

## POLYSOMNOGRAPHY HOOK-UP

### 1. Supplies

Below is a list of supplies for single person use (however, make sure you pack extras):

- 1 tube EC-2 paste
- 4 X 4 gauze pads
- 1 bottle Pre-Tac adhesive synergist
- 1 tape measure
- precut 1 x 1 gauze squares
- 1 scissors
- Alcohol swabs or Electrode Prep pads
- 1 small bottle acetone or acetone prep pads
- 2 cotton tip applicators
- 1 roll Transpore tape
- 1 roll Hypafix or Medipore tape (cut into 1x1”squares) or Cover All Gauze
- 1 roll Scanpor Surgical Tape
- Surgitube tube gauze (cotton wire cover)
- 2 hair pins
- 1 bottle Lemon Prep or NuPrep
- 2 disposable snap ECG pads (Medtronics Cleartrace)
- 1 wax pencil (do not use red, if possible)
- 1 oximeter (attached to cable connected to recorder)
- 1 thermistor
- (2) towels
- 1 tray
- drinking straws
- soap solution
- small cup
- face mirror
- non-latex gloves
- disposable underpads (Chux)
- plastic trash bags

### 2. The In-Lab Visit

Upon arrival, identify yourself and show identification. Explain the purpose of the visit. Explain/obtain informed consent (if not already obtained). Be professional and courteous to your participant at all times. Help the participant feel at ease and comfortable. Explain all procedures before and as you do them.

Listed are some features that will assure a successful visit:

- 1) Be courteous, professional, have ID.
- 2) Be sensitive to participant's needs
- 3) Provide overview of the Sleep Study
- 4) Be patient/Be interested
- 6) Make sure participant understands all aspects of study/Have subject demonstrate or repeat critical areas (e.g., detaching oximeter if needed)
- 7) Provide participant with telephone number to call for "help"
- 8) Schedule morning pick-up of the Safiro according to participant's needs
- 9) Keep a Positive Attitude

- 10) The participant's comfort always comes before study needs

## 2.1 The Setting

Set up can be done in any comfortable chair. Clear a flat surface area to set up supplies. Set all materials on a tray or disposable pad (Chux) and position for easy access. Have the subject sit close to your supply tray during hookup. Make sure you have easy access to subject's head, chest, etc.

If the participant has not taken a shower (24 hrs) prior to your arrival, ask him/her to wash his/her face and chest with soap and water before applying electrodes. Explain that the electrodes will adhere better and a better study will be produced if the skin is cleansed in this manner.

*TIP: If the setting is poorly lighted, you may consider using a camping style headlamp to help illuminate the scalp, the neck and other areas in which placement is critical.*

## 2.2 Sensor Placement

Proper sensor placement is very important for effectively recording sleep patterns. Because you will be connecting the sensors to the patient, you should become familiar with each sensor and learn how to correctly place and connect them. All sensors should be labeled to simplify their identification and connections.

[Note: When connecting the sensors be sure to hold the electrode at the neck, **not** by the wires. Also, for cleanliness, use non-sterile patient-care gloves when applying electrodes.]

Below are general rules for good sensor placement:

1. Request the participant to be bathed and dressed for bed at your arrival. Discourage silky bedclothes; they cause static electricity and the respiratory belts may slip.
2. Prep only areas of skin that electrodes cover
3. Use only small pieces of tape but enough to secure the sensor and wires
4. Provide for "stress" in wire/cables
5. Secure loose wires/cables with tape
6. For elements that require participant's hook-up, have subject demonstrate ability to place/replace/remove sensors (use a mirror if necessary)
7. Use non-dominant hand for oximeter placement
8. Ask participant about sensitivity to adhesives or latex products or choose to use all latex-free products.

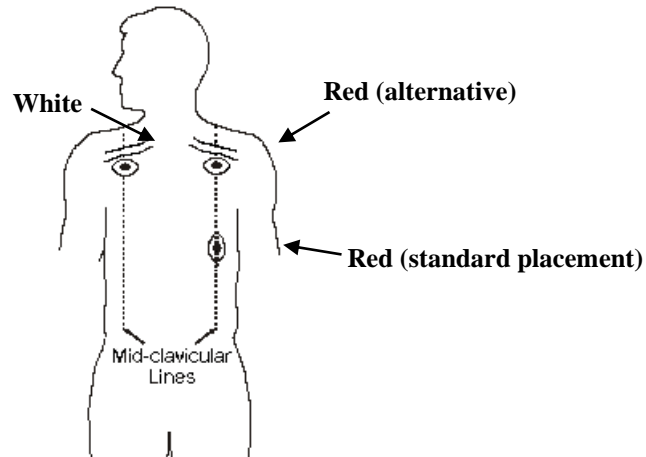
You will use 12 electrodes: Cz (reference) Forehead (GND), C3, C4, A1, A2, left EOG, right EOG, 2 chin EMG, and 2 ECG (snaps). You also will be using abdomen and chest belts, an oximeter, nasal/oral thermistor, nasal pressure cannula, 2 leg sensors and a body position sensor.

