Spirometer flow volume

Technician and teacher sheet

Apparatus

Spirometer.

Pressure filter fitted

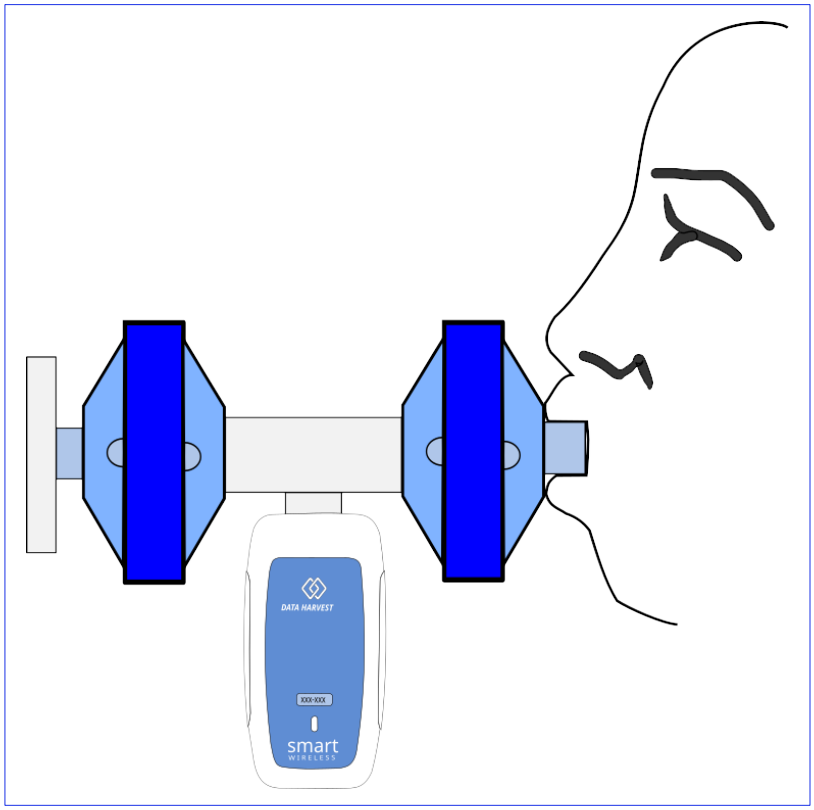
1 x filter per person to be tested

Data recording setup.

You need to go fast to get the best results, 50ms intersample or shorter.

A trigger of something like rises above 0.2 l/s

See practical notes for more detail.



A spirometer is a device that measures breathing patterns, lung capacities and function. The Spirometer measures accurately the flow of air through the device. This investigation will allow you to calculate the various lung capacities that can be measured.

The spirometer flowhead contains a sheet of resistance material that restricts the flow of air; the resistance to the air flow creates an increase in pressure across it. The increase in air pressure is measured via two air lines, one inside the flowhead and one inside the instrument body. An air pressure sensor is used to measure the changes in air pressure.

In the diagnosis of asthma and other lung complaints a measurement of the lung function is made and compared to a database of normal values. The percentage you deviate from normal values in the test is used to determine the degree

of problem and the type of problem, appropriate treatment can then be decided upon.

Peak flow rates are also used in sports training either to indicate the improvement in total body fitness during the training period or to watch for the onset of exercise induced asthma. Peak flow is also considered to be an indicator of potential.

In this exercise the subject will try to create lung function data for analysis. The Spirometer has not been calibrated for medical / diagnostic use and the instructor is not normally trained in fully interpreting the results. Any results should be regarded as demonstration of a principle and not to have any clinical significance.

The test will require you to take a very deep breath in followed by a very rapid forced expiration. This manoeuvre can cause some individuals discomfort and should not be undertaken by chronic asthmatics, individuals with bronchitis, lung infection or diagnosed lung disease.

A flow volume loop is an alternative method of producing Peak flow data; it is often used in the diagnostic stages of lung efficiency investigations as it highlights inconsistencies in the subjects breathing technique when using a spirometer. It is included as a practical for the sake of completeness, for reasons indicated above the results are for demonstration only.

Practical advice

The blue flowheads contain a bacterial and viral filter to prevent cross contamination. It is recommended that each user has their own flowhead and they should be marked to identify them. They are not washable; the filter material will felt and clog if immersed in water. One of the flowheads is “semi-permanent” it is to be used many times and it provides the resistance that creates the pressure change in the device. The fixed flowhead should have the circular guard fitted to make a strong visual reminder that it is not to be used for breathing into.

