AUSTIN PUBLIC SAFETY WELLNESS CENTER POLICY AND PROCEDURE		POLICY
SUBJECT: SPIROMETRY TESTING	EFFECTIVE DATE: 7/1/2015	RESCINDS: N/A
APPLICATION: FIRE, EMS		PAGE: 1 OF 17
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I. PURPOSE

To have a reference document that outlines the procedures and standards by which to perform spirometry testing to ensure accuracy of those results.

II. BACKGROUND

Spirometry testing is administered as a portion of the medical exam, pre-employment for candidates, as well as annually for incumbents. Spirometry tests are conducted to assess specific factors of lung function for occupational safety. These screenings are continued on an annual basis to allow the occupational health physician to screen for lung disease.

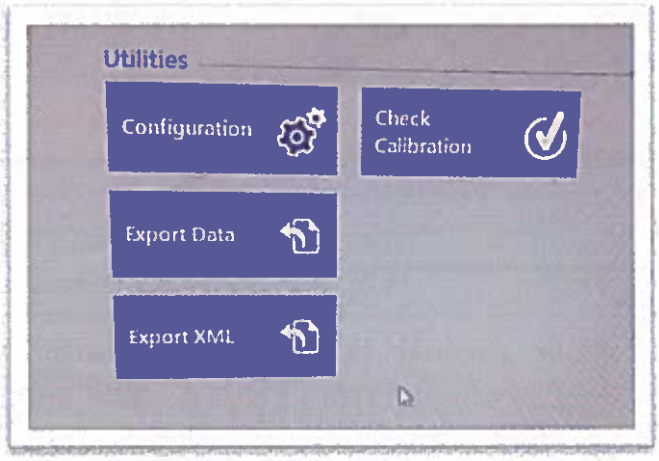
III. POLICY

1. According to section 6.8 of the National Fire Protection Association (NFPA) 1582 Standard on Comprehensive Occupational Medical Program for Fire Departments: 2013 Edition, spirometry testing is utilized in the medical evaluation of "the lungs and chest wall," of Austin Public Safety Workers.
2. According to section 7.7.4, spirometry testing is also to be measured as a component of the "annual occupational medical evaluation of members."
   A. "Spirometry shall be conducted annually to measure the member's forced vital capacity (FVC), forced expiratory volume in one second (FEV_1), and the absolute FEV_1/FVC ratio. "
   B. "The physician or other qualified medical evaluator shall compare spirometry results obtained during yearly evaluations with baseline and subsequent test results. "
   C. "FEV_1 and FVC results shall be expressed as the absolute value (liters or milliliters) and as a percent predicted adjusted for gender, age, height, and ethnicity using NHANES III normative equations. "

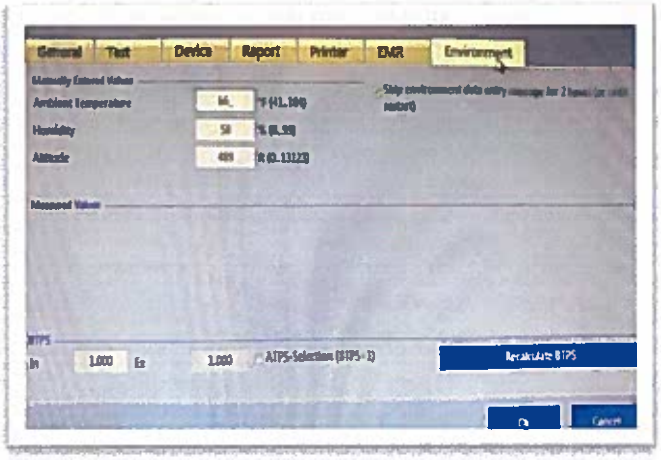
IV. PROCEDURE

1. Calibration Accuracy Check
   A. All spirometers must be calibrated In accordance with the 2005 American Thoracic Society (ATS) and European Respiratory Society (ERS) guidelines.
   B. The calibration accuracy check must be performed at least daily for incumbent fire fighters and EMS personnel and every 4 hours during the hiring process when the spirometer is in use.
      i. Open the Easy on-PC software from the desktop and select [Utilities] from the main menu.

ii. Select [Configuration].



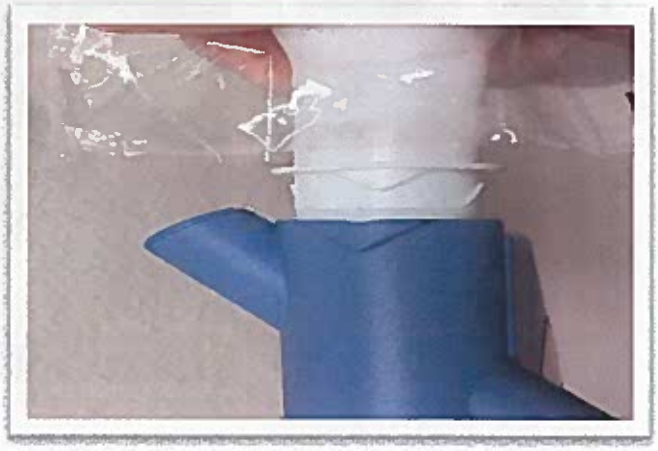
iii. Select [Environment]. Enter Ambient Temperature and select [Recalculate BTPS]. Select [OK].



