Polysomnography Set-up (Paediatric Patients)

Sleep Science

1. Purpose
This guideline provides recommendations regarding best practice for to support high quality paediatric polysomnography (PSG) set-up throughout Queensland public health facilities.

2. Scope
This guideline relates to sleep clinical measurement practitioners (CMP) who perform PSG set-up for paediatric patients.

3. Related documents
This guideline is primarily based on the following documents:

- Australasian Sleep Association and Australasian Sleep Technologists Association (2010). ASTA/ASA Commentary on AASM Manual for the Scoring of Sleep and Associated Events
- Australasian Sleep Association and Australasian Sleep Technologists Association (2011). ASTA/ASA Addendum to AASM Guidelines for recording and scoring of paediatric sleep

References from alternate sources of information have been identified in this document.

Authorising Policy and Standard/s:
- Nil

Procedures, Guidelines, Protocols
- Queensland Health Guide to Informed Decision-making in Healthcare
- Australian Guidelines for the prevention and control of infection in healthcare (CD33:2010)
4. Guideline Polysomnography Set-up (paediatric patients)

4.1. Emergency Protocol
- Follow local Hospital and Health Service protocols and procedures in the event of an emergency.

4.2. Infection Control Procedures
- Australian Guidelines for the prevention and control of infection in healthcare (CD33:2010)
- Refer to equipment manufacturer’s guidelines, in particular for single use items such as anti-bacterial filters, if used.

4.3. Gaining Consent
- Gain the patient’s consent using the Queensland Health Informed Decision-making In Healthcare document.
- Signed consent is required from the patient (or their legal guardian/carer) to record their digital clinical image. File the signed consent in the patient’s hospital record.

4.4. Identifying Indications/Contraindications
This procedure is primarily indicated in the setup of patients undergoing Type 1 PSG. This guideline, however, it can be tailored to Type 4 PSG as applicable (refer to the separate Queensland Health guideline for Type 4 PSG).
A PSG is an assessment or treatment under the direction of a paediatric sleep physician and co-ordinated by a dedicated paediatric sleep facility. PSG is only suitable for patients who are clinically stable.

4.5. Facilities and equipment

Facility requirements
For Type 1 PSG, utilise a room which meets the requirements of a designated body-protected electrical area. Include all signals in the configurations for both monitoring and analysis.
Paediatric patients should be studied in a dedicated facility with a décor that is both age-appropriate and non-threatening. The setting should accommodate a parent/guardian/carer comfortably during the study. A place should be made available for the parent/guardian/carer to sleep near the child while the study is in progress and to attend to the care requirements of the child such as preparation of feeds etc. There should be provision for co-sleeping arrangements for families where this is typical or for settling purposes.

Minimum Equipment Requirements
Minimum equipment requirements are detailed in:
Department of Health: Polysomnography Set-up (paediatric patients)

- ASTA/ASA Commentary on AASM Manual for the Scoring of Sleep and Associated Events.

For other ancillary equipment used within the recording configuration please refer to local Hospital and Health Service protocols and procedures and manufacturer guidelines.

4.6. Training requirements

A paediatric sleep clinical measurement practitioner who performs PSG Set-up will have a tertiary qualification with a strong foundation in human physiology. The paediatric sleep CMP will be required to:

- manage interactions with children of varying ages, developmental stages and disease spectrums.
- paediatric cardiopulmonary resuscitation
- demonstrate knowledge of childhood behaviour

Staff should be given instruction in child protection policy. A Blue Card is required by staff who are not Registered Health Practitioners. For further clarification on specific requirements see the Commission for Children and Young People and Child Guardian website (www.ccypcg.qld.gov.au).

An additional qualification relevant to the role may include:

- Board of Registered Polysomnographic Technologists (BRPT) - Registered Polysomnographic Technologist.

4.7. Test Procedure

The following describes the placement and application of sensors for paediatric patients undergoing a PSG. Refer to the appropriate Queensland Health guideline for each PSG type and the specific parameters to be recorded.

