Cellular respiration is the process in which the body consumes oxygen and produces carbon dioxide. External respiration is the exchange of oxygen and carbon dioxide between the lung tissues and the environment, and relies on a series of tubes called bronchioles that branch and terminate as clusters of small, membranous air sacs called alveoli.

Ventilation of the lungs occurs when chest muscles contract and the thorax expands. Inspiration is achieved by a contraction of the diaphragm and intercostal muscles. Expiration is usually passive in the resting individual as muscle relaxation and gravity act to decrease thoracic volume. Forced expiration, as during exercise, is achieved by contraction of intercostal muscles.

The amount of air that moves in or out of the lungs during breathing is called the lung volume. Lung volume is dynamic, changing according to the requirements of the body. The depth and rate of breathing are controlled by the respiratory control center in the brain, which insures that the exchange of oxygen and carbon dioxide takes place at a level that matches the body’s needs. In addition to variation due to activity, lung volumes are also influenced by a person’s height, physique, age, environmental conditions such as altitude and smoking, and state of health. Therefore, the measurement of lung volume is an important clinical assessment.

Pulmonary Function Tests (PFT) measure lung volumes with an instrument called a spirometer. In this lab you will use a flow-type spirometer to measure standard lung volumes. We measure airflow (ml/sec) by breathing into a sensitive pressure transducer. The mathematics of converting a continuously changing flow to volume is possible because we send information through the transducer to the computer and use software to compute the volume.

Today’s Objectives

1. Measure Tidal Volume (TV).
2. Calculate Respiration Rate and Minute Volume.
3. Measure Vital Capacity (VC) and compare to normative values.
4. Measure Forced Expiratory Volumes FEV₁ and FVC. Calculate the ratio of FEV₁ to Forced Vital Capacity (FEV₁%). Use this value to evaluate respiratory fitness.
Lung Volume Definitions

1. **Tidal Volume (TV)** is the volume of air that is inhaled or exhaled with each breathing cycle. It varies with conditions (e.g. rest, exercise, and posture). A more accurate measure is achieved if several breaths are averaged.

2. **Vital Capacity (VC)** is the volume change that occurs between maximal inspiration and maximal expiration.

3. **Forced Vital Capacity (FVC)** is the volume of gas that can be expelled during a forced breath from full inspiration to complete expiration. In normal subjects this volume differs little from vital capacity in which expiration is gentle and not forced.

4. **Forced Expiratory Volume (FEV)** is the volume of gas which can be expired in a short time, during a forced expiration starting from full inspiration. The time recorded is usually for one second, which is designated FEV$_1$.

5. **Forced Expiratory Volume Ratio (FEV1%)** is the forced expiratory volume expressed as a percentage of the forced vital capacity, i.e. (FEV$_1$/ FVC) X 100%.

*Figure 1. Respiratory Volumes*
Equipment

1. **Airflow transducer (SS11A).** The transducer for today’s lab is an airflow transducer. You will breathe into this apparatus and the software will convert airflow to volume. In order for this measurement to be accurate you must follow the procedure exactly as described. The airflow transducer should be plugged into Ch. 1.

2. **Bacteriological Filter.** This is a sanitary device designed to prevent contamination from user to user. This piece is NOT to be shared.

3. **Disposable Mouthpiece.** Obtain one of these from your instructor. This is the only part that your mouth will come in contact with during the exercise. This piece is NOT to be shared.

4. **Nose Clip.** The nose clip will prevent you breathing through your nose insuring that the airflow comes only from your mouth.

5. **Calibration Syringe.** The syringe is for calibrating the MP35 unit, by delivering one full liter of air during calibration procedure. This is will “teach” the software how much airflow corresponds to 1 liters.
Getting Started

1. Turn your computer ON. When the computer has finished booting up, turn the MP35 unit ON. The "Busy" light on the MP35 unit will flash. Once the "Busy" light goes out, launch the Biopac Student Lab software.

2. Choose Lesson 13 (L13-LUNG-2).

3. Type in your file name. Click OK.

4. Check to see if the airflow transducer (SS11LA) is plugged into Channel 1.

5. Place the calibration filter onto the end of the calibration syringe. NOTE: do not use your personal filter. Use the filter labeled "Calibration". A filter must be included in the calibration procedure because of the way it affects airflow. See Fig. 2.

