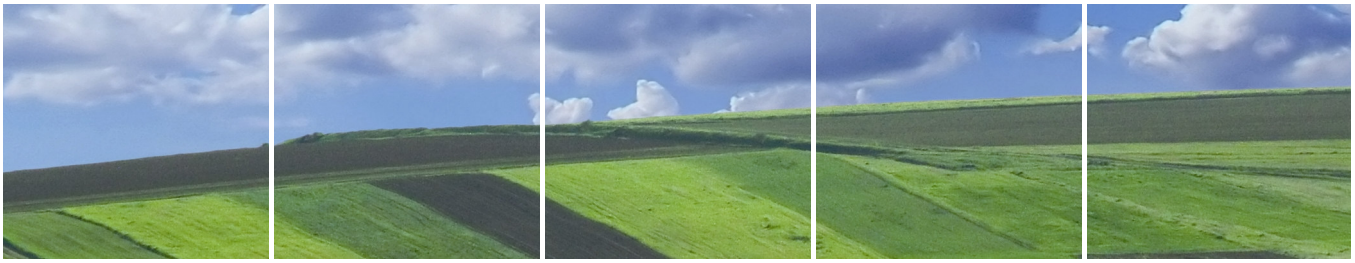
AEA



QA/QC Data Ratification and Intercalibration Report for the Automatic Urban and Rural Network, July-September 2008

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

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Executive summary

Part A Data Ratification for July-September 2008

AEA carries out the quality assurance and control (QA/QC) activities for the Automatic Urban and Rural Monitoring Network (AURN) on behalf of the UK Department for Environment, Food and Rural Affairs (Defra), Scottish Government, Welsh Assembly Government and DoE in Northern Ireland.

Ratified hourly average data capture for the network averaged 90.3% for all pollutants (O_3, NO_2, SO_2, CO, PM_{10} and $PM_{2.5}$) during the 3-month reporting period July-September 2008. Data capture rates for all pollutants were above 90%, with the exception of CO, PM_{10} and $PM_{2.5}$. There were 35 sites with data capture less than 90% for the period. These figures exclude the Partisol data, which remain provisional at present.

The number of monitoring sites in the AURN during this quarter was 124, of which 61 are Local Authority owned sites affiliated to the national network. Some are colocated gravimetric particulate analysers at sites with automatic analysers. Some significant changes have taken place in the network during 2008.

The main reasons for data loss at the sites have been provided and these were predominantly due to instrument faults, response instability or sites out of service for relocation or refurbishment. A summary of recommendations given in this report to help improve network performance is given in Appendix A4.

Substantial changes have been made to the AURN network from the end of September 2007, and these are summarised in this report. The changes are necessary to ensure compliance with the new European Air Quality Directive. Considerable progress has been made in implementing these changes though they will still take some time to complete.

Part B Summer 2008 Intercalibration Exercise

A total of 118 sites in the AURN were calibrated by AEA during the July-September 2008 Network Intercalibration exercise. This is less than the total number of sites operational during the period because new sites affiliated into the network are subject to pre-commissioning audits by the QA/QC Unit, but these do not form part of the intercalibration exercise. Two sites (Southwark and Norwich Centre) were not operational.

The results show that the majority of the network analysers are working satisfactorily and that data are generally of high quality. A total of 59 out of 334 analysers deviated by more than the appropriate acceptance criteria (see Section 7), and a further 2 NOx converters were found to be unacceptably inefficient. The concentrations of the on-site calibration gas cylinders were also checked. The certificate of calibration for the AURN is provided in Appendix 7.

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Appendices

PART A

QA/QC Data Ratification Report for the Automatic Urban and Rural Network, July-September 2008

1 Introduction

Part A of this quarterly report covers the Quality Assurance and Control (QA/QC) activities undertaken by AEA to ratify automatic monitoring data from Defra and the Devolved Administrations' urban and rural air quality monitoring network (AURN) for the period July-September 2008. During this period there were 124 monitoring sites in the Network of which there are 86 urban sites, 26 rural sites and a further 8 sites in the London Air Quality Monitoring Network (LAQN) which are affiliated into the national network. There are currently 61 Defra-funded sites and 63 affiliate sites. Auchencorth Moss, Harwell, London North Kensington and Marylebone Road have both Partisol and FDMS analysers for both PM_{10} and PM_{25}.

1.1 Recent changes in the network

This section gives an overview of the main changes that have taken place in the network during this quarter, including site closures, relocations or the addition of any new sites to the network. A summary of changes in the AURN for the period is given in Table 1.1. Major changes to the network at the end of September are described in Section 2.

Table 1.1 Changes in the Network, July-September 2008

Site Name	Owner	Pollutants	Date started	Date closed
Birmingham Centre	DEFRA	$PM_{2.5}$	03/09/2008	
Bristol St Paul's	DEFRA	$PM_{2.5}$	12/08/2008	
Charlton Mackrell	Affiliate	NO_2 O_3	03/09/2008	
Harwell PARTISOL	Affiliate	$PM_{2.5}$	04/07/2008	
Hull Freetown	DEFRA	$PM_{2.5}$	27/08/2008	
Leicester Centre	DEFRA	$PM_{2.5}$	01/09/2008	
Liverpool Speke	DEFRA	$PM_{2.5}$	17/09/2008	
London Harlington	Affiliate	$PM_{2.5}$	16/09/2008	
Newcastle Centre	DEFRA	$PM_{2.5}$	25/08/2008	
Reading New Town	DEFRA	$PM_{2.5}$	25/09/2008	
Saltash Roadside	Affiliate	$PM_{2.5}$	30/07/2008	
Sandy Roadside	Affiliate	$PM_{2.5}$ NO_2	28/07/2008	
Cardiff Centre	DEFRA	$PM_{2.5}$	12/08/2008	

The QA/QC unit has also liased closely with the CMCU to update the LSO manual for Partisol and FDMS analysers and LSOs with these analysers at their sites should now follow these new procedures.

Further details of the new sites, including locations, are given in Appendix A5.

A full description of the ratification procedures for FDMS data is given in the 2006 QA/QC Annual Report.

1.2 Overview of Network Performance

Ratified hourly average data capture for the network averaged 90.3% for all pollutants (O_3, NO_2, SO_2, CO, PM_{10} and $PM_{2.5}$) during the 3 month reporting period July-September 2008 (see Table 1.4 below). All pollutants were 90% or higher data capture, except for .CO (85%), PM_{10} (88.1%) and $PM_{2.5}$ (82.7%). All Partisol data remain provisional-see section 3.1. Data capture rates are calculated using the actual data capture as hourly averages (daily for Partisol) against the total number of hours (or days) in the relevant period; service and maintenance are counted as lost data. For sites starting or closing, the data capture is based on the actual date starting or closing.

Table 1.2: AURN Ratified Data Capture (%) by Quarter, 2008 (Using the start date of any new site)

	CO	PM_{10}	$PM_{2.5}$	NO_2	O_3	SO_2	Mean
Data capture Q1 2008	93.3%	91.3%	92.8%	92.4%	93.6%	89.8%	91.7%
Data capture Q2 2008	91.7%	89.7%	95.8%	91.2%	96.5%	92.7%	91.3%
Data capture Q3 2008	85.0%	88.1%	82.7%	91.8%	95.7%	93.8%	90.3%

Overall, 280 out of the 335 analysers (83%) achieved data capture levels above the required 90% target during this reporting period (See Table 1.3).