### Suggested Order of PSG Hook-up:

<b>ECG (2 snap electrodes)</b>	White (-) below right clavicle. Red (+) below the left breast, in a line extending from the midpoint of the left clavicle. <i>Drop electrode wire underneath clothing before attaching electrode to the body and thread wire upwards (over the shoulders).</i>
<b>Respiratory belts (2)</b>	Thoracic below left armpit Abdominal below the lower edge of the left ribcage <i>When placing respiratory bands observe the participant breathing normally to determine proper positioning.</i>
<b>Gold Disk Electrodes (10)</b>	Head, eyes and chin
<b>Position Sensor</b>	Velcro square at middle and top of thoracic respiratory band
<b>Oximeter</b>	On a finger of non-dominant hand, light diode on the nail
<b>Thermistor</b>	Between nose and upper lip, atop nasal cannula. <i>Heat sensors should be near, but not touching, nares and upper lip. Tape well to maintain placement.</i>
<b>Nasal Cannula</b>	Beneath nose and upper lip, beneath the body of the thermistor. Tubing should be inside the nares.
<b>Leg Sensor (2)</b>	Below the knee on the outside of the upper shin (lateral aspect) on the belly of the Tibialis Anterior muscle, one sensor on each leg. <i>Drop electrode wires underneath clothing (underwear, if worn) before attaching electrode to the leg and thread wire upwards</i>

### 2.2.1 Attachment of ECG electrodes

White (-) electrode 3-5 cm. (2 finger breadths) below midpoint of right clavicle.  
Red (+) electrode below the left breast crease, in line with the midpoint of the left clavicle.  
When determining this site, please be sensitive to patient modesty issues; lift only as much of the upper garment as necessary to determine placement and afford secure attachment of this electrode.

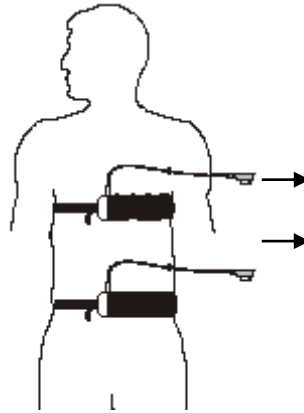


If modesty issues are of concern use alternative placement described below:

Below midpoint of left clavical, for the red (+) electrode can be used if the participant is uncomfortable with the standard placement, or if site cannot be determined due to body mass. This alternate placement is called subclavicular.

1. Feed electrode end of the wire down under the clothing.
2. Remove electrode from sealed package (e.g., Cleartrace or Red Dot Snap). Snap electrode to lead wire **before** applying to subject's skin.
3. Prepare the marked sites by lightly abrading with prep gel. Remove excess prep gel before placing the electrode. Remove backing from electrode and place gel electrode on cleansed sites, with gel side down.
4. Form a small "stress" loop with the wire immediately feeding the electrode, secure with a small amount of tape.
5. Indicate the ECG placement used on the **Signal Verification Form**.

### 2.2.2 Placement of respiratory bands



1. Place the **chest band** under the left armpit, with the lead wire facing upwards. Adjust the black extender belt so the belt is secure, but not tight. Run wires upwards and tape to the shoulder.
2. The **abdominal band** should be around the umbilicus (belly button) or, if this position is not possible, *below* the lower edge of the left rib cage with the lead wire facing upwards. Run wires upwards and tape to the shoulder.
  - Incorrect application of respiratory bands can cause very poor signals.
  - Do not restrict the participant's comfort or breathing.

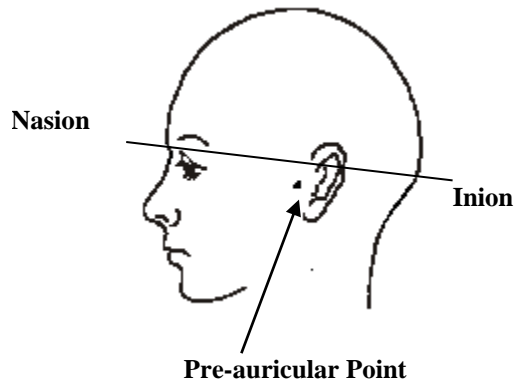
### 2.2.3 Apply EEG scalp electrodes(Gold Disk)

The process for placing EEG sensors on the adult participant will follow the 10-20 system for electrode placement. This standard was developed to provide consistent application of EEG electrodes for the collection of brain waves. This system is based on measurements from 4 standard points (landmarks): the nasion, inion, and left and right pre-auricular points (see glossary for definitions).

