Version 1.5

UK NO_2 Diffusion Tube Network Instruction Manual

Produced for the Department for Environment, Food and Rural Affairs, the Scottish Executive, the Welsh Assembly Government and the Department of Environment in Northern Ireland.

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Contents

1 Introduction 1

2 Oxides of Nitrogen in the Atmosphere 2

3 NO_2 Diffusion Tube Samplers 3

4 Organisation of the Network 4

4.1 ORGANISATIONAL STRUCTURE 4
4.2 QUALITY ASSURANCE AND QUALITY CONTROL 5
4.2.1 Local/Unitary Authority QA/QC Responsibilities 5
4.2.2 Analytical Laboratory QA/QC Responsibilities 6
4.3 CORRECTION FOR BIAS 7

5 Location of Monitoring Sites 7

5.1 DETAILED SITING OF THE SAMPLER 8
5.2 SITE CATEGORIES 8
5.2.1 Roadside sites 8
5.2.2 Urban background sites 9

6 Instructions for Exposing Diffusion Tubes 9

7 Comparing Data with Air Quality Standards 10

7.2 COMPARISON WITH THE EC DIRECTIVE 85/203 11
7.2 COMPARISON WITH DIRECTIVE 1999/30/EC LIMIT VALUES 12
7.3 COMPARISON WITH AQS OBJECTIVES 12

8 References 12

Appendices

APPENDIX 1 LOCAL & UNITARY AUTHORITY CODES
APPENDIX 2 COUNTY CODES
APPENDIX 3 ANALYTICAL LABORATORY CODES

1 Introduction

Ambient concentrations of oxides of nitrogen (principally NO and NO_2) have become the subject of increasing interest in recent years. Nitrogen dioxide (NO_2) is the most significant of this family of pollutant gases, because of its known human health impacts and contribution to acidification of the environment. In order to protect human health, ambient concentrations of nitrogen dioxide (NO_2) have been regulated throughout Europe by EC Directive 85/203[1], since 1985. This is being superseded by the first EC Daughter Directive (1999/30/EC)[2], which came into force in January 2000 and has set Limit Values for NO_2, to be achieved by 2010. The UK Department for Environment, Food and Rural Affairs (Defra), the Scottish Executive, the Welsh Assembly Government and the Department of Environment in Northern Ireland have also introduced The Air Quality Strategy (AQS) [3]. This document sets out air quality objectives for NO_2 and other air pollutants, which are in most cases to be achieved by the end of 2005. The recommendations for NO_2 objectives set out by the AQS have been formally made part of UK legislation by the Air Quality Regulations 2000 for England[4], Wales[5], Scotland[6] and Northern Ireland[7].

In June 1990, the UK Photochemical Oxidants Review Group published a major report reviewing all measurements of nitrogen oxides in the UK[8]. The conclusions of this report included recommendations for continued monitoring oxides of nitrogen, and pointed out that diffusion tube samplers provided a cost-effective method of determining spatial variation of NO_2 throughout the UK. The Government White Paper, "This Common Inheritance" committed Defra's predecessor, the Department of Environment, Transport and the Regions (DETR) to the expansion of air quality monitoring. This has partly been achieved by the creation of the Automatic Urban Network (AUN) and its affiliated automatic monitoring sites; these use continuous automatic techniques to monitor air quality at a number of urban locations. The detailed air quality information from these sites is used primarily for public information, via the Department's Air Quality Bulletin service and the National Air Quality Archive on the World Wide Web, at www.airquality.co.uk.

However, automatic air quality monitoring is expensive to set up, operate and maintain. Historically, this has limited spatial coverage. Simple passive samplers, such as diffusion tubes, are therefore a useful supplement to automatic monitoring. Passive samplers absorb pollutants direct from the ambient air, and do not need a power supply of any kind. They are exposed at the selected site for an extended period (typically several weeks), and subsequently analysed at a central laboratory. Passive samplers are easy to use and relatively inexpensive, so they can be deployed in large numbers over a wide area, giving good spatial coverage. They may be used to complement detailed measurements made at automatic monitoring sites.

In 1993 DETR established the UK Nitrogen Dioxide Network, using diffusion tube samplers. This network is now co-ordinated on behalf of Defra and the Devolved Administrations by **netcen**, an operating division of AEA Technology plc, in collaboration with a large number of Local and Unitary Authorities. The UK Network follows on from two successful short-term nationwide surveys carried out in 1986 and 1991[9,10], which utilised the infrastructure of the existing UK Smoke and SO_2 Monitoring Network. The NO_2 Diffusion Tube Network currently collects data from 324 Local and Unitary Authorities, and has the objective of assessing the spatial and temporal distribution of Nitrogen Dioxide concentrations in urban areas of the UK. The network is the first of its kind to monitor NO_2 concentrations over such a large area and long period with a consistent siting criteria optimised for the monitoring of NO_2 in the urban environment.

The network has also enabled the assessment of changes in urban NO_2 concentrations in the UK. This is particularly relevant as NO_x emissions from road traffic are expected to decrease as the percentage of the UK car fleet fitted with catalytic converters increases.

This instruction manual is intended to provide an introduction to the monitoring of NO_2 using diffusion tubes, for the purposes of the Network. It gives information on how to set up monitoring sites, expose tubes, and submit data to the network. With such a large number of participants in the study, it is essential that recommendations and instructions provided in this manual are followed closely. This will ensure that data are of the highest quality, and comparability.

- **The manual is periodically updated. This version (Version 1.5) was produced in February 2003.**

A published annual report provides the major route for public dissemination of data from the network. This report, and data from the network are also included in the Air Quality Archive on the World Wide Web, at **www.airquality.co.uk**
A copy of this Instruction Manual is also available via this web site, at http://www.aeat.co.uk/netcen/airqual/reports/no2man/no2man.html .

All measurement data supplied to **netcen** as part of the UK NO_2 Network must be regarded as "in the public domain", and subject to meeting data quality criteria will be made available on the Archive.

2 Oxides of Nitrogen in the Atmosphere

Oxides of nitrogen, collectively termed NO_x, are air pollutant gases. The most significant of these (in terms of anthropogenic ground level air pollution) are nitric oxide (NO) and nitrogen dioxide (NO_2). Nitrous oxide (N_2O) is the most prevalent oxide of nitrogen in the atmosphere, and although an important "greenhouse gas", it has no known detrimental effect on human health at ambient concentrations and will not be discussed further in this document.

Both NO and NO_2 are formed in high temperature combustion processes, though NO predominates. (The term NO_x, total oxides of nitrogen, is generally used to describe the sum of NO and NO_2 concentrations). In 2000, motor vehicles accounted for approximately 46%[11] of the UK's total estimated emission of oxides of nitrogen, with coal combustion (including coal fired power stations) accounting for about a further 18%. However, in urban areas, especially close to major roads, a much higher percentage of the observed oxides of nitrogen will arise from motor vehicles. Almost all oxidised nitrogen pollution is emitted as NO, which at ambient temperatures is oxidised to the more toxic secondary pollutant, NO_2. This process is accelerated in the presence of sunlight, reactive hydrocarbons and ozone.