Table 1.3: Number of Analysers with Data Capture below 90%

Total Number Of Analysers [2]		Q1 Jan-Mar 2008 (No. below 90%)	Q2 Apr-June 2008 (No. below 90%)	Q3 July-Sept 2008 (No. below 90%)
CO	26	6	5	7
NO_2	107	16	17	24
O_3	77	12	8	9
PM_{10}	69[1]	13	16	18
$PM_{2.5}$	24[1]	2	1	11
SO_2	43	6	6	7
Total <90%	335	55	53	76

1. Includes TEOM, FDMS, and Partisol analysers.
2. Figures for Quarter 3.

In total, 35 out of the 124 operational network sites in the quarter (28%) had an average data capture rate below the required 90% level for the January-March 2008 period. Note that new analysers at existing sites will have data capture figures calculated from the start date of the quarter, not from the start of the analyser itself. The sites with overall data capture below 90% 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 2008

Site	Owner	Site Average
England		
Brighton Preston Park	DEFRA	86.8
Bury Roadside	Affiliate	79.8
Camden Kerbside	Affiliate	88.1
Charlton Mackrell	Affiliate	72.1
Chesterfield	Affiliate	89.1
Exeter Roadside	Affiliate	76.9
Glazebury	DEFRA	76.9
Great Dun Fell	DEFRA	89.6
Haringey Roadside	Affiliate	82.6
Leamington Spa	Affiliate	75.5
Leeds Headingley Kerbside	Affiliate	54.0
London Bloomsbury	DEFRA	89.6
London Harlington	Affiliate	73.0
London N. Kensington PARTISOL	DEFRA	84.2
Lullington Heath	DEFRA	88.0

Site	Owner	Site Average
Middlesbrough	Affiliate	73.8
Northampton	Affiliate	70.2
Preston	DEFRA	89.8
Rochester Stoke	Affiliate	88.1
Saltash Roadside	Affiliate	66.7
Sheffield Tinsley	DEFRA	43.8
Southwark Roadside	Affiliate	0.0
St Osyth	DEFRA	54.2
Tower Hamlets Roadside	Affiliate	73.5
Walsall Willenhall	Affiliate	87.7
Yarner Wood	DEFRA	88.6
N Ireland		
Belfast Centre	DEFRA	75.8
Derry	Affiliate	70.3
Scotland		
Auchencorth Moss	DEFRA	89.5
Auchencorth Moss PM_{10} PM_{25}	DEFRA	84.0
Bush Estate	DEFRA	86.5
Dumfries	DEFRA	85.8
Lerwick	DEFRA	87.1
Wales		
Aston Hill	DEFRA	86.0
Newport	Affiliate	56.1
Number of sites < 90%		35

1.3 LSO Manual

As noted in Section 1.1, the LSO Manual has been updated to include a section on the TEOM FDMS analysers. In addition, the Partisol section of the manual has been updated. LSOs with these analysers at their site should now use the new version of the manual. A revised version featuring new analyser types recently introduced into the network is being prepared for release early in 2009.

Copies of the new TEOM FDMS and Partisol sections will be distributed to the relevant LSOs as these analysers are installed into the network. If LSOs have not received a copy of the manual or further copies are required please contact Andy.Cook@aeat.co.uk. The revised manual, including the new FDMS sections is available electronically on the following web site:

Air Quality Archive http://www.aeat.co.uk/netcen/airqual/reports/lsoman/lsoman.html

1.4 AURN Hub

The AURN project information hub has recently been moved to a new web address located at[1]: http://www.aurnhub.co.uk/ This is a new location due to a change of host server; the user names and password remain unchanged.

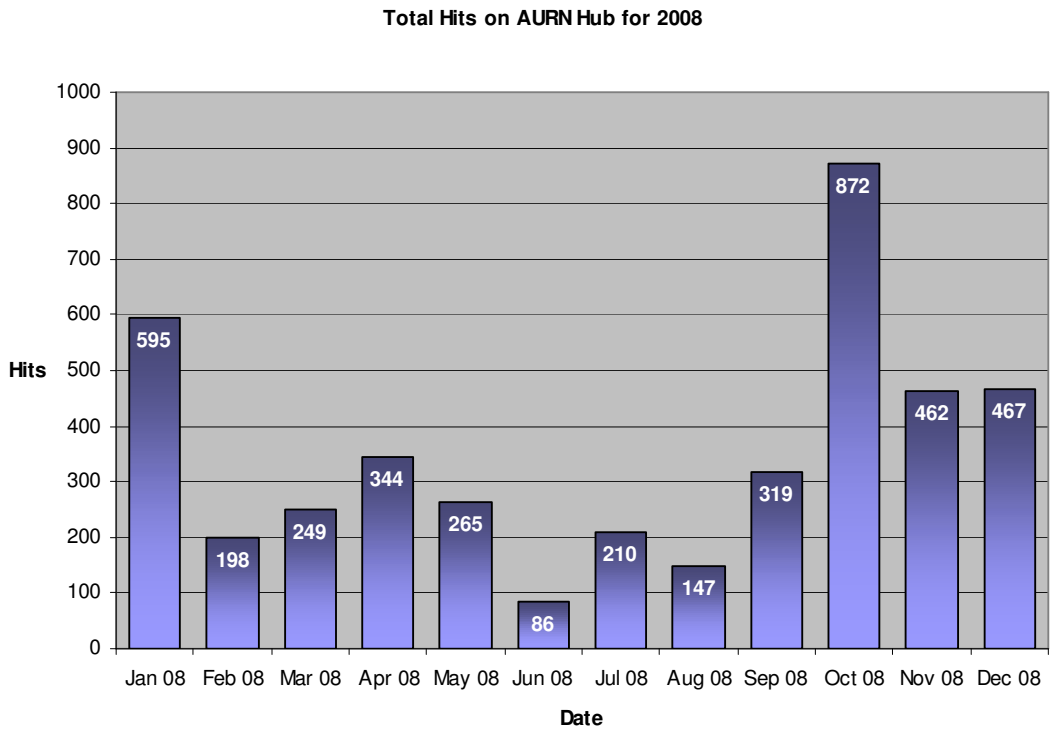
The site is regularly up-dated and some of the more recent information includes:

- Monthly PM_{10} (Gravimetric) exceedences up to September 2008;
- QA/QC Unit's Data Ratification and Intercalibration Report, April-June 2008;
- Recent Management Unit reports (January-March 2008); and
- Current version of the LSO manual.

[1] Password protected site: username and password available from stephen.bird@aeat.co.uk

The Hub has continued to provide a valuable source of information for interested organisations see Figure 1.4. The increase in usage in October corresponded with a user survey sent to all users.

Figure 1.1: AURN Hub Hits 2008



2 Changes in the Network for Directive Compliance

The QA/QC Unit and the CMCU Unit in conjunction with Defra and the DAs have carried out a major review of the monitoring network. This was necessary to ensure the network is compliant with the European Directive. There is a requirement for a minimum level of monitoring in each agglomeration and zone, and there is a need to measure $PM_{2.5}$ at many sites. The need for additional monitoring has been met by affiliating suitable sites from other organisations, adding additional analysers at existing sites, or in a small number of cases, installing new sites. Note that as a result of these changes, the concept of critical sites is no longer meaningful and has been discontinued.

Sites that are no longer necessary for compliance have, in a number of cases, been closed down, or individual analysers at sites have been de-affiliated. Table 2.1 shows the sites commissioned as part of the review.

Table 2.1: Sites Added to the AURN Since 1 January 2008

Site	Pollutants	Site type	Start date
York Bootham	PM_{10}	Urban background	01/01/2008
York Fishergate	NO_2 PM_{10}	Roadside	01/01/2008
Oxford St Ebbes	NO_2 PM_{10}	Urban background	01/01/2008
Chepstow A48	NO_2 PM_{10}	Roadside	01/01/2008
Liverpool Queen's Drive Roadside	NO_2	Roadside	01/01/2008
Aberdeen Union Street Roadside	NO_2	Roadside	01/01/2008
Stanford-le-Hope Roadside	NO_2 SO_2 PM_{10}	Roadside	22/01/2008
Carlisle Roadside	NO_2 PM_{10}	Roadside	14/02/2008
Leeds Headingley Kerbside	NO_2 PM_{10}	Kerbside	17/02/2008
Newcastle Cradlewell Roadside	NO_2	Roadside	10/03/2008
Chesterfield Roadside	NO_2 PM_{10}	Roadside	11/03/2008
Chesterfield	NO_2 PM_{10}	Urban background	13/03/2008
Port Talbot Margam $PM_{2.5}$ (FDMS)	PM_{25}	Urban Industrial	23/04/2008
London Marylebone Road PARTISOL	PM_{25}	Kerbside	02/05/2008
London N. Kensington PARTISOL	PM_{25}	Urban background	13/05/2008
Harwell PARTISOL	PM_{25}	Rural	04/07/2008
Sandy Roadside	NO_2	Roadside	28/07/2008
Saltash Roadside	PM_{10}	Roadside	30/07/2008
Charlton Mackrell	NO_2 O_3	Rural	03/09/2008
Warrington	NO_2	Urban background	21/10/2008