- Electrodes must be placed in the correct locations to yield valid data.
- Electrode sites must be properly prepared prior to electrode placement to insure tight bonding and low impedance values.
- Secure attachment of gold disk electrodes is crucial to successful recording of data.

#### **Identify your landmarks:**

1) Pre-auricular points: Standing at the side of the participant, look at the ear. In front of the ear canal is a small flap of cartilage called the tragus. Just above the tragus is the point at which the top of ear lobe begins to form. The small dimple-like indentation between the tragus and the formation of the top of the ear lobe is the pre-auricular point. If in doubt, ask the participant to open and close his jaw. Look and feel for movement at the indentation above the tragus. Using blue china marker, lightly mark these landmarks on both the right and left sides of the participant.



2) Nasion: Facing the participant, look into his/her eyes. Find the small dip at the bridge of the nose between the eyes. This point at which the forehead meets the nose is the nasion. Lightly mark the nasion.

3) Inion: Using a comb, unpadded cotton swab end or hair clip part the participant's hair down the center, in the back of the head. Starting at the nape of the neck, run a finger up the back of the participant's head until a bony ridge, or bump, can be felt. Having the participant move his/her head up and down may help you to identify this bony ridge. The slight hollow just beneath this bony ridge is the inion. Lightly mark the inion. This landmark may be difficult to feel on some <sup>Inion</sup>ials.

When the inion cannot be determined use the following method:

- Re-identify the nasion, which has been lightly marked.
- Re-identify both pre-auricular landmarks, which have been lightly marked.
- Standing on the side of the participant, visualize an imaginary line forming a band around the head using the nasion and preauricular sites that have been marked. The back of this imaginary band should identify the inion. Mark the inion lightly.

### Measure for electrode sites:

- Distance measurements are done with a *metric* tape measure, and taken in centimeters (cm.) and millimeters (mm.). When computing percentages to find the electrode site a quick measurement guide can be found below, as well as in the Equipment Maintenance Section. The guide can be photocopied and kept with your prep materials for handy reference.
- All marks on skin must be done with a non-toxic, non-permanent implement, such as a wax-based china marker. Bright blue is most easily seen against dark hair. Red can be misidentified as blood by the participant or family members.
- When working with participants having long or thick hair, create a part in the hair by means of a comb or the unpadded end of a cotton-tipped swab; then hold the hair in place with hair clips while you work. The skin must be visible at the electrode sites because the electrode must rest on the skin, not on hair.

- All scalp electrode sites are determined by creating 2 lines that intersect. The electrode is placed over the point at which the 2 lines cross.

### **Quick Reference: Measurement Chart**

<b><i>Total Measurement Value (cm.)</i></b>	<b><i>50% Value (cm.)</i></b>	<b><i>20% Value (cm.)</i></b>
30	15.0	6.0
31	15.5	6.2
32	16.0	6.4
33	16.5	6.6
34	17.0	6.8
35	17.5	7.0
36	18.0	7.2
37	18.5	7.4
38	19.0	7.6
39	19.5	7.8
40	20.0	8.0

Note: If the *total* value measurement contains a fraction, continue to use the percentage values as the whole number.

*Example:* Total measurement = 35.2, 35.5, 35.7 continue to use the percentage values for 35.

Remember: The 50% values are used to determine Cz. The 20% values are used to determine C<sub>3</sub> and C<sub>4</sub>.

#### To determine Cz:

1) Have the participant sit in a chair. Standing at the side of the participant, place the zero line (0) of the tape measure on the markedinion. Holding the tape measure in place with your non-dominant hand, stretch the tape measure upwards, over the crown of the head, until it reaches the marked nasion. Determine the total distance between the inion to nasion, in centimeters. Remember this number (it may help to write it down). Compute 50% of this total measurement (or use your measurement guide).

2) Remove the tape measure, and re-position with the zero line on the marked nasion. Stretching the tape measure upwards, over the crown of the head, mark the value for 50% of the nasion to inion total. When marking these sites, make a large enough line so it can be easily found.

3) Remove the tape measure and stand behind the participant. Place the zero line of the tape measure on the left pre-auricular mark. Stretch the tape measure over the top of the head, and along the mark that has just been made, until it reaches the right pre-auricular mark. Determine the total distance from pre-auricular to pre-auricular in centimeters.

