Report

QA/QC Data Ratification and Intercalibration Report for the Automatic Urban and Rural Network, January – March 2003

A report produced for the Department for Environment, Food and Rural Affairs, Scottish Executive, Welsh Assembly Government and the DoE in Northern Ireland

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PART A: Data Ratification January-March 2003

1 Introduction

This quarterly report covers the Quality Assurance and Control (QA/QC) activities undertaken by **netcen** to ratify automatic monitoring data from Defra and the Devolved Administrations' urban and rural air quality monitoring network (AURN) for the period January to March 2003. During this period there were 119 monitoring sites in the Network of which 83 are urban sites, 22 rural network sites and 14 sites in the London Air Quality Monitoring Network (LAQN) which are affiliated into the national network.

Included in this report for the first time, are the results of QA/QC Unit's 6-monthly intercalibration and audit exercise which was carried out during January-March 2003. The report is therefore divided in to two parts as follows:

Part A: Data ratification

Section 1:	Introduction including recent changes that have taken place in the network and a general overview of network performance
Section 2:	Generic data quality issues and recommendations for improving or resolving these issues
Section 3:	Site specific issues
Section 4:	Reasons for data loss at sites where data capture falls below 90%
Section 5:	Data capture statistics for January-March 2003 presented in tables
Appendix A1	Recommendations for replacing or up-grading equipment (compiled in conjunction with CMCUs).
Appendix A2	List of critical sites in the AURN
Appendix A3	Equipment Replacement Programme

Part B: Winter 2003 Intercalibration

Section 1	Introduction
Sections 2 -12	Results of the Winter 2003 intercalibration exercise
Appendix B1	Network Certificate of Calibration

1.1 Recent Changes in the Network

An overview of the main changes relating to sites in the AURN between January to July 2003 is presented below with a summary given in Table 1.1.

Liverpool Speke
The Liverpool Centre site was closed on 23rd September 2002 for health and safety reasons and consequently there were no data from the Liverpool Centre site for this quarter. The site has now been relocated approximately 10 miles away to the vacated hydrocarbon site in Speke. A new set of analysers was installed in April and the site resumed operation on 20th May 2003 following QA/QC Unit's commissioning audit.

Edinburgh Centre
There were no data from the Edinburgh Centre site for this period. The mobile station owned by Edinburgh City Council, which was in operation for 8 months from April 24th until 19th November 2002, was closed in order to prepare the local area for the Hogmanay celebrations. There was a long delay in re-instating the mobile station as work was taking place to repair ground in the area of the site. Monitoring at the mobile station commenced on 20th April 2003 following QA/QC Unit's commissioning audit. In the meantime work is underway to relocate the original site approximately 1 mile away to Richmond Gardens.

The site will be equipped with new analysers as part of the network equipment up-grading programme and monitoring is expected to commence in the near future.

Hounslow Roadside / Brentford Roadside

Hounslow Roadside site was closed on November 16th 2002 because the building in which the monitors were housed was being sold. As a result, there were no data from this site during this period. The site has been relocated to a cabin at the roadside of the A4 adjacent to the M4 flyover. The sample inlet is approximately 10 metres closer to the kerbside than the previous site. Because the site is now located outside the building where the previous monitoring equipment was housed it has been re-named Brentford Roadside. Monitoring at this new location started on 20th June 2003 and the site was commissioned by QA/QC Unit during the summer intercalibration exercise in July 2002.

Reading

The monitoring station at Reading was closed on 6th February 2003 as the lease for the site had expired. Arrangements are being made to relocate the site approximately 1 mile away to Junction Cemetery. There has been a long delay in the relocation of this site due to power supply problems. These have been resolved now and it is anticipated that the site will be commissioned once the phone line is installed at the end of August 2003.

London Westminster

Gravimetric PM_{10} sampling started on 19th February 2003. At QA/QC Unit's commissioning audit however, it was discover that a component was missing from the analyser resulting in internal sampling. The repair was carried out and PM_{10} monitoring recommenced on 19th March 2003.

Brighton Roadside PM_{10}

Gravimetric PM_{10} (Partisol) monitoring commenced at Brighton Roadside on 28th February 2003. This site is located approximately 30m further along the pavement from the "Brighton Roadside" automatic site so it has been given a separate site name "Brighton Roadside PM_{10}".

DD3 Requirements

Additional ozone and rural NO_x analysers have recently been installed in the network in order to comply with the Third Daughter Directive (DD3) which comes into force on 9th September 2003. So far, additional ozone analysers have been installed at five existing sites (Portsmouth, Cwmbran, Bournemouth, Northampton and Aberdeen) and an additional NO_x analyser at Somerton. During the forthcoming summer service exercise further NO_x analysers will be installed at Aston Hill, Bush, Eskdalemuir, Glazebury, High Muffles, and Yarner Wood.

Table 1.1 Changes to the AURN between January 2003 to April 2003

Sites	Date Commenced	Pollutants
New sites		
Brentford Roadside	20/6/03	NO_2 CO
Liverpool Speke	20/5/03	NO_2 SO_2 CO O_3 PM_{10}
Brighton Roadside PM_{10}	28/2/03	PM_{10} (Gravimetric)
Additional CO monitoring (DD2)		
Grangemouth	17th January 2003	CO
Additional Gravimetric PM_{10} (Partisol) monitoring		
London Westminster	Started 19th February 2003	PM_{10}
Brighton Roadside PM_{10}	Started 28th February 2003	PM_{10}
Additional O_3 and / or NO_x (DD3)		

Sites	Date Commenced	Pollutants
Portsmouth	Commenced 15th April 2003	O_3
Cwmbran	Commenced 30th April 2003	O_3
Somerton	Commenced 28th April 2003	NO_x
Bournemouth	Commenced 27th Feb 2003	O_3
Northampton	Commenced 17th March 2003	O_3
Aberdeen	Installed awaiting audit	O_3
Monitoring suspended	**Data loss**	
Grangemouth – site up grade	1st Aug 2002 – 17th Jan 2003	All
Edinburgh mobile site temporarily closed. Permanent site in place awaiting power supply	Closed 8th November 2002. Mobile unit re-instated 20/4/03	All
Liverpool Centre closed. Relocated to Liverpool Speke	Closed from 23rd September 2002. Liverpool Speke started 20th May 2003	All
Reading closed. Relocation to Junction Cemetery in progress	Closed 6th February 2003.	All
Hounslow Roadside closed. Relocated to Brentford Roadside.	Closed 16th November. Brentford Roadside started 20th June 2003	All

1.2 Overview of Network Performance

Ratified hourly average data capture for the network averaged 92.3% for all pollutants (O_3, NO_2, SO_2, CO and PM_{10}) during the 3-month reporting period January to March 2003 (see Table 1.2 below). This is slightly lower than the previous quarter (94.1%) but this is to be expected during a quarter which includes the Winter intercalibration and service exercise. On average, data capture for both NO_2 and PM_{10} were slightly below target at 89% and 88.4% respectively. This is mainly due to the fact that 3 sites with 0% data capture for this period (London Bloomsbury, London Southwark and Edinburgh Centre) have been included in the calculation of the average data capture for these pollutants. If these sites were excluded, the average data capture for NO_2 and PM_{10} would be satisfactory at 91.9% and 91.1% respectively.

Table 1.2 AURN Ratified Data Capture (%) January - March 2003
(Using the start date of any new site)

Pollutant	CO	NO_2	O_3	PM_{10}	SO_2	Average
Data Capture (%)	**91.6**	**89.0**	**93.9**	**88.4**	**92.4**	**92.3**

Overall, 324 out of the 392 analysers (82.7%) achieved data capture levels above the required 90% target during this reporting period (See Table 1.3). A relatively high proportion (20%) of NO_x and PM_{10} analysers in the network failed to meet the target. The reasons for data loss were varied but these were mainly due to sampling/pump faults, analyser malfunction and analysers being off-line awaiting repair or site relocation. (See Sections 3 and 4 for details).

Table 1.3 Number of Analysers with Data Capture below 90% January - March 2003

	Total Number Of Analysers	Analysers with Data Capture < 90%	Analysers with Data Capture <80%
CO	75	13	6
NO_2	96	19	16
O_3	78	9	5
PM_{10}	68	14	8
SO_2	75	13	4
All sites	392	68 (17.3%)	39

All data capture figures given in this report now include the gravimetric PM_{10} data. Note that there are two PM_{10} instruments at Northampton a TEOM and gravimetric PM_{10} (Partisol). Data from the Northampton TEOM instrument have been used to calculate the data capture. QA/QC Unit has developed data ratification procedures for the gravimetric analysers and an additional section on gravimetric PM_{10} data ratification has been included in this report (Section 4.1).

A more detailed breakdown of the hourly data capture statistics for each site is presented in Section 5, Table 5.1. In total, 20 out of the 119 network sites (17%) had an average data capture rate below the required 90% level for the January – March 2003 period. (See Table 1.4). The main site operational and QA/QC issues giving rise to data capture below the required 90% level are summarised in Section 4.

Table 1.4 Sites with Average Data Capture < 90%, January - March 2003
(Data capture calculated from site start date)

Site	Status	Average Data Capture(%)
Birmingham East	Affiliate	72.7
Brighton Roadside	Affiliate	74.1
Bristol Old Market	Affiliate	52.4
Hull Freetown	Defra	82.6
Leeds Centre	Defra	85.3
London Bloomsbury	Defra	59.2
London Southwark	Affiliate	73.9
London Wandsworth	Affiliate	88.8
London Westminster	Defra	82.4
Plymouth Centre	Defra	89
Rochester	Affiliate	75.5
Rotherham Centre	Affiliate	88.3
Southend-on-Sea	Defra	52.1
Sunderland	Defra	89.1
Wicken Fen	Defra	79.6
Belfast East	Affiliate	89
Lough Navar	Defra	89.7
Edinburgh Centre	Defra	0
Glasgow Centre	Defra	81.9
Narberth	Affiliate	81.3

Netcen carried out the winter intercalibration and site audits at 116 operational urban and rural sites during January-March 2003. 3 network sites were not operational at the time of the audits. Results from this intercalibration exercise have been used to assess the

accuracy and consistency of the data for this reporting period. Details of the winter 2003 intercalibration are provided in Section B of this report.

1.3 Annual Report and LSO Manual

The first in a series of annual data ratification reports has been produced for the AURN which provides a review of network performance and QA/QC Unit's main activities during 2002. This report is currently in draft and will be made available to all network participants in the near future.

QA/QC Unit has also up-dated the AURN Site Operator's manual and a draft has been sent to various organisations for consultation. When this is finalised it will be issued in hard copy to all network participants and made available electronically via the Air Quality Archive and AURN hub web sites.

QA/QC Unit's data ratification and intercalibration reports are available on the Air Quality Archive at the following address:
http://www.airquality.co.uk/archive/reports/reports.php?action=category&section_id=5
and also on the AURN project information hub web site*.
http://www.aeat.co.uk/com/AURNHUB/index.html.
The AURN Hub also contains copies of CMCU's quarterly reports for the AURN and LAQN affiliated sites.

1.4 AURN Equipment Replacement Programme

A major programme is underway to replace aged and/or problematic equipment in the AURN. This programme has been funded by Defra and the DAs and is being managed by CMCU (Casella Stanger). Primarily older equipment is being replaced at the original EUN and rural network sites. The new equipment has already been installed at some of these sites (see Table 1.5) and, where possible, the Equipment Support Units are installing the remaining new analysers at the sites during their scheduled summer service 2003 visits. QA/QC Unit will undertake commissioning audits and training where appropriate once installation of the new equipment is completed. To date, replacement equipment has been installed at the following sites:

Table 1.5 Replacement Equipment installed in the AURN, July 2003

Site	Analysers
Wirral Tranmere	SO_2
Reading Centre	Ambirack CO bench (awaiting site relocation)
London Bloomsbury	TEOM
Newcastle Centre	NO_x, SO_2, O_3, CO, TEOM
Liverpool Speke	NO_x, SO_2, O_3, CO, TEOM
Belfast Centre	NO_x, SO_2, O_3, CO, TEOM
Leicester Centre	TEOM

Additional O_3 and rural NO_x analysers are also being installed at existing sites in the network in order to meet the requirements of the third Daughter Directive which comes into force on 9th September 2003. (See Section 2.1). A table showing all of the sites where new and replacement equipment is being installed is given in Appendix A3.

* Password protected site: username and password available from Jane.vallance-plews@aeat.co.uk

2 Generic Data Quality Issues

2.1 Progress on Monitoring Requirements of the EU Daughter Directives

The programme to install additional CO monitors to comply with the EU second Daughter Directive (DD2) has been completed. CO monitoring at Grangemouth was delayed until 17th January 2003 due to the site infrastructure being up-graded.

In order to comply with the third Daughter Directive (DD3 implementation date 9th September 2003), an additional 5 ozone and 7 rural NO_x monitors are to be installed at a number of existing sites in the network.

Several of these analysers have already been installed and commissioning audits carried out by QA/QC Unit. (See Table 2.1). The remaining analysers are scheduled to be installed by the ESUs during the summer service exercise.

In order to satisfy the requirements of DD3 there are also plans to commission 4 new direct-funded NO_x and O_3 sites at the following locations:

- Brighton Preston Park (Brighton/Worthing/Littlehampton agglomeration)
- Fort William (Highland zone)
- Ashington (North East zone)
- Leominster (Midlands zone).

Further details on the second and third Daughter Directives can be found at: http://www.defra.gov.uk/environment/consult/air-23daughter/index.htm

Table 2.1 Progress on Installation of Analysers for DD3

Site	Pollutant	Scheduled	Installed	Commissioned
Portsmouth	O_3	27/02/2003	yes	15/04/2003
Cwmbran	O_3		yes	29/04/2003
Somerton	NO_x		yes	17/07/2003
Aberdeen	O_3		yes	29/07/03
Northampton	O_3		yes	13/03/2003
Bournemouth	O_3		yes	27/02/2003
Aston Hill	NO_x	28/07/2003		
Bush	NO_x	14/07/2003		
Eskdalemuir	NO_x (+PM_{10})			
Glazebury	NO_x	30/06/2003	Awaiting site power up-grade	
High Muffles	NO_x	14/07/2003	yes	05/08/2003
Yarner Wood	NO_x	30/06/2003	yes	25/07/2003

2.2 PM_{10} Episodes

During January to April there were three widespread PM_{10} episodes with many days exceeding 50 $\mu g/m^3$ at a range of monitoring sites, particularly at roadside, kerbside and industrial locations. Many of the monitoring stations recorded more than 20 exceedences of the daily mean PM_{10} standard in the first 3-months of 2003, which was more than they did during the whole of 2002.

Figure 2.1 shows a time series graph of running 24-hour mean concentrations for all sites which entered the Defra "high" band or above during January to April 2003.

These widespread episodes occurred during the periods 17th February to 2nd March (PM_{10}), 15th to 31st March (PM_{10} and O_3) and 12th to 30th April (PM_{10}) and were attributable to:

1) Poor dispersion due to low windspeeds, including recirculation of air over the UK and possible formation of secondary particulates from UK emissions (early April).

2) Easterly winds bringing secondary pollution across from Europe during warm settled weather (ozone and PM_{10} mid-late April).

3) Dust clouds from Saharan dust storms tracking northwards over Europe and reaching the UK around April 15th - 18th. See images at http://earthobservatory.nasa.gov/NaturalHazards/natural_hazards_v2.php3?img_id=10181 and http://earthobservatory.nasa.gov/NaturalHazards/natural_hazards_v2.php3?img_id=10183

The sites that recorded the highest number of exceedences up to the end of July this year are as follows:

103 Days - London Marylebone Road (Kerbside)	- Above 2004 objective
63 Days - Scunthorpe (Industrial)	- Above 2004 objective
40 Days - Glasgow Kerbside (Kerbside)	- Above 2004 objective
38 Days - Bury Roadside (Roadside)	- Above 2004 objective
38 Days - Stockton-on-Tees Yarm (Industry)	- Above 2004 objective
35 Days - Cardiff Centre (Construction)	
30 Days - Belfast Centre (Urban Centre)	
29 Days - Port Talbot (Industry)	
29 Days - Thurrock (Construction/local source)	
25 Days - Sheffield Centre (Urban Centre)	

London Marylebone Road, Scunthorpe, Glasgow Kerbside, Bury Roadside and Stockton-on-Tees Yarm have already exceeded the Air Quality Objective of 35 days > 50 $\mu g/m^3$, to be achieved by 31/12/2004. Construction activity near the Cardiff Centre site was much reduced in April 2003. Thurrock continued to be affected by emissions from nearby industry.

Further information on the extent and duration of the episodes and monthly PM_{10} exceedence statistics are presented on the Air Quality Archive and AURN hub at http://www.aeat.co.uk/com/AURNHUB/aunhubPUBLIC-399.htm.

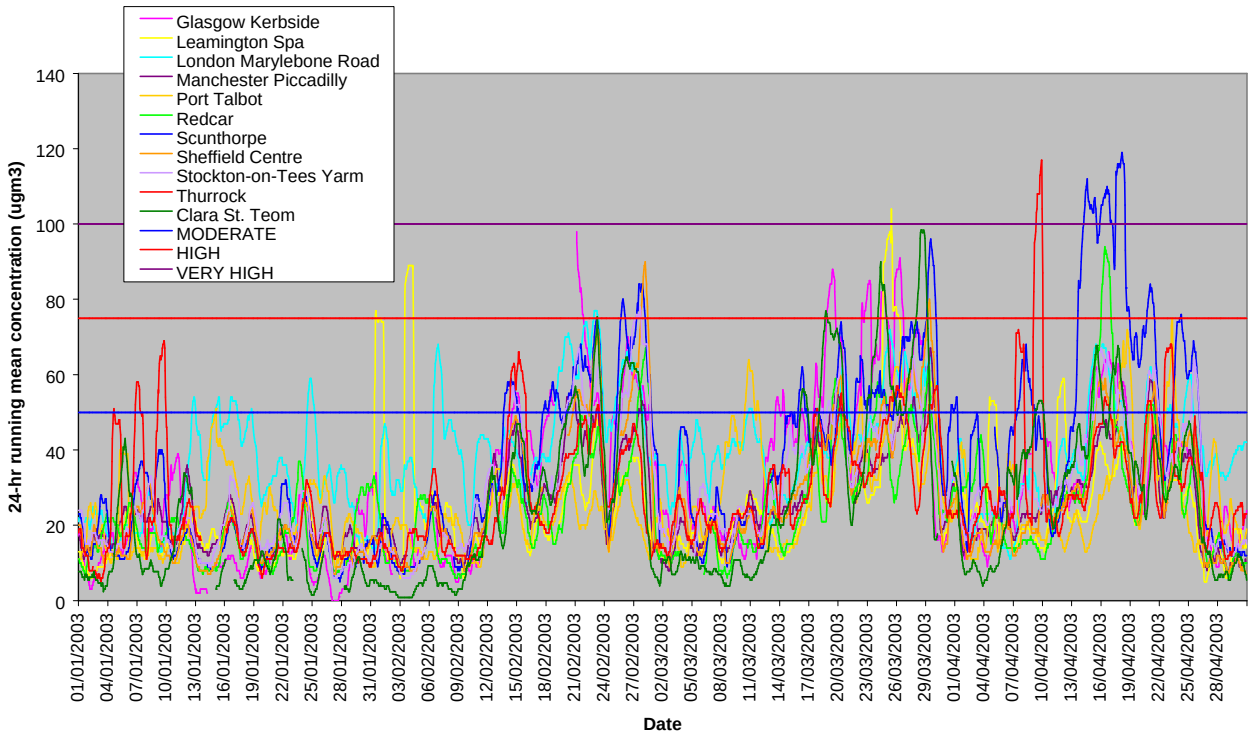

Figure 2.1 PM_{10} Episodes January-April 2003

2.3 Data Capture for Critical Sites in Zones and Agglomerations

In order to meet the requirements of the Daughter Directives, any zone or agglomeration[†] with an exceedence of the limit value must be formally reported to the Commission. The critical sites are those which, if data capture falls below 90%, there will be insufficient data for the whole zone or agglomeration. In most cases the critical sites are those where there is only one site in the zone or agglomeration. However, for some pollutants (especially ozone) monitoring is required at several sites in each zone or agglomeration and hence these may all need to be classified as critical sites for that pollutant. The list of the critical sites in the Network has been revised to reflect the requirements of the First, Second and Third Daughter Directives (see Appendix A2). In total 61 sites have been identified as critical for DD1, DD2 or DD3. (25 sites in agglomerations and 36 in zones).

Critical sites with less than 90% data capture during the 3-month period January to March 2003 are given in Table 2.2. Reasons for data loss at these sites are given in Section 4. In total 26 sites did not meet the required 90% data capture for one or more of the critical pollutants during the first 3 months of 2003.

