



## Nitrogen Dioxide (NO<sub>2</sub>) – Diffusion tubes

Nitrogen dioxide (NO<sub>2</sub>) is a gas produced by the reaction of nitrogen and oxygen during combustion processes. These oxides of nitrogen, known as NOX (pronounced knocks), take part in chemical reactions in the air changing, into nitric acid and nitrates, which may remain in the air as very small particles.

As an irritant gas, NO<sub>2</sub> can damage cell membranes and proteins. High concentrations can produce airway inflammation (experienced as cough, chest tightness and difficulty breathing), and may lead to narrowing of lung airways, particularly among people with pre-existing asthma. After exposure to NO<sub>2</sub> concentrations of 200-400 ppb (Parts per billion – a unit of measurement for example one microgram in a litre of water is 1 ppb) for one hour, asthma sufferers' airways may become more sensitive to other irritants found in the air we breathe. This outdoor air concentration is found occasionally in the United Kingdom.

Studies on the effects of long term exposure to nitrogen dioxide have been associated to increases in non-accidental mortality, cardiovascular diseases and lung cancer (Cesaroni *et al.*, 2013.)<sup>1</sup> Studies in Switzerland and the United States suggest people living in areas with higher NO<sub>2</sub> exposures have poorer lung function. Other similar studies have not found this link.

**Diffusion Tubes** are made from clear plastic, with a rubber stopper at each end. Designed for passive monitoring of gaseous airborne NO<sub>2</sub>.



They are commonly used by Local Authorities to obtain data in addition to those from high-end fixed monitoring stations.

**They work** by collecting information about NO<sub>2</sub> using a steel mesh coated with a chemical called triethanolamine (TEA), which is located



at the end of the tube with the red stopper. TEA absorbs nitrogen from the air when the white stopper

is removed and the laboratory analysis can show the levels of the pollutant in the air (N.B. tubes should always be positioned to allow the air to circulate freely). The results provide an average over the period when the tube was exposed to the environment. For more details, see [AEA Report](#).

Diffusion tubes can be positioned across different sites in a community; on lampposts, street signs, a fence or other appropriate sites. They should be left in the location for a month, or more, and then sent to the laboratory for analysis. The results from the analysis can be added to the 'Air Quality Community Map' to be shared with others.

### Materials Needed

To perform the sampling process (the Test), you will need:

- Diffusion tubes
- Tube holders
- Survey sheet (site details and timings to be filled)
- Maps
- Clipboard
- Re-sealable samples bag
- Pen

<sup>1</sup> Long-Term Exposure to Urban Air Pollution and Mortality in a Cohort of More than a Million Adults in Rome



## Purchasing Equipment

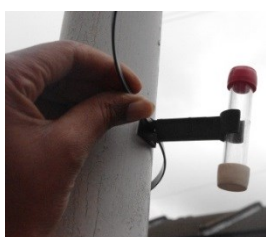
Diffusion tubes can be purchased from Gradko and other suppliers. The tube price (~£8.00) also includes the cost of analysis. If you are a charity or grassroots community group, you may be able to negotiate on getting a lower price. Gradko also sell tube holders and ties to fasten to lampposts and other objects. If you are a keen DIY person you can make your own from some rigid corrugated plastic.

## Collecting NO<sub>2</sub> samples - Diffusion tube

### Procedure

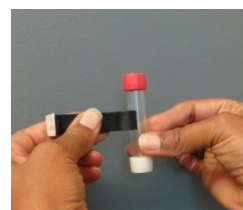
**\*\*\* Please READ through the instructions carefully before carrying out the survey. \*\*\***

**7 steps:** **Locate** (site) ⇒ **Assemble** (tube & holder) ⇒ **Fix** (sample) ⇒ **Remove** (cap) ⇒ **Write** (information) ⇒ **Collect** (sample) ⇒ **Write** (information)

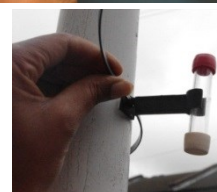


**LOCATE:** Select a suitable site to position the diffusion tube. If you are doing this as a community monitoring project then divide the area up into 200m grid squares and take a couple of samples in each of the grids to get a good coverage of the area

**ASSEMBLE:** Position tube **vertically** and insert into holder with **WHITE** cap facing downwards. Attach cable ties (or string) if fixing to a pipe or lamppost.