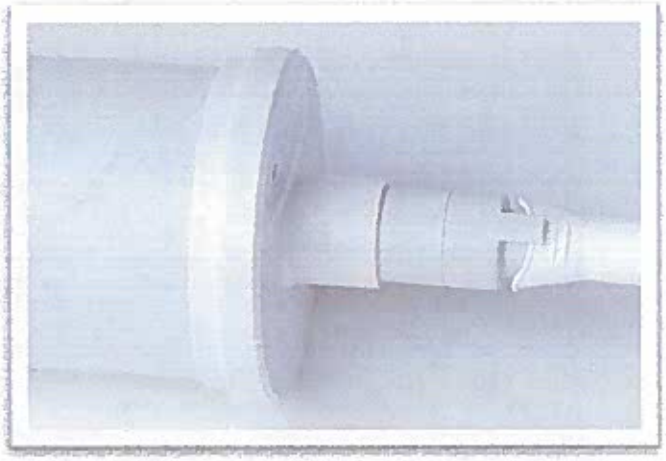
iv. Go back to Utilities Screen

v. Select [Syringe Calibration Check]

vi. Insert a new spirette into the TrueFlow sensor.

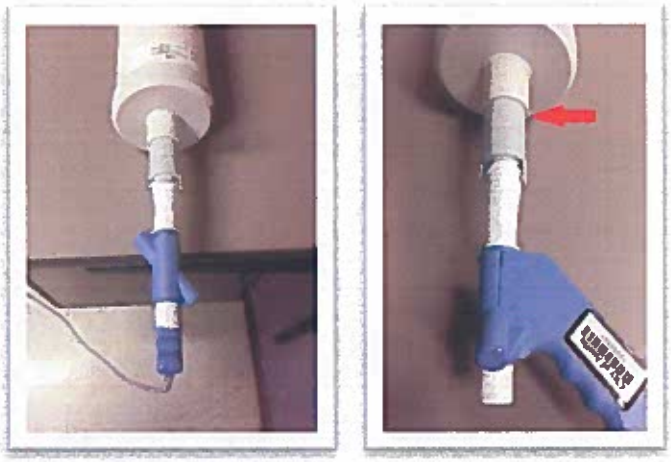


vii. Attach the spirette to the adapter end of the 3 liter (L) Calibration Syringe.



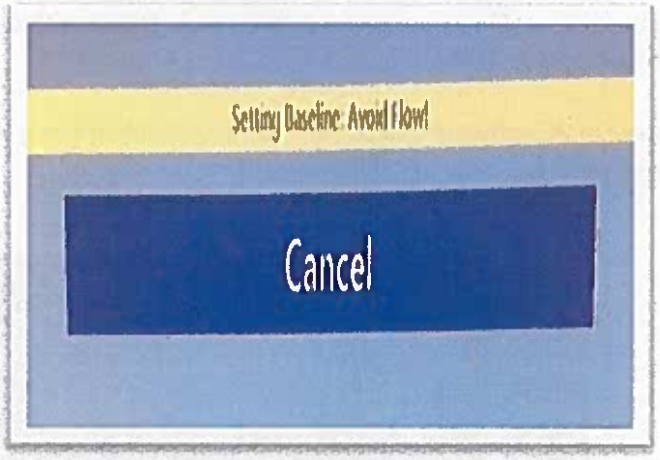
viii. Rotate the spirette to fit securely between the two prongs.

ix. The adaptor end may sit off of an edge during the calibration accuracy check or it may be rotated at the base of the adaptor to fit completely onto a flat surface.



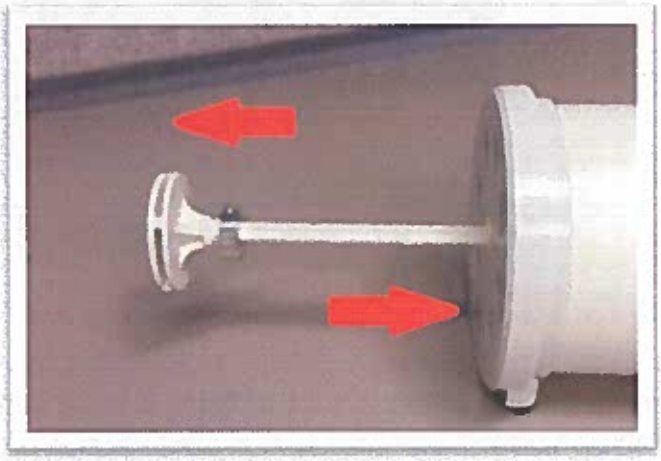
x. Press [OK]

xi. Do not manipulate or jar the system while the software establishes a baseline for calibration.



xii. Once the following screen appears, the technician may start the calibration accuracy check.

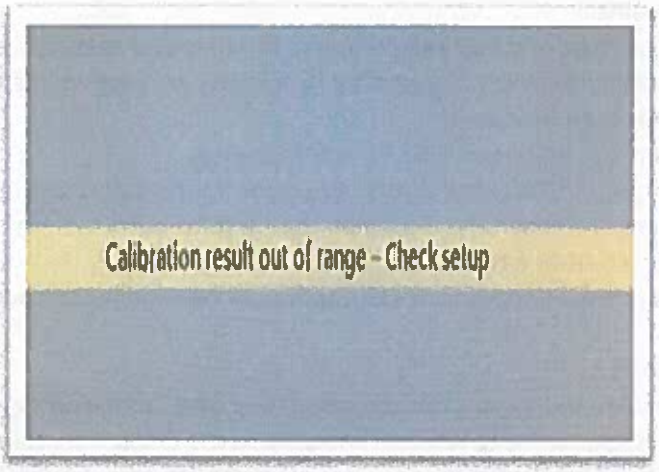
xiii. Using the 3 L Calibration Syringe, pull the plunger completely out and then push the plunger completely back in. This should be done at three different speeds: fast, medium, and slow speed. Fast should be done over 1 second, medium should be done over 2-4 seconds, and slow over 6 seconds. Three successful calibration trials must be completed at each speed to confirm the calibration accuracy of the equipment



