



# Tests to measure your breathing

## What are they?

Breathing tests measure how well your lungs are working. These tests are used to find the cause of problems such as feeling out of breath. They are sometimes called lung function tests. They measure things like:

- how much air you can take into your lungs
- how quickly you can blow air out of your lungs
- how well your lungs can take up oxygen
- the strength of your breathing muscles

Your results are compared to what they should be, using predicted values. These values are based on what would be expected in healthy people of your age, height, gender and ethnicity.

### Your body mass index or BMI

Your health care professional may also weigh you to calculate your body mass index (BMI) as a way of measuring whether you're a healthy weight for your height.

Your BMI is not relevant for predicted values of breathing test results. But it is important because being overweight or underweight can affect your breathing, lung function and general health. Being overweight can cause breathlessness.

Your health care professional will also compare your results with the results of any earlier tests to track your progress. Tests include:

- peak flow test
- spirometry and reversibility test
- lung volume test
- gas transfer test
- respiratory muscle strength
- exhaled carbon monoxide levels
- exhaled nitric oxide levels

## Peak flow test

### What is it?

The peak flow test measures how fast you can breathe out after you've taken a full breath in.

### What's it used for?

If the speed you can breathe out is reduced, that may cause breathlessness – especially during exercise when you have to shift air more quickly. It can also be reduced if you're unable to take a full breath in.



### If you have asthma

This test can help to diagnose asthma and choose treatment. Your GP or nurse should do a peak flow test at your annual asthma review. You may also be asked to monitor your own peak flow at home regularly for a period as part of your asthma action plan. These results are kept in a peak flow diary to see if your peak flow varies. This can be a feature of asthma, especially if it is not under control.

### What happens during the test?

You take the biggest breath in that you can and then blow out as fast as you can into a small, hand-held plastic tube called a peak flow meter. The measurement taken is called your peak flow.

Each time you check your peak flow, you should do three blows, with a short rest in between the blows. The best of the three is the one that should be recorded.

Your health care professional will make sure that your technique is correct, as this may affect the readings.

### What will the results look like?

Peak flow scores will vary depending on your age, your height and whether you're a man or a woman.

Your peak flow reading may be different at morning or at night. It's the pattern that's important.

Keeping track of your peak flow can help you spot when your symptoms are getting worse and when you need to take your reliever inhaler or get medical help.

## Spirometry and reversibility testing

### What is it?

Spirometry measures the total amount of air you can breathe out from your lungs and how fast you can blow it out. You will be asked to take a very deep breath and blow out as fast as you can into a mouthpiece until no more air comes out.

Spirometry can help to assess if inhaled medication or inhalers can open up your airways by **reversibility testing**. This is when your health care professional asks you to use your inhaler or other medication, wait some minutes, and then repeat the test.

A spirometry test usually takes less than 10 minutes, but will last about 30 minutes if it includes reversibility testing.

There are various spirometer devices, but they all measure the same thing. Many GP surgeries now have small, portable spirometers. Some spirometers are more sophisticated and can give more detailed results.



### What's it used for?

It can help tell if your breathing is obstructed by narrowed or inflamed airways. The results are useful in diagnosing lung conditions. For some conditions, it can be used to grade how severe your condition is.

### What happens during the test?

You will be asked some questions before you start to check that there is no medical reason why you should not do the test. It is important to put as much effort into the test as you can so the results are accurate.

You may have a clip put on your nose to make sure all the air goes into the mouthpiece. You will be shown how to blow into the spirometer before starting. You may be asked to blow three or more times into the spirometer to check the readings are similar each time.

Normally, you will be first asked to breathe in deeply and out gently. Once your health care professional is happy with the results you will move on to the next part of the test. You will have to breathe in again deeply, this time quite fast, and then breathe out as fast and as hard as you can until your lungs are empty.

Your health care professional may ask you to use your inhaler or other medication, wait 15–20 minutes and then repeat the test. For some drugs the wait may be 45 minutes between tests. This is called a **reversibility test** to see if the medication improves your breathing. If you use inhalers, you should bring them to your appointment.