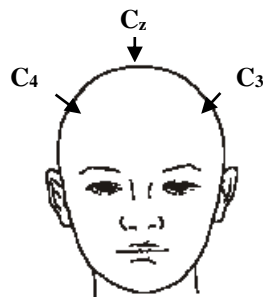
Remember this number (it may help to write it down). Compute 50% of this total measurement (or use your measurement guide). While firmly holding the tape measure at the left preauricular mark allow the tape measure to drape over the crown of the head while marking the value for 50% of the total measurement. This mark should intersect the previously made line. The point at which the lines intersect is the site for the Cz electrode placement.

To determine C4:

1) Continue to stand behind the participant. Place the zero line of the tape measure on the site for the Cz electrode placement. While firmly holding the tape measure in place, allow it to drape over the right side of the participant's head until it reaches the right pre-auricular mark. Compute 20% of the total pre-auricular to pre-auricular measurement (or use your measurement guide). Continue to hold the tape measure in place as you make a mark at the 20% location. Without moving the tape measure make another line, following the edge of the tape measure, to intersect the 20% mark. After removing the tape measure, extend both lines so they intersect. The point at which the lines intersect is the site for the C4 electrode placement.

To determine C3:

1) Stand in front of the participant. Place the zero line of the tape measure on the site for the Cz electrode placement. While firmly holding the tape measure in place, allow it to drape over the left side of the participant's head until it reaches the left pre-auricular mark. Compute 20% of the total pre-auricular to pre-auricular measurement (or use your measurement guide). Continue to hold the tape measure in place as you make a mark at the 20% location. Without moving the tape measure make another line, following the edge of the tape measure, to intersect the 20% mark. After removing the tape measure, extend both lines so they intersect. The point at which the lines intersect is the site for the C3 electrode placement.



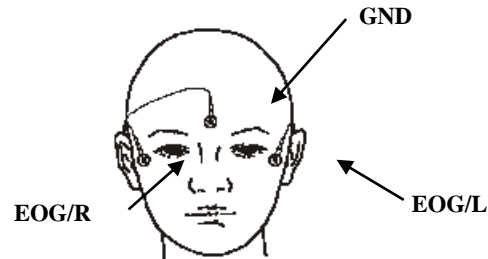
To determine A1 and A2:

These placement sites are on the mastoid process (bone behind the earlobe). The electrode should be placed on the skin between the crease of the earlobe and where the hairline begins. Lightly mark these sites. A1 is placed on the left mastoid, A2 on the right.

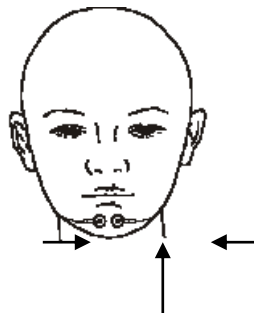


To determine EOG placements:

The EOG recording electrodes are placed about 1 cm. (one finger breadth) lateral to and 1 cm. below the outer canthus of the eye, (on the ridge of the orbital bone). Lightly mark these sites, and then stand in front of the participant to make certain that they are symmetric. Asymmetric placement of the EOG electrodes can create uncertainties in the data interpretation.

To determine EMG placement:

- The EEG waveforms in REM sleep resemble the waveforms of wakefulness. The facial muscles however, relax in REM sleep; therefore these EMG electrodes are crucial in correctly identifying REM sleep. These electrodes must be attached firmly to prevent displacement and to yield quality data through the recording period.
- Place one chin EMG electrode on the face below the lower lip, on the ledge of the chin, this provides a stable area for attachment. For proper pickup of muscle activity, a distance of at least 3 cm must separate the electrodes.
- The other two EMG electrodes are placed on each side of the submentalalis, which is a large muscle located underneath the chin. Having the participant activate this muscle may be helpful for determining the placement of the EMG electrodes. To activate the muscle, place your hand under the participant's chin, between the tip of the chin and the neck. Ask the participant to swallow. You will feel the submentalalis muscle move. The electrodes are placed on each side of this muscle but at least 3 cm. apart from each other. Placing one electrode on the ledge of the chin (below the lower lip) and the other on the belly of the submentalalis muscle is also acceptable.



**Two electrodes under the chin  
or  
1 under the chin and the other on the  
ledge of the chin**

Reference: **A Review of the International Ten-Twenty System of Electrode Placement**, 1974, The Grass Instrument Co., Quincy, Mass.

