Report

QA/QC Data Ratification and Intercalibration Report for the Automatic Urban and Rural Network, July – September 2004

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PART A: DATA RATITFICATION, JULY – SEPTEMBER 2004

PART A: Data Ratification July – September 2004

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 July to September 2004. During this period there were 121 monitoring sites in the Network of which there are 85 urban sites, 22 rural sites and a further 14 sites in the London Air Quality Monitoring Network (LAQN) which are affiliated into the national network.

Included in this report are the results of QA/QC Unit's 6-monthly intercalibration and audit exercise which was carried out during July to September 2004. 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 July - September 2004 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.

Part B: Summer 2004 Intercalibration

Section 6 Introduction
Sections 7–18 Results of the Summer 2004 intercalibration exercise
Appendix B1 Network certificate of calibration

1.1 Recent Changes in the Network

This section gives an overview of the main changes that have recently taken place in the network, including site closures, relocations or the addition of any new sites to the network. A summary of changes in the AURN for the year to date is given in Table 1.1.

QA/QC Unit has been working closely with Casella Stanger and the Local Authorities regarding the following site relocations:

Wigan Leigh
The Wigan Leigh site was closed on 28th September 2004 due to the necessary redevelopment of the Police Station. The Defra and DA's funded instruments were relocated to an existing site at Deanery School and the site renamed "Wigan Centre". The site commissioning audit was carried out on 6th October 2004 and the new site commenced operation on 11th October 2004.

Birmingham East and Centre
The Birmingham East site closed on 4th August 2004 as the school was unable to renew the lease for the site. QA/QC Unit worked closely with Birmingham County Council to identify another suitable site. The new site at Birmingham Tyburn commenced operation on August 16th 2004. The Birmingham Centre site is also scheduled for relocation by the end of March 2005.

Cwmbran
The site at Cwmbran will be temporarily relocated prior to construction activity taking place at the school in January 2005. A suitable site close to the original site and in similar surroundings has been identified.

Blackpool
The site at Blackpool ceased operation on 10th November 2004 due to redevelopment in the area. The housing will be moved to a new location at Stanley school as soon as provision of the electricity supply is sorted out.

Middlesbrough
The site at Middlesbrough needs to be relocated due to redevelopment in the area around the school. Groundwork started in early December 2004, giving rise to elevated PM_{10} concentrations. Another suitable site, 17 metres from the existing location, has been identified and plans to move the monitoring cabin are in place.

DD3 Requirements
Installation of additional ozone and rural NO_x analysers at existing sites in the network in order to comply with the Third Daughter Directive (DD3) is now complete. The final NO_x analyser was installed at Eskdalemuir on 13th October 2004. There was some initial delay whilst operational problems were resolved and monitoring finally commenced on 9th December 2004.

Brighton Preston Park
A new DD3 (NO_x and O_3) site at Brighton Preston Park commenced monitoring on November 3rd 2004.

Sunderland Silksworth
A new Local Authority site at Sunderland Silksworth measuring NO_x and O_3 (for DD3) was affiliated into the network on 9th December 2004.

Plans are also underway to add a further two new DD3 sites at Fort William and Leominster. Progress on the installation of the new sites is discussed in more detail in Section 2.1

Table 1.1 Changes to the AURN between January to December 2004

Sites	Date Commenced	Pollutants
New sites		
London Harlington	1/01/04	NO_2 CO O_3 PM_{10}
Brighton Preston Park	3/11/04	NO_2 and O_3
Sunderland Silksworth	9/12/04	NO_2 and O_3
Site Relocations		
Scunthorpe relocated to Scunthorpe Town	Scunthorpe closed 18/3/04 Scunthorpe Town started 6th June 2004	SO_2 PM_{10}
Wigan Leigh relocated to	Wigan Leigh closed on 28th	NO_x O_3 CO SO_2 and

Sites	Date Commenced	Pollutants
Wigan Centre	September 2004. Wigan Centre started on 13th October 2004	PM_{10}
Birmingham East relocated to Birmingham Tyburn	Birmingham East closed on 4th August 2004. Relocated to Birmingham Tyburn starting on August 16th 2004	NO_x O_3 CO SO_2 and PM_{10}
Additional O_3 and/or NO_x (DD3)		
Glazebury	NOx analyser commissioned on 26th January 2004	NO_x
Eskdalemuir	NO_x analyser commissioned on 9th December 2004.	NO_x

1.2 Overview of Network Performance

Ratified hourly average data capture for the network averaged 94% for all pollutants (O_3, NO_2, SO_2, CO, PM_{10} and $PM_{2.5}$) during the 3-month reporting period July to September 2004 (see Table 1.2 below). This has been another very good quarter with average data capture for all the pollutants being above the 90% target level.

Table 1.2 AURN Ratified Data Capture (%) April to June 2004
(Using the start date of any new site)

Data Capture (%)	CO	NO_2	O_3	PM_{10}	$PM_{2.5}$	SO_2	Network Average
Q1 Jan - March 2004	92.0	90.3	93.1	91.1	97.9	91.7	92
Q2 April – June 2004	93.2	93.6	96.2	94.7	98.1	93.1	94
Q3 July – Sept 2004	93.9	91.8	94.4	93.7	95.0	93.3	94

Overall, 351 out of the 420 analysers (84%) achieved data capture levels above the required 90% target during this reporting period (See Table 1.3). This demonstrates that the high level of network performance has been consistently maintained, even during this quarter when more disruption was expected due to the 6-monthly network intercalibration and service exercise. Only a relatively small proportion of analysers (15-20%) failed to meet the 90% data capture target, which is reasonable in a network of this size and complexity.

Table 1.3 Number of Analysers with Data Capture below 90%

	Total Number of Analysers	Analysers with Data Capture <90% in 2004		
		Q1 Jan–March	Q2 Apr – June	Q3 July-Sept
CO	79	16 (20%)	13 (16%)	12 (15%)
NO_2	106	26 (25%)	18 (17%)	24 (23%)
O_3	84	14 (16%)	10 (12%)	11 (13%)
PM_{10}	71	12 (17%)	11 (16%)	10 (14%)
$PM_{2.5}$	4	0	0	0
SO_2	76	16 (21%)	15 (19%)	12 (16%)
All sites	420	84 (20%)	67 (16%)	69 (16%)

A more detailed breakdown of the hourly data capture statistics for each site is presented in Section 5, Table 5.1 (July – September 2004) and Table 5.2 (January- September 2004). In total, 21 out of the 122 network sites (17%) had an average data capture rate below the required 90% level for the July – September 2004 period. These sites are listed in 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%, July -September 2004
(Data capture calculated from site start date)

Site	Owner	Site Average Data Capture (%)
England		
Brighton Roadside PM_{10}	Affiliate	83.7
Bristol Old Market	Affiliate	89.8
Cambridge Roadside	Affiliate	89.0
High Muffles	Defra	76.5
Ladybower	Defra	78.4
Leeds Centre	Defra	82.2
London Hackney	Affiliate	87.2
London Westminster	Defra	84.4
Lullington Heath	Defra	88.5
Manchester South	Affiliate	82.5
Manchester Town Hall	Defra	76.0
Middlesbrough	Affiliate	78.6
Northampton	Affiliate	69.3
Northampton PM_{10}	Affiliate	88.0
Rotherham Centre	Affiliate	86.3
Southend-on-Sea	Defra	88.2
Stockport Shaw Heath	Affiliate	43.8
Scotland		
Glasgow Centre	Defra	79.5
Strath Vaich	Defra	80.5
Wales		
Aston Hill	Defra	82.4
Swansea	Affiliate	77.5
Number of sites < 90%		21

Netcen carried out the summer intercalibration and site operator audits during July - September 2004. Results from this intercalibration exercise have been used to assess the accuracy and consistency of the data for this reporting period. Details of the Summer 2004 intercalibration are provided in Part B (Sections 6-18) of this report.

1.3 Annual Site Operator's Meeting

The Local Site Operator's annual meeting was held at Birmingham NEC on December 1st 2004. QA/QC Unit gave presentations on recent data ratification and intercalibration issues as well as the role of AURN data in UK modelling assessment. All presentations given at the meeting have been made available on the AURN Hub.

1.4 LSO Manual

Copies of the Local Site Operator's manual on disc (CD) were distributed to the network participants at the annual LSO meeting in December 2004. If LSOs have not received a copy or further copies are required please contact Jane.vallance-plews@aeat.co.uk. The manual is also available electronically on the following web sites:
AURN Hub http://www.aeat.co.uk/com/AURNHUB/lsoman.html
Air Quality Archive http://www.aeat.co.uk/netcen/airqual/reports/lsoman/lsoman.html

1.5 AURN Hub Updates

The AURN project information hub web is located at[1]:
http://www.aeat.co.uk/com/AURNHUB/index.html.

The site is regularly up-dated and some of the more recent information includes:

- Up-dated site lists (December 2004)
- Monthly PM_{10} (Gravimetric) exceedences for December 2004
- QA/QC Unit's Winter 2005 intercalibration and audit schedule
- Equipment Support Units' Winter 2005 service schedules
- QA/QC Unit's data ratification report, April - June 2004
- Recent Management Unit reports (April – June 2004)
- All presentations given at the AURN Site Operator's meeting on Dec 1st 2004
- Edition 8 of the Network Newsletter (issued December 2004)
- Change of address details for QA/QC Unit (Netcen)*

*Please note, as of 1st November 2004, QA/QC Unit (Netcen) has moved to Harwell at the following address:

netcen
Building 551
Harwell
Didcot
Oxfordshire
OX11 0QJ

All phone and fax numbers remain unchanged.

[1] 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

Installation of all of the additional NO_x and O_3 analysers required to comply with the Third Daughter Directive has now been completed. The final NO_x analyser was installed at Eskdalemuir on 13th October 2004 and, after further attention to the NO_x analyser, monitoring commenced on 9th December 2004. Further details on the third Daughter Directive can be found at:
http://www.defra.gov.uk/environment/consult/air-23daughter/index.htm

In order to satisfy the requirements of DD3, progress is also being made to commission 3 new direct-funded NO_x and O_3 sites and affiliate one Local Authority owned site, at the following locations:

- Brighton Preston Park (Brighton/Worthing/Littlehampton agglomeration)
- Sunderland Silkworth (North East zone) – Sunderland City Council
- Fort William (Highland zone)
- Leominster (Midlands zone).

Two of the four sites are now operational (Brighton Preston Park and Sunderland Silkworth) and progress on the establishment of the remaining sites is given in Table 2.1.

Table 2.1 New DD3 Monitoring Stations, October 2004

New Site	Pollutants	Progress to date	Expected integration date
Brighton Preston Park	O_3 and NO_x	The site commenced operation on November 3rd 2004.	Completed
Sunderland Silkworth	O_3 and NO_x	Following installation of a new O_3 analyser, the site was affiliated on 9th December 2004.	Completed
Fort William	O_3 and NO_x	Planning consent and lease agreement now completed. Site installation underway.	End April 2005
Leominster	O_3 and NO_x	Planning consent and lease agreement granted. Site installation going ahead.	End March 2005

2.2 PM_{10} Episodes

During December 2004 there were a few periods of poor dispersion which resulted in increased PM_{10} concentrations from December 1st to 3rd, 7th to 13th and 19th to 21st. A higher number of monitoring stations therefore recorded exceedences in December 2004 than in the previous months. However, overall there have been far fewer exceedences of the daily mean gravimetric PM_{10} standard recorded this year compared to the same time last year. The sites that have recorded the highest number of days with exceedences of 50µg/m^3 during 2004 (January to the end of December 2004) based on **provisional data** are given below:

95 days - London Marylebone Road (Kerbside) – above objective
40 days - Camden Kerbside (Kerbside) – above objective
38 days - Port Talbot (Industry) – above objective
35 days - Glasgow Kerbside (Kerbside)
30 days - Bury Roadside (Roadside)
26 days – Scunthorpe (Industrial)

Three of the above sites have exceeded the Air Quality Objective of 35 days > 50µg/m^3, to be achieved by 31/12/2004 based on the **provisiona**l 2004 monitoring results.

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.

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[2] 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 9-month period January to September 2004 are given in Section 5, Table 5.3. Reasons for data loss at these sites are given in Section 4. In total 46 out of the 185 critical site analysers (25%) did not meet the required 90% data capture during the first 9 months of 2004. Note in this period, Scunthorpe was relocated to Scunthorpe Town so both sites now appear in Table 5.3. Any critical site analyser with less than 86.5% data capture during this first 9-month period will not achieve the 90% data capture target for the year. The 27 site analysers that fall into this category are as follows:

- Leicester Centre CO
- Newcastle Centre CO
- Southend on Sea CO
- Grangemouth CO
- Leamington Spa CO

- Glasgow Centre NO_2
- Hull Freetown NO_2
- Leicester Centre NO_2
- Newcastle Centre NO_2
- Aston Hill NO_2
- Glazebury NO_2
- High Muffles NO_2
- Northampton NO_2
- Wicken Fen NO_2

[2] 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

- Reading New Town O_3
- Lough Navar O_3
- Northampton O_3

- Stoke-on-Trent PM_{10}
- Scunthorpe/Scunthorpe Town PM_{10}
- Wrexham PM_{10}

- Blackpool SO_2
- Hull Freetown SO_2
- Newcastle Centre SO_2
- Northampton SO_2
- Scunthorpe/Scunthorpe Town SO_2
- Wigan Leigh SO_2
- Wrexham SO_2

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 repair 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}). The gravimetric PM_{10} analyser at Northampton is also co-located with a TEOM analyser 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 for the 9-month period January-September 2004 are shown in Figure 2.1. In general, the agreement between the analysers is good, although a problem with the site telemetry resulted in an extended period of TEOM data loss during September.

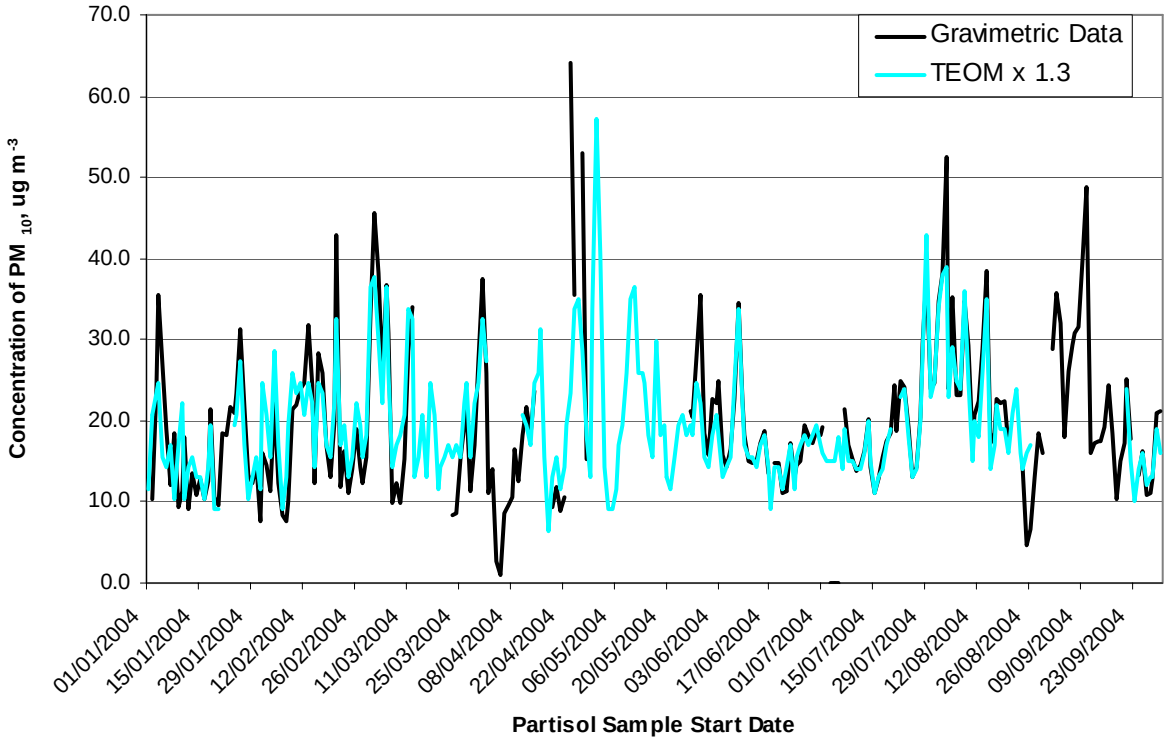

Figure 2.1 Partisol and TEOM (x1.3) Concentrations at Northampton (Jan-June 2004)

Data capture for the gravimetric PM_{10} (Partisol) analysers for the period July - September 2004 and for the 9-month period January – September 2004 is given in Table 2.2. Three out of the seven operational gravimetric PM_{10} analysers did not meet the required 90% data capture target for the July-September reporting period. Details of data loss associated with these three sites (Bournemouth, Brighton Roadside and Northampton) are given in Section 4.1. Some data were lost in this period (10 days from Bournemouth, 14 days from Brighton and 1 day from Dumfries) due to a breakdown in the laboratory analysis procedure that occurred when the initial weights were recorded.

Table 2.2 Gravimetric PM_{10} Data Capture (%) January – September 2004
(Calculated from site start date)

Site	Data Capture (%) July - Sept 2004	9-months Data Capture (%) January – Sept 2004
Bournemouth	85.9	92.7
Brighton Roadside PM_{10}	83.7	91.6
London Westminster	97.8	93.8
Northampton	88	79.6
Dumfries	98.9	89.1
Inverness	97.8	93.8
Wrexham	98.9	92
Average	**93**	90.4

Six out of the seven Partisol sites have now been connected to telemetry. This allows the exposure data and filter numbers to be downloaded automatically and regular checks on the operational status of the analyser can be carried out remotely. The one remaining

Partisol unit at Bournemouth still needs to be connected via a separate mobile phone system, as the existing line is not compatible with the Partisol software.

2.5 NO_2 Converter Efficiencies

Eight converter failures were identified during QA/QC Unit's Summer 2004 intercalibration exercise. This was an improvement from the previous audit when 15 converter faults were reported. Of the eight converter faults identified, three were considered to be borderline cases and there was no resulting effect on data quality or capture. A summary of all the converter faults and the resulting effect on data quality is given in Table 2.3 below. See also Section 8.3 in Part B of this report.

Table 2.3 Converter faults identified at the Summer 2004 Intercalibration Exercise (July-Sept 2004)

Site	Audit date	Converter Efficiency	Resulting Effect on Data Quality
Glasgow Kerbside	19/7	90.9%	1-minute NO_2 span calibration data were obtained which showed no history of a declining NO_2 span response. Data were therefore only deleted between the audit on 19th July to the service on 28th July when the converter was replaced. (9 days)
Manchester South	24/8	91.9%	Repeat offender (93% at previous audit). Data were deleted from the last stable calibration on 27th July until repair of converter at the service on 2/9/04. (5 weeks)
Middlesbrough	14/9	72%	Calibration data from mid May showed a slight divergence in NO_2 calibration response compared to the NO response, indicating the likely start of the converter fault. Data were therefore deleted from 18th May until the service on 14th September 2004. (4 months).
Oxford Centre	7/7	89.6%	Data were rejected from the first unstable NO_2 calibration on 2nd June until the converter was replaced at the service on 13th July 2004. (6 weeks)
Walsall Alumwell	22/9	86%	The poor converter result was due to water ingress. The sample inlet funnel was not attached and water had entered the sampling system. Data from 23rd September to the service on 27th September have been deleted (5 days). The converter was replaced at the service.
BORDERLINE FAIL			
Dumfries	12/7	94.8%	Repeat offender (94.6% at previous audit) Borderline case – no data loss
London A3 Roadside	8/7	94.8%	Borderline case - no data loss Converter replaced at service.
Yarner Wood	4/8	94.9	Borderline case - no data loss

Two sites (Manchester South and Dumfries) were identified as "repeat offenders" because the converters had also failed at the previous 6-month audit. Extra care should be taken

at these sites in order to determine the cause of the repeated converter failures and/or to ensure the converters are replaced.

Recommendations

The ESUs should have already replaced or repaired the faulty converters listed in Table 2.3 during the Summer 2004 service exercise in order to ensure satisfactory performance of the analysers.

It is recommended the ESUs undertake an additional 3-month converter test at Manchester South and Dumfries where the analysers have failed 2 consecutive audits.

The LSOs should continue to pay careful attention to the short-term stability of the NO_2 calibration response and notify CMCU if a declining NO_2 span is recorded during the calibration. (See trouble-shooting section of the LSO manual for further details).

QA/QC Unit has been taking measures to ensure procedures used in the AURN will comply with any CEN requirements before they become mandatory. These requirements are discussed further in Part B, Section 15 of this report. One of the CEN requirements is to ensure that the NO_x converter efficiency is better than 98%. NO_2 data will have to be rescaled for converter efficiencies between 95-98%, but rejected if below 95%. These are tougher requirements than currently used where "borderline failures" are accepted. It is, therefore, especially important that the borderline cases also get adequate attention at the service in order to ensure they are set up to operate satisfactorily for the next 6-month period.

Recommendation

We recommend that all NO_x analysers should be set up after service with converters operating at 98% or above.

2.6 NO_x Switching Valve Leaks

QA/QC Unit now routinely reports potential problems with NOx switching valve leaks as part of the 6-monthly intercalibration checks. If a significant leak in the NO_x /NO channel switching valve is present it may lead to NO_2 concentrations being under reported. Results of the checks carried out during the summer intercalibration are discussed in Part B, Section 8.2. The Equipment Support Units are notified of any sites with potential switching valve leak problems and it is recommended that the valves are cleaned and checked during each service.

2.7 Ozone Outliers

22 out of 84 ozone analysers (26%) were identified as outliers during QA/QC Unit's Summer 2004 intercalibration exercise (See Table 2.5). This is consistent the previous Winter intercalibration where again 26% of the analysers tested were identified as outliers. Where appropriate, the data from these sites have been rescaled accordingly during the ratification process.

Table 2.5 Ozone outliers identified at the summer 2004 intercalibration

	Site	Summer 2004 Outlier
1	Aberdeen	+6%
2	Barnsley Gawber	-15%
3	Birmingham East	+6%
4	Blackpool	-6%
5	Bristol Centre	-16%
6	Cwmbran	-10%
7	Derry	-16%
8	Exeter Roadside	-12%
9	Glazebury	+8%
10	Hull Freetown	+8%
11	Ladybower	+13%
12	Leeds Centre	-8%
13	London Haringey	-12%
14	London Harlington	+7%
15	London Teddington	-8%
16	Lough Navar	+10%
17	Manchester Piccadilly	-8%
18	Plymouth Centre	-14%
19	Reading New Town	-9%
20	Redcar	+11%
21	Salford Eccles	-8%
22	Stoke-on-Trent	-9%
23	Yarner Wood	+15%

2.8 TEOM k_0

Two of the TEOM instruments tested during the Summer 2004 intercalibration were found to be operating with a calibration constant (k_0) outside the acceptable ± 2.5% deviation. These were at Sheffield Centre and Wigan Leigh. Data from the analyser at Sheffield Centre have been rescaled. However, no data rescaling was required at Wigan Leigh as the k_0 value stored in the control unit agreed with the calculated k_0 at the audit. The results from this instrument were therefore being correctly reported.

In addition a further three TEOM analysers were found to have a k_0 mis-match, where the value of the calibration constant stamped on the sensor unit was found to be different from the value stored in the control unit. (See Table 2.6). At 2 of the sites the difference was small and within the acceptable ± 2.5% limit so no data rescaling was necessary. At London A3 Roadside, however, the difference was much larger resulting in ambient data being rescaled by 10%.

Four TEOM analysers were also found to be operating outside of the expected flow rates during the audits. (See Section 12.2 in Part B of this report). Major flow leaks at Glasgow Centre and Swansea resulted in significant data loss during this period. (See Sections 3.6 and 3.7)

As part of the summer intercalibration exercise, QA/QC Unit compiled additional information on the operational configuration of PM_{10} analysers in the network. Full details are given in Section 12.3 in Part B of this report.

Table 2.6 TEOM k_0 issues identified at the Summer 2004 Intercalibration

Site	Problems identified at audit	Effect on data quality
Sheffield Centre	k_0 outlier (-2.9%) at audit on 9/8/04. This was consistent with the previous Winter audit result (-3.1%).	Data from 1/1/04 have been rescaled by 3%.
Wigan Leigh	k_0 outlier (+10%). The k_0 value stamped on sensor unit was low by 10%. However, the measured k_0 determined at audit agreed with the control unit so no data rescaling was necessary.	No data rescaling required. **Note:** this site has recently been relocated to Wigan Centre. The k_0 mis-match will still need to be fixed.
Portsmouth	k_0 values were found to be different on sensor unit and in the control unit software at the summer audit on 14/7/04. This agreed with findings at the previous 6-month audit on 16/1/03.	The difference was 1% so within acceptable limit and no data rescaling was necessary. ESU needs to set control unit to agree with sensor.
Thurrock	k_0 values were found to be different on sensor unit and in the control unit software at the summer audit.	The difference was 1.7% so within acceptable limit and no data rescaling was necessary. ESU needs to set the control unit to agree with sensor.
London A3 Roadside	k_0 on sensor and control unit different by 10% at summer audit on 8/7/04.	Data rescaled from when the replacement TEOM was installed on 21st April until the ESU visit on 23rd July 2004 to exchange the TEOM.

Recommendations

The ESUs need to confirm that the necessary changes have been made to re-certify the TEOM k_0 at Sheffield Centre and set the control unit k_0 to agree with the sensor unit at Portsmouth and Thurrock. At Wigan Leigh (now relocated to Wigan Centre) the k_0 value stamped on sensor unit needs to be changed to agree with the value stored in the control unit.