[†] A definition of zones and agglomerations can be found under "Article 5 Assessment Zones and Agglomerations Monitoring Maps" at http://www.defra.gov.uk/environment/airquality/index.htm

Table 2.2 Critical Sites in Agglomerations and Zones with <90% data capture, January - March 2003
(Data capture calculated from 1st January to 31st March 2002)

Site	CO	NO_2	O_3	PM_{10}	SO_2	Comments
Critical Sites in Agglomerations						
Belfast Centre	81.3	✓	✓			
Blackpool	✓	✓	86.8	✓	80.2	
Bournemouth	✓	✓	36.6	✓	✓	O_3 started 27/2/03
Brighton Roadside PM_{10}			-	35.6	-	PM_{10} started 28/2/03
Bristol Centre			✓	✓	✓	
Cardiff Centre	✓	✓	✓	✓	✓	
Coventry Memorial Park	✓	✓	✓	88.4	87.8	
Edinburgh Centre	0	0	0	0	0	Closed for relocation
Glasgow Centre		79.4	✓		44.4	
Hove Roadside			-	-	✓	
Hull Freetown	43.6	✓	✓	78.9	✓	Empty CO cylinder
Leicester Centre	✓	✓	✓	84.9	✓	
Liverpool Centre	0	0	0	0	0	Closed for relocation
Newcastle Centre	✓	78.8	✓	✓	✓	
Nottingham Centre	81.6	✓	✓	88.8	✓	
Portsmouth	✓	✓	-	✓	✓	
Preston	✓	✓	✓	✓	✓	
Reading	37.6	37.5	37.6	37.5	37.5	Closed on 6/2/03 for relocation
Sheffield Centre				✓		
Southampton Centre	✓	✓	✓	✓	✓	
Southend-on-Sea	55	48.2	55.3	62.5	39.6	Temperature/power faults
Stoke-on-Trent Centre	✓	✓	✓	✓	✓	
Swansea	✓					
Wirral Tranmere	86.5	✓	✓	✓	✓	
Critical Sites in Zones						
Aberdeen	✓	✓	-	✓	✓	
Aston Hill	-	-	✓	-	-	
Barnsley Gawber	✓	✓		-		
Bush Estate	-	-	✓	-	-	
Canterbury	-		-	✓	-	
Cwmbran	✓	74.5	-	✓	✓	
Derry	✓	✓	83.2	✓	✓	
Dumfries	✓	✓	-	✓	-	
Glazebury	-	-	✓	-	-	
Grangemouth	80.8	✓	-	✓	✓	CO started 17/1/03
Great Dun Fell	-	-	✓	-	-	
High Muffles	-	-	✓	-	-	
Inverness		✓	-	81.1	-	
Ladybower	-	✓	✓	-		
Leamington Spa	✓	✓	✓	✓	✓	
Lough Navar	-	-	84.3		-	
Narberth	-		73.6			
Northampton	57.1	✓	16.6	✓	✓	O_3 started13/3/03

Site	CO	NO_2	O_3	PM_{10}	SO_2	Comments
Norwich Centre		✓	✓			
Oxford Centre	✓		-	-		
Plymouth Centre				✓		
Scunthorpe	-	-	-		✓	
Sibton	-	-	✓	-	-	
Somerton	-	-	✓	-	-	
Stockton-on-Tees Yarm	✓	81	-	✓	-	
Strath Vaich	-	-	✓	-	-	
Sunderland	-	-	-	-	89.1	
Thurrock		✓	✓			
Wicken Fen	-	43.2	✓	-		
Wigan Leigh	✓	✓	✓	✓	✓	
Wrexham	✓	✓	-	84.4	✓	
Yarner Wood	-	-	✓	-	-	
Number of Sites < 90%	9	9	10	11	8	

Key ▭ Pollutant not critical at this site
✓ Data capture for critical pollutant >90%
- not monitored

RECOMMENDATION
Every effort should be made to ensure that data capture is maximised for the critical sites. LSOs and ESUs should undertake call-outs and repairs as soon as possible to avoid unnecessary data loss at these sites.

2.4 Gravimetric PM_{10} Data Ratification

Gravimetric PM_{10} analysers (Partisols) are located at seven sites in the network (Bournemouth, Northampton, Wrexham, Dumfries, Inverness, London Westminster and Brighton Roadside PM_{10}). PM_{10} monitoring commenced at London Westminster on 19th February 2003 and at Brighton Roadside PM_{10} on 28th February 2003.

The gravimetric PM_{10} analyser at Northampton is also co-located with a TEOM which provides a useful check that both techniques are operating correctly. Gravimetric PM_{10} concentrations and the daily mean TEOM scaled by 1.3 at Northampton are shown in Figure 2.2. The Partisol has always shown good agreement with the TEOM and continues to do so, although there were significant differences in the peak values during the high pollution episodes in February and March 2003.

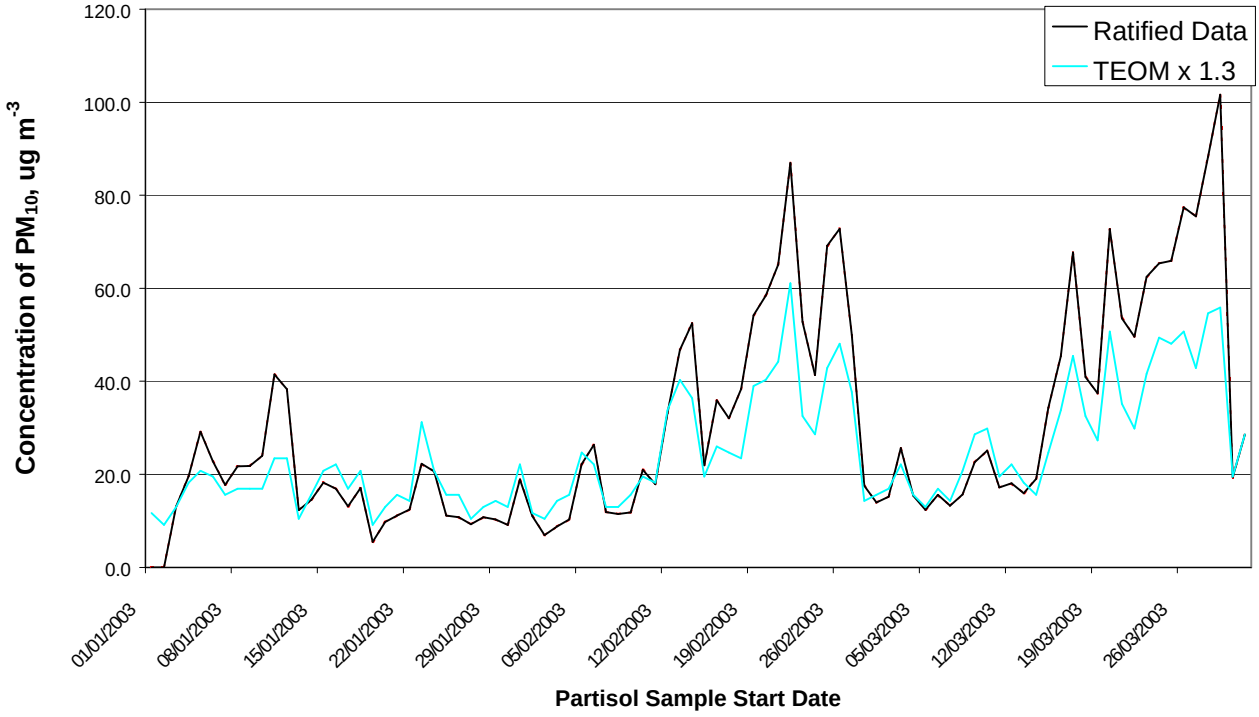

Figure 2.2 Partisol and TEOM (x1.3) Concentrations at Northampton (Jan-March 2003)

Data capture for the gravimetric PM_{10} (Partisol) analysers during January to March 2003 is given in Table 2.3. Four out of the seven operational Partisols met the required 90% data capture target for this period. The average data capture for the gravimetric PM_{10} analysers during January to March 2003 was 83.1%. Details of data loss associated with each site are given in Section 4.1.

Table 2.3 Gravimetric PM_{10} Data Capture (%) January – March 2003
(Calculated from site start date)

Site	Data Capture (%) Jan – March 2003
Bournemouth	94.4
Brighton Roadside PM_{10}	100
London Westminster	31.7
Northampton	97.8
Dumfries	92.2
Inverness	81.1
Wrexham	84.4
Average	83.1

In the previous ratification report QA/QC Unit recommended that remote collection of instrument diagnostics and alarms would be beneficial, since as much as 2 weeks (4%) data can be lost between sites visits. CMCU are currently in the process of making arrangements for the Partisol analysers to be connected to a telemetry system and telephone lines have now been installed at the stations.

2.5 NO_2 Converter Efficiencies

Four converter failures were identified during QA/QC Unit's Winter 2003 intercalibration exercise. Details of these and the resulting effect on data quality are given in Table 2.4 below.

Table 2.4 Converter faults identified at the Winter 2003 Intercalibration

Site	Test Date	Converter Efficiency	Effect on Data Quality
Sheffield Centre	4/2/03	94%	None – borderline case. Converter replaced 6 February 2003
London A3 Roadside	9/1/03	88%	NO_2 data deleted from last stable calibration on 3rd December until replacement of converter at the service on 22/1/03 (50 days).
Wolverhampton Centre	24/1/03	90%	Data deleted from audit until converter replaced on 28/1/03. (4 days)
Bournemouth	18/2/03	91%	Data rejected from audit on 18/2/03 to replacement of converter at service on 24/2/03 (7 days)

RECOMMENDATION

The ESUs have replaced the converters at all of the above sites to ensure satisfactory performance of the analysers.

LSOs should continue to pay careful attention to the short-term stability of the NO_2 calibration response and notify the CMCU if a declining NO_2 span response is recorded during the calibration. Full details of this check can be found in the "Trouble-shooting" section of the Site Operator's Manual. (http://www.aeat.co.uk/netcen/airqual/reports/lsoman/lsoman.html

2.6 Ozone Outliers

34 out of 79 ozone analysers (43%) were identified as outliers during QA/QC Unit Winter 2003 intercalibration exercise. Full details are given in Table B2 in the Intercalibration section of this report (Part B). Where appropriate, the data from these sites have been rescaled accordingly during the ratification process.

2.7 TEOM k_0

The TEOM instruments in the AURN use a k_0 constant to determine PM_{10} concentrations. Each TEOM sensor unit has a k_0 determined by the manufacturer and this value is stamped on the sensor unit. This value must also be entered into the TEOM software to correctly calculate the concentrations. Errors can occur if the sensor unit is replaced without the software being updated. This is checked during the intercalibration exercise by the use of pre-weighted filters to determine the k_0. The measured, stamped and software values of k_0 are then compared. Deviations within ± 2.5% are considered acceptable. Table 2.5 shows the sites where there were deviations between the measured and stamped k_0 values.

Table 2.5 TEOM k_0 Deviations identified at the Winter 2003 Intercalibration Exercise

Site	k_0 Deviation (%)
Wigan Leigh	k_o value on sensor and control unit miss-match.
Leicester Centre	25%

At Wigan Leigh the k_o value stamped on the side of the control unit did not agree with the value stored in the software. The deviation between them was, however, within the acceptable limit and no corrections to the data were necessary.

A large deviation in k_0 at Leicester Centre was identified at the previous Summer 2002 audit. Results of the Winter 2003 audit again confirmed the large deviation which arose because the k_0 value stamped on the side of the unit did not match the value stored in the software. PM_{10} data have been rescaled accordingly from July 17th 2002 until the ESU corrected the discrepancy at the Winter service in April 2003.

RECOMMENDATION

ESUs should continue to ensure that the correct k_0 value is entered into the analyser software whenever the sensor unit is repaired or replaced.

2.8 Auto-Calibration Run-ons

This problem is seen when auto-calibration gas introduced between 0045 and 0115 remains in the instrument until about 0200. The ambient measurements between 0130 and 0200 are therefore invalid and must be removed during data ratification. This problem can occur if the solenoid valves in the pneumatic system do not close fully after the zero and span cycle. Calibration gas may then leak into the instrument during the ambient measurement period. This problem can be a serious source of data loss resulting in one hour out of twenty-four being lost, which is 4% of the annual data capture.

The ESUs have investigated this problem at many of the sites and thorough cleaning of the solenoid valves has, in most cases, resolved the problem. The number of sites showing this problem has been significantly reduced as a result of this extra effort put in by the ESUs. There are now only a few sites showing a problem with the autocalibration over-run and these are given in Table 2.6. Any autocalibration run-on data that look visibly significant have been deleted from these data sets during ratification, resulting in a loss of an additional hour of data each day (4% data loss).

Table 2.6 Estimate of Spike or Dip due to Auto-calibration Run-on (Hourly average)

Site	Gas	Over-run (ppb)
Cardiff Centre	CO SO_2	0.1 ppm - 1 hour lost 1 ppb - up to 2 hours lost
Cwmbran	SO_2	0.7 ppb - 1 hour lost
Lullington Heath	NO_2	0.5 ppb - 1 hour lost
Narberth	NO_2	3.0 ppb - 1 hour lost
St Osyth	NO_2	0.2 ppb - 1 hour lost
Wigan Leigh	SO_2	1 ppb - 1 hour lost

RECOMMENDATION

The CMCU and ESUs should continue to monitor the situation and initiate service visits to clean/repair solenoid valves were necessary.

3 Site Specific Issues

3.1 Bristol Old Market NO_x

Unusually high NO_2 concentrations were recorded at the Bristol Old Market site from November2001 due to a sampling manifold fault (See Figure 3.1). All spurious data have therefore been rejected from the last reliable audit check of the manifold sample flow on 31st July 2001 to March 26th 2003 (19 months) when the site was relocated. Details of this problem have been extensively reported in the previous October –December 2002 data ratification report (Section 3.1). The analysers were removed from their original location on 26th March 2003 and installed in the nearby replacement site with a completely new sample inlet manifold arrangement. Provisional data collected from the NO_x analyser at its new location are now lower and more typical of the levels to be expected.

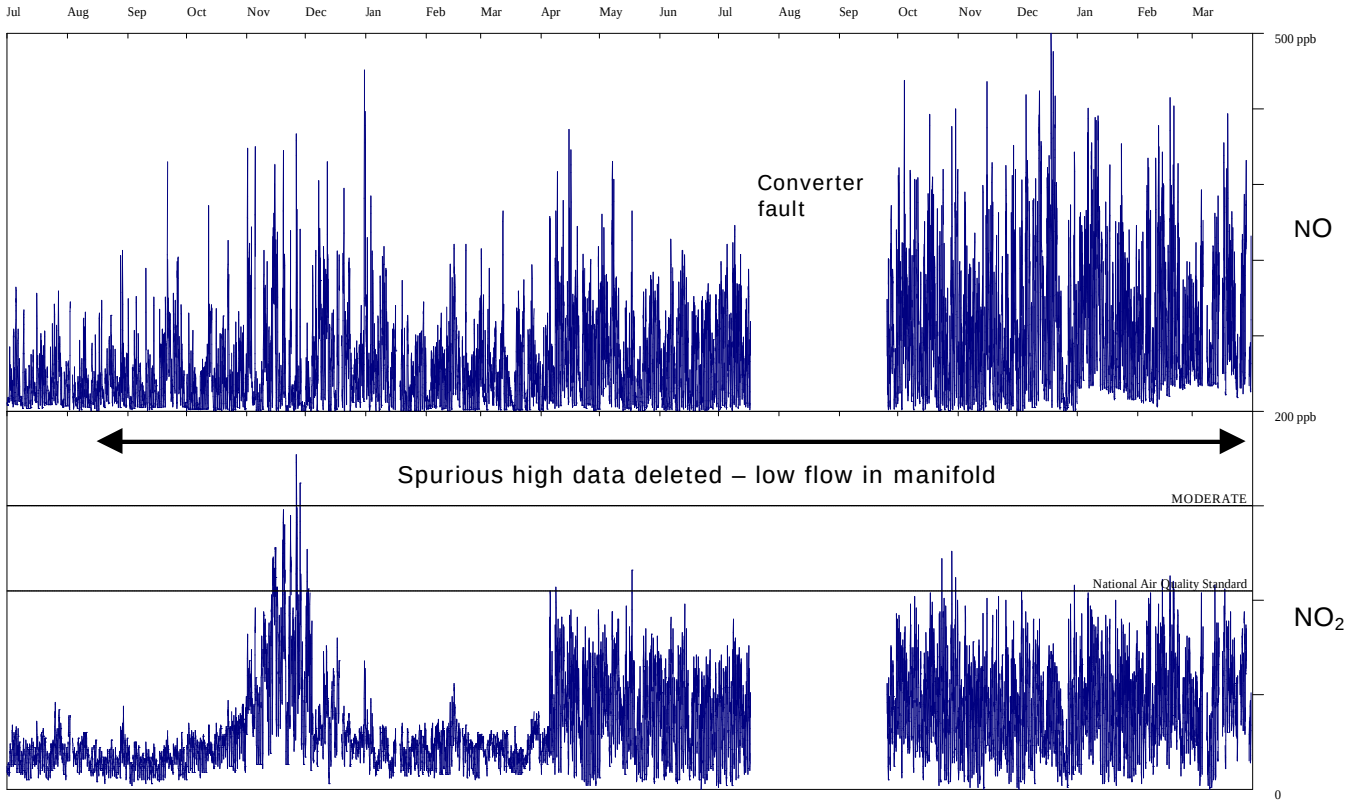

Figure 3.1 High NO_2 Concentrations at Bristol Old Market August 2001 to March 2003

3.2 London Bloomsbury PM_{10}

It was noticed during a Netcen modelling study using PM_{10} /$PM_{2.5}$ ratios, that the measured PM_{10} data at London Bloomsbury in 2002 were high relative to previous years. Further investigation identified a step change in the PM_{10} baseline in June 2002 which corresponded with the replacement of the TEOM control unit on 25th June 2002 (See Figures 3.2 and 3.3). It was suspected that the TEOM calibration factor (k_0) was not correctly up-dated in the software when the control unit was replaced which may account for the step change in reported PM_{10} concentrations. Unfortunately the TEOM at this site was an older TEOM "E" model and it was not straightforward to interrogate the software in order to check the k_0 factor on site. The TEOM "E" was therefore removed by the ESU in May 2003 and the k_o factor determined back in the laboratory. A discrepancy in the k_o was found however, this alone did not account for the apparent offset in the data. No further instrument or data base information could be found to explain the offset and therefore the London Bloomsbury PM_{10} data have been deleted from 25th June 2002 until 21st May 2003 (11 months) when a new TEOM model AB was installed at the site. Preliminary data from the site indicated that measured PM_{10} concentrations have returned to the original levels expected.

QA/QC Unit routinely checks all k_o factors and other relevant parameters programmed into the TEOMs during the 6-monthly audits. At sites with the older TEOM "E" analysers it has not been not possible to carry out these checks and hence this type of problem is not readily identified. Fortunately all the older TEOM "E" analysers in the network at the 12 original EUN sites are scheduled to be replaced during the Summer 2003.

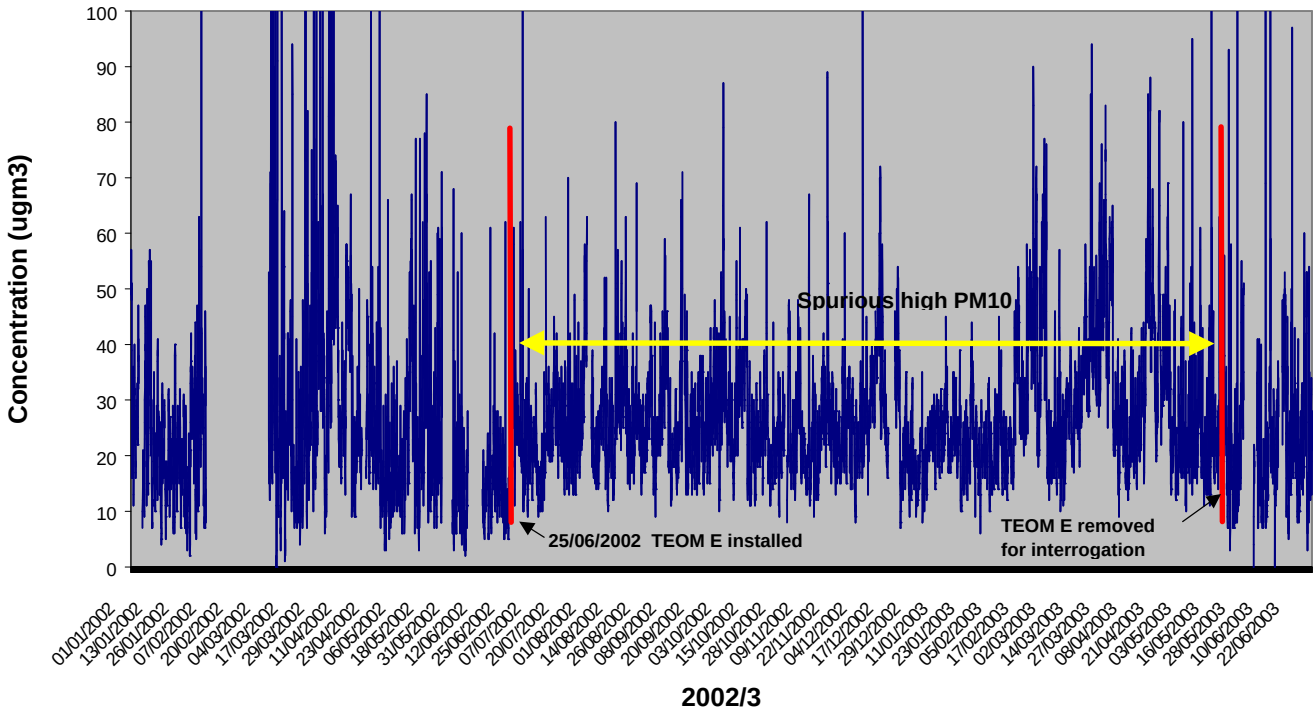

Figure 3.2 Step change in PM_{10} Concentrations at London Bloomsbury from June 2002 to May 2003

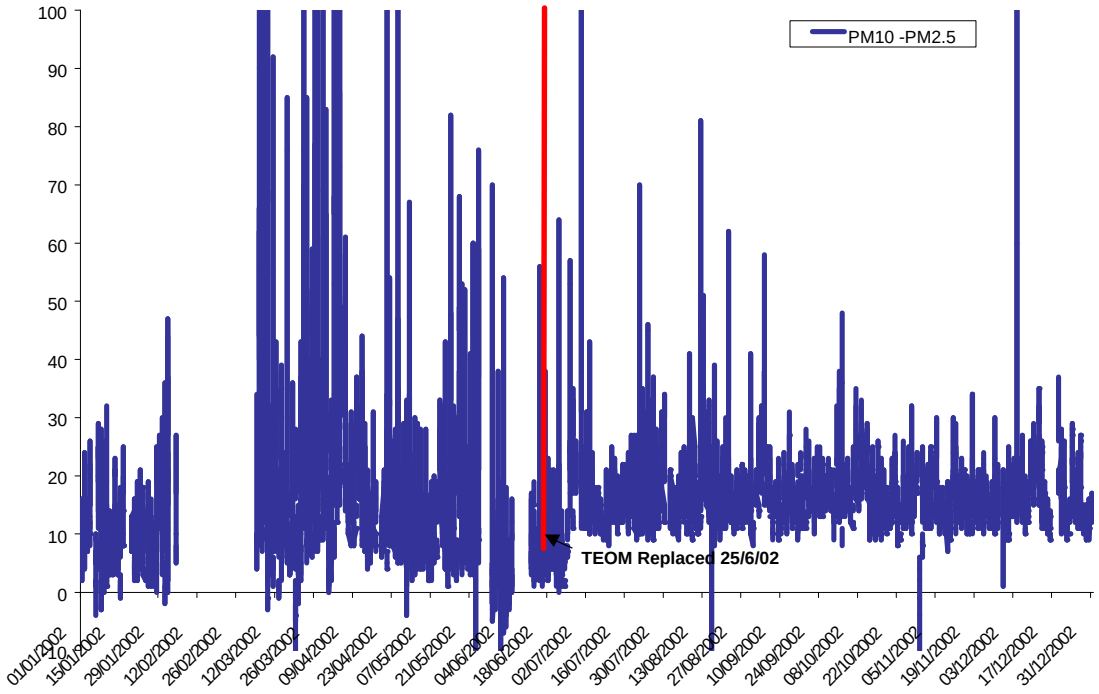

Figure 3.3 London Bloomsbury (PM_{10} – $PM_{2.5}$) concentrations showing step change in June 2002.