## What will the results look like?

Spirometry usually measures:

- how much air you can blow out in a relaxed manner, like a gentle sigh out until your lungs are completely empty. This is called your **slow vital capacity** or **VC**.
- the amount of air you can blow out in one second. With healthy lungs and airways, you can normally blow out most of the air from your lungs in one second. This is called your **forced expiratory volume** in one second or **FEV<sub>1</sub>**.
- the total amount of air you can blow out in one complete breath after taking a deep breath in. You will be asked to blow out as hard and as fast as you can until your lungs are completely empty. This is called your **forced vital capacity** or **FVC**.
- Your health care professional will look at how much air you can blow out in the first second and compare this to the total amount. This will give a percentage of air you can blow out in the first second. This is calculated by looking at your **FEV<sub>1</sub>** and your **VC**.

The format in which the results appear will vary depending on the type of spirometer used. Normally, your health care professional will compare your measurements with the normal range of values. The curves drawn by the spirometer are also important for your health care professional to understand your results.

Think of a five-lane motorway that has been reduced to three lanes due to roadworks. The traffic will take longer to travel through that stretch of motorway.

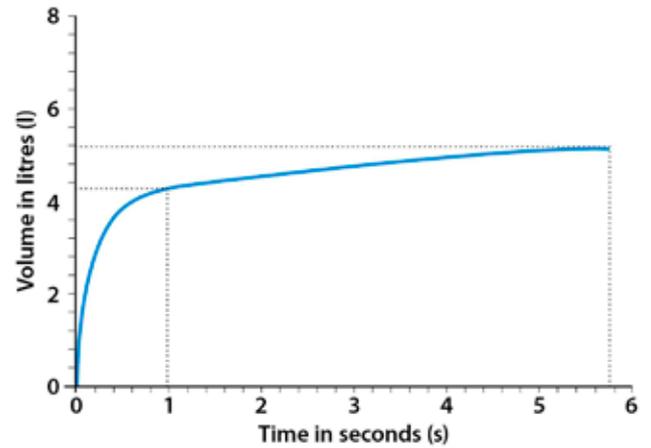
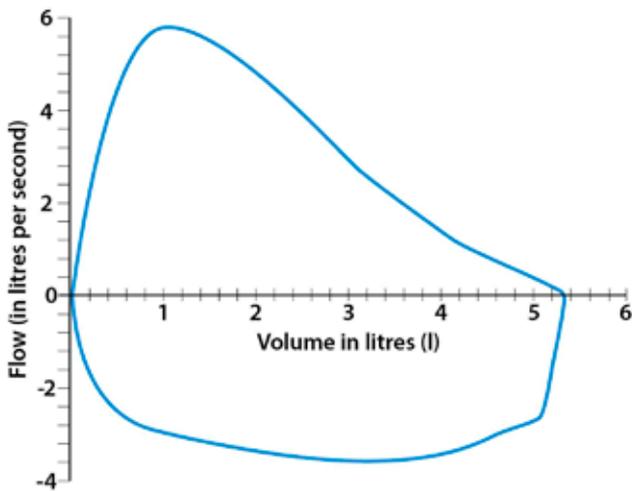
In the same way, if your airway is narrower than normal, it will take you longer to empty your lungs of air.

A spirometer records how much air you can breathe out in one second. That will be less if your airways are narrower than someone of your gender, age, height and ethnicity with healthy airways.

It can also compare that result to how much air you breathed out altogether, and this ratio measures how much your airways are blocked.

In someone with healthy airways, at least 70% of the total air they breathe out would be expelled in one second.

## An example of a (normal) spirometry result for a hospital spirometer



	Min	Ref	Max	Best	%Ref	SR
FEV1 [L]	3.76	4.31	4.99	4.31	100	0.0
FVC [L]	4.71	5.35	5.81	5.35	100	0.0
VC [L]	4.82	5.47	5.92	5.47	100	0.0
FEV1/VC [%]	68.1	78.8	-	78.8	100	0.0