3 NO_2 Diffusion Tube Samplers

The development and use of passive samplers originated in the field of occupational exposure monitoring[12]. However, diffusion sampling techniques have been further developed and tested[13], and now are widely used for ambient air quality monitoring, where concentrations are generally much lower. NO_2 diffusion samplers are designed either as a badge, or tube configuration. In this study, diffusion tube samplers are used. These consist of a small plastic tube, approximately 7cm long, as shown in Figure 1. During sampling, one end is open and the other closed. The closed end contains an absorbent for the gaseous species to be monitored, in this case NO_2.

Diffusion tube samplers operate on the principle of molecular diffusion, with molecules of a gas diffusing from a region of high concentration (open end of the sampler) to a region of low concentration (absorbent end of the sampler). The movement of molecules of gas (1) through gas (2) is described by Fick's law, which states that the flux is proportional to the concentration gradient:

$$J = -D_{12}\frac{dC}{dz}$$

where J = the flux of gas (1) through gas (2) across unit area in the z direction
C = the concentration of gas (1) in gas (2)
z = the length of the diffusion path
D_{12} = the constant of proportionality - the molecular diffusion constant of gas (1) in gas (2), with dimensions of length^2 time^{-1}.

For a tube of area a (m^2) and length l (m) then Q (moles), the quantity of gas transferred along the tube in t seconds, is given by:

$$Q = \frac{D_{12}\,(C_1 - C_0)\,a\,t}{l}$$

where C_0 and C_1 are the gas concentrations at either end of the tube.

In a diffusion tube, the concentration of gas (1) is maintained at zero (by an efficient absorbent) at one end of the tube (i.e. C_0 = zero) and the concentration C_1 is the average concentration of the gas (1) at the open end of the tube over the period of exposure. Hence:

$$C = \frac{Q\,l}{D_{12}\,a\,t}$$

where Q = the quantity of the gas absorbed over the period of exposure
a = the cross sectional area of the tube
t = the time of exposure
l = the length of the tube

For the gas monitored, the diffusion coefficient must be determined, or obtained from the literature. The area and length of the tube are determined by measurement.

Triethanolamine (TEA) is the absorbent used for NO_2 in diffusion tubes. The closed end of the tube holds stainless steel mesh discs, coated with this absorbent. Tubes must be prepared in a clean atmosphere, to minimise contamination by atmospheric NO_2. The open end of the tube is then sealed and the tube stored in a sealed container prior to exposure.

For monitoring, the end cap *not* containing the mesh discs is removed and the tube mounted vertically with the open end at the bottom. NO_2 is absorbed as nitrite and after exposure, the lower end cap is replaced and the tubes sent for chemical analysis. Step-by-step instructions for exposing the tubes are given in Section 6.

For the purpose of the network, the tubes must be analysed by standard colorimetric or spectrophotometric techniques. This generally involves the addition of a solution of sulphanilamide in orthophosphoric acid and naphthyl ethylene diamine dihydrochloride (NEDA) solution, to form an azo dye, the intensity of which is determined on a spectrometer at 540nm. The spectrometer is calibrated against standard nitrite solutions, to allow the total NO_2 as nitrite, collected by the tube, to be determined. If required, the method can be automated for a large throughput of samples.

It should be noted that diffusion tubes are an *indicative* monitoring technique. Whilst ideal for screening surveys, or for identifying locations where NO_2 concentrations are highest, they do not provide the same level of accuracy as automatic monitoring techniques.

4 Organisation of the Network

4.1 ORGANISATIONAL STRUCTURE

The organisation of the UK NO_2 Network is similar to that of the long-running UK Smoke & SO_2 monitoring network. **netcen** provides the organisational infrastructure, quality assurance and control, data collation and reporting for the network. Participating Local and Unitary Authorities are responsible for undertaking the measurements of NO_2 with diffusion tube samplers, and reporting of results to **netcen** on a monthly basis following the instructions given in this manual.

Each participating Local/Unitary Authority is asked to set up a minimum 4 monitoring sites, in accordance with the siting requirements set out in Section 5 of this manual. Full details of the monitoring locations and Authority contacts must be forwarded to **netcen** using the 'Site Details' form provided. In addition, participants are asked to supply copies of suitable 1:1250 scale maps or GIS town planning maps with the location of monitoring sites clearly identified. This enables the **netcen** team to check that sites meet the criteria of the network.

Supply and analysis of diffusion tubes may be obtained from any of the organisations listed in Appendix 3. All of these laboratories participate in the network's laboratory performance testing scheme, which tests to ensure their analyses are of sufficient quality to be included in the network. Participants should note that data will be rejected from the network if the contracted laboratory does not meet satisfactory QA/QC standards.

Diffusion tube exposure periods and change over dates are defined by the network's monitoring timetable, which will be supplied annually. Under this timetable the year is

divided into twelve "pollution months" which contain either 4 or 5 whole weeks, i.e. 28 or 35 days. These start on Tuesdays, to avoid the problem of Bank Holidays. Wherever possible, the diffusion tube change over must occur on the stipulated date, however, if this is not possible tubes may be changed within ±2 days of the due date. If for any reason diffusion tube exposure periods differ from standard dates provided in the relevant timetable, **netcen** must be informed; generally, a note on the regular monthly concentration report form is sufficient for this purpose.

The Local/Unitary Authority and analyst must set up a system to ensure that all tubes are individually numbered and careful records kept of where and when each tube is exposed. This numbering system needs to be maintained throughout the analytical procedure, so that the final result can be unambiguously assigned to a particular site and a particular period.

Results for each monitoring site are to be sent to **netcen** as soon as they are available and in any case no later than **2 months** after the end of the sampling period. A 'concentration report form' will be sent to each Local/Unitary Authority on around the 10th day of each month for this purpose. **netcen** will then collate and archive the results and prepare annual reports on the data and the operation of the network. **Please note that we must receive all data for the preceding calendar year by the end of February, to ensure its inclusion in the Annual Report.**

4.2 QUALITY ASSURANCE AND QUALITY CONTROL

Quality assurance and control of diffusion tube location, handling and also diffusion tube preparation and analysis are important tasks in the network. These activities attempt to minimise uncertainties in the network's data and to optimise the comparability of data produced by the various authorities and laboratories taking part in the network. Responsibilities to QA/QC may be broadly split into two areas. These are discussed below.

4.2.1 Local/Unitary Authority QA/QC Responsibilities

It is vital that the siting criteria detailed in Section 5 of this manual are followed as strictly as possible. This will ensure that data from equivalent siting locations in other authorities in the UK are directly comparable. If you are at any stage unsure about the best option to take or require clarification of the criteria, please contact **netcen** for further assistance.