2.9 Zero Response Truncation

There were a few sites where significant periods of data were lost due to zero truncation (or baseline clipping). This occurs when the analyser response drifts downwards until it falls below the minimum response threshold resulting in extended period of 0mV response. This problem can occur if the analyser is not configured to output negative voltages or if the logger cannot record a response below a certain voltage threshold. Cases of zero response truncation were seen at the following sites during this period:

- Leamington Spa CO — 25th June- 11 July 2004 (16 days data loss)
- London Westminster SO_2 — June/July 2004 – no data loss as levels were very low
- Bristol Old Market CO — 27 July – 13th August 2004 (17 days data loss). A new CO analyser has now been installed at this site.

Recommendation

We recommend that, wherever possible, all analysers are routinely set up after the service with zero baseline offsets of 20-50mV. Special attention should be given to the sites mentioned above in order to ensure the baseline response does not drift downwards over time, resulting in further periods of truncation and data loss.

2.10 Auto-Calibration Run-ons

Autocalibration "run-on" is a generic problem affecting many analysers in the network and is due to autocalibration gas leaking into the sampling system during the ambient measurement period immediately after the autocalibration cycle. Invalid measurements (usually between 01:30 and 02:00) have been removed during data ratification. This can be a serious source of data loss resulting in one hour out of twenty four being deleted, which is 4% of the annual data capture. At some sites significantly more data are being lost resulting in data capture below the 90% data capture target for the period.

The problem can be identified by examining the diurnal variation of NO_2 concentrations for the individual sites. An example of a site where there is **no** autocalibration run on problem is shown in Figure 2.2. In contrast, a large NO_2 autocalibration run-on seen at High Muffles (resulting in 11 hours data loss per day) is shown in Figure 2.3.

The ESUs have investigated the autocalibration run-ons at many of the sites and tried different ways to resolve the problem including thorough cleaning of the solenoid valves and installation of permapure driers. In most cases this has improved the situation but it has not always eliminated the problem completely. The 37 sites showing continuing problems with the autocalibration run-on during July to September 2004 are given in Table 2.7. Any autocalibration run-on data that look visibly significant have been deleted from these data sets during ratification.

Table 2.7 Estimate of Spike or Dip due to Auto-calibration Run-on (15-minute average) July - September 2004

Site	Pollutant	Run-on (ppb)	Data loss (Hours per day)	Autocal span concentration (ppb)
Aberdeen	NO_2	5	1	200
Belfast Centre	NO_2	7	1	300
Birmingham Centre	NO_2	9	1	750
Blackpool	NO_2	4	1	400
Bournemouth	NO_2	5	1	100
Bury Roadside	NO_2	12	1	700
Bush Estate	NO_2	2.4	1	240
Derry	NO_2	3	1	300
Dumfries	NO_2	7	1	700
Glazebury	NO_2	3.3	1	380
High Muffles	NO_2	8	11	500
Leamington Spa	NO_2	11	1	1700
London A3 Roadside	NO_2	7	1	500
Lullington Heath	NO_2	2.4	1	300
Manchester Town Hall	NO_2	4	1	450
Market Harborough	NO_2	3.2	2	350

Site	Pollutant	Run-on (ppb)	Data loss (Hours per day)	Autocal span concentration (ppb)
Narberth	NO_2	1.9	3	150
Newcastle Centre	NO_2	6	1	300
Norwich Centre	NO_2	3	1	350
Oxford Centre	NO_2	7	1	250
Preston	NO_2	5	1	500
Reading New Town	NO_2	5	1	250
Rochester	NO_2	3.6	1	200
Somerton	NO_2	4.1	3	45
Southend-on-Sea	NO_2	3	2	200
St Osyth	NO_2	1.9	1	300
Stoke-on-Trent Centre	NO_2	4	1	335
Thurrock	NO_2	4	1	400
Wirral Tranmere	NO_2	4	1	300
Wrexham	NO_2	3	1	350
London Brent	SO_2	1	1	900
London Marylebone Rd	SO_2	0.5	1	375
Narberth	SO_2	0.3	1	500
Plymouth Centre	SO_2	0.1	1	800
Stoke-on-Trent	SO_2	1	2	650
Wigan Leigh	SO_2	1	1	-
Leeds Centre	CO	0.2 ppm	1	35 ppm

Recommendations

ESU to investigate and minimise effect where possible, especially at sites with large autocalibration run-ons or where data loss is in excess of 1 hour. These sites are shown in **bold** in Table 2.7.

QA/QC Unit and CMCU are currently arranging meetings with the Equipment Support Units to discuss the autocalibration run-ons and to identify ways to resolve the problem.

In the meantime, we recommend that the autocalibration devices be adjusted at the problem sites to reduce the concentration of the span gas. It is strongly advised that NO_2 autocalibration span concentrations of less than 200ppb (urban sites) and 100ppb (rural sites) are used throughout the network.

At High Muffles where the autocalibration run-on is causing up to 50% data loss at a critical site, we recommend that the autocalibration span is switched off and with just the autocalibration zeros being recorded for data validation purposes, until a satisfactory solution can be found.

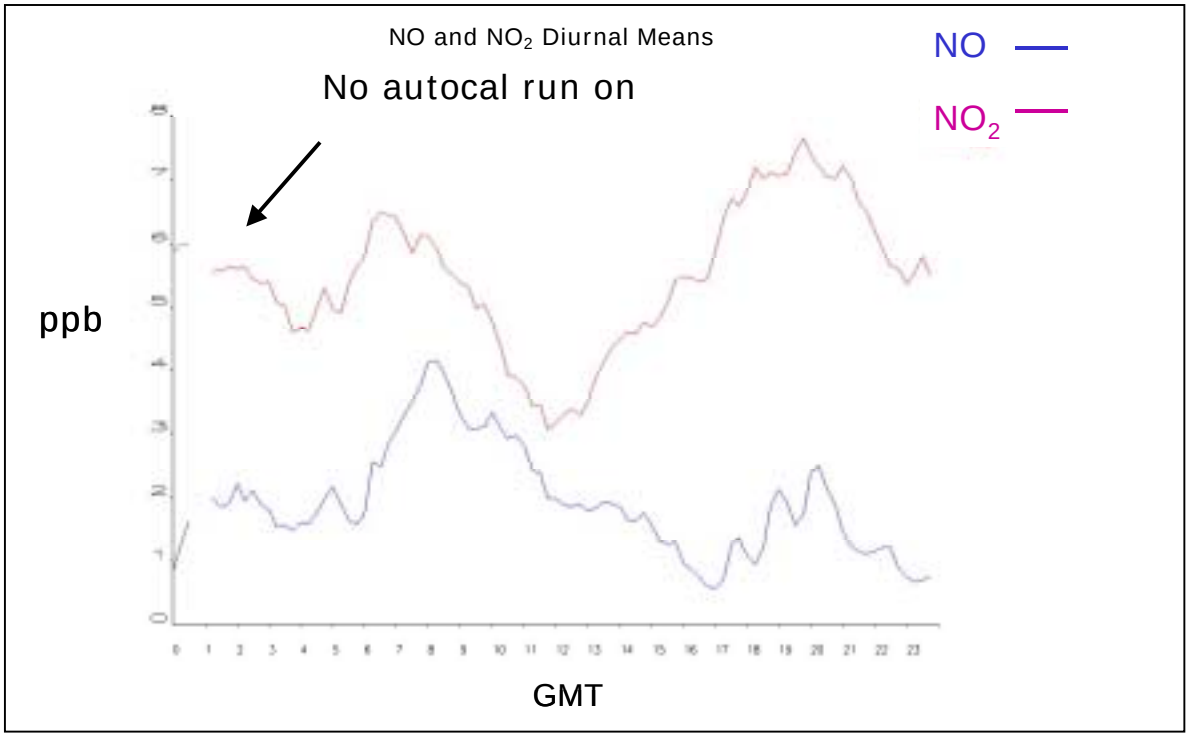

Figure 2.2 Example of site with no autocalibration run-on problem

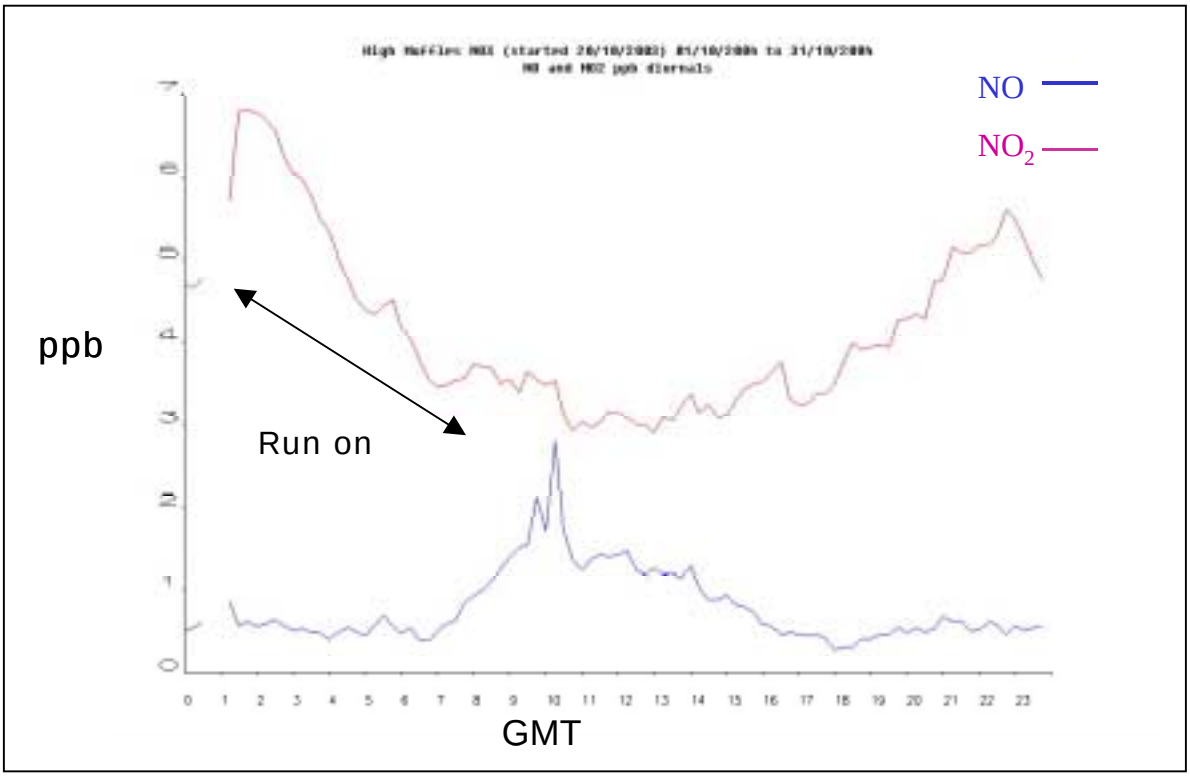

Figure 2.3 Auto calibration run-on seen at High Muffles, October 2004

3 Site Specific Issues

3.1 Wolverhampton NO_2

A spurious drop in ambient NO_2 concentration following the service in September was identified during CMCU's routine data checking. The Equipment Support Unit was called out and found that the analyser had not been connected to the sampling manifold. Following this call-out however, ambient concentrations continued to be lower than expected compared to nearby sites, and further investigation by the ESU in October identified a blockage in the NO_x sampling system. After the blockage was cleared and the reaction chamber cleaned, ambient levels returned to normal (see Figure 3.1). All data from the service on 13th September until repair on 8th October have been deleted during ratification (3 weeks).

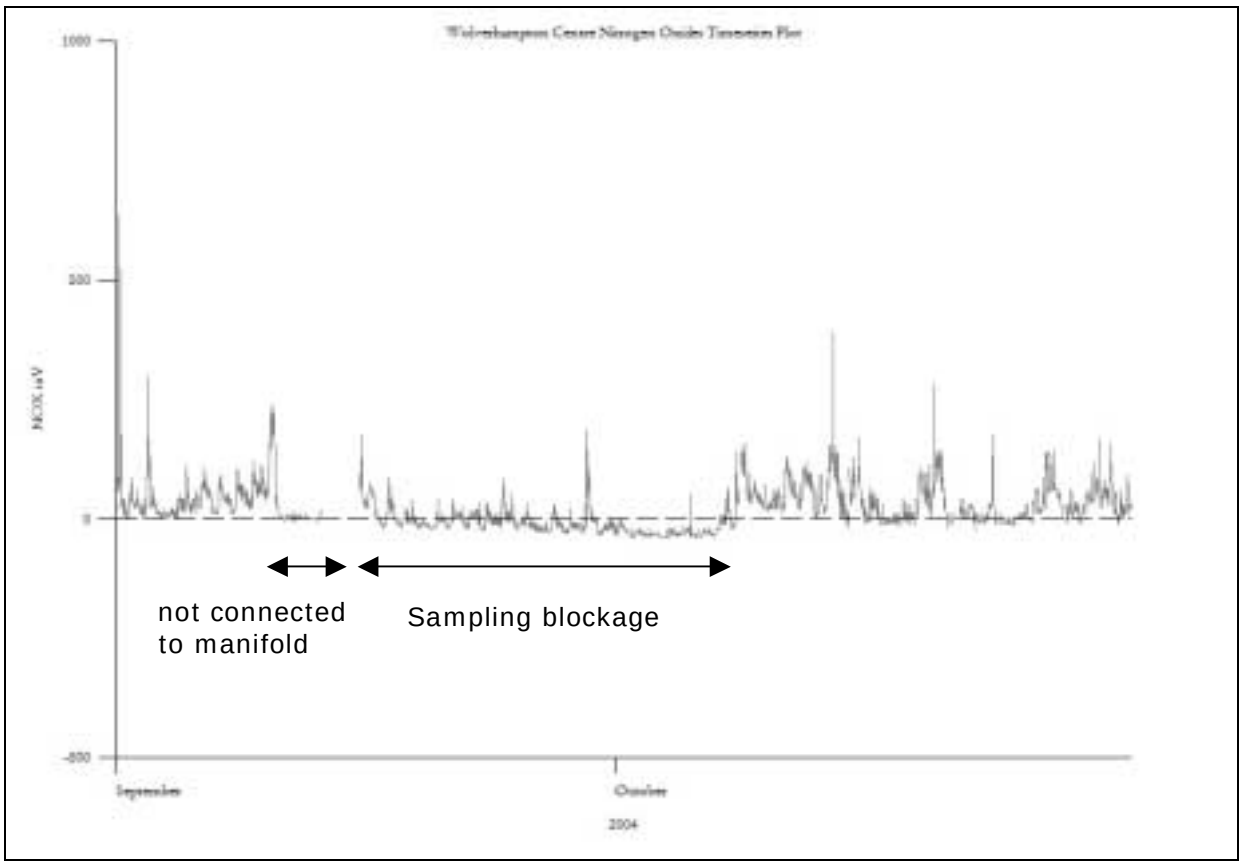

Figure 3.1 Wolverhampton NO_x sampling faults, September-October 2004

3.2 Leeds Centre O_3

Three unrelated O_3 sampling faults occurred at Leeds Centre resulting in 6 weeks data loss during July and August. Spurious low ozone levels were recorded immediately after an ESU visit on 22nd July. A faulty scrubber in the ozone analyser was identified and, when replaced, the ambient levels returned to normal. However, shortly after this unusually high ozone levels were recorded. Investigation by QA/QC Unit at the audit on 16th August identified a leak in the ozone sampling system. This problem also coincided

with elevated ozone levels inside the hut arising from a leak in the charcoal scrubber on the exhaust vent of the NO_x analyser. The combination of the analyser sampling leak and high ozone concentrations inside the hut resulted in artificially high ozone levels being recorded. A pump failure resulted in a further period of poor quality data at the end of August. (See Figure 3.2). The pump was repaired at the 6-monthly service on 2nd September. All spurious ozone data from 22nd July until repair of the pump at the service on 2nd September have been deleted during ratification. (Critical site)

Recommendation

LSOs should be aware that high ozone concentrations venting from the exhaust of a NO_x analyser might affect ambient ozone levels being record. If there is an unusually strong smell of ozone inside the hut, CMCU should be notified immediately.

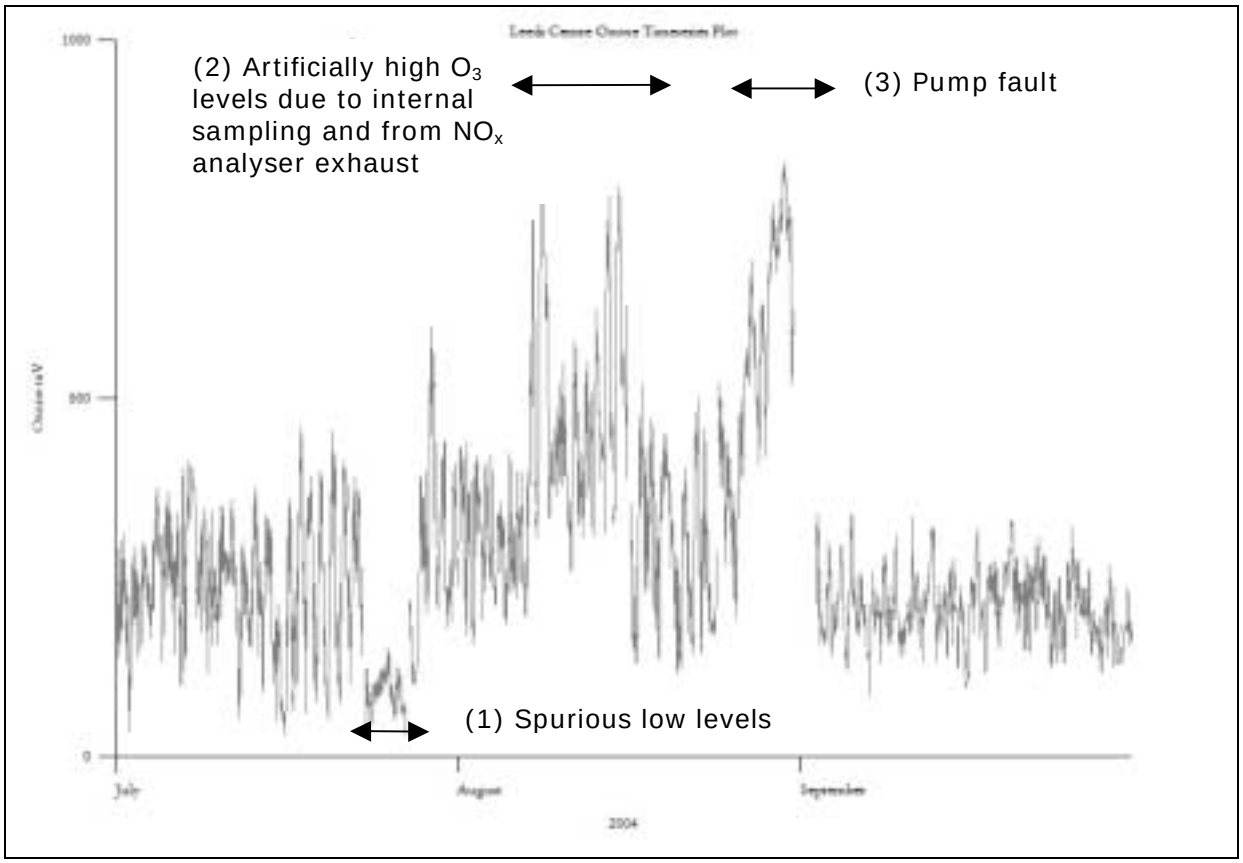

Figure 3.2 Leeds Centre O_3 sampling faults, July – August 2004

3.3 Manchester Town Hall CO

A 2-month period of erratic response and high noise CO data was recorded at Manchester Town Hall from 7th June until 3rd August 2004 (See Figure 3.3). A fault with the infra-red source was rectified on 13th July, but further problems persisted. A sample flow fault and blockage in the 3-way solenoid valve was cleared on 3rd August and satisfactory monitoring was resumed.

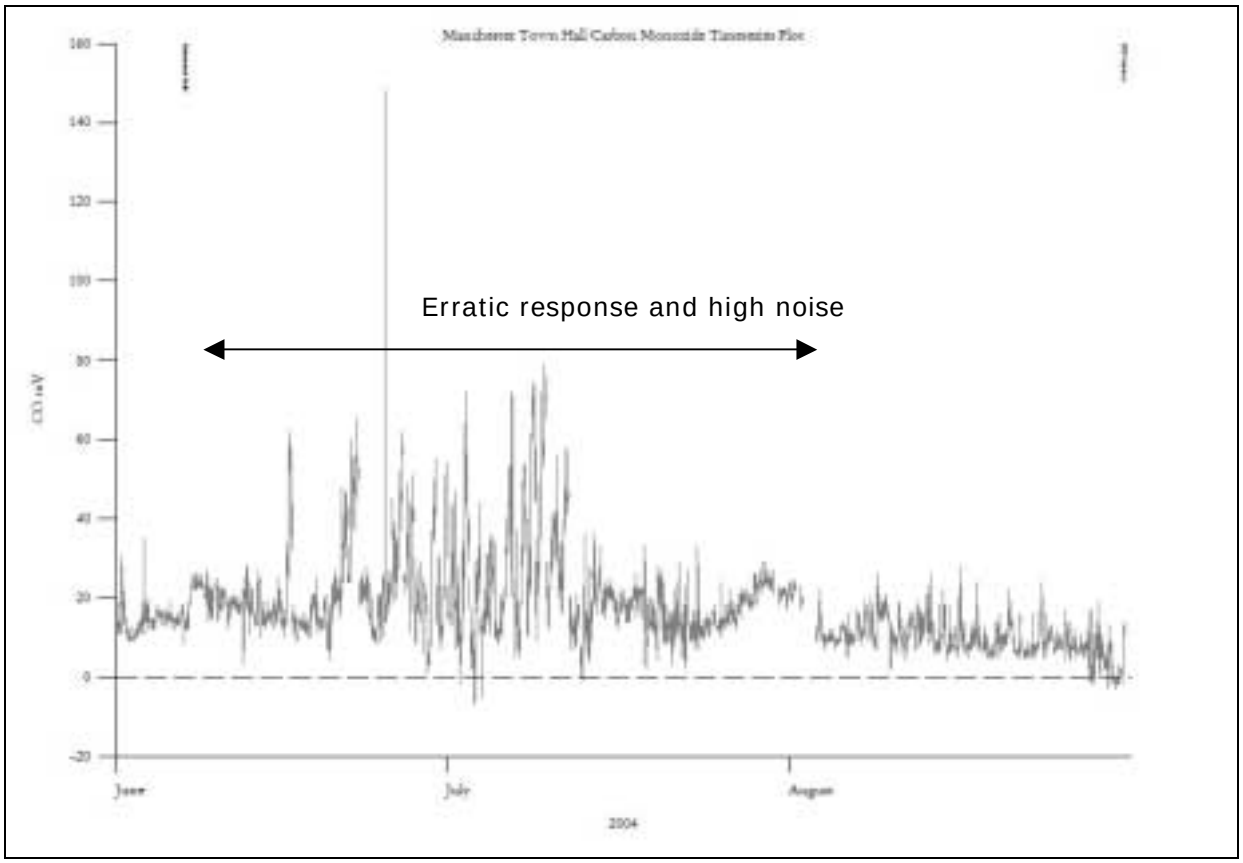

Figure 3.3 Manchester Town Hall CO analyser unstable response

3.4 Southend-on-Sea CO

The CO analyser at Southend-on-Sea has shown a history or response instability problems over the last 6-months. (See Figure 3.4) Four months of unacceptable high noise data from February to May 2004 have already been deleted, as reported in the January-March 2004 data ratification report. Repairs to the infra-red lamp and pump were carried out on 19th May however, although the response improved for a few weeks, further problems with negative response spikes and high noise were recorded again in June and July. The analyser was removed for repair and a replacement box installed on 29th July. In view of the long-term response problems, data deletion has been continued resulting in a total of 5.5 months data loss from 10th February until 29th July 2004. (Critical site)

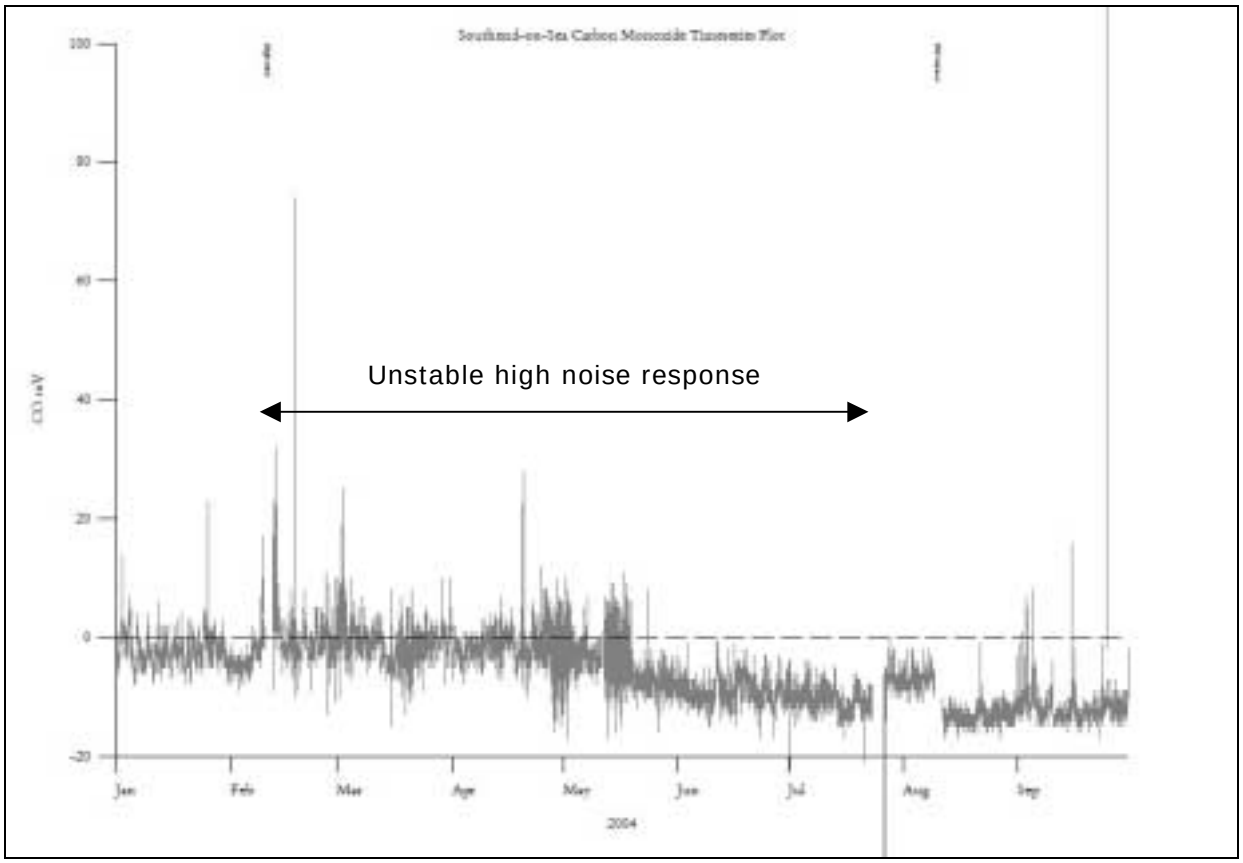

Figure 3.4 Southend–on-Sea CO high noise and negative response, Feb- July 2004

3.5 Aston Hill O_3

Over the 2-month period August-September, the ozone analyser at Aston Hill was replaced six times due to a number of operational faults which are summarised below:

12th August:	Original O_3 analyser re-installed at service (1)
15th August:	Analyser fault and response instability
19th August:	Replacement analyser installed (2)
31st August:	IZS temperature fault. Analyser replaced (3)
7th Sept :	Analyser failure. Removed to workshop for repair
10th Sept	Repaired analyser reinstalled (4) but IZS fault persisted
15th Sept	Replacement analyser installed (5) but damaged in transit so removed again.
20th Sept	Replacement analyser installed (6)

This analyser is one of the relatively new instruments that were purchased as part of the recent major equipment up-grading exercise. Although the cost of repairs will have been carried out under warranty, the high number of recurring faults also has a direct impact on the time taken to ratify the data. All periods of unstable response data shown in Figure 3.5 have been deleted resulting in a total of 3 weeks data loss. (Critical site)

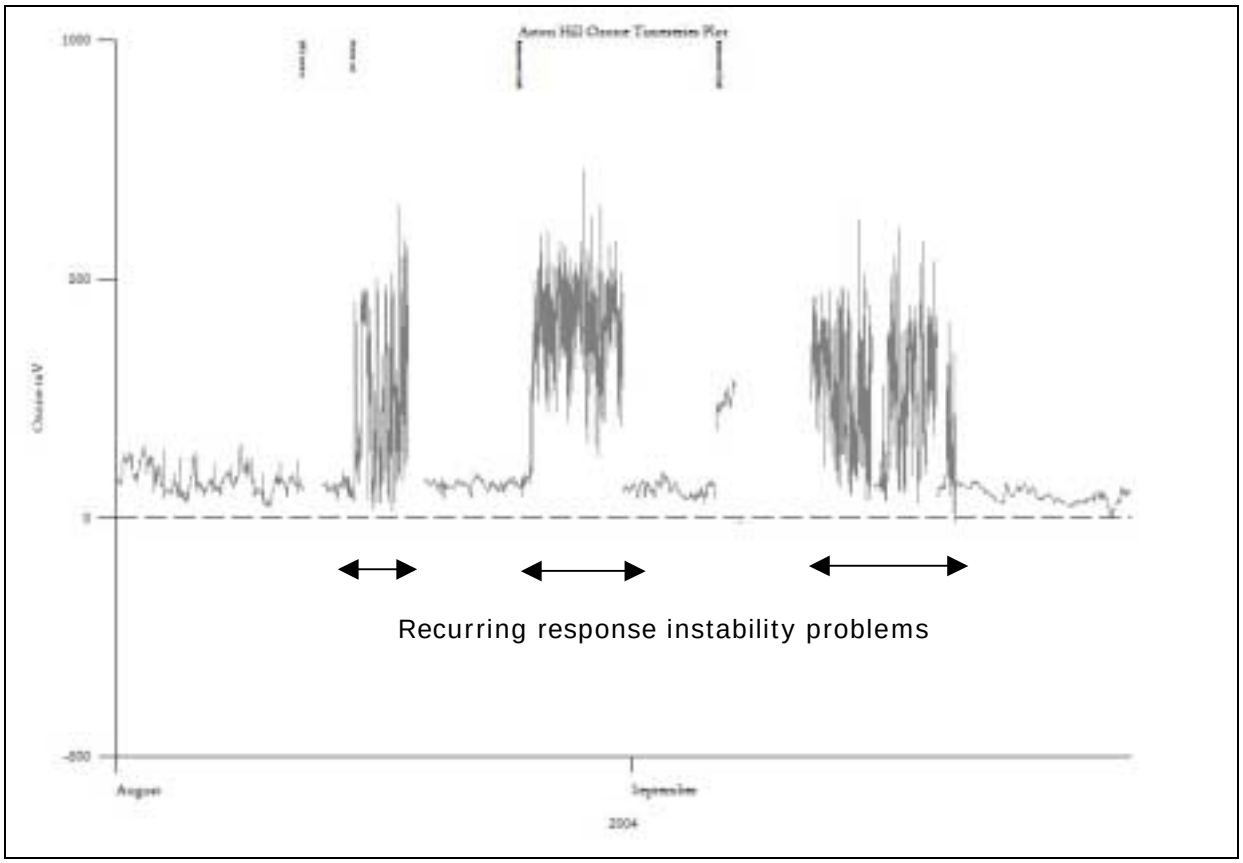

Figure 3.5 Aston Hill O_3 recurring response instability problem

3.6 Glasgow Centre PM_{10}

Over 3.5 months of PM_{10} data have been rejected from Glasgow Centre during ratification due to periods of high noise and negative response (See Figure 3.6). In addition a major sampling leak (total flow 73% low) was identified at the audit in July 2004. All data from April 20th April until 13th August when the TEOM was replaced have been rejected. (Critical site)

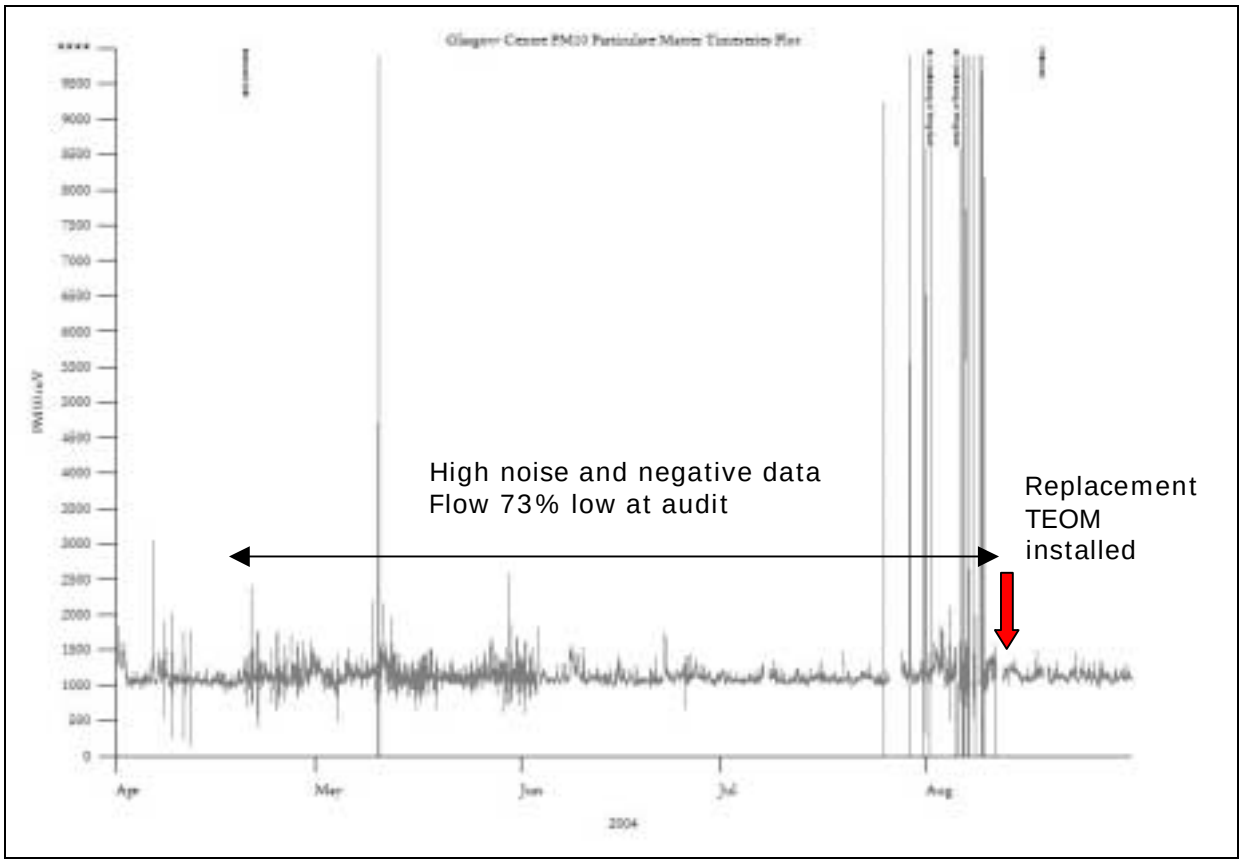

Figure 3.6 Glasgow Centre PM_{10} high noise and flow leak, April – August 2004

3.7 Swansea PM_{10}

Major leaks in the TEOM analyser at Swansea have been identified at the last two successive QA/QC audits on the 16th March 2004 (main flow 60% low) and on the 20th September 2004 (main flow 45% low). The first leak was due to a cracked plastic fitting at the mass flow controller. The second leak was due to a cracked disposable filter unit (DFU). Due to the magnitude of the leaks and resulting effect on sampling efficiency, all poor quality data from January 2004 until repair of the second leak at the service on 4th October 2004 (9 months) have been deleted. (Critical site)

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 July to September 2004 (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% July to September 2004
(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							
Barnsley Gawber							
O_3	88.8%	01-Jul-04	01-Jul-04	PC/logger	PC rebooted	0.3	6
		21-Jul-04	23-Jul-04	PC/logger	PC unit replaced due to on-going communications fault.	2	47
		25-Jul-04	28-Jul-04	Pump fault	Ozone pump failed. Original PC unit reinstated.	3.2	76
		14-Aug-04	14-Aug-04	Analyser fault	Recurring lock-up of the O_3 analyser's processor card. Analyser reset by LSO.	0.5	11
		15-Aug-04	16-Aug-04	Analyser fault	As above.	0.7	17
		18-Aug-04	20-Aug-04	ESU service	Service	2	49
		14-Sep-04	14-Sep-04	Analyser fault	As above. O_3 processor card replaced on 8th Oct 2004.	0.7	16
Birmingham Centre							
SO_2	68.5%	14-Jul-04	31-Jul-04	Response instability	Instrument response instability.	18	431
		01-Aug-04	11-Aug-04	Response instability and service	Instrument response instability. Pre-amp board replaced at service	10.5	251
		04-Sep-04	05-Sep-04	Response instability	Spurious negative data deleted	0.3	8
Birmingham East							
General					Site closed on 4th August 2004. Relocated to Birmingham Tyburn		
CO	37.0%	04-Aug-04	30-Sep-04	Site closed	Site closed for relocation	56.7	1360
NO_2	34.0%	09-Jul-04	12-Jul-04	Telemetry	Disruption in data polling due to trial of an alternative data management system	2.8	66
		04-Aug-04	30-Sep-04	Site closed	Site closed for relocation	56.7	1360
O_3	37.0%	04-Aug-04	30-Sep-04	Site closed	As above	56.7	1360
PM_{10}	34.1%	29-Jul-04	30-Jul-04	Unstable response	TEOM filter reseated	1	25
		02-Aug-04	30-Sep-04	Site closed	Unstable response after audit on 2/8/04 until site closure.	58.5	1408
SO_2	37.0%	04-Aug-04	30-Sep-04	Site closed	As above	56.7	1360

Blackpool							
SO_2	81.1%	03-Jul-04	03-Jul-04	Unstable response	Unstable high response data rejected	0.5	12
		07-Jul-04	07-Jul-04	Unstable response	Spurious low data deleted after calibration.	0.5	11
		06-Sep-04	22-Sep-04	Pump fault	Pump fault. Pump replaced on 16/8 but unstable response continued until 22/0/04.	15.6	374
Bolton							
NO_2	83.6%	07-Aug-04	20-Aug-04	Power cut and unstable response	Power cut due to air conditioning problems. Low and unstable response data deleted from after power cut on 7/8/04 until repair on 20/8/04.	13.1	314
		21-Sep-04	22-Sep-04	ESU service	Service	1.1	27
		26-Sep-04	26-Sep-04	Power cut	Power cut	0.5	12
Bristol Centre							
O_3	88.8%	20-Jul-04	21-Jul-04	Instrument fault	Spurious high ozone data deleted due to bad connection on IZS lamp. Joint resoldered.	1.3	31
		02-Aug-04	04-Aug-04	Instrument fault	Thermistor board fault. Replacement analyser installed.	2.3	55
		09-Aug-04	11-Aug-04	ESU service	Service. Original analyser reinstated	2.3	54
		02-Sep-04	06-Sep-04	Sampling fault	Leak in sample inlet filter holder	4	97
Bristol Old Market							
CO	81.4%	27-Jul-04	13-Aug-04	Baseline truncated	CO zero baseline offset dropped below response threshold. The old CO analyser which was susceptible to zero truncation problems was removed and a new analyser installed on 12th August 2004.	17	407
Bury Roadside							
SO_2	83.3%	01-Jun-04	14-Jul-04	Instrument fault	UV lamp fault. Lamp driver board replaced on 14th July 2004.	43.8	1050
		17-Aug-04	17-Aug-04	QA/QC audit	QA/QC audit	0.3	6
		25-Aug-04	26-Aug-04	ESU service	Service	1	25
Cambridge Roadside							
NO_2	89.0%	08-Jul-04	08-Jul-04	Air conditioning	Air conditioning unit malfunction giving elevated site temperatures and causing NO_x analyser response problems.	0.4	10
		10-Jul-04	12-Jul-04	Air conditioning	Temporary portable air conditioning unit installed.	2	48
		23-Jul-04	26-Jul-04	Air conditioning	Portable air conditioning unit	2.4	57

					failed resulting in unstable analyser response again. Original a/c unit reinstalled following repair		
		10-Sep-04	13-Sep-04	Monitoring suspended	Site operation suspended to allow up-grading of the communications system within the Council building.	2.8	68
		16-Sep-04	17-Sep-04	Operator error	NO_x analyser accidentally left out of service following calibration visit	0.8	19
		23-Sep-04	24-Sep-04	No mV data collected	Possible ESU service	1	24
Glazebury							
NO_2	89.9%	02-Sep-04	07-Sep-04	ESU service	Data deleted due to spurious response after service.	5.3	128
High Muffles							
NO_2	53.8%	12-Aug-04	23-Sep-04	Instrument fault	Fault found at audit. Sample flow and reaction cell pressure problems causing slow response. Also extreme autocalibration run-on problem resulting in up to 11 hours data loss per day. (See Section 2.10)	42.2	1012
Hove Roadside							
NO_2	83.2%	17-Jul-04	26-Jul-04	Pump fault	Pump fault due to residue around pump valves.	9.5	227
		19-Aug-04	23-Aug-04	Pump fault	Pump failure	4.5	107
		16-Sep-04	17-Sep-04	ESU service	6-month service	1	25
Ladybower							
General					Site power cuts and modem problems. Logger battery back up system not working properly resulting in several days data loss. New modem fitted on 20th August 2004.		
O_3	50.9%	06-Aug-04	07-Aug-04	Power cut	Power cut causing communications fault.	0.5	13
		09-Aug-04	22-Sep-04	Sampling fault	New API analyser installed but found to be leaking at audit. Data deleted until repair of analyser on 3rd September. Following repair, spurious high data were recorded and further attention to clear a blockage in the sampling system was carried out on 22/9/04.	44.3	1064
Leamington Spa							
CO	86.2%	25-Jun-04	11-Jul-04	Baseline truncated	Step change in zero baseline resulting a response truncation.	16.4	394
		15-Sep-04	16-Sep-04	ESU service	Service	1.1	26

Leeds Centre							
CO	86.1%	23-Jul-04	23-Jul-04	ESU visit	ESU call-out to investigate NO_x and O_3 analyser response instability.	0.3	6
		29-Jul-04	29-Jul-04	No mV data	Reason not given.	0.3	7
		24-Aug-04	02-Sep-04	Air conditioning	Air conditioning unit iced up giving rise to elevated rack temperatures and unstable anlayser response.	9.1	218
NO_2	89.4%	23-Jul-04	23-Jul-04	Pump fault	ESU call-out to investigate NO_x and O_3 analyser response instability. Charcoal bag on NO_x pump replaced.	0.3	6
		31-Aug-04	02-Sep-04	ESU service	Service	2.1	50
		09-Sep-04	15-Sep-04	Sampling fault	NO_x analyser flow fault. Leak in charcoal scrubber found.	6.4	153
O_3	53.4%	22-Jul-04	02-Sep-04	Internal sampling	Leak in O_3 analyser sampling system coincided with an O_3 scrubber leak from the NO_x analyser exhaust resulting in artificially elevated O_3 concentrations. (See Section 3.2)	42.5	1019
SO_2	85.0%	23-Aug-04	24-Aug-04	Instrument fault	Air conditioning unit malfunction causing over-heating and unstable response.	1	25
		31-Aug-04	02-Sep-04	ESU service	Service	2.1	50
		18-Sep-04	28-Sep-04	Pump fault	Pump fault. Repaired on 20th September but fault recurred 4 days later.	9.7	233
Leicester Centre							
NO_2	72.2%	08-Jun-04	26-Jul-04	ESU service	Low NO_x data and unstable calibration response recorded after new analyser installed on 8th June 2004.	48	1153
London Brent							
SO_2	79.2%	02-Jul-04	08-Jul-04	Instrument fault	UV lamp and driver board fault	5.6	135
		15-Jul-04	20-Jul-04	Instrument fault	Analyser not responding to span gas at calibration and switched out of service. ESU visit found no obvious fault.	5.4	129
		30-Jul-04	04-Aug-04	Analyser fault and ESU service	UV lamp fault. Lamp replaced at the service on 3rd August 2004.	5.3	127
London Bromley							
CO	87.2%	01-Jul-04	05-Jul-04	Operator error	Analyser not switched back into sampling mode after calibration.	4.1	99
		15-Jul-04	16-Jul-04	Power cut	Site power cut	0.8	20
		29-Jul-04	30-Jul-04	Air Conditioning	Air conditioning failure giving high cabin temperatures and data loss	0.5	13
		31-Jul-04	31-Jul-04	Air Conditioning	As above	0.3	7

				or Temp fault			
		04-Aug-04	08-Aug-04	Air Conditioning	As above	4.3	104
		26-Aug-04	27-Aug-04	ESU service	6-month service visit	1.1	26
London Hackney							
General					O_3 analyser suffered intermittent faults during resulting in short periods of data loss. The problem eventually resulted in a persistent internal temperature sensor fault in October 2004		
O_3	70.5%	28-Jul-04	28-Jul-04	Flat response	Intermittent fault	0.3	7
		18-Aug-04	18-Aug-04	Flat response	As above	0.4	9
		31-Aug-04	31-Aug-04	Flat response	As above	0.3	8
		01-Sep-04	01-Sep-04	Flat response	A above	0.4	9
		07-Sep-04	11-Oct-04	Instrument fault	Internal temperature sensor fault	34.4	825
London Hillingdon							
O_3	78.7%	06-Jul-04	09-Jul-04	ESU service	Service	2.9	69
		11-Aug-04	27-Aug-04	Instrument fault	Flat response data deleted until repair of 3-way solenoid valve.	16	384
London Teddington							
NO_2	89.9%	29-Jun-04	06-Jul-04	Internal Sampling	Sample manifold fan fault. Spurious low data rejected.	7.4	177
London Westminster							
CO	81.7%	09-Aug-04	25-Aug-04	ESU service and internal sampling	Manifold fan accidentally left switched off after routine service.	16.3	390
NO_2	79.4%	22-Jul-04	23-Jul-04	Instrument fault	Photomultiplier tube temperature fault.	0.6	14
		09-Aug-04	25-Aug-04	ESU service and internal sampling	Manifold fan left off after service.	16.3	390
		22-Sep-04	23-Sep-04	Instrument fault	Recurrence of PMT temperature fault.	1.4	34
O_3	81.8%	09-Aug-04	25-Aug-04	ESU service and internal sampling	Manifold fan left off after service	16.2	389
SO_2	81.3%	03-Aug-04	04-Aug-04	No mV data collected	No reason given	0.3	6
		06-Aug-04	06-Aug-04	QA/QC audit	Audit	0.3	7
		09-Aug-04	25-Aug-04	ESU service and internal sampling	Manifold fan left off after service	16.2	389
Lullington Heath							
SO_2	77.9%	02-Jul-04	19-Jul-04	Instrument fault	SO_2 analyser not resetting properly after power cuts causing intermittent periods of data loss	16.5	397
		10-Sep-04	11-Sep-04	Power cut	Analyser fault following power cut	0.9	22

		14-Sep-04	14-Sep-04	Power cut	As above	0.4	9
		29-Sep-04	30-Sep-04	ESU service	Service	1.6	38
Manchester Piccadilly							
NO_2	81.7%	31-Aug-04	02-Sep-04	ESU service	Service	2	48
		06-Sep-04	10-Sep-04	NO_x converter fault	Analyser failed to respond to span gas due to a converter fault. Analyser returned to workshop for repair.	4.5	107
		19-Sep-04	28-Sep-04	NO_x converter fault	Recurrence of converter fault and analyser removed for further investigation. Converter and temperature control boards replaced.	9.5	228
SO_2	86.7%	31-Aug-04	10-Sep-04	ESU service and unstable response	Unstable response after service	9.6	231
		22-Sep-04	24-Sep-04	Unstable response	Unstable response data deleted	2	49
Manchester South							
NO_2	59.4%	27-Jul-04	02-Sep-04	NO_x converter fault	Low converter efficiency (92%) found at audit. (See Section 2.5)	37.1	890
O_3	89.7%	01-Sep-04	10-Sep-04	Instrument fault	Spurious low ambient data recorded after service. Malfunction of analyser's pressure and temperature switch. Sample manifold also cleaned	9.1	219
Manchester Town Hall							
CO	61.9%	07-Jun-04	03-Aug-04	Instrument fault	Noisy and erratic response data deleted due to IR source fault. (See Section 3.3)	57.3	1374
		31-Aug-04	01-Sep-04	ESU service	Six monthly service	1.2	28
Middlesbrough							
CO	82.2%	13-Sep-04	14-Sep-04	ESU service	Service	1.3	31
		16-Sep-04	07-Oct-04	Sampling fault	Sample filter holder not closed properly causing leak and internal sampling.	20.6	495
NO_2	16.9%	18-May-04	14-Sep-04	NOx converter fault	Converter fault (78%) identified at audit. Data deleted from start of NO_2 calibration span divergence on 18th May until service on 14th September 04. (See Section 2.5)	119	2863
Northampton General					The station uses a mobile telephone for telemetry. Problems with the mobile network provider and the College administration resulted in a 3-week disruption to data collection.		
CO	72.0%	20-Jul-04	21-Jul-04	ESU service	Service	1.1	27

		27-Aug-04	20-Sep-04	Telemetry	Mobile phone service problems	24.1	579
NO_2	65.4%	02-Jul-04	05-Jul-04	Power cut	Analyser failed to reset correctly after site power cut	2.9	69
		20-Jul-04	21-Jul-04	ESU service	Service	1.1	27
		27-Aug-04	23-Sep-04	Telemetry	Mobile phone service problems	27.4	658
O_3	68.9%	20-Jul-04	21-Jul-04	ESU service	Service	1.1	27
		20-Aug-04	23-Aug-04	Instrument fault	Faulty flow meter sensor.	2.9	69
		27-Aug-04	20-Sep-04	Telemetry	Mobile phone service problems	24.1	579
SO_2	67.9%	16-Jul-04	21-Jul-04	Instrument fault	SO_2 analyser found to be switched out of service at the audit due to a fault with the hydrocarbon kicker. Repaired at service on 20/7/04	5.1	122
		27-Aug-04	20-Sep-04	Telemetry	Mobile phone service problems	24.1	579
Oxford Centre							
NO_2	85.0%	02-Jun-04	13-Jul-04	NO_x converter fault	NO_x converter low (88%) at audit on 7/7/04. (See Section 2.5)	41.3	991
Plymouth Centre							
CO	75.0%	09-Aug-04	31-Aug-04	ESU service	High noise data deleted after routine service.	22.7	544
NO_2	89.4%	09-Aug-04	17-Aug-04	ESU service and sampling fault	Service followed by pump fault	8.3	200
		23-Aug-04	23-Aug-04	High noise	Short period of high noise data rejected	0.3	7
Rotherham Centre							
SO_2	72.1%	30-Jun-04	23-Jul-04	Sampling fault	High noise data and drifting response due to pump fault.	23.6	567
		23-Aug-04	25-Aug-04	ESU service	Service	2.1	51
Somerton							
NO_2	85.1%	Daily		Autocal run-on	NO_2 autocal run-on (6 ppb) resulting in 3 hours data loss each day		3 hr/day
		09-Aug-04	11-Aug-04	ESU service	Service	1.7	41
Southend-on-Sea							
CO	65.6%	10-Feb-04	29-Jul-04	High noise	High noise and negative data deleted. IR source and pump replaced on 19th May 2004. Continuation of noise and drift in calibration sensitivity until analyser replaced on 29th July 2004. (See Section 3.4)	170	4091
		09-Aug-04	11-Aug-04	ESU service	Service	2.3	56
Stockport Shaw Heath							
CO	36.7%	12-Jul-04	12-Jul-04	Power cut	Power supply interruptions	0.5	12
		04-Aug-04	30-Sep-04	Instrument fault	Intermittent reference voltage fault. Problem investigated by ESU on several occasions in	57.6	1382