3.3 London Bloomsbury NO_x

ERG initially raised concerns over the relatively low NO_2 concentrations measured at London Bloomsbury compared with other sites. Extensive investigations were subsequently carried out by QA/QC Unit and NPL. A parallel monitor was installed which confirmed that the NO_2 concentrations from the site analyser were, on average, 7ppb lower than those measured by the duplicate analyser. NPL undertook tests on the sample manifold and concluded that the sampling system was unlikely to be the cause of the apparent under read. Their findings did however, identify an unusually high NO response to NO_2 calibration gas suggesting a possible leak in the analyser's NO_x/NO channel switching valve. The Equipment Support Unit (EMC) carried out an on-site investigation on 14/4/03 and confirmed a significant leak of the NO_x stream into the reaction chamber during the NO measurement cycle giving an erroneously high NO response. The leak in the valve only affected the NO measurement cycle and NO_x measurements were unaffected. The overall effect of the leak lead to a reduction in measured NO_2. The ESU noted that one of the switching valve ports was very dirty and this would have prevented adequate seals being made within the valve causing it to leak. The leaking valve was replaced during the ESU's investigations on 14th April 2003.

Examination of the data revealed that the start of the problem coincided with the relocation of the London Bloomsbury site on 5th March 2002. The NO and NO_2 data from 5th March 2002 until 14th April 2003 (13 months) have been deleted from the database. Due to the nature of the fault, the NO_x data for this period were unaffected and these data therefore remain on the archive.

Recommendation

QA/QC Unit has developed new audit criteria to help routinely identify any potential valve leaks based on the NO response of the site/audit NO_2 cylinders. If a NO response of > 10ppb is recorded then ESUs are advised to leak test and clean the NO_x analyser switching valve. In general ESUs should routinely check/clean the switching valves at the service particularly at the more polluted sites.

3.4 Southend-on-Sea

There was significant data loss at Southend-on-Sea site with data capture below 65% for all pollutants during this period because of unstable rack temperatures. The power cut out switch activated when the instrument rack temperature became too high. The problem was traced to an electrical fault on the air conditioning unit and a new unit was therefore installed on 12th March 2003.

3.5 Redcar CO

As seen in Figure 3.4 very high concentration CO spikes were record on 3rd February 2003 (maximum 15-minute average 32ppm) and 2nd March 2003 (maximum 15-minute average of 45 ppm). There was no reported evidence of instrument malfunction to suggest the data were invalid. Other nearby sites (e.g. Middlesbrough) did not show similar high concentration episodes which suggests a very localised source. The LSO at Redcar was able to provided hydrocarbon data for 2nd February 2003 for the C2 to C5 hydrocarbons. These data show that there were elevated VOC concentrations occurring a few hours after the CO peak (see Figure 3.5). Further efforts are being made to obtain data for the aromatic hydrocarbons (BTX) as well as nearby meteorological data in order to check the validity of the CO spikes and determine whether it is possible that the CO and VOCs came from the same source. In the meantime the CO data at Redcar have been kept as provisional until further investigation.

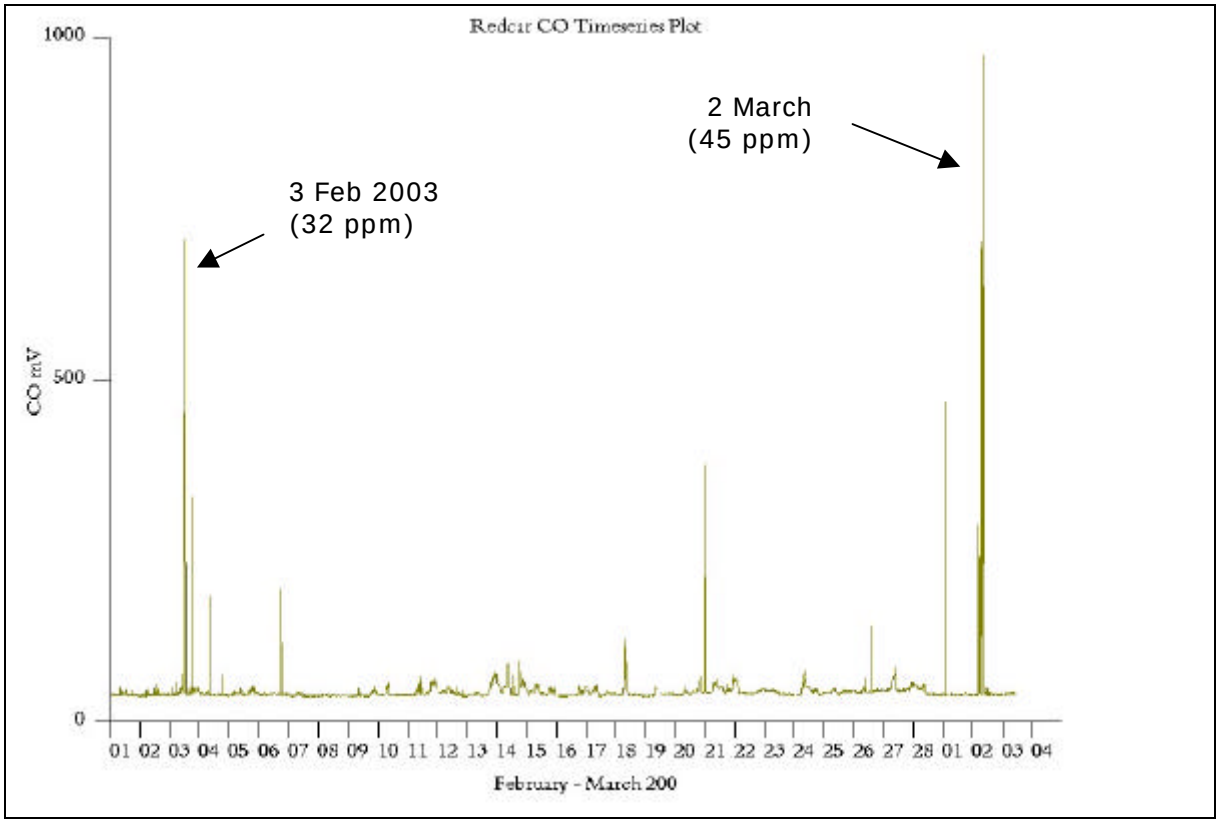

Figure 3.4 Spurious High Concentration CO spikes at Redcar

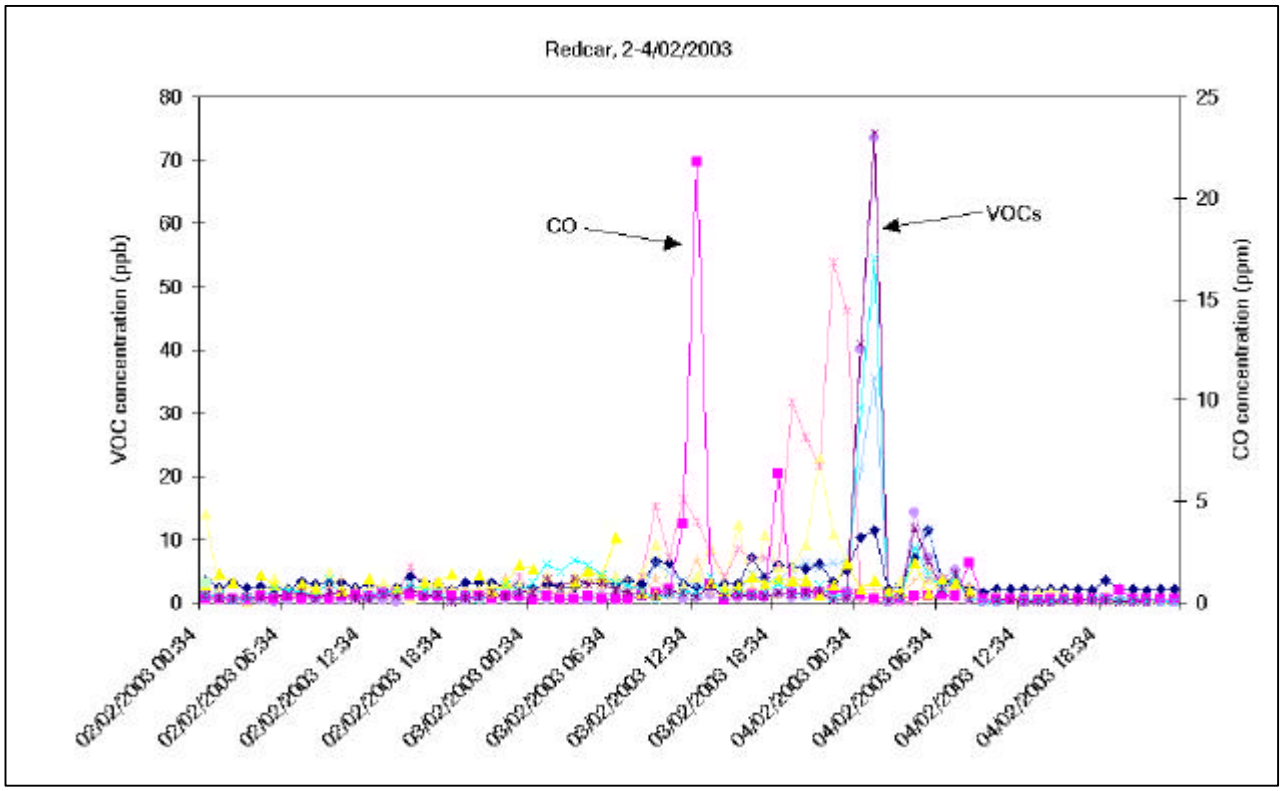

Figure 3.5 Redcar CO and VOC episode data on 3 February 2003

3.6 Sheffield Tinsley CO

The CO analyser at Sheffield Tinsley showed high response noise and spurious large negative spikes throughout this period (see Figure 3.6). Although the overall data loss was small, the ratification process involving the manual deletion of the spurious data from this site was considerably more time-consuming. CMCU were advised of the problem and a replacement analyser was installed in May 2003. Provisional data from the new analyser however shows evidence of baseline drift.

Recommendation

ESU to investigate the CO baseline drift and apply a baseline offset to ensure that analyser response does not fall below the baseline cut off.

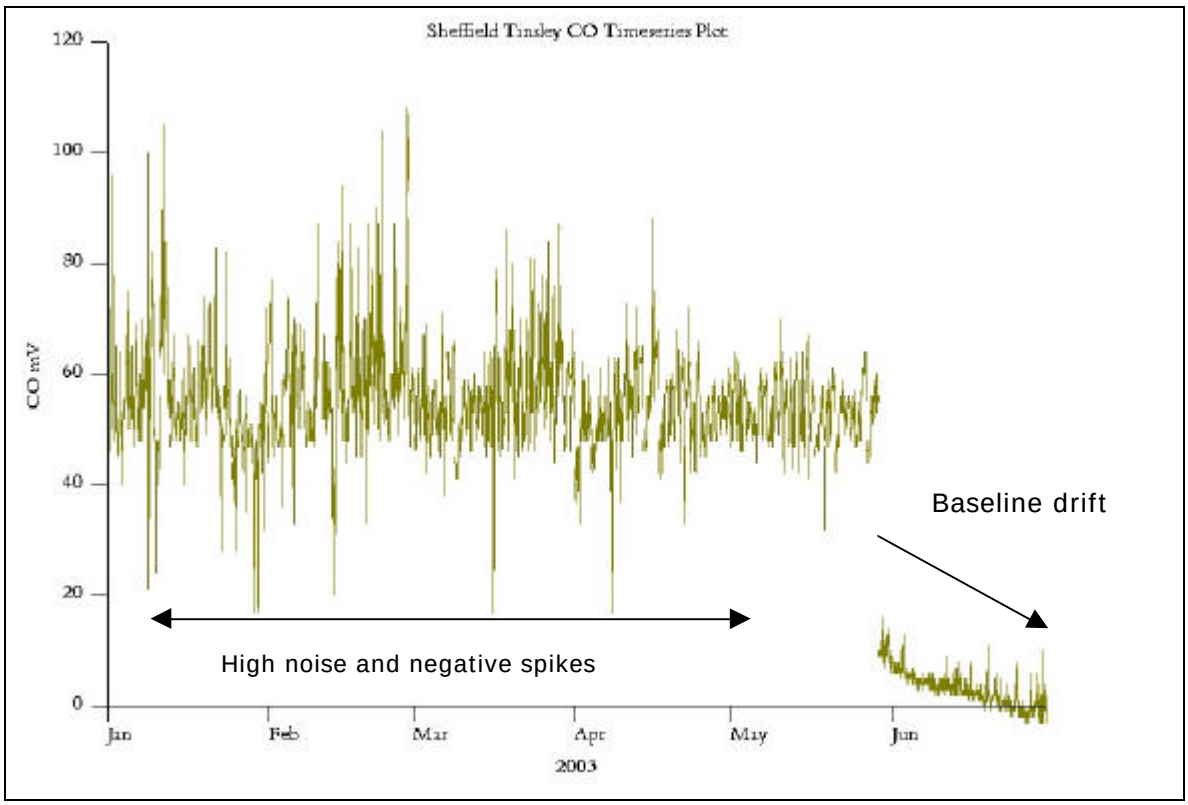

Figure 3.6 Sheffield Tinsley CO response noise and baseline drift

4 Sites with Data Capture Below 90%

The following section provides a summary of the main site operational problems which have resulted in data capture below the required 90% level during the reporting period January to March 2003 (Table 4.1). The number of days and hours of data lost for each cause is also given. In some cases the data gap extends beyond this three-month reporting period.

Table 4.1 Sites with data capture below 90% January to March 2003
(Using the start date of any new site or end date of site closed)

Data Capture (%)		Start date	End date	Reason	Comments	Days	Hours
ENGLAND							
Birmingham East							
CO	52.7%	17-Feb-03	14-May-03	Instrument fault	Chopper motor seized. Analyser removed for repair. Reinstalled 27th March but further fault until repair on 14th May 2003	86.1	2066
Blackpool							
O_3	86.8%	28-Jan-03	31-Jan-03	ESU service	Service	2.9	69
		11-Feb-03	14-Feb-03	Unstable response	Problems with optical bench causing noisy and negative data	2.9	70
		20-Feb-03	25-Feb-03	Unstable response	Large negative data rejected and missing data	5.5	132
SO_2	80.2%	28-Jan-03	14-Feb-03	Instrument fault	UV lamp fault and excessive drift in response after service.	17.2	412
Brighton Roadside							
NO_2	55.9%	20-Feb-03	31-Mar-03	Instrument fault	NOx converter fault. Analyser removed from site but repair considered "uneconomical". Replacement analyser installed on 28 March 2003.	39.3	944
Bristol Centre							
CO	89.7%	26-Feb-03	28-Feb-03	ESU service	Service	2.1	51
		07-Mar-03	13-Mar-03	Air Conditioning	Unstable rack temperatures due to air conditioning fault effecting analyser response	6.1	146
NO_2	89.7%	17-Jan-03	21-Jan-03	Instrument fault	Ozone generator fault.	3.5	85
		18-Feb-03	21-Feb-03	Instrument fault	NO_x chopper motor failure.	2.7	65
		26-Feb-03	28-Feb-03	ESU service	Service	2.1	50
Bristol Old Market							
NO_2	7.0%	02-Aug-01	25-Mar-03	Manifold fault	Low flow through sample manifold (See Section 3.1)	600	14400
Bury Roadside							
NO_2	66.2%	06-Feb-03	07-Feb-03	ESU service	Service	1.1	26
		12-Feb-03	13-Feb-03	Communication fault	Telemetry fault	0.7	16
		20-Feb-03	20-Mar-03	Instrument fault	Ozone generator fault	28.1	675
Coventry Memorial Park							

Data Capture (%)		Start date	End date	Reason	Comments	Days	Hours
PM_{10}	88.4%	09-Feb-03	17-Feb-03	Instrument fault	Broken tapered element. Replacement unit installed.	8.1	194
		17-Mar-03	19-Mar-03	ESU service	Service	2.1	50
SO_2	87.8%	09-Feb-03	18-Feb-03	Instrument fault	UV lamp fault.	8.5	205
		17-Mar-03	19-Mar-03	ESU service	Service	2.1	50
Harwell							
NO_2	79.7%	22-Jan-03	23-Jan-03	ESU service	Service	1.3	30
		24-Feb-03	12-Mar-03	Pump fault	NO_x pump failure. Analyser replaced 4th March but excessive response drift until repair on 12th March.	16.3	391
Hull Freetown							
CO	43.6%	05-Nov-02	20-Feb-03	No calibrations	New site started 5th November 2002. No fortnightly CO calibrations as the cylinder was empty and data could not be accurately scaled. New cylinder installed 20th February 2003.	76	1824
PM_{10}	78.9%	14-Jan-03	29-Jan-03	Instrument fault	Spurious data after QA/QC audit until service.	15.1	363
		25-Mar-03	28-Mar-03	Instrument fault	Tapered element broken by LSO during routine calibration	3.3	80
Leeds Centre							
CO	76.8%			General	Intermittent problem with the air conditioning unit freezing up and effecting analyser response. Thermostat repaired 29 Jan 03		
		01-Jan-03	02-Jan-03	Air Conditioning	Drop in hut/rack temperatures	0.5	12
		06-Jan-03	10-Jan-03	Air Conditioning	Drop in hut/rack temperatures	3.8	91
		17-Jan-03	29-Jan-03	Air Conditioning	Erratic hut/rack temperatures	12.1	291
		17-Feb-03	20-Feb-03	ESU service	Service	3	73
		02-Mar-03	02-Mar-03	Unstable response	Baseline response erratic.	0.3	7
		04-Mar-03	05-Mar-03	Unstable response	Baseline response erratic	0.3	7
NO_2	77.2%	01-Jan-03	02-Jan-03	Air Conditioning	Drop in hut/rack temperatures	0.9	21
		06-Jan-03	09-Jan-03	Air Conditioning	Drop in hut/rack temperatures	3.3	80
		17-Jan-03	29-Jan-03	Air Conditioning	Erratic hut/rack temperatures	12.3	296
		17-Feb-03	20-Feb-03	ESU service	Service	3	73
SO_2	84.3%	24-Jan-03	27-Jan-03	Air Conditioning	Air conditioning fault – missing data	3.5	84
		17-Feb-03	27-Feb-03	Instrument fault	Chopper motor fault following service	10.2	244
Leicester Centre							
PM_{10}	84.9%	10-Jan-03	13-Jan-03	Unstable response	Spurious response data deleted	2.6	62
		22-Jan-03	24-Jan-03	Unstable response	Spurious data after new TEOM unit installed on 22nd January 03.	1.9	45
		28-Jan-03	30-Jan-03	ESU service	Service	2.1	50
		05-Mar-03	11-Mar-03	Unstable response	Increasing and upward drifting response data deleted. TEOM unit replaced again on April 23rd 2003.	6	144
London A3 Roadside							

Data Capture (%)		Start date	End date	Reason	Comments	Days	Hours
NO_2	74.9%	03-Dec-02	22-Jan-03	NO_x converter	Converter efficiency fault (88%). Data deleted from unstable calibration on 3 Dec to service.	50.1	1202
		14-Mar-03	14-Mar-03	Sampling fault	Manifold fan fault	0.3	6
		19-Mar-03	19-Mar-03	Communication fault	Communications fault	0.3	6
		20-Mar-03	20-Mar-03	Communication fault	Communications fault	0.3	8
London Bloomsbury							
NO_2	0%	04-Feb-02	14-Apr-03	Instrument fault	Leaking solenoid valve inside analyser causing low NO response. (see section 3.3)	434	10413
PM_{10}	0%	25-Jun-02	21-May-03	Instrument fault	Unexplained TEOM offset (see section 3.2)	330	7922
London Brent							
O_3	76.3%	01-Feb-03	01-Feb-03	Communication fault	Telemetry fault	0.7	17
		04-Feb-03	05-Feb-03	ESU service	Service	1.2	28
		21-Feb-03	07-Mar-03	Instrument fault	Erratic response. Analyser removed for repair. Re-installed on 7th March but still faulty. Problem traced to wiring fault.	14.3	342
		15-Mar-03	18-Mar-03	Instrument fault	Erratic IZS fault	3.6	87
London Cromwell Road 2							
CO	88.7%	17-Jan-03	22-Jan-03	Instrument fault	Chopper motor and correlation wheel fault	4.7	113
		17-Mar-03	18-Mar-03	ESU service	Service	1.2	28
		23-Mar-03	26-Mar-03	Instrument fault	Infra red detector fault	3.7	88
SO_2	87.7%	04-Jan-03	07-Jan-03	Instrument fault	Intermittent flow fault	3.3	79
		20-Jan-03	21-Jan-03	Operator error	Internal sampling. LSO left sample line disconnected after calibration	0.9	21
		17-Mar-03	19-Mar-03	ESU service	Service	2	47
		27-Mar-03	31-Mar-03	Instrument fault	Blocked valve causing flow restriction	4	97
London Hillingdon							
PM_{10}	66.2%	15-Jan-03	17-Jan-03	ESU service	Service	2	48
		19-Feb-03	19-Mar-03	Unstable response	Excessive response noise between filter changes due to poorly seated filter.	28.1	674
London Southwark							
NO_2	0%	20-Nov-02	04-Apr-03	Instrument fault	PMT cooler fault. Unable to repair due to age of analyser. Replacement analyser purchased by LA and installed on 4th April 2003.	135	3232
London Wandsworth							
NO_2	78.4%	25-Feb-03	25-Feb-03	QAQC audit	QA/QC audit	0.3	6
		13-Mar-03	31-Mar-03	Pump fault	Pump fault. Pump replaced on 11th April.	18.9	454
London Westminster							