In addition, several existing sites have had additional analysers (mainly $PM_{2.5}$) installed to ensure compliance. The analysers are listed in Table 2.2:

Table 2.2: Additional Analysers installed for Directive Compliance from 1 Jan 2008

Site	Pollutant	Date started
Port Talbot Margam	PM_{25}	See above
Derry	PM_{25}	21/02/2008
London Bexley	PM_{25}	25/02/2008
London N. Kensington PARTISOL	PM_{25}	13/05/2008
London Eltham	PM_{25}	15/05/2008
London Marylebone Road PARTISOL	PM_{25}	22/05/2008
Brighton Preston Park	PM_{25}	30/05/2008
Harwell PARTISOL	PM_{25}	04/07/2008
Cardiff Centre	PM_{25}	12/08/2008
Bristol St Paul's	PM_{25}	12/08/2008
Newcastle Centre	PM_{25}	25/08/2008
Hull Freetown	PM_{25}	27/08/2008
Leicester Centre	PM_{25}	01/09/2008
Birmingham Centre	PM_{25}	03/09/2008
London Harlington	PM_{25}	16/09/2008
Liverpool Speke	PM_{25}	17/09/2008
Reading New Town	PM_{25}	25/09/2008
Belfast Centre	PM_{25}	01/10/2008
Edinburgh St Leonards	PM_{25}	01/11/2008
Southampton Centre	PM_{25}	05/11/2008
Sunderland Silkworth	SO_2	01/04/2008
Stoke-on-Trent Centre	PM_{25}	05/11/2008

.

A full description of the changes necessary for compliance with the Directive is given in Part B Section 8 of the October-December 2007 Report.

3 Generic Data Quality Issues

3.1 Gravimetric PM_{10} and $PM_{2.5}$ Data Ratification

Eight Gravimetric PM_{10} analysers and four gravimetric $PM_{2.5}$ analysers (Partisol 2025s) are currently located at seven sites in the network. These are listed below. Provisional data capture for the gravimetric PM_{10} (Partisol) analysers for the period July-September 2008 is given in Table 2.4. Six of the gravimetric analysers for which data are available did not reach the 90% data capture target in this quarter, but the average data capture over all eight analysers of 93%.

Table 3.1: Gravametric PM_{10} and $PM_{2.5}$ Data Capture (%) July-September 2008

Site	3-months Data Capture July-September 2008
Auchencorth Moss PM_{10}	86%
Auchencorth Moss $PM_{2.5}$	84%
Bournemouth	97%
Brighton Preston Park PM_{10}	61%
Harwell $PM_{2.5}$	100%
London Marylebone Road PM_{10}	90%
London Marylebone Road $PM_{2.5}$	93%
London N. Kensington PM_{10}	79%
London N. Kensington $PM_{2.5}$	89%
London Westminster	97%
Inverness	99%
Wrexham	83%

The reasons for data loss in the gravimetric analysers are given in Appendix A5. Bureau Veritas has supplied the measured data, undertaken the filter weighing and calculated the particulate concentrations. Final ratification of these Partisol data are delayed until the outcome of the current detailed investigations on all previous UK Partisol data are completed. These are described in "Analysis of Trends in Gravimetric Particulate Mass Measurements in the United Kingdom" published by CMCU in May 2008, available from:

http://www.airquality.co.uk/archive/news.php?news_id=106.

As a result of this, improved QA/QC procedures for Partisol measurements have been implemented by BV and the QA/QC Unit. These include:

- Participation of both AEA and BV in the Workplace Analysis Scheme for Proficiency (WASP) run by HSL. Participants send in pre-weighed filters, which are spiked with sodium borate solution, dried and returned to participants to reweigh. (The dried borate is thus a surrogate for real particulate on a filter);
- Round-robin of blank filter weighings between BV, AEA and NPL. Three sets of filters are weighed by all three organisations. This may be repeated at regular intervals;
- Each batch of 14 days' filters now include a travel (field) blank in the cannister, which is treated exactly the same as the other filters in the batch, but not exposed;
- Each batch of pre-weighed filters has an associated lab blank, which does not go to the site but stays in a sealed container at the lab for the duration of the exposure period, and be weighed again when the final weighings are done; and
- Both field and lab blank values are communicated to the QA/QC Unit, who would monitor them on a long-term basis and check for any step changes, trends, or deviations from the typical spread of results.

The implementation of these initiatives is complete, and the outcome will be reported in future QA/QC reports.

As a result of these investigations, it has been decided to switch to using Emfab filters for gravimetric sampling as soon as possible from 1 January 2009.

3.2 Auto-calibration Run-on

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. The problem can be identified by examining the diurnal variation of pollutant concentrations for the individual sites. 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 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 or silica gel driers. In most cases this has improved the situation but it has not always eliminated the problem completely.

The 25 sites (26 analysers) showing continuing problems with the autocalibration run-on during July-September 2008 are given in Table 2.5. Any autocalibration run-on data that look visibly significant have been deleted from these data sets during ratification.

Table 3.2: Autocalibration Run-ons: July-September 2008

Site	Pollutant	Run-On Concentrations (ppb)	Autocal concentrations (ppb)	Hours lost	Months
Aston Hill	NO_2	0.4	50	**4**	July to Sept
Barnsley Gawber	NO_2	2	200	1	July to Sept
Belfast Centre	NO_2	6	200	1	July to Sept
Bournemouth	NO_2	-1	200	1	Aug
Bush Estate	NO_2	2.2	450	**3**	July to Sept
Canterbury	NO_2	2	120	**2**	July to Aug
				1	Sept
Glazebury	NO_2	2.8	150	**2**	Aug
				1	Sept
Hull Freetown	NO_2	3	200	1	July to Sept
Leominster	NO_2	2	500	**3**	July to Sept
Liverpool Speke	NO_2	3	250	1	July to Sept
London N. Kensington	NO_2	2	200	1	July to Sept
Newcastle Centre	NO_2	5	300	1	July to Sept
Preston	NO_2	2	250	1	July to Sept
St Osyth	NO_2	1.5	10	**3**	July
				1	Aug
				2	Sept
Stockton-on-Tees Yarm	NO_2	3	448	1	July to Aug
Walsall Willenhall	NO_2	5	250	1	July to Aug
Yarner Wood	NO_2	0.8	200	1	July to Sept
Belfast Centre	O_3	-2	200	**2**	July
				1	Aug
Stoke-on-Trent Centre	O_3	-2	1000	1	July to Sept
Barnsley Gawber	SO_2	-1	250	1	July to Aug

Bristol St Paul's	SO_2	0	400	1	July to Sept
Cardiff Centre	SO_2	0	400	1	July to Sept
Harwell	SO_2	0.2	175	1	July to Sept
London Westminster	SO_2	0	450	1	July to Sept
Scunthorpe Town	SO_2	2	500	1	July to Sept
Wicken Fen	SO_2	0.2	300	1	July to Sept

4 Site Specific Issues

In this section, we now discuss in turn specific site issues for sites in the following geographic groupings – London, England (except London), Scotland, N. Ireland and Wales.

