

University of Texas Medical Branch Pulmonary Function Clinic Policy 03-08 Plethysmography Test	Effective Date: Aug 00 Revised Date: Oct 21 Review Date: Aug 23

## Patient Testing – Elite Plethysmography

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**Audience** All personnel in the Pulmonary Function Clinic.

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**Purpose** Thoracic Gas Volume (TGV) testing determines the volume of gas in the patient’s thorax. The principle of this test is based on Boyle’s Law, which states that the volume of gas is inversely proportional to the pressure to which it is subjected providing that the temperature remains constant.

Airway Resistance (Raw) is used to determine the pressure difference per unit flow as gas flows into or out of the lungs. Airway Resistance is the difference between mouth pressure and alveolar pressure, divided by flow at the mouth. Primarily the friction of gas molecules in contact with the airways causes this pressure difference.

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### Instructing the Patient

Standard testing procedures begin with instructing the patient and demonstrating proper technique. The greatest potential source for error is the failure of the patient to perform the test properly.

Allow the patient to sit inside the box with the door open while you familiarize the patient with the box and intercom system. The procedures should be explained thoroughly to the patient. If the patient is relaxed, the collected data will represent true TGV and Raw measurements.

When the patient is comfortable you may close the door, which will seal automatically if the Inflate/Deflate switch on the left side of the Elite is in the Inflate Mode.

**Note:** On the inside of the box is a “Door Release/Reset” switch. This switch can be used by the patient to open the door. Once this switch has been activated, it must be pressed a second time to reset the door locks.

During testing, the patient will have on their nose clips and be instructed to breathe through the mouthpiece. Once comfortably breathing, the patient will then place the palms of their hands against their cheeks for support. Supporting their cheeks prevents pressure fluctuations due to cheek flexing. The patient should be sitting fully erect.

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**Procedure** The following is the correct procedure for performing Thoracic Gas Volumes and Airway Resistance on a patient:

- Zero the pneumotach by clicking the Zero Flow button. There must be no flow through the pneumotach during this procedure.

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- Ensure that the pneumotach is attached to the pneumotach umbilical clip and that this unit is attached to the patient circuit in the arm of the Elite.
- Place nose clips on the patient.
- Instruct the patient to breathe normally through the pneumotach.
- Ensure that the box is equilibrated. To verify equilibration, click Box Vent after the door has been closed for approximately 1 minute, the box vent will close and a Vent Closed message will be displayed across the pressure graph. If the indicator line on the Box Pressure Indicator Bar remains near the center, testing may begin. Click Box Vent again to open the vent.
- If the vent is not used, the therapist can wait 45 seconds to start the procedure.

**Note:** The box vent window remains open until effort collection begins.

- Have the patient breathe normally on the mouthpiece. Click Start or press the spacebar to begin testing. Collect at least four stable tidal breaths and then press the spacebar or Next button. At the end of the next tidal breath, instruct the patient to gently pant. Panting frequency, which should be approximately 30 to 60 breaths per minute or 0.5 to 1 Hz (per ATS guidelines), is displayed on the test pad. If frequency is too high or too low, the breath frequency indicator turns red.
- After the minimum number of panting efforts are displayed on the graph, click Next or press the spacebar to collect Closed-Shutter data. The computer goes through the following routine.
  - Closes the shutter.
  - Collects the loops performed during closed shutter panting.
  - Opens the shutter.

**Tip:** The number of open-shutter loops (efforts) to be collected and the time for the shutter to be closed are both specified on the Pleth Options tab (select Options from the Tools menu and click on the Pleth tab).

- When the shutter reopens, you may have the patient perform an SVC maneuver (instruct the patient to inspire slowly and maximally then exhale slowly and maximally). Then press the spacebar or stop button. Instruct the patient to return to normal breathing.
- Repeat the above steps until the required efforts have been obtained. Three acceptable and reproducible efforts are usually considered sufficient for valid results.

**Tip:** You can select which parameter and what range to allow for repeatability on the Pleth Options tab (select Options from the Tools menu and click on the Pleth tab).