Normal range
Your best effort

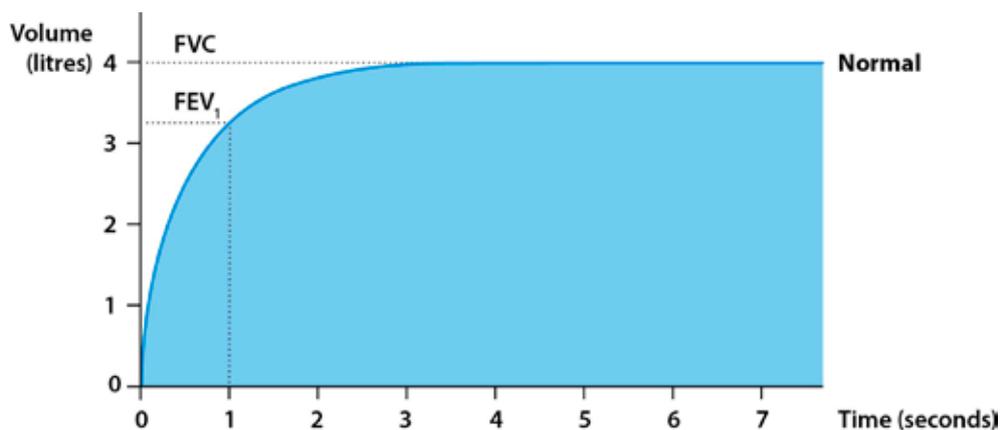
If your best effort is below the minimum value (Min), your result is below what it is expected it to be. This information and the shape of the loop will help your health care professional understand your results.

A spirometry reading usually shows one of three main patterns. These depend on how much air you can breathe out and what proportion you can get out in the first second:

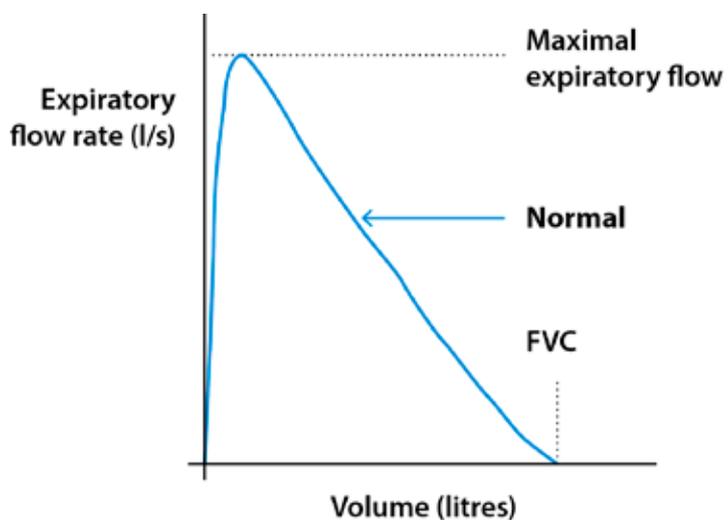
- normal
- an obstructive pattern
- a restrictive pattern

## Normal pattern

### Measuring FEV<sub>1</sub> and FVC:



### Flow-volume measurement:

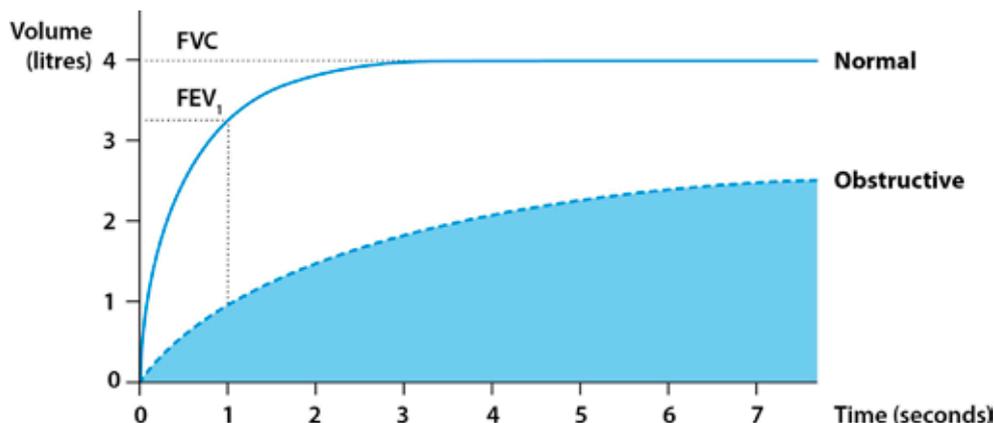


Source:  
[www.brit-thoracic.org.uk/document-library/delivery-of-respiratory-care/spirometry/spirometry-in-practice-a-practical-guide-\(2005\)/](http://www.brit-thoracic.org.uk/document-library/delivery-of-respiratory-care/spirometry/spirometry-in-practice-a-practical-guide-(2005)/)