4.1 London

4.1.1 Data Capture

The data capture for sites in London (within the M25) for the period July-September 2008 is given in Table 4.1:

Table 4.1: Data capture for London: July-September 2008

Site	Owner	CO	PM_{10}	PM_{25}	NO_2	O_3	SO_2	Site Average
England								
Camden Kerbside	Affiliate	-	77.7	-	98.5	-	-	88.1
Haringey Roadside	Affiliate	-	66.5	-	98.8	-	-	82.6
London Bexley	Affiliate	97.5	-	97.2	97.4	-	97.6	97.4
London Bloomsbury	DEFRA	98.5	73.4	70.0	98.5	98.7	98.5	89.6
London Cromwell Road 2	DEFRA	97.8	-	-	80.1	-	97.8	91.9
London Eltham	Affiliate	-	-	99.0	95.7	99.1	-	98.0
London Haringey	Affiliate	-	-	-	98.0	99.5	-	98.8
London Harlington	Affiliate	-	96.3	0.0	96.9	98.7	-	73.0
London Hillingdon	DEFRA	-	-	-	91.2	98.3	-	94.7
London Marylebone Road	Affiliate	96.8	98.7	99.0	99.2	99.3	99.4	98.7
London Marylebone Road PARTISOL	DEFRA	-	90.2	93.5	-	-	-	91.8
London N. Kensington	Affiliate	97.4	99.0	-	95.1	99.1	99.2	98.0
London N. Kensington PARTISOL	DEFRA	-	79.3	89.1	-	-	-	84.2
London Teddington	Affiliate	-	-	-	98.6	98.6	-	98.6
London Westminster	DEFRA	98.4	96.7	-	98.3	98.4	94.0	97.2
Southwark Roadside	Affiliate	-	-	-	0.0	-	-	0.0
Tower Hamlets Roadside	Affiliate	47.3	-	-	99.6	-	-	73.5
Number of sites		7	9	7	15	9	6	17

Site	Owner	CO	PM_{10}	PM_{25}	NO_2	O_3	SO_2	Site Average
Number of sites < 90%		1	4	3	2	0	0	7
Network Mean (%)		90.5	86.4	78.3	89.7	98.9	97.8	85.7

Shaded boxes are for data capture < 90%

4.1.2 Site Specific Issues

Haringey Roadside
The main and auxiliary flows were found to have significant leaks; the TEOM was removed for repair by the ESU on 31 August. TEOM faults continue into the following quarter.

London Harlington $PM_{2.5}$
The $PM_{2.5}$ analyser was found not to be working correctly on installation on 16 September, as was removed by the ESU shortly after for repair. No valid data were measured during this quarter.

4.2 England (excluding London)

4.2.1 Data Capture

The data capture for sites in England for the period July-September 2008 is given in Table 4.2:

Table 4.2: Data capture for England (except London): July-September 2008

Site	Owner	CO	PM_{10}	PM_{25}	NO_2	O_3	SO_2	Site Average
England								
Barnsley 12	DEFRA	-	-	-	-	-	94.4	94.4
Barnsley Gawber	Affiliate	-	-	-	94.2	98.6	95.7	96.2
Bath Roadside	Affiliate	-	-	-	96.4	-	-	96.4
Billingham	DEFRA	-	-	-	98.6	-	-	98.6
Birmingham Centre	DEFRA	-	96.0	97.0	98.0	95.7	-	96.7
Birmingham Tyburn	Affiliate	-	69.5	-	97.5	97.5	97.7	90.5
Blackpool Marton	DEFRA	-	96.6	-	95.8	96.0	-	96.2
Bottesford	Affiliate	-	-	-	-	98.4	-	98.4
Bournemouth	DEFRA	-	96.7	-	96.6	98.3	-	97.2
Brighton Preston Park	DEFRA	-	-	60.9	99.8	99.6	-	86.8
Brighton Roadside	Affiliate	-	-	-	91.5	-	-	91.5
Bristol Old Market	Affiliate	93.1	-	-	99.6	-	-	96.3
Bristol St Paul's	DEFRA	98.5	93.7	72.0	98.3	98.5	87.5	91.4
Bury Roadside	Affiliate	43.1	97.6	-	98.7	-	-	79.8
Cambridge	Affiliate	-	-	-	99.1	-	-	99.1

Site	Owner	CO	PM_{10}	PM_{25}	NO_2	O_3	SO_2	Site Average
Roadside								
Canterbury	Affiliate	-	-	-	91.3	-	-	91.3
Carlisle Roadside	Affiliate	-	96.4	-	98.9	-	-	97.6
Charlton Mackrell	Affiliate	-	-	-	95.8	96.0	-	95.9
Chesterfield	Affiliate	-	98.4	-	79.8	-	-	89.1
Chesterfield Roadside	Affiliate	-	99.0	-	87.4	-	-	93.2
Coventry Memorial Park	DEFRA	-	99.9	-	98.5	98.4	-	98.9
Exeter Roadside	Affiliate	-	-	-	76.9	76.9	-	76.9
Glazebury	DEFRA	-	-	-	64.6	89.3	-	76.9
Great Dun Fell	DEFRA	-	-	-	-	89.6	-	89.6
Harwell	DEFRA	-	97.4	97.4	97.3	97.4	93.3	96.5
Harwell PARTISOL	Affiliate	-	-	100.0	-	-	-	100.0
High Muffles	DEFRA	-	-	-	98.2	98.4	-	98.3
Horley	Affiliate	-	-	-	99.5	-	-	99.5
Hull Freetown	DEFRA	97.2	98.5	88.4	93.2	97.3	97.3	95.3
Ladybower	DEFRA	-	-	-	96.0	96.0	96.0	96.0
Leamington Spa	Affiliate	-	38.5	-	87.9	88.0	87.9	75.5
Leeds Centre	DEFRA	99.2	99.4	-	99.4	99.2	99.3	99.3
Leeds Headingley Kerbside	Affiliate	-	97.6	-	10.4	-	-	54.0
Leicester Centre	DEFRA	98.0	99.0	99.2	98.0	98.1	98.0	98.4
Leominster	DEFRA	-	-	-	85.9	98.1	97.1	93.7
Liverpool Queen's Drive Roadside	Affiliate	-	-	-	99.3	-	-	99.3
Liverpool Speke	DEFRA	81.7	97.8	92.6	93.3	97.1	89.3	92.0
Lullington Heath	DEFRA	-	-	-	98.3	98.3	67.5	88.0
Manchester Piccadilly	DEFRA	-	99.5	-	88.4	91.9	-	93.3
Manchester South	Affiliate	-	-	-	83.3	98.5	-	90.9
Market Harborough	DEFRA	94.1	-	-	98.2	98.3	-	96.9
Middlesbrough	Affiliate	74.7	3.6	-	96.7	96.9	97.0	73.8
Newcastle Centre	DEFRA	97.5	96.8	92.2	86.1	89.9	97.4	93.3
Newcastle Cradlewell Roadside	Affiliate	-	-	-	99.6	-	-	99.6
Northampton	Affiliate	-	0.0	-	93.9	88.9	98.1	70.2
Nottingham Centre	DEFRA	-	89.1	-	95.3	97.6	97.6	94.9
Oxford Centre Roadside	Affiliate	-	-	-	99.2	-	-	99.2
Oxford St Ebbes	Affiliate	-	98.0	-	98.2	-	-	98.1
Plymouth	DEFRA	-	77.4	-	97.1	97.5	-	90.7

Site	Owner	CO	PM_{10}	PM_{25}	NO_2	O_3	SO_2	Site Average
Centre								
Portsmouth	Affiliate	-	85.4	-	95.4	99.5	-	93.4
Preston	DEFRA	-	79.5	-	92.9	97.1	-	89.8
Reading New Town	DEFRA	-	96.6	90.3	96.9	96.9	-	95.2
Rochester Stoke	Affiliate	-	98.6	99.8	99.3	99.4	43.3	88.1
Salford Eccles	Affiliate	94.2	91.7	-	94.2	94.2	86.7	92.2
Saltash Roadside	Affiliate	-	66.7	-	-	-	-	66.7
Sandwell West Bromwich	Affiliate	-	-	-	98.5	98.5	94.4	97.1
Sandy Roadside	Affiliate	-	98.7	-	84.0	-	-	91.3
Scunthorpe Town	Affiliate	-	96.2	-	98.0	-	86.8	93.7
Sheffield Centre	DEFRA	97.4	99.8	-	97.4	97.4	96.6	97.7
Sheffield Tinsley	DEFRA	-	-	-	43.8	-	-	43.8
Sibton	DEFRA	-	-	-	-	96.1	-	96.1
Southampton Centre	DEFRA	94.4	99.2	-	94.6	94.5	94.6	95.5
Southend-on-Sea	DEFRA	-	96.6	-	98.4	98.4	-	97.8
St Osyth	DEFRA	41.9	-	-	58.8	61.8	-	54.2
Stanford-le-Hope Roadside	Affiliate	-	99.7	-	98.6	-	99.6	99.3
Stewartby	Affiliate	-	-	-	-	-	98.5	98.5
Stockton-on-Tees Yarm	Affiliate	-	98.7	-	94.7	-	-	96.7
Stoke-on-Trent Centre	DEFRA	-	98.6	-	98.2	94.4	-	97.0
Sunderland Silksworth	Affiliate	-	-	-	98.5	98.6	91.4	96.2
Thurrock	Affiliate	-	98.4	-	98.0	97.3	98.1	98.0
Walsall Willenhall	Affiliate	-	-	-	87.7	-	-	87.7
Weybourne	Affiliate	-	-	-	-	93.6	-	93.6
Wicken Fen	DEFRA	-	-	-	98.2	98.2	94.1	96.8
Wigan Centre	Affiliate	-	-	-	98.6	97.4	-	98.0
Wirral Tranmere	DEFRA	-	99.0	-	96.4	97.7	-	97.7
Yarner Wood	DEFRA	-	-	-	86.6	90.6	-	88.6
York Bootham	Affiliate	-	99.0	-	-	-	-	99.0
York Fishergate	Affiliate	-	87.9	-	99.6	-	-	93.8