					September but fault persisted. Replacement detector assembly fitted on October 11th 2004. Further intermitted data loss occurred indicating recurrence of fault.		
NO_2	67.7%	12-Jul-04	12-Jul-04	Power cut	Power supply interruptions.	0.5	12
		20-Jul-04	18-Aug-04	Sampling fault	Spurious elevated NO_2 levels recorded between routine LSO visits. NO_2 cylinder possibly not closed properly after calibration.	29	696
SO_2	0.0%	09-Jun-04	30-Oct-04	Analyser fault	UV lamp board failure. Delay whilst awaiting provision of new UV lamp driver board. Board replaced on 12th August but further faults with the lamp and autocal switching valve resulted in extended data loss. Service was delayed due ingress of rainwater at the site from a leak in the roof. Still awaiting delivery of second replacement UV lamp driver board.	144	3456
PM_{10}	70.8%	12-Jul-04	12-Jul-04	Power cut	Power cut	0.5	13
		12-Aug-04	07-Sep-04	Instrument fault	TEOM response failed to stabilise after site power cut. Response improved after ESU service in September.	26.2	629
Stoke-on-Trent Centre							
PM_{10}	88.30 %	04-Aug-04	04-Aug-04	Unstable response	High noise data deleted data after filter change.	0.3	6
		31-Aug-04	02-Sep-04	ESU service	Service	2	49
		15-Sep-04	23-Sep-04	Unstable response	TEOM response instability again after filter change. Filter reseated. This analyser has been identified by QA/QC Unit as a needing to be up-graded/replaced. A new TEOM analyser was installed in October 2004.	8	192
Wigan Leigh							
General					Wigan Leigh site closed on 28th September due to the necessary redevelopment of the Police Station. Analysers were relocated to Wigan Centre and monitoring commenced after the audit on 11th October 2004.		
O_3	88.2%	03-Aug-04	04-Aug-04	Power cut	Power cut.	0.8	19
		03-Sep-04	07-Sep-04	Instrument fault	3-way solenoid valve fault.	4.5	108
		28-Sep-04	30-Sep-04	Monitoring suspended	Site closed for relocation	2	785

Wolverhampton Centre							
NO_2	77.0%	13-Sep-04	08-Oct-04	Analyser/sampling fault	Spurious low data deleted. Not sampling from manifold and flow blockage. (See Section 3.1)	25.2	605
SCOTLAND							
Aberdeen							
NO_2	87.7%	07-Jul-04	14-Jul-04	Instrument fault	Unstable response following repair of photomultiplier tube.	6.5	156
		05-Aug-04	06-Aug-04	ESU service	Service	1	25
Glasgow Centre							
General				Air Conditioning	Air conditioning unit malfunction causing significant effect on NO_x and TEOM analyser performance. Air conditioning unit replaced on 11th August.		
CO	88.5%	07-Jul-04	08-Jul-04	Operator error	LSO failed to switch analyser back into service after calibration	0.8	20
		26-Jul-04	28-Jul-04	ESU service	Service	2	47
		11-Aug-04	18-Aug-04	Instrument fault	Unexplained 50% drop in analyser response. Repaired by ESU.	7	169
NO_2	74.3%	07-Jul-04	08-Jul-04	Operator error	Not switched back into service after calibration	0.8	20
		26-Jul-04	17-Aug-04	Air conditioning	Data deleted due to site temperature problems effecting analyser response stability. Analyser replaced on August 11th but not operating satisfactorily so replaced again on 17th August	22.2	533
PM_{10}	51.0%	20-Apr-04	13-Aug-04	Instrument fault	High noise data deleted. TEOM unit replaced on June 9th but spare analyser not working correctly so original re-installed. Audit showed main flow leak (-73%) so data deleted until repair at service on 28th July. Further temperature problems effecting response stability until TEOM replaced on 13th August. (See Section 3.6)	116	2772
		18-Aug-04	19-Aug-04	Operator error	LSO failed to switch TEOM back into service after calibration	0.8	18
SO_2	88.6%	07-Jul-04	08-Jul-04	Operator error	Not switched back into service after calibration	0.8	20
		21-Jul-04	28-Jul-04	Response instability and ESU service	Spurious step change in baseline prior to service, probably due to site temperature problems.	7	168
		11-Aug-04	12-Aug-04	Air Conditioning or Temp fault	ESU on site to attend air conditioning problems.	1	24

		18-Aug-04	19-Aug-04	Operator error	LSO failed to switch TEOM back into service after calibration	0.8	18
Glasgow Kerbside							
NO_2	89.2%	01-Jul-04	01-Jul-04	No mV data	No reason given	0.3	6
		19-Jul-04	28-Jul-04	NO_2 converter fault	NO_x converter found to be low (90%) at audit. (See Section 2.5)	9.1	219
Strath Vaich							
General					Problem with the ozone analyser giving intermittent periods of erratic noisy data.		
O_3	80.5%	05-Aug-04	10-Aug-04	Instrument fault	Erratic data deleted	5	119
		07-Sep-04	09-Sep-04	Instrument fault	As above	2.3	55
		15-Sep-04	18-Sep-04	Instrument fault	As above	3.1	75
		22-Sep-04	29-Sep-04	Instrument fault	As above. The O_3 analyser was replaced on 29th September 2004.	7.1	170
WALES							
Aston Hill							
General					Major problems with ozone analyser associated with the IZS cycle. Analyser replaced 4 times over a 3-month period (See Section 3.5**).** Site also prone to frequent power cuts.		
O_3	71.1%	12-Aug-04	13-Aug-04	ESU service	Service. Original site analyser re-installed after repair.	1.1	26
		15-Aug-04	19-Aug-04	Power cut	Faulty analyser response after power cut. Analyser replaced.	4.2	101
		25-Aug-04	31-Aug-04	Instrument fault	Erratic data due to IZS temperature fault. Original site analyser re-instated.	5.6	135
		06-Sep-04	20-Sep-04	Instrument fault	Erratic data due to faulty IZS and central processing unit failure. Analyser replaced.	14.4	346
Narberth							
NO_2	89.1%	Daily		Autocal run-on	NO_2 autocal run-on (1.9 ppb) resulting in 3 hours data loss each day		3 hours per day
		27-Sep-04	29-Sep-04	ESU service	Service	1.9	46
PM_{10}	83.40 %	31-Jul-04	12-Aug-04	Response instability	High noise and negative response data deleted	12.4	297
		27-Sep-04	29-Sep-04	ESU service	Service	1.9	46
Port Talbot							
NO_2	69.7%	03-Sep-04	15-Oct-04	Response Instability	Analyser unable to maintain stable span response during calibrations. Analyser removed at service on 3/9/04 and re-instated after repair on 15 October 2004	42	1008

Swansea

PM_{10}	0.00%	01-Apr-04	06-Oct-04	ESU service	Data deleted for this period. Major leak was found at audit on 20 September 2004. Investigated by ESU and TEOM main flow found to be 45% low. Leak due to cracked DFU. (See Section 3.7**)**	189	4530

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 July to September 2004. Casella Stanger has supplied the measured data, undertaken the filter weighing and calculated the particulate concentrations.

Bournemouth (Data capture 86%)

There was one recurrence on 20th August of the error code 40000 problem (i.e. coefficient of variation of average flow too high) which was seen repeatedly in the previous quarter. A further 10 days data (15-25th September) were lost due to a breakdown in laboratory procedures which prevented the filters from being properly weighed.

Month	Comment	Data Loss
August	12th August, Power failure 20th August, Large variation in flow (error code 40000)	1 day 1 day
September	15-25th Sept, laboratory procedure problem	10 days

Brighton Roadside (Data capture 84%)

Two days data (18th August and 29th September) were lost due to damaged filters. A further 14-day gap occurred from 16th – 28th September due to a breakdown in laboratory procedures which prevented the filters from being properly weighed.

Month	Comment	Data Loss
August	18th August, Filter damaged	1 day
September	16th -28th Sept, laboratory procedure problem	10 days

Northampton (Data capture 88%)

Four days data (2nd – 5th July) were lost due to a power failure. A further 7 days were lost due to filter exchange failures (6th July, 20-23rd August, and 30-31st August). One filter (23rd Sept) was not returned for weighing.

Month	Comment	Data Loss
July	2nd–5th July: power failure 6th July: filter exchange failure	4 days 1 day
August	20-23rd and 30-31st: filter exchange failure	6 days
September	23rd Sept: filter not returned	1 day

Dumfries

Although high data capture was achieved in the period, frequent occurrences of error codes P, R and PR continued as report in the previous quarter. If left unattended these may result in future data loss.

Recommendation

The ESUs should investigate the cause of the frequent R and P error codes recorded at Dumfries.

5 Ratified Data Capture Statistics

Table 5.1 provides the ratified data capture figures for each site for the 3-month period July to September 2004. Data capture values below 90% are shown in the shaded boxes.

Table 5.1 AURN Ratified Data Capture (%) for July to September 2004
(Using the start date of any new site or end date of site closed)

Site	CO	NO_2	O_3	PM_{10}	$PM_{2.5}$	SO_2	Site Average
England							
Barnsley 12	-	-	-	-	-	98.4	98.4
Barnsley Gawber	90.5	91.9	88.8	-	-	91.8	90.8
Bath Roadside	98.3	98.2	-	-	-	-	98.3
Billingham	-	98.7	-	-	-	-	98.7
Birmingham Centre	97.1	92.8	96.3	97.4	-	68.5	90.4
Birmingham East[1]	97.3	89.3	97.3	89.5	-	97.3	94.1
Birmingham Tyburn	99.6	99.6	99.5	99.7	-	99.2	99.5
Blackpool	99.1	94.4	97.2	96.4	-	81.1	93.7
Bolton	97.2	83.6	97.3	96.7	-	97.4	94.4
Bottesford	-	-	99.5	-	-	-	99.5
Bournemouth	97.0	92.4	97.2	85.9	-	96.9	93.9
Bradford Centre	96.3	91.5	97.6	96.0	-	97.5	95.8
Brentford Roadside	99.5	99.6	-	-	-	-	99.6
Brighton Roadside	98.1	98.1	-	-	-	-	98.1
Brighton Roadside PM_{10}	-	-	-	83.7	-	-	83.7
Bristol Centre	97.1	96.7	88.8	96.6	-	93.3	94.5
Bristol Old Market	81.4	98.1	-	-	-	-	89.8
Bury Roadside	98.2	94.0	98.3	97.6	-	83.3	94.3
Cambridge Roadside	-	89.0	-	-	-	-	89.0
Camden Kerbside	-	98.3	-	93.6	-	-	96.0
Canterbury	-	98.3	-	98.2	-	-	98.2
Coventry Memorial Park	98.0	98.1	97.9	98.1	-	97.9	98.0
Exeter Roadside	94.4	98.0	98.0	-	-	98.0	97.1
Glazebury	-	89.9	98.5	-	-	-	94.2
Great Dun Fell	-	-	97.6	-	-	-	97.6
Haringey Roadside	-	96.2	-	99.6	-	-	97.9
Harwell	-	98.1	98.1	98.1	91.9	98.1	96.9
High Muffles	-	53.8	99.2	-	-	-	76.5
Hove Roadside	98.2	83.2	-	-	-	98.1	93.2
Hull Freetown	95.5	95.4	95.6	95.2	-	95.6	95.5
Ladybower	-	91.4	50.9	-	-	92.9	78.4
Leamington Spa	86.2	94.0	98.2	97.1	-	98.1	94.7
Leeds Centre	86.1	89.4	53.4	97.0	-	85.0	82.2
Leicester Centre	99.6	72.2	99.4	99.2	-	99.5	94.0
Liverpool Speke	97.5	97.4	97.5	96.5	-	97.5	97.3
London A3 Roadside	96.0	91.3	-	95.5	-	-	94.2
London Bexley	97.6	97.4	97.8	97.6	-	97.6	97.6
London Bloomsbury	97.1	96.1	97.1	97.2	97.2	97.1	97.0
London Brent	93.9	92.9	93.8	93.3	-	79.2	90.6
London Bromley	87.2	97.3	-	-	-	-	92.3
London Cromwell Road 2	95.3	99.3	-	-	-	99.0	97.9
London Eltham	-	92.4	99.3	98.7	-	99.0	97.3
London Hackney	92.0	99.0	70.5	-	-	-	87.2
London Haringey	-	-	99.5	-	-	-	99.5
London Harlington	91.8	99.7	98.6	98.7	-	-	97.2

Site	CO	NO_2	O_3	PM_{10}	$PM_{2.5}$	SO_2	Site Average
London Hillingdon	96.1	95.7	78.7	96.3	-	96.0	92.5
London Lewisham	-	99.6	99.5	-	-	99.7	99.6
London Marylebone Road	97.5	97.6	97.8	98.4	91.4	91.3	95.7
London N. Kensington	99.2	99.5	94.3	99.1	-	98.6	98.1
London Southwark	97.7	95.2	98.1	-	-	98.0	97.2
London Teddington	-	89.9	93.7	-	-	93.7	92.4
London Wandsworth	-	99.1	99.0	-	-	-	99.1
London Westminster	81.7	79.4	81.8	97.8	-	81.3	84.4
Lullington Heath	-	91.5	96.0	-	-	77.9	88.5
Manchester Piccadilly	97.1	81.7	97.1	97.0	-	86.7	91.9
Manchester South	-	59.4	89.7	-	-	98.3	82.5
Manchester Town Hall	61.9	90.1	-	-	-	-	76.0
Market Harborough	98.0	93.5	92.9	-	-	-	94.8
Middlesbrough	82.2	16.9	98.4	97.5	-	98.1	78.6
Newcastle Centre	97.0	92.9	97.1	97.1	-	96.6	96.1
Northampton	72.0	65.4	68.9	72.3	-	67.9	69.3
Northampton PM10	-	-	-	88.0	-	-	88.0
Norwich Centre	97.1	92.9	97.3	97.3	-	97.1	96.3
Norwich Roadside	-	98.2	-	-	-	-	98.2
Nottingham Centre	96.7	96.7	96.9	96.4	-	96.8	96.7
Oxford Centre	99.3	85.0	-	-	-	99.5	94.6
Plymouth Centre	75.0	89.4	96.0	97.0	-	94.8	90.4
Portsmouth	98.8	98.4	99.2	98.1	-	97.6	98.4
Preston	99.6	95.1	99.6	99.3	-	99.4	98.6
Reading New Town	97.2	93.1	97.2	96.8	-	96.9	96.2
Redcar	97.0	96.9	97.0	96.9	-	96.9	97.0
Rochester	-	95.3	99.4	98.7	99.5	99.5	98.5
Rotherham Centre	-	95.7	91.1	-	-	72.1	86.3
Salford Eccles	97.0	97.0	96.9	97.1	-	97.0	97.0
Sandwell West Bromwich	97.8	98.0	97.8	-	-	98.1	97.9
Scunthorpe Town	-	-	-	93.9	-	98.1	96.0
Sheffield Centre	96.9	92.9	96.0	97.1	-	96.7	95.9
Sheffield Tinsley	93.5	98.3	-	-	-	-	95.9
Sibton	-	-	99.2	-	-	-	99.2
Somerton	-	85.1	97.6	-	-	-	91.3
Southampton Centre	95.5	93.0	97.2	97.2	-	97.0	96.0
Southend-on-Sea	65.6	91.3	96.4	94.1	-	93.6	88.2
Southwark Roadside	98.2	97.2	-	-	-	98.5	97.9
St Osyth	98.1	91.9	98.2	-	-	-	96.1
Stockport Shaw Heath	36.7	67.7	-	70.8	-	0.0	43.8
Stockton-on-Tees Yarm	98.2	98.8	-	97.6	-	-	98.2
Stoke-on-Trent Centre	97.1	93.0	97.3	88.3	-	91.7	93.5
Sunderland	-	-	-	-	-	99.3	99.3
Thurrock	95.3	93.7	98.1	99.5	-	98.1	96.9
Tower Hamlets Roadside	99.6	98.5	-	-	-	-	99.0
Walsall Alumwell	-	91.7	-	-	-	-	91.7
Walsall Willenhall	-	99.2	-	-	-	-	99.2
West London	97.7	97.7	-	-	-	-	97.7
Weybourne	-	-	100.0	-	-	-	100.0
Wicken Fen	-	97.9	97.5	-	-	97.6	97.7
Wigan Leigh	96.1	94.5	90.2	97.4	-	94.2	94.5
Wirral Tranmere	99.4	97.8	99.6	98.1	-	95.2	98.0
Wolverhampton Centre	92.3	77.0	96.6	96.3	-	97.1	91.9
Yarner Wood	-	97.0	92.7	-	-	-	94.8
N Ireland							
Belfast Centre	99.4	95.1	99.2	99.0	-	99.3	98.4

Site	CO	NO_2	O_3	PM_{10}	$PM_{2.5}$	SO_2	Site Average
Belfast Clara St	-	-	-	92.7	-	-	92.7
Belfast East	-	-	-	-	-	96.7	96.7
Derry	96.2	91.8	96.4	95.7	-	95.9	95.2
Lough Navar	-	-	99.7	99.5	-	-	99.6
Scotland							
Aberdeen	98.6	87.7	98.3	95.7	-	98.1	95.7
Bush Estate	-	93.7	97.8	-	-	-	95.7
Dumfries	97.6	94.3	-	98.9	-	-	96.9
Edinburgh St Leonards	98.3	98.3	94.6	98.5	-	98.1	97.5
Eskdalemuir	-	-	95.5	-	-	-	95.5
Glasgow Centre	88.5	74.3	95.1	51.0	-	88.6	79.5
Glasgow City Chambers	98.6	98.3	-	-	-	-	98.5
Glasgow Kerbside	97.8	89.2	-	94.3	-	-	93.8
Grangemouth	97.3	99.2	-	98.2	-	99.2	98.5
Inverness	98.3	95.1	-	97.8	-	-	97.1
Strath Vaich	-	-	80.5	-	-	-	80.5
Wales							
Aston Hill	-	93.7	71.1	-	-	-	82.4
Cardiff Centre	97.8	97.5	97.9	97.6	-	97.1	97.6
Cwmbran	99.5	99.4	99.5	99.0	-	99.2	99.3
Narberth	-	89.1	97.3	83.4	-	96.1	91.5
Port Talbot	-	69.7	97.7	95.2	-	97.5	90.0
Swansea	97.6	97.3	94.7	0.0	-	97.6	77.5
Wrexham	98.8	95.2	-	98.9	-	98.8	97.9
Number of sites	80	107	85	72	4	77	122*
Number of sites < 90%	12	24	11	10	0	12	21
Network Mean (%)	93.9	91.8	94.4	93.7	95.0	93.3	94

[1] Note Birmingham East closed on 4th August 2004 and relocated to Birmingham Tyburn
* Site count of 122 as both Birmingham East and Birmingham Tyburn included

Sites and instruments established between 01/7/2004 and 30/9/2004

Site	Status	Pollutants	Start Date
Birmingham Tyburn	Affiliate	NO_2 CO O_3 PM_{10} SO_2	16/08/2004

Table 5.2 provides the ratified data capture figures for each site for the 9-month period January to September 2004. Data capture values below 90% are shown in the shaded boxes.

Table 5.2 AURN Ratified Data Capture (%) for January to September 2004
(Using the start date of any new site or end date of site closed)

Site	CO	NO_2	O_3	PM_{10}	$PM_{2.5}$	SO_2	Site Average
England							
Barnsley 12	-	-	-	-	-	98.7	98.7
Barnsley Gawber	95.5	94.9	95.1	-	-	95.9	95.4
Bath Roadside	98.7	97.9	-	-	-	-	98.3
Billingham	-	99.0	-	-	-	-	99.0
Birmingham Centre	95.5	91.4	92.5	96.4	-	87.1	92.6
Birmingham East	98.5	90.8	97.9	97.4	-	98.5	96.6
Birmingham Tyburn	99.6	99.6	99.5	99.7	-	99.2	99.5
Blackpool	95.8	90.3	96.0	97.3	-	66.3	89.1
Bolton	97.2	92.6	97.2	96.4	-	97.2	96.1
Bottesford	-	-	99.6	-	-	-	99.6
Bournemouth	98.2	95.3	98.5	92.7	-	97.9	96.5
Bradford Centre	97.4	95.2	97.8	96.7	-	97.3	96.9
Brentford Roadside	96.7	97.5	-	-	-	-	97.1
Brighton Roadside	98.7	98.8	-	-	-	-	98.8
Brighton Roadside PM_{10}	-	-	-	91.6	-	-	91.6
Bristol Centre	97.0	95.7	90.7	96.8	-	94.4	94.9
Bristol Old Market	62.5	98.4	-	-	-	-	80.5
Bury Roadside	91.6	90.3	89.3	91.2	-	67.9	86.0
Cambridge Roadside	-	95.5	-	-	-	-	95.5
Camden Kerbside	-	55.1	-	97.3	-	-	76.2
Canterbury	-	96.1	-	99.2	-	-	97.6
Coventry Memorial Park	98.9	97.8	98.4	90.2	-	98.6	96.8
Exeter Roadside	87.1	96.0	96.2	-	-	80.0	89.8
Glazebury	-	93.1	95.0	-	-	-	94.0
Great Dun Fell	-	-	98.9	-	-	-	98.9
Haringey Roadside	-	98.3	-	98.8	-	-	98.5
Harwell	-	95.6	97.8	97.3	95.3	97.7	96.7
High Muffles	-	70.1	99.0	-	-	-	84.6
Hove Roadside	98.2	93.2	-	-	-	97.6	96.3
Hull Freetown	94.8	86.0	92.0	94.5	-	84.4	90.3
Ladybower	-	88.7	82.3	-	-	96.4	89.1
Leamington Spa	85.3	93.3	98.4	98.2	-	98.2	94.7
Leeds Centre	78.4	89.8	77.1	97.3	-	92.7	87.1
Leicester Centre	85.7	81.0	97.5	94.6	-	96.8	91.1
Liverpool Speke	98.0	98.0	97.8	96.9	-	97.7	97.7
London A3 Roadside	97.9	96.2	-	97.7	-	-	97.3
London Bexley	93.2	95.0	94.2	90.2	-	94.4	93.4
London Bloomsbury	96.2	96.9	96.6	97.6	97.6	97.0	97.0
London Brent	97.2	93.6	97.2	97.0	-	92.2	95.4
London Bromley	95.0	98.0	-	-	-	-	96.5
London Cromwell Road 2	97.6	98.9	-	-	-	98.8	98.4
London Eltham	-	97.0	95.7	92.2	-	98.8	95.9
London Hackney	96.9	99.3	89.1	-	-	-	95.1
London Haringey	-	-	92.4	-	-	-	92.4
London Harlington	90.1	99.2	99.1	99.4	-	-	97.0

Site	CO	NO_2	O_3	PM_{10}	$PM_{2.5}$	SO_2	Site Average
London Hillingdon	97.4	97.1	90.4	97.4	-	97.4	95.9
London Lewisham	-	99.6	88.8	-	-	99.1	95.8
London Marylebone Road	95.1	97.8	97.6	97.7	96.0	92.8	96.2
London N. Kensington	98.7	98.8	97.7	94.8	-	96.6	97.3
London Southwark	93.1	85.0	93.3	-	-	93.2	91.1
London Teddington	-	93.8	95.3	-	-	95.3	94.8
London Wandsworth	-	99.1	99.2	-	-	-	99.1
London Westminster	92.9	74.3	91.7	93.8	-	92.7	89.1
Lullington Heath	-	92.1	94.7	-	-	85.8	90.9
Manchester Piccadilly	97.0	91.9	97.0	97.0	-	93.6	95.3
Manchester South	-	85.0	95.1	-	-	98.0	92.7
Manchester Town Hall	75.6	94.4	-	-	-	-	85.0
Market Harborough	94.2	90.2	93.1	-	-	-	92.5
Middlesbrough	91.3	53.8	98.9	97.2	-	98.9	88.0
Newcastle Centre	80.0	77.3	90.4	90.2	-	78.4	83.3
Northampton	87.2	83.1	83.0	86.4	-	85.8	85.1
Northampton PM10	-	-	-	79.6	-	-	79.6
Norwich Centre	92.4	90.2	96.4	96.4	-	95.4	94.2
Norwich Roadside	-	97.1	-	-	-	-	97.1
Nottingham Centre	89.4	91.6	97.1	97.0	-	97.1	94.4
Oxford Centre	96.4	82.1	-	-	-	99.0	92.5
Plymouth Centre	85.4	85.6	97.1	96.6	-	96.8	92.3
Portsmouth	95.9	97.7	98.5	91.1	-	87.8	94.2
Preston	91.6	95.5	98.8	98.2	-	98.5	96.5
Reading New Town	95.1	92.9	81.5	95.5	-	88.2	90.6
Redcar	97.1	97.0	95.6	97.0	-	97.1	96.8
Rochester	-	96.1	99.1	98.5	99.2	99.0	98.4
Rotherham Centre	-	96.6	87.3	-	-	83.6	89.2
Salford Eccles	95.6	95.7	89.2	95.2	-	87.5	92.6
Sandwell West Bromwich	97.9	98.4	98.1	-	-	98.4	98.2
Scunthorpe	-	-	-	96.3	-	97.4	96.9
Scunthorpe Town	-	-	-	93.2	-	98.4	95.8
Sheffield Centre	97.7	96.3	97.4	97.7	-	74.9	92.8
Sheffield Tinsley	96.6	98.6	-	-	-	-	97.6
Sibton	-	-	97.6	-	-	-	97.6
Somerton	-	89.0	96.6	-	-	-	92.8
Southampton Centre	88.3	95.2	88.0	95.8	-	95.4	92.5
Southend-on-Sea	36.6	90.7	97.0	96.1	-	94.2	82.9
Southwark Roadside	98.2	67.7	-	-	-	98.6	88.2
St Osyth	98.7	89.6	98.8	-	-	-	95.7
Stockport Shaw Heath	78.0	88.3	-	86.9	-	57.7	77.7
Stockton-on-Tees Yarm	96.5	98.3	-	97.7	-	-	97.5
Stoke-on-Trent Centre	92.5	92.9	97.5	71.4	-	93.4	89.5
Sunderland	-	-	-	-	-	89.6	89.6
Thurrock	95.0	86.7	98.1	93.8	-	98.0	94.3
Tower Hamlets Roadside	99.4	95.2	-	-	-	-	97.3
Walsall Alumwell	-	93.4	-	-	-	-	93.4
Walsall Willenhall	-	89.5	-	-	-	-	89.5
West London	98.4	98.4	-	-	-	-	98.4
Weybourne	-	-	97.6	-	-	-	97.6
Wicken Fen	-	64.2	91.3	-	-	91.4	82.3
Wigan Leigh	96.9	96.1	94.4	97.4	-	69.1	90.8
Wirral Tranmere	94.2	93.2	98.8	98.1	-	95.4	95.9