Assembly of the protective ring to the reference flowhead is shown

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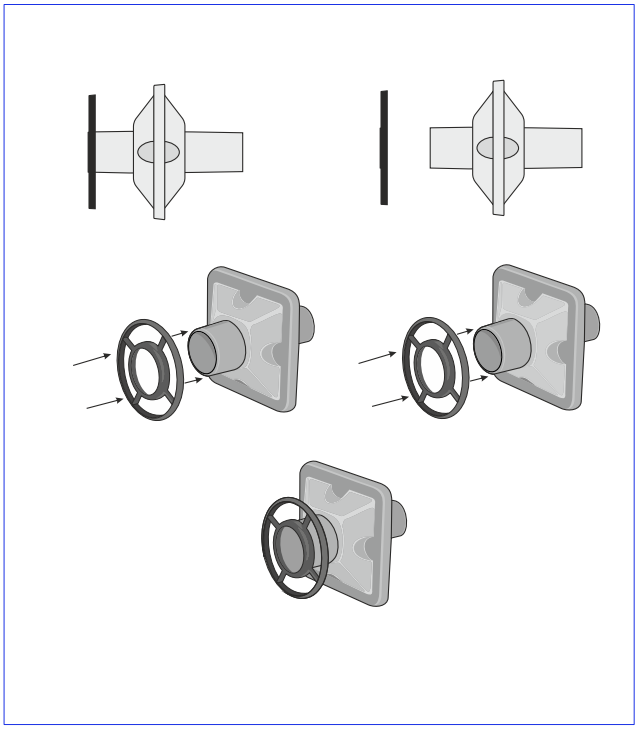
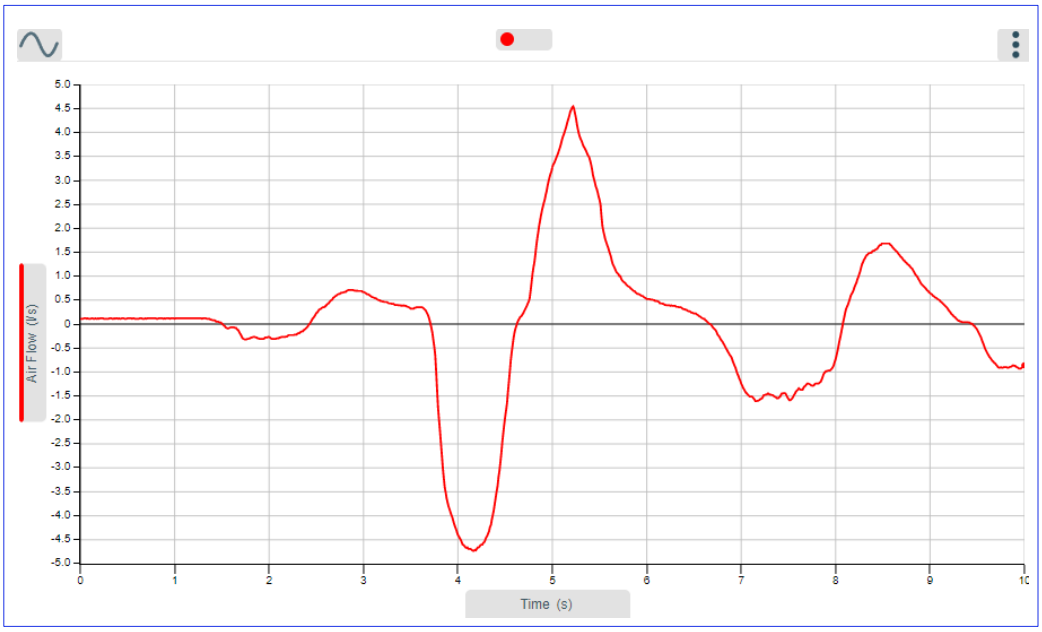


Measurement procedure

The procedure to record lung volumes / efficiencies is not instinctive and may require practice by the test subject. It is recommended that they try a few sample logs before attempting to collect “real” data. Breathing through the apparatus is unnatural and takes adjustment. Don’t snatch at the breathing or rush to complete.