### 2.2.4 Prepare the Electrode Sites

Before the attachment of gold disk electrodes the skin at the marked sites must be properly cleansed and lightly abraded. This insures low impedance values. Excessive impedance defeats the passage of signals into the electrode and, in turn, to the recorder. For optimal recording the impedance readings of the electrodes should be  $< 10 \text{ k}\Omega$  and should be balanced (values should be approximately the same). One exception is ECG, which can tolerate impedance values up to  $30 \text{ k}\Omega$ .

- Successful skin preparation prior to electrode placement helps to reduce the level of impedance thereby improving the quality of signal.
  - Skin preparation requires abrasion to the top layer of the participant's skin at the electrode site. Although blood is not evident, the field technician must understand that these areas are now non-intact skin and pose a risk for blood borne pathogens. SHHS recommends wearing latex or non-latex gloves as personal protective equipment (PPE) at all times when working with non-intact skin and equipment, which has been in direct contact with non-intact skin (i.e.: used electrodes).
  - Use an abrasive preparation. Preparations such as Nu-Prep and Skin Pure contain relatively less pumice and may be preferred for participants with sensitive or fragile skin. Preparations with higher pumice concentration (such as Lemon Prep) may be useful for participants with tough or oily skin (and for bald participants).
  - Abrade only the area at the marked site. Gold disk electrodes have a diameter of 1 centimeter, therefore the abrasion should be limited to an area the size of or just slightly larger than the electrode. On marked sites, remember that the electrode should be placed where the 2 lines intersect.
  - The participant should know what to expect! Please communicate. You may choose to use the following script: "Before I attach the electrodes, I have to get your skin ready. I will be using a special cleaner that sets the skin up for a good contact. You may feel a little bit of scratching on your skin, it may feel a little like sandpaper, but it should not hurt, and it will not harm your skin."
1. Place a small amount of skin prep abrasive onto a clean disposable surface (i.e.: 4x4 gauze square or small plastic med. cup).
  2. If working in a hairy area, separate the hair in order to see the skin. You may find a comb or hairclips useful to create a part and hold the hair back.
  3. Use a cotton tipped applicator to transfer a small amount of skin prep directly onto the electrode site. Before lifting the applicator, apply a moderate pressure and make small circular motions repeatedly on the skin. Take care that you include the center of the site, not just make circles around it leaving the center un-prepped. You may prefer to use a combination of back and forth strokes along with some circular motions.

4. Continuing with moderate pressure, slowly count to 5 while you scrub the site (1 one-thousand, 2 one-thousand, 3 one-thousand, 4 one-thousand, 5 one-thousand). You are done when the skin “pinks up”. Expect some participants to have more fragile skin than others; keep an eye on what you do. You may have to adjust the pressure or the count time.
5. Prep abrasives are not designed as conductors; remove any excessive prep abrasive from the skin prior to electrode placement.
6. Repeat the above steps for each electrode site. It is much easier to prep 2 or 3 sites, and then to apply those electrodes, provided you do not lose your prepped sites.
7. Discard the applicator and prep abrasive when finished. Never contaminate your original tube or bottle.

### **2.2.5 Attach Gold Disk Electrodes**

The gold disk electrodes are applied to the prepared sites with an electrolyte paste. This paste serves a dual purpose: providing both a conductive pathway for the signal to enter the electrode cup, as well as holding the electrode in place on the skin. There are different electrolyte pastes available, as well as different application techniques.