Data Capture (%)		Start date	End date	Reason	Comments	Days	Hours
NO_2	89.8%	01-Jan-03	07-Jan-03	Instrument fault	Unexplained low response of NO channel. Rectified after ESU attention on 7th January 2003.	6.6	158
		29-Jan-03	30-Jan-03	Operator error	LSO failed to switch analysers back into service after calibration	0.8	20
		05-Mar-03	06-Mar-03	Service	Service.	1.2	29
PM_{10} (Grav)	31.7%	19-Feb-03	19-Mar-03	Instrument fault	PM_{10} gravimetric monitoring started on 19/3/03 after replacement of missing part. See Section 4.1		
Manchester South							
SO_2	80.9%	07-Jan-03	24-Jan-03	ESU service	As seen in previous period response noise and erratic output giving large negative spikes. Rectified at service when pump fault and leaking hydrocarbon kicker repaired.	16.8	404
Middlesbrough				General	Equipment up-graded during routine service on 28 February.		
O_3	88.1%	26-Feb-03	04-Mar-03	No mV data	Problems with ozone analyser locking up following site up-grade.	6	145
		08-Mar-03	10-Mar-03	No mV data	As above	2.1	50
		27-Mar-03	28-Mar-03	No mV data	As above	1.3	32
Newcastle Centre							
NO_2	78.8%	15-Feb-03	06-Mar-03	Pump fault	Sample pump fault and instrument leak	18.5	445
Northampton							
O_3	78.5%	01-Jan-03	17-Mar-03	New analyser	New analyser installed on 17th March for DD3	76	1824
Nottingham Centre							
CO	81.6%	06-Jan-03	22-Jan-03	Instrument fault	IR source fault giving rise to noisy response. Replacement analyser installed on 10th January but also unstable. Original analyser re-installed at service.	16	385
PM_{10}	88.8%	13-Jan-03	16-Jan-03	Sampling fault	TEOM low flow fault. Electronic adjustment and re-installation of TEOM software	3.1	74
		20-Jan-03	22-Jan-03	ESU service	Service	2.3	54
		27-Mar-03	04-Apr-03	Instrument fault	TEOM failed to return to correct operating status after routine calibration. Replacement TEOM installed on 4th April 2003	7.9	190
Plymouth Centre							
CO	64.5%	17-Dec-02	24-Jan-03	Unstable response	Rapid baseline drift and erratic response due to pump and optical bench faults.	37.7	905
		10-Mar-03	18-Mar-03	ESU service	No data after service possibly due to high hut temperatures.	8.2	197
Reading							
CO	37.6%	15-Jan-03	17-Jan-03	ESU service	Service	2	49
		06-Feb-03	30-Jun-03	Site relocation	Site closed 6/2/03 as lease expired. Relocation underway.	145	3477
NO_2	37.5%	15-Jan-03	17-Jan-03	ESU service	Service	2	49

Data Capture (%)		Start date	End date	Reason	Comments	Days	Hours
		06-Feb-03	30-Jun-03	Site relocation	Site closed 6/2/03	145	3477
O_3	37.6%	15-Jan-03	17-Jan-03	ESU service	Service	2	49
		06-Feb-03	30-Jun-03	Site relocation	Site closed 6/2/03	145	3477
PM_{10}	37.5%	15-Jan-03	17-Jan-03	ESU service	Service	2	49
		06-Feb-03	30-Jun-03	Site relocation	Site closed 6/2/03	145	3477
SO_2	37.5%	15-Jan-03	17-Jan-03	ESU service	Service	2	49
		06-Feb-03	30-Jun-03	Site relocation	Site closed 6/2/03	145	3477
Rochester							
PM_{10}	7.3%	15-Aug-02	25-Mar-03	Instrument fault	TEOM unit sent to USA for 7 months to be repaired. Re-installed at service on 25 March.	222	5336
Rotherham Centre							
SO_2	75.8%	20-Dec-02	20-Jan-03	Sampling fault	Pump fault giving low sample flow rate	30.9	741
		19-Feb-03	21-Feb-03	ESU service	Service	1.9	45
Sheffield Centre							
CO	85.6%	27-Jan-03	06-Feb-03	Unstable response	Unstable and intermittent response. Analyser replaced on 6th February.	10.5	253
		17-Feb-03	19-Feb-03	ESU service	Service	2.1	50
SO_2	83.1%	17-Feb-03	19-Feb-03	ESU service	Service	2.1	50
		19-Mar-03	08-Apr-03	Unstable response	Baseline noisy due to pump fault	20.1	482
Sheffield Tinsley							
CO	89.6%	08-Jan-03	13-Jan-03	Unstable response	Unstable baseline response giving large negative spikes. (See Section 3.6)	4.5	107
		29-Jan-03	30-Jan-03	Unstable response	Unstable baseline response	0.8	20
		31-Jan-03	31-Jan-03	Air Conditioning	Cabin temperature too low so re-set by ESU	0.5	12
		10-Feb-03	11-Feb-03	ESU service	Service	1.1	26
		13-Feb-03	13-Feb-03	Unstable response	Unstable baseline response	0.6	14
		09-Mar-03	09-Mar-03	Unstable response	Unstable baseline response	0.4	10
Southend-on-Sea				General	Significant data loss throughout this period due to unstable rack temperatures. Power off when temperature cut-off switch activated. Problem due to electrical fault on air con unit.		
CO	55.0%	11-Jan-03	20-Jan-03	Air Conditioning	Power off due to high temperature	8.9	214
		28-Jan-03	30-Jan-03	ESU service	Service	2.1	51
		02-Feb-03	11-Feb-03	Air Conditioning	Power off due to high temperature	8.7	209
		21-Feb-03	13-Mar-03	Air Conditioning	Power off. Air con unit replaced 12/3/03	20.1	482
NO_2	48.2%	09-Jan-03	20-Jan-03	Air Conditioning	As above	11.4	273
		28-Jan-03	11-Feb-03	ESU service	Service	14	337
		21-Feb-03	13-Mar-03	Air Conditioning	As above	20.1	483
O_3	55.3%	11-Jan-03	20-Jan-03	Air Conditioning	As above	8.9	214
		28-Jan-03	30-Jan-03	ESU service	Service	2.1	51
		02-Feb-03	11-Feb-03	Air Conditioning	As above	8.8	210

Data Capture (%)		Start date	End date	Reason	Comments	Days	Hours
		21-Feb-03	13-Mar-03	Air Conditioning	As above	20	479
PM_{10}	62.5%	11-Jan-03	14-Jan-03	Air Conditioning	As above	3	72
		28-Jan-03	30-Jan-03	ESU service	Service	2.1	51
		02-Feb-03	11-Feb-03	Air Conditioning	As above	8.7	209
		21-Feb-03	12-Mar-03	Air Conditioning	As above	19.3	462
SO_2	39.6%	11-Jan-03	20-Jan-03	Air Conditioning	As above	8.9	214
		28-Jan-03	14-Mar-03	ESU service	Service	45	1081
Stockton-on-Tees Yarm							
NO_2	81.0%	27-Jan-03	30-Jan-03	Instrument fault	Analyser power supply failed	2.5	61
		03-Mar-03	17-Mar-03	Instrument fault	Photomultiplier tube fault after service. Analyser replaced on 17th March.	14.2	340
Sunderland							
SO_2	89.1%	13-Feb-03	19-Feb-03	Operator error	Internal sampling. Sample line not connected to manifold after routine calibration	6	144
		18-Mar-03	21-Mar-03	Instrument fault	Photomultiplier tube failed.	3.2	77
Wicken Fen							
NO_2	43.2%	01-Jan-03	19-Feb-03	Unstable response	7 weeks data deleted due to unstable response and no calibration cylinder until 20th February 03.	49.5	1188
		10-Mar-03	11-Mar-03	ESU service	Service	1.1	27
Wirral Tranmere							
CO	86.50%	02-Jan-03	02-Jan-03	Unstable response	Long history of poor performance with high noise and response instability. Analyser replaced at service on 12th February 2003	0.6	15
		15-Jan-03	15-Jan-03	unstable response	Noise and response instability	0.5	12
		23-Jan-03	24-Jan-03	Unstable response	Noise and response instability	0.4	10
		03-Feb-03	12-Feb-03	Unstable response	Unstable response then service	8.5	203
		16-Feb-03	16-Feb-03	Unstable response	Noise and response instability	0.3	8
		03-Mar-03	04-Mar-03	Power cut	Power cut	0.8	19
NORTHERN IRELAND							
Belfast Centre							
CO	81.3%	18-Feb-03	27-Feb-03	Unstable response	Unstable response	9.1	218
		09-Mar-03	10-Mar-03	Air conditioning	Site power failure due to air conditioning fault	1.5	37
		17-Mar-03	22-Mar-03	Unstable response	Unstable response after service	5	119
		29-Mar-03	29-Mar-03	Air conditioning	Site power failure due to air conditioning fault	0.6	15
Belfast East							
SO_2	89.0%	25-Feb-03	06-Mar-03	Sampling fault	Blocked sample flow valve. Instrument switched off until repair at service on 6 March.	9.2	220

Data Capture (%)		Start date	End date	Reason	Comments	Days	Hours
Derry							
O_3	83.2%	05-Jan-03	13-Jan-03	Instrument fault	Major internal leak in solenoid valve.	8.6	206
		03-Mar-03	06-Mar-03	ESU service	Service	2.9	70
Lough Navar							
O_3	84.2%	22-Jan-03	04-Feb-03	Instrument fault	Lamp voltage fault. Analyser replaced on 4th February 03. Original analyser re-installed at service.	12.9	310
		19-Mar-03	20-Mar-03	ESU service	Service	0.8	20
SCOTLAND							
Edinburgh Centre							
CO	0.0%	19-Nov-02	20-Apr-03	Monitoring suspended	Site (mobile trailer belonging to the Council) closed to prepare for Hogmanay celebrations. Mobile trailer re-installed 20th April 03.	153	3663
NO_2	0.0%	19-Nov-02	20-Apr-03	Monitoring suspended	As above	153	3663
O_3	0.0%	19-Nov-02	20-Apr-03	Monitoring suspended	As above	153	3663
PM_{10}	0.0%	19-Nov-02	20-Apr-03	Monitoring suspended	As above	153	3663
SO_2	0.0%	19-Nov-02	20-Apr-03	Monitoring suspended	As above	153	3663
Glasgow Centre							
NO_2	79.4%	01-Feb-03	02-Feb-03	Power cut	Power cut	1.4	34
		17-Feb-03	19-Feb-03	ESU service	Service	2.1	51
		05-Mar-03	19-Mar-03	Unstable response	Spurious step change in baseline response. No suitable zero from data scaling.	14.2	341
SO_2	44.4%	22-Jan-03	04-Feb-03	Unstable response	Random step changes in baseline response	13.3	318
		17-Feb-03	25-Mar-03	Unstable response	Baseline step change without calibration	36.5	877
Inverness							
PM_{10} (Grav)	81.0%				See Section 4.1 for details		
WALES							
Cwmbran							
NO_2	74.50%	25-Feb-03	26-Feb-03	ESU service	Service	1	24
		10-Mar-03	07-Apr-03	Low flow rate	Flow fault.	28	671
Narberth				General	Ageing equipment generally unstable. Problems with site power supply tripping off causing operating systems to lock up.		
NO_2	79.1%	14-Jan-03	14-Jan-03	Power cut	Power cut	0.4	10
		19-Jan-03	20-Jan-03	QA/QC audit	Audit	0.8	18
		30-Jan-03	30-Jan-03	Power cut	Power cut	0.4	9
		06-Feb-03	11-Feb-03	Power cut	Faulty SO_2 pump over heating and tripping out the mains power supply	5	120
		23-Feb-03	24-Feb-03	Logging system	Corruption of Ambirak logging system.	0.8	19

Data Capture (%)		Start date	End date	Reason	Comments	Days	Hours
		03-Mar-03	05-Mar-03	ESU service	Service	2.1	50
		13-Mar-03	17-Mar-03	Instrument fault	Ozone generator failed	4.2	100
		27-Mar-03	28-Mar-03	Power cut	Power cut	0.8	19
O_3	73.6%	14-Jan-03	14-Jan-03	Power cut	Power cut	0.4	10
		19-Jan-03	20-Jan-03	QAQC audit	Audit	0.8	18
		30-Jan-03	30-Jan-03	Power cut	Power cut	0.4	9
		06-Feb-03	24-Feb-03	Instrument fault	Analyser temperature fault. Analyser repositioned in cabinet to improve ventilation.	18.2	436
		03-Mar-03	05-Mar-03	ESU service	Service	2.1	50
		27-Mar-03	28-Mar-03	Power cut	Power cut	0.8	19
PM_{10}	87.6%	14-Jan-03	14-Jan-03	Power cut	Power cut	0.4	10
		19-Jan-03	20-Jan-03	QA/QC audit	Audit	0.8	18
		06-Feb-03	11-Feb-03	Power cut	Faulty SO_2 pump over heating and tripping out the mains power supply	5	119
		23-Feb-03	24-Feb-03	Logging system	Corruption of Ambirak logging system.	0.8	19
		03-Mar-03	05-Mar-03	ESU service	Service	2.1	50
		27-Mar-03	28-Mar-03	Power cut	Power cut	0.8	19
SO_2	85.0%	14-Jan-03	14-Jan-03	Power cut	Power cut	0.4	10
		19-Jan-03	20-Jan-03	QA/QC audit	Audit	0.8	18
		30-Jan-03	30-Jan-03	Power cut	Power cut	0.4	9
		06-Feb-03	13-Feb-03	Power cut	Faulty SO_2 pump over heating and tripping out the mains power supply. Pump replaced by ESU.	7.1	170
		23-Feb-03	24-Feb-03	Logging system	Corruption of Ambirak logging system.	0.8	19
		03-Mar-03	05-Mar-03	ESU service	Service	2.1	50
		27-Mar-03	28-Mar-03	Power cut	Power cut	0.8	19
Wrexham PM_{10} (Grav)	84.4%				See Section 4.1 for details		

4.1 Gravimetric PM_{10} Sites with Data Capture Below 90%

This section gives details of the main operational problems which have resulted in gravimetric PM_{10} data capture below the required 90% level during the reporting period January to March 2003. Casella Stanger has supplied the measured data and, since mid January 2003, they have also undertaken the filter weighing and calculated the particulate concentrations.

Two new Partisol sites were commissioned during this period. Sampling at London Westminster began on 19th February 2003. However, it was later discovered during the QA/QC Unit commissioning audit that the tube connecting the sampling head to the instrument was missing. The analyser had therefore been sampling air from within the cabinet. The problem was resolved and sampling re-commenced on 19th March 2003.

The Brighton Roadside PM_{10} site was commissioned on 28 February 2003. There were some high PM_{10} concentrations measured at this site as a result of the Brighton West Pier Fire on and around 28th March.

Four out of the seven gravimetric PM_{10} sites achieved data capture above 90% (calculated from site start date for Brighton Roadside PM_{10}). Details of the reasons for data loss at the remaining 3 sites are given below:

London Westminster (31.7% data capture)

Month	Comment	Data Loss
February	Site started 19th. Internal sampling due to missing part from 19th February to 19th March.	28 days

Inverness (81.1% data capture)

Month	Comment	Data Loss
January	3rd no reason provided	1 day
January	14th – 17th no reason provided	4 days
January	30th no reason provided	1 day
February	5th – 8th, filter jam.	4 days
February	16th – 20th filters unexposed.	5 days

Wrexham (84.4% data capture)

Month	Comment	Data Loss
January	17th – 21st no reason provided	5 days
February	6-7th , 21-24th no reason provided	6 days
March	9-10th no reason provided	2 days

At this site each occurrence of data loss happened after 14 days of good data. It therefore seems likely that the Partisol has been allowed to run out of filters.

RECOMMENDATION

LSOs should be aware that in order to achieve the 90% data capture target, there should, on average, be no more than 3 days data loss per month (37 days/year). We recommend that care be taken to ensure the Partisol filter cartridges are exchanged as soon possible after each 14-day sampling period.

5 Ratified Data Capture Statistics

Table 5.1 provides the ratified data capture figures for each site for the 3-month period January to March 2003. Data capture values below 90% are shown in the shaded boxes.

Table 5.1 AURN Ratified Data Capture (%) for January to March 2003
(Using the start date of any new site or end date of site closed)

SITE	CO	NO_2	O_3	PM_{10}	SO_2	Site Average
ENGLAND						
Barnsley 12	-	-	-	-	97.2	97.2
Barnsley Gawber	96.7	96.5	95.9	-	96.6	96.4
Bath Roadside	97.1	96.3	-	-	-	96.7
Billingham	-	98.3	-	-	-	98.3
Birmingham Centre	97	95.2	96.9	97	96.4	96.5
Birmingham East	52.7	98.1	97.7	17	98.1	72.7
Blackpool	96.1	95.7	86.8	96.1	80.2	91
Bolton	95.5	96.8	96.9	97.1	96.9	96.6
Bottesford	-	-	99.5	-	-	99.5
Bournemouth	97.3	90.8	99.9	94.4	97.2	95.92
Bradford Centre	94.2	95	96.4	96	95.7	95.5
Brighton Roadside	92.2	55.9	-	-	-	74.1
Brighton Roadside PM_{10}				100		100
Bristol Centre	89.7	89.7	96.9	94.5	97	93.5
Bristol Old Market	97.7	7	-	-	-	52.4
Bury Roadside	97.5	66.2	97.4	96.7	97.5	91.1
Cambridge Roadside	-	99.6	-	-	-	99.6
Camden Kerbside	-	93.3	-	99.5	-	96.4
Canterbury	-	98.5	-	99.3	-	98.9
Coventry Memorial Park	96.4	96.4	96.4	88.4	87.8	93.1
Exeter Roadside	96.8	97.9	97.9	-	97.9	97.6
Glazebury	-	-	98.7	-	-	98.7
Great Dun Fell	-	-	99.5	-	-	99.5
Haringey Roadside	-	99.1	-	99.2	-	99.1
Harwell	-	79.7	97.8	-	97.7	91.7
High Muffles	-	-	97.6	-	-	97.6
Hove Roadside	97.8	97.8	-	-	97.7	97.8
Hull Freetown	43.6	96.6	96.9	78.9	96.8	82.6
Ladybower	-	97.9	98.1	-	98.1	98
Leamington Spa	97.6	97.8	97.9	98.1	97.4	97.8
Leeds Centre	76.8	77.2	92.4	95.9	84.3	85.3
Leicester Centre	91.9	96.8	95.8	84.9	96.9	93.3
London A3 Roadside	97.5	74.9	-	98.6	-	90.3
London Bexley	96.9	96.9	96.9	96.9	96.9	96.9
London Bloomsbury	97.9	0	99	0	98.9	59.2
London Brent	95.8	93.8	76.3	93.7	95.8	91.1
London Bromley	91.3	96.2	-	-	-	93.7

SITE	CO	NO_2	O_3	PM_{10}	SO_2	Site Average
London Cromwell Road 2	88.7	96.3	-	-	87.7	90.9
London Eltham	-	99.4	95.6	99.4	99.7	98.5
London Hackney	98.8	99.5	98.5	-	-	98.9
London Haringey	-	-	99.7	-	-	99.7
London Hillingdon	94.6	96.9	96.8	66.2	97	90.3
London Lewisham	-	99.5	99.6	-	99.6	99.6
London Marylebone Road	97.9	98	98.2	98.8	98.4	98.3
London N. Kensington	96	99.3	97.1	96.9	97	97.3
London Southwark	98.5	0	98.6	-	98.7	73.9
London Teddington	-	99.4	99.5	-	99.5	99.5
London Wandsworth	-	78.4	99.3	-	-	88.8
London Westminster	97	89.8	97.1	31.7	96.5	82.4
Lullington Heath	-	91.7	96	-	96.4	94.7
Manchester Piccadilly	97	97	97	97.2	92.8	96.2
Manchester South	-	98	93.1	-	80.9	90.7
Manchester Town Hall	94.1	97.8	-	-	-	95.9
Middlesbrough	94.9	96	88.1	96.3	96	94.3
Newcastle Centre	97.9	78.8	99.4	99.4	99.2	94.9
Northampton	91.8	99.4	78.5	99.5	99.4	93.7
Northampton PM_{10} (Grav)				97.8		97.8
Norwich Centre	93.8	96.9	97.1	97.2	96.3	96.3
Norwich Roadside	-	94.8	-	-	-	94.8
Nottingham Centre	81.6	97	95.3	88.8	95.5	91.6
Oxford Centre	99.1	99.1	-	-	94.1	97.4
Plymouth Centre	64.5	91.1	96.6	96.2	96.9	89
Portsmouth	97.8	95.4	-	99	97.9	97.5
Preston	97.1	96.4	90.5	95.7	96.8	95.3
Reading	91.4	91.2	91.6	91.2	91.3	91.4
Redcar	96.7	94.3	95	96.9	93.2	95.2
Rochester	-	98.2	98.2	7.3	98.2	75.5
Rotherham Centre	-	92.3	96.9	-	75.8	88.3
Salford Eccles	97	97	97	96.1	97	96.8
Sandwell West Bromwich	96.9	97	96.4	-	97.1	96.9
Scunthorpe	-	-	-	98.8	91	94.9
Sheffield Centre	85.6	96.5	97	95.7	83.1	91.6
Sheffield Tinsley	89.6	98.1	-	-	-	93.9
Sibton	-	-	98.4	-	-	98.4
Somerton	-	-	95.5	-	-	95.5
Southampton Centre	97.1	94.6	97.1	96.9	97	96.5
Southend-on-Sea	55	48.2	55.3	62.5	39.6	52.1
Southwark Roadside	99.1	99.4	-	-	99.3	99.2
St Osyth	98.1	94.1	98.3	-	-	96.8
Stockport Shaw Heath	98.2	97.9	-	99.8	98.2	98.5
Stockton-on-Tees Yarm	98.2	81	-	97.1	-	92.1
Stoke-on-Trent Centre	94.8	96.5	97.3	97	95.6	96.2
Sunderland	-	-	-	-	89.1	89.1
Thurrock	97.1	96.9	94.2	96.8	97	96.4
Tower Hamlets Roadside	99.4	99.4	-	-	-	99.4
Walsall Alumwell	-	98	-	-	-	98