Site	Owner	CO	PM_{10}	PM_{25}	NO_2	0_3	SO_2	Site Average
Number of sites		14	42	11	69	50	28	78
Number of sites < 90%		4	10	3	16	7	7	19
Network Mean (%)		86.1	88.7	90.0	91.6	95.2	92.0	91.1

4.2.2 Site Specific Issues

Bury Roadside
The CO analyser had several periods of unstable data during the period; a total of 68 days were deleted in this quarter.

Exeter Roadside
The site was switched off for 43 days due to building work

Glazebury
The NOx converter failed the winter 2008 audit (174 days lost), and several minor ozone faults

Leamington Spa
Communications faults prevented regular data collection by the CMCU during the summer and autumn; on closer inspection of the data, faults were identified and much of the data deleted by the QA/QC Unit.

Leeds Headingley Kerbside
The NOx converter failed the summer 2008 audit, and 69 days were deleted.

Saltash Roadside
Site started 29 July; power supply fault resulted on no data from 27 August to 17 September

Sheffield Tinsley
NOx converter failure repaired 21 August.

St Osyth
Persistent air conditioning faults resulted in a substantial loss of data during the summer.

4.3 Scotland

4.3.1 Data Capture

The data capture for sites in Scotland for the period July-September 2008 is given in Table 4.3.

Table 4.3: Data Capture for Scotland July-September 2008

Site	Owner	CO	PM_{10}	PM_{25}	NO_2	O_3	SO_2	Site Average
Scotland								
Aberdeen	Affiliate	-	98.1	-	95.0	98.2	-	97.1
Aberdeen Union Street Roadside	Affiliate	-	-	-	93.4	-	-	93.4
Auchencorth Moss	DEFRA	-	84.8	83.7	-	99.9	-	89.5
Auchencorth Moss PM_{10}	DEFRA	-	99.7	68.3	-	-	-	84.0

Site	Owner	CO	PM_{10}	PM_{25}	NO_2	O_3	SO_2	Site Average
PM_{25} (FDMS)								
Bush Estate	DEFRA	-	-	-	79.7	93.3	-	86.5
Dumfries	DEFRA	-	-	-	85.8	-	-	85.8
Edinburgh St Leonards	DEFRA	94.9	97.7	-	97.3	86.9	97.6	94.9
Eskdalemuir	DEFRA	-	-	-	95.2	95.2	-	95.2
Fort William	DEFRA	-	-	-	83.2	98.5	-	90.9
Glasgow Centre	DEFRA	82.9	97.5	-	97.4	97.3	97.4	94.5
Glasgow City Chambers	DEFRA	-	-	-	95.7	-	-	95.7
Glasgow Kerbside	DEFRA	-	98.0	-	89.2	-	-	93.6
Grangemouth	Affiliate	-	95.3	-	97.2	-	97.2	96.6
Inverness	DEFRA	-	98.9	-	98.6	-	-	98.8
Lerwick	DEFRA	-	-	-	-	87.1	-	87.1
Strath Vaich	DEFRA	-	-	-	-	93.9	-	93.9
Number of sites		2	8	2	12	9	3	16
Number of sites < 90%		1	1	2	4	2	0	5
Network Mean (%)		88.9	96.2	76.0	92.3	94.5	97.4	92.3

4.3.2 Site Specific Issues

Auchencorth Moss PM_{10} $PM_{2.5}$ (FDMS)
Continuing occurrences of negative data from both FDMS analysers continue. Investigations into this are continuing.

Dumfries
NOx reaction chamber fault resulted in periods of noisy data during the quarter.

4.4 Wales

4.4.1 Data Capture

The data capture for sites in Wales for the period July-September 2008 is given in Table 4.4.

Table 4.4 Data Capture for Wales, July-September 2008

Site	Owner	CO	PM_{10}	PM_{25}	NO_2	O_3	SO_2	Site Average
Wales								
Aston Hill	DEFRA	-	-	-	81.5	90.5	-	86.0
Cardiff Centre	DEFRA	96.8	93.0	84.3	96.6	96.8	92.6	93.3
Chepstow A48	Affiliate	-	99.1	-	97.8	-	-	98.5
Cwmbran	Affiliate	-	-	-	98.7	98.9	-	98.8
Narberth	DEFRA	-	94.7	-	93.4	96.1	96.1	95.1

Newport	Affiliate	-	12.3	-	100.0	-	-	56.1
Port Talbot Margam	Affiliate	96.9	82.5	81.5	96.6	96.6	96.7	91.8
Swansea Roadside	Affiliate	-	99.4	95.9	97.2	-	-	97.5
Wrexham	DEFRA	-	96.7	-	98.3	-	98.3	97.8
Number of sites		2	7	3	9	5	4	9
Number of sites < 90%		0	2	2	1	0	0	2
Network Mean (%)		96.8	82.5	87.2	95.6	95.8	95.9	90.6

Data from Port Talbot Margam $PM_{2.5}$ (FDMS) were not received in time for this report and will be reported with the fourth quarter data

4.4.2 Site Specific Issues

Newport PM_{10}
The Newport PM_{10} analyser suffered from persistent mass transducer faults and unstable volatile mass fraction during the quarter, QA/QC Unit deleted most of the data.

4.5 Northern Ireland (including Mace Head)

4.5.1 Data Capture

The data capture for sites in Northern Ireland (including Mace Head) for the period July-September 2008 is given in Table 4.5.

Table 4.5: Data Capture for Ireland, July-September 2008

Site	Owner	CO	PM_{10}	PM_{25}	NO_2	O_3	SO_2	Site Average
Ireland								
Mace Head	Affiliate	-	-	-	-	100.0	-	100.0
N Ireland								
Belfast Centre	DEFRA	0.0	95.7	-	93.0	92.9	97.1	75.8
Derry	Affiliate	-	32.4	32.7	88.9	98.8	98.8	70.3
Lough Navar	DEFRA	-	99.0	-	-	98.7	-	98.8
Number of sites		1	3	1	2	4	2	4
Number of sites < 90%		1	1	1	1	0	0	2
Network Mean (%)		0.0	75.7	32.7	90.9	97.6	98.0	86.2

4.5.2 Site Specific Issues

Belfast Centre CO
The Belfast CO analyser has performed poorly for some time, and the QA/QC unit deleted the data from 30 April to 30 October 2008. The ESU visited the site several times during this period. Repairs have now been successfully carried out.

Derry $PM_{2.5}$ and PM_{10}
Poor sample vacuums were reported on both FDMS analysers; the pumps were rebuilt at service.

4.6 Sites Highlighted in Previous Reports

Several analysers have been highlighted recently as being of concern to the QA/QC unit. An update is given in Table 4.6.