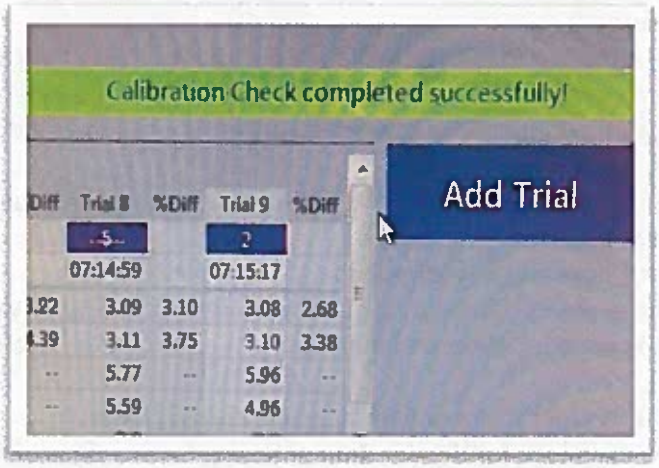
xiv. Verify the acceptable value for each calibration trial is within ± 3.5% of the 3L injection volume, or 2.90 to 3.10 L.

xv. The Easy-On PC software will confirm an acceptable measurement by prompting the following message when a calibration trial is successful:

xvi. If the trial is out of range the following message will be shown instead, and an additional trial must be attempted by clicking [Add Trial].



xvii. After the three successful calibration of a specific speed, the following screen will be displayed. Please note that this display must be present for all three speeds in order for the calibration to be completed.



xviii. The technician may add as many trials as needed, in order to complete the three successful trials that are required to complete the calibration accuracy check.

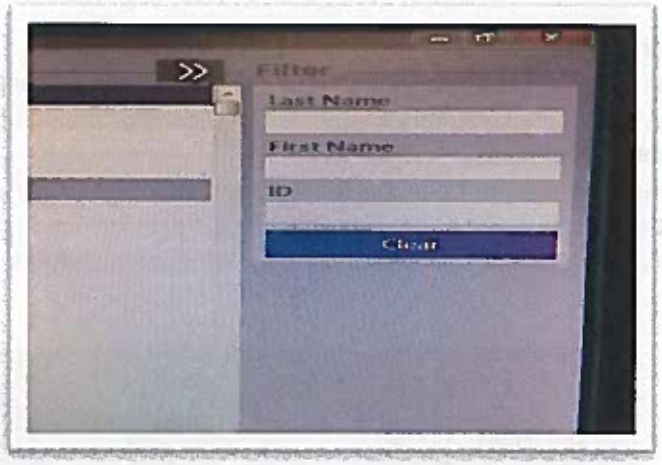
xix. Print the calibration accuracy check report for each separate speed and store the results in the spirometry binder. There will be three different reports for each separate speed that will be recorded in the spirometry binder.

xx. Once reports are printed, the technician must sign each individual reports with their credentials. The technician must also record their signature on the signature log located in front of the spirometry binder.

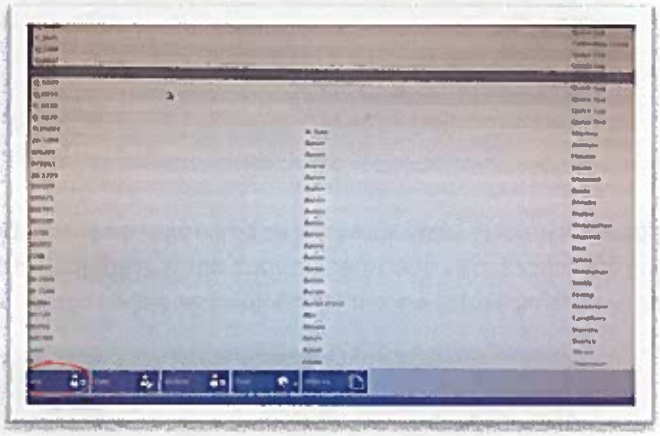
xxi. If three successful calibration trials are not able to be completed, the spirometer may not be used for testing and a technical support inquiry must be made at the New Diagnostic Design (NDD) website.

2. Care of the 3L Calibration Syringe
   A. Store the 3L calibration syringe and the TrueFlow sensor in the same environmental conditions to increase the probability of a successful calibration accuracy check.
   B. Return the 3L calibration syringe to the manufacturer for yearly recalibration. The manufacturer will provide a temporary replacement during the recalibration of the APSWC 3L calibration syringe.
   C. If the 3L calibration syringe is dropped or damaged it must be returned to the manufacturer for repair.