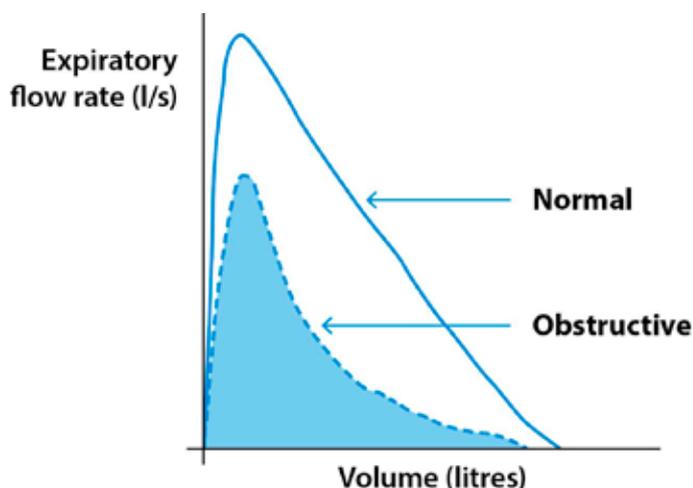
The **normal** range is calculated by the spirometer based on your height, age, gender and ethnicity. If your lungs and airways are healthy, you can blow out most of your breath in the first second. This pattern tells your doctor that your spirometry test is normal when compared to the expected results for you.

## Obstructive pattern

### Measuring FEV<sub>1</sub> and FVC:



### Flow-volume measurement:



An **obstructive** pattern is typical if you have a lung conditions that narrow your airways, such as COPD and asthma. This means that the air flows out of your lungs more slowly than it should (**low FEV<sub>1</sub>**) with less than 70% of the total amount in the first second.

Spirometry can help to assess if inhaled medication or inhalers can open up your airways by **reversibility testing**. Usually, medication is more effective if you have asthma. Reversibility testing helps to grade the severity of COPD and other conditions according to your FEV<sub>1</sub> measurement after you have taken a medication to relax and widen your airways.

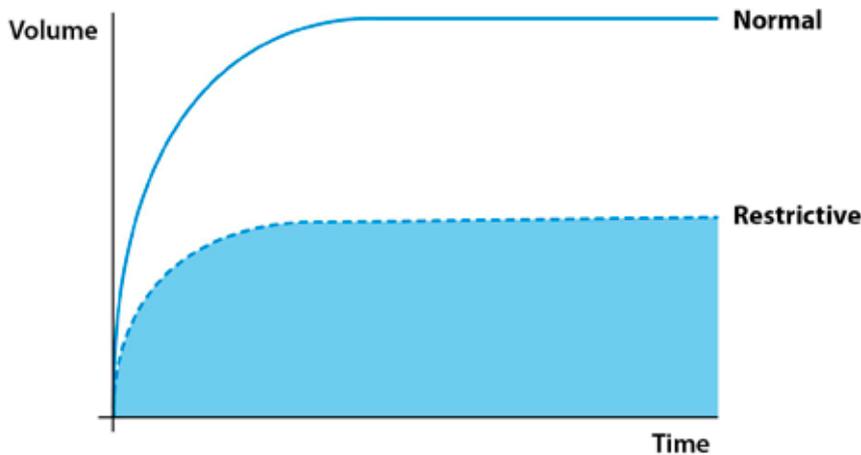
If you are living with COPD and the **FEV<sub>1</sub>/FVC ratio is lower than expected**, the criteria below is used. This is a guide:

Grade of airflow obstruction	
mild	FEV <sub>1</sub> is 80% or more of the predicted value. If you have mild COPD, you spirometry test results can be normal after you take medication
moderate	FEV <sub>1</sub> is 50-79% of the predicted value after medication
severe	FEV <sub>1</sub> is 30-49% of the predicted value after medication
very severe	FEV <sub>1</sub> is below 30% of the predicted value after medication

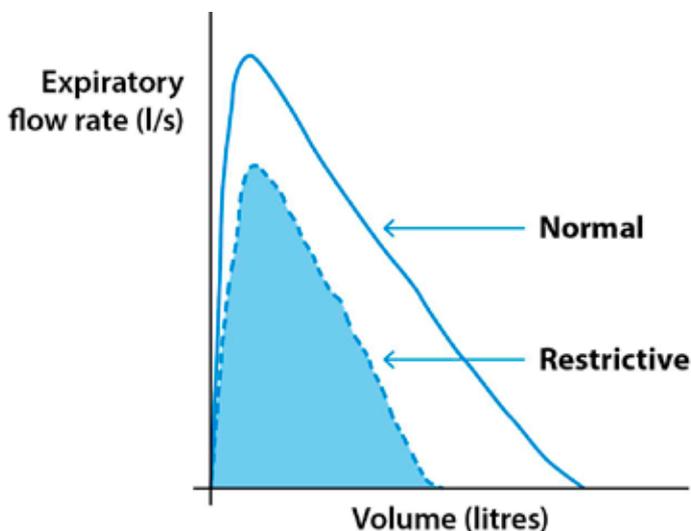
Source: NICE clinical guideline CG101: Chronic obstructive pulmonary disease in over 16s. June 2010, Table 4

## Restrictive pattern

### Measuring FEV<sub>1</sub> and FVC:



### Flow-volume measurement:



With a **restrictive** pattern, the total amount of air you can breathe in **is reduced** but the speed you can breathe out is preserved. In this situation, both the **FEV<sub>1</sub>** and **FVC** will be lower than predicted, but the ratio between the two will not be reduced.

This is caused by various conditions that affect the tissue of your lungs or affect the capacity of your lungs to expand and hold a normal amount of air, such as pulmonary fibrosis. This pattern can also be seen in people who are significantly overweight, have an abnormal curvature of the spine or weak breathing muscles.

## Combined patterns

Sometimes these two processes (obstruction and restriction) combine – where both the total amount of air and how fast you can blow out are reduced. This happens in severe emphysema or cystic fibrosis, and can also happen if someone is obese.

## Lung volume test

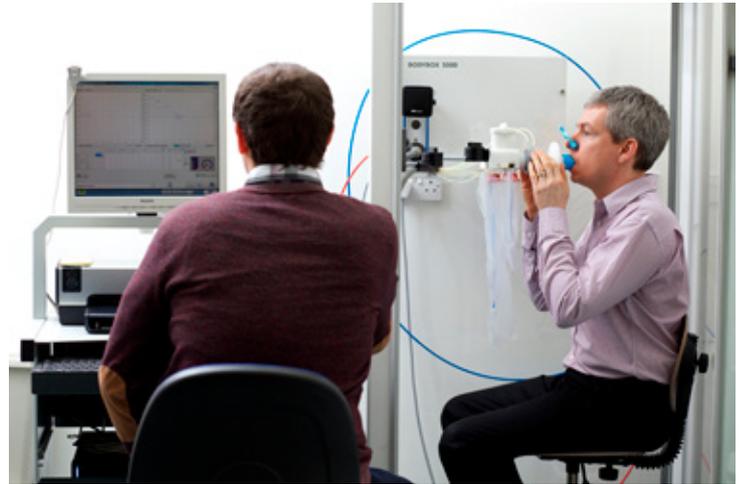
### What is it?

It's a way of measuring the total amount of air in your lungs, and how much air is left after you have breathed out as far as you can.

### What's it used for?

It helps your health care professional to tell if your lung condition is restrictive or obstructive:

- If you have an **obstructive** lung condition, there is a narrowing of the airways inside your lungs. Your lungs never empty of air completely and more air stays in your lungs than normal after you breathe out. Examples of obstructive conditions are COPD, asthma and bronchiectasis.
- If you have a **restrictive** lung condition, you cannot fill your lungs fully with air because your lungs are restricted from expanding fully. This is because your lungs have lost their elasticity. Examples of restrictive conditions are pulmonary fibrosis and sarcoidosis. Sometimes this may also be seen in people who have a curvature of the spine or changes to shape of their ribcage.