**FIX** sample in a secure position in the selected location. Make sure: there is free circulation of air around the tube and that they are positioned more than 10m away from air conditioning outlets, extractor vents or heater flues.



sample is placed at breathing height. In most public places this may not be feasible; to reduce loss or theft, it is recommended that tubes are placed at a height of 1.5-2m on public thoroughfares. **Remember**, the further away from the road, the less likely your readings will reflect the levels you are exposed to whilst walking around your community. Note, Defra guidance on height recommends 2-4m (this recommendation is based on standardizing for comparison across sites see:



[http://laqm.defra.gov.uk/documents/0802141004\\_NO2\\_WG\\_PracticalGuidance\\_Issue1a.pdf](http://laqm.defra.gov.uk/documents/0802141004_NO2_WG_PracticalGuidance_Issue1a.pdf).



**REMOVE:** the **WHITE** cap (sometimes it's grey in colour), which should be facing **downwards** and leave tube for 4 weeks exposure period.

**WRITE:** Fill in the record sheet ensuring **date and times** are recorded. **Mark 'x' on map** provided to identify **sampling location** and the last **3 digits of the tube reference number**. Record any information that will help identify the location if someone else needs to collect the tube and also to help explain the results when you get them. Store the cap, map and record sheet in the re-sealable sample bag. If you are using a mapping application on your phone or use a GPS receiver, you can record the location using these devices.

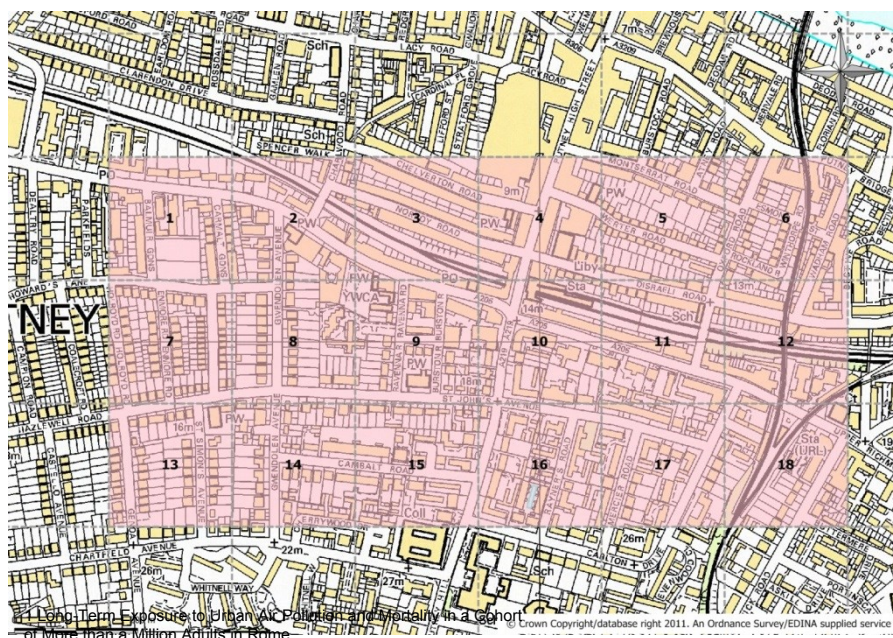


**COLLECT:** the sample from its location 4 weeks after placement.

**Replace the WHITE** cap securely on the end of the tube, **in the location**. Note any details regarding the tube condition, changes in site conditions, or anything that might affect the results. Record collection date and time on the survey record sheet and place everything in the re-sealable bag with your name clearly marked on it. Ensure bag is tightly sealed.

**You have now completed all the steps necessary to collect you data!** All you need to now is to send your sample/s off to the lab for analysis and wait for the results. The lab may have their own record sheet that you will be required to complete when sending samples in for analysis. Once you have your results be sure to enter them onto the [Air Quality Monitoring Community Map](#).

## *Example of: Survey area divided into grid squares*



Why not hold a community meeting to share your results and begin thinking about what steps can be taken to reduce your exposure to poor air quality and deliver change real change.



## *Diffusion tubes - Survey Sheet*

**Surveyor Name:**

**Contact Details:**

Details	Tubes Put Out	Tubes Taken In
Map Grid Ref. (e.g. W1)		
Tube Ref. (e.g. 631122)		
Date		
Time (use 24 hour clock)		
Name of Road		
Location Description (e.g. residential street, park, high street).		
Approximate height tube positioned off the ground		
Site Characteristics (e.g. building/road works, traffic diversion)		
Tube Condition (e.g. tube found on the ground, dirt, insect or liquid inside tube).		