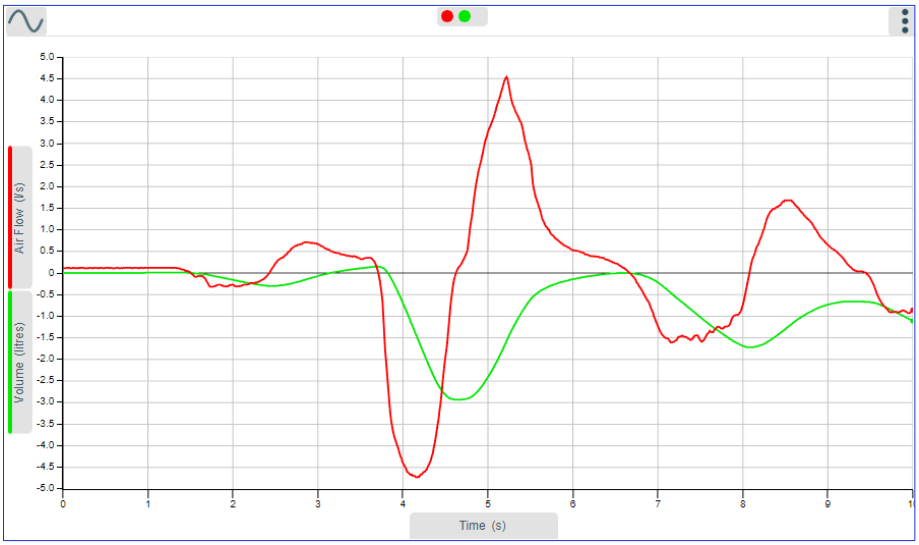
It may take a few attempts before successfully collecting data; do not over practice the manoeuvre can be quite stressful.

Example data and analysis

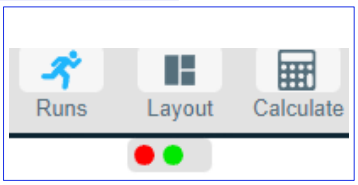


Data as collected, this the flow rate data for a deep inhale followed by a deep forced exhalation. The scale has been changed to min - max.

The calculation to convert flow to volume is then applied.



At this point the data can remain displayed as shown or the coloured dots at the top of the page (series control)can be used to show hide data series

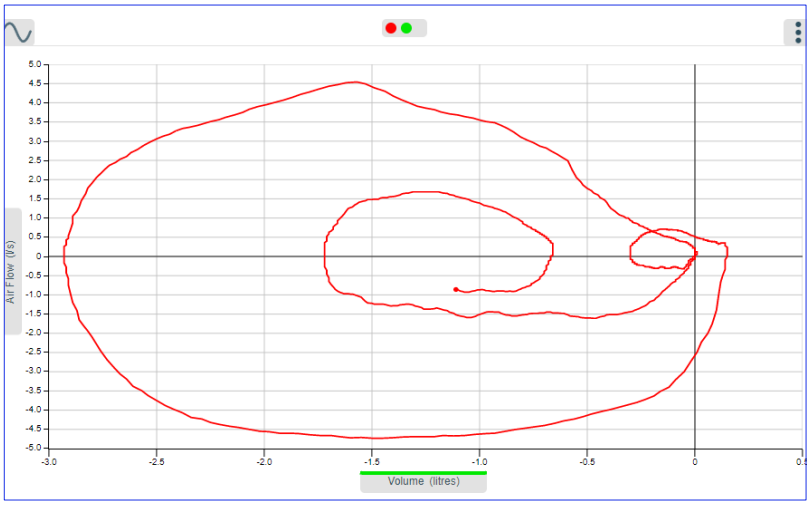


The next step is to change the axis labels to plot volume against flow. Opening the axis labels shows the choice of what can be displayed on the axis.