4.7.1. Prior to Patient Set-up

- Ensure appropriate documentation is available at the time of the PSG, including the referral form.
- Review the patient’s hospital record prior to arrival.
- Record relevant medical history that may assist in the interpretation/reporting of the PSG.
- Evaluate the patient’s background information for any special instructions or requirements, and for information to manage any potential emergencies that may arise.
- Confirm the patient’s identify on arrival.
- Identify any special requirements for each patient (mobility, dietary).
- Ensure the patient observes their usual pre-bedtime routine where possible (i.e. time in bed and use of medication and alcohol intake), unless otherwise specified.
4.7.2. PSG Documentation

Complete all documentation relevant to the PSG. Add the initial baseline observations and demographic data to the patient’s PSG observation record.

This information includes, but is not limited to:

- patient identification (usually label from hospital patient record)
- PSG date and type
- paediatric sleep CMP’s name conducting the PSG
- patient’s height and weight
- Epworth sleepiness score, if able to complete
- sleep pattern from previous 24hrs including reported naps
- blood pressure measurement prior to set-up
- baseline measurements for pulse oximetry
- any medication taken in the last 24 hours
- any allergies
- time for lights off
- other relevant comments.

4.7.3. Sensor & Electrode Application

Before the application of the sensors and electrodes, explain the procedure to the paediatric patient and parent/guardian/carer. Further explanation and information can be given during the set-up procedure to alleviate any concerns the paediatric patient may experience.

Prepare the skin with abrasives and cleansing agents prior to electrode application this will ensure optimal signal conductance.

Do not use chemical based products near the eyes (i.e. alcohol or collodion) for safety and consideration of patient comfort.

Follow local Hospital and Health Service protocols and procedures for electrode and sensor application, with consideration given to the following:

- all paired electrodes are of the same type (e.g. gold-cup)
- use a protective base before applying any strong adhesive tape to the face of paediatric patients
- if alternative or additional placements are required, document the change and an explanation for the alternative placement.

The recommended recording parameters and placements for each are listed below. See Appendix 1 for the recommended sampling rates and filter settings for each parameter.
Electroencephalogram (EEG)
The system of electrode placement used for routine PSG is based on the International 10-20 System for EEG (electroencephalogram) electrode placement ⁹, ¹⁰.

The three EEG derivations recommended ³ are:
- C4-M1 with C3-M2 as backup
- O2-M1
- F4-M1, where M refers to the contra-lateral mastoid process.

Additional electrodes are added as required.

Note: Secure the EEG leads together.

For infants, to ensure there is less pressure on the fontanel and to reduce artefact, avoid placing EEG electrodes directly over fontanel positions. Instead place them to the rear of the 10-20 positions that are affected.

Reference and Ground
Place a reference electrode, as described in the International 10-20 System for EEG electrode placement of Cz ⁹, ¹⁰.

Apply a suitable ground electrode as required.

Electro-oculogram (EOG)
The EOG electrode placements are:
- E1-M2 (Where E1 electrode is placed one centimetre below the left outer canthus)
- E2-M2 (Where E2 electrode is placed one centimetre above the right outer canthus).

Additional EOG electrodes are recommended for the multiple sleep latency test:
- FP1 –M2 (placement of the electrode according to 10-20 System for EEG)
- FP2 –M1 (placement of the electrode according to 10-20 System for EEG).

Chin Electromyogram (EMG)
The Chin EMG placements are EMG1-EMG2 (mentalis/sub-mentalis differential pair)
- The mentalis electrode is placed in the midline one centimetre above the inferior edge of the mandible.
- The left and right submental electrodes should be placed at approximately the width of the mouth (or two centimetres to the left and right of the midline, respectively, if mandible is wide enough), and two centimetres below on the inferior edge of the mandible (or less, if chin is too small for this dimension). One of these will be used as a back-up electrode, labelled EMG3. If the patient is old enough to understand, instruct them to swallow and feel for the submental muscle position. If the patient is an infant/child that drools or is feeding, it is possible to use the sub-mental differential pair, if there is good impedance.
Diaphragm EMG:

There are two options for placement.

1. Intercostal diaphragmatic EMG electrodes can be used:
   - electrodes are placed in the sixth and seventh intercostal space on the right-hand side at the mid-clavicular line
   - an alternate placement is at the mid-clavicular line on the diaphragm not more than one centimeter below the costal margin and two finger spaces apart.