Table 4.6: Status of Analysers Highlighted in Previous Reports

Site	Analyser	Fault	Current status
Reading New Town	FDMS	Anomalous volatile fraction	Drier replaced on PM_{10} analyser.
London Hillingdon Glazebury Manchester Picc.	NOx	Chamber fault Converter fault Converter fault	Now repaired
Glasgow Centre	CO	Flow faults	Now repaired
Belfast Centre	CO	Data flat	Faults continue in Q3
Sheffield Tinsley	NO_2	Converter and switching valve	Fixed September 2008
Auchencorth Moss	FDMS PM_{10} and $PM_{2.5}$		Negative data still observed, particularly $PM_{2.5}$
Narberth	O3	Anomalous data	QA/QC closely examining data. Replacement analyser was installed early 2009
Cwmbran	NOx	Cylinders contaminated	ESU installed non-permeable tubing (effected in Q3-appears fixed)
Bush	NOx	Poor performance	Replacement analyser recommended
Weybourne	O_3	No manual calibrations or IZS	No progress reported
Rural CO analysers	CO	Baseline drift	Drift still evident
Various	Rural ozone analysers	Temporary instruments installed some of which have no autocals	Two analysers have been upgraded by the manufacturer and are currently under test by the ESU.

4.7 FDMS Issues

There have been a number of issues affecting the collection of valid data from FDMS analysers as these have been introduced into the network. The CMCU, QA/QC and ESU have put considerable effort into solving these issues.

These issues may be summarised in the following general areas:

- Poor pump performance. The vacuum is critical to maintaining correct analyser function, and it is noted that some pumps have failed prematurely. These were found to be of the incorrect mains frequency, and the supplier is working on replacing these with units more appropriate to UK mains supply. It is also important that where $PM_{2.5}$ and PM_{10} FDMS units are co-located, the flows must be within 3% of each other.

- Filter changes during reference cycle. It was found that opening the FDMS unit during the reference cycle allowed excessive moisture to enter the cooler unit, resulting in considerable analyser instability. The procedures have been updated to ensure the unit is locked in base mode whilst the door is open. LSOs have been issued with spare filter cartridges to allow filter changes to be carried out more rapidly.

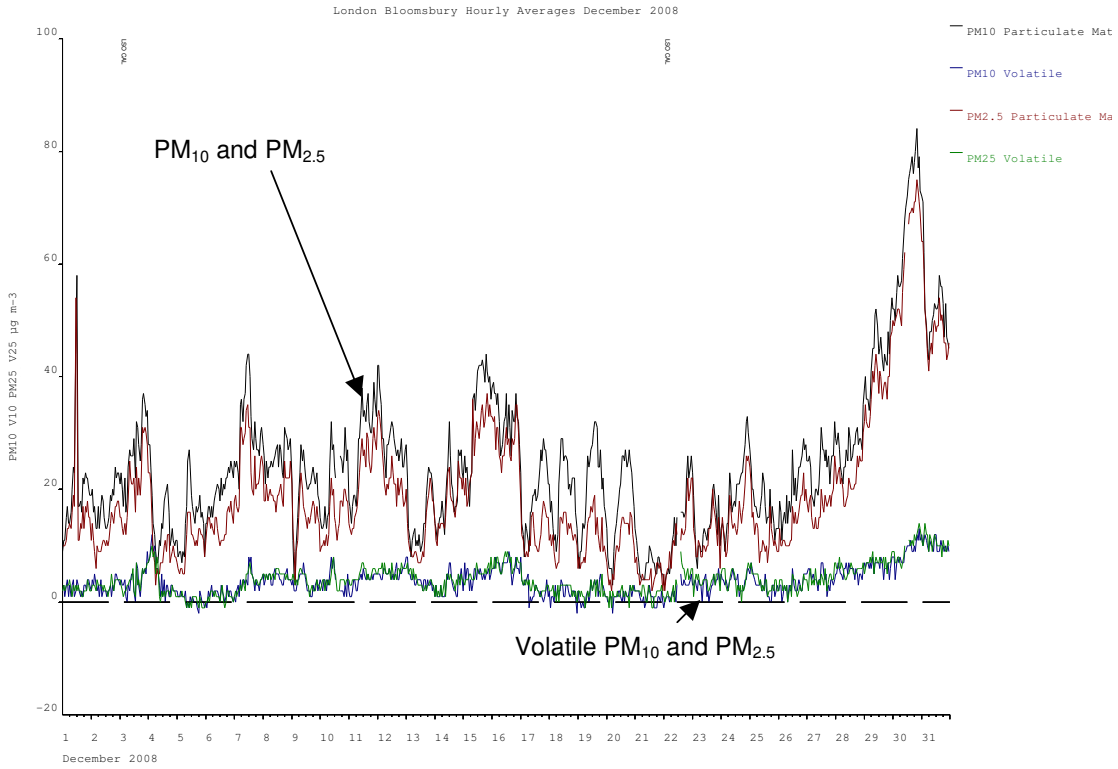
- Temperature instability. There have been several issues with air conditioning and heating being inadequate to maintain a constant temperature.

- $PM_{10}/PM_{2.5}$ comparison. With the introduction of $PM_{2.5}$ analysers, it is possible to compare concentrations with PM_{10}. In some cases, measured $PM_{2.5}$ concentrations have been higher than the PM_{10}, which is of course illogical. Careful examination of the data are required to establish which, if either, is correct.

- The performance of the FDMS drier is also critical to the quality of data. In some cases these have failed, resulting in poor quality data. The performance of the drier needs to be carefully monitored to ensure optimal data quality. The measured sample dew point must always be below –2C, and there must be a minimum of 10C between the ambient temperature and the sample dewpoint. As the drier fails, these parameters are frequently not met.

An example of a good site is shown in Figure 4.1

Figure 4.1 FDMS PM_{10} and $PM_{2.5}$ Mass Concentration and Volatiles Concentrations, December 2008 at Bloomsbury



During December 2008, a period of elevated particulate matter was observed, where the PM_{10} was almost identical to the $PM_{2.5}$ at many sites across the UK. This provides a useful check on analyser

performance. The Bloomsbury FDMS analysers show excellent agreement for both PM concentrations, and more significantly, the volatile fractions, which should be fairly consistent across both size fractions.

5 Sites with Data Capture below 90%

A summary of the main site analyser operational problems, which have resulted in data capture below the required 90% level during the reporting period July-September 2008 is given in Appendix 2. 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. The table lists all gaps of 6 hours or more for each pollutant.

6 Ratified Data Capture Statistics

Table 6.1 provides a summary of the ratified data capture figures for the network for the 3-month period July-September 2008.

Table 6.1 Ratified Data Capture Statistics July-September 2008

Site	CO	PM_{10}	PM_{25}	NO_2	O_3	SO_2	Site Average
Number of sites	26	69	24	107	77	43	124
Number of sites < 90%	7	18	11	24	9	7	35
Network Mean (%)	85.0	88.1	82.7	91.8	95.7	93.8	90.3

Table 6.2 provides a summary of the ratified data capture figures for the network for the 9-month period January-September 2008.

Table 6.2 Ratified Data Capture Statistics January-September 2008

Site	CO	PM_{10}	PM_{25}	NO_2	O_3	SO_2	Site Average
Number of sites	27	74	24	110	80	44	128
Number of sites < 90%	8	20	10	24	12	8	32
Network Mean (%)	89.7	89.8	86.1	91.6	94.9	91.6	90.6

Part B Intercalibration Results Summer 2008

7 Introduction

In January to March 2008, AEA undertook an intercalibration of 120 monitoring stations in operation in the Defra and the Devolved Administrations Automatic Urban and Rural Monitoring Network.

The intercalibration exercise is a vital step in the process of data ratification. The audits are used to undertake a number of analyser and infrastructure performance checks that cannot be performed by Local Site Operators, with a view to ensuring confidence in the accuracy, consistency and traceability of air pollution measurements made at all the monitoring stations.

The intercalibration requires the coordination and close cooperation of QA/QC unit, Management Units, ESU's and LSO's in making sure the entire operation runs smoothly and is the result of many months of planning.

Leading up to the intercalibration, a draft schedule of visits is prepared and circulated to MU's and ESU's for approval. ESU ozone photometers are calibrated at AEA and all QA/QC equipment and cylinders are tested, calibrated and verified before use.

QA/QC visits are always undertaken before any ESU visits, to allow the performance of the sites to be quantified for the six month period prior to the visit. During the QA/QC visit, the LSO usually attends to demonstrate their competence in performing routine calibrations.