In addition, it is essential for **netcen** to be kept fully informed of changes to routine monitoring. For example :

- ***If a monitoring location needs to be moved, please notify netcen in advance*** with full details of the replacement site, reasons for moving the sampler location and dates when sampling is to stop at the existing site and recommence the replacement site.
- ***If there are any changes in your address or contact details, please forward these to netcen*** immediately.
- ***If you change your analytical laboratory, please notify netcen of the change and the month when it took place.***

Local and Unitary Authorities are also responsible for arranging and record keeping of travel blank diffusion tubes. In order to quantify any contamination of diffusion tubes during transit and storage, an additional diffusion tube must be used as a "travel blank", once per quarter. The travel blank must accompany the diffusion tubes for exposure to and from the sites, although it must not be exposed. During the exposure period the

travel blank must be stored in a sealed bag in a refrigerator. The mass of nitrite on the blank will provide an indication of possible contamination during transit.

NO_2 diffusion tubes are known to degrade over time. Therefore, the interval between preparation and analysis should be kept to a minimum. For the purposes of this network, this interval shall not be more than three months. Diffusion tubes shall be kept refrigerated, in a sealed plastic bag, during storage before and after exposure and care shall also be taken to isolate them from other nitrite and nitrate based chemicals to minimise the possibility of contamination.

Any laboratory wishing to undertake supply and analysis of NO_2 diffusion tubes for the UK NO_2 Diffusion Tube Network must take part in the following:

- The Workplace Analysis Scheme for Proficiency (WASP) for NO_2 Diffusion Tubes, which is now run independently by the Health and Safety Laboratory (HSL). See section 4.2.2.
- The NO_2 Network Field Intercomparison.
- Analysis of Quality Control Solutions supplied by **netcen**.

It is strongly recommended that Local/Unitary Authorities check the overall performance of a laboratory prior to placing a contract for supply and analysis of diffusion tubes. This can be done by requesting information on the laboratory's performance in the WASP programme, from the laboratory concerned. Full details of the WASP programme are given in section 4.2.2 below. Results from the scheme are distributed to the laboratories monthly, and summarised in the NO_2 Network annual report. They provide an indication of the quality of the laboratory's diffusion tube analysis. It should be noted that if the laboratory fails to demonstrate satisfactory performance in the WASP programme and the Field Intercomparison, data produced by this laboratory may be rejected from the network's dataset. It is, therefore, important to choose a laboratory with a proven track record and also to check on a laboratory's performance regularly, if data is to be fully utilised.

4.2.2 Analytical Laboratory QA/QC Responsibilities

As explained above, any laboratory providing supply and analysis of diffusion tubes for the purposes of the UK NO_2 Network must take part in the following QA/QC programmes.

(i) The WASP Programme. The Health and Safety Laboratory WASP scheme for NO_2 diffusion tubes was initiated in 1999, and replaced the old Performance Testing Scheme. It involves the analysis, by each participating analytical laboratory, of a tube doped with a known mass of nitrite. Each month a doped diffusion tube is distributed to each participant. This is analysed and the result returned to HSL for checking. Performance scores are then assigned to the analyses on the basis of their difference from the actual mass nitrite, and the standard deviation. Hence results are classified as follows:

Good	< 2 Standard deviations from true value
Warning	2-3 Standard deviations from true value
Action	≥ 3 Standard deviations from true value

Performance test results are disseminated to participating laboratories on a monthly basis.

(ii) The Field Intercomparison. This comprises an ongoing monthly field trial, designed to complement the monthly performance testing scheme described in (i) above by providing information on the uncertainties arising from both the sampling and analysis phases of diffusive sampling in the field. Formerly an annual exercise, run by **netcen**, in

November 2002 this was expanded to an ongoing monthly programme, also operated independently by HSL. Each laboratory supplies three tubes plus a travel blank, to be exposed in the field at an existing automatic NO_2 monitoring station. Diffusion tube results for each laboratory are compared with the NO_2 concentration as measured by the automatic analyser. Laboratories have the option of participating monthly or quarterly.

(iii) Quality Control Solution Testing Scheme operated by netcen. This involves the monthly analysis of a nitrite solution of known concentration by all participating laboratories. Every six months approximately 150ml of a stock nitrite solution is distributed to each laboratory. The laboratories analyse a sample of this stock solution on a monthly basis and return the result to **netcen** for checking.

4.3 CORRECTION FOR BIAS

Many of the Local Authorities participating in the NO_2 Network also use their diffusion tube measurements for Local Air Quality Management purposes, in their ongoing Updating And Screening Assessment of local air quality. Local Authorities using diffusion tubes in this context are advised by Defra's Technical Guidance[14] to establish the average bias (i.e. over-read or under-read) of the tubes they are using, and to make appropriate correction for this bias when calculating the annual mean.

However, at the present time, there is insufficient information available to allow diffusion tube data from every participating Local Authority to be corrected for bias in a reliable and consistent manner throughout the Network. Also, bias can vary from month to month, so it is only appropriate to apply bias correction to the annual mean, not the individual monthly measurements. **Therefore, at the present time, data sent to netcen for the purposes of the Nitrogen Dioxide Network should continue to be submitted *without* any bias correction.** This will be reviewed as more information on bias correction becomes available, and participants will be informed of any changes.

5 Location of Monitoring Sites

This section gives information about the general location of the monitoring sites, as required from January 2001 onwards. The network will take data from a minimum of 4 sites in each Local/Unitary Authority area. Two sites will be close to busy roads (roadside sites), and two sites will be at a distance of at least 50 m from a busy road (urban background sites). *Prior to December 2002, a third "Intermediate" classification was also used. However, this category of sites had been found, over the years, to provide little additional information, so Intermediate sites were discontinued from the end of 2002, to be replaced in most cases with additional roadside sites.*

Sites should be located in areas where people are normally present in daily life. The network is primarily designed to monitor general urban air pollution, rather than that from specific industrial sources, and hence, locations where industrial sources predominate should not be included.

The immediate area around sampler location must be open, allowing free circulation of air around the tube. Ideally, samplers would be placed at breathing height, but in order to reduce theft of tubes, it is recommended that tubes are placed at a height 2-4 m, and in all cases no higher than 5 m.

5.1 DETAILED SITING OF THE SAMPLER

Diffusion tubes must be held vertically with the open end downwards during sampling. Generally a permanent clip e.g. Terry clip or plastic clip, is mounted so that the tubes can be changed easily (see Figure 2). The clip and spacer (see below) may be simply mounted at the monitoring site with PVC tape, double sided tape, or cable tie as appropriate.