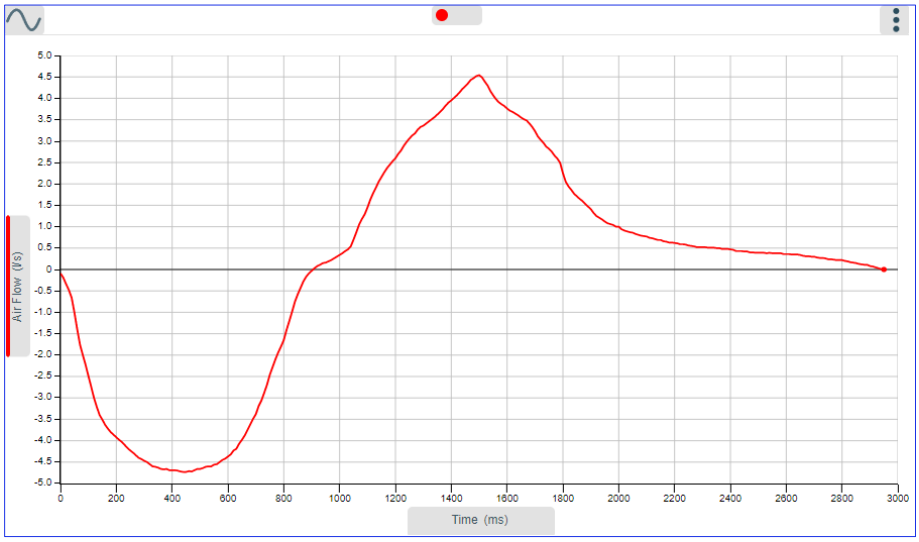
The data needs to be corrected from simple flow to volume. Use calculate > spirometer > flow to volume

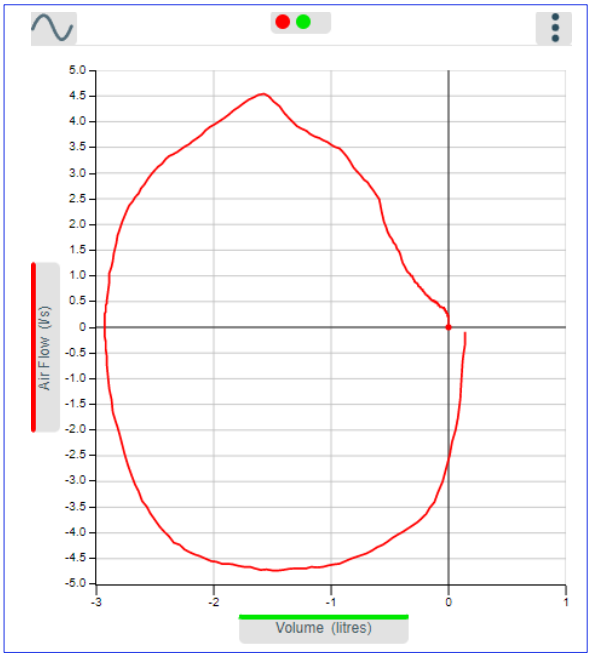
It is convention for this graph display to have volume on the x axis and flow on the y axis.

The example shown is where the entire data has been used, you can see the preceding and trailing data creates spirals. For clarity the data needs cleaning up.



Use tools > select data.





Data plotted as flow vs. volume after the data has been cleaned up.Note the loop is on the negative side as the subject exhaled first. The position of the graph can be changed by multiplying the airflow data by -1.

Volume flow loops are used diagnostically to identify breathing problems to do with obstructions of the airway. An ideal (theoretical) pattern would have a smooth downward slope of Air Flow vs. Volume. This is derived from the experimental model of something like an inflated balloon being deflated through a spirometer. The constant tension of the balloon surface should give a constant flow and volume released over time. In reality the lungs are very rarely as elastic as the model, most individuals undergoing this test will show some form of diagnosable obstruction. The skill for the diagnostician is in interpreting the normal from the medical.

It is also noticeable that naïve users of the apparatus reveal more problems than experienced users. This suggests that a period of training on the use of the apparatus is required before meaningful results can be produced, and that change over time is more important than the absolute result.

Most of the analysis of Flow Volume loop is based around the changes in the slope of the upper section of the plot.

- A perfect sample will show a smooth linear decrease of Flow vs. Volume.
- A graph with a step in it will indicate a “glottal stop” and suggests poor technique
- A graph with a curve to it will indicate some form of obstruction to air flow
- A graph with a rounded peak will indicate some form of obstruction.

Because the breathing technique can give “false positive” results a trained practitioner is required if the data is to have any medical significance. A trained operative will watch and listen to the effort of the subject and identify if the results have a medical basis or are artefacts of the subjects response, to what is a very unnatural breathing procedure.

Software knowledge required.

- Connect spirometer to the software.
- Use a triggered setup to get comparable data (optional)
- Use tare to zero the flow before data collection.
- Use flow to volume tool
- Use Drift correction tool
- Use values to extract required data.
- Change axis.
- Change scale of the axis