

University of Texas Medical Branch Pulmonary Function Clinic Policy 03-09 Functional Residual Capacity	Effective Date: Revised Date: Review Date:	Apr 02 Aug 23 Aug 23
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Patient Testing – Functional Residual Capacity Testing on Ultima

Audience All personnel in the Pulmonary Function Clinic.

Purpose To describe the procedure for performing Functional Residual Capacity (FRC) on the Ultima in the Pulmonary Function Clinic.

FRC is the volume of gas remaining in the lungs at the end of a quiet breath. Residual volume (RV) cannot be exhaled; it is the volume remaining in the alveoli after the airways have closed. FRC is measured and the RV calculated by subtracting expiratory reserve volume (ERV) obtained from simple spirometry.

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. If the patient is relaxed, the end-expiratory volume will represent true resting end-tidal volume (FRC).

Prior to Testing

The following steps should be done prior to testing the patient:

- Be sure the system has been warmed up and that the daily complete pneumotach calibration has been performed.
- Select the FRC N2 tab. The system begins the pre-test calibration.
- Attach the pneumotach clip to the Profiler cal port. At this point please perform a gas calibration before testing a patient. The system samples room air. If the room air N2 levels is not within the systems allowable range (79.6% +/-2%), flush the system with room air using a calibration syringe. Press the spacebar when N2 gain is within range.
- Attach the patient circuit to the arm of the Profiler. Connect pneumotach and umbilical clip to patient circuit so that the umbilical tubing is in a straight up (12 o'clock) position.

Note: In order to calculate RV and TLC, an SVC test should be conducted prior to performing a Nitrogen Washout test. Optionally, you can perform a SVC within the Nitrogen Washout test. Select Individual SVC Maneuver from the FRC N2 Option tab to allow SVC efforts within FRC N2 testing.

Procedure The following is the correct procedure for performing a Functional Residual 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 the pre-vent pneumotach with rubber mouthpiece and clip assembly are attached to the patient circuit in the arm of the Profiler so the umbilical tubing is in the straight up (12 o'clock) position.

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- Place nose clips on the patient.
- Instruct the patient to relax as much as possible and breathe normally. Perform a minimum of four stable tidal breaths. The Volume/Time graph displays the patient's breathing pattern while the patient is breathing on the system.

Note: If the patient's breathing pattern is unstable, have the patient continue to breathe tidally beyond the minimum four breaths.

- After four stable tidal breaths, press the spacebar or click Next during an exhalation to begin the washout process. At the end of that exhalation, the computer automatically switches the patient to 100% oxygen. The graph on the right of the screen displays the percent nitrogen of each breath the patient exhales.

Note: After switching to 100% O₂, observe the Switch-In Error and N₂ indicators on the screen. The nitrogen concentration of each breath is displayed in real time.

- Instruct the patient to continue tidal breathing throughout the test. Have the patient occasionally take a deep breath to ensure complete nitrogen washout. Ensure that the patient's lips remain tightly closed around the mouthpiece. If there are any leaks, the values from the washout test will be invalid and the study must be repeated.
- When nitrogen concentration is reduced to 1.7%, the computer prompts you to sigh the patient (inspire deeply and exhale maximally). The test stops automatically when the program senses three consecutive breaths with nitrogen concentrations of 1.7% or less.
- Remove nose clips from patient and have patient come off of mouthpiece.

Note: The less uniform the distribution of ventilation, the more time will be required to washout the nitrogen from the lungs. Chronic obstructive patients may not be able to obtain a nitrogen reading less than 1.7%. In these cases the lab should have a protocol to end the test at different nitrogen percentages or after a specified time (usually 7 to 8 minutes).

Repeating Efforts

If the procedure needs to be repeated, allow sufficient time for the patient to washout excess oxygen in the lungs before attempting the next effort. A rule of thumb is to wait twice as long as the patient was breathing 100% oxygen. If the patient has chronic obstructive lung disease, wait three to four times as long as the patient was breathing 100% oxygen.

Before re-testing the patient, flush the circuit with a syringe and re-zero the pneumotach.

Acceptability Criteria

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The following are the acceptability criteria for FRC testing:

- The washout tracing or display should indicate a continually falling concentration of alveolar N₂.
- The test should be continued until the N₂ concentration falls to 1.0%.
- Washout times should be appropriate for the type of subject tested. Healthy subjects should washout N₂ completely in 3 to 4 minutes.
- The washout time should be reported. Failure to washout N₂ within 7 minutes should be noted.
- To be acceptable trials, according to ATS standards, at least 2 trials should be within 10%; the average FRC from acceptable trials should be used to calculate lung volumes. Patient should wait double the washout time between repeated trials.

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	
5/14	A. Duarte, MD Medical Director Pulmonary Laboratory Changes made to policy	
8/16	A. Duarte, MD Medical Director Pulmonary Laboratory No changes made to policy	
11/17	A. Duarte, MD Medical Director Pulmonary Laboratory No changes made to policy	
9/19	A. Duarte, MD Medical Director Pulmonary Laboratory No changes made to policy	
8/21	A. Duarte, MD Medical Director Pulmonary Laboratory No changes made to policy	

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A. Duarte, MD
Medical Director Pulmonary Laboratory
Changes made to policy