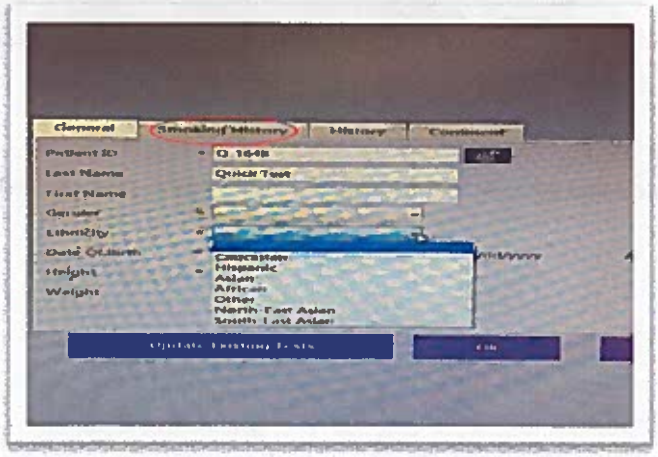
3. Technician Training
   A. Technicians must enroll in and complete the first available National Institute for Occupational Safety and Health (NIOSH)-approved spirometry training course that is offered in Austin, Texas, after their hire date.
   B. Technicians will be responsible for the following:
      i. Maintain the TrueFlow sensor and perform the daily calibration accuracy test
      ii. Instruct and coach the examinee during spirometry testing
      iii. Verify whether a trial is valid
   C. Technicians must undergo a NIOSH-approved recertification course at a minimum of every five years.
4. Infection Control
   A. Wash hands or use hand sanitizer before and after administering a spirometry test.
   B. Instruct the examinee to remove and discard the disposable spirette.
   C. Disinfect the TrueFlow sensor and countertop with an antimicrobial wipe after each test.
5. Preparing the Patient for Testing
   A. Before conducting the spirometry test, review the examinee's "Annual Update and Policy Acknowledgement" form. Consult the occupational health physician to consider postponing the spirometry test if it has been less than six weeks after eye, ear, nose, throat, or any other relevant surgery.
   B. Ask the examinee if they have had any prior spirometry testing done and if so, if they experienced severe light headedness or fainting. If the examinee states that they did experience any of the above contraindications, it is recommended that the test be performed in the sitting position.
   C. If the examinee has anything in their mouth such as jewelry, gum, or candy, instruct them to remove it at this time.
   D. The use of a nose clip is recommended, but not mandatory.
6. Safety- Examinees are to stand during spirometry testing unless they cannot do so because of a safety or health concern. When standing during the spirometry test, take the following safety precautions:
   A. Place a sturdy chair without wheels behind the examinee.
   B. Watch the examinee for the duration of testing for any signs of light-headedness.
   C. Place a hand on the examinee's arm or back, if needed, to steady them.
   D. If the examinee becomes unsteady due to light headedness or experiences fainting, the remainder of the test must be performed in the sitting position.
   E. If the examinee is observed fainting in the sitting position, the test is to be terminated and the examinee must be referred to the occupational health physician.
   F. Document in the permanent comment section of the subject's profile if he or she experiences fainting or any other circumstance that prevents them from completing the test. To enter permanent comments refer to Appendix 1.
   G. No trials are deleted and will be a part of the examinee's medical record.
7. Selecting a Test Subject
   A. On the home screen, find the desired test subject under the "Filter" screen shown below.



B. Once the test subject is located, click once on the name.
C. If the search yields no results select [New] at the bottom of the screen.

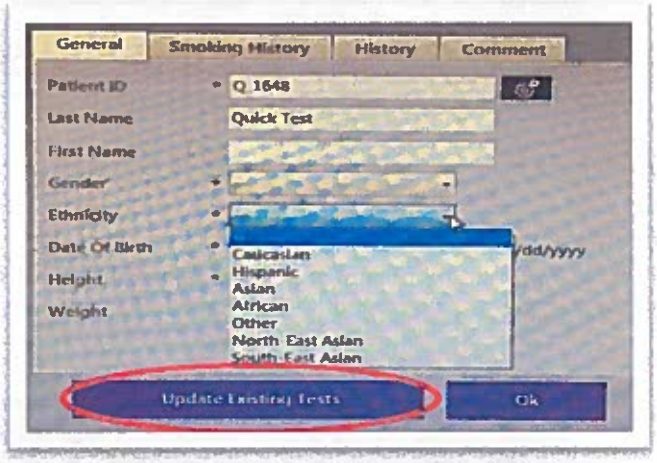


i. When adding a new subject it is imperative to accurately enter their first and last name, gender, age, height and ethnicity under the [General] tab in order to achieve reliable spirometry results.
ii. Note any patient history of smoking, asthma, or chronic obstructive pulmonary disease in the [Smoking History] section.

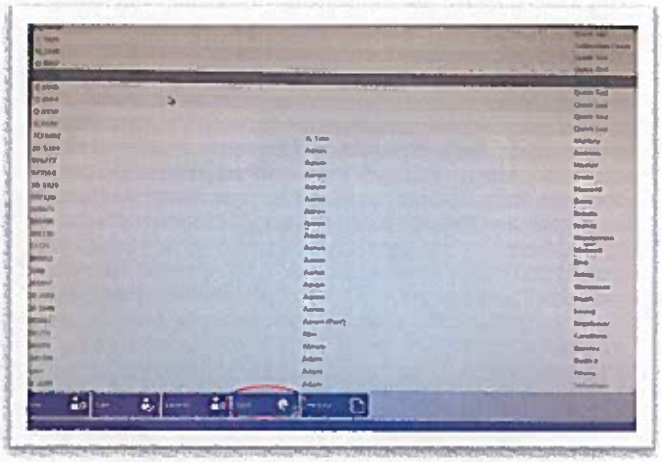


8. To Verify or Edit Demographics
   A. Before performing a spirometry test on a subject with an existing file, the technician should verify that all previously entered information is correct, including first and last name, gender, age, height and ethnicity.
   B. If the technician has identified any inconsistencies in the information previously entered on a subject, the Edit Patient tab may be utilized to make corrections.
      i. Select [Edit Patient] while the subject's name is highlighted

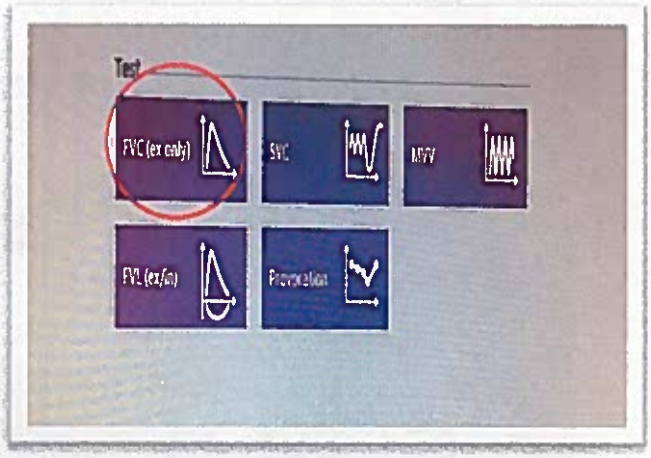
      ii. Previous spirometry tests should also be corrected at this time as they are likely to reflect inaccurate test results due to erroneous demographical information. To do this, select [Update Existing Tests] once information has been corrected.