SITE	CO	NO_2	O_3	PM_{10}	SO_2	Site Average
Walsall Willenhall	-	93.3	-	-	-	93.3
West London	99.5	99.5	-	-	-	99.5
Weybourne	-	-	99.7	-	-	99.7
Wicken Fen	-	43.2	97.8	-	97.7	79.6
Wigan Leigh	99.3	99.4	99.4	99.4	96.5	98.8
Wirral Tranmere	86.5	96.4	96.5	94.2	95.8	93.9
Wolverhampton Centre	96.1	91.9	96.9	96.9	96.7	95.7
Yarner Wood	-	-	98.4	-	-	98.4
NORTHERN IRELAND						
Belfast Centre	81.3	92.8	94.7	94.6	94.8	91.6
Belfast Clara St	-	-	-	93.2	-	93.2
Belfast East	-	-	-	-	89	89
Derry	96	96.1	83.2	96.1	95.9	93.5
Lough Navar	-	-	84.2	95.3	-	89.7
SCOTLAND						
Aberdeen	90.2	98.2	-	96.5	98.2	95.8
Bush Estate	-	-	98.8	-	-	98.8
Dumfries	95.3	97.9	-	92.2	-	96.6
Edinburgh Centre	0	0	0	0	0	0
Eskdalemuir	-	-	99.5	-	-	99.5
Glasgow Centre	94.9	79.4	94.8	96	44.4	81.9
Glasgow City Chambers	92.4	92.3	-	-	-	92.3
Glasgow Kerbside	98.2	98	-	93.9	-	96.7
Grangemouth	98.3	98.6	-	97.5	98.6	98.2
Inverness	98.4	98.3	-	81.1	-	92.6
Strath Vaich	-	-	95.1	-	-	95.1
WALES						
Aston Hill	-	-	98.2	-	-	98.2
Cardiff Centre	91.3	96.8	97.2	97.2	94.5	95.4
Cwmbran	98	74.5	-	98.1	94.4	91.3
Narberth	-	79.1	73.6	87.6	85	81.3
Port Talbot	-	96.8	96.7	99	97.3	97.4
Swansea	97	97.1	96.9	97.1	97.1	97
Wrexham	97.5	97.5	-	84.4	97.4	94.2
Number of sites	75	96	78	68	75	
Network Mean (%)	91.6	89	93.9	88.4	92.4	92.3

Sites and instruments established between 01/01/2003 and 31/03/2003

Site	Instruments	Start Date
Grangemouth	CO	17/01/2003
London Westminster PM_{10}	PM_{10} (Grav)	19/02/2003
Bournemouth	O_3	27/02/2003
Brighton Roadside PM_{10}	PM_{10} (Grav)	28/02/2003
Northampton	O_3	13/03/2003

PART B: Winter 2003 Intercalibration Results January-March 2003

PART B - Intercalibration Results for the Automatic Urban, Rural and London Networks, January to March 2003

1 Introduction

In January to March 2003, **netcen** undertook an intercalibration of 116 monitoring stations in operation in defra and the Devolved Administrations sponsored Urban, Rural and London Monitoring Networks. This is the first time ever that an intercalibration has been undertaken across all sites in all 3 networks by a single organisation. This will allow data from all of the analysers in the networks to be harmonised to a single set of audit standards, thereby improving confidence in the accuracy, consistency and traceability of air pollution measurements made in the UK.

The tests were undertaken to cross-reference the individual data sets to common traceable calibration standards. This enabled the consistency of measurements throughout the network to be determined. The following major checks are made:

1. **Analyser accuracy and precision**, as a basic check to ensure reliable datasets from the analysers.
2. **Instrument linearity**, to check that doubling a concentration of gas to the analyser results in a doubling of the analyser signal response. If an analyser is not linear, data cannot be reliably scaled into concentrations.
3. **Instrument signal noise**, to check for a stable analyser response to calibration gases.
4. **Analyser response time**, to check that the analyser responds quickly to a change in gas concentrations.
5. **Leak and flow checks**, to ensure that ambient air reaches the analysers without being compromised in any way.
6. **NOx analyser converter efficiency**, to ensure reliable operation. This is the device that allows the measurement of NO_2 to be undertaken, so it must work acceptably.
7. **TEOM k_o evaluation**. The analyser uses this factor to calculate mass concentrations, so the value is calculated to determine its accuracy.
8. **Particulate analyser flow rate checks**, to ensure that the flow rates through critical parts of the analyser are within specified limits.
9. **SO_2 analyser hydrocarbon interference**, as certain hydrocarbons are known to interfere with the SO_2 detector.
10. **Evaluation of site cylinder concentrations**, using a set of **netcen** certified cylinders that are taken to all the sites. The concentrations of the site cylinders are used to scale pollution datasets, so it is important to ensure that the concentration of gas in the cylinder does not change.
11. **Competence of Local Site Operators** (LSOs) in undertaking calibrations. As it is the calibrations by the LSOs that are used to scale pollution datasets, it is important to check that these are undertaken competently.

In addition to the above tests, a “Network Intercomparison” is conducted. This exercise utilises audit gas cylinders transported to each site in the Network. These cylinders have been recently calibrated by the Calibration Laboratory at **netcen**, and allow us to examine how different site analysers respond when they are supplied with the same gas used at other sites. For ozone analysers, the calibration is undertaken with recently calibrated ozone photometers.

The technique used to process the intercomparison results is broadly as follows:

- The analyser responses to audit gas are converted into concentrations, using provisional calibration factors obtained on the day of the intercalibration. This factor is also used for the provisional data supplied to the web/teletext.

- These individual results are tabulated, and statistical analyses undertaken (e.g. network average result, network standard deviation, deviation of individual sites from the network mean etc.)

These results are then used to pick out problem sites, or "outliers", which are investigated further to determine reasons and investigate possible remedies for the outliers. The definition of an outlier is a site result that falls outside the following limits:

- ±10% of the network average for NOx, CO and SO_2 analysers,
- ±5% of the reference standard photometer for Ozone analysers,
- ±2.5 % of the stated k_0 value for TEOM analysers,
- ±10% for particulate analyser flow rates,
- ±10% for the recalculation of site cylinder concentrations.

Thus the intercalibration investigates the quality of provisional data output by the Management Units for use in forecasting, teletext and the web. It also provides input into the ratification process by highlighting sites where close scrutiny of datasets is likely to be required.

As stated earlier, any outliers that are identified are rigorously checked to determine the cause and corrective action is then taken if necessary. There are a number of likely main causes for outlier results, as discussed below:

- Drift of an analyser between scheduled LSO calibrations. This is by far the most common cause of an outlier result, and one that is simply corrected for during ratification of data.
- Drift of site cylinder concentrations between intercalibrations. Site cylinders can sometimes become unstable, especially at low pressures. All site cylinder concentrations are checked every six months, and are replaced as necessary.
- Erroneous calibration factors. Occasionally an analyser calibration is unsuccessful and this results in unsuitable scaling factors being used to produce pollution datasets. Again, these are readily identified and corrected for during ratification.
- Pressurisation of the sampling system at the audit. Occasionally an analyser can be extremely sensitive to small changes in applied flow rates of calibration gas. This is more difficult to identify and correct, and may have consequences for data quality.

The procedures used to determine network performance are documented in **netcen** Work Instructions. These methods are regularly updated and improved and have been evaluated by the United Kingdom Accreditation Service (UKAS). **netcen** holds UKAS accreditation for the on-site calibration of all the analyser types (NOx, CO, SO_2, O_3) and for the determination of the TEOM k_0 factor and PM_{10} analyser flow rates used in the network. A UKAS Certificate of Calibration (Calibration Laboratory number 0401) for the Automatic Urban, Rural and London Networks is appended to this report.

2 Results Summary

A total of 116 sites were audited in this exercise. The sites at Edinburgh Centre, Hounslow Roadside and Liverpool Centre were not in operation at the time of the audit. This section of the report identifies analysers that did not meet performance standards, investigates the possible causes of these results and recommends any remedial action required.

The results of the intercalibration are summarised in Table 1 below:

Table 1 – Summary of network performance

Parameter	Number of outliers	Number in network	% outliers in total
NOx analyser	22	92	24%
CO analyser	8	70	11%
SO_2 analyser	10	73	14%
Ozone analyser	34	79	43%
TEOM and BAM analysers	3	63 TEOM 1 BAM	5%
Gravimetric PM_{10} analysers	-	7	n/a
Total	77	384	20%

An outlier is defined as an analyser that shows a deviation from the network mean of greater than 10% for NOx, CO and SO_2 and 5% for O_3. For PM_{10} analysers, the flow rates must be within 10% of the specified limits and the TEOM k_0 factor must be within 2.5% of the stated value.

In addition to these results, 3 of the 327 site cylinders (0.9%) used to scale instrument data into concentrations appeared to have drifted by more than 10% from their certificated values. Four NOx converters were found to be outside the 95% acceptance limit.

The number of analyser outliers identified is slightly worse than the previous exercise. At the summer 2002 intercalibration (which audited 82 AUN sites), 16% of the analysers in use were identified as outliers. This result is significantly influenced by the large increase in the number of ozone outliers identified during this exercise. Table 2 below presents a breakdown of the outliers identified, on a site-by-site basis:

Table 2 – Summary of Intercalibration Results Winter 2003

SITE	Date visited	NO_x	CO	SO_2	O_3	PM_{10}
ENGLAND						
Barnsley 12	05/02			OK		
Barnsley Gawber	05/02	Outlier 18%	OK	OK	Outlier -13%	
Bath Roadside	17/03	Outlier –11%	OK			
Billingham	18/02	OK				
Birmingham Centre	10/03	OK	OK	OK	Outlier -17%	OK
Birmingham East	14/03	OK	Not tested	OK	OK	OK
Blackpool	22/01	Outlier –21%	OK	Outlier –21%	Outlier -19%	OK
Bolton	28/01	OK	OK	OK	OK	OK
Bottesford	13/01				Outlier +16%	
Bournemouth	18/02	OK (CE 91%)	OK	OK	OK	OK
Bradford Centre	06/02	Outlier –14%	Outlier +16%	Outlier +19%	Outlier -17%	OK

SITE	Date visited	NO_x	CO	SO_2	O_3	PM_{10}
Brighton Roadside	13/03	Not tested	OK			
Brighton Roadside PM_{10}	13/03					OK
Bristol Centre	10/02	OK	OK	OK	OK	OK
Bristol Old Market*	18/03	OK	Outlier –16%			
Bury Roadside	28/01	OK	OK	OK	OK	OK
Cambridge Roadside	03/03	OK				
Camden Kerbside	08/01	OK				OK
Canterbury	08/01	Outlier +12%				OK
Coventry Memorial Park	12/03	OK	OK	OK	OK	OK
Exeter Roadside	12/02	OK	OK	OK	OK	
Glazebury	21/01				Outlier -14%	
Great Dun Fell	23/01				Outlier -15%	
Haringey Roadside	09/01	OK				OK
Harwell	13/01	OK		OK	Outlier -7%	
High Muffles	20/02				Outlier -31%	
Hounslow Roadside	Not operational at the time of the audit visit – relocating in Summer 03					
Hove Roadside	13/03	Outlier +12%	OK	OK		
Hull Freetown	14/01	OK	Outlier +398%	OK	OK	OK
Ladybower	22/01	OK		OK	OK	
Leamington Spa	13/03	OK	OK	OK	Outlier -7%	OK
Leeds Centre	07/02	OK	OK	OK	Outlier -9%	OK
Leicester Centre	15/01	OK	OK	OK	Outlier -15%	Outlier (k_0 +26%)
Liverpool Centre	Not operational at the time of the audit visit – relocating to Liverpool Speke					
London A3 Roadside	09/01	Outlier +33% (CE 88%)	OK			OK
London Bexley	08/01	OK	OK	OK	OK	OK
London Bloomsbury	21/03	OK	Outlier +12%	OK	OK	Outlier (flow)
London Brent	20/01	OK	OK	OK	Outlier -6%	OK
London Bromley	04/02	OK	OK			
London Cromwell Road 2	10/03	OK	OK	OK	OK	
London Eltham	12/02	OK		OK	OK	Outlier (flow)
London Hackney	21/03	Outlier +16%	Outlier +12%			
London Haringey	09/01				OK	
London Hillingdon	06/01	Outlier +12%	OK	OK	OK	OK
London Lewisham	07/02	OK		OK	Outlier -10%	
London Marylebone Road	07/01	OK	OK	Outlier +12%	OK	OK
London N. Kensington	06/01	OK	OK	Outlier +15%	OK	OK
London Southwark	03/02	Not tested	Outlier +13%	OK	OK	
London Teddington	19/03	OK		OK	Outlier -6%	
London Wandsworth	25/02	OK			Outlier –8%	
London Westminster	27/02	OK	OK	OK	OK	OK
Lullington Heath	12/03	OK		OK	Outlier +31%	
Manchester Piccadilly	22/01	OK	OK	OK	OK	OK
Manchester South	21/01	OK		Outlier –13%	Outlier –10%	
Manchester Town Hall	20/01	OK	OK			
Middlesbrough	18/02	OK	OK	OK	OK	OK
Newcastle Centre	20/02	Not tested	Not tested	Not tested	Outlier –9%	OK
Northampton	20/02	Outlier +11%	OK	OK	Outlier +25%	OK

SITE	Date visited	NO_x	CO	SO_2	O_3	PM_{10}
Northampton PM_{10} (Grav)	20/02					OK
Norwich Centre	04/03	OK	OK	OK	Outlier –17%	OK
Norwich Roadside	04/03	OK				
Nottingham Centre	13/01	OK	OK	OK	OK	OK
Oxford Centre	08/01	OK	OK	Outlier -25%		
Plymouth Centre	11/02	Outlier +12%	OK	OK	OK	OK
Portsmouth	19/02	OK	OK	OK	OK	OK
Preston	21/01	OK	Outlier –35%	OK	Outlier –8%	OK
Reading	07/01	Outlier -15%	OK	OK	OK	OK
Redcar	19/02	Outlier +18%	OK	OK	OK	OK
Rochester	11/03	OK		OK	OK	OK
Rotherham Centre	04/02	OK		Outlier –14%	Outlier –6%	
Salford Eccles	21/01	OK	OK	OK	OK	OK
Sandwell West Bromwich	27/01	Outlier +15%	OK	OK	OK	
Scunthorpe	14/01			OK		OK
Sheffield Centre	03/02	OK (CE 94%)	Outlier +14%	OK	OK	OK
Sheffield Tinsley	03/02	OK	OK			
Sibton	22/01				OK	
Somerton	11/02				OK	
Southampton Centre	28/02	OK	OK	OK	Outlier –8%	OK
Southend-on-Sea	21/01	OK	OK	OK	OK	OK
Southwark Roadside	05/02	OK	OK	OK		
St Osyth	21/01	OK	OK		Outlier –6%	
Stockport Shaw Heath	27/01	Outlier +15%	OK	OK		OK
Stockton-on-Tees Yarm	17/02	Outlier +21%	OK			OK
Stoke-on-Trent Centre	29/01	Outlier +13%	OK	OK	OK	OK
Sunderland	19/02			OK		
Thurrock	07/01	OK	OK	OK	OK	OK
Tower Hamlets Roadside	26/02	OK	OK			
Walsall Alumwell	29/01	OK				
Walsall Willenhall	24/02	OK				
West London	10/03	OK	OK			
Weybourne	05/03				OK	
Wicken Fen	05/03	Outlier –13%		Outlier –12%	OK	
Wigan Leigh	28/01	Outlier –10%	OK	OK	Outlier +21%	OK
Wirral Tranmere	21/01	OK	OK	OK	OK	OK
Wolverhampton Centre	24/01	OK (CE 90%)	OK	OK	Outlier –9%	OK
Yarner Wood	12/02				OK	
NORTHERN IRELAND						
Belfast Centre	25/02	OK	Not tested	OK	Outlier –13%	OK
Belfast Clara St	28/02					OK
Belfast East	25/02			OK		
Derry	26/02	OK	OK	Outlier –32%	Outlier –27%	OK
Lough Navar	06/03				Outlier –10%	OK
SCOTLAND						
Aberdeen	15/01	Outlier +11%	OK	OK		OK
Bush Estate	07/02				Outlier –16%	
Dumfries	04/02	OK	OK			OK

SITE	Date visited	NO_x	CO	SO_2	O_3	PM_{10}
Edinburgh Centre	Not operational at the time of the audit visit					
Eskdalemuir	03/02				OK	
Glasgow Centre	04/02	Outlier –15%	OK	OK	Outlier –8%	OK
Glasgow City Chambers	07/02	OK	OK			
Glasgow Kerbside	05/02	OK	OK			OK
Grangemouth	17/01	OK	OK	OK	OK	OK
Inverness	12/01	OK	OK			OK
Strath Vaich	12/01				OK	
WALES						
Aston Hill	04/03				OK	
Cardiff Centre	17/02	OK	OK	OK	Outlier –7%	OK
Cwmbran	17/02	OK		OK	OK	OK
Narberth	19/02	Outlier +11%		OK	OK	OK
Port Talbot	18/02	OK		OK	OK	OK
Swansea	18/02	OK	OK	OK	Outlier +6%	OK
Wrexham	20/01	OK	OK	Outlier –14%		OK

* - The manifold at Bristol Old Market has been vandalised repeatedly over the past 18 months. While this is not apparent from the audit results, the ambient data have been severely compromised as a result. Data from the site have been rejected up until the site was repositioned on 26/3/03.

The following sections look at each pollutant in turn, and investigate causes for outliers.

3 Oxides of Nitrogen

3.1 Intercalibration Outliers

The intercalibration highlighted that the results from 22 sites were outside the ±10% acceptance limit from the network mean. Of these, 15 can be attributed to small drifts in calibration factors between LSO calibrations, and no data will be lost as a result of this.

The outlier at London A3 Roadside is due to a major analyser drift between calibrations, and a poor converter result. The severity of these faults has resulted in some 50 days of data being rejected from this site.

The outlier at Reading is due to a combination of analyser and site cylinder drift. Despite these faults, no data will need to be rejected from this site.

The outlier at Glasgow Centre is due to the use of scaling factors from a bad LSO calibration. This has been corrected during ratification and no data were lost.

The outliers at London Hackney, Sandwell West Bromwich and Stockton-on-Tees Yarm all appear to be due to incorrect scaling factors used by the Management Units. These were corrected during ratification, and no data were lost as a result.

The outlier at Barnsley Gawber appears to be due to the analyser exhibiting some differences in response when gas was introduced through the sample inlet, as opposed to the dedicated cylinder inlet. This may well have some consequences for ambient data, as

the results from the scheduled calibrations may not accurately represent what the analyser samples from ambient air. The data from the site have been examined during ratification; it appears that the above responses do not affect measured concentrations unduly, and the data will be retained.

Due to site instrument malfunctions, it was not possible to test the analysers at Brighton Roadside, London Southwark, Newcastle Centre and Weybourne. The Bury Roadside analyser failed during the converter test.

Using the methodology as described in Section 1, comparison of the network averages to audit cylinder concentrations showed that the network underestimates NO concentrations by an average of 3.3% and underestimates NO_2 concentrations by an average of 4.7%. The percentage standard deviations of these results, which is an indication of how close the results are grouped together, was less than 5% in both cases. These are good results, and demonstrate that data from the vast majority of NOx analysers are accurate, harmonised and traceable to national metrology standards.

Converter Tests

Four converters were found to be less than 95% efficient:

- Bournemouth – 91% (7 days data rejected)
- London A3 Roadside – 88% (50 days data rejected)
- Sheffield Centre - 94% (no data rejected)
- Wolverhampton Centre – 90% (4 days data rejected)

The Sheffield Centre result is a borderline failure, and is unlikely to affect data quality unduly. However, the data from the other three sites were closely examined, and some data were rejected as a result, as noted above.

4 Carbon Monoxide

The intercalibration showed that the results from 8 analysers were outside the ±10% acceptance criterion. Of these, 4 can be attributed to small drifts in calibration factors between LSO calibrations, and no data were lost as a result of this.

The outlier at Hull Freetown appears to be due to an incorrect scaling factor used by the Management Unit. This was corrected during ratification, and no data were lost as a result.

The outlier at London Southwark was due to the use of calibration factors from a bad LSO calibration. This was corrected during ratification; no data were lost as a result.

The outlier at Sheffield Centre appears to be due to a combination of analyser drift between LSO calibrations and noisy, erratic response characteristics during the intercalibration visit. The data from this site has been checked during ratification and as a result, 10 days of data were rejected.

The analyser at Preston appears to be exhibiting some differences in response when gas was introduced through the sample inlet, as opposed to the dedicated cylinder inlet. This may well have some consequences for ambient data, as the results from the scheduled calibrations may not accurately represent what the analyser samples from ambient air. The

data from the site have been examined during ratification; it appears that the above responses do not affect measured concentrations unduly, and the data will be retained.

As a result of site instrument malfunctions, it was not possible to test the analysers at Birmingham East, Newcastle Centre and Belfast Centre at the time of the intercalibration visits.

Comparison of the network average to the audit cylinder concentration showed that the network underestimates CO concentrations by an average of 2.6%. The percentage standard deviation was 3.4%. These are very good results, and demonstrate that data from the CO analysers are accurate, harmonised and traceable to national metrology standards.

5 Sulphur Dioxide

1.1. Intercalibration Outliers

The intercalibration showed that the results from 10 analysers were outside the ±10% acceptance criterion. Of these, 9 can be attributed to small drifts in calibration factors between LSO calibrations, and no data were lost as a result of this.

The analyser at Derry appears to be exhibiting some differences in response when gas was introduced through the sample inlet, as opposed to the dedicated cylinder inlet. This may well have some consequences for ambient data, as the results from the scheduled calibrations may not accurately represent what the analyser samples from ambient air. The data from the site have been examined during ratification; it appears that the above responses do not affect measured concentrations unduly, and the data will be retained.

