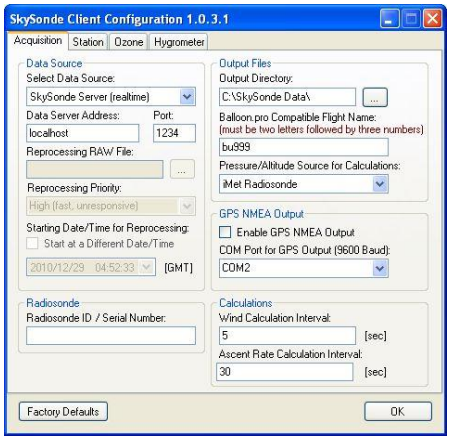
B. Slide the switch to the desired transmission frequency (marked on the paper packaging of the sonde).

4. Plug in the white Molex ozonesonde battery connectors to power up the ozonesonde.

5. Plug in the white Molex hygrometer battery connectors to power up the NOAA FPH.

6. Making sure the receiver is set to the iMet's transmission frequency, check to see if PTUX, GPS, and XDATA packets are being received by SkySonde Server (circles/lights should be blinking on the screen for each packet type being received).





7. Open the SkySonde Client program

A. Leave the Data Server Address at "localhost" and port at "1234" to connect to the SkySonde Server program on the same computer.

B. Enter in the flight number, iMet serial number, station pressure/temperature/humidity, ozonesonde values, hygrometer mirror number, etc. Press "OK" to start receiving data.

C. Make sure data is coming in for the radiosonde, ozonesonde, and hygrometer.

D. You can click any of the data field check boxes to plot incoming values.

8. Close the iMet radiosonde, making sure the boom is sticking out properly and the antenna is down.

9. Place the reward notice (in plastic sleeve) on the ozonesonde lid, securing with some tape.

10. Put the lid on the ozonesonde box. Wrap orange duct tape around the lid and box (shown in the picture above this section), covering the L-shaped pieces of tape securing the radiosonde to the package.

Adding Cryogen (minutes before launch)

1. Remove the foam cap from the hygrometer Dewar and insert a funnel.

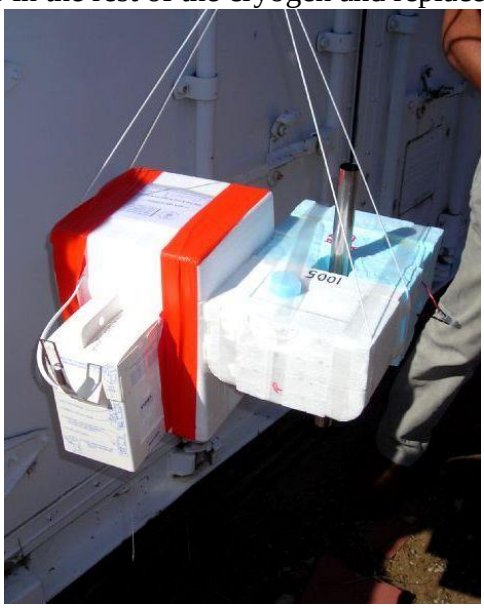
2. Locate the cryogen thermos cup, wrench, fill tube, and gloves.

3. Stand the cryogen tank up on the ground and attach the fill tube with the wrench. Make sure the fill tube is pointing down.

4. Wearing the gloves, hold the cup under the fill tube and open the tank.

A. After a while, liquid cryogen will start flowing into the cup. Continue filling until it reaches the line marked in the cup, approximately ¾ full. The Dewars hold roughly 300ml.

5. Pour a small splash of cryogen into the hygrometer (NOT the full cup yet).
    A. Monitor the frostpoint temperature through SkySonde, making sure it heats back up after the initial cold dip (indicating that the heater is working).
6. After verifying the mirror heater is working, pour in the rest of the cryogen and replace the foam cap.



7. Loosely wrap strapping tape around the hygrometer and cryogen cap as seen in the picture above.
8. Make one last check to make sure instrument data is coming into SkySonde:
    A. The ozone mixing ratio should be reading above zero, and the hygrometer frostpoint should be similar to the radiosonde frostpoint (though it might be oscillating until after launch).

Flight

1. Carry the instrument package over to the balloon and attach the payout reel's clip to the package's split ring.
2. Have one person hold the balloon near the valve harness and unclip from the payoff weight.

3. While kneeling to avoid scraping the balloon on the top of the door, have both operators walk the balloon and package outside.

A. Make sure to walk far enough to clear any obstacles, paying attention to the wind direction.

4. The person holding the balloon should "walk" the balloon up hand-over-hand until everything but the package is aloft, leaving the launch to the second person holding the package.
5. The person carrying the instrument package should now gently release it to begin the flight.