

## How to use a gas diffusion tube



*Photo: Residents of Charlton in the London borough of Greenwich install diffusion tubes for measuring air pollution. A cable tie is used to secure a clip which holds the diffusion tube.*

Gas diffusion tubes are analogue devices for measuring the concentration of a chemical pollutant in the air – specifically ones which are gases. The diffusion tubes measure the concentration of a single chemical pollutant and there are versions for nitrogen dioxide, ozone and carbon monoxide for example. Diffusion tubes are robust, easy to use, and relatively low cost. Local authorities, government and environmental scientists use them in their monitoring of air pollution.

### **What is a diffusion tube?**

Physically, they are very simple: a plastic tube about the length and diameter of your little finger. One end of the tube is sealed and the other is open but supplied with a cap on it. When the cap is removed, one end of the tube is open and air circulates in the tube without assistance from a fan or similar. Hence air diffuses into it. The sealed end of the tube has a mesh which is coated in a substance that is sensitive to the air pollutant gas being measured. The change in the concentration sensitive chemical as it reacts with the air pollutant being studied, can be used to calculate the average concentration of air pollution.

You will receive the diffusion tube from the supplier or laboratory with a cap on the end which completely seals the tube. Both ends of the tube are sealed in this way and the air does not circulate. Prior to using the tube, store the tube in a sealed plastic bag in a cool place like a fridge or cool cupboard out of direct heat. The tubes

have 'use-by' dates by which you must use them for a valid result. Keep the caps on the tubes until the air pollution monitoring is to start.

### Putting the diffusion tubes up



*Photo: Erecting a gas diffusion tube in Greenwich with the Cutty Sark ship in the background. The gas diffusion tube is held by a clip. The closed end – the capped end – is pointing skyward, and the open end is pointing downward. This prevents the collection of rainwater in the tube.*

The diffusion tube is mounted in a clip which attaches to a street sign or a lamp post. The tube should be between 2 – 3 meters above the ground. We recommend you affix it at 2.5 meters which will mean that it is above the eye line and less likely to be seen and stolen. If you attach it to a post with a sign on it then make sure the tube is at right angles to the face of the sign otherwise the flow of air will be obstructed.

The area above the tube should be open to the sky. Do not place it under a canopy where the flow of air might be restricted. Do not attach the tube to vegetation – a tree or similar. The diffusion tube may be occupied by insects or spiders and these are common in vegetation. This may block the tube and invalidate the results although complete obstruction of the tube in this way is uncommon.

When you start the monitoring then removed the cap and place the tube in the clip. The exposure of the tube begins once the cap is removed, and the end of the monitoring period when the cap is replaced and the exposure stops. The tube must be mounted with the open end – without the cap – facing down. This presents rain water collecting in the tube and invalidating the result. Be sure to store the cap safely as it is the only reliable way of sealing the tube!

We recommend that you put the tubes up and take them down with another person assisting. You might need a stool or a small step ladder to comfortably reach the

height of 2.5 meters. It's easier for example, to have one person holding a tape measure and another attaching the tube, its clip and the tie, to a lamp post!

### **Recording your monitoring**

It's important to record the time and date when tube is put up – when the cap is removed from the diffusion tube and the exposure begins. Similarly, these details should also be recorded when the cap is replaced. If you notice anything in the tube eg. Spider, etc then note these details. Similarly, the location of the tube is important and needs to be recorded. You will be supplied with a record sheet where these details and others are to be noted. There is one sheet for each diffusion tube.

We recommend that you photograph the diffusion tube once it is in place/put up so as to show its citing and help to determine the location.

### **Taking the tubes down**

Once the tube is removed from its clip at the end of the monitoring then cap the tube and return it to the supplier or laboratory for chemical analysis. The clip and tie which affixed the tube to the post should also be removed unless you intend to use it again.

Record all the information requested on your record sheet. There will also be a form – the 'laboratory form' which must be completed and returned with the tubes. However, do not return your record sheet(s). The record sheet is retained for your records. Only the laboratory form is returned with the tubes to the laboratory. You will find the address to return the tubes on the last page of the laboratory sheet.

### **Results**

A gas diffusion tube gives a single result which is the average concentration of the pollutant gas under study for the whole the study or exposure period. It doesn't show when the pollution was worse for example – at the beginning of the study or the end. It only shows the average.

Once the laboratory has analysed the tubes then a bias is applied to the result. It's a standard procedure to bias the results. This is necessary to compensate for the inherent physical characteristics of the tube where the air does not exchange perfectly with the surrounding air. It tends to become partially trapped in the tube which is semi-open. Diffusion tubes are well understood and characterised hence the need to apply a bias. You will received the results with this bias applied - using a figure recommended by the laboratory.



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