2. A diaphragm 2-lead differential can also be used. Attach three electrodes (all same type) and record from the best quality signal pair:
   - place electrode 1 at the right lateral diaphragm attachment (ninth rib intercostal)
   - place electrode 2 over the base of the sternum (ensiform cartilage)
   - place electrode 3 at the left lateral diaphragm attachment (ninth rib intercostal).

Electrocardiogram (ECG)

ECG acquisition is a single modified lead II placement (ECG1-ECG2):
- ECG1 - The negative electrode is placed below the right clavicle
- ECG2 - The positive electrode is placed on the sixth or seventh left inter-costal space on the midline of the patient’s left side
- additional electrodes are added as required.

Body Position

Place a body position monitor on the patient to record left lateral, right lateral, supine and prone positions.

If an automatic position monitor cannot be used on the patient, ensure there is capacity for manual indication of the body position during the recording of PSG.

Sound

A microphone can be used but an assessment of ‘snore’ or other sounds would need a note stating it is a subjective measure of sound.

Alternatively, place the tracheal microphone at the site of largest snoring vibration. This is identified by palpating the neck during a simulated snore. Fix the microphone/sensor to this site.

Closed Circuit Television (CCTV) Monitoring

Only use CCTV Monitoring with Type 1 PSG and ensure the image displays the entire bed.

Pulse Oximetry

Ideally, place the sensor on the finger. Alternative sites include the foot/toe (parallel to the fifth metatarsal bone of the foot for neonates/small children, else the big toe) or earlobe, however the sensor tends to dislodge more easily from these sites during sleep. Document the position of the sensor if it is not placed on the finger.
Department of Health: Polysomnography Set-up (paediatric patients)

**Transcutaneous carbon dioxide monitoring**

Apply the transcutaneous carbon dioxide electrode as per the manufacturer guidelines, to a well-vascularised area with minimal skin thickness. The electrode may need to be re-sited every four hours to prevent possible skin damage from the heated probe for children aged five and above, and follow the guidelines of the manufacturer for younger children (< five years old) and infants.

**Thoracic and Abdominal Movement**

Respiratory inductance plethysmography (RIP) bands are used for the recording of thorax and abdominal movement:

- fit the thoracic band under the armpits, and above the nipple line
- fit the abdominal band just above the hips, at navel level
- the bands need to be firm enough to expand and contract with the patient’s breathing, yet loose enough for comfort.

**Nasal Air Pressure**

Position a nasal cannula in the nares to measure nasal air pressure. Ensure nasal passages are clear of secretions.

*Note:* O₂ cannula prongs should not be trimmed unless instructed by a medical officer, such as for a nasal-pharyngeal tube in-situ.

**Oro-nasal Thermal Sensor**

Position an oro-nasal thermal sensor in the nares for nasal flow measurement, and over the mouth for oral flow measurement. Ensure nasal passages are clear of secretions.

**Positive Airway Pressure (PAP)**

Attach a pressure line to the mask to allow measurement of mask pressure. Measure calibrated leak and flow if available.

**Supplemental Oxygen:**

*Without PAP*

- At supplemental oxygen flows less than one litre per minute, add supplemental oxygen via a three-way tap. The other two ports on the tap are attached to the nasal cannula and the pressure sensor, respectively. The sensor must be capable of linear measurements at the higher pressures created by the supplemental oxygen.
- At flows higher than one litre per minute, a split-type nasal cannula should be used where oxygen is delivered via one prong and the pressure is measured from the other.

*With PAP*

- Deliver oxygen into the ventilation circuit as per local Hospital and Health Service protocols and procedures.
4.7.4. Optional Parameters

Utilise optional parameters in extended PSG recording configurations according to clinical need and local Hospital and Health Service protocols and procedures. These may include, but are not limited to, the following.

**Leg EMG**

Record the leg EMG from the anterior tibialis muscle of both the left and the right leg. Place electrodes two to three centimetres apart over the belly of the anterior tibialis muscle for both right and left legs.

**Sound – Decibel meter**

Place the sound level meter approximately 1.2 metres from the patient’s head.