It is important that the open end of the tube is exposed to free circulation of air. Also, certain surfaces may act as absorbers for NO_2 leading to a thin layer of reduced atmospheric concentrations immediately adjacent to the surface. For these reasons tubes must not be mounted directly adjacent to surfaces. **A spacer block of at least 5 cm must be used between the surface and the tube, as indicated in Figure 2. A small block of wood or plastic can be used as the spacer. The open end of the tube must be located below the lower surface of the spacer, as shown in Figure 2.**

When tubes are mounted on the side of a building, ideally the tube with spacer block should be mounted on some projection 0.5 - 1 m horizontal distance from the face of the building. If this is not possible, it may sometimes be acceptable to fix the spacer block directly to the side of the building. However, it must not be placed in any form of recess, to avoid the possibility of sampling stagnant air. Also, to avoid sampling in an area of higher than usual turbulence, the tube should not be located on the corner of a building.

Care must be taken to avoid any very localised sources, or sinks of NO_2, or disturbances to the airflow. For example, close proximity (less than 10 m) to the following must be avoided:

- heater flues (particularly low level balanced flues)
- trees and other vegetation
- air conditioning outlets
- extractor vents
- underground ventilation shafts

This network is intended to provide data over the long term. Hence, it is important that, as far as possible, the general area surrounding the site location remains substantially unchanged. Areas designated for redevelopment or subject to new road construction or traffic management schemes must be avoided.

5.2 SITE CATEGORIES

5.2.1 Roadside sites

Formerly named "kerbside" sites, at least two roadside sites are required. These two sites should reflect the "worst case scenario" - the maximum concentration of NO_2 to which people may be regularly exposed, even if only for short periods, close to a busy main road (A-road). The road with maximum traffic flow within the area may not produce the highest ambient concentrations, if it is situated in an open area, for instance a dual carriageway. Higher concentrations may be observed at a less busy road with tall buildings on either side (the street canyon effect), for instance in a town centre. In general, unless data from other sources exists, local knowledge will be required to select the most appropriate sites. Local and Unitary Authorities may discuss this individually with **netcen** if they require further guidance.

The diffusion tube should be sited between ***1-5 m from the kerb edge***, and mounted ideally either on a lamp post or road sign on the pavement, or on the face of a building adjoining the pavement. Measurements from roadside sites will only be representative over a very small area, as NO_2 concentrations close to sources vary considerably, even over short distances.

5.2.2 Urban background sites

At distances of more than 50m from a busy road, it is anticipated that NO_2 concentrations will have been diluted to the local urban background concentration. Hence, measurements made in this type of location are likely to be representative of a fairly large area, and can be reliably compared with similar locations in other urban areas.

Urban background sites must be located ***>50 m from any busy road***. Examples of typical urban background sites are on lampposts or street signs in quiet residential areas, schools or other public buildings, either close to the town centre or in suburbs bordered by a busy arterial road. When street furniture is used, even on quiet roads, the sampler must be more than 1 m from the kerb. At least two urban background sites are required.

6 Instructions for Exposing Diffusion Tubes

On the exposure date detailed in the UK NO_2 Network monitoring calendar the following procedures should be followed:

- Remove tubes from the refrigerator and transport to site in a snap seal bag. Travel blanks, where applicable, should be identified and their code numbers noted on the exposure details form provided by your analytical laboratory.
- Transport tubes for exposure to monitoring sites, with travel blanks if appropriate, and exposure details form.
- At each site, select a tube. Record its ID number, and the site at which it is to be exposed on the exposure details form.
- With the absorbent end cap uppermost, remove the bottom end cap and clip the tube into the holder. Ensure the sampler is mounted vertically with its open end downwards
- Record the date and time of the start of the exposure period on the exposure details form, and make a note of any site irregularities (for example building/road works, traffic diversions).
- Keep the end caps in the bag, for use when the exposure period is completed.

On the appropriate date, the samplers will need to be changed and a new batch of tubes identified for exposure. The following procedures should be followed:

- Transport the new batch of unexposed tubes to site, together with the end caps from the last batch, any travel blanks as appropriate, and exposure details forms for both batches.
- At each site, remove the exposed tube from sample holder and replace end cap tightly.

- Record the time and date of the end of the exposure period on the exposure details form, against the appropriate tube number.
- Make a note of any site irregularities (building/road works, traffic diversions), also anything which might affect the tube, (for example the tube found on the ground, insects or moisture inside the tube) on the form.
- Select a new tube for exposure. Remove its end cap and place it open end down in the holder, as above. Record tube ID details, date and time. Tubes that are damaged or have splits in the end-caps should not be used.

Tubes should always be capped securely after exposure; any tubes returned uncapped to the laboratory will be rejected. When visiting sites, it is recommended that the operator takes some spare tube end caps, also some spare mounting clips and spacer blocks to replace any missing or damaged.

7 Comparing Data with Air Quality Standards

Ambient concentrations of nitrogen dioxide are covered by EC Directives, and by the UK's own Air Quality Strategy (AQS). Prior to 2001, within Europe this pollutant was covered by the 1985 NO_2 Directive (85/203/EC)[1]. This has been superseded by a new EC Directive (the 1st Daughter Directive, 1999/30/EC [2]) which came into force on 19 July 2001. However, the 1985 NO_2 Directive remains in force until fully repealed in January 2005, so demonstration of compliance is still required. In the UK, the Air Quality Regulations (2000) for England[4], Wales[5], and Scotland[6], and the Air Quality Limit Values Regulations (Northern Ireland) 2002[7] , include standards and objectives for NO_2. These are explained in the Air Quality Strategy (January 2000)[3]. Therefore, the following air quality standards for NO_2 were applicable to the UK in 2001:

Table 1. Limit Values and Objectives for NO_2

1. EC 85/203.	Limit Value, 200 μg m^{-3} (105 ppb) as the 98th percentile of hourly averages
	Guide Value, 135 μg m^{-3} (70.6 ppb) as the 98th percentile of hourly averages
	Guide Value, 50 μg m^{-3} (26 ppb) as the 50th percentile of hourly averages
2. 1st Daughter Directive 1999/30/EC	200 μg m^{-3} (105 ppb) as an hourly average, not to be exceeded more than 18 times in a calendar year, to be achieved by 1 January 2010
	40 μg m^{-3} (21 ppb) as an annual average, to be achieved by 1 January 2010
	30 μg m^{-3} as an annual average for *total NOx*, for protection of vegetation in rural areas only. To be achieved by 19 July 2001
3. AQS Objectives	200 μg m^{-3} (105 ppb) as an hourly average not to be exceeded more than 18 times in a calendar year, to be achieved by 31 December 2005.
	40 μg m^{-3} (21 ppb) as an annual average to be achieved by 31 December 2005
	30 μg m^{-3} as an annual average for *total NOx*, for protection of vegetation in rural areas only. To be achieved by 19 July 2001

In the case of the AQS Objectives and Daughter Directive, "exceedence" is defined as "greater than".