![Figure 2. Calibration syringe with filter attached.](image)

6. Please read ALL of Step 6 before attaching the syringe to the airflow transducer. Insert the calibration syringe with its filter into the Airflow Transducer on the side labeled “Inlet”. CAUTION: The calibration syringes are extremely fragile. NEVER HOLD ONTO THE AIRFLOW TRANSDUCER HANDLE when using the calibration syringe or the tip will break off (See Fig 3a and 3b for proper handling). BOTH hands must be placed on the syringe itself. One hand should be on the plunger, the other on the body of the syringe (see Fig 3b).

![Figure 3a. Incorrect way to hold onto the syringe/transducer assembly.](image)
Calibration

You are not holding on to the airflow transducer handle now are you? Good. You should have both hands on the calibration syringe. Practice using the plunger of the calibration syringe until you feel you can get a smooth but firm motion of air moving in and out of the barrel. Continue once you feel confident with the handling of the syringe.

1. Pull the Calibration Syringe Plunger all the way out and hold the Calibration Syringe/Filter Assembly parallel to the ground.

2. Read the Journal window on the lower screen for directions:
   - The first part of the calibration sets the baseline. It calibrates with no air movement within the barrel. Hold the syringe still without touching the plunger.
   - Click **Calibrate**. A prompt will remind you to do nothing during this first part of calibration (Figure 4).

   ![Figure 4. Warning to not touch plunger at this time.](image)

Note the green line traveling across the screen. After two screens, it will stop on its own. Wait for it to end.
3. The second part of the calibration measures 1 Liter of airflow through the barrel. The method of delivery needs to be very precise and is described in detail in the Journal window on the lower screen of your computer. Read those directions before clicking Yes.

The following directions summarize the directions in the Journal window:
You will push and pull the plunger a total of ten times, 5 in and 5 out, forcefully enough to cause the plunger to produce a whistling sound. Practice this a few times before actually calibrating.

Follow this rhythm as you practice: plunger in, wait 2 seconds; plunger out, wait 2 seconds. Continue this pattern until you have finished the 10 strokes.

Note: The repeated strokes are required because of the complexity of the Airflow to Volume calculation. The accuracy of this conversion is increased when analyzing the airflow variations occurring over five complete cycles of the calibration syringe.

4. When you are ready to begin, click Yes. The second stage of the calibration procedure will begin to record. Wait 2 seconds, then begin by pushing the plunger in. Cycle the syringe plunger in and out completely 5 times (10 strokes) following the rhythm practiced above. Click End Calibration. Your calibration recording should look like Figure 5.

![Figure 5. Results from a correct calibration](image)

5. If your data looks like that of Figure 5, you can proceed to the next step. If it does NOT look like the image above, click Redo Calibration. It may take two or three tries to get the calibration right. Check with your instructor to determine what you may be doing wrong and repeat the calibration.
6. When you are satisfied with your recording gently detach the transducer from the calibration syringe and filter. **Be gentle**, as the torque on the syringe tip can cause it to break off.
RECORDING TIDAL VOLUME AND VITAL CAPACITY

1. Attach the subject's own filter onto the airflow transducer on the inlet side and then attach the mouthpiece onto the filter (Fig. 6).

![Airflow transducer with filter and mouthpiece attached.](image)

2. Seat the subject facing away from the computer monitor. The subject should wear the nose clip, and hold the airflow transducer by the handle (now you are allowed), with its attached filter and mouthpiece parallel to the floor. Keep the airflow transducer upright at all times (Figure 6).

Practice Run

3. Practice the first breathing routine without recording on the computer:
   
   Have the subject breathe in and out through the mouthpiece as normally and relaxed as possible (easier said than done).

   It is OK to bite on the mouthpiece as they breathe. A breath is made up of one inhale and one exhale cycle. The subject should try to inhale normally, followed by an unrushed exhaling. There is a tendency to not exhale completely before beginning a new breath because of the awkwardness of the situation. Try to breath as normally as possible without too much conscious thought.

4. Monitor the subject's breathing pattern by the rise and fall of their torso. After five cycles, have the subject inhale as deeply as possible followed by exhaling as completely as possible.