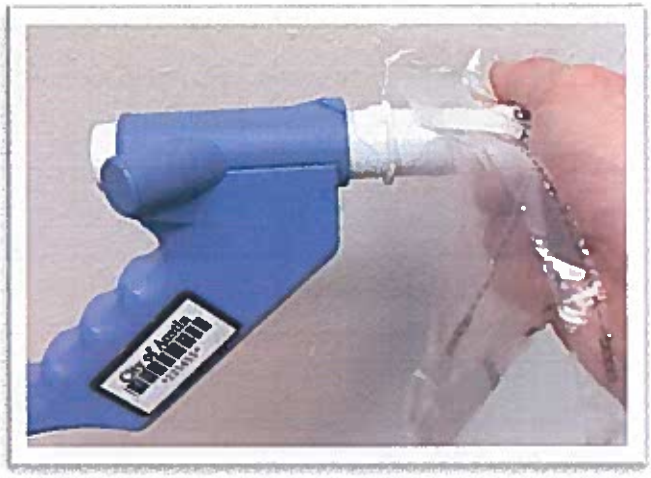
9. Performing the Test
   A. After selecting a test subject or entering a new one, select [Test] at the bottom of the screen.



B. Select [FVC (ex only)].



C. Insert a spirette into the TrueFlow sensor.
   i. Partially remove the spirette by pushing it through the serrated line along the side of the plastic cover. Remove the plastic cover only as far as the mouthpiece, as to not contaminate it during insertion.

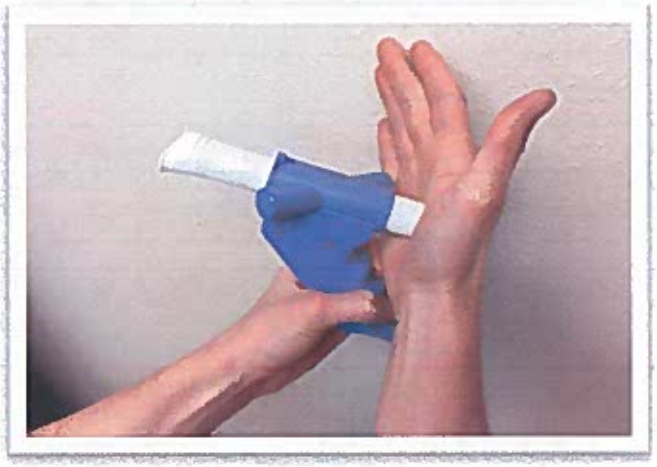


ii. Match up the arrow on the spirette to the corresponding arrow on the TrueFlow sensor. Be sure to completely insert the spirette before fully removing the plastic cover.

iii. Pass the TrueFlow sensor to the examinee.

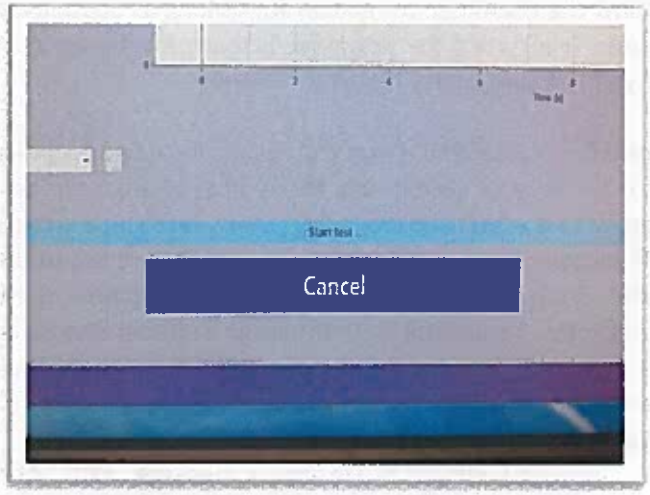
D. Establish an initial baseline setting, also known as the "zero flow reference point."

i. Instruct the examinee to hold the TrueFlow sensor with one hand and use the palm-side of the other hand to block the backside of the spirette.

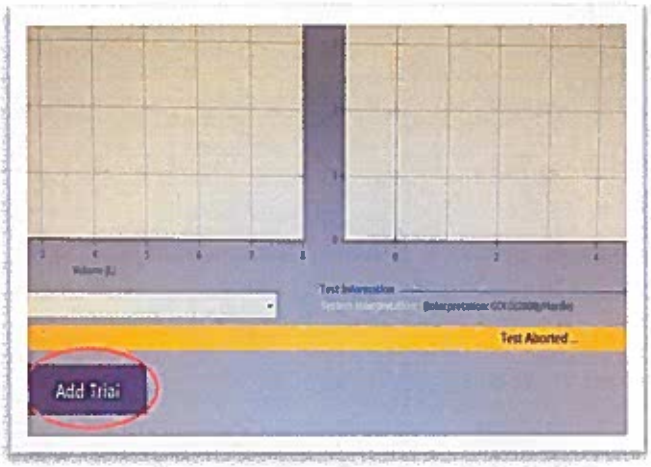


ii. Select [Ok].

iii. When the "Start test" prompt appears, instruct the examinee to remove their palm from the spirette.



iv. Explain, instruct, and demonstrate the spirometry test to the examinee. Refer to Appendix 2 for suggested explanations and refer to Appendix 3 for suggested cues for instruction. During this period, the trial may time out and read "Test Aborted." In this event select [Add Trial] to reinitiate the start of the test, and then instruct the examinee to begin the maneuver.



v. Coaching
   a. Instruct the examinee through each spirometry trial, using various cues to encourage the subject to continue blowing, for a minimum of 6 seconds, through the entirety of the maneuver.
   b. Inform the examinee to stop blowing once the computer has ceased measuring airflow and has returned a feedback message.
   c. Allow the examinee to recover for as long as needed after each attempt.