7.2 COMPARISON WITH THE EC DIRECTIVE 85/203

The 1985 EC Directive Limit Value for NO_2 is 200 μg m^{-3} (104.6 ppb) for the 98th percentile of hourly average NO_2 concentrations over a calendar year, (measured using a continuously monitoring NO_x analyser). Monthly diffusion tube measurements are not directly comparable with the EC Directive standards, as the latter are based on hourly sampling periods (98th percentile of hourly means, 1-hour mean). However, there is now a well-established procedure whereby the annual mean NO_2 concentration, (obtained using diffusion tube data), can be used to estimate the 98th percentile of hourly means, and hence to assess compliance with the Directive standard. This procedure has been developed by investigating the relationship between the annual average and the annual 98th percentile of hourly means.

There is now sufficient data to identify an appropriate scaling factor specifically for the UK. By examining data from the UK monitoring networks between 1993 and 1999, where hourly measurements are taken throughout the year, the average ratio between the annual mean and annual 98th percentile was estimated to be 2.2 . The ratio between 50th percentile (median) and annual mean is close to one (average 1.06).

These ratios can be used to scale the 98th percentile Limit and Guide Values to produce 'surrogate statistics' for comparison with diffusion tube annual averages. Surrogate Limit and Guide Value statistics are listed in Table 2 below.

Table 2. Surrogate Limit and Guide Value Statistics for NO_2

1985 EC Directive Limit/Guide Value	***Value µg m^{-3} (ppb)***	***Surrogate Statistic as an Annual Average µg m^{-3}(ppb)***
98%ile Limit Value	200 (104.6)	91 (48)
98%ile Guide Value	135 (70.6)	61 (32)
50%ile Limit Value	50 (26)	47 (25)

Hence, ***if the annual average NO_2 concentration calculated from diffusion tube measurements throughout the year is 91 µg m^{-3} (48 ppb) or greater then EC Directive 85/203 may have been exceeded.*** The following points should be noted:

- Using this method diffusion tube data can be use to **indicate** where the EC Directive Limit and Guide Values **may have** been exceeded. **Formal compliance with the Directive can only be assessed with continuous automatic monitoring.**
- The 2.2 scaling factor can only be used on comparisons with annual averages of NO_2, **it must not be used for monthly measurements.**

7.2 COMPARISON WITH DIRECTIVE 1999/30/EC LIMIT VALUES

The Daughter Directive provides two Limit Values for NO_2 to be achieved by the end of year 2010. The first applies to the hourly average NO_2 concentration, which must not exceed 200 μg m^{-3} (105 ppb) on more than 18 occasions per calendar year. The second applies to the annual average concentration, which must not exceed 40 μg m^{-3} (21 ppb). Diffusion tube measurements from the UK NO_2 Network cannot be used to assess compliance with the maximum hourly average standard. However, direct comparison of an annual average calculated from diffusion tube monthly measurements may be made with the annual average Limit Value of 40 μg m^{-3} as set out in the Daughter Directive. Analysis of NO_2 data from automatic monitoring sites indicates that the annual average Limit Value is generally the more stringent of the two.

7.3 COMPARISON WITH AQS OBJECTIVES

The Objectives for NO_2 are essentially the same as those set in the Daughter Directive above, with the exception of the more stringent dates by which they must be achieved. The regulations set down two air quality standards for NO_2 with the objective of achieving compliance by the end of year 2005. The first applies to the hourly average NO_2 concentration, which must not exceed 200 μg m^{-3} (105 ppb) on more than 18 occasions per calendar year. The second applies to the annual average concentration, which must not exceed 40 μg m^{-3} (21 ppb). Diffusion tube measurements from the UK NO_2 Network are based on a monthly sampling period and therefore cannot be used to assess compliance with the maximum hourly average standard. However, direct comparison of an annual average calculated from diffusion tube monthly measurements may be made with the annual average standard of 40 μg m^{-3} as set out in the AQS.

8 References

1. Commission of the European Communities (1985) Council Directive of 7 March 1985 on Air Quality Standards for Nitrogen Dioxide (85/203/EEC) O.J. L 87 27/03/85 pp 1-7.
2. Council Directive 1999/30/EEC relating to Limit Values for sulphur dioxide, nitrogen dioxide and oxides of nitrogen, particulate matter and lead in ambient air. 22 April 1999.
3. The Air Quality Strategy for England, Scotland, Wales and Northern Ireland. Working Together for Clean Air. The Stationery Office, January 2000.
4. The Air Quality (England) Regulations 2000 (Statutory Instrument 2000 No. 928), March 2000.
5. The Air Quality (Wales) Regulations 2000 (Statutory Instrument 2000 No. 1940 (W.138)), July 2000.
6. The Air Quality (Scotland) Regulations 2000 (Scottish Statutory Instrument 2000 No. 97), March 2000.
7. The Air Quality Limit Values Regulations (Northern Ireland) 2002 (Statutory Rule 2002 No. 94), March 2002.
8. Photochemical Oxidants Review Group. Oxides of Nitrogen in the UK. Department of the Environment 1990 ISBN 0 7058 1616 8.

9. Campbell, G.W. et al. A Survey of Nitrogen Dioxide Concentrations in the United Kingdom using Diffusion Tubes. July to December 1991. Stevenage: Warren Spring Laboratory. 1992. LR893(AP).
10. Bower, J.S., Lampert, J.E., Stevenson, K.J., Atkins, D.H.F. and Law, D.W. A Diffusion Tube Survey of NO_2 Levels in Urban Areas of the UK Atmospheric Environment. 1991. Vol 25B, No. 2, pp 255-265.
11. Goodwin J W L, Salway A G, Murrells T P, Dore CJ, Passant NR, and Eggleston H S. UK Emissions of Air Pollutants 1970-1998. August 2000. AEA Technology Report N° AEAT/R/ENV/0270
12. Palmes, E.D., Gunniston, A.F., DiMattio, J. and Tomczyk, C. Personal Sampler for Nitrogen Dioxide. Am Ind Hyg Assoc. J. 1976, Vol 37.
13. Atkins, D.H.F., Sandalls, J., Law, D.V., Hough, A.M. and Stevenson, K.J. The measurements of Nitrogen Dioxide in the Outdoor Environment using Passive Diffusion Tube Samplers. London: HMSO, 1986, AERE-R12133.
14. Part IV The Environment Act 1995, Local Air Quality Management. Review and Assessment: Draft Technical Guidance. http://www.defra.gov.uk/environment/consult/laqm/pdf/laqmtg02consult.pdf