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### Quiet Breathing Option

As an alternative to the Raw panting test procedure, Breeze Suite allows you to collect Raw data by using the quiet breathing technique. Select Quiet Breathing from the Pleth Options tab (select Options from the Tools menu and click on the Pleth tab). This option can be used, but currently is not practiced in the lab.

While the name does not truly describe this technique, the breathing frequency during the procedure is significantly less than during the panting maneuver, approximately 30-50 breaths per minute.

During Raw data collection, there is a change in box pressure caused by increased heat and humidity due to the patient's presence. This change becomes evident during quiet breathing testing. Thus, a manual compensation allows you to adjust for box pressure changes.

While the patient is breathing on the system, a tracing is displayed on the Flow/Pressure graph. This tracing should always maintain a clockwise rotation and should be as tight as possible without crossing over itself. You can compensate a tracing with the left and right arrow keys on the keyboard while the patient is performing open shutter breathing.

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### Separate TGV

Breeze Suite allows you to collect TGV efforts separate from Raw efforts. Select TGV (Separate Maneuver) from the Pleth Options tab (select Options from the Tools menu and click on the Pleth tab). When this option is selected, the test pad includes a TGV button.

- Zero the pneumotach by clicking the Zero Flow button. There must be no flow through the pneumotach during this procedure.
- Ensure that the pneumotach is attached to the pneumotach umbilical clip and that this unit is attached to the patient circuit in the arm of the Elite.
- Place nose clips on the patient.
- Instruct the patient to breathe normally through the pneumotach.
- Ensure that the box is equilibrated. To verify equilibration, click Box Vent after the door has been closed for approximately 1 minute. The box vent will close and a Vent Closed message will be displayed across the pressure graph. If the indicator line on the Box Pressure Indicator Bar remains near the center, testing may begin. Click Box Vent again to open the vent.

**Note:** The box vent window remains open until effort collection begins.

- Have the patient breathe normally on the mouthpiece. Click TGV to begin testing. Collect at least four stable tidal breaths and then press the spacebar or Next button. Wait until the shutter closes, then instruct the

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patient to pant. Panting frequency, which should be approximately 60 to 90 breaths per minute, is displayed on the test pad. If the frequency is too high or too low, the breath frequency indicator turns red.

- When the Next button or spacebar is activated to collect closed shutter data, the computer goes through the following routine:
  - Closes the shutter.
  - Collects the loops performed during closed shutter panting.
  - Opens the shutter.

**Tip:** The time for the shutter to be closed is specified on the Pleth Options tab (select Options from the Tools menu and click on the Pleth tab).

- Repeat the above steps until the required efforts have been obtained. Three acceptable and reproducible efforts are considered sufficient for valid results.

**Tip:** You can select which parameter and what range to allow for repeatability on the Pleth Options tab (select Options from Tools menu and click on the Pleth tab).

**This form documents the approval and history of the policies and procedures for the Pulmonary Function Laboratory. The Medical Director signs all policies verifying initial approval. Annually thereafter, the Director and/or designee may approve reviews and revisions.**

<b>Date</b>	<b>Approved by:</b>	<b>Signature</b>
11/07	V. Cardenas, MD Medical Director Pulmonary Laboratory	
6/09	V. Cardenas, MD No changes to the policy	
7/10	V. Cardenas, MD No changes to the policy	
2/12	A. Duarte, MD Medical Director Pulmonary Laboratory No changes to the policy	
5/14	A. Duarte, MD Medical Director Pulmonary Laboratory No changes to the policy	
8/16	A. Duarte, MD Medical Director Pulmonary Laboratory No changes to the policy	
11/17	A. Duarte, MD Medical Director Pulmonary Laboratory No changes to the policy	

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- 8/19**            **A. Duarte, MD**  
**Medical Director Pulmonary Laboratory**  
**No changes to the policy**
  
- 8/21**            **A. Duarte, MD**  
**Medical Director Pulmonary Laboratory**  
**No changes to the policy**
  
- 8/23**            **A. Duarte, MD**  
**Medical Director Pulmonary Laboratory**  
**No changes to the policy**