### What happens during the test?

To measure your lung volume you will sit in a sealed, clear box with a clip on your nose to make sure that no air escapes from your nose. Changes in pressure inside the box help to determine your lung volume.

People sometimes worry that they will have to sit in a box. You'll be able to talk to the lung physiologist performing the test throughout. Let them know if you are anxious. The tests only takes about 5 minutes.

During the test you will be asked to pant or breath quickly for a couple of seconds. You will also be asked to put your hands firmly onto your cheeks to stop them puffing in and out. You will then breathe in and out using a mouthpiece for a short time.

The method used to measure lung volumes may vary depending on your condition or the equipment that is available at your hospital.

### What will the results look like?

Your lung volume results will be compared to the results for others of your age, height, gender and ethnicity. If they fall outside of the normal range, this may suggest obstruction or restriction.

In people with COPD, if the tests show that there is a lot of trapped gas it may mean that you are suitable for a lung volume reduction treatment. Ask your doctor about this.

## Gas transfer (or TLco) test

### What is it?

It's to see how well your lungs are able to take up oxygen from the air you breathe. The result of the test is called the transfer factor or sometimes the diffusing capacity.

### What's it used for?

It's used to help diagnose and monitor certain lung conditions including COPD and pulmonary fibrosis. It may also be used to assess your lungs before surgery or to assess how your lungs react when undergoing chemotherapy.

### What happens during the test?

You breathe in air containing very small amounts of helium and carbon monoxide gases. These are completely harmless at the very low levels used. You will be asked to take in a big breath through a mouthpiece while wearing a nose clip. You then hold your breath for a minimum of 8 seconds and then breathe out steadily into the machine.

You will need to do this a few times with a pause in between. The whole test should take no more than 10 minutes.

### What will the results look like?

The test tells your doctor how efficient your lungs are at exchanging oxygen from the lungs into the blood. The results will depend on your age, height, gender and ethnicity as well as the level of haemoglobin in your blood. Haemoglobin is the protein in red blood cells that carries oxygen.

The results can be affected by smoking, so if you are a smoker, try not to smoke for 24 hours before your test.

# Respiratory muscle tests

## What is it?

Respiratory muscle tests measure how much pressure your breathing muscles can generate when you breathe in or out.

## What happens during the test?

Sometimes a handheld device with a mouthpiece is used. Alternatively a fixed piece of equipment in a lung function lab can be used. Your health care professional will explain how you should breathe:

### **Mouth pressures**

- to measure the strength of the muscles that help you breathe in, you will be asked to breathe out as long as you can and then suck hard on a mouthpiece for at least 1 second. This is the maximum inspiratory pressure.
- to check how strong the muscles are that help you breathe out, you'll be asked to breathe in deeply first and then blow out as hard as you can into a mouthpiece. This is the maximum expiratory pressure.

### **Sniff pressures**

For these a small probe is placed to block one of your nostrils. It measures the pressure while you sniff as hard as you can.

The lung specialist may also ask you to do a spirometry test lying down to see if this makes your lung capacity fall (a sign of muscle weakness).

## What will the result look like?

You will usually have to repeat each test a few times to make sure the results are as good as you can get.

## Exhaled carbon monoxide test

### What is it?

This is a test to see how much carbon monoxide – a poisonous gas in cigarette smoke – is in your body. Carbon monoxide from smoking reduces the ability of red blood cells to carry oxygen.

It's a simple and easy test to do.

### What's it used for?

It's used to monitor smoking and help people to quit. Public health guidance recommends using this test for all pregnant women as a routine part of their antenatal care.

Carbon monoxide exposure is especially risky if you are pregnant because it affects a growing baby's access to oxygen. Your baby needs oxygen to grow and develop.

### What happens during the test?

You breathe into a cardboard tube attached to a handheld monitor. The monitor then shows the reading on its screen.

You will be asked to hold your breath for as long as possible, ideally 15 seconds. Then you will breathe out slowly into the mouthpiece aiming to empty your lungs completely.