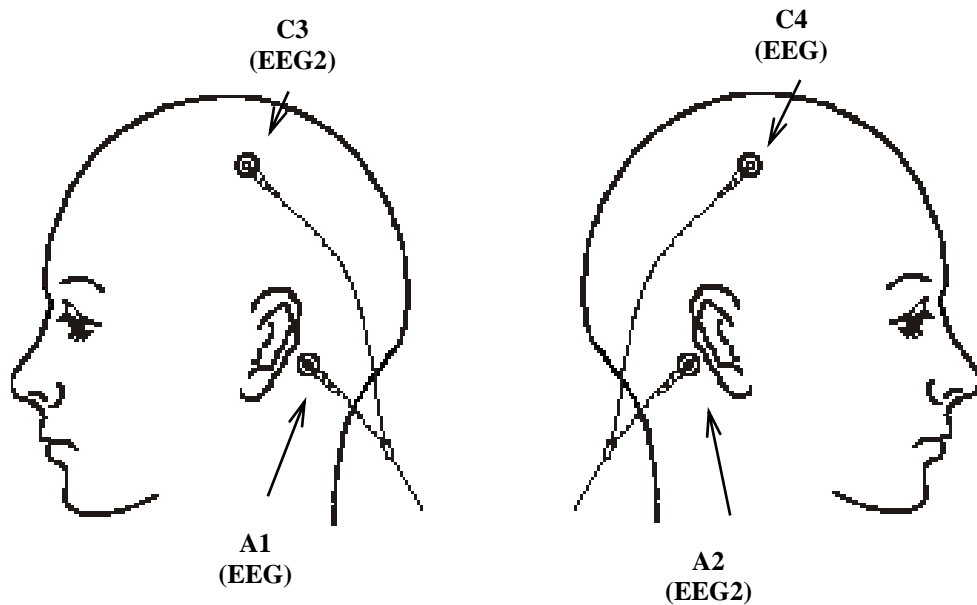
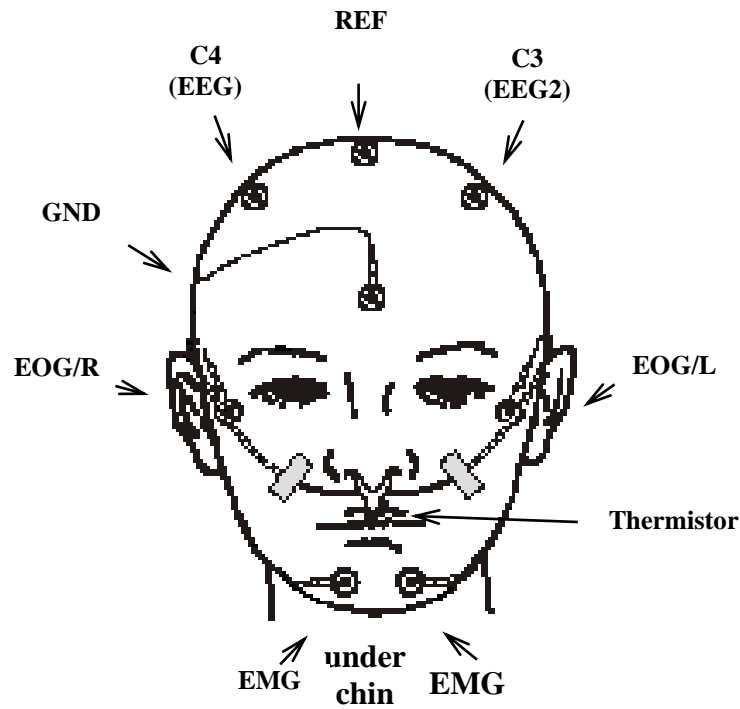
Although different pastes may be used for different electrodes sites (EEG, EOG or EMG sites) both MrOS and manufacturers recommend never mixing pastes for the same electrode. *Adverse reactions to mixing 2 electrolytes together cannot be predicted.*

- Assemble your supplies in advance. Have several pieces of cut gauze or pieces of tape ready to place on top of the electrode once it is placed on the skin. Gravity can move the electrode from its proper site while you fumble with equipment.
- Prior to attaching gold disk electrodes, cut a sufficient length (approximately 2 arm’s length) of Surgitube 1” tube gauze. Run the gold disk electrodes through the length of the tube gauze to create a cotton sheath encasing all of the wires. Secure the Surgitube sheath with a twisty or another appropriate fastener approximately 12-18” from the gold disks. This will allow for the electrodes to be placed according to the color codes and for range of motion at the neck, yet will still provide for bundling of the 10 electrode wires.
- Place a small amount of EC2 electrolyte paste onto a clean disposable surface (i.e.: 4x4 gauze square, small plastic med. cup, or the back of your gloved non-dominant hand).
- If working in a hairy area, separate the hair in order to see the skin. Your site should still be visible from the prep phase.

- If the participant is expected to sweat, there are additional skin preparations that reduce the moisture of the skin (such as PRE-TAC) and help improve the holding power of the adhesive. Try experimenting with such preparations. Generally, these liquids are applied very sparingly to prepped skin and allowed to dry before continuing with electrode application.
- If using tape, ask the participant about sensitivity to tape, latex or adhesives. For participants with sensitivity use Micropore (paper) or Scanpor tape.
- If using EC2 cream on the gauze square to anchor the electrode, it must also be the electrolyte used within the electrode cup.
- When applying disk electrodes, work in a fashion so that the wires on the forehead and top of the head all point to the back of the head and down toward the neck, and the wires on the face and chin point upwards over the ears and then down toward the back of the neck. Use small pieces of tape to hold the wires in place as they course toward the back of the head, but allow enough slack so there is no pull when the participant moves.
- Discard the unused electrolyte paste when finished. Never contaminate your original tube or bottle.