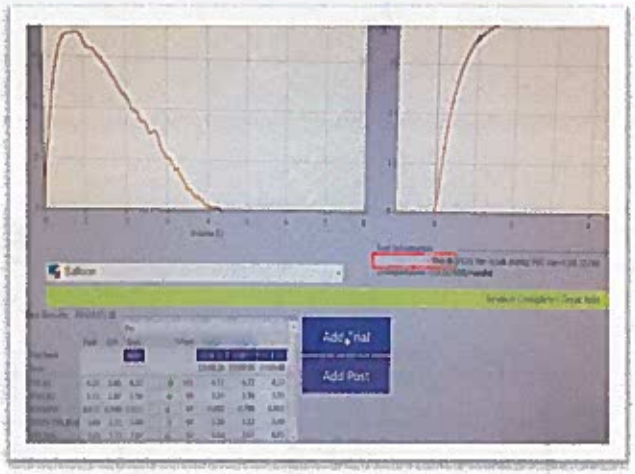
vi. Click [Add Trial] when the examinee is ready for the next trial. Continue to add trials until validity of the spirometry test is confirmed.

E. Validity
   i. Acceptability – Determine that the results include 3 technically acceptable curves.
      a. For a trial to be acceptable, there must be a hard initial blast free of hesitation and/or cough in the first second, rising immediately to a sharp peak and smoothly descending to zero. The Easy-On PC software determines the acceptability after each trial. If the trail is determined to be unacceptable, the software will strike-out the trial with a horizontal line. However it should also be manually assessed by the technician by reviewing the volume-time curve. An example of an acceptable volume-time curve is shown in Appendix 4.
      b. Non-Acceptable Curve Interpretation
         I. Abrupt Ending-If the feedback message reads "Abrupt Ending" remind the examinee to continue blowing until the technician instructs them to stop. If the examinee is unable to extend their expiratory effort long enough to achieve an acceptable curve, instruct the examinee to remove the spirette from their mouth prior to inhaling their next breath.
         II. Hesitation Detected-If the feedback message reads "Hesitation Detected" remind the examinee that their expiratory effort must begin with an initial hard blast, for 1 second, without any hesitation. Demonstrate the proper maneuver technique for the examinee again, if needed.

   ii. Repeatability
      a. Determine that the best acceptable maneuvers are repeatable by meeting both of the following criteria:
         I. The sum of the largest FVC minus the second largest FVC is equal to or less than 150 mL (0.15 L).
         II. The sum of the largest FEV_1 minus the second largest FEV_1 is equal to or less than 150 mL (0.15 L).

b. The Easy-On PC software ranks each trial based on repeatability of the highest values, and may give the following feedback messages based on the maneuver:
   I. Deeper Breath-Instruct the examinee to take a deeper breath prior to blowing through the spirette.
   II. Session Complete-Acceptability and repeatability have been reached among the completed trials. No further trials are needed.

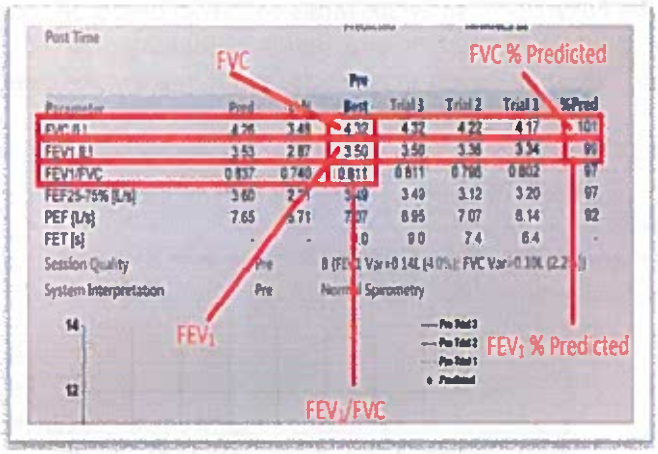
iii. Quality
   a. Ensure the "Session Quality" is rated A or B.

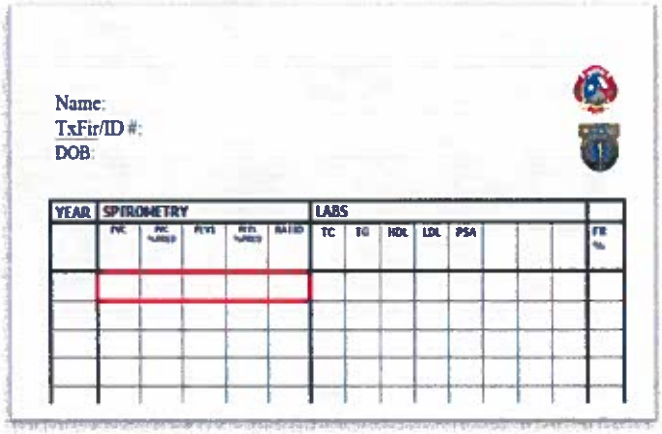


   b. For any "Session Quality" rated C, D or F, the technician must enter a temporary comment as to the probable cause. To enter a temporary comment, refer to Appendix 5. Possible causes include the following:
      I. Difficulty with technique despite multiple corrections
      II. Fainting
      III. Excessive uncontrollable coughing
      IV. Suboptimal effort
      V. Current or resolving respiratory infection
      VI. Smoking within one hour of the test