As a result of a site instrument malfunction, it was not possible to test the analyser at Newcastle Centre at the time of the intercalibration visit.

Comparison of the network average to the audit cylinder concentration showed that the network overestimates SO_2 concentrations by an average of 3.8%. The percentage standard deviation was 4.8%. These are good results, and demonstrate that data from the SO_2 analysers are accurate, harmonised and traceable to national metrology standards.

1.2. m-xylene tests

The efficiency of the hydrocarbon “kicker” was evaluated with a 1 ppm m-xylene cylinder. The kicker selectively removes hydrocarbons from the sample inlet prior to analysis. This is an important test, because m-xylene behaves in a similar manner to SO_2 when exposed to UV light within the analyser, and could therefore interfere with the analyser response, if the kicker does not function properly.

To pass the test, the analyser must not respond by more than 1% (10 ppb) of the m-xylene cylinder concentration. However, it should be noted that this particular test is very demanding; typical ambient hourly maximum concentrations of this pollutant rarely exceed 50 ppb, and annual concentrations rarely exceed 5 ppb.

The following 17 analysers were outside the required standard:

1. Barnsley Gawber (12 ppb)

2. Birmingham East (12 ppb)
3. Exeter Roadside (11 ppb)
4. London Bloomsbury (11 ppb)
5. London Cromwell Road 2 (16 ppb)
6. London Marylebone Road (15 ppb)
7. London North Kensington (14 ppb)
8. Lullington Heath (14 ppb)
9. Manchester Piccadilly (21 ppb)
10. Manchester South (19 ppb)
11. Salford Eccles (13 ppb)
12. Southend-on-Sea (12 ppb)
13. Southwark Roadside (13 ppb)
14. Wirral Tranmere (11 ppb)
15. Wolverhampton Centre (12 ppb)
16. Derry (12 ppb)
17. Grangemouth (15 ppb)

RECOMMENDATION

The kickers at Exeter Roadside and Derry have now been identified as outliers at four consecutive exercises, and it is recommended that replacement kickers are installed at these sites.

These results are worse than the previous intercalibration, when 14 analyser kickers (of 61 AUN analysers tested) were identified as outliers. However the magnitude of the responses to m-xylene was lower; none of these results give immediate cause for concern and no data have been rejected.

To put these results into perspective, at the expected maximum ambient concentrations of m-xylene (50ppb), the worst kicker would show an interference response of around 1 ppb.

6 Ozone

Calibration of the network analysers against the **netcen** reference photometers showed that 34 of 79 analysers were outside the ±5% acceptance criterion. This is significantly worse than the previous exercise, where 15 of the 46 AUN analysers tested were identified as outliers. It is not clear why so many analysers have drifted outside the acceptance limits, **netcen** will keep a close eye on the results from the summer intercalibration.

Of the 34 analysers, 18 had drifted by less than 10%; ratification of these datasets was straightforward, with no loss of data.

11 analysers had drifted between 10 and 20%. Ratification of the data from these analysers has been more complex, to ensure that suitable scaling of the data could be applied, but no losses of data were necessary.

The ozone analysers at High Muffles, Lullington Heath, Northampton, Wigan Leigh and Derry all gave results greater than 20% from the reference photometers. These severe outliers can be indicative of potential problems or faults. The datasets have been carefully checked during ratification, to ensure the data can be scaled reliably. No data need to be rejected as a result of these investigations except at Derry where 8 days were rejected due to a major internal leak in the solenoid valve.

7 Particulate analysers

1.3. TEOM k_0

Only one calculated k_0 value was found to be outside the ±2.5% acceptance limit. The Leicester Centre TEOM outlier was due to the replacement of a sensor unit, and the lack of a software update of the k_0 value. The data were rescaled and no data were rejected as a result.

The sensor and software values for the k_0 of the Wigan Leigh TEOM were found to be different at the intercalibration visit. However the calculated result was found to agree with the sensor unit value, and both these were within 2.5% of the software value. No data have been rejected as a result of this finding.

1.4. Analyser Flow Rates

The flow rates of the analyser at London Bloomsbury were found to be outside the ±10% acceptance limit. In addition, as noted in Part A, section 3.2 of this report, the analyser response has been carefully investigated as a result of an apparent baseline offset. As a result of these findings, 11 months of data have been rejected from this site.

The flow rates of the analyser at London Eltham were found to be outside the ±10% acceptance limit. Close examination of the datasets suggests that ambient data have not been affected unduly, therefore no data have been rejected.

8 Site Cylinder Concentrations

During the intercalibration, the concentrations of the on-site cylinders were evaluated using the audit cylinder standards. The calculated results showed that 3 of the 324 cylinders (0.9%) used to scale analyser data into concentrations (NO, CO and SO_2) appear to be outside the ±10% acceptance criterion. The NO cylinder at London Teddington and the SO_2 cylinder at Preston were both within 12% of their stated values, while the Reading NO cylinder was found to be 20% from the certified concentrations. The results for these cylinders will be carefully checked at the next intercalibration, and replacements issued if necessary.

In addition, the concentrations of 18 NO_2 cylinders appear to have drifted by more than 10%.

In total, 21 of the 324 cylinders (~6%) were outside the acceptance limits. This is much better than the previous intercalibration, where 9% of the cylinders were found to be out of specification.

The site cylinder evaluations are performed by calibrating the analysers with audit and site cylinder gas through the same inlet system, and using the conditioned site cylinder regulators, thus minimising any possible errors due to contaminated tubing or regulators.

9 LSO Audits

The performance of 41 of the 82 Local Site Operators was also assessed during this exercise, to determine their performance in undertaking scheduled calibrations. As with previous intercalibrations, the LSOs that were assessed remain keen and continue to perform their tasks to high standards.

The LSO audit exercises continue to demonstrate that operators are generally competent, enthusiastic and knowledgeable about their sites, which is a major factor in ensuring the high performance of the network.

10 Safety

netcen has undertaken extensive risk assessments of all its activities on-site to ensure that its staff are not exposed to unsafe practices while working.

The only issue that remains a significant risk is access to particulate analyser sampling heads to determine flow rates. At a number of sites, it is not possible to safely access the roof to access the inlet, which has prevented taking flow measurements up to this intercalibration. However, during this exercise **netcen** has been trialling a new method of calibrating the analyser flow rates that does not require roof access. This has proved to be very successful, and will now be used at all sites where roof access is unsafe.

11 Certification

The Network Certificate of Calibration is presented in Appendix B1. This certificate presents the results of the individual analyser scaling factors on the day of the audit, as calculated by **netcen** using the audit cylinder standards, in accordance with our UKAS accreditation.

12 Summary

The intercalibration exercise has demonstrated its value as an effective tool in determining overall site performance and assessing the reliability and traceability of air quality measurements from a large scale network. The results from this intercalibration have been used to assess data quality during the ratification of the network datasets for the 6-month period July to December 2002.

Appendix A1

As requested by the Department, QA/QC Unit has provided a list of suggestions for equipment that may need replacing or up grading in the network. The following provides a summary of the list and the actions taken to date. Recommendations have been prioritised from October 2000 as follows:

Priority	Definition	Time-scale
High*	Immediate action necessary to avoid compromising data capture/quality or safety	Within 2 weeks
Medium	Essential but not immediate	3-6 months
Low	Desirable but not essential	As appropriate

*Note – QA/QC Unit's practice is to notify CMCU immediately of any high priority issues at the time of the event.

	Recommendations: October 1998		Action
1	Replace old teflon-coated sample manifolds at former SUN sites		Completed
2	Replace long sample line at Manchester Town Hall		Completed
3	Use of 1 micron sample filters on API ozone analysers		In-hand at Defra sites
4	Fitting all AUN sites with ladder securing clips		In hand
5	Improving access to PM_{10} head at Scunthorpe (Affiliate site)		No action
6	Safer access to Walsall Alumwell		Railings installed
7	Installing temperature probes at sites without air-conditioning		Access to temp data from Ambirack sites now possible
	Recommendations: April 2000		
8	Consideration could be given to up-grading the "older generation" Ambirack system at Coventry in view of the problems identified at the audit.		Site relocated and analysers up-graded (February 2001)
	Recommendations: October 2000	**Priority**	**Action**
9	The site at Walsall Alumwell should be moved from school roof to ground level in order to improve site access and safety.	Medium	Railings installed
10	Safer access to PM_{10} head at Scunthorpe	Medium	Outstanding
11	Safer access to PM_{10} head at Stockport. Check that the recent fire damage to the next door building has not reduced the structural integrity of the shared flat roof.	Medium	Smoke damage only
12	The CO analyser at Birmingham Centre is very noisy (outside the ±0.5ppm acceptance level) and should be considered for replacement/up-grade	Medium	A new instrument was installed in March 2001
	Recommendations April 2001	**Priority**	**Action**
13	Up-grade or repair noisy CO analyser at Birmingham Centre	Medium	New instrument installed March 01
	Recommendations October 2001	**Priority**	**Action**
14	Up-grade or repair noisy CO analyser at Hull Centre	Medium	Site temporarily closed. Re-opened at Hull Freetown 8/11/02

	Recommendations May 2002	Priority	Action
None			
	Recommendations November 2002	**Priority**	**Action**
15	Up-grade or repair noisy CO analyser at Reading (Ambirak)	Critical Site	Repaired July 02
16	Up-grade or repair CO analyser (Environnement SA) at Liverpool (response noise and drift).	Critical Site	Site Closed
17	Up–grade or repair noisy analyser at Coventry Memorial Park (SO_2, and CO – Ambirak)	Critical Site	Scheduled for Winter Service
18	Up-grade or repair noisy PM_{10} analyser (TEOM) at Leicester Centre	Critical Site	To be replaced
19	Add remote dial up facility to collect instrument diagnostics for all Partisol analysers in the Network	Critical Sites	Phone lines installed – in hand
	Recommendations February 2003	**Priority**	**Action**
20	Sunderland SO_2 baseline response cycling	Medium	ESU investigated but no fault found. On-going
21	Investigate/repair SO_2 analyser at Glasgow Centre (random step changes in sensitivity)	Critical Site	On-going
22	Repair/replace Narberth SO_2 analyser (response instability)	High	On-going
	Recommendations April 2003	**Priority**	**Action**
23	ESU to carry out a 3-month converter test at Sheffield Centre, London A3 Roadside, Bournemouth and Wolverhampton Centre.	Medium	Converters replaced by ESUs
24	Investigation of auto calibration run-on problem at sites identified in Table 2.7	Medium	Carried out at service
25	Investigate/repair unstable SO_2 analyser at Narberth or replace analyser.	High	ESU visit 13/2/03 to repair. Ageing Ambirack needs up-grading
26	Investigate/repair SO_2 analyser at Glasgow Centre (random step changes in sensitivity)	Critical Site	UV lamp replaced 21/3/03
27	Casella Stanger and QA/QC Unit are currently working in conjunction to carry out a programme of site up-grades involving equipment replacement at a number of original EUN sites and rural sites in the network.	Some priority sites for new analysers have been identified	See Appendix A3
	Recommendations July 2003	**Priority**	**Action**
	A major programme to install new equipment is underway. (See appendix A3)		

APPENDIX A2

CRITICAL SITES IN THE AURN (20/07/2003)

Table A1 Critical Sites in Agglomerations

Site Name	Agglomeration	Critical Pollutants		
		DD1	DD2[7]	DD3
Belfast Centre	Belfast Urban Area	NO_2	CO	NO_2 $O3$
Wirral Tranmere	Birkenhead Urban Area	NO_2 PM_{10} SO_2	CO	NO_2 $O3$
Blackpool	Blackpool Urban Area	NO_2 PM_{10} SO_2	CO	NO_2 $O3$
Bournemouth+	Bournemouth Urban Area	NO_2 PM_{10} SO_2	CO	NO_2 O_3
Brighton Preston Park	Brighton/Worthing/Littlehampton			NO_2[6] O_3[6]
Brighton Roadside PM_{10} +	Brighton/Worthing/Littlehampton	PM_{10}		
Hove Roadside+	Brighton/Worthing/Littlehampton	SO_2		
Bristol Centre	Bristol Urban Area	PM_{10} SO_2		NO_2 O_3
Cardiff Centre	Cardiff Urban Area	NO_2 PM_{10} SO_2	CO	NO_2 O_3
Coventry Memorial Park+	Coventry/Bedworth	NO_2 PM_{10} SO_2	CO	NO_2 O_3
Edinburgh Centre	Edinburgh Urban Area	NO_2 PM_{10} SO_2	CO	NO_2 O_3
Glasgow Centre	Glasgow Urban Area	SO_2		NO_2 O_3
Hull Freetown	Kingston upon Hull	NO_2 PM_{10} SO_2	CO	NO_2 O_3
Leicester Centre	Leicester Urban Area	NO_2 PM_{10} SO_2	CO	NO_2 O_3
Liverpool Speke	Liverpool Urban Area	NO_2 PM_{10} SO_2	CO	NO_2 O_3
Nottingham Centre	Nottingham Urban Area	NO_2 PM_{10} SO_2	CO	NO_2 O_3
Portsmouth+	Portsmouth Urban Area	NO_2 PM_{10} SO_2	CO	NO_2 O_3
Preston	Preston Urban Area	NO_2 PM_{10} SO_2	CO	NO_2 O_3
Reading	Reading/Wokingham Urban Area	NO_2[5] PM_{10}[5] SO_2[5]	CO[5]	NO_2[5] O_3[5]
Sheffield Centre	Sheffield Urban Area	PM_{10}		
Southampton Centre	Southampton Urban Area	NO_2 PM_{10} SO_2	CO	NO_2 O_3
Southend-on-Sea	Southend Urban Area	NO_2 PM_{10} SO_2	CO	NO_2 O_3
Swansea+	Swansea Urban Area		CO	
Stoke-on-Trent Centre	The Potteries	NO_2 PM_{10} SO_2	CO	NO_2 O_3
Newcastle Centre	Tyneside	NO_2 PM_{10} SO_2	CO	NO_2 O_3

"+ indicates Affiliate site"

Note 2: PM_{10} monitored by Gravimetric and TEOM
Note 3: DD3 Critical as Rural Background station
Note 4: If NO_2 at Shrewsbury/Leominster is Suburban then NO_2 at Leamington Spa is no longer critical for DD1
Note 6: Not Affiliated/Monitoring yet. Target date 09 September 2003
Note 7: Addresses CO, Benzene not included here

Table A2 Critical Sites in Zones

Site Name	Zone	Critical Pollutant		
		DD1	DD2[7]	DD3
Grangemouth+	Central Scotland	NO_2 PM_{10} SO_2	CO	
Bush Estate	Central Scotland			NO_2[6] O_3
Ladybower	East Midlands			NO_2 O_3
Northampton+	East Midlands	NO_2 PM_{10}[2] SO_2	CO	NO_2 O_3
Sibton	Eastern			O_3[3]
Norwich Centre	Eastern			NO_2 O_3
Wicken Fen	Eastern			NO_2 O_3
Thurrock	Eastern			NO_2 O_3
Fort William	Highland			NO_2[6] O_3[6]
Strath Vaich	Highland			O_3[3]
Inverness	Highland	NO_2 PM_{10}		
Ashington	North East			NO_2[6] O_3[6]
Stockton-on-Tees Yarm+	North East	NO_2 PM_{10}	CO	
Sunderland	North East	SO_2		
Aberdeen+	North East Scotland	NO_2 PM_{10} SO_2	CO	NO_2 O_3
Aston Hill	North Wales			NO_2[6] O_3
Wrexham	North Wales	NO_2 PM_{10} SO_2	CO	
Great Dunn Fell	North West & Merseyside			O_3[3]
Wigan Leigh+	North West & Merseyside	NO_2 PM_{10} SO_2	CO	NO_2 O_3
Glazebury	North West & Merseyside			NO_2 O_3
Lough Navar	Northern Ireland			O_3[3]
Derry+	Northern Ireland	NO_2 PM_{10} SO_2	CO	NO_2 O_3
Eskdalemuir	Scottish Borders			NO_2[6] O_3
Dumfries	Scottish Borders	NO_2 PM_{10}	CO	
Canterbury+	South East	PM_{10}		
Oxford Centre+	South East	SO_2	CO	
Narberth	South Wales			O_3[3]
Cwmbran+	South Wales	NO_2 PM_{10} SO_2	CO	NO_2 O_3
Somerton	South West			NO_2 O_3
Yarner Wood	South West			NO_2[6] O_3
Plymouth Centre	South West	PM_{10}		
Shrewsbury/Leominster	West Midlands			NO_2[4 & 6] O_3[6]
Leamington Spa+	West Midlands	NO_2 PM_{10} SO_2	CO	NO_2 O_3
Barnsley Gawber+	Yorkshire & Humberside	NO_2	CO	NO_2 O_3
High Muffles	Yorkshire & Humberside			NO_2[6] O_3
Scunthorpe+	Yorkshire & Humberside	PM_{10}		

Total of 61 Critical Sites (25 in Agglomerations and 36 in Zones)
51% of network stations critical under one or more Daughter Directives
"+ indicates Affiliate site"

Note 2: PM_{10} monitored by Gravimetric and TEOM
Note 3: DD3 Critical as Rural Background station
Note 4: If NO_2 at Shrewsbury/Leominster is Suburban then NO_2 at Leamington Spa is no longer critical for DD1
Note 6: Not Affiliated/Monitoring yet. Target date 09 September 2003
Note 7: Addresses CO, Benzene not included here

APPENDIX A3

AURN EQUIPMENT REPLACEMENT PROGRAMME - July 2003

	PART A Replacement at Critical Defra Sites					
	Site	**New Instrument**	**Scheduled w/c**	**Installed**	**QA/QC commissioned**	**Notes**
1	Blackpool Centre	TEOM	11/08/2003			***Signal to replace during service***
2	Glasgow Centre	TEI 43C SO2 }	04/08/2003			***Signal to replace during service***
3	Preston	TEI 43C SO2 }				***Await results of Wirral mod***
4	Wirral Tranmere	TEI 43C SO2 }		Yes		***Modified Signal unit installed 01-07-03; await evaluation***
5	Reading	Ambirak CO bench		Yes		***await relocation completion***
6	Sunderland	API M100 SO2	14/08/2003			***ET to replace during service***
7	Plymouth	TEI 43C SO2 TEOM	21/07/2003			***Signal to replace during service***
	PART B Replacement at Non-Critical Defra Sites					
8	Glasgow Kerbside	TEOM	04/08/2003			***Signal to replace during service***
9	London A3	TEOM	07/07/2003			***Signal to replace during service***
10	London Hillingdon	TEI 43C SO2 TEOM	14/07/2003			***Signal to replace during service***
11	Wolverhampton	TEI 43C SO2	04/08/2003			***Signal to replace during service***
	PART C Replacement at Critical Affiliate Sites					
12	Coventry MP	HORIBA NOX, SO2, O3, CO TEOM				***Horiba to upgrade during next 2 months***
13	Aberdeen	TEOM	28/07/2003			***ET to replace during service***
	PART D Replacement of Original EUN Network					
14	London Bloomsbury	API NOX, SO2, O3, CO TEOM	09/07/2003	TEOM		***TEOM replaced by ETI on 21/5/03. ET to replace other during service***
15	Bristol Centre	API NOX, SO2, O3, CO TEOM	21/07/2003			***ET to replace during service***
16	Edinburgh	API NOX, SO2, O3, CO TEOM				***Relocation not yet complete - will eventually be upgraded by ET***
17	Cardiff	API NOX, SO2, O3, CO TEOM	18/08/2003			***ET to replace during service***
18	Birmingham Centre	API NOX, SO2, O3, CO TEOM	08/09/2003			***ET to replace during service***
19	Newcastle	ML NOX, SO2, O3, CO, TEOM	25/04/2003	yes	15/05/03	***Replaced by ETI 25/04/03***
20	Liverpool Speke	ML NOX, SO2, O3, CO, TEOM		yes	20/05/03	***Replaced by ETI 16/04/03***
21	Belfast Centre	ML NOX, SO2, O3, CO, TEOM		yes	21/05/03	***Replaced by ETI 01/05/03***
22	Southampton	ML NOX, SO2, O3, CO TEOM	04/08/2003			***ETI to replace during service***
23	Hull	ML NOX, SO2, O3, CO TEOM	21/07/2003	TEOM		***TEOM replaced by ETI on 13/5/03. Others to be replaced during service***
24	Leeds	HORIBA NOX, SO2, O3, CO TEOM				***Normal ETI service - others will eventually be upgraded by Horiba***
25	Leicester	HORIBA NOX, SO2, O3, CO TEOM		TEOM		***TEOM replaced by ETI on 23/4/03. Normal ETI service - will eventually be***

						upgraded by Horiba
26	Ambirack Sites	HORIBA NOX, SO2, O3, CO				***unidentified as yet***
27	Ambirack Sites	HORIBA NOX, SO2, O3, CO				***unidentified as yet***
	PART E Replacement of Aged Rural Network Equipment					
28	Aston Hill	API M400 O3 (NOx DD3)	28/07/2003			***ETI to replace during service***
29	Bush	API M400 O3 (NOx DD3)	14/07/2003			***ETI to replace during service***
30	Eskdalemuir	API M400 O3 (NOx DD3)	04/08/2003			***ETI to replace during service***
31	Glazebury	API M400 O3 (NOx DD3)	30/06/2003			***ETI to replace during service***
32	Great Dun Fell	API M400 O3	04/08/2003			***ETI to replace during service***
33	Harwell	API M400 O3, NOx, SO2	14/07/2003			***ETI to replace during service***
34	High Muffles	API M400 O3 (NOx DD3)	25/08/2003			***ETI to replace during service***
35	Ladybower	API M400 O3, NOx, SO2	28/07/2003			***ETI to replace during service***
36	Lough Navar	API M400 O3	TBC			***ETI to replace during service***
37	Sibton	API M400 O3	14/07/2003			***ETI to replace during service***
38	Strath Vaich	API M400 O3	28/07/2003			***ETI to replace during service***
39	Wicken Fen	API M400 O3, NOx, SO2	18/08/2003			***ETI to replace during service***
40	Yarner Wood	API M400 O3 (NOx DD3)	21/07/2003			***ETI to replace during service***

	DD3 Requirements		**Scheduled**	**Installed**	**Commissioned**	
1	Portsmouth	O3	27/02/2003	Yes	15/04/2003	
2	Cwmbran	O3		Yes	29/04/2003	
3	Somerton	NOx		Yes	28/04/2003	
4	Aberdeen	O3		Yes	29/7/2003	
5	Northampton	O3		Yes	13/03/2003	
6	Bournemouth	O3		Yes	27/02/2003	
7	Aston Hill	NOx	28/07/2003			
8	Bush	NOx	14/07/2003			
9	Eskdalemuir	NOx				
10	Glazebury	NO_x (+ PM_{10} to be installed)	30/06/2003			
11	High Muffles	NO_x	14/07/2003	Yes	5/8/2003	
12	Yarner Wood	NO_x	30/06/2003		25/7/2003	

TBC = to be confirmed
w/c = week commencing

Appendix B1

Network Certificate of Calibration

CERTIFICATE OF CALIBRATION

AEA Technology Environment

Culham, Abingdon, Oxfordshire OX14 3ED. Telephone 01235 463099 Facsimile 01235 463011

UKAS CALIBRATION 0401 0401 S1

Certificate No: 00606
AEA Identification Number: 20568104

Approved Signatories: ✓ K. Stevenson
S. Eaton

Signed: Date:

Date of issue: 21 July 2003

Customer Name and Address: Dr Janet Dixon
AEQ Division
Department for Environment, Food and Rural Affairs
Ashdown House (Zone E14)
123 Victoria Street
London SW1E 6DE

Description: Calibration factors for monitoring stations in the Automatic Urban Monitoring Network

1. Carbon Monoxide

Date Year =2003	Site	Analyser number	[1]Zero output	Uncertainty (ppm)	[2]Calibration Factor	Uncertainty (%)	*R^2
	Scottish Sites						
15/01	Aberdeen	10269	1	0.3	1.04	3	0.9998
4/02	Dumfries	m300-1498	11	0.3	0.010	3	0.9986
4/02	Glasgow Centre	gra410-009	-10	0.3	0.045	3	0.9996
7/02	Glasgow City Chambers	m300-721	-10	0.3	0.052	3	0.9997
5/02	Glasgow Kerbside	HAR 002	0	0.3	0.044	3	0.9992
17/01	Grangemouth	12894	1	0.3	1.083	3	0.9986
12/01	Inverness	12577	76	0.3	0.010	3	0.9988
	Welsh Sites						
17/02	Cardiff Centre	co11m8280	25	0.3	0.053	3.2	0.9996
17/02	Cwmbran	103006	0	0.5	1.093	3.2	0.9904
18/02	Swansea	m300-070	11	0.3	0.051	3	0.9997
20/01	Wrexham	12556	108	0.3	0.010	3	0.9999
	N.Irish Sites						
26/02	Derry	J-AR-009	-2	0.3	0.049	3	0.9994

The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor k = 2, providing a level of confidence of approximately 95%. The uncertainty evaluation has been carried out in accordance with UKAS requirements.