Site	CO	NO_2	O_3	PM_{10}	$PM_{2.5}$	SO_2	Site Average
Wolverhampton Centre	92.1	88.9	97.3	97.5	-	97.6	94.7
Yarner Wood	-	98.1	96.7	-	-	-	97.4
N Ireland							
Belfast Centre	96.9	92.7	96.8	96.4	-	95.1	95.6
Belfast Clara St	-	-	-	91.7	-	-	91.7
Belfast East	-	-	-	-	-	96.0	96.0
Derry	96.7	91.0	96.9	96.2	-	94.6	95.1
Lough Navar	-	-	66.7	99.5	-	-	83.1
Scotland							
Aberdeen	97.6	94.8	99.0	98.0	-	98.8	97.6
Bush Estate	-	93.4	97.9	-	-	-	95.7
Dumfries	98.1	97.0	-	89.1	-	-	94.7
Edinburgh St Leonards	97.5	88.5	96.6	98.3	-	98.2	95.8
Eskdalemuir	-	-	96.0	-	-	-	96.0
Glasgow Centre	89.7	84.8	96.8	56.3	-	87.4	83.0
Glasgow City Chambers	98.7	97.7	-	-	-	-	98.2
Glasgow Kerbside	97.8	94.8	-	93.5	-	-	95.4
Grangemouth	74.9	98.2	-	97.9	-	98.2	92.3
Inverness	98.1	97.7	-	93.8	-	-	96.5
Strath Vaich	-	-	90.2	-	-	-	90.2
Wales							
Aston Hill	-	83.3	86.6	-	-	-	85.0
Cardiff Centre	95.0	97.0	88.4	97.1	-	96.5	94.8
Cwmbran	97.4	99.2	99.4	99.3	-	95.9	98.2
Narberth	-	88.9	94.2	59.9	-	88.8	83.0
Port Talbot	-	84.2	96.8	95.3	-	96.7	93.3
Swansea	98.0	89.9	97.0	2.6	-	97.8	77.1
Wrexham	98.5	95.6	-	92.0	-	85.7	93.0
Number of sites	80	107	85	73	4	78	123*
Number of sites < 90%	15	28	13	8	0	19	27
Network Mean (%)	**93.1**	**91.9**	**94.6**	**92.8**	**97.0**	**92.8**	**93**

* Site count of 123 as both Birmingham East and Birmingham Tyburn included as well as Scunthorpe and Scunthorpe Town

Sites and instruments established between 01/1/2004 and 30/9/2004

Site	Status	Pollutants	Start Date
Glazebury	Defra	NO_2	26/01/2004
London Harlington	Affiliate	NO_2 CO O_3 PM_{10}	01/01/2004
Scunthorpe Town	Affiliate	SO_2 PM_{10}	06/06/2004
Birmingham Tyburn	Affiliate	NO_2 CO O_3 PM_{10} SO_2	16/08/2004

Table 5.3 shows the ratified AURN data capture for the 61 **critical sites** in the network for the 9-month period January to September 2004. Sites with less than 90% data capture are shaded. Sites with less than 86.5% data capture (shown in red) for this 9-month period will not achieve the 90% data capture target for the year.

Table 5.3 AURN Ratified Data Capture (%) for CRITICAL SITES January to September 2004 (Calculated from 1/1/04)

Critical Sites		CO	NO_2	O_3	PM_{10}	SO_2
AGGLOMERATIONS						
Belfast Centre	DEFRA	96.9	92.7	96.8		
Blackpool	DEFRA	95.8	90.3	96.0	97.3	66.3
Bournemouth	Affiliate	98.2	95.3	98.5	92.7	97.9
Brighton Roadside PM_{10}	Affiliate				91.6	
Bristol Centre	DEFRA		95.7	90.7	96.8	94.4
Cardiff Centre	DEFRA	95.0	97.0	88.4	97.1	96.5
Coventry Memorial Park	DEFRA	98.9	97.8	98.4	90.2	98.6
Edinburgh St Leonards	DEFRA	97.5	88.5	96.6	98.3	98.2
Glasgow Centre	DEFRA		84.8	96.8		87.4
Hove Roadside	Affiliate			-	-	97.6
Hull Freetown	DEFRA	94.8	86.0	92.0	94.5	84.4
Leicester Centre	DEFRA	85.7	81.0	97.5	94.6	96.8
Liverpool Speke	Affiliate	98.0	98.0	97.8	96.9	97.7
Newcastle Centre	DEFRA	80.0	77.3	90.4	90.2	78.4
Nottingham Centre	DEFRA	89.4	91.6	97.1	97.0	97.1
Portsmouth	Affiliate	95.9	97.7	98.5	91.1	87.8
Preston	DEFRA	91.6	95.5	98.8	98.2	98.5
Reading New Town	DEFRA	95.1	92.9	81.5	95.5	88.2
Sheffield Centre	DEFRA				97.7	
Southampton Centre	DEFRA	88.3	95.2	88.0	95.8	95.4
Southend-on-Sea	DEFRA	36.6	90.7	97.0	96.1	94.2
Stoke-on-Trent Centre	DEFRA	92.5	92.9	97.5	71.4	93.4
Swansea	Affiliate	98.0				
Wirral Tranmere	DEFRA	94.2	93.2	98.8	98.1	95.4
ZONES						
Aberdeen	Affiliate	97.6	94.8	99.0	98.0	98.8
Aston Hill	DEFRA	-	83.3	86.6	-	-
Barnsley Gawber	Affiliate	95.5	94.9	95.1	-	
Bush Estate	DEFRA	-	93.4	97.9	-	-
Canterbury	Affiliate	-		-	99.2	-
Cwmbran	Affiliate	97.4	99.2	99.4	99.3	95.9
Derry	Affiliate	96.7	91.0	96.9	96.2	94.6
Dumfries	DEFRA	98.1	97.0	-	89.1	-
Eskdalemuir	DEFRA	-	-	96.0	-	-
Glazebury	DEFRA	-	84.6	95.0	-	-
Grangemouth	Affiliate	74.9	98.2	-	97.9	98.2
Great Dun Fell	DEFRA	-	-	98.9	-	-
High Muffles	DEFRA	-	70.1	99.0	-	-
Inverness	DEFRA		97.7	-	93.8	-
Leamington Spa	Affiliate	85.3	93.3	98.4	98.2	98.2
Lough Navar	DEFRA	-	-	66.7		-
Narberth	Affiliate	-		94.2		
Northampton	Affiliate	87.2	83.1	83.0	86.4	85.8
Norwich Centre	DEFRA		90.2	96.4		
Oxford Centre	Affiliate	96.4		-	-	99.0
Plymouth Centre	DEFRA				96.6	
Scunthorpe*	Affiliate	-	-	-	27.4	27.7
Scunthorpe Town*	Affiliate	-	-	-	39.8	42.0

Critical Sites		CO	NO_2	O_3	PM_{10}	SO_2
Sibton	DEFRA	-	-	97.6	-	-
Somerton	Affiliate	-	89.0	96.6	-	-
St Osyth	DEFRA	98.7	89.6	98.8	-	-
Stockton-on-Tees Yarm	Affiliate	96.5	98.3	-	97.7	-
Strath Vaich	DEFRA	-	-	90.2	-	-
Sunderland	DEFRA	-	-	-	-	89.6
Thurrock	Affiliate		86.7	98.1		
Wicken Fen	DEFRA	-	64.2	91.3	-	
Wigan Leigh	Affiliate	96.2	95.4	93.7	96.7	68.6
Wrexham	DEFRA	98.5	95.6	-	85.7	85.7
Yarner Wood	DEFRA	-	98.1	96.7	-	-
Number of critical analysers		32	42	44	35	32
Number of sites < 90%		10	17	6	9	14

Key Pollutant monitored but not critical at this site

\- Not monitored

* Scunthorpe site closed on 18/3/04 and relocated to Scunthorpe Town where monitoring commenced on 6/6/04

Note that critical sites where monitoring has not yet commenced are not included in the above table.

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.

PART B: Summer Intercalibration Results July-September 2004

PART B - Intercalibration Report for the Automatic Urban, Rural and London Networks, July to September 2004

6 Introduction

In Summer 2004, **netcen** undertook an intercalibration of the 121 monitoring stations in operation in the defra and the Devolved Administrations sponsored Urban, Rural and London Monitoring Networks. This has allowed 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** (LSO) in undertaking calibrations. As it is the calibrations by the LSO's 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 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. It can occasionally happen that an analyser calibration is unsuccessful, and results in unsuitable scaling factors being used to produce pollution datasets. These are identified and corrected during ratification.
- Pressurisation of the sampling system at the audit. Occasionally, an analyser can be very 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.
- Leaks, sample switching valves, etc. Outliers can be generated if an analyser is not sampling ambient air properly. It is likely that if a leaking analyser is identified, data losses will result.

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.

A total of 121 sites were audited in this exercise.

The following sections of this report identify analysers that did not meet performance standards, investigates the possible causes of these results and recommends any remedial action required.

7 Results Summary

The results of the intercalibration are summarised in Table 7.1 below:

Table 7.1 – Summary of network performance

Parameter	Number of outliers	Number in network	% outliers in total
NOx analyser	35	106	33%
CO analyser	5	79	6%
SO_2 analyser	8	76	11%
Ozone analyser	22	85	26%
TEOM and BAM analysers	2 k_0, 4 flow	69 TEOM 1 BAM	8%
Gravimetric PM_{10} analysers	-	7	n/a
Total	76	423	18%

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% from the standard photometer 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, 15 of the 367 site cylinders (~4%) used to scale instrument data into concentrations appeared to have drifted by more than 10% from their certificated values. Five NO_x converters were found to be lower than the 95% acceptance limit.

The number of analyser outliers identified is better than the previous exercise. At the winter 2004 intercalibration 21% of the analysers in use were identified as outliers.

Table 7.2 below presents a breakdown of the outliers identified, on a site-by-site basis:

Table 7.2 – Performance Breakdown

SITE	Date visited	NO_x	CO	SO_2	O_3	PM_{10}
ENGLAND						
Barnsley 12	10/8			OK		
Barnsley Gawber	10/8	Outlier +15%	OK	OK	Outlier –15%	
Bath Roadside	19/7	OK	OK			
Billingham	7/9	OK				
Birmingham Centre	4/8	OK	OK	OK	OK	OK
Birmingham East	2/8	OK	OK	OK	Outlier +6%	OK
Blackpool	27/9	Outlier -13%	OK	OK	Outlier –7%	OK
Bolton	17/8	failed in test	OK	OK	OK	Main flow fail
Bottesford	27/7				OK	
Bournemouth	21/7	Outlier -17%	OK	OK	OK	OK
Bradford Centre	16/8	Outlier -19%	OK	OK	OK	OK
Brentford Roadside	25/8	Outlier +15%	Outlier +12%			
Brighton Roadside	7/9	OK	OK			
Brighton Roadside PM_{10}	7/9					OK
Bristol Centre	2/8	OK	OK	OK	Outlier –16%	OK

SITE	Date visited	NO_x	CO	SO_2	O_3	PM_{10}
Bristol Old Market	2/8	OK	Outlier -16%			
Bury Roadside	17/8	OK	OK	Outlier +12%	OK	OK
Cambridge Roadside	9/8	OK				
Camden Kerbside	7/7	OK				OK
Canterbury	21/7	OK				OK
Coventry Memorial Park	8/7	Outlier -16%	OK	OK	OK	OK
Exeter Roadside	3/8	OK	OK	OK	Outlier -12%	
Glazebury	19/8	OK			Outlier +8%	
Great Dun Fell	15/9				OK	
Haringey Roadside	14/7	OK				OK
Harwell	5/7	OK		OK	OK	
High Muffles	7/9				OK	
Hove Roadside	6/9	Outlier +11%	OK	OK		
Hull Freetown	29/7	Outlier +45%	OK	OK	Outlier +8%	OK
Ladybower	24/8	Outlier -12%		OK	Outlier +14%	
Leamington Spa	9/9	OK	OK	OK	OK	OK
Leeds Centre	16/8	OK	OK	OK	Outlier -8%	OK
Leicester Centre	16/6	OK	OK	Outlier +12%	OK	OK
Liverpool Speke	7/9	OK	OK	OK	OK	OK
London A3 Roadside	8/7	Outlier +22%	OK			OK
London Bexley	19/7	Outlier +11%	OK	OK	OK	OK
London Bloomsbury	6/7	OK	OK	OK	OK	OK
London Brent	20/8	Outlier +14%	OK	OK	OK	OK
London Bromley	19/8	OK	OK			
London Cromwell Road 2	20/9	Outlier -13%	OK	OK	OK	
London Eltham	23/8	Outlier +17%		OK	OK	OK
London Hackney	24/8	Outlier +16%	Outlier +15%		OK	
London Haringey	14/7				Outlier -12%	
London Harlington	2/9	OK	OK		Outlier +7%	OK
London Hillingdon	5/7	Outlier -32%	OK	Outlier -17%	OK	OK
London Lewisham	24/9	OK		OK	OK	
London Marylebone Road	15/7	OK	OK	OK	OK	OK
London N. Kensington	9/7	OK	OK	OK	OK	OK
London Southwark	13/7	OK	OK	OK	OK	
London Teddington	21/9	OK		Outlier +47%	Outlier -8%	
London Wandsworth	18/8	OK			OK	
London Westminster	6/8	OK	OK	OK	OK	OK
Lullington Heath	6/9	OK		OK	OK	
Manchester Piccadilly	25/8	OK	OK	OK	OK	OK
Manchester South	24/8	Converter 92%		OK	OK	
Manchester Town Hall	25/8	OK	OK			
Market Harborough	30/7	Outlier -18%	OK		OK	
Middlesbrough	8/9	Outlier +29% Converter 72%	OK	OK	OK	OK
Newcastle Centre	13/9	OK	OK	OK	OK	OK
Northampton	16/7	OK	OK	OK	OK	OK
Northampton PM_{10} (Grav)	16/7					OK

SITE	Date visited	NO_x	CO	SO_2	O_3	PM_{10}
Norwich Centre	12/8	Outlier +25%	OK	OK	OK	OK
Norwich Roadside	11/8	OK				
Nottingham Centre	27/7	OK	OK	OK	OK	OK
Oxford Centre	7/7	Outlier +16% Converter 90%	OK	OK		
Plymouth Centre	4/8	OK	OK	OK	Outlier -14%	OK
Portsmouth	9/7	OK	OK	OK	OK	OK
Preston	27/9	OK	OK	OK	OK	OK
Reading New Town	22/7	Outlier +26%	OK	OK	Outlier -9%	OK
Redcar	7/9	Outlier +18%	OK	OK	Outlier +11%	OK
Rochester	20/7	OK		OK	OK	OK
Rotherham Centre	9/8	OK		OK	OK	
Salford Eccles	24/8	Outlier +14%	OK	OK	Outlier -8%	OK
Sandwell West Bromwich	8/7	Outlier +28%	OK	OK	OK	
Scunthorpe	28/7			OK		OK
Sheffield Centre	10/8	OK	OK	OK	OK	k_0 -2.9%
Sheffield Tinsley	9/8	OK	OK			
Sibton	12/8				OK	
Somerton	3/8	OK			OK	
Southampton Centre	23/8	OK	Outlier -19%	OK	OK	OK
Southend-on-Sea	5/8	OK	OK	OK	OK	OK
Southwark Roadside	13/7	OK	OK	OK		
St Osyth	4/8	Outlier +33%	OK		OK	
Stockport Shaw Heath	18/8	OK	OK	OK		Aux flow fail
Stockton-on-Tees Yarm	6/9	OK	OK			OK
Stoke-on-Trent Centre	16/8	Outlier +16%	OK	OK	Outlier -9%	OK
Sunderland	14/9			OK		
Thurrock	22/7	OK	OK	OK	OK	k_0's different
Tower Hamlets Roadside	23/9	OK	OK			
Walsall Alumwell	22/9	Converter 86%				
Walsall Willenhall	3/8	OK				
West London	20/9	OK	OK			
Weybourne	10/8				OK	
Wicken Fen	9/8	OK		Outlier +19%	OK	
Wigan Leigh	19/8	OK	OK	OK	OK	k_o +10.1%
Wirral Tranmere	28/9	Outlier +19%	OK	OK	OK	OK
Wolverhampton Centre		OK	OK	OK	OK	OK
Yarner Wood	4/8	OK			Outlier +15%	
NORTHERN IRELAND						
Belfast Centre	13/9	OK	OK	OK	OK	OK
Belfast Clara St	13/9					OK
Belfast East	13/9			Outlier +16%		
Derry	15/9	OK	OK	OK	Outlier -17%	OK
Lough Navar	16/9				Outlier +10%	OK
SCOTLAND						
Aberdeen	27/7	OK	OK	OK	Outlier +6%	OK
Bush Estate	13/7	Outlier +11%			OK	

SITE	Date visited	NO_x	CO	SO_2	O_3	PM_{10}
Dumfries	12/7	OK	OK			OK
Edinburgh St Leonards	14/7	OK	OK	OK	OK	OK
Eskdalemuir	13/7				OK	
Glasgow Centre	19/7	Outlier -12%	OK	OK	OK	Total flow fail
Glasgow City Chambers	20/7	OK	OK			
Glasgow Kerbside	20/7	Converter 91%	OK			OK
Grangemouth	15/7	OK	OK	Outlier +15%	OK	OK
Inverness	28/7	OK	OK			OK
Strath Vaich	27/7				OK	
WALES						
Aston Hill	9/8	Outlier +14%			OK	
Cardiff Centre	16/9	OK	Outlier +11%	OK	OK	OK
Cwmbran	17/9	Outlier +21%	OK	OK	Outlier -10%	OK
Narberth	21/9	Outlier +14%		OK	OK	OK
Port Talbot	20/9	Outlier -15%		OK	OK	OK
Swansea	20/9	OK	OK	Outlier +15%	OK	Outlier-flows
Wrexham	28/9	Outlier -36%	OK	OK		OK

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

8 Oxides of Nitrogen

8.1 Intercalibration Outliers

The intercalibration highlighted that the results from 35 sites were outside the ±10% acceptance limit from the network mean. These outliers can be broken down into various types, as presented below:

Twelve outliers can be attributed to changes in the site cylinder concentrations, as listed below:

1. Brentford Roadside ®
2. Hull Freetown ®
3. London Eltham ®
4. London Hillingdon
5. Norwich Centre
6. Reading New Town ®
7. Redcar ®
8. St Osyth
9. Stoke-on-Trent
10. Wirral Tranmere
11. Glasgow Centre ®
12. Aston Hill

® denotes a repeat offender

Data from all the affected sites has been carefully examined and rescaled as needed. No data have been lost as a result of the rescaling. A further 21 outliers can be attributed to drifts in calibration factors between LSO calibrations, and no data will be lost as a result of

these findings. The analysers at Bolton and Middlesbrough were outliers as a result of instrument malfunctions at the time. Some data from these sites have been rejected as a result.

Using the methodology detailed in Section 6, comparison of the network averages to audit cylinder concentrations showed that the network measures concentrations of NO to within 1% of the network standard and NO_2 concentrations to within 6%. The percentage standard deviations of these results, which is an indication of how close the results are grouped together, were 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.

8.2 Leaking switching valves

This phenomenon has been observed as a significant cause of outliers in NOx analysers. When NO_2 gas is used for calibration, some analysers have been seen to produce a significant NO signal. This gives cause for concern, because a cylinder of NO_2 will be virtually 100% NO_2, very little NO will be present in the mixture.

Analysers that exhibit this behaviour could be underestimating concentrations of NO_2, as highlighted by the following five outliers:

1. Barnsley Gawber – measured 25 ppb NO in an NO_2 cylinder ®
2. Bournemouth – measured 20 ppb NO in an NO_2 cylinder ®
3. Cromwell Road 2 – measured 10 ppb NO in an NO_2 cylinder
4. Edinburgh St Leonards – measured 15 ppb NO in an NO_2 cylinder
5. Wrexham – measured 16 ppb NO in an NO_2 cylinder

In addition, whilst not identified as outliers, the following sites also measured significant concentrations of NO:

1. Brighton Roadside – measured 13 ppb NO in an NO_2 cylinder
2. Bristol Centre – measured 10 ppb NO in an NO_2 cylinder
3. Bristol Old Market – measured 17 ppb NO in an NO_2 cylinder ®
4. Canterbury – measured 14 ppb NO in an NO_2 cylinder ®
5. Leamington Spa – measured 13 ppb NO in an NO_2 cylinder
6. Bloomsbury – measured 11 ppb NO in an NO_2 cylinder
7. Bromley – measured 13 ppb NO in an NO_2 cylinder ®
8. Manchester South – measured 18 ppb NO in an NO_2 cylinder
9. Middlesbrough – measured 12 ppb NO in an NO_2 cylinder
10. Reading – measured 26 ppb NO in an NO_2 cylinder
11. Southwark Roadside – measured 14 ppb NO in an NO_2 cylinder
12. Wigan Leigh – measured 25 ppb NO in an NO_2 cylinder ®
13. Dumfries – measured 20 ppb NO in an NO_2 cylinder ®

® denotes a repeat offender

These results are worse than those found at the winter 04 exercise where 16 analysers were seen to have this response. The observation is clearly showing an increasing trend – 8 analysers were identified at the summer 03 intercomparison.

The most likely cause for this observation is a leaking switching valve inside the analyser. The valves cycle the analysers between sampling NOx, NO and, on some models, reference gases, and any leaks within these systems appear to manifest themselves when

calibrating the analysers with NO_2 gas. In many ways, this phenomenon is similar to the leaking main valve faults common to ozone analysers. Unfortunately, as the valves are inside the analysers, it is not possible for LSO's or QA/QC to leak check these valves.

Recommendation

It is therefore recommended that LSO's pay particular attention to the NO_2 calibration results, to see whether the NO response is significantly higher (>10ppb) than that obtained for the zero calibration. These observations should be reported to CMCU as soon as possible.

These faults were highlighted to the ESU's in the weekly report emails during the intercalibration, to ensure that particular attention was paid to servicing and cleaning these switching valves during services, to try to minimise the occurrence of these outliers.

Recommendation

It is strongly recommended that ESU's clean all NOx analyser switching valves during servicing, and ensure the valve is leak checked afterwards.

netcen will continue to monitor these results at audit visits.

8.3 Converter Tests

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

- Glasgow Kerbside – 91% (9 days data rejected)
- Manchester South – 92% (repeat offender – 5 weeks data rejected)
- Middlesbrough – 72% (Engineer on site during audit – 17 weeks data rejected)
- Oxford – 90% (6 weeks data rejected)
- Walsall Alumwell – 86% (due to water ingress - 1 week data rejected)

A further 3 sites were identified as borderline fail cases where there was no resulting effect on data quality:

- Dumfries – 94.8%
- London A3 Roadside – 94.8%
- Yarner Wood - 94.9%

It is worth noting at this point that the future requirement for the performance of NOx analysers is likely to become much tighter. Converters will need to be at least 98% efficient to avoid data rescaling, and at least 95% efficient to avoid data rejection. Based on the results from the current intercalibration, data rescaling would be required on half of the NOx analysers (53 of the total 106 analysers). Clearly, significant effort would be required to rescale this amount of data. The following analysers showed a response of between 95 and 98%:

Barnsley Gawber - 95.2%	Newcastle Centre – 96.8%
Bath Roadside – 97.7%	Norwich Centre – 96.3%
Billingham – 95.8%	Norwich Roadside – 95.2%
Birmingham Centre – 95.9%	Preston – 97.5%
Blackpool – 97.7%	Redcar 95.6%
Brighton Roadside – 95.5%	Rotherham Centre – 97.9%

Bristol Old Market – 95.7%	Sandwell West Bromwich – 96.4%
Cambridge Roadside – 97.9%	Sheffield Centre – 97.4%
Camden Roadside – 96.4%	Sheffield Tinsley – 96.9%
Canterbury – 96.3%	Somerton – 97.4%
Hove Roadside – 95.3%	Southwark Roadside – 95.6%
Leeds Centre – 95.8%	Stockton-on-Tees Yarm – 95.3%
Liverpool Speke – 96.6%	Stoke-on-Trent Centre – 95.1%
London Bloomsbury – 95.1%	Thurrock – 97%
London Brent – 95.7%	Wicken Fen – 96.8%
London Bromley – 96%	Wigan Leigh – 96%
London Cromwell Road 2 – 96.2%	Wirral Tranmere – 97.6%
London Eltham – 95.1%	Derry – 96.3%
London Harlington – 96.1%	Glasgow Centre – 95.5%
London Marylebone Road – 96.7%	Glasgow City Chambers – 96%
London North Kensington – 96.3%	Grangemouth – 97.5%
London Southwark – 95.6%	Inverness – 96.1%
London Wandsworth – 95.2%	Aston Hill – 96.5%
London Westminster – 95.9%	Cardiff Centre – 95.2%
Lullington Heath – 95.1%	Narberth – 96.7%
Manchester Piccadilly – 97.2%	Swansea – 96.6%
	Wrexham – 97.7%

9 Carbon Monoxide

The intercalibration showed that the results from 5 analysers were outside the ±10% acceptance criterion. Of these, 2 can be attributed to drifts in calibration factors between LSO calibrations, and no data were lost as a result of this.