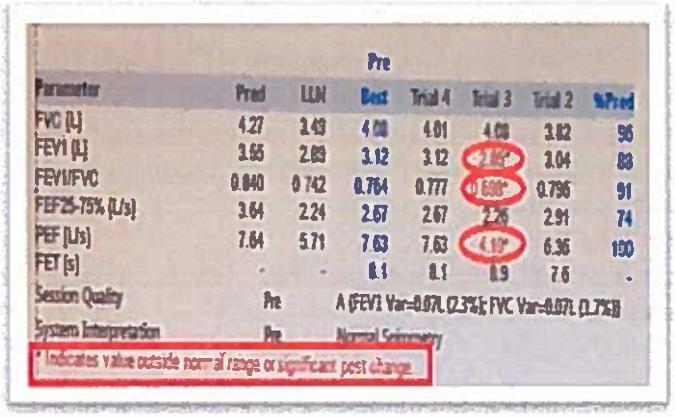
iv. Up to eight trials can be attempted to record a valid spirometry test, unless the examinee cannot continue. However if the last trial produces the best result, one additional trial must be performed.

10. Measurements to be Reported
   A. Record the best FVC, FVC % predicted, FEV_1, FEV_1% predicted, and FEV_1/FVC ratio values on the spirometry record form.





B. To ensure abnormal values are clearly indicated (in red), the spirometry test report must be printed on a color printer and placed in the subject's chart



C. If a color printer is not available, the abnormal values must be flagged either by any color of highlighter or red pen in order to visually alert the occupational health physician.

11. Record Keeping in Spirometry Binder
    A. Spirometry Test Reports
        i. All test reports are to be maintained in the examinees' chart.
        ii. All test reports must be kept for at least 30 years following the end of employment, or according to AFD policy.
    B. Equipment Maintenance Records
        i. The model, serial number, and identification number of the spirometer must be noted.

ii. The dates and versions of the computer software and hardware updates or changes must be recorded.
iii. A list of supplies must be noted.
iv. A list of contacts for the manufactures, supplies, and maintenance must be noted.

C. Quality Control Log Records
i. The daily accuracy calibration checks are to be saved indefinitely.
ii. The routine annual maintenance on the 3L calibration syringe which is conducted by the manufacturer should be kept indefinitely.

D. Personnel Training Records- A copy of each technician's certificate from the completed NIOSH-approved spirometry training course, as well as all recertification must be kept in the spirometry binder indefinitely.

E. Spirometry Policy and Procedure Guideline

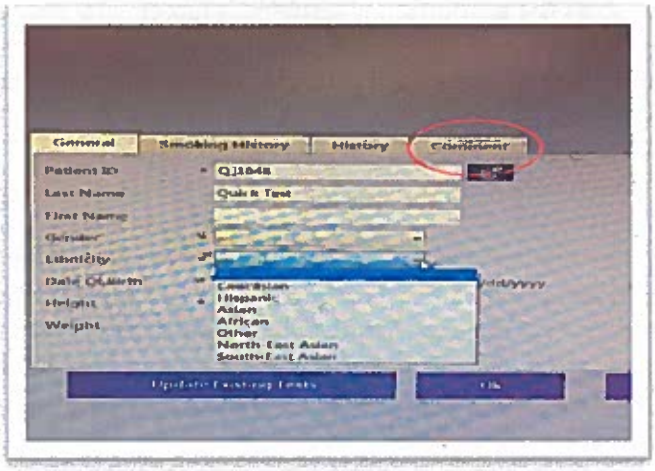
V. DEFINITIONS

1. Abnormal Values - Spirometry results outside of the NHANES III reference values.
2. Acceptable Curve – A curve is considered acceptable when it displays maximal inhalation, a hard initial blast free of hesitation or cough in the first second, complete exhalation, and maximal effort throughout the maneuver.
3. Baseline - Refers to the procedure prior to the start of a spirometry test session, in which the spirette is occluded by the palm of an examinee. This allows the Easy-on PC software to establish a reference point at which to measure flow.
4. Baseline Spirometry Test - A lung function test that can be used to compare with subsequent annual screenings to monitor respiratory health
5. Calibration Accuracy Check - The process to verify accuracy of the TrueFlow sensor via the Easy-on PC software using a standardized 3L calibration syringe
6. Calibration Syringe 3L- A syringe used by a technician to complete the daily calibration accuracy test which expels 3L ± 3.5% of air
7. Easy-on PC Software - Spirometry software that provides real time curves, interprets results, and summarizes information to produce the Spirometry Test Report.
8. FEV1/FVC Ratio - Is a calculated ratio used in the diagnosis of obstructive and advanced lung disease. It represents the proportion of a subject's forced vital capacity that they are able to expire in the first second of forced expiration.
9. Forced Expiratory Volume in One Second (FEV_1) - Is the maximal amount of air that can be forcefully expired in one second
10. Forced Vital Capacity (FVC) - Is the maximum amount of air that can be expelled from the lungs after a maximum inhalation. This measures the presence of restrictive lung disease.
11. Members - A public safety worker that currently occupies a particular position or job.
12. National Fire Protection Association (NFPA)-Is an international nonprofit organization that advocates for fire prevention and acts as an authority on public safety
13. National Institute on Occupational Safety and Health (NIOSH)- Is the U.S. federal agency that conducts research and makes recommendations to prevent worker injury and illness
14. NHANES III Normative Equations- Predication equations used to generate age, gender, and ethnicity- specific spirometric reference values.
15. Nose Clip – A disposable plastic clip positioned on the distal portion of the nares, to prevent air from escaping through the nose during the spirometry test. The use of a noseclip is voluntary. (The examinee has the option to pinch his/her nose with their fingers.) Use of a noseclip ensures examinee is not taking in extra breaths during test.
16. Permanent Comment – A notation entered under the examinee's "Comment" tab. This notation entry becomes part of the examinee's permanent spirometry record and will appear on subsequent
17. Repeatability – A subject's ability to reproduce their best spirometry trial.