### What will the results look like?

The results will be in parts per million (ppm) of carbon monoxide in your breath.

reading	suggests
10 ppm and over	recent exposure to a high level of carbon monoxide and that you are a smoker
5–9 ppm	recent exposure to a moderate level of carbon monoxide and you are possibly smoking
1–4 ppm	recent exposure to a low level of carbon monoxide. It's normal to have a small amount of carbon monoxide in your breath even if you're not a smoker

## Exhaled nitric oxide test

### What is it?

It's a simple test to see how much nitric oxide – a substance that can be found in high amounts in patients who have sensitive airways – is in your breath. It is also called a FeNO test.

### What's it used for?

If you have a breathing condition, your airways may be inflamed. The FeNO test is useful to help your doctor understand if you have asthma. The measurements may also help your health care professional check if the medication you are taking is working.

### What happens during the test?

You breathe into a cardboard tube attached to a handheld monitor. The monitor shows the reading on its screen.

You will breathe in deeply, with your mouth open, and then breathe out little by little until your lungs are empty. The breath out will normally take 12 seconds. You may have to do the same measurement a few times.

### What will the results look like?

The results will be in parts per billion (ppb) of nitric oxide in your breath. Your health care professional will also check your symptoms, such as cough, wheeze and shortness of breath.

reading	suggests
> 51 ppb	your airways are inflamed and medication can improve your symptoms
26–50 ppb	grey area – if you have symptoms, medication may help
< 25 ppb	you're unlikely to have inflamed airways

## More information on having tests

Breathing keeps us alive. It provides the oxygen that our bodies need and removes carbon dioxide, the waste gas that we produce. If you have problems with your breathing, your health care professional may suggest taking one or more tests. These can help to work out:

- if your lungs are working normally, or if there is a problem
- if there is a problem, what type of problem it is
- if there is a problem, how severe is it

Highly-trained health care professionals will run your tests. They will make sure the equipment gives an accurate result and that it is hygienic to use, for example by using a separate, disposable mouthpiece for each person.

### Remember:

- The results of tests can be used together with your medical history, symptoms and examination results as well as X-rays and scans to help guide your treatment.
- Different people may need more or less complicated tests. Sometimes the tests need to be done only once to see what the problem is. Sometimes they are repeated to monitor changes over time or response to treatment.
- When you get your results, ask your health care professional to explain them to you. Keep asking questions until you understand what your results mean.

## Preparing for your test

When you're going for a test, you may get a leaflet or an appointment letter with specific instructions. Read them carefully before your test. For some tests, you may be asked:

- to wear loose-fitting clothing, or suitable shoes for a walking test
- to stop smoking for 24 hours before the test (if you smoke, this can alter the results of some tests)
- to avoid eating for some hours before
- to avoid drinking alcohol and caffeinated drinks (like coffee, tea, cola or energy drinks) for some hours before
- not to take your medication for some hours before
- to bring along your medication, such as inhalers

If you're unsure how to prepare, get in touch with the person who made the appointment for you.

If you've had a chest infection or a flare-up of symptoms and taken drugs such as steroids or antibiotics to treat it, this may affect your test results. If your test appointment is within 4–6 weeks of this, check with your health care professional about going ahead. Remember to tell whoever does your test about your recent chest infection and the drugs used to treat it.

## Questions about your test

This information gives general information about breathing and other tests. But you may have more detailed questions. We've suggested some questions you could ask when your health care professional suggests you have some tests done or at the test appointment itself:

- What is the test for?
- Who will carry out the test, and where?
- What will happen during the test and how long does it take?
- Do I need to prepare for the test?
- Will there be any side effects and how long will they last?
- How and when will I get the results?

Get in touch with us to find support near you.

Helpline: 03000 030 555

Monday to Friday, 9am-5pm

Ringling our helpline never costs more than a local call and is usually free, even from a mobile.

[helpline@blf.org.uk](mailto:helpline@blf.org.uk)

[blf.org.uk](http://blf.org.uk)

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We value feedback on our information. To let us know your views, and for the most up to date version of this information and references, call the helpline or visit **blf.org.uk**