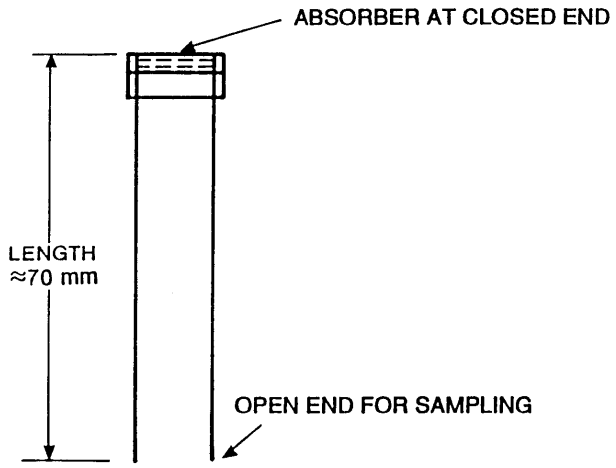

Figure 1 Diffusion Tube Sampler

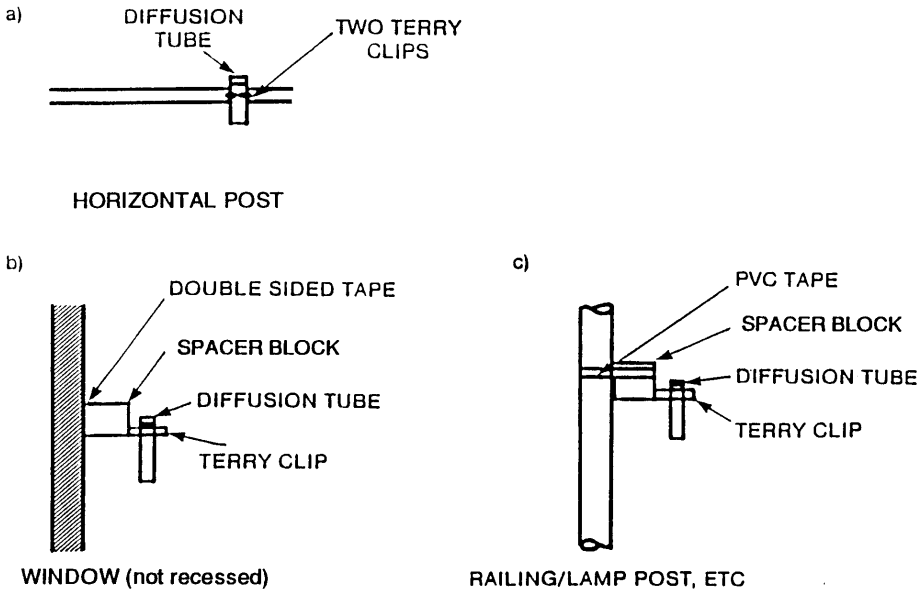

Figure 2 Suggested Mounting Methods for Diffusion Samplers

24724

Appendices

CONTENTS

Appendix 1 Local & Unitary Authority Codes
Appendix 2 County Codes
Appendix 3 Analytical Laboratory Codes

Appendix 1
Local & Unitary Authority Codes

Local/Unitary Authority Codes

Local/Unitary Authority	Code	Local/Unitary Authority	Code
Adur	1	Cambridge	52
Allerdale	2	Camden	53
Alnwick	3	Cannock Chase	54
Amber Valley	4	Canterbury	55
Anglesey	5	Caradon	56
Arun	6	Cardiff County	57
Ashfield	7	Cardiganshire	58
Ashford	8	Carlisle	59
Aylesbury Vale	9	Carmarthenshire County	60
Babergh	10	Carrick	61
Barking	11	Castle Morpeth	62
Barnet	12	Castle Point	63
Barnsley	13	Charnwood	64
Barrow in Furness	14	Chelmsford	65
Basildon	15	Cheltenham	66
Basingstoke	16	Cherwell	67
Bassetlaw	17	Chester	68
Bath & NE Somerset	18	Chester-le-Street	69
Beaconsfield	19	Chesterfield	70
Bedford	20	Chichester	71
Berwick Upon Tweed	21	Chiltern	72
Bexley	22	Chorley	73
Birmingham	23	Christchurch	74
Blaby	24	Kingston Upon Hull	75
Blackburn with Darwen	25	York City Council	76
Blackpool	26	City of London	77
Blaenau Gwent	27	Colchester	78
Blyth Valley	28	Congleton	79
Bolsover	29	Conwy	80
Bolton	30	Copeland	81
Boston	31	Corby	82
Bournemouth	32	Cotswold	83
Bracknell	33	Coventry	84
Bradford	34	Craven	85
Braintree	35	Crawley	86
Breckland	36	Crewe & Nantwich	87
Brent	37	Croydon	88
Brentwood	38	Dacorum	89
Bridgend	39	Darlington	90
Bridgnorth	40	Dartford	91
Brighton & Hove	41	Daventry	92
Bristol	42	Denbighshire County	93
Broadland	43	Derby City	94
Bromley	44	Derbyshire Dales	95
Bromsgrove	45	Derwentside	96
Broxbourne	46	Doncaster	97
Broxtowe	47	Dover	98
Burnley	48	Dudley	99
Bury	49	Durham	100
Caerphilly	50	Ealing	101
Calderdale	51	Easington	102

With Effect of February 2003

Local/Unitary Authority Codes

Local/Unitary Authority	Code	Local/Unitary Authority	Code
East Cambridgeshire	103	High Peak	154
East Devon	104	Hillingdon	155
East Dorset	105	Hinckley & Bosworth	156
East Hampshire	106	Horsham	157
East Hertfordshire	107	Hounslow	158
East Lindsey	108	Huntingdon	159
East Northamptonshire	109	Hyndburn	160
East Riding of Yorkshire	110	Ipswich	161
East Staffordshire	111	Isle of Wight	162
Eastbourne	112	Islington	163
Eastleigh	113	Kennet	164
Eden	114	Kensington & Chelsea	165
Ellesmere Port	115	Kerrier	166
Elmbridge	116	Kettering	167
Enfield	117	Kingston Upon Thames	168
Epping Forest	118	Kirklees	169
Epsom & Ewell	119	Knowsley	170
Erewash	120	Lambeth	171
Exeter	121	Lancaster	172
Fareham	122	Leeds	173
Fenland	123	Leicester City	174
Flintshire County	124	Leominster	175
Forest Heath	125	Lewes	176
Forest of Dean	126	Lewisham	177
Fylde	127	Lichfield	178
Gateshead	128	Lincoln	179
Gedling	129	Liverpool	180
Gillingham	130	Luton	181
Gloucester	131	Macclesfield	182
Gosport	132	Maidstone	183
Gravesham	133	Maldon	184
Great Yarmouth	134	Malvern Hills	185
Greenwich	135	Manchester	186
Guildford	136	Mansfield	187
Gwynedd	137	Melton	188
Hackney	138	Mendip	189
Halton	139	Merthyr Tydfil	190
Hambleton	140	Merton	191
Hammersmith & Fulham	141	Mid Bedfordshire	192
Harborough	142	Mid Suffolk	193
Haringey	143	Mid Sussex	194
Harlow	144	Middlesbrough	195
Harrogate	145	Milton Keynes	196
Harrow	146	Mole Valley	197
Hartlepool	147	Monmouthshire	198
Hartley Witney	148	Neath & Port Talbot	199
Hastings	149	New Forest	200
Havant	150	Newark	201
Havering	151	Newbury	202
Herefordshire	152	Newcastle Under Lyme	203
Hertsmere	153	Newcastle Upon Tyne	204