The audits are used to transport independent calibration standard gases and test apparatus to all of the sites, to quantify the performance of the entire measurement process at the monitoring stations. The results obtained from these tests are fed into the ratification process, where any correction of datasets can be applied to account for any performance anomalies.

ESU visits are normally undertaken within a two week period following the QA/QC visit. At this time, the analysers and sampling systems are all cleaned and serviced in accordance with manufacturer's specifications. The analysers are then set up ready for the following six month period, until the next round of intercalibrations and servicing.

This scheduling has proven to be very successful in delivering reliable operation of monitoring stations and high quality data. The programme is iterative: improvements and enhancements are continually added to further improve performance and analyse results.

8 Scope of Intercalibration Exercise

The QA/QC visits fulfil a number of important functions:

- A "health check" on the production of provisionally scaled data, which is rapidly disseminated to the public soon after collection.
- Identification of poorly performing analysers and infrastructure, together with recommendations for corrective action.
- A measure of network performance, by examining for example, how different NOx analysers around the network respond to a common gas standard. This test checks how "harmonised" UK measurements are; ie that a 200ppb NO_2 pollution episode in Edinburgh would be reported in exactly the same way at every other site in the UK, regardless of the location or the analyser used to record the event.
- Assessment of the area around the monitoring station: has the environment changed in the last six months? Is the location still representative of the site classification?

The QA/QC audits test the following aspects of analyser performance:

- Analyser accuracy and precision. These are basic checks to ensure analysers respond to known concentrations of gases in a reliable manner.
- Instrument linearity. This test refines the response checks on analysers, by assessing whether doubling a concentration of gas to the analyser results in a doubling of the analyser signal response. If an analyser's response characteristics are not linear, data cannot be reliably scaled into concentrations.
- Instrument signal noise. This test checks that an analyser responds to calibration gases in a stable manner with time. A "noisy" analyser may not provide high quality data which may be difficult to process at lower concentrations.
- Analyser response time. This test checks that the analyser responds quickly to a change in gas concentrations. If analyser response is too slow, data may not accurately reflect ambient concentrations.
- Leak and flow checks. These tests ensure that ambient air reaches the analysers, without being compromised in any way. Leaks in the sampling system can affect the ability of the analyser to sample ambient air reliably.
- NOx analyser converter efficiency. This test evaluates the ability of the analyser to measure NO_2. An inefficient converter severely compromises the data from the analyser.
- TEOM ko evaluation. The analyser uses this factor to calculate mass concentrations, so the value is calculated to determine its accuracy compared to the stated value.
- Particulate analyser flow rate checks. These tests ensure that the flow rates through critical parts of the analyser are within specified limits. There are specific analyser flow rates that are set to make sure particle size fractions and mass concentration calculations are performed correctly.
- SO_2 analyser hydrocarbon interference. This test evaluates the analyser's ability to remove interfering hydrocarbon gases from the sample gas. A failed test could have significant implications for analyser data.
- Evaluation of site cylinder concentrations. These tests use a set of AEA 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 concentrations of gases in the cylinders do not change.
- 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.

Once all data have been collected, a "Network Intercomparison" is conducted. This utilises the audit gas cylinders transported to each site in the Network. These cylinders are recently calibrated by the Calibration Laboratory at AEA, 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 are as follows:

- The analyser responses to audit gas are converted into concentrations, using provisional calibration factors obtained from the Management Units on the day of the intercalibration. These factors are also used for the provisional data supplied to the web/interactive TV services.

- 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 an analyser 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 ko 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, interactive television services and the web. It also provides input into the ratification process by highlighting sites where close scrutiny of datasets is likely to be required.

Any outliers that are identified are rigorously checked to determine the cause, and any required corrective action to be 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; and

- 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.

9 Results

The results section has been restructured to allow easier regional analysis. As well as a detailed national summary, a regional summary and breakdown outlier analysis is provided.

9.1 National Network Overview

The results of the intercalibration are summarised in Table 9.1 below:

Table 9.1 Summary of audited analyser performance – 120 UK stations

Parameter	Number of outliers	Number in network	% outliers in total
NOx analyser	26	109	24%
CO analyser	3	25	12%
SO_2 analyser	9	43	21%
Ozone analyser	15	78	19%
TEOM and BAM analysers	3 k_0, 3 flow	34 TEOM PM_{10} 29 FDMS PM_{10} 4 TEOM $PM_{2.5}$ 6 FDMS $PM_{2.5}$	8%
Gravimetric PM analysers	0	5 PM_{10} 1 $PM_{2.5}$	0%
Total	59	334	17%

Two of the 120 sites were not in operation at the time of the intercalibration: Norwich Centre and Southwark Roadside are awaiting relocation.

In addition to these results, 16 of the 286 site cylinders (~5%) used to scale instrument data into concentrations appeared to have drifted by more than 10% from their certificated values.

Five NOx converters were found to be outside than the ±5% acceptance limit.

The number of analyser outliers identified is similar to the previous exercise. At the Winter 2008 intercalibration 16% of the analysers in use were identified as outliers.

The procedures used to determine network performance are documented in AEA Work Instructions. These methods are regularly updated and improved and are evaluated by the United Kingdom Accreditation Service (UKAS). AEA holds ISO17025 accreditation for the on-site calibration of all the analyser types (NOx, CO, SO_2, O_3) and for the determination of the TEOM ko factor and particulate analyser flow rates used in the network. An ISO17025 certificate of calibration (Calibration Laboratory number 0401) for the analysers in the AURN is appended to this report.

A total of 118 sites were audited in this exercise; significant restructuring of the monitoring network is currently in progress to ensure compliance with the EC Air Quality Directive. Southwark Roadside and Norwich Centre remain off-line, pending redevelopment and planning permissions.

9.2 Network Comparisons

- Oxides of Nitrogen

  A total of 26 outliers (24%) were identified during this intercalibration. This is slightly better than the Winter exercise where 25% of the analysers were identified as outliers. In addition, there were five converters which fell outside the ±5% acceptance limits. Individual outliers will be discussed in detail in the following sections.

  Using the methodology detailed earlier, comparison of the network averages to audit cylinder concentrations showed that the network measures concentrations of NOx, NO and NO_2 to within a maximum of 2% of the network standards. The percentage standard deviations of these results, which are an indication of how close the results are grouped together, were less than 5% in all cases. These are excellent results, and demonstrate that provisional data from the vast majority of NOx analysers are accurate, harmonised and traceable to national metrology standards.

- Carbon Monoxide

  A total of 3 analysers (12%) were identified as outliers at this intercalibration. This result is better than the Winter 08 exercise, when 4 analysers fell outside the acceptance limits. Individual outliers will be discussed in detail in the following sections.

  Comparison of the network average to audit cylinder concentrations showed that the network measures concentrations of CO to within 1.5% of the network standards. The percentage standard deviation of these results, which are an indication of how close the results are grouped together, was less than 4%. This is a very good result, and demonstrates that provisional data from the vast majority of CO analysers are accurate, harmonised and traceable to national metrology standards.

- Sulphur Dioxide

  A total of 9 outliers (21%) were identified at this intercalibration. This is worse than the Winter 08 exercise, when 5 analysers were identified as outliers. Individual outliers will be discussed in detail in the following sections. All m-xylene interference tests were less than 50ppb.

  Comparison of the network averages to audit cylinder concentrations showed that the network measures concentrations of SO_2 to within 1% of the network standards. The percentage standard deviation of these results, which are an indication of how close the results are grouped together, was less than 5%. This is a very good result, and demonstrates that provisional data from the vast majority of SO_2 analysers are accurate, harmonised and traceable to national metrology standards

- Ozone

  A total of 15 outliers (19%) were identified during the Winter 08 exercise. This is similar to the previous intercalibration, where 14 analysers were found to be outside the ±5% acceptance criterion.

  Of the 15 outliers, 6 were within ±10%, 8 were within ±25% and one was significantly greater than ±25%. Individual outliers will be discussed in detail in the following sections.

- Particulate Analysers

  Three calculated TEOM and FDMS PM_{10} k_o determinations were outside the required ±2.5% of their stated values. This is worse than the previous exercise - no outliers were identified in the Winter 08 intercalibration.