**Oesophageal pressure manometry:**

Insert the oesophageal balloon catheter into the mid-third of the oesophagus as per local Hospital and Health Service protocols and procedures.

**Synchronised Digital Video Recording**

Display the entire patient on the video image.

**Arm EMG**

Place electrodes two to three centimetres apart over the belly of the extensor digitorum muscle for both the right and left arm.

4.7.5. Connecting to the PSG system

Once sensor and electrode application is complete and the patient is ready for bed, ensure that:

- there is easy access to the staff alert system
- the patient is comfortable (e.g. urine bottles are available, appropriate bedding and bed position)
- there is clear access to the patient (e.g. removal of obstacles at patient bedside, and outside the room).

4.7.6. Signal Display and Impedance Checks

Prior to the commencement of the PSG:

- connect all electrodes and sensors to the PSG system
- perform a visual check to ensure signals are clear and free of interference with a stable baseline
- perform and document an impedance check of AC recording parameters including the Reference and Ground. Ensure that impedances are below ten kΩ for ECG and limb EMG, and below five kΩ for all other signals
- undertake a patient bio-calibration (once appropriate corrective action is taken, if required)
Department of Health: Polysomnography Set-up (paediatric patients)

- record a square wave signal of known amplitude to confirm amplifier and filter settings.

If the signal quality is poor, review the sensor and electrode attachment on the patient before adjusting the polysomnograph display.

Document any changes to the default values of sensitivity and filter settings for AC inputs such as EEG, EOG, and ECG.

All other recording parameters may require small adjustments in sensitivity to occupy adequate space in the trace layout configuration as described above.

4.7.7. Patient Bio-Calibration

Record patient bio-calibrations to:

- ensure and demonstrate that all electrodes, sensors and other monitoring devices are functioning correctly prior to the commencement of the PSG
- acquire a set of baseline data for the PSG.

During the patient bio-calibration, observe the recorded signals to ensure that the correct PSG responses are evoked for all of the defined manoeuvres. See Appendix 2 for the most commonly performed patient bio-calibration tests. Ensure the patient bio-calibration is available for review during analysis and interpretation of the raw data.

Make every effort to correct poor signals observed during bio-calibration or before “Lights Off”. The PSG is ready for data acquisition once successful bio-calibration and impedance testings are completed. At this stage, follow the appropriate PSG-type Queensland Health guideline.

4.8. Quality Control Procedures

Elements of quality control are outlined within the above document. For further readings related to quality management within sleep disorder services refer to the electronic article Australasian Sleep Association (2012) Standard for Sleep Disorders Services. ¹⁰

5. Review

This Guideline is due for review on: 07/12/2016

Date of Last Review: New document

Supersedes: Nil

6. Business Area Contact

Statewide Clinical Measurements Network (SWCMN)
### 7. Definitions of terms used in the policy and supporting documents