Local/Unitary Authority Codes

Local/Unitary Authority	Code	Local/Unitary Authority	Code
Newham	205	Rugby	256
Newport	206	Runnymede	257
North Cornwall	207	Rushcliffe	258
North Devon	208	Rushmoor	259
North Dorset	209	Rutland	260
North East Derbyshire	210	Ryedale	261
NE Lincolnshire	211	Salford	262
North Hertfordshire	212	Salisbury	263
North Kesteven	213	Sandwell	264
North Lincolnshire	214	Scarborough	265
North Norfolk	215	Sedgefield	266
North Shropshire	216	Sedgemoor	267
North Somerset	217	Sefton	268
North Tyneside	218	Selby	269
North Warwickshire	219	Sevenoaks	270
NW Leicestershire	220	Sheffield	271
North Wiltshire	221	Shepway	272
Northampton	222	Shrewsbury	273
Norwich	223	Slough	274
Nottingham	224	Solihull	275
Nuneaton	225	South Bedfordshire	276
Oadby & Wigston	226	South Cambridgeshire	277
Oldham	227	South Derbyshire	278
Oswestry	228	South Gloucestershire	279
Oxford	229	South Hams	280
Pembrokeshire	230	South Herefordshire	281
Pendle	231	South Holland	282
Penwith	232	South Kesteven	283
Peterborough	233	South Lakeland	284
Plymouth	234	South Norfolk	285
Poole	235	South Northamptonshire	286
Portsmouth	236	South Oxfordshire	287
Powys	237	South Ribble	288
Preston	238	South Shropshire	289
Purbeck	239	South Somerset	290
Reading	240	South Staffordshire	291
Redbridge	241	South Tyneside	292
Redcar & Cleveland	242	Southampton	293
Redditch	243	Southend-on-sea	294
Reigate & Banstead	244	Southwark	295
Restormel	245	Spelthorne	296
Rhondda Cynon Taff	246	St Albans	297
Ribble Valley	247	St Edmundsbury	298
Richmond Upon Thames	248	St Helens	299
Richmondshire	249	Stafford	300
Rochdale	250	Staffordshire Moorlands	301
Rochester upon Medway	251	Stevenage	302
Rochford	252	Stockport	303
Rossendale	253	Stockton-On-Tees	304
Rother	254	Stoke-On-Trent	305
Rotherham	255	Stratford on Avon	306

Local/Unitary Authority Codes

Local/Unitary Authority	Code	Local/Unitary Authority	Code
Stroud	307	West Lindsey	358
Suffolk Coastal	308	West Norfolk	359
Sunderland	309	West Oxfordshire	360
Surrey Heath	310	West Somerset	361
Sutton	311	West Wiltshire	362
Swale	312	Westminster	363
Swansea	313	Weymouth & Portland	364
Swindon	314	Wigan	365
Tameside	315	Winchester	366
Tamworth	316	Windsor & Maidenhead	367
Tandridge	317	Wirral	368
Taunton Deane	318	Woking	369
Teesdale	319	Wokingham	370
Teignbridge	320	Wolverhampton	371
Tendring	321	Worcester	372
Test Valley	322	Worthing	373
Tewkesbury	323	Wrexham County Borough	374
Thanet	324	Wychavon	375
The Wrekin	325	Wycombe	376
Three Rivers	326	Wyre	377
Thurrock	327	Wyre Forest	378
Tiverton	328	Aberdeen City	379
Tonbridge & Malling	329	Aberdeenshire	380
Torbay	330	Angus	381
Torfaen	331	Argyll & Bute	382
Torridge	332	City of Dundee	383
Tower Hamlets	333	City of Edinburgh	384
Trafford	334	City of Glasgow	385
Tunbridge Wells	335	Clackmannanshire	386
Tynedale	336	Dumfries & Galloway	387
Uttlesford	337	East Ayrshire	388
Vale of Glamorgan	338	East Dunbartonshire	389
Vale of White Horse	339	East Lothian	390
Vale Royal	340	East Renfrewshire	391
Wakefield	341	Falkirk	392
Walsall	342	Fife	393
Waltham Forest	343	Highland	394
Wandsworth	344	Inverclyde	395
Wansbeck	345	Midlothian	396
Warrington	346	Moray	397
Warwick	347	North Ayrshire	398
Watford	348	North Lanarkshire	399
Waveney	349	Orkney Islands	400
Waverley	350	Perth & Kinross	401
Wealden	351	Renfrewshire	402
Wear Valley	352	Scottish Borders	403
Wellingborough	353	Shetland Islands	404
Welwyn & Hatfield	354	South Ayrshire	405
West Devon	355	South Lanarkshire	406
West Dorset	356	Stirling	407
West Lancashire	357	West Dunbartonshire	408

Local/Unitary Authority Codes

Local/Unitary Authority	Code
West Lothian	409
Western Isles	410
Antrim	411
Ards	412
Armagh	413
Ballymena	414
Ballymoney	415
Banbridge	416
Belfast	417
Carrickfergus	418
Castlereagh	419
Coleraine	420
Cookstown	421
Craigavon	422
Down	423
Dungannon	424
Fermanagh	425
Larne	426
Limavady	427
Lisburn	428
Derry	429
Magherafelt	430
Moyle	431
Newry & Mourne	432
Newtownabbey	433
North Down	434
Omagh	435
Strabane	436
Jersey	437
Isle of Man	438
Isles of Scilly	439

Appendix 2
County Codes

County Codes

County	*Code*	*County*	*Code*
Avon	1	Borders	55
Bedfordshire	2	Central Region	56
Berkshire	3	Dumfries and Galloway	57
Buckinghamshire	4	Fife	58
Cambridgeshire	5	Grampian	59
Cheshire	6	Highland	60
Cleveland	7	Lothian	61
Clwyd	8	Strathclyde	62
Cornwall	9	Tayside	63
Cumbria	10	Orkney	64
Derbyshire	11	Shetland	65
Devon	12	Western Isles	66
Dorset	13	Northern Ireland	67
Durham	14	Channel Islands	68
Dyfed	15	Isle of Man	69
East Sussex	16		
Essex	17		
Gloucestershire	18		
Greater London	19		
Greater Manchester	20		
Gwent	21		
Gwynedd	22		
Hampshire	23		
Hereford and Worcester	24		
Hertfordshire	25		
Humberside	26		
Isle of Wight	27		
Kent	28		
Lancashire	29		
Leicestershire	30		
Lincolnshire	31		
Merseyside	32		
Mid-Glamorgan	33		
Norfolk	34		
Northamptonshire	35		
Northumberland	36		
North Yorkshire	37		
Nottinghamshire	38		
Oxfordshire	39		
Powys	40		
Salop	41		
Somerset	42		
South Glamorgan	43		
South Yorkshire	44		
Staffordshire	45		
Suffolk	46		
Surrey	47		
Tyne and Wear	48		
Warwickshire	49		
West Glamorgan	50		
West Midlands	51		
West Sussex	52		
West Yorkshire	53		
Wiltshire	54		