   Note: Inhaling as deeply as you can and exhaling as deeply as you can takes EFFORT. The subject should truly force their inhalation and then their exhalation until they are bending over trying to eliminate the last volume of air.
5. Let the subject breathe normally once again for five cycles. Remember a cycle is one inhalation followed by exhalation. These steps differ from the prompt in the lower journal window on your laptop. Do NOT follow the computer screen prompt. Follow the directions on this handout instead. From here on, this handout will differ from the prompts on the screen. **Ignore the prompts.**

**Ready to Record (The real thing)**

6. When ready and clear on the directions above, a member of the group other than the subject will click **Record FEV**.

7. Read the following steps aloud to your subject as you record.
   a) Breathe normally until we tell you otherwise. (Helper counts 5 cycles)
   b) Inhale as deeply as you can, and exhale as deeply as you can.
   c) Breathe normally until we tell you to stop. (Helper counts 5 cycles)

8. Click **Stop**. The recording should look like the Figure 7.

![Figure 7. Tidal Volume plus Forced Expiratory Volume tracing.](image)

9. You may redo the recording if you feel there was an error in your methodology and it does not look like the recording above. It is best to fix errors now, early in your data collection than later. Don’t hesitate to re-do. Obtaining a good recording usually takes a couple of attempts.

10. You will collect data from this screen. **DO NOT click "Setup FEV".**
Measuring Tidal Volume

1. Set up two measurement boxes on the upper left side of the screen (see Figure 8.). The first should be P-P, the second should be Delta T. P-P will measure volume in liters (Y-axis) and Delta T will measure time in seconds (X-axis).

   ![Figure 8. Measurement boxes set up for P-P and Delta T](image)

Check glossary at the end of this week's exercise for an explanation of the P-P or Delta T calculation.

2. Measure the volume (Y-axis) of one breath (TV) by using the I-beam cursor to highlight one breathing cycle. Position the I-beam cursor from the valley to valley of one breath (see Figure 9). Use three significant digits. Record P-P in liters in Table 1.

   ![Figure 9. I-beam location for measuring Tidal Volume (P-P)](image)

3. The time of a breath, or the cycle time, is measured on the X-axis as Delta T in seconds. Record Delta T for one breath in Table 1.
Repeat these measurements for two more breathing cycles from your recording. (Pick those without any major anomalies).

4. Calculate the average TV and cycle time for all three breaths. Tidal volume values may range from 0.2 L to 0.6 L, depending on the size and respiratory health of the individual. Cycle time may range from 3 to 6 seconds per breath.

Note: Averages are preferable because they account for variability between breathes.

<table>
<thead>
<tr>
<th>Table 1: Tidal Volume (TV)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cycle</strong></td>
</tr>
<tr>
<td>#1</td>
</tr>
<tr>
<td>#2</td>
</tr>
<tr>
<td>#3</td>
</tr>
<tr>
<td>Per Cycle Average</td>
</tr>
<tr>
<td>Respiratory Rate (cycles/minute)</td>
</tr>
<tr>
<td>Minute Volume (liters/minute)</td>
</tr>
</tbody>
</table>

Calculating Respiratory Rate and Minute Volume

Respiratory rate by itself is of limited clinical value, but may be useful in conjunction with other signs of respiratory distress. The simple act of measuring respiratory rate is often sufficient to alter it. Respiratory rate can vary widely and is often difficult to measure accurately because it is relatively slow. In a clinical setting, the most accurate measurements of respiratory rate should be taken over a full minute and without the subject's knowledge.

Minute Volume takes into account both rate and depth of breathing. It is particularly important in sick or injured patients using ventilators to support their breathing. The volume of air delivered by the ventilator must be closely monitored.

1. Calculate your subject’s Respiratory Rate: **Respiratory Rate** (breaths/min) is the number of breaths in a minute. Use the average cycle time from Table 1 to calculate respiratory rate using the formula below.

   \[
   \text{Respiratory Rate} = \frac{\text{Number of breaths}}{\text{Cycle Time (sec)}} \times 60 \text{ sec.} = \frac{\text{breaths}}{1 \text{ min.}}
   \]
Average Respiratory Rate is between 12 and 17 breaths per minute. Record your result in Table 1.