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition / Explanation / Details</th>
<th>Source</th>
<th>See also</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bio-calibration</td>
<td>A series of exercises performed prior to initiating a polysomnogram, to verify correct input derivations and signal quality.</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>Electrocardiogram (ECG)</td>
<td>A non-invasive transthoracic recording of the electrical activity of the heart.</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>Electroencephalogram (EEG)</td>
<td>A non-invasive recording from the scalp of the electrical activity of the brain (cortical field potentials).</td>
<td>12</td>
<td>International 10-20 system for electroencephalogram placement</td>
</tr>
<tr>
<td>Electromyogram (EMG)</td>
<td>A non-invasive recording of the muscle activity from the overlying skin.</td>
<td>13</td>
<td></td>
</tr>
<tr>
<td>Electro-oculogram (EOG)</td>
<td>A non-invasive recording of the changes in orientation of the resting potential of the eye (a small potential difference exists between the cornea and retina).</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>Filter settings</td>
<td>The limit of the frequencies of a recorded parameter.</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>Ground electrode</td>
<td>The driven ground electrode completes a noise reduction circuit by inverting and cancelling out any signals that are common to the reference electrode and the ground.</td>
<td>12</td>
<td>Reference electrode</td>
</tr>
<tr>
<td>Infant patient</td>
<td>A patient &lt; 2 years of age</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Informed Consent</td>
<td>Agreement to a proposed procedure, given after proper and sufficient explanation of the condition, the procedure, the general and specific risks, the benefits and anticipated outcomes, alternative treatment available, and the risk of not having the procedure.</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>International 10-20 system for electroencephalogram placement</td>
<td>Standardised method for identifying equally spaced electrode positions on the scalp, based on four identifiable skull landmarks.</td>
<td>10</td>
<td>EEG</td>
</tr>
<tr>
<td>Lights off</td>
<td>Start of sleep opportunity, time (zero) from which sleep latency is calculated (also, referred to as Lights Out).</td>
<td>14</td>
<td>Lights on</td>
</tr>
<tr>
<td>Lights on</td>
<td>End of sleep opportunity.</td>
<td>14</td>
<td>Lights off</td>
</tr>
<tr>
<td>Term</td>
<td>Definition / Explanation / Details</td>
<td>Source</td>
<td>See also</td>
</tr>
<tr>
<td>-------------------------------------------</td>
<td>----------------------------------------------------------------------------------------------------</td>
<td>--------</td>
<td>----------</td>
</tr>
<tr>
<td>Multiple sleep latency test (MSLT)</td>
<td>Measures the physiological tendency to fall asleep in a sleep inducing environment in the absence of competing stimuli. It is indicated as part of the investigation of individuals presenting with suspected narcolepsy or hypersomnolence not better explained by other causes.</td>
<td>14, 15</td>
<td>Narcolepsy</td>
</tr>
<tr>
<td>Nasal air pressure</td>
<td>Used to detect nasal airflow.</td>
<td>16</td>
<td></td>
</tr>
<tr>
<td>Oro-nasal thermal sensor</td>
<td>Device to measure changes in airflow based on changes in temperature.</td>
<td>16</td>
<td></td>
</tr>
<tr>
<td>Paediatric patient</td>
<td>A patient aged between 2 and 18 years</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Paediatric Sleep Clinical Measurements Practitioner (Paediatric sleep CMP)</td>
<td>Registered paediatric nurse or a Health practitioner within Queensland Health included in the allied health stream under the clinical measurements group. Paediatric Sleep CMP denotes the profession of sleep science within the Clinical Measurements group, or can also refer to a registered paediatric nurse.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Paediatric Sleep Physician</td>
<td>Trained physician who is a member of the Royal Australian College of Physicians with current accreditation by the Respiratory and Sleep Medicine Specialist Training Committee (STC) with continuous professional development and ongoing experience in paediatric sleep medicine.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Polysomnography (PSG)</td>
<td>PSG refers to the continuous recording of multiple physiological variables to measure sleep architecture and cardio-respiratory function during sleep. Type 1 PSG is considered the reference standard for sleep monitoring and the clinical evaluation of sleep disorders, and the effectiveness of treatment.</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>Positive airway pressure (PAP)</td>
<td>Where room air is delivered via tubing connected from a turbine- or fan-driven air blower to a mask interface. Therapy types include Continuous Positive Airway Pressure (CPAP), Non-Invasive Ventilation 17, and Servo-Adaptive Ventilation (ASV).</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>Pulse oximetry</td>
<td>A non-invasive measure of arterial oxygen saturation in blood (SpO2%) and pulse rate.</td>
<td>18</td>
<td></td>
</tr>
</tbody>
</table>
## Department of Health: Polysomnography Set-up (paediatric patients)

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition / Explanation / Details</th>
<th>Source</th>
<th>See also</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reference electrode</td>
<td>“An electrode against which voltage fluctuations from an exploring electrode are measured”. This is usually an electrically silent area.</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>Respiratory inductance plethysmography (RIP)</td>
<td>“A method of detecting chest and abdominal movement secondary to changes in the inductance of bands around those regions.”</td>
<td>16</td>
<td></td>
</tr>
<tr>
<td>Sleep physician</td>
<td>Trained physician who is a member of the Royal Australian College of Physicians with current accreditation by the Respiratory and Sleep Medicine Specialist Training Committee (STC) with continuous professional development and ongoing experience in adult sleep medicine.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Type 1 polysomnography (PSG)</td>
<td>A sleep CMP-attended PSG with the following recording parameters: EEG, EOG, EMG (limb and chin), ECG, airflow, respiratory effort, pulse oximetry, and body position. This type of PSG allows for behaviour observations, standardised recording conditions, addressing technical issues, and making interventions during the night.</td>
<td>19</td>
<td></td>
</tr>
</tbody>
</table>