**Attachment sites for gold disk electrodes:**

GND	Middle of the forehead, between the nasion and the start of the hairline.
REF	Cz top of head
EEG	C4 right Central A1 left mastoid
EEG 2	C3 left Central A2 right mastoid
LOC	left eye, below outer canthus
ROC	right eye, below outer canthus
EMG (chin)	Either side of submentalis muscle underneath the chin spaced at least 3 cm. apart.  or 1 on the belly of the submentalis muscle (under chin) and 1 on ledge of chin



**Techniques for disk electrode appucauon:**

Bare skin (Face, mastoids):

- 1) Using the gold disk as a scoop, fill the electrode cup with electrolyte paste so it is slightly rounded (there must be no “air pockets” which act to increase impedance).

- 2) Place the electrode onto the prepped site, paste side down and cover with a square of gauze or piece of tape (depending on your preference).
- 3) Press lightly on the top of the electrode as well as firmly around the rim of the cup to insure a good seal. Hold in place until electrolyte begins to set and feels secure.
- 4) A larger second piece of tape may be placed over the electrode, if desired.

#### Scalp with hair:

- 1) Separate hairs to make sure skin is visible.
- 2) Using the above technique, fill the electrode cup with EC2 cream and attach to prepped site.
- 3) Place a small amount of EC2 cream on the gauze or tape used to cover the electrode.
- 4) Press firmly on electrode and hold in place until EC2 begins to set and feels secure.

#### Bearded chins:

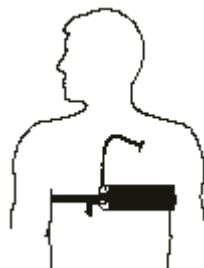
- 1) Separate hairs of beard to make sure skin is visible.
- 2) Fill the electrode cup with EC2 cream and attach to prepped site.
- 3) After attaching electrode to skin, use cotton applicator to place small amount of EC2 cream on top of electrode.
- 4) Crisscross small amounts of beard hair over the electrode, as an anchor
- 5) Place a small amount of EC2 cream on the gauze or tape used to cover the electrode.
- 6) Press firmly on electrode and hold in place until EC2 begins to set and feels secure.

#### **After electrodes are applied:**

1. Plug in each electrode to its Safiro connector.
2. Gather gold disk electrode wires together just above nape of neck. Bundle and secure as desired. If using tape, fold the ends for easier removal.

### **2.2.6 Attach the position sensor**

Attach the position sensor to the Velcro square on the chest band. Ensure that picture on top of position sensor, indicating correct orientation of patient's left and right, is observed (wire should be going toward participant's head). Apply tape as needed to further secure the position sensor.



### 2.2.7 Attach oximeter

The finger oximeter records pulse and oxygen saturation using a small light that shines through the finger. Oximeter should be placed on the ring finger of the non-dominant hand. (If large rings are worn, may use the middle or index fingers.) Colored nail polish defeats the function of the oximeter. Colored nail polish must be removed from the finger prior to sensor attachment.

*Directions for disposable probe:* Grip the tabs on the sensor's bottom adhesive cover and peel the adhesive cover off. Place the finger into the sensor nail-side up with the tip of the centerline mark in the curved area. Wrap the tape firmly around the finger. The fingernail should not be covered with tape during this step. Fold the sensor's top over the top of the finger and make sure the two sides are vertically aligned. Do not stretch the tape while applying the sensor. This may cause inaccurate readings or skin blister. Be sure that the emitting and receiving diodes directly "face" each other.

*Directions for non-disposable probe:* Place probe, white side against adhesive, on the surface of a piece of gauze tape cut so that its width extends approximately .5 cm. on either side of the probe (placed in the middle of the tape), and, its length is approximately 1 cm. longer than each top and bottom edge of the probe. Place the probe (covered with this tape) over the top of finger with light sensor nail side up. Be sure that the receiving circle directly "faces" the light-emitting circle. Place a second piece of gauze tape around the probe (perpendicular to the first tape), spiraling the tape so the beginning and end are displaced approximately .5-1.0 cm. (This prevents perfusion problems to the finger). To further secure, place Posey wrap around sensor/finger, so that the sensor is securely in place but not tight.

After securing oximeter sensor, ask the participant if any throbbing is felt. If so, reapply, loosening tape. Pass the oximeter cable over the surface of the hand, creating a circular "stress" loop, also securing with tape. Use several additional pieces of tape along the hand and lower arm, securing loose areas of cable (to prevent the cable from getting tugged.) Check that the participant can move/bend his hand in all directions; if not, reapply, with more "slack" in the cabling.