CERTIFICATE OF CALIBRATION

0401
0401 S1

Date Year =2003	Site	Analyser number	[1]Zero output	Uncertainty (ppm)	[2]Calibration Factor	Uncertainty (%)	*R^2
	English Sites						
5/02	Barnsley Gawber		4	0.3	0.051	3	0.9997
17/03	Bath Roadside	11388	-2	0.3	0.052	3	0.9992
10/03	Birmingham Centre	13072	12	0.3	0.052	3	0.9992
22/01	Blackpool	l-ar-010	-1	0.4	0.058	3	1.0000
28/01	Bolton	440	0	0.3	1.105	3	0.9999
18/02	Bournemouth	1501	0	0.3	1.153	3	0.9995
6/02	Bradford Centre		17	0.3	0.047	3	0.9998
13/03	Brighton Roadside	m300-525	-16	0.3	0.052	3	0.9993
10/02	Bristol Centre	24	23	0.3	0.058	3	0.9986
18/03	Bristol Old Market	N121	101	0.3	0.064	3	0.9972
28/01	Bury Roadside	277	0	0.3	1.050	3	0.9993
12/03	Coventry Memorial Park		-6	0.3	0.056	3	0.9983
12/02	Exeter Roadside	244	21	0.3	0.052	3	0.9995
13/03	Hove Roadside	m3001433	8	0.3	0.054	3	0.9994
14/01	Hull Freetown	m300-	-82	0.3	0.011	3	0.9996
13/03	Leamington Spa	2198	57	0.3	0.054	3	0.9981
7/02	Leeds Centre	148	77	0.3	0.053	3	0.9996
15/01	Leicester Centre	c011m104	72	0.3	0.053	3.9	0.9987
9/01	London A3 Roadside	Ambirak H	-1	0.3	0.062	3	0.9986
8/01	London Bexley	m300-079	-8	0.3	0.052	3	0.9920
21/03	London Bloomsbury	r1260	68	0.3	0.047	3	0.9984
20/01	London Brent	9830-339	19	0.3	0.051	3	0.9988
4/02	London Bromley	37855-256	3	0.3	0.953	3	0.9976
10/03	London Cromwell Road 2	10776	28	0.3	0.051	3	0.9996
21/03	London Hackney	36674-254	41	0.3	0.051	3	0.9974
6/01	London Hillingdon	GRA0410-005	32	0.5	0.048	3.8	0.9994
7/01	London Marylebone Rd	651	0	1.1	1.045	5.8	0.9994
6/01	London N. Kensington	360	2	1.0	1.021	3	0.9993
3/02	London Southwark	843	0	0.3	1.022	3	0.9989
27/02	London Westminster	867	4	0.3	0.051	3	0.9996
22/01	Manchester Piccadilly	GRA0410-008	-3	0.3	0.053	3	0.9997
20/01	Manchester Town Hall	720	1	0.3	0.051	3	0.9995
18/02	Middlesbrough	214	1	0.3	0.053	3	0.9984
20/02	Northampton		0	0.3	1.019	3	0.9982
4/03	Norwich Centre		2	0.3	0.051	3	0.9999
13/01	Nottingham Centre		5	0.3	0.052	3	0.9989
8/01	Oxford Centre	214b-127	106	0.3	0.051	3	0.9999
11/02	Plymouth Centre	h-rao-410	-6	0.3	0.050	3	0.9997
19/02	Portsmouth	902015	0	0.3	1.020	3	0.9985
21/01	Preston	Ambirak N	7	0.3	0.093	3	0.9979
7/01	Reading		-2	0.3	0.050	3	0.9999
19/02	Redcar	10194	34	0.3	0.050	3	0.9981
21/01	Salford Eccles	438	0	0.3	1.016	3	0.9997

The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor k = 2, providing a level of confidence of approximately 95%. The uncertainty evaluation has been carried out in accordance with UKAS requirements.

Date Year =2003	Site	Analyser number	[1]Zero output	Uncertainty (ppm)	[2]Calibration Factor	Uncertainty (%)	*R^2
27/01	Sandwell West Bromwich	94603	12	0.3	0.053	3	0.9995
3/02	Sheffield Centre	410-006	8	0.3	0.051	3	0.9966
3/02	Sheffield Tinsley	1856	16	0.3	0.048	3	0.9990
28/02	Southampton Centre	co11m-90	35	0.3	0.054	3	0.9999
21/01	Southend-on-Sea		-6	0.3	0.056	3	0.9989
5/02	Southwark Roadside	410b-931	-1	0.8	1.053	4.4	0.9988
27/01	Stockport Shaw Heath	9830-340	17	0.3	0.053	3	0.9996
17/02	Stockton-on-Tees Yarm	9830-399	0	0.3	1.103	3	0.9995
29/01	Stoke-on-Trent Centre	h-ar-003	9	0.3	0.070	3	0.9984
7/01	Thurrock	m300-262	18	0.3	0.055	3	0.9965
26/02	Tower Hamlets Roadside	co11m-272	4	0.3	1.155	3	0.9999
10/03	West London	92915	121	0.3	0.050	3	0.9998
28/01	Wigan Leigh	6011	0	0.3	1.126	3	0.9998
21/01	Wirral Tranmere		-26	0.3	0.055	3	0.9998
24/01	Wolverhampton Centre	loan	4	0.3	0.057	3.1	0.9994

2. Sulphur Dioxide

Date Year =2003	Site	Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	*R^2	*m-xylene interference (ppb)
	Scottish Sites							
15/01	Aberdeen	12182	3	4.3	0.999	5	0.9995	4.5
4/02	Glasgow Centre	gra477018	47	4.1	0.226	5.1	0.9928	0
17/01	Grangemouth	702b-214	0	4.2	1.000	5	0.9978	15.0
	Welsh Sites							
17/02	Cardiff Centre	m100-054	16	4.1	0.184	5	0.9998	
17/02	Cwmbran	408001	10	4.1	0.903	5	0.9909	
19/02	Narberth	H-RS458	29	8.2	0.833	6.3	0.9988	
18/02	Port Talbot	943	0	4.3	1.001	5	0.9910	
18/02	Swansea	m100-168	12	4.1	0.187	5	0.9994	
20/01	Wrexham	12183	10	4.1	0.300	4.3	0.9952	2.4
	N.Irish Sites							
25/02	Belfast Centre	m400-052	44	4.1	0.203	5	0.9965	5.0
25/02	Belfast East	api100A703	11	4.2	0.955	5	0.9976	9.5
26/02	Derry	J-AR-009	84	4.5	0.942	5	0.9966	11.5
	English Sites							
5/02	Barnsley 12	2839	-3	4.3	0.942	5.2	0.9998	2.6
5/02	Barnsley Gawber		57	4.6	1.054	5.7	0.9977	12.4
10/03	Birmingham Centre	92378	20	4.2	0.233	5.1	0.9957	
14/03	Birmingham East	92458	1	4.1	0.194	5.1	0.9967	11.5
22/01	Blackpool	l-ar-010	37	8.5	2.061	6.9	0.9990	

The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor k = 2, providing a level of confidence of approximately 95%. The uncertainty evaluation has been carried out in accordance with UKAS requirements.

CERTIFICATE OF CALIBRATION

0401
0401 S1

Date Year =2003	Site	Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	*R^2	*m-xylene interference (ppb)
28/01	Bolton	780	1	4.2	0.945	5	0.9995	
18/02	Bournemouth	1179	0	4.2	1.076	5	0.9971	3.6
6/02	Bradford Centre		73	5.9	0.890	6	0.9997	7.6
10/02	Bristol Centre	92312	6	4.1	0.202	5	0.9946	2.5
28/01	Bury Roadside	559	-5	5.0	0.975	5.2	0.9999	4.9
12/03	Coventry Memorial Park		124	6.0	0.813	6.6	0.9985	
12/02	Exeter Roadside	634	20	4.3	0.978	5	0.9969	11.2
13/01	Harwell	25322	13	4.1	0.189	5.1	0.9169	7.1
13/03	Hove Roadside	m1001178	-2	4.1	0.922	5.6	0.9992	8.3
14/01	Hull Freetown	m100-205	-57	4.3	0.209	5	0.9988	7.6
13/03	Leamington Spa		18	4.5	0.924	5.9	0.9981	
7/02	Leeds Centre	m100-053	10	4.0	0.191	5.7	0.9992	3.8
15/01	Leicester Centre	m100-204	7	4.2	0.191	5	0.9989	9.2
8/01	London Bexley	m100-066	13	4.2	0.190	5.5	0.9989	8.0
21/03	London Bloomsbury	m100 055	84	5.7	0.215	5.8	0.9957	11.0
20/01	London Brent	9850-663	21	4.1	0.922	9.4	0.9945	8.3
10/03	London Cromwell Road 2	10779	-5	4.2	0.953	5.3	0.9997	16.2
12/02	London Eltham	822	10	4.3	0.931	5	0.9738	9.8
6/01	London Hillingdon	GRA0477017	-9	4.2	0.191	5.1	0.9816	1.7
7/02	London Lewisham	m1220m498	0	4.1	0.939	5	0.9968	9.4
7/01	London Marylebone Rd	411	1	4.2	0.911	5.2	0.9995	14.5
6/01	London N. Kensington	1020	5	4.1	0.904	5.3	0.9999	13.6
3/02	London Southwark	535	10	4.3	1.032	5	0.9911	2.8
19/03	London Teddington	58811-320	4	4.2	0.924	5.3	0.9990	5.3
27/02	London Westminster	705	-1	4.3	0.932	5	0.9993	4.4
12/03	Lullington Heath	m1649m640	69	4.1	0.455	5.1	0.9998	14.0
22/01	Manchester Piccadilly	GRA0477-013	-19	4.1	0.184	5.8	0.9993	20.5
21/01	Manchester South	E4770104	-20	4	0.253	6.1	0.9990	19.2
18/02	Middlesbrough	93123	10	4	0.199	5.1	0.9957	1.6
20/02	Northampton	890563033	4	4.1	0.335	5	0.9941	1.6
4/03	Norwich Centre		78	7.0	2.631	7.1	0.9997	8.6
13/01	Nottingham Centre	0477-016	398	4	0.211	5	0.9987	2.5
8/01	Oxford Centre	376b-161	98	5.0	1.360	5.5	0.9935	4.4
11/02	Plymouth Centre	35689-251	-21	4.4	0.921	5.1	0.9961	7.7
19/02	Portsmouth	578323093	10	4.2	0.998	5	0.9979	0.7
21/01	Preston	Ambirak N	88	4.2	1.151	5	0.9998	0
7/01	Reading		195	4.5	1.000	5	0.9943	7.0
19/02	Redcar	10355	7	4.6	0.990	6.5	0.9991	10.4
11/03	Rochester	m100-414	-1	4.2	0.833	5.5	0.9995	3.7
4/02	Rotherham Centre	447-0109	-25	4.2	1.136	5.4	0.9967	8.0
21/01	Salford Eccles	792	-1	4.2	0.744	7.9	0.9985	13.2
27/01	Sandwell West Bromwich	93082	3	4.1	0.922	5.2	0.9962	3.7
14/01	Scunthorpe	m200a-468	3	4.3	1.052	5	0.9993	1.8

The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor k = 2, providing a level of confidence of approximately 95%. The uncertainty evaluation has been carried out in accordance with UKAS requirements.

Date Year =2003	Site	Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	*R^2	*m-xylene interference (ppb)
3/02	Sheffield Centre	477-015	5	4.1	0.203	5.3	0.9995	1.1
28/02	Southampton Centre	m100-203	7	4.1	0.187	5.3	0.9999	2.2
21/01	Southend-on-Sea		169	4.8	1.145	5.7	0.9925	12
5/02	Southwark Roadside	3008-659	-3	4.2	0.895	5	0.9982	13.2
27/01	Stockport Shaw Heath	ml-9850-742	21	4.2	0.987	5	0.9989	
29/01	Stoke-on-Trent Centre	h-ar-003	48	4.4	1.230	5.3	0.9933	
19/02	Sunderland	508	2	4.1	0.826	5.2	0.9987	1.7
7/01	Thurrock	m100a-555	3	4.3	0.987	5	0.9986	8.1
5/03	Wicken Fen	29433-234	8	4.1	0.202	5.2	0.9988	6.7
28/01	Wigan Leigh	2	1	4.2	1.012	5.3	0.9962	
21/01	Wirral Tranmere		50	4.5	1.328	5	0.9987	11.3
24/01	Wolverhampton Centre	447-009	-8	4.4	0.229	5.1	0.9982	11.7

3. Ozone

Date Year =2003	Site	Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	*R^2
	Scottish Sites						
7/02	Bush Estate	m8810-346	13	5.2	0.594	4.5	0.9997
3/02	Eskdalemuir	m8810-639	8	3	0.512	3.1	0.9992
4/02	Glasgow Centre	gra427-013	-22	5.2	0.219	3.7	0.9971
12/01	Strath Vaich	338	-15	3	0.513	3.3	0.9998
	Welsh Sites						
17/02	Cardiff Centre	m400-057	25	3	0.108	3.1	0.9999
17/02	Cwmbran	402009	3	3	0.974	3.3	0.9997
19/02	Narberth	H-RS458	2	3	1.018	3.2	0.9992
18/02	Port Talbot	339	0	3	0.502	3.1	0.9999
18/02	Swansea	m400-156	30	3	0.094	3.1	0.9999
	N.Irish Sites						
25/02	Belfast Centre	m400-051	5	3	0.115	3.1	1.0000
26/02	Derry	J-AR-009	2	3	1.371	3.3	0.9994
6/03	Lough Navar	841B-176	1	3	0.439	3.1	0.9980
	English Sites						
5/02	Barnsley Gawber		0	3	1.156	3.1	0.9998
10/03	Birmingham Centre	92379	20	3	0.121	3.2	0.9998
14/03	Birmingham East	92456	18	3	0.096	3.6	1.0000
22/01	Blackpool	l-ar-010	26	3	1.271	3.1	0.9883
28/01	Bolton	195	2	3	1.005	3.1	1.0000
13/01	Bottesford	EA369	0	3	0.863	3.1	1.0000
18/02	Bournemouth	824	-1	3	1.008	3.1	1.0000
6/02	Bradford Centre		3	3.4	1.211	3.3	0.9994
10/02	Bristol Centre	92313	13	3	0.102	3.1	1.0000
28/01	Bury Roadside	106	3	3	1.015	3.1	1.0000
12/02	Exeter Roadside	94	20	3	1.052	3.1	0.9999

The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor k = 2, providing a level of confidence of approximately 95%. The uncertainty evaluation has been carried out in accordance with UKAS requirements.

CERTIFICATE OF CALIBRATION

0401
0401 S1

Date Year =2003	Site	Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	*R^2
21/01	Glazebury	471	10	3	0.574	3.1	0.9997
23/01	Great Dun Fell		8	3	0.585	3.5	0.9999
13/01	Harwell	324	15	3	0.513	3.3	0.9997
20/02	High Muffles	336	-13	3	0.717	3.1	0.9974
14/01	Hull Freetown	m400-219	3	3	0.099	3.1	1.0000
13/03	Leamington Spa		18	3	1.076	3.1	0.9997
7/02	Leeds Centre	m400-056	-12	3	0.110	3.1	0.9999
15/01	Leicester Centre	m400-218	0	3	0.118	3.2	0.9999
8/01	London Bexley	m400-062	26	3	0.099	3.4	0.9997
21/03	London Bloomsbury	eti91	5	3	0.105	4.8	0.9979
20/01	London Brent	9812-123	18	3	0.527	3.1	0.9999
12/02	London Eltham	375	8	3	1.015	3.2	0.9996
21/03	London Hackney	36870-254	2	3	1.024	3.6	0.9998
9/01	London Haringey	538	10	3	1.061	3.3	0.9998
6/01	London Hillingdon	GRA0427-012	2	3	0.101	3.1	1.0000
7/02	London Lewisham	939b-187	1	3	0.912	3.1	1.0000
7/01	London Marylebone Rd	769	0	3	1.009	3.1	0.9999
6/01	London N. Kensington	497	10	3	1.026	3.1	1.0000
3/02	London Southwark	5776	2	3	1.009	3.2	0.9997
19/03	London Teddington	374	-23	3	0.211	3.1	0.9999
25/02	London Wandsworth	o341m-491	10	3	1.083	3.4	0.9999
27/02	London Westminster	879	8	3	0.508	3.1	1.0000
12/03	Lullington Heath	m1655-m337	98	3	0.334	3.1	0.9541
22/01	Manchester Piccadilly	427-017	13	3	0.211	3.2	0.9930
21/01	Manchester South	E4270102	3	3	0.112	3	1.0000
18/02	Middlesbrough	93112	10	3	0.102	3.1	0.9999
20/02	Newcastle Centre	96	-12	3	0.111	3.1	0.9999
20/02	Northampton		1	3	0.799	3.1	1.0000
4/03	Norwich Centre		0	3	1.223	3.3	0.9988
13/01	Nottingham Centre	0427-011	-10	3	0.100	3.1	0.9991
11/02	Plymouth Centre	39525-251	0	3	0.504	3.2	0.9999
21/01	Preston	Ambirak N	0	3	1.095	3.1	0.9999
7/01	Reading		0	3	1.057	3.1	0.9984
19/02	Redcar	10195	3	3	0.490	3.1	1.0000
11/03	Rochester	m400-378	0	3	1.016	3.1	1.0000
4/02	Rotherham Centre	d4270106	0	3	0.985	3.1	0.9994
21/01	Salford Eccles	194	2	3.7	1.058	3.4	0.9998
27/01	Sandwell West Bromwich	93083	-3	3	0.507	3.1	1.0000
3/02	Sheffield Centre	427-010	0	3	0.098	3.1	0.9999
22/01	Sibton	8810-434	5	3	0.512	3.2	0.9998
11/02	Somerton	95249	1	3	0.485	3.1	1.0000
28/02	Southampton Centre	m400-217	3	3	0.109	3.1	0.9998
21/01	Southend-on-Sea		0	3	0.981	3.1	1.0000
21/01	St Osyth	60869	-2	3	0.53	3.1	0.9999
29/01	Stoke-on-Trent Centre	h-ar-003	3	3	1.045	3.4	0.9994
7/01	Thurrock	m400-1040	2	3	0.497	3.1	1.0000
5/03	Weybourne		0	3	1.009	3.1	0.9994

The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor k = 2, providing a level of confidence of approximately 95%. The uncertainty evaluation has been carried out in accordance with UKAS requirements.