### 8. Approval and Implementation

**Policy Custodian:**
Julie Hulcombe – Chief Allied Health Officer

**Responsible Executive Team Member:**
Dr Michael Cleary  
Deputy Director-General  
Health System and Clinical Innovation

**Approving Officer:**
Dane Enkera – Statewide Clinical Measurements Network (Chair)
Consulting stakeholders:

Key stakeholders (position and business area) who will review this version are:

QH Sleep Sciences Working Party:

- Katrina Barton (Sleep Scientist, The Prince Charles Hospital)
- Anita Brake (Health Practitioner - Advanced, Sleep Disorders Centre Royal Brisbane and Women’s Hospital)
- Chris Brown (Respiratory and Sleep Scientist - Advanced, Respiratory and Sleep Unit The Townsville Hospital)
- Brett Duce (Scientific Director, Sleep Disorders Centre Princess Alexandra Hospital, President Australasian Sleep Technologists Association)
- Carl Downey (Senior Sleep Scientist, Sleep Disorders Centre, The Prince Charles Hospital)
- Matthew Leong (Sleep Scientist, Sleep Disorders Centre, The Prince Charles Hospital)
- Chloe Parsley (Senior Sleep/Respiratory Scientist, Mater Children’s Hospital)
- Kelli Rixon (Sleep Sciences Working Party Chair, Senior Sleep Scientist, Sleep Disorders Centre Princess Alexandra Hospital)
- Teresa Shirlaw (Sleep Scientist, Sleep Disorders Centre Princess Alexandra Hospital)
- Philip Teuwen (Sleep Sciences Working Party Deputy Chair, Statewide Clinical Educator for Sleep Sciences)
- Patricia Wales (Clinical Nurse Consultant, Department of Respiratory Medicine and Sleep Unit, Mater Children’s Hospital)
- Gordon Williams (Chief Paediatric Sleep Scientist, Department of Respiratory Medicine and Sleep Unit, Mater Children’s Hospital).

QH Sleep Disorders Centres Managers:

- Mike Brown (Royal Brisbane and Women’s Hospital)
- Greg Jorgensen (The Prince Charles Hospital)
- Luke Slingsby (Gold Coast Hospital)

QH Sleep Disorders Program Executive Committee:

- Dr Carolyn Daikin (Mater Children's Hospital)

Australasian Sleep Technologist Association:

- Tom Churchward (Secretary, Australasian Sleep Technologists Association 2010-2012)
- Nicole Verginis (on behalf of Professional Standards Sub-Committee 210-2012, Australasian Sleep Technologists Association)
Australasian Sleep Association Clinical Committee:

- Associate Professor Nick Antic, Clinical Director Adelaide Institute for Sleep Health, Staff Specialist Sleep and Respiratory Medicine Southern Adelaide Local Health Network

Clinical Measurements Advisory Group (CMAG) for Clinical Education and Training.

State-wide Clinical Measurements Network (SWCMN)