Appendix 3
Analytical Laboratory Codes

UK Nitrogen Dioxide Network Participating Laboratories

Code	Laboratory Name	Contact Name		
2	**Bristol City Council Scientific Services** Bristol City Council Scientific Services 7 Redcross Street Old Market Bristol BS2 0BA	Mr S D Pearce	Tel: Fax:	0117 903 8666 0117 903 8667
5	**Cardiff Scientific Services** Cardiff Scientific Services Crofts Street Roath Cardiff CF2 3DY	Mr T F Billimore	Tel: Fax:	029 2082 2158 029 2087 1159
6	**Clyde Aalytical Ltd** Clyde Analytical Ltd Mentor Gardens 1 Ratho Street Greenock Scotland PA15 2BU	Ms Angela Johnson	Tel: Fax:	01475 721007 01475 722296
9	**Dundee City Council Scientific Services** Dundee City Council Scientific Services Scientific Services 24 Mains Loan Dundee DD4 7AA	Dr K H Mole	Tel: Fax:	01382 455909 01382 461381
10	**City of Edinburgh Council** Regional Analyst's Laboratory City of Edinburgh Council 4 Marine Esplanade Edinburgh EH6 7LU	Mr Arthur Moan	Tel: Fax:	0131 555 7984 0131 555 7987
12	**Gradko International Ltd** Gradko International Ltd St Martin's House 77 Wales Street Winchester Hampshire SO23 0RH	Mr Gerry Stutchbury	Tel: Fax:	01962 860331 01962 841339
13	**Casella CRE Air** Casella CRE Air The Heath Runcorn Cheshire WA7 4QF	Mr John Carrington	Tel: Fax:	01928 517800 01928 517830
15	**Harwell Scientifics Ltd** Harwell Scientifics Ltd 551 Harwell Didcot Oxfordshire OX11 0RA	Mr Geraint Apps	Tel: Fax:	01235 434610 01235 434917

Code	Laboratory Name	Contact Name		
16	**Rotherham Metropolitan Borough Council** Rotherham Metropolitan Borough Council Scientific Services Laboratory Elm Bank House 73 Alma Road Rotherham S60 2BY	Mr Andy Hawkins	Tel: Fax:	01709 822348 01709 367554
17	**Worcestershire Scientific Services** Worcestershire Council Scientific Services County Buildings St Mary's Street Worcester WR1 1TN	Carol A Stevens	Tel: Fax:	01905 765453 01905 765454
19	**Kent Scientific Services** Kent Scientific Services 8 Abbey Wood Road Kings Hill West Malling Kent ME19 6YT	Ms Samantha Keller or Mr David Heath	Tel: Fax:	01732 220001 01732 220006
21	**Lambeth Scientific Services Ltd** Lambeth Scientific Services Ltd P.O. Box 27800 London SE24 0ZR	Mr Cecil Samasuwo	Tel: Fax:	020 7926 8877 020 7926 8882
22	**Lancashire County Analyst** Lancashire County Analyst County Laboratory Pedders Way Preston Riversway Docklands Ashton-on-Ribble, PR2 2TX	Mr M Ainscough	Tel: Fax:	01772 721660 01772 732417
26	**Glasgow Scientific Services** Glasgow Scientific Services Colston Laboratory 64 Everard Drive Glasgow G21 1XG	Dr Alan Bruce	Tel: Fax:	0141 562 2270 0141 563 5129
28	**Jesmond Dene Laboratory** Jesmond Dene Laboratory Jesmond Dene Road Off Matthew Bank Newcastle upon Tyne NE2 2EY	Mr Colin Bird	Tel: Fax:	0191 281 2779 0191 281 8589
32	**Walsall Metropolitan Borough Council** Walsall Metropolitan Borough Council Environmental Health & Consumer Services Department Challenge Building Hatherton Rd Walsall WS1 1YG	Mr Mick Clews / Mrs Alison Coleman	Tel: Fax:	01922 454219 01922 630697

Code	Laboratory Name	Contact Name		
34	**West Yorkshire Analytical Services** West Yorkshire Analytical Services PO Box 11 Nepshaw Lane South Morley Leeds LS27 0UQ	Mr Richard Sykes	Tel: Fax:	0113 383 7567 0113 383 7551
36	**University of Essex** Department of Chemistry & Biological Chemistry University of Essex Wivenhoe Park Colchester CO4 3SQ	Dr I Colbeck	Tel: Fax:	01206 873333 01206 873593
38	**Milton Keynes Council** Environmental Health Environmental Directorate Milton Keynes Council 1 Saxon Gate East Milton Keynes MK9 3HH	Mr Neil Crook	Tel: Fax:	01908 691691 01908 682456
40	**Staffordshire County Council** Scientific Services Staffordshire County Council Martin Street Stafford ST16 2LG	Mr V M Stanway	Tel: Fax:	01785 277817 01785 277812
41	**Ruddock and Sherratt** Ruddock and Sherratt Room 74 4th Floor 16 Donegall Square South Belfast BT1 5JJ	Ms Tara O'Neill	Tel: Fax:	028 9032 1691 028 9043 9604
42	**Northampton Borough Council** Northampton Borough Council Pollution Team Cliftonville House Bedford Rd Northampton NN4 7NR	Mr Joe Alfano	Tel: Fax:	01604 238788 01604 238755
47	**Aberdeen City Council Public Analyst** Aberdeen City Council Old Aberdeen House Dunbar Street Aberdeen AB2 1UE	Mr James Darroch	Tel: Fax:	01224 491648 01224 276873
48	**STL Bridgend** STL Bridgend Mid Glamorgan Science Park 2 Technology Drive Bridgend Mid Glamorgan CF31 3NA	Ms Michelle Harman	Tel: Fax:	01656 647557 01656 646525

Code	Laboratory Name	Contact Name		
49	**Kirklees Environmental Services** Kirklees Environmental Services Scientific Services West Riding House 9 Manchester Road Huddersfield HD1 3HH	Margaret Durkin or Brian Wharam	Tel: Fax:	01484 226477 01484 226475
50	**City of Liverpool Public Analysts** City Analyst & Scientific Services Liverpool City Council Third Floor 126 Mount Pleasant Liverpool L69 3GR	Ms Elizabeth Moran	Tel: Fax:	0151 709 3932 0151 708 8361