The analysers at Bristol Old Market, Hackney and Southampton Centre all exhibited faults at the time of the audit, and it is likely that this has compromised the audit results. The data from the sites have been examined during ratification; some data from all three sites have been rejected as a result of these investigations.

Comparison of the network average to the audit cylinder concentration showed that the network measures CO concentrations to within 1% of the reference standard. The percentage standard deviation was 3%. These are very good results, and demonstrate that data from the CO analysers are accurate, harmonised and traceable to national metrology standards.

The analyser at Stockport Shaw Heath failed during the audit. Two months data have been rejected from this analyser.

10 Sulphur Dioxide

10.1 Intercalibration Outliers

The intercalibration showed that the results from 8 analysers were outside the ±10% acceptance criterion. Of these, 7 can be attributed to drifts in calibration factors between LSO calibrations, and no data were lost as a result of this. The remaining outlier arose as a result of a change in the concentration of the site cylinder. Data from this site (London Teddington) have been carefully examined and rescaled as needed.

Comparison of the network average to the audit cylinder concentration showed that the network measures SO_2 concentrations to within 1% of the reference standard. The percentage standard deviation was less than 5%. These are good results, and demonstrate that data from the SO_2 analysers are accurate, harmonised and traceable to national metrology standards.

The Northampton analyser was found to have moisture in the sample tubing, which compromised the results of the audit. One week of data have been rejected as a result.

10.2 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 27 analysers were outside the required standard:

1.	Barnsley Gawber	(16ppb) ®
2.	Birmingham Centre	(19ppb)
3.	Blackpool	(12ppb) 2x®
4.	Bolton	(18ppb) ®
5.	Bournemouth	(11ppb)
6.	Bristol Centre	(20ppb)
7.	Bury	(29ppb) ®
8.	Exeter	(20ppb)
9.	Harwell	(11ppb)
10.	Hove	(14ppb) ®
11.	Hull Freetown	(22ppb) ®
12.	Leamington Spa	(21ppb)
13.	Liverpool	(21ppb)
14.	Bexley	(15ppb)
15.	Bloomsbury	(17ppb) ®
16.	Brent	(12ppb) ®
17.	Eltham	(24ppb)

18.	Lewisham	(20ppb)
19.	Marylebone Road	(12ppb)
20.	North Kensington	(21ppb) 2x®
21.	Westminster	(21ppb)
22.	Lullington Heath	(22ppb) ®
23.	Manchester Piccadilly	(17ppb) 2x®
24.	Manchester South	(21ppb) 2x®
25.	Middlesbrough	(16ppb)
26.	Newcastle	(23ppb) 2x®
27.	Norwich Centre	(21ppb) 2x®
28.	Oxford	(13ppb)
29.	Preston	(18ppb)
30.	Rochester	(11ppb)
31.	Rotherham	(11ppb) ®
32.	Eccles	(14ppb)
33.	Sheffield Centre	(20ppb) ®
34.	Southampton	(21ppb) 2x®
35.	Stockport Shaw Heath	(20ppb) ®
36.	Stoke-on-Trent	(22ppb) ®
37.	Sunderland	(16ppb) ®
38.	Thurrock	(23ppb)
39.	Wicken Fen	(17ppb)
40.	Belfast Centre	(20ppb)
41.	Edinburgh St Leonards	(23ppb)
42.	Grangemouth	(21ppb) 2x®
43.	Cardiff	(11ppb)
44.	Narberth	(20ppb) 2x®
45.	Port Talbot	(12ppb) ®

® denotes a repeat offender

Recommendation

The hydrocarbon kickers at Blackpool, North Kensington, Manchester Piccadilly, Manchester South, Newcastle, Norwich Centre, Southampton, Grangemouth and Narberth have now failed on three consecutive occasions and should be replaced as soon as possible. Replacement of the other kickers that are repeat offenders should be considered.

These results are significantly worse than the previous intercalibration, when 27 analyser kickers were identified as outliers. There will be a future CEN requirement that kicker response to 1ppm m-xylene must be lower than 1% (i.e. 10ppb SO_2), or data will be rejected. It is therefore concerning that an increasing number of analysers are failing this test. However, at present, none of these results give immediate cause for concern. No data have been rejected, and no specific actions are required at present, other than the replacement recommendations at the repeat offender sites listed above.

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 1.5 ppb.

11 Ozone

Calibration of the network analysers against the **netcen** reference photometers showed that 22 analysers were outside the ±5% acceptance criterion. This is identical to the previous exercise, where 22 analysers tested were also identified as outliers.

Of the 22 analysers, 13 had drifted by less than 10%; ratification of these datasets was straightforward, with no loss of data.

The remaining 9 analysers had drifted by less than 17%. 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.

These results are significantly better than the winter 2004 intercalibration, where 5 analysers were found to be more than 20% from the reference photometer. This is an encouraging result, and is a reflection of the ESU's having a better understanding of what is required in terms of calibrations at service exercises.

12 Particulate analysers

12.1 TEOM k_0

There were two outliers for TEOM k_0 during this intercalibration.

The analyser at Sheffield Centre was again identified as an outlier at 2.9% from its stated value. The history of the analyser has been examined, and the dataset has been rescaled as appropriate with no loss of data. It is recommended that the k_0 values on the control and sensor units of this analyser are now adjusted accordingly.

The analyser at Wigan Leigh was found to have a sensor unit k_0 value that was more than 10% from the calculated result. However, the value held in the control unit agreed with the calculated k_0 value, thus the results from the instrument are being scaled correctly. We recommend that the value on the sensor unit is adjusted to agree with the value stored on the control unit.

All other TEOM calibration factors were calculated to be within 2.5% of their stated values.

12.2 Analyser Flow Rates

The flow rates of the analysers at four sites were found to be outside the ±10% acceptance limit:

1.	Bolton	(Main Flow +13%)
2.	Stockport	(Aux Flow -40%)
3.	Glasgow Centre	(Total Flow -73%)
4.	Swansea	(Main Flow –45%) ®

® denotes a repeat offender

The analysers at Stockport, Glasgow Centre and Swansea also failed the leak tests. Close examination of the datasets suggests that ambient data at Stockport, Glasgow Centre and Swansea have been effected by the response leaks. The analyser at Swansea was also

identified as failing the leak test in the previous winter 2004 intercomparison, 9 months data have been rejected as a result of these findings.

12.3 Analyser Configuration Information

The PM_{10} analysers used in the network, especially the TEOMs, are a wide range of ages and permutations. We have started to compile a database of how all the analysers are configured. Tables 12.1 and 12.2 below summarise the major settings:

Table 12.1 – TEOM Configurations:

Site	Type	Serial Number	Software	Flow corrected to 25°C, 1atm?	Wait time = 1800s	MR/MC ave = 300	Main Flow	Const A = 3	Const B = 1.03
Birmingham Centre	A	2297	**2.106**	**No**	Yes	Yes	3	Yes	Yes
Birmingham East	AB	24637	3.017	Yes	Yes	Yes	3	Yes	Yes
Blackpool									
Bolton	AB	21197	3.003	Yes	Yes	Yes	3	Yes	Yes
Bradford Centre	AB	21494	3.008	Yes	**No - set to 180**	Yes	**2**	Yes	Yes
Brighton Roadside									
Bristol Centre	A	24426	3.017	Yes	Yes	Yes	**2**	Yes	Yes
Bury Roadside	AA	658	3.014	No	Yes	Yes	**2**	Yes	Yes
Camden Kerbside									
Canterbury	A	20931	**2.115**	**No**	Yes	Yes	3	Yes	Yes
Coventry Memorial Park	AB	25026	3.018	Yes	Yes	Yes	3	Yes	Yes
Haringey Roadside	A	20695	**2.115**	**No**	Yes	**No - set 900**	3	Yes	Yes
Harwell	AB	21489	3.013	Yes	Yes	Yes	3	Yes	Yes
Harwell PM2.5	AB	21490	3.005	Yes	Yes	Yes	3	Yes	Yes
Hull Freetown	A	24445	3.017	**No**	**No - set 10**	Yes	**2**	Yes	Yes
Leamington Spa	A	2075	**2.113**	**No**	Yes	Yes	3	Yes	Yes
Leeds Centre									
Leicester Centre									
Liverpool Speke									
London A3 Roadside									
London Bexley	AB	2000	3.005	**No**	Yes	Yes	**2**	Yes	Yes
London Bloomsbury	AB	24446	3.017	**No**	Yes	Yes	3	Yes	Yes
London Bloomsbury PM2.5	AB	21492	3.005	Yes	Yes	Yes	3	Yes	Yes
London Brent	AB	21145	3.003	**No**	Yes	Yes	3	Yes	Yes
London Eltham	AA	2096	3.013	**No**	Yes	**No – set 900**	3	Yes	Yes
London Harlington									
London Hillingdon									
London Marylebone Road	AB	21306	3.005	Yes	Yes	**No – set 900**	3	Yes	Yes
London N. Kensington									
Manchester	AA	2000	3.015	**No**	Yes	Yes	**2**	Yes	Yes

Site	Type	Serial Number	Software	Flow corrected to 25°C, 1atm?	Wait time = 1800s	MR/MC ave = 300	Main Flow	Const A = 3	Const B = 1.03
Piccadilly									
Middlesbrough									
Newcastle Centre									
Northampton	AB	21621	3.009	Yes	Yes	Yes	3	Yes	Yes
Norwich Centre	AB	21495	3.012	Yes	**No - set180**	Yes	**2**	Yes	Yes
Nottingham Centre	A	20904	3.016	**No**	Yes	Yes	**2**	Yes	Yes
Plymouth Centre	AB	24428	3.017	Yes	**No - set180**	Yes	**2**	Yes	Yes
Portsmouth	AB	21578	3.009	Yes	Yes	Yes	3	Yes	Yes
Preston									
Reading New Town	AB	2000	3.016	Yes	**No - set180**	Yes	**2**	Yes	Yes
Redcar	AB	21344	3.005	**No**	**No – set450**	Yes	3	Yes	Yes
Rochester	AB	24381	3.017	Yes	Yes	Yes	3	Yes	Yes
Rochester PM2.5	AB	21491	3.012	Yes	Yes	Yes	3	Yes	Yes
Salford Eccles	AB	21168	3.003	Yes	Yes	Yes	**2**	Yes	Yes
Scunthorpe Town	A	2000	3.018	**No**	Yes	Yes	3	Yes	Yes
Sheffield Centre	AA	20915	3.016	**No**	**No - set180**	Yes	**2**	Yes	Yes
Southampton Centre	AB	4484	3.017	Yes	**No – set300**	Yes	**2**	Yes	Yes
Southend-on-Sea									
Stockport Shaw Heath	AA	2000	3.015	**No**	Yes	Yes	3	Yes	Yes
Stockton-on-Tees Yarm	AB	22885	3.013	Yes	Yes	Yes	3	Yes	Yes
Stoke-on-Trent Centre	AB	21317	3.005	Yes	Yes	Yes	**2**	Yes	Yes
Thurrock	AB	25039	3.018	**Corrects to ambient**	Yes	Yes	3	Yes	Yes
Wigan Leigh	AB	22188	3.016	Yes	Yes	Yes	3	Yes	Yes
Wirral Tranmere									
Wolverhampton Centre									
Belfast Centre	AB	24423	3.017	Yes	Yes	Yes	3	Yes	Yes
Derry	AB	49608	3.005	Yes	Yes	Yes	**2**	Yes	Yes
Lough Navar	AB	21196	3.012	Yes	**No - set900**	Yes	3	Yes	Yes
Aberdeen	AB	24427	3.017	**No**	Yes	Yes	3	Yes	Yes
Edinburgh St Leonards	AB	21308	3.005	Yes	Yes	Yes	**2**	Yes	**No - set to 1.0**
Glasgow Centre	A	20913	**2.115**	**No**	Yes	Yes	**2**	Yes	Yes
Glasgow Kerbside	AB	24444	3.017	**No**	Yes	Yes	**2**	Yes	Yes
Grangemouth	AB	22763	3.012	Yes	Yes	Yes	3	Yes	Yes
Cardiff Centre	AB	2449	3.017	Yes	Yes	Yes	**2**	Yes	Yes
Cwmbran	AB	21557	3.009	Yes	Yes	Yes	3	Yes	Yes
Narberth	AB	21143	3.017	Yes	**No - set180**	Yes	3	Yes	Yes
Port Talbot	AA	9402	3.011	**No - corrects to 0°**	Yes	Yes	3	Yes	Yes
Swansea	A	2130	**2.103**	**No**	Yes	Yes	**2**	Yes	Yes

Table 12.2 – Partisol Configurations:

Site	Serial number	Software	Flow corrected to 25°C, 1atm?	Start time	Duration	Mode
Bournemouth	21257	1.4	Yes	0:00	24h	Basic
Harwell PM2.5	21020	1.202	Yes	0:00	24h	Basic
London Westminster	20939	1.202	Yes	0:00	24h	Basic
Northampton						
Dumfries	21221	1.4	Yes	0:00	24h	Basic
Inverness	21255	1.4	Yes	0:00	24h	Basic
Wrexham						

Note - sites with blank entries will be completed during the Winter 2005 roadshow.

Values highlighted in bold are at settings that are different from the configurations being used for the PM_{10} intercomparison studies. Once the results of these studies are known, QA/QC Unit will provide recommendations for any required flow adjustments**. No flow adjustments should, therefore, be made at this time**. However, the Wait Time settings must be 1800 and the MR/MC average and TM average settings must be 300. ESU's should therefore adjust these settings, if needed, at the next service visit"

Recommendations

Specific actions required are:

- Wait time must be set to 1800 seconds
- MR/MC average must be set to 300 seconds
- Constant B on the TEOM at Edinburgh must be set to 1.03

13 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 15 of the 367 cylinders (~4%) used to scale analyser data into concentrations (NO, CO and SO_2) appear to be outside the ±10% acceptance criterion. This is better than the Winter 2004 roadshow, where 5% (18 cylinders) were outside the acceptance limits.

In addition, the concentrations of 30 NO_2 cylinders appear to have drifted by more than 10%.

In total, 45 of the 367 cylinders (~12%) were outside the acceptance limits. This is better than the previous intercalibration, where 14% 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.

As a result of this exercise, nine cylinders were identified for replacement:

1. Teddington SO_2
2. Teddington NO_2
3. Swansea SO_2
4. Hull Freetown NO
5. Eltham NO
6. Reading New Town NO
7. Stoke-on-Trent NO
8. Wirral Tranmere NO
9. Glasgow Centre NO

14 Site Information

We have compiled additional information about the monitoring stations in the network, including the types of sampling systems deployed on site.

The Table below presents information about the sampling systems deployed on site, together with accurate, validated grid references. Considerable effort has been made, both in compiling these grid references, and in ensuring the measurements are accurate to within 1 metre (it should be noted that the uncertainty of the GPS system used is typically the order of ±10 metres).

The following Table 41.1 presents the information collated to date:

Table 14.1 – Site Information

Site Name	Manifold type	Grid Reference	6 figure easting	6 figure northing
Aberdeen	Glass	NJ944074	394416	807408
Aston Hill	Glass	SO299901	329902	290062
Barnsley 12	Narrow-bore Teflon	SE343065	434276	406542
Barnsley Gawber	Wide-bore Teflon	SE325075	432529	407472
Bath Roadside	Narrow-bore Teflon	ST759661	375882	166069
Belfast Centre	Glass	lat/long	5°55'39.3''W	54°35'58.8''N
Belfast Clara St	N/A	lat/long		
Belfast East	Narrow-bore Teflon	lat/long	5°54'2.1''W	54°35'47.5''N
Billingham	Glass	NZ470237	446962	523650
Birmingham Centre	Glass	SP063869	406342	286862
Birmingham Tyburn	Glass	SP115889	411536	288870
Blackpool	Wide-bore Teflon	SD323332	332320	433215
Bolton	Wide-bore Teflon	SD710086	371000	408562
Bottesford	Narrow-bore Teflon	SK798377	479768	337654
Bournemouth	Narrow-bore Teflon	SZ123933	412320	93344
Bradford Centre	Wide-bore Teflon	SE166331	416615	433098

Site Name	Manifold type	Grid Reference	6 figure easting	6 figure northing
Brentford Roadside	Narrow-bore Teflon	TQ174780	517425	178074
Brighton Preston Park	Wide-bore Teflon	TQ305062	530508	106222
Brighton Roadside	Glass	TQ313043	531307	104305
Brighton Roadside $_{PM10}$		TQ313043	531322	104302
Bristol Centre	Glass	ST594733	359427	173285
Bristol Old Market	Glass	ST596732	359570	173173
Bury Roadside	Glass	SD809048	380922	404772
Bush Estate	High Flow wide tube	NT246639	324626	663880
Cambridge Roadside	Narrow-bore Teflon	SL452582	545248	258155
Camden Kerbside	Narrow-bore Teflon	TQ268841	526786	184075
Canterbury	Narrow-bore Teflon	TR162573	616198	157330
Cardiff Centre	Glass	ST184765	318417	176505
Coventry Memorial Park	Wide-bore Teflon	SP328773	432801	277340
Cwmbran	Wide-bore Teflon	ST305954	330510	195436
Derry	Wide-bore Teflon	lat/long	7°19'42.1''W	55°0'2.2''N
Dumfries	Narrow-bore Teflon	NX970763	297012	576278
Edinburgh St Leonards	Glass	NT263731	326250	673132
Eskdalemuir	Narrow-bore Teflon	NT235030	323528	603030
Exeter Roadside	Stainless Steel	SX919928	291940	92840
Glasgow Centre	Wide-bore Teflon	NS589650	258902	665028
Glasgow City Chambers	Narrow-bore Teflon	NS595653	259528	665308
Glasgow Kerbside	Wide-bore Teflon	NS587652	258708	665200
Glazebury	Narrow-bore Teflon	SJ687960	368733	396034
Grangemouth	Wide-bore Teflon	NS538810	293840	681032
Great Dun Fell	Narrow-bore Teflon	NY710322	371020	532190
Haringey Roadside	Narrow-bore Teflon	TQ339907	533885	190669
Harwell	Wide-bore Teflon	SU468860	446772	186020
High Muffles	Wide-bore Teflon	SE774939	477535	493865
Hove Roadside	Glass	TQ301045	530088	104484
Hull Freetown	Glass	TA095293	509478	429329
Inverness	Glass	NH657457	265720	845680

Site Name	Manifold type	Grid Reference	6 figure easting	6 figure northing
Ladybower	Wide-bore Teflon	SK166896	416575	389565
Leamington Spa	Glass	SP321659	465906	265906
Leeds Centre	Glass	SE300343	429976	434268
Leicester Centre	Glass	SK588041	458767	304075
Liverpool Speke	Glass	SJ439836	343860	383598
London A3 Roadside	Wide-bore Teflon	TQ190652	518983	165220
London Bexley	Glass	TQ519764	551852	176396
London Bloomsbury	Glass	TQ301820	530107	182041
London Brent	Glass	TQ196893	519570	189275
London Bromley	Narrow-bore Teflon	TQ405693	540533	169334
London Cromwell Road 2	Wide-bore Teflon	TQ265790	526530	178975
London Eltham	Narrow-bore Teflon	TQ440747	543978	174668
London Hackney	Wide-bore Teflon	TQ348862	534812	186230
London Haringey	Narrow-bore Teflon	TQ299891	529914	189132
London Harlington	Narrow-bore Teflon	TQ083778	508299	177809
London Hillingdon	Glass	TQ082778	508294	177791
London Lewisham	Narrow-bore Teflon	TQ069786	506933	178607
London Marylebone Road	Glass	TQ376737	537637	173669
London N. Kensington	Narrow-bore Teflon	TQ280820	528049	181989
London Southwark	Glass	TQ240817	524049	178494
London Teddington	Glass	TQ323785	532299	178494
London Wandsworth	Narrow-bore Teflon	TQ155704	515538	170427
London Westminster	Glass	TQ258747	525778	174677
Lough Navar	Glass	lat/long	7°53'55.9''W	54°26'21.5''N
Lullington Heath	Wide-bore Teflon	TQ538016	553800	101600
Mace Head	Narrow-bore Teflon	lat/long	9°54'14.1''W	53°19'35.2''N
Market Harborough	Glass	SP833959	483337	295905
Manchester Piccadilly	Glass	SJ843983	384310	398325
Manchester South	Glass	SJ839858	383912	385828
Manchester Town Hall	Wide-bore Teflon	SJ839980	383874	397976
Middlesbrough	Glass	NZ505196	450480	519632
Narberth	Wide-bore Teflon	SN146127	214640	212700
Newcastle Centre	Glass	NZ250649	425016	564940
Northampton	Glass	SP761645	476111	264524
Norwich Centre	Wide-bore Teflon	TG231089	623078	308910

Site Name	Manifold type	Grid Reference	6 figure easting	6 figure northing
Norwich Roadside	Narrow-bore Teflon	TG235078	623460	307817
Nottingham Centre	Glass	SK574401	457420	340050
Oxford Centre	Wide-bore Teflon	SP514062	451366	206152
Plymouth Centre	Glass	SX477546	247742	54610
Port Talbot	Glass	SS780882	278036	188249
Portsmouth	Glass	SU657036	465686	103607
Preston	Wide-bore Teflon	SD552301	355248	430143
Reading	Wide-bore Teflon	SU734732	473441	173198
Redcar	Glass	NZ600246	459975	524563
Rochester	Narrow-bore Teflon	TQ831762	583133	176220
Rotherham Centre	Teflon coated metal	SK431930	443088	393028
Salford Eccles	Glass	SJ779987	377932	398713
Sandwell West Bromwich	Glass	SO597467	459720	246684
Scunthorpe	Narrow-bore Teflon	SE906107	490592	410689
Scunthorpe Town	TBA			
Sheffield Centre	Glass	SE903108	490316	410837
Sheffield Tinsley	Glass	SK351869	435134	386885
Sibton	Wide-bore Teflon	TM363719	636271	271875
Somerton	Wide-bore Teflon	ST485265	348544	126525
Southampton Centre	Glass	SU426123	442565	112255
Southend-on-Sea	Wide-bore Teflon	TQ856861	585566	186130
Southwark Roadside	Wide-bore Teflon	TQ346777	534621	177680
St Osyth	Glass	TM104132	610426	213205
Stockport Shaw Heath	Glass	SJ894896	389386	389604
Stockton-on-Tees Yarm	Wide-bore Teflon	NZ419129	441908	512886
Stoke-on-Trent Centre	Wide-bore Teflon	SJ883479	388348	347894
Strath Vaich	Wide-bore Teflon	NH348748	234829	874785
Sunderland	Narrow-bore Teflon	NZ399570	439895	556970
Sunderland Silksworth	Wide-bore Teflon	NZ381545	438142	554473
Swansea	Glass	SS656932	265566	193158
Thurrock	Glass	TQ610779	561018	177894
Tower Hamlets Roadside	Narrow-bore Teflon	TQ359822	535914	182230
Walsall Alumwell	Narrow-bore Teflon	SO994983	399374	298264

Site Name	Manifold type	Grid Reference	6 figure easting	6 figure northing
Walsall Willenhall	Glass	SO979012	397860	201173
West London	Wide-bore Teflon	TQ250788	525041	178751
Weybourne	Narrow-bore Teflon	TG098438	609832	343775
Wicken Fen	Wide-bore Teflon	TL563692	556310	269210
Wigan Leigh	Narrow-bore Teflon	SD578060	357825	406025
Wigan Centre	TBA			
Wirral Tranmere	Wide-bore Teflon	SJ665998	366468	399842
Wolverhampton Centre	Glass	SJ321866	332096	386644
Wrexham	Glass	SO914989	391368	298942
Yarner Wood	Wide-bore Teflon	SJ329499	332862	349904

TBA = to be advised in a future report

The grid references quoted in the above table are obtained from GPS measurements, confirmed by reference to Ordnance Survey 1:25000 maps and internet street mapping services. The 6 figure easting and northing references are obtained from GPS measurements, quoted to 1 metre accuracy, and also referenced to internet street mapping services. It should be noted that these figures are likely to carry an uncertainty of ±10 metres.

For sites in Northern Ireland, Latitude and Longitude references are used to ensure accurate positioning. The GB and Irish grid reference systems are slightly different, which can lead to positioning errors.

It is suggested that Management Units check the accuracy of their databases and websites against these data, and provide feedback or update accordingly.

This table will be used to calculate a number of additional parameters, including: Latitude / Longitude of all sites and altitude of the station above sea level. Future reports will include this information, plus the height of sampling inlets above the ground.

15 CEN

The European Committee for Normalisation (CEN) have prepared a series of documents prescribing how analysers must be operated, to produce datasets that conform to the Data Quality Objectives of the EC Directives. The CEN documents for operation of air pollution analysers; ISO14211 (NOx), ISO14212 (SO_2), ISO14626 (CO) and ISO14625 (O_3) set out a series of performance criteria for analysers which must be achieved, both in the field and under laboratory conditions.