Approval date: 07/12/2013
Effective from: 07/12/2013
### 9. Appendices

#### Appendix 1:

**Recommended Sampling Rates and Filter Settings for each Recording Parameter**

<table>
<thead>
<tr>
<th>Channels</th>
<th>Minimum Sampling Rates</th>
<th>Polarity</th>
<th>Low Frequency Filter</th>
<th>High Frequency Filter</th>
</tr>
</thead>
<tbody>
<tr>
<td>EEG</td>
<td>200Hz</td>
<td>Negative</td>
<td>0.3 Hz</td>
<td>35 Hz</td>
</tr>
<tr>
<td>EOG</td>
<td>200Hz</td>
<td>Negative</td>
<td>0.3 Hz</td>
<td>35 Hz</td>
</tr>
<tr>
<td>EMG</td>
<td>200Hz</td>
<td>Positive/Negative</td>
<td>10 Hz</td>
<td>100 Hz</td>
</tr>
<tr>
<td>ECG</td>
<td>200Hz</td>
<td>Positive</td>
<td>0.3 Hz</td>
<td>70 Hz</td>
</tr>
<tr>
<td>Oro-nasal Thermal Sensor</td>
<td>25Hz</td>
<td>Positive</td>
<td>0.1 Hz</td>
<td>15 Hz</td>
</tr>
<tr>
<td>Oximetry</td>
<td>10Hz</td>
<td>Positive</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Nasal Pressure</td>
<td>25Hz</td>
<td>Negative</td>
<td>0.1 Hz</td>
<td>15 Hz</td>
</tr>
<tr>
<td>Pressure</td>
<td>25Hz</td>
<td>Positive</td>
<td>0.1 Hz</td>
<td>15 Hz</td>
</tr>
<tr>
<td>Patient Flow/Leak</td>
<td>25Hz</td>
<td>Positive</td>
<td>0.1 Hz</td>
<td>15 Hz</td>
</tr>
<tr>
<td>Oesophageal Pressure</td>
<td>25Hz</td>
<td>Negative</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Piezo Movement Sensors</td>
<td>25Hz</td>
<td>Positive</td>
<td>0.3 Hz</td>
<td>35 Hz</td>
</tr>
<tr>
<td>Body Position</td>
<td>1Hz</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Snoring Sounds (Microphone)</td>
<td>200Hz</td>
<td>Positive</td>
<td>10 Hz</td>
<td>100 Hz</td>
</tr>
<tr>
<td>Snoring Sounds (Piezo Sensor)</td>
<td>25Hz</td>
<td>Positive</td>
<td>0.1 Hz</td>
<td>15 Hz</td>
</tr>
<tr>
<td>Snoring Sounds (Decibel Meter)</td>
<td>10Hz</td>
<td>Positive</td>
<td>DC Coupled</td>
<td>DC Coupled</td>
</tr>
<tr>
<td>Thoracic and Abdominal Movements</td>
<td>25Hz</td>
<td>Positive</td>
<td>0.1 Hz</td>
<td>15 Hz</td>
</tr>
</tbody>
</table>

**Note:** Set sampling rates for all external DC inputs and optional parameters to manufacturer recommendations and laboratory specific guidelines for the PSG system being used. An optional 50Hz notch filter may be required to eliminate external electrical noise.
### Appendix 2:
**Commonly Performed Patient Bio-Calibrations**

<table>
<thead>
<tr>
<th>Recording Parameter</th>
<th>Patient Instruction</th>
</tr>
</thead>
</table>
| **EEG***              | 1. Eyes open, staring straight ahead  
                        2. Eyes closed, but remain awake |
| **EOG***              | 1. Look right, look left, look right, look left  
                        (keeping head still)  
                        2. Look up, look down, look up, look down  
                        (keeping head still)  
                        3. Blink five times |
| **EMG** – mental/submental | 1. Grit your teeth and swallow |
| **Thermal Sensor, Nasal Pressure, Respiratory Inductance, Plethysmography, Diaphragm EMG, Oesophageal Pressure, PAP** | 1. Hold breath (for approximately ten seconds) |
| **Thermal Sensor, Nasal Pressure** | 1. Breathe through nose only  
                        2. Breathe through mouth only |
| **EMG – Anterior Tibialis** | 1. Move (dorsi-flex, then plantar-flex) right foot, and relax, repeat  
                        2. Move (dorsi-flex, then plantar-flex) left foot, and relax, repeat |
| **Body Position** | 1. Roll to right side, roll to left side (if able to) |
| **Sound** | 1. Cough or make a snoring sound |
| **EMG – Extensor Digitorum** | 1. Clench left hand…and relax, clench right hand…and relax, clench left hand…and relax, clench right hand…and relax |

*Note:* * An abridged patient bio-calibration routine is performed for MSLT/MWT recordings using manoeuvres 1 to 3. Additional manoeuvres may be performed depending on the recording configuration utilised.
10. **Suggested Readings and References**

10.1. **Suggested Reading**


10.2. **References**


