Patient Testing – Diffusion Capacity Profiler & Elite Plethysmograph – RGA (Rapid Gas Analyzer)

Audience All personnel in the Pulmonary Function Clinic.

Purpose To describe the procedure for performing Diffusion Capacity (DLCO) on the Profiler and Elite Plethysmograph in the Pulmonary Function Clinic.

Diffusion Capacity is measured by using small volumes of carbon monoxide to assess the gas exchange ability of the lungs across the alveolocapillary membrane.

Cautions **DLCO Testing is performed using the pre-vent pneumotach and mouthpiece connected to the pneumotach umbilical. The pneumotach must also be connected to the patient circuit in the arm of the Profiler or Elite.**

Note: If both diffusion and nitrogen washout tests are to be conducted, the diffusion test should be performed first. Inhaling 100% oxygen during a nitrogen washout test may saturate the hemoglobin and decrease the patient's diffusion capacity values.

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.

Prior to Testing

The following should be performed prior to testing:

- Be sure you have warmed up the system and performed the daily complete pneumotach calibration. Before testing, the Gas Calibration must be on for **twenty** minutes. Warm-up time is displayed on the associated timer at the top of the screen.
- Select the DLCO tab.
- Click the DLCO tab, then perform gas calibration for CO, CO2 and O2.

If the system meets these criteria, patient testing may begin. If the system does not meet these criteria, check the gas tanks and/or connections and repeat Gas Calibration.

Procedure The following is the correct procedure for performing Diffusion Capacity on a patient:

- Before beginning the test, click Zero Flow to zero the pneumotach. There must be no flow through the pneumotach during this procedure.

- Ensure that the pneumotach is attached to the flow sensor umbilical clip and that this unit is attached to the patient circuit in the arm of the Profiler or Elite.
- Place nose clips on the patient.
- Instruct the patient to breathe normally through the pneumotach. If you have the Keystroke to Start Test option turned on (default), press the spacebar to begin data collection. If not, breathing on the system starts the testing procedure and begins data collection. The patient's breathing efforts are displayed immediately on the screen.
- Instruct the patient to exhale slowly and maximally to residual volume (RV). While the patient is exhaling, or at the end of this exhalation, click Next or press the spacebar. When the computer detects zero flow, the patient valve closes for start of inspiration and the patient circuit opens to the source gas (diffusion gas).
- After the valving system is activated, instruct the patient to rapidly inhale to total lung capacity, filling the lungs with diffusion gas. The valve will close automatically when zero inspiratory flow is sensed.

Note: If the patient begins to inhale before the valving system is activated, the patient's inspired volume will not be measured correctly. The numeric data displayed in the "volume inspired" row will be lower than the trace displayed on the volume/time graph.

- When the valve system closes, the patient is locked out for the time specified in the Setup Menu. Instruct the patient to relax against the closed valve for this period. The end of lock-out is shown as a vertical dotted line on the Volume/Time graph. During lock-out, watch the graph to see when the valve is about to open.
- At the end of lock-out, the valve opens. Instruct the patient to exhale until the sample is collected.
- The test ends automatically. Remove patient from mouthpiece and take off nose-clips.

Automatic Gas Analysis

At the end of each effort, a gas sample is collected automatically into the chromatograph for analysis. Analysis of the patient sample is superimposed on the Pre-analysis graph and all measured values are displayed on the Data Collection screen. While the sample is being analyzed, the diffusion circuit is flushed. Once the results from the previous effort are displayed, the system is ready for additional efforts.

Acceptability, Repeatability and Quality Control Criteria

Criteria for acceptability

- A VI $\geqslant$90% of the largest VC in the same test session; alternatively a VI $\geqslant$85% of the largest VC in the same test session and VA within 200 mL or 5% (whichever is greater) of the largest VA from other acceptable maneuvers.

- 85% of test gas VI inhaled in <4 s.
- A stable calculated breath-hold for 10±2 s with no evidence of leaks or Valsalva/Müller maneuvers during this time.
- Sample collection completed within 4 s of the start of exhalation. For RGA systems, virtual sample collection should be initiated after dead-space washout is complete.

Criteria for repeatability

- At least two acceptable DLCO measurements within 2 mL·min−1·mmHg−1 (0.67 mmol·min−1·kPa−1) of each other.

Quality control grading#:

Score	VI/VC	tBH	Sample collection
A	⩾90%	8–12 s	⩽4 s
B	⩾85%	8–12 s	⩽4 s
C	⩾80%	8–12 s	⩽5 s
D	⩽80%	<8 or >12 s	⩽5 s
F	⩽80%	<8 or >12 s	>5 s

According to ATS guidelines, the average DLCO values from two or more grade A maneuvers that meet the repeatability criterion should be reported if only one grade A maneuver is attained, the DLCO value from that maneuver should be reported. If no grade A maneuver is obtained, maneuvers of grades B to D might still have clinical utility. The average of such maneuvers should be reported but these deviations from the acceptability criteria must be noted to caution the interpreter of the test results.

Reporting

1) If two or more grade A maneuvers that are not repeatable are obtained, then the average DLCO value from the acceptable maneuvers is reported.
2) If only one grade A maneuver is obtained, then the DLCO value from that maneuver is reported.
3) If no acceptable maneuvers are obtained, then the average DLCO value of the maneuvers with grades B, C or D is reported.
4) If only grade F maneuvers are obtained, then no DLCO value is reported.

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.

Date	Approved by:	Signature
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
Changes to the policy

11/17 **A. Duarte, MD**
Medical Director Pulmonary Laboratory
Changes to the policy

8/19 **A. Duarte, MD**
Medical Director Pulmonary Laboratory
Changes to the policy

7/21 **A. Duarte, MD**
Medical Director Pulmonary Laboratory
No changes to policy

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