2. Calculate Minute Volume:

   **Minute Volume** (liters/min) is the volume of air inspired in a minute. This is calculated by multiplying Tidal Volume by Respiratory Rate. Use the formula below for your calculation.

   \[
   \text{Minute Volume} = \text{TV} \times \text{Resp. Rate} = \frac{L}{\text{breath}} \times \text{breaths} = \text{(L/minute)}
   \]

3. Record your results on the board or overhead projector with the rest of the class data. We do this to get an idea of variability seen in a random group of individuals.

### Measuring Vital Capacity

You will now measure the volume of exchanged air occurring between maximal inspiration and maximal expiration, called **vital capacity (VC)**. Normal values for VC are affected by age, gender, and height. Go to this website to calculate normative values for your age, weight, gender, and ethnic background:


1. Use the I-beam cursor to select the area of maximum exhale. You do this by placing the cursor at the start of exhale (just before the drop) and dragging the I-beam over to the lowest point of the following valley. This highlighted section should be about 3 seconds in length. See figure 10. Record the P-P value in Table 2. Record your results on the board or overhead projector with the rest of the class data.

2. **Do not exit your screen yet.** We will use the same file to collect one more set of data to measure FEV₁ and FVC.
Figure 10. I-beam location for measuring Vital Capacity.

Table 2: Vital Capacity

<table>
<thead>
<tr>
<th>Vital Capacity (P-P) (Liters)</th>
<th>Room Temperature</th>
<th>BTPS Factor (from Table 3)</th>
<th>BTPS Adjusted Volume</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The BTPS factor is a conversion factor used to correct for variations in airflow caused by ambient temperature differences. Multiply your vital capacity value by the factor in Table 3 corresponding to your room temperature. Enter the result in Table 2.

Example: Vital Capacity: 3.71 Liters
Room temperature: 21 degrees C. requires a 1.096 factor
BTPS= 3.71 X 1.096= 4.066 Liters
Table 3. Conversion Factors from ATPS to BTPS

<table>
<thead>
<tr>
<th>Room Temperature (°C)</th>
<th>BTPS Factor*</th>
</tr>
</thead>
<tbody>
<tr>
<td>18°</td>
<td>1.113</td>
</tr>
<tr>
<td>19°</td>
<td>1.108</td>
</tr>
<tr>
<td>20°</td>
<td>1.102</td>
</tr>
<tr>
<td>21°</td>
<td>1.096</td>
</tr>
<tr>
<td>22°</td>
<td>1.091</td>
</tr>
<tr>
<td>23°</td>
<td>1.085</td>
</tr>
<tr>
<td>24°</td>
<td>1.080</td>
</tr>
<tr>
<td>25°</td>
<td>1.075</td>
</tr>
<tr>
<td>26°</td>
<td>1.069</td>
</tr>
<tr>
<td>27°</td>
<td>1.063</td>
</tr>
<tr>
<td>28°</td>
<td>1.057</td>
</tr>
<tr>
<td>29°</td>
<td>1.051</td>
</tr>
</tbody>
</table>

* Assumes a of 760 mmHg barometric pressure

Forced Expiratory Volume in One Second (FEV₁)

Forced Expiratory Volume is a reflection of the mechanical aspects of the functioning of the respiratory system and is measured as FEV₁. FEV₁ is the volume of gas expired in the first second of forced expiration. The ratio of FEV₁ to Forced Vital Capacity is a measure of the speed with which air can be expelled from the lungs and is also referred to as FEV₁/FVC. The FEV₁/FVC ratio is the most important factor for distinguishing obstructive disease from restrictive disease. In general, healthy individuals are able to expel 75% to 80% of FVC in the first second of expiration.

Reduction in this ratio, coupled with relatively normal lung volumes, indicates obstructive pulmonary disease. Relatively normal FEV₁/FVC ratios coupled with reduced lung volumes indicates restrictive disorders. Another factor in distinguishing obstructive from restrictive disorders is the use of bronchodilators. A bronchodilator, such as albuterol, can improve the FEV₁/FVC ratio as much as 10% to 15% in obstructive disorders. If there is no effect, the disorder is probably restrictive.

