

## Information Sheet – NO<sub>2</sub> Diffusion Tubes



20% TEA:80% Water  
50% TEA:50% Acetone



Alternate Holder

### Overview;

It has been shown (*Palmes et al 1976*) that the principle of molecular diffusion can be utilised for the indicative measurement of ambient nitrogen dioxide in the atmosphere. Using this research, a cost effective passive sampler was developed for the diffusive monitoring of NO<sub>2</sub>.

### Diffusion Tube Performance:

Uncertainty:	Under European guidelines, diffusion tubes are considered an indicative method, and as such the uncertainty is defined as <20%. (In field intercomparisons Scientifics' diffusion tubes perform at <10% uncertainty.)
Analytical Repeatability:	± 2.1%
LOD:	0.03µg NO <sub>2</sub> on the tube. Over a 4-week exposure this would equate to 0.6µg/m <sup>3</sup> , or 0.3ppb
Shelf-life:	Tubes should be analysed within 4 months of manufacture
Storage:	Ideally, tubes should be stored in a fridge. A cool dark location is an acceptable alternative.
Exposure:	2-6 Weeks
Diffusion Coefficient:	0.1361cm <sup>2</sup> s <sup>-1</sup> at STP ( <i>Massman 1998</i> )
Quality Assurance:	<ul style="list-style-type: none"> <li>- The manufacture and analysis of NO<sub>2</sub> diffusion tubes is covered by our UKAS accreditation</li> <li>- The method meets the requirements laid out in DEFRA's "Diffusion Tubes For Ambient NO<sub>2</sub> Monitoring: Practical Guidance."</li> <li>- The laboratory has taken part in the WASP proficiency scheme since it's inception, and has the highest ranking of 'Satisfactory' as well achieving 100% on the DEFRA scoring system.</li> </ul>

### Manufacture:

Description:	Two stainless steel grids coated in the absorbent are located within a coloured polyethylene end cap. The cap is placed on a polypropylene tube and the open end sealed with a white polyethylene cap.		
Quality Control:	2% of manufactured tubes are analysed to check the tubes are free from contamination.		
Tubes:	Material:	Natural Polypropylene	
	Internal Diameter:	10.8 ± 0.2 mm	
	Outer Diameter:	13.8 ± 0.4 mm	
	Length:	71.0 ± 1.0 mm	
Stainless Steel Grids:	Type:	304	
	Diameter:	12mm	
	Weave:	Plain	
	Mesh Number:	100	
	Wire Diameter:	0.112mm	
	Aperture:	0.142mm	
	Open Area:	31.3%	
	Weight:	0.62 kg/m <sup>2</sup>	
End Caps (Grid End):	Material:	LDPE (Low Density Polyethylene)	
	Colour:	Black	
	Internal Diameter:	13.70mm ± 0.25mm	
	Height:	14.99mm ± 0.25mm	
End Cap:	Material:	LDPE (Low Density Polyethylene)	
	Colour:	White	
Absorbent:	50% Triethanolamine : 50% Acetone	Dipping Method	
	20% Triethanolamine : 80% Ultrapure Water	Pipette Method	

## Dispatch:

- Each tube is labelled with a unique, sequentially numbered ID, and each batch placed in an airtight bag before being dispatched to the customer.
- An exposure sheet, pre-printed with the tube IDs and manufacturing lot number, is included with each batch of tubes.
- Each bag of tubes is marked with a use by date.
- Tubes will normally be dispatched 7-14 days prior to the changeover date.
- Upon receipt the tubes should be checked, and then left in the airtight bag prior to use.

## Exposure:

- A monitoring site should be selected that best meets current guidelines.
- Clips or similar should be used to position the tubes, so that they are approximately 5cm from any flat surface, and ideally 1.5m from the ground. However, it is not uncommon practice to position the tubes higher to prevent vandalism.
- To begin exposure, remove the white end cap, and position the tube perpendicular to the ground with the open-end facing down.
- Note the time and date in the 'On Time' column of the exposure sheet.
- If required, a brief description of the tube location should be entered in the 'Site' column.
- Once the exposure is complete the process should be reversed – Remove the tube, replace the white cap, and note the date and time in the 'OFF time' column. Return the tube to the airtight bag.
- Where applicable, additional observations should be annotated on the exposure sheet e.g. spider in tube, water in tube etc,
- The tubes should then be returned to the laboratory for analysis as soon as possible.

*Note 1: Insects should be removed before the white cap is replaced.*

*Note 2: The tubes should be put out for exposure no later than the use-by date given on the tubes.*

## Analysis:

Analytical Technique:	Colorimetric
Instrument:	Continuous Flow Auto-analyser
Principle:	Nitrite ions react with Sulphanilamide to form a diazonium compound. In acidic conditions, this couples with N-(1-naphthyl)-ethylenediamine dihydrochloride to form a purple azo dye. Utilising spectrophotometric analysis at 540nm, the NO <sub>2</sub> concentration is calculated by quantification of the colour change in comparison to that produced by known standards.
Extraction:	To ensure complete, homogeneous extraction, a vibrating tray or vortex mixer is used.
Quality Control:	A quality control sample of known concentration is run every 10 samples. The data generated is compared to acceptable limits as determined statistically using a Shewhart Chart control system.  The laboratory takes part in inter-comparison schemes, to monitor data accuracy.

## Reporting & Calculations:

- Data is imported directly from the analytical software, eliminating the possibility of transcription errors
- As per current guidelines, air volumes are calculated assuming an average exposure temperature of 11°C, and a pressure of 101.3kPa
- Final results are converted to an equivalency at 20°C, to allow direct comparison to EU guidelines
- The report lists;
  - The amount of the Nitrite (NO<sub>2</sub>) on the tube in µg. This is the analytically derived value.
  - The µg/m<sup>3</sup> of gaseous NO<sub>2</sub> at the sampling location. Knowing the tube dimensions and gas diffusion coefficient, the sampling rate of the tube can be calculated. In turn, knowing the sampling rate, the length of exposure and the total µg of NO<sub>2</sub> on the tube allows the µg/m<sup>3</sup> of NO<sub>2</sub> to be calculated.
  - Parts Per billion (ppb) NO<sub>2</sub>. The ppb levels are calculated from the µg/m<sup>3</sup> value, using the known relationship that ppb = 24.04 x Concentration (µg/m<sup>3</sup>) / Molecular Weight. For NO<sub>2</sub>, 1ppb = 1.91 µg/m<sup>3</sup>, or 1 µg/m<sup>3</sup> = 0.52ppb (at 20°C, 101.3kPa)
- A soft copy of the report is emailed to the customer (for ease of data handling), with a hard copy being available on request

**NOTE:** *The reported values are NOT bias adjusted. The guidance is for the end user to select and use the bias factor best suited to their monitoring program.*

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