### 2.2.8 Attach nasal cannula

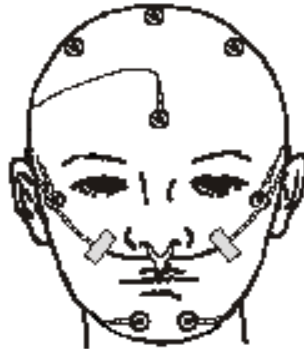
This is clear tubing, which is positioned directly in the flow of air just under the thermistor. The nasal cannula should be placed under nasal area on participant's upper lip so that the two tubular prongs are resting within the nares. Secure in place by looping wire around ear and taping wires over cheek. The thermistor will be placed on top of the nasal cannula.

### 2.2.9 Attach thermistor

These are made of temperature sensitive wires, which are positioned directly in the flow of air.

Thermistor should be placed between the nose and upper lip, atop the body of the cannula. *The nasal beads of the thermistor should not be within the nares.* Secure in place by looping wire around ear and taping wires over cheek.

Note: The thermistor is sensitive to displacement or moisture. Before leaving, show the participant (in a mirror) and/or a family member how the thermistor should be positioned. Show the participant how to readjust this, if needed. Warn him to try and keep his upper lip dry. Nighttime beverages should be consumed through a drinking straw.



### **2.2.10 Attach leg sensors**

Using adhesive patient tape attach leg sensor over the bulk of the left (right) Tibialis Anterior muscle, where the greatest movement occurs. Ensure sensors are taped at both ends.

## **2.3 Interface sensors to Safiro, verify autostart**

1. Interface all electrodes to Safiro.
2. Power laptop and Safiro on. Access Net Beacon. Access Configure (top task bar). From the drop down menu, select Device. Verify Auto Start Flash Disk Recording is enabled. Check that battery status reads at least 5.7V. Close Device Settings.

### **2.3.1 Check impedance, annotate SV form**

Click on the IMPEDANCE  $\Omega$  icon on the task bar. When enabled the button will become light grey and a screen will pop-up on the right. Slide the threshold to 10k. Click on All Channels. Impedance values will be displayed to the right. Annotate the SV form with the impedance values. When finished, disable impedance testing by clicking on the IMPEDANCE icon on the task bar



- Impedance defeats the passage of signals into the electrode and, in turn, the recorder. For PSG studies, impedance value is measured in Kilohms, or thousandths of an ohm. Later the manual abbreviation k will be used for Kilohms.
- For EEG, EOG, and EMG, you want to achieve impedance of < 10 k. Most important is the balance (difference) between two sets of paired EEG electrodes. For accurate recording the difference in impedance levels between pairs of EEG electrodes should be less than 5 k.

*If all electrodes register high:*

During the impedance check, if all electrodes register high (>10 k) remove the ground electrodes (at Cz and the forehead), re-prep the sites and replace the electrodes.

*If only certain electrodes register high:*

1. If impedance of any pair of electrodes (other than ECG) is > 10 k, or the difference between any pair of electrodes is > 5k remove the electrode, re-prep the electrode site and replace the electrode.

1. If, on a second placement, impedance is still high there are two possible problems:
  - a) the area of the skin identified for sensor placement has an unusually high impedance; or
  - b) the lead wire or sensor is damaged.

Therefore, attempt to address both potential problems by choosing an alternative electrode site (e.g., immediately adjacent to previous site, or use of one of the alternative sites indicated above), and change lead wires.

2. If impedance is still high on a third attempt do not attempt to re-prep area. Document your activities on the **Signal Verification** form.

For ECG impedance of < 30 k are acceptable.

### **2.3.2 Check live signals and wrap wires**

Enable View on top task bar. The button will turn light grey. Soon you will see live signals scroll across the screen. The upper screen will scroll faster than the lower screen. The upper screen is set to a 30 sec timebase and shows gold disk and ECG signals. The lower screen is set to a 5 min timebase and shows leg movement, all respiratory and oxygenation signals as well as position of the participant. Look at each signal on the upper and lower screens. Make sure that all signals look clean and each respiratory channel shows visible deflection (movement). Adjust respiratory sensors, if needed. When satisfied with signal quality, power off the Safiro. Wrap or bundle wires as desired. Close PSG Online. Power off the laptop.

### 3. Instruct participant for final details

With the Safiro off, review instructions on how to turn the unit on. Have the participant demonstrate the power up. After successful demonstration, turn the Safiro off and place the Flash Disk into the Safiro, arrow side up. Prior to leaving the home, repeat instructions to power up at bedtime, but do not demonstrate (*once powered on with the card in the Safiro will begin to record!*). Provide instructions for electrode removal the following morning and for details of equipment retrieval.

Before leaving the home, clean up, leaving the area as neat as it was before your visit.