See “Interpretation of Pulmonary Function Tests” below for more information on abnormal values and possible pathologies.
Recording Steps for FEV$_1$

1. We are still using the old screen. Make sure you have recorded all the values in the last exercise because your old screen will now be erased. Click **Redo** and erase the current FEV data.

2. **Click Yes.** You are actually performing a new experiment, but tricking the program into thinking it is a repetition of the old one. The next screen will give you the option to **Record FEV** again. Do not record until you have read the procedure below. If you get the dialog box shown in Fig. 11, click **NO**.

   ![Figure 11. Dialog box warning before the opening of a new file.](image)

   This section requires the subject to take **three** measurements of FEV$_1$ in a row. The goal is to exhale the vital capacity as **FAST** as the subject can manage. The subject will need to do this three times with three normal breaths inserted between each forced, **fast** exhalation.

3. Read the steps below and **PRACTICE** the following procedure before actually recording:

   a) Breathe normally until we signal you to inhale. *(Let them breathe 3 cycles)*
   
   b) Inhale as deeply as you can and hold your breath for at least 2 seconds.
   
   c) Exhale as **FAST** as you can and continue to exhale for at least 5 seconds.
   
   d) Breathe normally until we tell you inhale again. *(Let them breathe for 3 cycles)*
   
   e) Repeat steps b-d two more times.

   Once the subject is clear on the directions, proceed with the recording.

4. Place the nose clip on the subject and click **Record FEV**.

5. Have the subject perform step 3 so that three forced expirations are recorded.

6. **Click Stop.** Your recording should look like the one below.
Measuring FEV$_1$

1. Measure FEV$_1$ by placing the I-Beam on the peak of your inhalation curve and dragging it over to the right as you watch the Delta time value in the measurement box increasing from zero. Remember you are trying to gather data only on the first second of exhalation. When the Delta T value reaches approximately 1.000 second, end the highlighting. You may overshoot the second slightly, or be slightly short of the second, getting values such as 0.980 or 1.010 seconds. These values are acceptable.

2. Make a note of your P-P value for the one second highlighted.
3. Repeat steps 4 and 5 for all three forced exhalations and record your results in Table 5. Since FEV$_1$ is a ratio, you must now record the FVC (Forced Vital Capacity) for each of the three trials.

4. Position the I-Beam on the peak of your first inhalation curve. Drag the I-Beam until it reaches the lowest point in the recording. Record the P-P value. Repeat these steps for the next two forced exhalations. Record your results in Table 5.

5. Calculate the percentage of vital capacity that can be exhaled in 1 second:

$$\text{FEV}_1\% = \left(\frac{\text{FEV}_1}{\text{FVC}}\right) \times 100$$

This is based on the average of the three forced exhalations.

6. Record your results on Table 5 and on the board or overhead projector with the rest of the class data.

7. To exit the screen or record from another individual, click Setup FEV.

8. The dialog box in Figure 14 should appear. Ignore the instructions and highlight any three-second area on your screen. (We are tricking it here, just go with the flow.)

![Figure 14. Dialog box to be ignored.](image)

9. Click Done. Click Yes. (More tricking)

10. A dialog box will appear giving you the option to Record from another Subject or to Quit (Fig. 15). At this point, you have finished recording for one individual. If you wish to repeat this for another group member, first check to see whether time will allow for it. If so, request a new filter and mouthpiece from your instructor.

![Figure 15. Dialog box giving you the option to record from another individual or quit.](image)
Table 5. Forced Expiratory Volume Data

<table>
<thead>
<tr>
<th>Trial</th>
<th>FEV₁ (liters)</th>
<th>FVC (liters)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\[ \text{FEV}_1\% = \left( \frac{\text{FEV}_1}{\text{FVC}} \right) \times 100 \]

Interpretation of Pulmonary Function Tests

Accurate clinical interpretation of pulmonary function tests (PFTs) is complicated because of the nature of spirometry technology. Even under the most controlled clinical conditions, it can be difficult to get good, reproducible PFT results for an individual. Reproducibility is dependent on the effort put forth by the subject, the reliability of the equipment, calibration of the equipment and the experience of the operator. Variation is influenced by environmental factors such as temperature or barometric pressure.