Date Year =2003	Site	Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	*R^2
5/03	Wicken Fen	8810-578	3	3	0.509	4.0	0.9998
28/01	Wigan Leigh	4009	3	3	0.825	3.1	1.0000
21/01	Wirral Tranmere		-1	3	1.022	3.1	0.9998
24/01	Wolverhampton Centre	427-009	-9	3	0.109	3.1	0.9996
12/02	Yarner Wood	92418	10	3	0.481	3.1	1.0000

4. Oxides of Nitrogen

Date Year =2003	Site		Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	*R^2	*Converter efficiency (%)
	Scottish Sites								
15/01	Aberdeen	NO NOx	10268	0 -1	5 5.4	1.481 1.478	5 5	0.9996 0.9997	98.1
4/02	Dumfries	NO NOx	m200a-1494	4 -10	5 5.2	0.513 0.500	5 5	0.9982 0.9982	97.4
4/02	Glasgow Centre	NO NOx	gra447-011	7 9	5 5.8	0.522 0.497	5 5	0.9963 0.9966	95.2
7/02	Glasgow City Chambers	NO NOx	m200a-575	-2 -1	5 5.7	1.678 1.677	5 5	0.9992 0.9992	95.3
5/02	Glasgow Kerbside	NO NOx		23 22	5 5.5	1.654 1.685	5 5	0.9976 0.9978	97.8
17/01	Grangemouth	NO NOx	700b-312	0 1	5 5.5	1.114 1.112	5 5	0.9996 0.9996	98.8
12/01	Inverness	NO NOx	12184	-52 -57	5 5.3	0.405 0.403	5 5	0.9989 0.9987	98.1
	Welsh Sites								
17/02	Cardiff Centre	NO NOx	m200-033	11 8	5 5.2	0.436 0.429	5 5	0.9996 0.9996	97.8
17/02	Cwmbran	NO NOx	406003	0 7	5 5.8	1.074 0.953	5 5	0.9987 0.9959	95.1
19/02	Narberth	NO NOx	H-RS458	22 23	5 5.3	1.201 1.190	5.3 5	0.9988 0.9994	95.2
18/02	Port Talbot	NO NOx	320	1 -1	5 5.3	1.257 1.242	5 5	0.9995 0.9996	104.8
18/02	Swansea	NO NOx	m200-148	2 1	5 5.4	0.440 0.434	5 5	0.9996 0.9997	95.7
20/01	Wrexham	NO NOx	12185	4 7	5 5.5	0.541 0.541	5 5	0.9998 0.9997	98.3
	N.Irish Sites								
25/02	Belfast Centre	NO NOx	m200-038	-19 -22	5 6.0	0.497 0.485	5 5	0.9920 0.9927	100.0
26/02	Derry	NO NOx	J-AR-009	43 43	8.5 6.8	2.271 2.296	5 5	0.9974 0.9979	96.5
	English Sites								
5/02	Barnsley Gawber	NO NOx		94 99	15.9 19.9	2.935 3.056	17.9 12.5	0.9997 0.9996	95.8
17/03	Bath Roadside	NO NOx	12758	7 7	5 5.5	1.242 1.242	5 4	0.9991 0.9991	98.7

The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor k = 2, providing a level of confidence of approximately 95%. The uncertainty evaluation has been carried out in accordance with UKAS requirements.

CERTIFICATE OF CALIBRATION

UKAS CALIBRATION 0401 0401 S1

Certificate No: 00606

AEA Identification Number: 20568104

Date Year =2003	Site		Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	*R^2	*Converter efficiency (%)
18/02	Billingham	NO NOx	10440	-1 -2	5 5.4	1.469 1.470	5 5	0.9994 0.9997	98.6
10/03	Birmingham Centre	NO NOx	92377	-9 -10	5 5.2	0.425 0.442	5 5	0.9991 0.9990	98.7
14/03	Birmingham East	NO NOx	92457	-15 -28	5 5.2	0.456 0.449	5 5	0.9999 0.9997	98.3
22/01	Blackpool	NO NOx	l-ar-010	39 40	5 6.6	2.918 2.832	5 5	0.9994 0.9993	95.9
28/01	Bolton	NO NOx	433	0 1	5 5.8	1.175 1.182	5 5	0.9999 0.9999	103.1
18/02	Bournemouth	NO NOx	522	1 1	5 5.3	1.230 1.241	5 5	0.9958 0.9964	91.4
6/02	Bradford Centre	NO NOx		35 36	5 6.2	2.261 2.351	5 5.2	0.9990 0.9991	96.3
10/02	Bristol Centre	NO NOx	92311	-7 -4	5 5.6	0.445 0.427	5 5	0.9984 0.9983	98.9
18/03	Bristol Old Market	NO NOx	ap1200a653	-2 -2	5 6.9	3.124 3.167	5 5	0.9985 0.9994	94.9
28/01	Bury Roadside	NO NOx	1710	0 1	5 5.5	1.170 1.209	5 5	Analyser failed during tests	
3/03	Cambridge Roadside	NO NOx	55355-303	0 0	5 5.4	1.072 1.073	5 5	0.9999 0.9999	99.2
8/01	Camden Kerbside	NO NOx	623	2 2	5 5.4	1.262 1.284	5 5	0.9995 0.9994	98.5
8/01	Canterbury	NO NOx	11666	0 -2	5 5.4	1.400 1.364	5 5	0.9974 0.9975	98.8
12/03	Coventry Memorial Park	NO NOx		4 5	5 6.5	1.730 1.743	5 5	0.9985 0.9987	97.7
12/02	Exeter Roadside	NO NOx	9841a-85	21 21	5 7.7	2.613 2.622	5 5	0.9990 0.9993	101.0
9/01	Haringey Roadside	NO NOx	397	2 3	5 5.5	1.513 1.346	5 5	0.9999 0.9998	95.7
13/01	Harwell	NO NOx	205	22 20	5 5.3	0.545 0.544	5 5	0.9963 0.9963	95.0
13/03	Hove Roadside	NO NOx	615b-273	99 100	5 6.0	2.088 2.166	5 5	0.9999 1.0000	99.2
14/01	Hull Freetown	NO NOx	m200-186	-19 -9	5 6.2	0.508 0.513	5 5	0.9985 0.9969	100.0
13/03	Leamington Spa	NO NOx	1705	23 21	5.1 6.2	2.370 2.386	5 5	0.9983 0.9985	104.6
7/02	Leeds Centre	NO NOx	93098	0 12	5 6.2	0.398 0.406	5 5	0.9999 0.9998	98.5
15/01	Leicester Centre	NO NOx	m200-191	23 24	5 5.3	0.453 0.447	5 5	0.9990 0.9988	97.9
9/01	London A3 Roadside	NO NOx	Ambirak H	62 61	6.8 6.6	2.852 2.919	5 5	0.9972 0.9974	88.4
8/01	London Bexley	NO NOx	m200a-571	13 15	5 5.2	0.216 0.212	5 5	0.9979 0.9982	95.1
21/03	London Bloomsbury	NO NOx	m200-039	12 3	5 5.6	0.482 0.507	5 5	0.9987 0.9991	100.0
20/01	London Brent	NO	9841a-283	23	5	2.288	5	0.9996	

The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor k = 2, providing a level of confidence of approximately 95%. The uncertainty evaluation has been carried out in accordance with UKAS requirements.

CERTIFICATE OF CALIBRATION

UKAS CALIBRATION 0401 0401 S1

Certificate No: 00606

AEA Identification Number: 20568104

Date Year =2003	Site		Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	*R^2	*Converter efficiency (%)
		NOx		28	6.1	2.312	5	0.9997	98.2
4/02	London Bromley	NO	787	-1	5	1.347	5	0.9975	
		NOx		-1	5.4	1.348	5	0.9981	97.8
10/03	London Cromwell Rd 2	NO	10775	-2	5	2.637	5	0.9997	
		NOx		-2	5.8	2.669	5	0.9997	97.6
12/02	London Eltham	NO	307	2	5	1.255	5	0.9562	
		NOx		6	5.6	1.412	5	0.9571	97.8
21/03	London Hackney	NO	532b-234	98	5	0.916	5	0.9983	
		NOx		97	5.3	0.989	5	0.9977	96.0
6/01	London Hillingdon	NO	GRA0447-010	-27	5	0.462	5	0.9963	
		NOx		-25	5.6	0.468	5	0.9966	95.7
7/02	London Lewisham	NO	m1231-m530	0	5	0.913	5	0.9988	
		NOx		2	5.4	0.936	5	0.9989	98.9
7/01	London Marylebone Rd	NO	API-439	0	5	1.410	5	0.9995	
		NOx		1	5.5	1.445	5	0.9994	99.4
6/01	London N. Kensington	NO	459	2	5	0.924	5	0.9999	
		NOx		2	5.3	0.837	5	0.9998	95.4
19/03	London Teddington	NO	287	0	5	0.971	5	0.9988	
		NOx		2	5.4	0.967	5	0.9993	100.4
25/02	London Wandsworth	NO	ac31m-378	0	5	1.337	5	0.9994	
		NOx		2	5.5	1.326	5	0.9996	97.4
27/02	London Westminster	NO	573	-5	5	3.829	5	0.9995	
		NOx		-7	6.5	3.907	5	0.9996	97.1
12/03	Lullington Heath	NO	m1657-m675	98	5	0.991	5	0.9997	
		NOx		98	5.3	0.996	5	0.9998	98.7
22/01	Manchester Piccadilly	NO	GRA0744-006	6	5	0.438	5	0.9995	
		NOx		9	5.7	0.440	5	0.9998	95.1
21/01	Manchester South	NO	J-RA-0447	-23	5	0.398	5	0.9996	
		NOx		-13	5.2	0.408	5	0.9994	98.2
20/01	Manchester Town Hall	NO	846	1	5	2.418	5	0.9999	
		NOx		2	5.7	2.415	5	0.9999	99.6
18/02	Middlesbrough	NO	200a-2287	5	5	0.228	5	0.9985	
		NOx		5	5.2	0.226	5	0.9984	98.2
20/02	Northampton	NO	85131806 1	0	5	1.048	5	0.9949	
		NOx		5	5.4	0.975	5	0.9965	103.8
4/03	Norwich Centre	NO		12	5	2.489	5	0.9997	
		NOx		14	5.8	2.547	5	0.9997	98.1
4/03	Norwich Roadside	NO	m200-296	-2	5	1.242	5	0.9998	
		NOx		-6	5.5	1.247	5	0.9998	99.1
13/01	Nottingham Centre	NO	gra0447-009	-25	5	0.426	5	0.9987	
		NOx		-22	5.4	0.429	5	0.9986	99.1
8/01	Oxford Centre	NO	411b-179	99	5	1.091	5	0.9998	
		NOx		102	6.5	1.086	5	0.9997	97.4
11/02	Plymouth Centre	NO	999c-343	0	5	2.014	5	0.9988	
		NOx		-7	5.6	2.127	5	0.9989	99.7
19/02	Portsmouth	NO	903005	0	5	1.037	5	0.9980	
		NOx		0	5.3	1.009	5	0.9982	101.7
21/01	Preston	NO	Ambirak N	23	5	1.828	5	0.9987	
		NOx		22	6.3	1.885	5	0.9974	95.4
7/01	Reading	NO		3	5	2.452	5	0.9993	
		NOx		4	6.2	3.431	5	0.9986	100.0

The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor k = 2, providing a level of confidence of approximately 95%. The uncertainty evaluation has been carried out in accordance with UKAS requirements.

Date Year =2003	Site		Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	*R^2	*Converter efficiency (%)
19/02	Redcar	NO	10196	1	5	1.091	5	0.9995	
		NOx		2	5.3	1.094	5	0.9978	94.4
11/03	Rochester	NO	m200-473	-2	5	1.028	5	0.9998	
		NOx		-2	5.4	1.041	5	0.9998	98.6
4/02	Rotherham Centre	NO	447-055	4	5	3.046	5	0.9992	
		NOx		7	7.0	3.276	5	0.9994	96.6
21/01	Salford Eccles	NO	436	1	5	1.267	5	0.9999	
		NOx		1	6.0	1.386	5	0.9999	104.9
27/01	Sandwell West Bromwich	NO	93081	2	5	1.061	5	0.9998	
		NOx		1	5.4	1.063	5	0.9997	98.8
3/02	Sheffield Centre	NO	447-008	-6	5	0.469	5	0.9996	
		NOx		-10	5.2	0.469	5	0.9998	93.6
3/02	Sheffield Tinsley	NO	847	1	5	2.427	5	0.9998	
		NOx		2	5.7	2.415	5	0.9997	97.7
28/02	Southampton Centre	NO	m22-187	-13	5	0.465	5	0.9991	
		NOx		-10	5.2	0.483	5	0.9992	98.5
21/01	Southend-on-Sea	NO		58	5	2.763	5	0.9989	
		NOx		58	7.4	2.765	5	0.9964	97.7
5/02	Southwark Roadside	NO	1443	2	5	1.205	5	0.9983	
		NOx		1	5.3	1.193	5	0.9985	95.6
21/01	St Osyth	NO	60988	0	5	0.648	5	0.9981	
		NOx		0	5.3	0.653	5	0.9978	97.1
27/01	Stockport Shaw Heath	NO	9841a-1853	19	8.3	3.700	5	0.9982	
		NOx		20	8.1	4.034	5	0.9979	96.1
17/02	Stockton-on-Tees Yarm	NO	9841a-113	3	5	0.886	5	0.9991	
		NOx		3	5.4	0.903	5.1	0.9991	96.2
29/01	Stoke-on-Trent Centre	NO	h-ar-003	34	5	3.070	5	0.9988	
		NOx		34	6	3.092	5	0.9991	101.2
7/01	Thurrock	NO	m200a-920	-4	5	1.234	5	0.9977	
		NOx		-6	11.0	1.238	5	0.9976	95.9
26/02	Tower Hamlets Roadside	NO	ac31m-306	1	5	1.318	5	0.9996	
		NOx		12	5.4	1.526	5	0.9997	99.0
29/01	Walsall Alumwell	NO	848	1	5	1.518	5	0.9998	
		NOx		2	5.4	1.519	5	0.9997	95.5
24/02	Walsall Willenhall	NO	9841a-1337	6	5	1.162	5	0.9993	
		NOx		8	5.3	1.160	5	0.9992	103.4
10/03	West London	NO	10774	1	5	1.388	5	0.9999	
		NOx		1	5.6	1.388	5	0.9998	95.2
5/03	Wicken Fen	NO	29847-236	0	5	1.194	5	0.9985	
		NOx		1	5.5	1.173	5	0.9982	100.1
28/01	Wigan Leigh	NO	hil j 1646	0	5	1.023	5	0.9998	
		NOx		-3	5.3	0.987	5	0.9998	97.9
21/01	Wirral Tranmere	NO		22	5	1.815	5	0.9994	
		NOx		24	5.8	1.846	5	0.9996	96.3
24/01	Wolverhampton Centre	NO	997-007	1	5	0.643	5	0.9992	
		NOx		-12	5.7	0.647	5	0.9994	90.1

5. Particulate Analysers

Date Year	Site	Analyser number	Calculated Spring	Uncertainty (%)	*[4]k_0 accuracy	[3]Measured Main Flow	Uncertainty (%)	[3]Measured Total Flow	Uncertainty (%)

The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor k = 2, providing a level of confidence of approximately 95%. The uncertainty evaluation has been carried out in accordance with UKAS requirements.

CERTIFICATE OF CALIBRATION

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=2003			Constant k_0		(%)	(l/min)		(l/min)	
	Scottish Sites								
15/01	Aberdeen	21371	12918	1	-1	3.01	6.3	Not tested	
4/02	Dumfries							16.68	3.7
4/02	Glasgow Centre	20913	13343	1	0	1.82	6.3	15.67	3.7
5/02	Glasgow Kerbside	21316	13680	1	-0.1	Not tested			
17/01	Grangemouth	22763	12374	1	-2.2	3.11	6.3	Not tested	
12/01	Inverness	2025a2125						17.66	3.7
	Welsh Sites								
17/02	Cardiff Centre	1735	11235	1	0.9	2.16	6.3	17.07	3.7
17/02	Cwmbran	21557	12570	1	0.3	3.12	6.3	16.45	3.7
19/02	Narberth	21143	12583	1	0.8	3.44	6.3	16.89	3.7
18/02	Port Talbot	9402	10762	1	1.5	3.09	6.3	16.61	3.7
18/02	Swansea	2130	14392	1	-1.2	1.81	6.3	16.57	3.7
	N.Irish Sites								
25/02	Belfast Centre	1818	13341	1	-0.8	2.10	6.3	15.41	3.7
28/02	Belfast Clara St	95366						16.99	3.7
26/02	Derry	49608	10942	1	0.5	2.14	6.3	17.58	3.7
6/03	Lough Navar	21196	12915	1	0.8	3.12	6.3	Not tested	
	English Sites								
10/03	Birmingham Centre	2297	12141	1	0.5	2.04	6.3	16.61	3.7
22/01	Blackpool	22980	13054	1	-0.7	Not tested		16.37	3.7
28/01	Bolton	21197	15188	1	0.2	Not tested			
18/02	Bournemouth							15.95	3.7
6/02	Bradford Centre	21494	11319	1	-0.3	1.98	6.3	16.17	3.7
10/02	Bristol Centre	92432	6905	1	-0.7	3.23	6.3	16.89	3.7
28/01	Bury Roadside	658	11599	1	0	1.97	6.3	15.60	3.7
8/01	Camden Kerbside	21152	16554	1	0.8	3.14	6.3	17.49	3.7
8/01	Canterbury	20931	13952	1	-0.6	3.07	6.3	Not tested	
12/03	Coventry Memorial Park	21918	12266	1	0.7	2.86	6.3	16.09	3.7
9/01	Haringey Roadside	20695	11385	1	-0.6	2.98	6.3	17.09	3.7
14/01	Hull Freetown	2399	13821	1	-2.5	2.98	6.3	16.68	3.7
13/03	Leamington Spa		11009	1	0.6	Not tested		16.38	3.7
7/02	Leeds Centre	2032	13098	1	2	1.95	6.3	17.86	3.7
15/01	Leicester Centre	2145	11463	1	26.3	2.07	6.3	16.28	3.7
9/01	London A3 Roadside	21314	10532	1	0.7	2.13	6.3	17.29	3.7
8/01	London Bexley	2000	10450	1	-0.2	2.06	6.3	Not tested	
21/03	London Bloomsbury	1200-1904	9661	1	2.5	2.76	6.3	7.1	3.7
20/01	London Brent	21145	17424	1	-0.5	Not tested			
12/02	London Eltham	2096	12967	1	-0.1	3.17	6.3	14.09	3.7
6/01	London Hillingdon	20903	8630	1	0.6	Not tested		16.90	3.7
7/01	London Marylebone Road	21306	13489	1	1.1	3.00	6.3	17.22	3.7

The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor k = 2, providing a level of confidence of approximately 95%. The uncertainty evaluation has been carried out in accordance with UKAS requirements.

CERTIFICATE OF CALIBRATION

UKAS CALIBRATION 0401 0401 S1

Certificate No: 00606

AEA Identification Number: 20568104

Date Year =2003	Site	Analyser number	Calculated Spring Constant k_0	Uncertainty (%)	[*4]k_0 accuracy (%)	[3]Measured Main Flow (l/min)	Uncertainty (%)	[3]Measured Total Flow (l/min)	Uncertainty (%)
6/01	London N. Kensington	20715	10783	1	-0.3	Not tested			
22/01	Manchester Piccadilly	2000	12123	1	0.6	Not tested			
18/02	Middlesbrough		15322	1	0	1.83	6.3	15.37	3.7
20/02	Newcastle Centre	2146	12065	1	0.3	2.02	6.3	16.87	3.7
20/02	Northampton	21621	11080	1	-0.6	3.07	6.3	16.89	3.7
4/03	Norwich Centre	21495	12108	1	-0.8	1.88	6.3	15.31	3.7
13/01	Nottingham Centre	20904	8652	1	-0.3	2.09	6.3	Not tested	
11/02	Plymouth Centre	21308	12815	1	0	2.09	6.3	Not tested	
19/02	Portsmouth	21578	10432	1	-1.3	3.14	6.3	Not tested	
21/01	Preston	22881	12789	1	-1.3	2.00	6.3	16.81	3.7
7/01	Reading	2000	13180	1	-0.2	Not tested			
19/02	Redcar	21344	11832	1	0.4	2.97	6.3	16.37	3.7
21/01	Salford Eccles	21168	14484	1	0.5	1.82	6.3	17.19	3.7
14/01	Scunthorpe	2033	4961	1	-0.5	3.03	6.3	Not tested	
3/02	Sheffield Centre	21244	12308	1	1.1	1.97	6.3	16.63	3.7
28/02	Southampton Centre		13867	1	0.2	1.93	6.3	16.32	3.7
21/01	Southend-on-Sea	22927	13228	1	-1.2	1.88	6.3	Not tested	
27/01	Stockport Shaw Heath	2000	10563	1	1.4	Not tested			
17/02	Stockton-on-Tees Yarm	22885	14199	1	-0.7	2.86	6.3	16.26	3.7
29/01	Stoke-on-Trent Centre	21317	18494	1	0.7	2.06	6.3	15.46	3.7
7/01	Thurrock	2077	6363	1	0	1.96	6.3	Not tested	
28/01	Wigan Leigh		13184	1	1	3.26	6.3	17.50	3.7
21/01	Wirral Tranmere	22883	13216	1	-0.6	1.98	6.3	16.27	3.7
24/01	Wolverhampton Centre	20917	13808	1	0.5	1.88	6.3	15.62	3.7

The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor k = 2, providing a level of confidence of approximately 95%. The uncertainty evaluation has been carried out in accordance with UKAS requirements.

The above factors have been calculated using certified standards. The analysers listed above have been tested for zero response, calibration factor, linearity, converter efficiency (NOx analysers), m-xylene interference (SO_2 analysers), k_0 / main flow rate (for TEOM analysers) and total flow rate (for particulate analysers), by documented methods. Note that the test results are valid on the day of test only, as analyser drift over time cannot be quantified.

The calibration results for NOx, NO, CO, SO_2, O_3 and Particulates are those that fall within our scope of accreditation. Results marked with an asterisk (*) on this certificate are not UKAS accredited, but have been included for completeness.

[1]The zero response is the zero reading on the logging system of the analyser when audit zero gas was introduced to the analysers under test.

[2]The calibration factor is the multiplying factor required to scale the reading on the data logging system into concentration units (ppb for NO, NOx and SO_2, ppm for CO – 1ppm = 1000 ppb). It should be used in conjunction with the analyser output and the zero response, according to the following equation:

Concentration = (output – zero response) x Calibration factor

[3]The calculated main flow rate (where this is applicable) is the flow rate through the sensor unit of a TEOM analyser. The calculated total flow rate is the flow rate through a particulate analyser.

[4]The k_0 accuracy value (specifically for TEOM analysers) indicates the closeness of the calculated result to the manufacturer's specified value of k_0.

*R^2 is the correlation coefficient of linearity

*Converter is the measured efficiency of the NO_2 to NO converter in the Oxides of Nitrogen analyser

*meta-xylene interference is the response of the SO_2 analyser when supplied with approx 1ppm meta-xylene

This certificate is an electronic representation of a master copy, held at AEA Technology Environment. Hard copies of this document are available on request.