By way of example, the performance of an analyser in the field must pass a number of tests, including:

- Linearity – the analyser must have a maximum error at any point of less than 5% of the predicted value. This is much tougher to achieve than the current criteria (r^2

of 0.99 or better). Netcen has begun to record maximum residuals from linearity tests, to evaluate the performance of current analysers against these tougher requirements. These results will be reported in detail in the Winter 2005 intercalibration report.

- NOx Converter efficiency must be better than 98%. Data may be rescaled for efficiencies between 95 and 98%, but rejected if below 95%. Again, this is tighter than currently, where we accept "borderline" failures. Netcen already use the CEN method for undertaking converter tests.

- The sampling system that delivers air to the analyser must remove no more than 2% of the gas to be analysed. Netcen continue to evaluate systems to calibrate sampling systems, but this is not currently undertaken on a routine basis in the UK. A report on the evaluation of methodologies to test losses of gases to sampling manifolds has been completed by QA/QC Unit. This report is available on the AURN Hub and Air Quality Archive.

- The concentration of the site cylinders will need to be determined every six months, and the revised values used to scale ambient data. This is a change to our current procedures, where no action is taken until a cylinder deviates from its stated value by more than 10%. Netcen have introduced a new procedure for handling drifting cylinder concentrations. In future, the uncertainty of this calculation will need to be substantially lower than the current 10% limit (in the order of 4-5% maximum).

- SO_2 response to a 1ppm meta xylene cylinder will need to be less than 1% (10ppb). This is the current requirement, but action is not taken unless the result is very high (>50ppb), or until an analyser repeats a failure six months later.

The CEN operating methodologies will be formally ratified in February 2005, and adopted into the requirements of the Framework Directive in August 2005. It is understood that Member States will then have up to two years to ensure their monitoring networks are compliant. Netcen are taking steps to ensure the procedures used in the UK comply with the requirements ahead of any imposed deadlines.

16 Safety

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

There are no significant issues identified that presented significant risk during this intercalibration exercise. The issue of safe roof access, to audit PM_{10} analyser flow rates has largely been worked around. This has been achieved either by installing ladder securing points on the outside of the huts, or by auditing flow rates inside the monitoring station. However, performing flow measurements inside means that we are unable to perform leak tests on these analysers. For this reason, it would be useful if safer roof access (ladder securing points) could be considered for the following sites:

1. Blackpool (site closed on 10th November 2004 for relocation)
2. London Brent
3. Southend-on-Sea
4. Narberth

In addition, safe roof access is not possible at the following sites:

1. Bolton
2. Coventry Memorial Park

We will be undertaking a full safety review of the monitoring stations during the Winter 2005 roadshow.

Recommendation

Whist the Blackpool site is out of service, the opportunity should be taken to ensure ladder securing points are attached to allow safer roof access prior to the site being relocated.

17 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.

18 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 period July to September 2004.

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 since January 2004. Recommendations have been prioritised as follows:

Priority	Definition	Time-scale
High*	Immediate action necessary to avoid compromising data capture/quality or safety. Critical sites should be treated as high priority.	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 January 2004	Priority	Action
1	Advice on requirements for further AURN equipment up-grades has been given to CMCU (20/1/04)		On-going
2	Recommend up-grade/modifications to SO_2 Ambirack bench at Blackpool and Norwich Centre to improve response noise. (Already done at Wirral Tranmere and Preston)	Blackpool Critical Site	Blackpool - new SO_2 bench fitted 9th March 2004
	Recommendations July 2004		
3	Recommend up-grading or modify SO_2 Ambirack bench at Reading New Town	Critical Site (Defra)	On-going
4	Sheffield Tinsley CO noisy and drifting response. Recommend up-grade or repair	Medium	On-going
5	Exeter Roadside CO unstable baseline. Recommend up-grading or repair.	Medium	On-going
	Recommendations October 2004		
6	Further advice for AURN equipment replacement and up-grading was given to CMCU on 8th September 2004.		
7	Recommend repair or up-grading of 11 unstable CO analysers detailed in Section 3.1 of this report. Of these, Barnsley Gawber (Affiliate) and Nottingham Centre (Defra) are critical for CO.	Critical sites	
	Recommendations January 2005		
8	As the Blackpool site is now closed, we recommend the opportunity be taken to install ladder securing points to allow safer access to the site roof, prior to the site being relocated.	Critical site	
9	Recommend the High Muffles NO_x autocalibration system is repaired/up-graded or turned off (span off only) until a satisfactory solution to autocalibration run-on problem is found.	Critical site	

APPENDIX A2

CRITICAL SITES IN THE AURN (January 2005)

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 O_3
Wirral Tranmere	Birkenhead Urban Area	NO_2 PM_{10} SO_2	CO	NO_2 O_3
Blackpool	Blackpool Urban Area	NO_2 PM_{10} SO_2	CO	NO_2 O_3
Bournemouth+	Bournemouth Urban Area	NO_2 PM_{10} SO_2	CO	NO_2 O_3
Brighton Preston Park	Brighton/Worthing/Littlehampton			NO_2 O_3
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 St Leonards	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 New Town	Reading/Wokingham Urban Area	NO_2 PM_{10} SO_2	CO	NO_2 O_3
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 West Midlands is Suburban then NO_2 at Leamington Spa is no longer critical for DD1
Note 6: Not Affiliated/Monitoring yet.
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 O_3
Northampton+	East Midlands	NO_2 PM_{10}[2] SO_2	CO	NO_2 O_3
Sibton	Eastern			O_3[3]
St Osyth	Eastern			NO_2 O_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}		
Sunderland Silkworth+	North East			NO_2 O_3
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 O_3
Wrexham	North Wales	NO_2 PM_{10} SO_2	CO	
Great Dunn Fell	North West & Merseyside			O_3[3]
Wigan Leigh+/Centre[8]	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 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 O_3
Plymouth Centre	South West	PM_{10}		
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 O_3
Scunthorpe Town+	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 Leominster is Suburban then NO_2 at Leamington Spa is no longer critical for DD1
Note 6: Not Affiliated/Monitoring yet
Note 7: Addresses CO, Benzene not included here
Note 8: Wigan Leigh relocated to Wigan Centre on 11th October 2004

APPENDIX B1

Network Certificate of Calibration

netcen

CERTIFICATE OF CALIBRATION

551 Harwell, Didcot, Oxfordshire OX11 0QJ. Telephone 0870 1906465 Facsimile 0870 1906377

UKAS CALIBRATION
0401
0401 S1

Certificate No: 01214

AEA Identification Number: 45077030

Approved Signatories: K. Stevenson
✓ S. Eaton

Signed: Date: 28 Jan 2005

Date of issue: 21 January 2005

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 and Rural Monitoring Network

1. Carbon Monoxide

Date Year =2004	Site	Analyser number	[1]Zero output	Uncertainty (ppm)	[2]Calibration Factor	Uncertainty (%)	*R^2
	Scottish Sites						
27/07	Aberdeen	10269	0	0.3	1.015	3	0.9987
12/07	Dumfries	12555	-5	0.3	0.020	3	0.9983
14/07	Edinburgh St Leonards	14331	-1	0.3	1.020	3	0.9998
19/07	Glasgow Centre	gra410009	33	0.3	0.052	3	0.9992
20/07	Glasgow City Chambers	721	0	0.3	1.015	3	0.9985
20/07	Glasgow Kerbside	HAR 002	-3	0.3	0.050	3	0.9987
15/07	Grangemouth	12894	-1	0.3	0.976	3	0.9997
28/07	Inverness	12557	35	0.3	0.020	3	0.9986
	Welsh Sites						
16/09	Cardiff Centre	242	0	0.3	1.005	3	0.9996
17/09	Cwmbran	103006	0	0.3	1.057	3	0.9998
20/09	Swansea	70	2	0.3	0.050	3	0.9996
28/09	Wrexham	api-1499	1	0.3	0.967	3	0.9984
	N.Irish Sites						
13/09	Belfast Centre	m491	56	0.3	0.051	3	0.9992
15/09	Derry	j-ar-009	3	0.3	0.058	3	0.9984

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.

netcen

CERTIFICATE OF CALIBRATION

551 Harwell, Didcot, Oxfordshire OX11 0QJ. Telephone 0870 1906465 Facsimile 0870 1906377

0401
0401 S1

Certificate No: 01214

AEA Identification Number: 45077030

Date Year =2004	Site	Analyser number	[1]Zero output	Uncertainty (ppm)	[2]Calibration Factor	Uncertainty (%)	*R^2
	English Sites						
10/08	Barnsley Gawber		-3	0.3	0.052	3	0.9983
19/07	Bath Roadside	11388	-7	0.3	0.053	3	0.9988
04/08	Birmingham Centre	14418	-10	0.3	0.049	3	0.9999
02/08	Birmingham East	106006	0	0.3	0.992	3	0.9999
27/09	Blackpool	L-AR010	-11	0.3	0.044	3	0.9998
17/08	Bolton	2371	0	0.3	0.997	3	0.9998
21/07	Bournemouth	1501	1	0.3	1.129	3	0.9997
16/08	Bradford Centre		4	0.3	0.057	3	0.9999
25/08	Brentford Roadside	93034	7	0.3	0.971	3	0.9987
07/09	Brighton Roadside	1434	1	0.3	1.029	3	0.9996
02/08	Bristol Centre	257	-1	0.3	1.015	3	0.9958
02/08	Bristol Old Market	121	-1	0.3	0.058	3	0.9945
17/08	Bury Roadside	1357	0	0.3	0.958	3	0.9999
08/07	Coventry Memorial Park	207001	0	0.3	1.041	3	0.9964
03/08	Exeter Roadside	8830-244	24	0.3	0.051	3	0.9942
06/09	Hove Roadside	1433	2	0.3	1.000	3	0.9994
29/07	Hull Freetown	m489	46	0.3	0.050	3	0.9947
09/09	Leamington Spa	2198	24	0.3	0.050	3	0.9998
16/08	Leeds Centre	148	68	0.3	0.051	3	1.0000
16/06	Leicester Centre	207004	0	0.3	1.000	3	0.9998
07/09	Liverpool Speke	m487	1050	0.3	0.005	3	0.9982
08/07	London A3 Roadside	Ambirak H	1	0.3	0.053	3	0.9988
19/07	London Bexley	14871	0	0.3	1.005	3	0.9997
06/07	London Bloomsbury	14330	-3	0.3	0.052	3	0.9983
20/08	London Brent	1694	21	0.3	0.050	3	0.9982
19/08	London Bromley	37853256	0	0.3	1.086	3	0.9999
20/09	London Cromwell Rd 2	10776	11	0.3	0.050	3	0.9992
24/08	London Hackney	5156	33	0.3	0.050	3	0.9999
02/09	London Harlington	1045	1	0.3	0.972	3	0.9975
05/07	London Hillingdon	0410-005	-38	0.4	0.055	3.1	0.9994
15/07	London Marylebone Rd	651	-1	0.3	1.024	3	0.9965
09/07	London N. Kensington	360	3	0.3	0.962	3	0.9993
13/07	London Southwark	8043	-1	0.3	1.009	3	0.9985
06/08	London Westminster	10777	16	0.3	0.050	3	0.9988
25/08	Manchester Piccadilly	0040-008	1	0.3	0.044	3	0.9969
25/08	Manchester Town Hall	720	4	0.3	0.050	3	0.9945
30/07	Market Harborough	60983-329	94*	0.3*	0.006*	9.1*	0.9955
08/09	Middlesbrough	14202	0	0.3	1.007	3	0.9994
13/09	Newcastle Centre	m488	49	0.3	0.050	3	0.9999
16/07	Northampton	8905410102	0	0.3	1.036	3	0.9983
12/08	Norwich Centre		-9	0.3	0.049	3	0.9997
27/07	Nottingham Centre		1	0.3	0.047	3.2	0.9911
07/07	Oxford Centre	214b-217	101	0.3	0.047	3	0.9998
04/08	Plymouth Centre	h-rao-410	2	0.3	0.058	3	0.9987
09/07	Portsmouth	902015	0	0.3	1.114	3	0.9998
27/09	Preston	71010-02	3	0.3	0.046	3	0.9991

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Date Year =2004	Site	Analyser number	[1]Zero output	Uncertainty (ppm)	[2]Calibration Factor	Uncertainty (%)	*R^2
22/07	Reading New Town		0	0.3	0.051	3	0.9924
07/09	Redcar	10620	0	0.3	0.042	3	0.9998
24/08	Salford Eccles	2386	0	0.3	1.003	3	0.9988
08/07	Sandwell West Bromwich	94603	11	0.3	0.049	3	0.9997
10/08	Sheffield Centre	410-006	4	0.3	0.052	3	0.9931
09/08	Sheffield Tinsley	517	-13	0.3	0.049	3	0.9971
23/08	Southampton Centre	M490	48	0.3	0.064	3	0.9999
05/08	Southend-on-Sea	L-AR-011	0	0.3	0.050	3	0.9980
13/07	Southwark Roadside	API 358	-3	0.3	0.990	3	0.9985
04/08	St Osyth	60872	1*	0.3*	0.568*	10.2*	0.9982
06/09	Stockton-on-Tees Yarm	m1368-m399	0	0.3	0.985	3	1.0000
16/08	Stoke-on-Trent Centre	h-ar-003	-41	0.3	0.053	3	0.9999
22/07	Thurrock	95024	-8	0.3	0.050	3	0.9988
23/09	Tower Hamlets Roadside	272	5	0.3	1.102	3	0.9997
20/09	West London	m300-081	-3	0.7	0.057	3.9	0.9966
19/08	Wigan Leigh		0	0.3	1.038	3	0.9985
28/09	Wirral Tranmere	L-AR-012	-13	0.3	0.059	3	0.9991

2. Sulphur Dioxide

Date Year =2004	Site	Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	*R^2	*m-xylene interference (ppb)
	Scottish Sites							
27/07	Aberdeen	12182	-1	4.2	1.007	5	0.9910	8.8
14/07	Edinburgh St Leonards	14320	0	4.2	1.097	5	0.9999	23.1
19/07	Glasgow Centre	gra477018	13	4.0	0.192	5	0.9974	0
15/07	Grangemouth	703B-214	-1	4.3	0.810	5	0.9999	21.1
	Welsh Sites							
16/09	Cardiff Centre	70	7	4.2	1.247	5.6	0.9990	10.6
17/09	Cwmbran	408001	3	4.3	1.047	5.5	0.9956	5.0
21/09	Narberth	h-rs-458	71	4.2	0.696	5	0.9991	20.4
20/09	Port Talbot	943	0	4.2	1.115	7.1	0.9992	12.3
20/09	Swansea	168	8	4.0	0.225	5	0.9980	10.1
28/09	Wrexham	api-1181	-7	4.2	1.103	5.3	0.9989	5.5
	N.Irish Sites							
13/09	Belfast Centre	m637	222	4.1	0.189	5	0.9994	20.1
13/09	Belfast East	10778	2	4.2	0.863	5	0.9991	5.8
15/09	Derry	j-ar-009	140	4.5	1.054	5	0.9977	3.2
	English Sites							
10/08	Barnsley 12	706	5	4.2	1.209	5	0.9983	9.7
10/08	Barnsley Gawber		86	5.2	1.220	5.7	0.9960	15.6
04/08	Birmingham Centre	14352	40	8.0	0.200	10.0	0.9950	16.6

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Date Year =2004	Site	Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	*R^2	*m-xylene interference (ppb)
02/08	Birmingham East	301002	0	4.1	0.853	5	0.9960	6.8
27/09	Blackpool	L-AR010	13	4.5	1.327	5.5	0.0000	11.6
17/08	Bolton	2344	2	4.2	0.982	5	0.9991	17.7
21/07	Bournemouth	1139	0	4.2	1.006	5.4	0.9996	11.3
16/08	Bradford Centre		86	4.3	1.330	5.1	0.9969	12.0
02/08	Bristol Centre	73	1	4.2	1.172	5.3	0.9951	19.9
17/08	Bury Roadside	1581	1	4.1	0.890	5	0.9999	28.5
08/07	Coventry Mem. Park	215003	1	4.3	0.941	5.3	0.9951	1.6
03/08	Exeter Roadside	1835	22	4.2	1.069	5.3	0.9962	20.3
05/07	Harwell	14350	-11	4.1	0.499	5	0.9997	10.8
06/09	Hove Roadside	1178	0	4.2	1.079	5.3	0.9970	13.6
29/07	Hull Freetown	m686	245	4.0	0.210	5.2	0.9927	21.6
24/08	Ladybower	84	5	4.1	0.582	5	0.9972	5.2
09/09	Leamington Spa	1793	17	4.2	1.037	5.3	0.9973	20.7
16/08	Leeds Centre	m100 053	-15	4.0	0.190	5	0.9997	4.9
16/06	Leicester Centre	215001	0	4.2	1.007	5.6	0.9995	2.0
07/09	Liverpool Speke	m626	242	4.1	0.176	5	0.9931	20.7
19/07	London Bexley	14869	2	4.2	0.936	5.3	0.9995	15.2
06/07	London Bloomsbury	14323	6	4.1	0.220	5	0.9994	17.0
20/08	London Brent	0	18	4.7	0.850	5	0.9939	11.5
20/09	London Cromwell Rd 2	10779	2	4.2	1.112	5.3	0.9991	7.8
23/08	London Eltham	822	55	4.2	1.036	5	0.9976	23.8
05/07	London Hillingdon	77580-386	6	4.3	0.234	5.9	0.9979	5.3
24/09	London Lewisham	M498	1	4.2	1.037	5.3	0.9993	19.7
15/07	London Marylebone Rd	411	24	4.1	0.767	5.4	0.9986	12.2
09/07	London N. Kensington	1020	38	4.3	0.983	5	0.9958	21.1
13/07	London Southwark	535	7	4.2	0.982	5	0.9984	7.9
21/09	London Teddington	m100-374	3	4.2	0.795	5.3	0.9989	3.0
06/08	London Westminster	10780	6	4.1	0.926	5	0.9985	21.3
06/09	Lullington Heath	m690	102	4.1	0.495	5.2	0.9949	22.3
25/08	Manchester Piccadilly	0447-013	-58	4.0	0.203	5.7	0.9945	16.9
24/08	Manchester South	e4770104	8	4.0	0.213	5.1	0.9949	21.3
08/09	Middlesbrough	14166	2	4.2	1.135	5.5	0.9997	15.8
13/09	Newcastle Centre	m689	242	4.1	0.186	5	0.9961	22.5
12/08	Norwich Centre		64	8.3	3.258	11.2	0.9921	21.2
27/07	Nottingham Centre	0447-016	231	4.2	0.223	5.8	0.9901	5.5
07/07	Oxford Centre	376b-161	102	4.5	0.949	5.6	0.9931	12.6
04/08	Plymouth Centre	77561-386	0	4.2	1.008	5.3	0.9970	2.1
09/07	Portsmouth	215004	1	4.2	1.031	5.4	0.9995	3.0
27/09	Preston	71010-02	36	4.2	1.209	5.3	0.9939	18.1
22/07	Reading New Town		6	4.4	1.301	6.0	0.9946	3.6
07/09	Redcar	10355	17	4.1	0.879	5	0.9995	8.8
20/07	Rochester	95058	13	4.2	1.022	5.3	0.9995	11.2
09/08	Rotherham Centre	447-0109	-15	4.1	0.876	5	0.9972	11.4
24/08	Salford Eccles	2346	-1	4.3	0.951	6.4	0.9984	13.8
08/07	Sandwell West Bromwich	93082	0	4.3	1.017	5.5	0.9997	8.9
28/07	Scunthorpe Town	468	-2	4.3	1.004	5.9	0.9971	8.5
10/08	Sheffield Centre	0477-015	-23	4.0	0.219	5	0.9971	20.3

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Date Year =2004	Site	Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	*R^2	*m-xylene interference (ppb)
23/08	Southampton Centre	M1768-M676	230	4.0	0.151	5	0.9993	20.8
05/08	Southend-on-Sea	L-AR-011	90	5.2	1.453	7.3	0.9988	5.1
13/07	Southwark Roadside	Dasibi 659	4	4.2	1.071	6.0	0.9988	5.4
18/08	Stockport Shaw Heath	1690	19	4.1	0.485	5	0.9904	19.8
16/08	Stoke-on-Trent Centre	H-AR-003	40	4.5	1.976	5	0.9986	21.7
14/09	Sunderland	14321	1	4.4	1.221	5	0.9989	15.6
22/07	Thurrock	10554	4	4.2	1.053	5.3	0.9995	23.2
09/08	Wicken Fen	14349	-20	4.1	0.592	5	0.9987	16.6
19/08	Wigan Leigh	2	0	4.3	1.438	5.3	0.9983	4.2
28/09	Wirral Tranmere	L-AR-012	7	5.1	3.159	6.1	0.9959	9.5

3. Ozone

Date Year =2004	Site	Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	*R^2
	Scottish Sites						
27/07	Aberdeen	13073	1	3	0.940	3.1	0.9999
13/07	Bush Estate	77087-385	-1	3	0.503	3.1	1.0000
14/07	Edinburgh St Leonards	14334	0	3	0.991	3.1	1.0000
13/07	Eskdalemuir	14341	-1	3	0.488	3.1	1.0000
19/07	Glasgow Centre		-6	6.3	0.204	4.7	0.9994
27/07	Strath Vaich	14439	21	3	0.507	3.1	1.0000
	Welsh Sites						
09/08	Aston Hill	8810-367	7	3	0.491	3.2	0.9998
16/09	Cardiff Centre	168	0	3	0.983	3.2	0.9999
17/09	Cwmbran		0	3	1.106	3.1	1.0000
21/09	Narberth		3	4.0	1.028	3.4	0.9998
20/09	Port Talbot	339	4	3	0.505	3.1	0.9994
20/09	Swansea	156	6	3	0.103	3.1	0.9999
	N.Irish Sites						
13/09	Belfast Centre	m355	231	3	0.099	3.1	1.0000
15/09	Derry	j-ar-009	0	3	1.205	3.2	0.9999
16/07	Lough Navar	14346	-11	3	0.456	3.1	1.0000
	English Sites						
10/08	Barnsley Gawber		2	3	1.178	3.2	0.9997
04/08	Birmingham Centre	14357	25	3	0.101	3.1	1.0000
02/08	Birmingham East	301002	5	3	0.949	3.1	0.9998
27/09	Blackpool	L-AR010	0	3	1.069	3.2	0.9999
17/08	Bolton	2371	0	3	0.977	3.1	1.0000
27/07	Bottesford	49c-ea357	5	3	0.992	3.1	1.0000
21/07	Bournemouth	854	0	3	0.957	3.1	0.9998

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Date Year =2004	Site	Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	*R^2
16/08	Bradford Centre		2	3	1.026	3.1	0.9999
02/08	Bristol Centre	155	-2	3	1.202	3.2	1.0000
17/08	Bury Roadside	1453	0	3	1.051	3.1	0.9996
08/07	Coventry Memorial Park	205001	2	3	1.000	3.1	1.0000
03/08	Exeter Roadside	1317	21	3	1.151	3.2	0.9997
19/08	Glazebury	138	9	3	0.457	3.1	0.9999
15/09	Great Dun Fell	14456	1	3	0.512	3.1	0.9999
05/07	Harwell	14347	1	3	0.501	3.2	0.9999
07/09	High Muffles	14343	-7	3	0.509	3.1	1.0000
29/07	Hull Freetown	m356	228	3	0.093	3.1	1.0000
24/08	Ladybower	125b-101	56	3	0.441	3.1	0.9998
09/09	Leamington Spa	1469	21	3	0.974	3.1	1.0000
16/08	Leeds Centre	m400 056	137	3	0.109	3.1	0.9999
16/06	Leicester Centre	205006	0	3	1.003	3.1	1.0000
07/09	Liverpool Speke	9810b-m331	267	3	0.097	3.1	1.0000
19/07	London Bexley	14872	0	3	0.975	3.1	0.9999
06/07	London Bloomsbury	14907	11	3	0.103	3.1	1.0000
20/08	London Brent	1608	21	3	0.956	3.1	0.9998
23/08	London Eltham	375	8	3	0.983	3.1	0.9999
24/08	London Hackney	5155	23	3	0.202	3.8	0.9997
14/07	London Haringey	538	9	3	1.146	3.3	0.9998
02/09	London Harlington	107	-1	3	0.931	3.2	1.0000
05/07	London Hillingdon	0427-012	5	3	0.099	3.1	0.9968
24/09	London Lewisham	939B-187	2	3	0.975	3.1	0.9998
15/07	London Marylebone Rd	769	0	3	1.034	3.1	0.9999
09/07	London N. Kensington	497	10	3	0.967	3.4	0.9993
13/07	London Southwark	5776	4	3	1.048	3.1	1.0000
21/09	London Teddington	58811-320	-23	3	0.218	3.3	0.9999
18/08	London Wandsworth	491	1	5.5	1.043	7.3	0.9964
06/08	London Westminster	10444	10	3	0.520	3.1	1.0000
06/09	Lullington Heath	m1655-m337	102	3	0.479	3.2	0.9999
25/08	Manchester Piccadilly	427-017	-11	4.3	0.191	3.8	0.9998
24/08	Manchester South	e4270102	0	3	0.100	3.1	0.9995
30/07	Market Harborough	60894-328	5	3	0.486	3.2	0.9999
08/09	Middlesbrough	14203	0	3	0.974	3.1	1.0000
13/09	Newcastle Centre	m1820-m357	240	3	0.104	3.1	0.9999
16/07	Northampton	8905240110	-1	3	0.951	3.2	0.9999
12/08	Norwich Centre		0	3	1.025	3.1	0.9984
27/07	Nottingham Centre	427-011	-13	3	0.100	3.1	0.9999
04/08	Plymouth Centre		-1	3	0.585	3.1	0.9999
09/07	Portsmouth	205002	1	3	1.039	3.1	0.9999
27/09	Preston	71010-02	-1	3	0.962	3.1	0.9969
22/07	Reading New Town		-2	4.5	1.070	3.5	0.9984
07/09	Redcar	10195	0	3	0.451	3.1	0.9999
20/07	Rochester	95063	-1	3	1.015	3.1	1.0000
09/08	Rotherham Centre	D4270106	5	3	0.959	3.1	0.9998
24/08	Salford Eccles	2363	0	3	1.084	3.2	0.9998
08/07	Sandwell West Bromwich	93083	6	3	0.479	3.1	1.0000