If the evaluation is considered reliable, then the results must be compared to normative values depending on age, gender, body size and ethnicity.

- **Age**: loss of elasticity with age results in smaller lung volumes and capacities.
- **Gender**: Males usually have larger lung volumes and capacities than females, even when matched for age and height.
- **Height and body size**: Taller individuals will have larger lung volumes and capacities than shorter individuals, when matched for gender and age. When body size increases due to an increase in the body fat to lean body mass ratio (obesity), abdominal mass prevents the diaphragm from descending as far as it could, resulting in smaller lung volumes and capacities.
- **Race**: Hispanics, Native Americans, Asians, and African-Americans have different PFT results compared to Caucasians. Race appropriate PFT tables are available for comparison.

In general, PFTs place subjects into three categories: normal lung function, obstructive disease, or restrictive disease.

**Obstructive lung disease** patients have decreased airflow (decreased FEV₁/FVC ratio) and usually have normal or above-normal lung volumes. Chronic obstructive pulmonary disease (COPD) encompasses this category and includes emphysema, chronic bronchitis, asthma, cystic fibrosis, and bronchiectasis, a disease that causes localized, irreversible dilatation of part of the bronchial tree. Involved bronchi are dilated, inflamed, and easily collapsible. Bronchiectasis most commonly results from bacterial infections.
**Restrictive lung disease** patients have decreased lung volumes or TLC with normal airflow (normal FEV₁/FVC ratio, but with reduced values for both FVC and FEV₁ individually. Conditions that lead to restrictive lung diseases include pleural disorders, alveolar disorders (pneumonia, cancer, or pulmonary edema), interstitial disorders that decrease the space between, neuromuscular disorders that affect the diaphragm or intercostals muscles (Guillain-Barré syndrome, myasthenia gravis, amyotrophic lateral sclerosis, otherwise known as Lou Gehrig’s disease, poliomyelitis), or skeletal disorders (kyphosis or scoliosis).

**Glossary**

**P-P-** finds the difference between the maximum and minimum value in the selected area and subtracts the minimum value found in the selected area. This is used to measure amplitude of the waves recorded or **Tidal Volume** (L/breath).

**Delta T-** The Delta Time measurement is the difference in time between the end and the beginning of the selected area. This is used to measure the time taken for a full breath in Liters.
Questions

1. Define tidal volume, respiratory rate, minute volume, inspiratory reserve, expiratory reserve, and vital capacity.

2. Compare your various lung volume measurements to those of others in the class. How do you account for differences? (Consider factors such as age, height, gender, smoking, etc.)

3. How do age, gender, height and body size affect normal lung volumes and capacities?

4. What is the significance of FEV₁? Why must it be compared to FVC as FEV1% to be meaningful?

5. What is the physiological difference between pulmonary obstructive disorder and pulmonary restrictive disorder?

6. How can PFTs (Pulmonary Function Tests) help distinguish between these two types of pulmonary disorders?

7. Kim is 62” tall and 18 years old. Her results for her PFT in Physiology class were as follows:

   Tidal Volume: 0.385 Liters
   Delta T for one breath: 4.5 seconds
   Vital Capacity: 2.124 Liters
   FEV₁: 1.787 Liters

   Calculate Kim’s Respiratory Rate and Minute Volume. Give units of measurement. Does Kim have a respiratory disorder? If so, is it restrictive or obstructive? Explain.

8. The medical records of Kyle and Beth may have gotten mixed up. One of these two individuals has asthma. Given the data below, who has asthma?

<table>
<thead>
<tr>
<th></th>
<th>Kyle</th>
<th>Beth</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age and Height</td>
<td>25 y.o./63 inches</td>
<td>27 y.o./64 inches</td>
</tr>
<tr>
<td>Tidal Volume (L):</td>
<td>0.487</td>
<td>0.398</td>
</tr>
<tr>
<td>Delta T for one breath (s):</td>
<td>4.1</td>
<td>4.5</td>
</tr>
<tr>
<td>Vital Capacity (L):</td>
<td>4.124</td>
<td>3.80</td>
</tr>
<tr>
<td>FEV₁ (L):</td>
<td>2.685</td>
<td>2.97</td>
</tr>
</tbody>
</table>