18. Session Quality – The grade assigned by the Easy-On PC Software to rate the validity of all completed spirometry trials based on acceptability and repeatability.
    a. Grade A and B – requires a minimum difference of 100 and 101-150 ml for both FEV_1 and FVC
    b. Grade C - requires a difference of 151-200 ml for both FEV_1 and FVC
    c. Grade D - requires only one acceptable maneuver but with FEV_1 values within 200 ml.
    d. Grade F – requires no acceptable maneuver.
19. Spirometry Test- Measures lung function, specifically the volume and speed of air that can be exhaled.
20. Spirometry Test Report- Spirometry test results displayed into a printable form.
21. Spirometry Trial-Each attempt made during spirometry testing where a subject expels the maximum amount of air from the lungs after a maximum inhalation; synonymous with maneuver.
22. Temporary Comment – A notation entered into the "Comment link," located on the bottom, right corner of the examinee's Spirometry Test Report, following a trial or session. The comment entered will be included in the printed report for the associated spirometry session. The Temporary Comment will not be displayed on the examinee's subsequent Spirometry Test Reports.
23. TrueFlow sensor-A hand-held device connected to the USB port of a computer in which a spirette is inserted. The examinee uses this instrument to perform the spirometry test.
24. Zero flow reference point- Refers to the procedure at the beginning of a spirometry test in which the spirette is occluded by the palm of an examinee in order for the software to establish a reference point, at which to measure flow; synonymous with baseline.

VI. APPENDIX

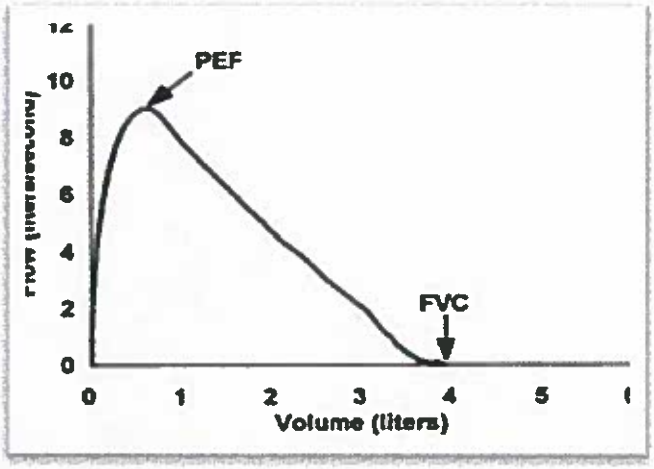
1. To Enter a Permanent Comment
    A. A comment in this section is entered to document any factor that is likely to affect both current and future sessions. This includes observed fainting or symptomatic dizziness which is to signal to the next technician that the examinee is required to perform the test while sitting.
    B. Select [Edit Patient] from the home screen while the subject's name is highlighted.
    C. Select the [Comment] tab from the screen.
    D. The comment must include the date as well as the position in which the test was conducted.



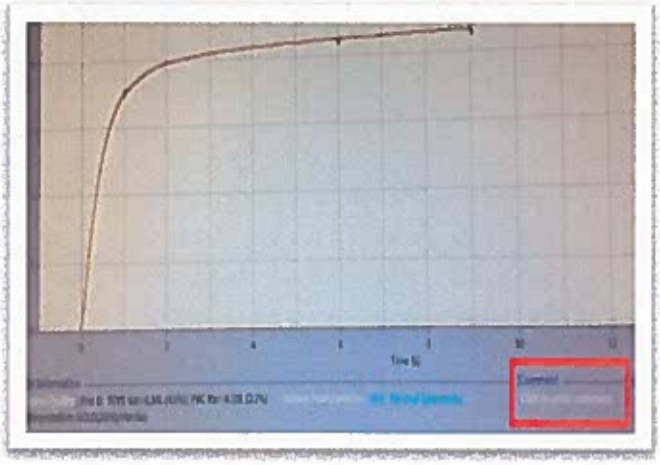
2. Example of Explanations of the Test
    A. "The purpose of the spirometry test is to see how much air your lungs can hold and how hard and fast you can blast it out."
    B. "The spirometry test is an important screening tool in assessing the health of the airways."
3. Example of the Instruction for the Test.

A. "Take the deepest possible breath to fill your lungs."
B. "Place the mouthpiece on top of the tongue and between the teeth."
C. "Seal your lips tightly around the mouthpiece, making sure not to purse the lips behind the mouthpiece as you would in playing an instrument."
D. "Slightly elevate your chin and keep your tongue out of the way of the mouthpiece."
E. "Keep your shoulders relaxed and back."
F. "Blast, without hesitating, into the mouthpiece as hard, fast, and as completely as possible."
G. Keep blowing as long as you can, or until you are told to stop."

4. Example of an Acceptable Volume-Time Curve



5. Contact information for 3L syringe calibration tube is Occupational Marketing Inc. (OMI) at 1-800-869-6783.
6. Temporary Comment Procedure
   A. Use the [Click to enter comment] link at the end of the spirometry test to enter a temporary comment.



   B. The temporary comment will appear on the printed version of the spirometry test and will automatically include the date entered as well as the EM or FD identification number of the technician who entered it.

VII. REFERENCES

American Thoracic Society
Journal of Occupational and Environmental Medicine

Merriam-Webster Dictionary
National Fire Protection Association (NFPA) 1582 Standard on Comprehensive Occupational Medical Program for Fire Departments, 2013 Edition Easy-On-PC Operator Manual, Version 3
Occupational Safety and Health Administration
Primary Care Respiratory Journal