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Date Year =2004	Site	Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	*R^2
10/08	Sheffield Centre	427-010	-16	3	0.097	3.4	0.9999
12/08	Sibton	92416	5	3	0.467	3.1	0.9999
03/08	Somerton	427	3	3	0.511	3.1	1.0000
23/08	Southampton Centre	m1802m1354	273	3	0.099	3.1	0.9999
05/08	Southend-on-Sea	L-AR-011	0	3	1.023	3.1	0.9998
04/08	St Osyth	49c-60869	976	3	0.050	3.2	1.0000
16/08	Stoke-on-Trent Centre	H-AR-003	5	3	1.119	3.1	0.9993
22/07	Thurrock	10788	1	3	0.493	3.1	0.9999
10/08	Weybourne	195	-1	3	1.053	3.1	0.9999
09/08	Wicken Fen	14345	-8	3	0.491	3.1	1.0000
19/08	Wigan Leigh	4009	2	3	1.031	3.2	0.9999
28/09	Wirral Tranmere	L-AR-012	0	3	1.007	3.2	0.9997
04/08	Yarner Wood	347	-2	3	0.430	3.2	0.9999

4. Oxides of Nitrogen

Date Year =2004	Site		Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	*R^2	*Converter efficiency (%)
	Scottish Sites								
27/07	Aberdeen	NO NOx	10266	-1 -1	5 5.3	1.013 1.038	5 5	0.9979 0.9983	98.5
13/07	Bush Estate	NO NOx	77584-386	-3 -3	5 5.3	0.866 0.955	5 5	0.9963 0.9948	98.1
12/07	Dumfries	NO NOx	12189	5 6	5 5.4	0.413 0.421	5 5.1	0.9989 0.9991	94.8
14/07	Edinburgh St Leonards	NO NOx	14327	1 -2	5 5.3	0.809 0.775	5 5.1	0.9999 0.9999	98.6
19/07	Glasgow Centre	NO NOx	gra-447 011	-10 -5	5 5.2	0.453 0.457	5 5.1	0.9993 0.9993	95.5
20/07	Glasgow City Chambers	NO NOx	575	1 1	5 5.3	1.169 1.19	5 5.2	0.9961 0.9969	96
20/07	Glasgow Kerbside	NO NOx	H-AR-002	15 13	5 5.6	2.066 2.087	5.1 5.2	0.9947 0.9949	90.9
15/07	Grangemouth	NO NOx	700B-312	0 2	5 5.4	1.073 1.089	5 5.4	0.9999 0.9999	97.5
28/07	Inverness	NO NOx	12184	8 8	5 5.2	0.443 0.465	5 5	0.9991 0.9994	96.1
	Welsh Sites								
09/08	Aston Hill	NO NOx	m200a-2221	8 6	5 5.3	1.174 1.168	5 5	0.999 0.9989	96.5
16/09	Cardiff Centre	NO NOx	71	0 0	5 5.5	1.742 1.752	5 5	0.9997 0.9996	95.2
17/09	Cwmbran	NO NOx	406003	-1 -6	5 5.4	1.035 1.006	5 5	0.9990 0.9993	98.1
21/09	Narberth	NO NOx	H-RS458	44 42	5 5.3	0.949 0.980	5 5.2	0.9995 0.9997	96.7

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CERTIFICATE OF CALIBRATION

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0401
0401 S1

Certificate No: 01214-

AEA Identification Number: 45077030

Date Year =2004	Site		Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	*R^2	*Converter efficiency (%)
20/09	Port Talbot	NO NOx	320	2 0	5 5.8	1.234 1.225	7.5 7.2	0.9995 0.9993	99.5
20/09	Swansea	NO NOx	148	-10 3	5 5.2	0.482 0.499	5 5	0.9995 0.9997	96.6
28/09	Wrexham	NO NOx	api-1490	1 0	5 5.5	1.175 1.192	5 5	0.9983 0.9985	97.7
	N.Irish Sites								
13/09	Belfast Centre	NO NOx	m733	243 247	5 5.4	0.428 0.448	5 5.1	0.9985 0.9988	98.3
15/09	Derry	NO NOx	j-ar-009	43 43	5 6.1	2.044 2.110	5.6 5.4	0.9991 0.9995	96.3
	English Sites								
10/08	Barnsley Gawber	NO NOx		57 60	6.6 10.5	2.857 2.883	5.9 12.4	0.9926 0.9949	95.2
19/07	Bath Roadside	NO NOx	12758	2 3	5 5.4	1.289 1.326	5 5.1	0.9980 0.9981	97.7
07/09	Billingham	NO NOx	10440	3 3	5 5.5	1.560 1.589	5 5.1	0.9997 0.9998	95.8
04/08	Birmingham Centre	NO NOx	14324	12 27	13.7 20.8	0.612 0.655	9.5 12.4	0.9980 0.9985	96.0
02/08	Birmingham East	NO NOx	209006	0 0	5 5.3	1.016 1.038	5 5	Failed	in test
27/09	Blackpool	NO NOx	l-ar010	47 48	5 6.6	2.690 2.713	5.3 5.6	0.9975 0.9982	97.7
21/07	Bournemouth	NO NOx	522	0 0	5 5.3	1.192 1.205	5 5.1	0.9980 0.9983	102.5
16/08	Bradford Centre	NO NOx		27 28	5 6.7	2.597 2.803	5.4 5.6	0.9992 0.9995	100
25/08	Brentford Roadside	NO NOx	M1759/M7 12	-5 -3	5 5.3	1.057 1.104	5 5.1	0.9995 0.9998	100
07/09	Brighton Roadside	NO NOx	1225	2 4	5 5.3	1.215 1.221	5 5	1.0000 1.0000	95.5
02/08	Bristol Centre	NO NOx	77	4 5	5 5.4	1.435 1.531	5 5	0.9948 0.9951	98.7
02/08	Bristol Old Market	NO NOx	653	2 3	5 5.9	2.845 2.886	5 5	0.9959 0.9962	95.7
17/08	Bury Roadside	NO NOx	1710	0 6	5 5.3	1.057 1.098	5 5.1	0.9999 0.9999	103.4
09/08 09/08	Cambridge Roadside	NO NOx	42C- 55355-303	-1 -2	5 5.3	1.048 1.061	5 5	0.9999 0.9999	97.9
07/07 07/07	Camden Kerbside	NO NOx		4 8	5 5.4	1.363 1.345	5 5	0.9978 0.9985	96.4
21/07	Canterbury	NO NOx	11666	1 -1	5 5.3	1.224 1.217	5 5	1.0000 1.0000	96.3
08/07	Coventry Memorial Park	NO NOx	210003	0 0	5 5.3	0.944 0.874	5 5	0.9962 0.9960	98.9
03/08	Exeter Roadside	NO NOx	9841a-85	21 23	5 5.9	2.623 2.767	5 5	0.995 0.9958	102.5
19/08	Glazebury	NO NOx	78	2 -5	5 5.2	0.446 0.438	5 5	0.9975 0.9975	99.6

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Date Year =2004	Site		Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	*R^2	*Converter efficiency (%)
14/07	Haringey Roadside	NO NOx	397	2 2	5 5.3	1.088 1.055	5 5.4	0.9998 0.9999	98.8
05/07	Harwell	NO NOx	14366	-1 -4	5 5.3	1.214 1.215	5 5.1	0.9995 0.9996	98.4
07/09	High Muffles	NO NOx	12553	24 17	5 5.2	0.594 0.630	5 5	Failed	in test
06/09	Hove Roadside	NO NOx	199	0 3	5 5.3	0.914 0.929	5 5	0.9998 0.9998	95.3
29/07	Hull Freetown	NO NOx	m732	220 228	5 5.2	0.374 0.376	4 5	0.9951 0.9949	98.8
24/08	Ladybower	NO NOx	72	10 9	5 5.2	0.599 0.587	5 5	0.9980 0.9980	98.2
09/09	Leamington Spa	NO NOx	1705	24 20	5 6.7	3.068 2.951	5.2 5.6	0.9996 0.9995	103.2
16/08	Leeds Centre	NO NOx	hsp00009	263 248	5 5.2	0.539 0.561	5 5.3	0.9999 0.9993	95.8
16/06	Leicester Centre	NO NOx	apna-360-210004	-1 -3	5 5.3	1.000 0.985	6.2 8.1	0.9996 0.9996	99.2
07/09	Liverpool Speke	NO NOx	9841b-m734	247 242	5 5.4	0.450 0.457	5 5.9	0.9976 0.9981	96.6
08/07	London A3 Roadside	NO NOx	H-AR-001	65 69	5 7.1	2.877 3.122	5.6 7.2	0.9993 0.9988	94.8
19/07	London Bexley	NO NOx	14870	16 17	5 5.3	0.933 0.912	5 5	0.9999 0.9999	100
06/07	London Bloomsbury	NO NOx	14328	-22 -11	5 5.8	0.485 0.500	5 5.4	0.9990 0.9995	95.1
20/08	London Brent	NO NOx	0	24 28	5 5.7	2.151 2.221	5 5.1	0.9971 0.9964	95.7
19/08	London Bromley	NO NOx	10669	0 0	5 5.4	1.276 1.308	5 5.1	0.9999 0.9999	96.0
20/09	London Cromwell Rd 2	NO NOx	10775	-2 8	5 15.3	2.513 2.962	5 9.1	0.9990 0.9990	96.2
23/08	London Eltham	NO NOx	307	2 3	5 5.3	0.706 0.937	5 5.1	0.9969 0.9972	95.1
24/08	London Hackney	NO NOx	532b-234	101 101	5 5.7	1.138 1.201	5 5.2	0.9998 1.0000	99.5
02/09	London Harlington	NO NOx	1090	0 0	5 5.4	1.292 1.314	5 5.1	0.9976 0.9977	96.1
05/07	London Hillingdon	NO NOx	g-ra0447-010	15 27	5 5.6	0.556 0.590	5 5.3	0.9958 0.9949	111.2
24/09	London Lewisham	NO NOx	M1231-M530	-1 1	5 5.4	1.355 1.492	5 5.3	0.9990 0.9989	100
15/07	London Marylebone Rd	NO NOx	439	1 -2	5 5.5	1.874 1.846	5 5.6	0.9975 0.9963	96.7
09/07	London N. Kensington	NO NOx	459	3 5	5 5.3	1.011 1.016	5 5.3	0.9979 0.9981	96.3
13/07	London Southwark	NO NOx	14863	21 21	5 5.3	1.022 1.027	5 5.1	1.0000 0.9999	95.6
21/09	London Teddington	NO NOx	m200-287	1 0	5 5.7	1.091 1.104	5 5.1	0.9993 0.9990	100

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Certificate No: 01214

AEA Identification Number: 45077030

Date Year =2004	Site		Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	*R^2	*Converter efficiency (%)
18/08	London Wandsworth	NO NOx	378	3 3	5 5.4	1.566 1.481	5.2 6.5	0.9974 0.9979	95.2
06/08	London Westminster	NO NOx	10439	3 2	5 7.1	2.891 3.210	5.1 5.9	0.9958 0.9965	95.9
06/09	Lullington Heath	NO NOx	m1657-m675	100 102	5 5.3	0.813 0.821	5 5	0.9989 0.9991	95.1
25/08	Manchester Piccadilly	NO NOx	G-RA0447-006	5 13	5 5.5	0.422 0.422	5 5.3	0.9985 0.9984	97.2
24/08	Manchester South	NO NOx	J-RA0447 008	-10 3	5 5.3	0.607 0.639	5 5.2	0.9969 0.9981	91.9
25/08	Manchester Town Hall	NO NOx	846	1 4	5 5.7	2.338 2.400	5.8 5.9	0.9992 0.9993	98.9
30/07	Market Harborough	NO NOx	42c-61963-333	0 1	5 5.2	0.507 0.513	5 5	0.9943 0.9955	100.6
08/09	Middlesbrough	NO NOx	13160	0 0	5 5.3	0.974 1.001	5 5	0.9999 0.9995	71.5
13/09	Newcastle Centre	NO NOx	m1800-m730	243 250	5 5.2	0.396 0.402	5.4 5.8	0.9997 0.9997	96.8
16/07	Northampton	NO NOx	8513180611	-1 -6	5 5.4	0.969 0.972	5 5.2	0.9979 0.9984	100.9
12/08	Norwich Centre	NO NOx	H-AR005	77 81	5 5.6	2.125 2.182	5 5.2	0.9983 0.9984	96.3
11/08	Norwich Roadside	NO NOx	94604	0 1	5 5.3	1.120 1.150	5 5.1	0.9997 0.9998	95.2
27/07	Nottingham Centre	NO NOx	GRA0447-009	10 9	5 5.3	0.416 0.408	5 5	0.9938 0.9938	98.7
07/07	Oxford Centre	NO NOx	411b-179	101 102	5 5.5	1.171 1.213	5 5.2	0.9983 0.9987	89.6
04/08	Plymouth Centre	NO NOx	42c-66639-353	0 -1	5 5.6	2.061 2.038	5 5	0.9983 0.9984	98.5
09/07	Portsmouth	NO NOx	903005	0 0	5 5.3	1.034 0.985	5 5.1	0.9999 0.9998	100.8
27/09	Preston	NO NOx	71010-02	58 60	15.5 12.7	5.659 6.063	11.4 8.4	0.9972 0.9983	97.5
22/07	Reading New Town	NO NOx	H-AR-004	10 10	5 5.7	1.093 1.186	5 5.1	0.9935 0.9938	99.1
07/09	Redcar	NO NOx	10196	1 1	5 5.3	1.176 1.208	5 5	1.0000 0.9999	95.6
20/07	Rochester	NO NOx	95059	0 3	5 5.3	1.149 1.154	5 5	0.9999 0.9999	98.7
09/08	Rotherham Centre	NO NOx	Q-RA0447-001	4 3	5 5.4	1.285 1.326	5 5.1	0.9978 0.9980	97.9
24/08	Salford Eccles	NO NOx	2381	1 7	5 5.4	1.095 1.422	5.6 5.4	0.9963 0.9976	101.5
08/07 08/07	Sandwell West Bromwich	NO NOx	93081	-3 -3	5 5.4	0.985 0.991	5 5.1	0.9998 0.9998	96.4
10/08	Sheffield Centre	NO NOx	G-RA0447-008	10 8	5 5.2	0.425 0.429	5 5.2	0.9969 0.997	97.4
09/08	Sheffield	NO	847	-6	5	2.552	5.2	0.9975	

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	Tinsley	NOx		-5	6.3	2.572	5.3	0.9971	96.9
03/08	Somerton	NO	2120	5	5	0.511	5	0.998	
		NOx		9	5.2	0.505	5	0.998	97.4
23/08	Southampton Centre	NO	M1781-M723	228	5	0.446	6.4	0.9994	
		NOx		244	5.3	0.456	5.1	0.9992	100.6
05/08	Southend-on-Sea	NO	L-AR-011	50	5	2.202	8.2	0.9995	
		NOx		53	9.4	2.472	7.4	0.9994	102.6
13/07	Southwark Roadside	NO	API 1443	2	5	1.186	5	0.9981	
		NOx		1	5.3	1.201	5.3	0.9983	95.6
04/08	St Osyth	NO	42c-60988	2	5	0.036	5	0.9986	
		NOx		8	5.3	0.041	5	0.9984	99.6
18/08	Stockport Shaw Heath	NO	1853	20	5	2.643	5	0.9988	
		NOx		19	5.8	2.653	5.2	0.9987	100
06/09	Stockton-on-Tees Yarm	NO	1356	4	5	1.018	7	0.9998	
		NOx		7	5.4	1.023	5.8	0.9994	95.3
16/08	Stoke-on-Trent Centre	NO	H-AR-003	17	5	2.681	5	0.9992	
		NOx		18	6.5	2.758	6.5	0.9992	95.1
22/07	Thurrock	NO	11004	3	5	1.338	5	0.9999	
		NOx		4	5.5	1.344	5	0.9999	97
23/09	Tower Hamlets Roadside	NO	306	4	5	1.299	5	0.9990	
		NOx		4	5.3	1.135	5.3	0.9990	98.7
22/09	Walsall Alumwell	NO	m200a-848	0	5	1.282	5	0.9981	
		NOx		0	5.4	1.293	5.3	0.9984	85.5
03/08	Walsall Willenhall	NO	9800-1337	5	5	1.113	5	0.9989	
		NOx		7	5.4	1.134	5.1	0.9990	104
20/09	West London	NO	m200a-845	-1	5	1.273	5	0.9987	
		NOx		0	5.8	1.311	5.4	0.9988	98.9
09/08	Wicken Fen	NO	13069	15	5	0.522	5	0.9999	
		NOx		14	5.2	0.518	5	0.9999	96.8
19/08	Wigan Leigh	NO		0	5	0.982	5	0.9984	
		NOx		2	5.3	1.012	5.2	0.9986	96
28/09	Wirral Tranmere	NO	L-AR-012	39	5	1.315	6.4	0.9967	
		NOx		39	6.0	1.345	5.8	0.9977	97.6
04/08	Yarner Wood	NO	1784	6	5	0.941	5	0.9914	
		NOx		6	5.3	0.931	5	0.9909	94.9

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5. Particulate Analysers

Date Year =2004	Site	Analyser number	Calculated Spring Constant k_0	Uncertainty (%)	[*4]k_0 accuracy (%)	[3]Measured Main Flow (l/min)	Uncertainty (%)	[3]Measured Total Flow / **Aux Flow** (l/min)	Uncertainty (%)
	Scottish Sites								
27/07	Aberdeen	24427	11600	1	0.3	2.91	2.2	16.26	2.2
12/07	Dumfries	2025a2122						17.4	2.2
14/07	Edinburgh St Leonards	21308	12858	1	0.3	**1.97**	2.2	**14.32**	2.2
19/07	Glasgow Centre	20913	13316	1	-0.2	1.89	2.2	4.57	2.2
20/07	Glasgow Kerbside	24444	15442	1	-1.2	**2.05**	2.2	**15.00**	2.2
15/07	Grangemouth	22763	12491	1	-1.3	**2.98**	2.2	**13.92**	2.2
28/07	Inverness	21255						15.55	2.2
	Welsh Sites								
16/09	Cardiff Centre	24449	14114	1	-1.4	**2.04**	2.2	**14.32**	2.2
17/09	Cwmbran	21557	12459	1	-0.6	**2.95**	2.2	**13.39**	2.2
21/09	Narberth	21557	12415	1	-0.6	**3.01**	2.2	**13.53**	2.2
20/09	Port Talbot	9402	10625	1	0.3	**3.08**	2.2	**13.84**	2.2
20/09	Swansea	2130	14285	1	-1.9	2.39	2.2	9.15	2.2
	N.Irish Sites								
13/09	Belfast Centre	24423	14238	1	0.3	2.04	2.2	15.64	2.2
13/09	Belfast Clara St	95366						15.18	2.2
15/09	Derry	49608	11088	1	1.8	2.09	2.2	16.15	2.2
16/07	Lough Navar	21196	12963	1	1.1	**2.99**	2.2	**13.71**	2.2
	English Sites								
04/08	Birmingham Centre	2297	12074	1	0	2.99	2.2	14.82	2.2
02/08	Birmingham East	24637	13607	1	-0.1	3.02	2.2	15.76	2.2
27/09	Blackpool	24424	12810	1	-0.7	2.02	2.2	15.78	2.2
17/08	Bolton	21197	15288	1	0.8	**3.39**	2.2	**13.46**	2.2
16/08	Bradford Centre	21494	11410	1	0.5	2.11	2.2	16.02	2.2
02/08	Bristol Centre	24426	13090	1	-0.7	**2.05**	2.2	**14.17**	2.2
17/08	Bury Roadside	658	11571	1	-0.2	2.07	2.2	15.88	2.2
07/07	Camden Kerbside	21152	16258	1	-1	3.09	2.2	15.89	2.2
21/07	Canterbury	20931	14051	1	0.1	3.09	2.2	16.72	2.2
08/07	Coventry Memorial Park	25026	13033	1	-1.2	**2.7**	2.2	**12.80**	2.2
14/07	Haringey Roadside	20695	11402	1	-0.5	**2.81**	2.2	**13.50**	2.2
05/07	Harwell PM_{10}	21489	14972	1	0.4	3.04	2.2	16.69	2.2
05/07	Harwell $PM_{2.5}$	21490	10965	1	0.7	3.09	2.2	14.97	2.2
29/07	Hull Freetown	24445	14033	1	-0.5	2.01	2.2	15.56	2.2
09/09	Leamington Spa	2075	10948	1	0.1	**2.98**	2.2	**13.85**	2.2
16/08	Leeds Centre	2032	13014	1	1.3	2.07	2.2	18.21	2.2
16/06	Leicester Centre	24442	13962	1	-0.4	2	2.2	16.62	2.2

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07/09	Liverpool Speke	24450	15923	1	0.7	Not	tested	15.37	2.2
08/07	London A3 Roadside	24425	12321	1	-2.2	**1.92**	2.2	**14.58**	2.2
19/07	London Bexley	2000	10550	1	0.8	2.04	2.2	16.18	2.2
06/07	London Bloomsbury PM_{10}	24446	13719	1	-0.2	2.98	2.2	15.66	2.2
06/07	London Bloomsbury $PM_{2.5}$	21492	15009	1	0.4	2.88	2.2	15.81	2.2
20/08	London Brent	21145	17511	1	0	**3.02**	2.2	**12.55**	2.2
23/08	London Eltham	2096	12992	1	0.1	**2.94**	2.2	**13.23**	2.2
02/09	London Harlington	22835	14095	1	-0.8	**1.99**	2.2	**14.79**	2.2
05/07	London Hillingdon	24422	14050	1	-1.3	2.03	2.2	16.09	2.2
15/07	London Marylebone Road PM_{10}	21306	13125	1	-1.6	**3.08**	2.2	**13.23**	2.2
09/07	London N. Kensington	20715	10698	1	-1.1	2.97	2.2	15.94	2.2
06/08	London Westminster							15.85	2.2
25/08	Manchester Piccadilly	2000	12113	1	0.5	**1.97**	2.2	**14.34**	2.2
08/09	Middlesbrough	14325	13925	1	-1.5	**2.09**	2.2	**14.68**	2.2
13/09	Newcastle Centre	24448	13728	1	-0.7	**2.95**	2.2	**13.16**	2.2
16/07	Northampton	21621	11020	1	-1.2	**2.98**	2.2	**13.65**	2.2
12/08	Norwich Centre	21495	12101	1	-0.9	**2.19**	2.2	**14.34**	2.2
27/07	Nottingham Centre	20904	8725	1	0.6	Not	tested	15.57	2.2
04/08	Plymouth Centre	24428	12886	1	-0.5	**2.06**	2.2	**14.02**	2.2
09/07	Portsmouth	21578	10465	1	-1	**2.75**	2.2	**12.36**	2.2
27/09	Preston	22881	12738	1	-1.7	2.08	2.2	16.81	2.2
22/07	Reading New Town	0	13148	1	-0.4	2.01	2.2	16.19	2.2
07/09	Redcar	21344	12021	1	2	**3.07**	2.2	**13.39**	2.2
20/07	Rochester PM_{10}	24381	12090	1	0.3	2.97	2.2	15.42	2.2
20/07	Rochester $PM_{2.5}$	21491	13827	1	-.8	3.07	2.2	15.73	2.2
24/08	Salford Eccles	21168	14476	1	0.4	**1.95**	2.2	**13.49**	2.2
28/07	Scunthorpe Town	2000	12466	1	-0.2	3.18	2.2	17.94	2.2
10/08	Sheffield Centre	20915	10996	1	-2.9	**1.96**	2.2	**14.50**	2.2
23/08	Southampton Centre	4484	13838	1	-0.3	2.05	2.2	15.65	2.2
05/08	Southend-on-Sea	22927	13321	1	-0.5	**1.89**	2.2	**13.66**	2.2
18/08	Stockport Shaw Heath	2000	10607	1	1.8	**3.24**	2.2	**8.27**	2.2
06/09	Stockton-on-	22885	14377	1	0.6	3.18	2.2	16.85	2.2

netcen
CERTIFICATE OF CALIBRATION
551 Harwell, Didcot, Oxfordshire OX11 0QJ. Telephone 0870 1906465 Facsimile 0870 1906377

UKAS CALIBRATION 0401 0401 S1

Certificate No: 01214

AEA Identification Number: 45077030

Date Year =2004	Site	Analyser number	Calculated Spring Constant k_0	Uncertainty (%)	*[4]k_0 accuracy (%)	[3]Measured Main Flow (l/min)	Uncertainty (%)	[3]Measured Total Flow / **Aux Flow** (l/min)	Uncertainty (%)
	Tees Yarm								
16/08	Stoke-on-Trent Centre	21317	18391	1	0.1	1.88	2.2	15.22	2.2
22/07	Thurrock	25039	12842	1	-1	**3.09**	2.2	**14.28**	2.2
19/08	Wigan Leigh	22015	13212	1	10.1	3.02	2.2	16.02	2.2
28/09	Wirral Tranmere	22883	13264	1	-0.2	2.02	2.2	15.33	2.2

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 logging system of the analyser 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 sample inlet. The calculated aux flow rate is the flow rate through the auxiliary (bypass) tubing of a TEOM analyser. Where flow rates are highlighted in **bold**, it indicates that measurements were not made at the analyser sample inlet. These measurements therefore may not accurately reflect analyser performance in normal operation.

[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 the original, signed by Stewart Eaton on 28 January 2005. Photocopies can be obtained by writing to Brian Stacey at the address given on the top of the certificate.