Three TEOM PM_{10} main flows were found to be outside the ±10% acceptance limits, compared to three in total at the Winter 08 exercise.

All Partisol and $PM_{2.5}$ analysers successfully passed the audit tests.

- Site Cylinder Concentrations

  16 of the 286 site cylinders used to scale ambient pollution data were found to be outside the ±10% acceptance limit. These outliers will be examined in detail in the following sections.

9.3 London Sites

The results of the intercomparison for the 14 London sites in operation at the time of the intercalibration are summarised below:

Table 9.2 Summary of audited analyser performance – London Sites

Parameter	Number of outliers	Number in region
NOx analyser	4	14
CO analyser	0	7
SO_2 analyser	3	7
Ozone analyser	0	9
TEOM and BAM analysers	1 k_0, 1 flow	8 TEOM PM_{10} 0 FDMS PM_{10} 0 BAM PM_{10} 2 TEOM $PM_{2.5}$ 0 FDMS $PM_{2.5}$
Gravimetric PM analysers	0	1 PM_{10} 0 $PM_{2.5}$
Cylinders	2	42

The NOx outliers at Camden Roadside and Marylebone Road were attributed to changes in site cylinder concentrations, no data have been lost during ratification.

The NOx outliers at London Hillingdon and London Teddington were attributed to drifts in the analysers responses between calibrations. Again, no data were lost from either site during the ratification process.
The NOx converter at Cromwell Road was found to be 92% efficient. Close examination of the data has resulted in two weeks data being rejected as a result of this finding.

The SO_2 outliers at Cromwell Road and Marylebone Road were attributed to drifts in the analysers responses between calibrations. No data were lost from either site during the ratification process.

The SO_2 analyser at North Kensington was seen to exhibit some sensitivity to varying calibration gas inlet pressures. The data from the site have been carefully examined, no data have been rejected during ratification.

The NO cylinders at Camden Roadside and Marylebone Road were found to have become contaminated, drifting by 16 and 19% respectively from their stated values. The cylinders were earmarked for urgent replacement at the time of the audits. Data have been carefully examined and adjusted as necessary, no deletion of data has been required.

The flow rates of the TEOM analyser at Haringey Roadside were again found to be 15% lower than required. The data have been carefully examined and rescaled during ratification, no data rejection was required.

9.4 Scottish Sites

The results of the intercomparison for the 16 Scottish sites are summarised below:

Table 9.3 Summary of audited analyser performance – Scottish Sites

Parameter	Number of outliers	Number in region
NOx analyser	3	13
CO analyser	0	2
SO_2 analyser	0	3
Ozone analyser	2	9
TEOM and BAM analysers	1 k_0, 0 flow	4 TEOM PM_{10} 2 FDMS PM_{10} 0 BAM PM_{10} 0 TEOM $PM_{2.5}$ 1 FDMS $PM_{2.5}$
Gravimetric PM analysers	0	2 PM_{10} 1 $PM_{2.5}$
Cylinders	0	31

The NOx outliers at Glasgow Centre and Glasgow City Chambers were traced to analyser drifts in responses between LSO calibrations. No data were rejected during ratification.

The NOx outlier at Bush performed badly on the day of the audit. The performance history of the analyser was carefully examined during ratification, no data were rejected as a result of the audit findings.

The Ozone outliers at Eskdalemuir and Glasgow Centre were successfully re-scaled without data losses during ratification.

The TEOM k_0 at Grangemouth was found to be under-reading by 5.6%. The data was successfully re-scaled without data losses during ratification.

The NOx converter at Dumfries was found to be just under the required 95% performance requirement (94.5%). However, careful examination of calibration data confirms that the analyser performance is acceptable and no data has been rejected at this stage. This will be reviewed again at the Winter 09 intercalibration.

9.5 Welsh Sites

The results of the intercomparison for the 9 Welsh sites is summarised below:

Table 9.4 Summary of audited analyser performance – Welsh Sites

Parameter	Number of outliers	Number in region
NOx analyser	3	9
CO analyser	0	2
SO_2 analyser	0	4
Ozone analyser	0	5
TEOM and BAM analysers	0 k_0, 1 flow	3 TEOM PM_{10} 3 FDMS PM_{10} 0 BAM PM_{10} 0 TEOM $PM_{2.5}$ 1 FDMS $PM_{2.5}$
Gravimetric PM analysers	0	1 PM_{10} 0 $PM_{2.5}$
Cylinders	2	24

The NOx outlier at Newport St Julians was attributable to an unstable site cylinder. At the time of the audit, the site had not been formally integrated into the network, thus no action is required at this stage. The cylinder was earmarked for replacement.

The NOx outlier at Swansea was due to analyser drift between calibrations. Data have been successfully rescaled with no rejection required.

The NOx analyser at Wrexham responded poorly to site and audit NO_2 gas. It is possible that this was due to poor response on the day of the audit, as close examination of the timeseries data did not highlight any unusual analyser performance. No data were rejected on this occasion.

The site NO cylinder at Cwmbran was once again found to be contaminated, resulting in significant oxidation of NO in the cylinder. This has been a persistent issue at this site – QA/QC are working with the equipment supplier to identify a solution, we are hopeful that a modification to the gas delivery system will resolve the problem. This modification was undertaken in the summer and will be assessed during the winter intercalibration. If successful, the modification will be recommended for all sites that use site NO cylinders for daily autocal checks.

The SO_2 outlier at Narberth was due to analyser drift between calibrations. Data has been successfully re-scaled; there was no data loss as a result of this finding.

Data from the Ozone outlier at Cwmbran was successfully rescaled with no data rejection necessary.

The flow outlier for the TEOM at Cardiff appeared to be due to a small leak in the analyser shuttle valve. Investigation of the fault revealed this to be a recent occurrence, one week of data were rejected as a result of the finding.

9.6 Northern Ireland Sites (incl. Mace Head)

The results of the intercomparison for the 4 Northern Irish and Mace Head sites are summarised below:

Table 9.5 Summary of audited analyser performance – Northern Irish Sites

Parameter	Number of outliers	Number in region
NOx analyser	0	2
CO analyser	0	1
SO_2 analyser	0	2
Ozone analyser	0	4
TEOM and BAM analysers	0 k_0, 0 flow	2 TEOM PM_{10} 1 FDMS PM_{10} 0 BAM PM_{10} 0 TEOM $PM_{2.5}$ 1 FDMS $PM_{2.5}$
Gravimetric PM analysers	0	0 PM_{10} 0 $PM_{2.5}$
Cylinders	0	7

All analysers in this part of the network were found to be operating within satisfactory limits.

9.7 English Sites

The results of the intercomparison for the 76 English sites are summarised below:

Table 9.6 Summary of audited analyser performance – English Sites

Parameter	Number of outliers	Number in region
NOx analyser	16	69
CO analyser	3	14
SO_2 analyser	5	27
Ozone analyser	12	52
TEOM and BAM analysers	1 k_0, 1 flow	18 TEOM PM_{10} 22 FDMS PM_{10} 0 BAM PM_{10} 2 TEOM $PM_{2.5}$ 3 FDMS $PM_{2.5}$
Gravimetric PM analysers	0	2 PM_{10} 0 $PM_{2.5}$
Cylinders	8	179

Of the 16 NOx outliers, 8 can be attributed to changes in analyser responses between LSO calibrations (Bristol St Pauls, Hull, Leominster, Lullington Heath, Sandwell West Bromwich, Somerton, St Osyth and Stoke). All of these outliers were corrected for with no rejection of data required.

The NOx outliers at Preston and Sheffield Centre appear to be due to poorly performing analysers on the day of the audit. The data from all three sites has been carefully examined, no data rejection was required at either of the sites.

The NOx outlier at Northampton appears to be due to the factor and processing used by CMCU, compared to those used by QA/QC. Ambient data are unaffected and data quality has not been compromised.

The remaining 5 NOx outliers were due to changes in site cylinder concentrations (Barnsley Gawber, Canterbury, Middlesbrough, Southend and Yarm). Data have been carefully examined and rescaled as necessary at all sites, no data were lost as a result of these adjustments.

Four NOx converters fell outside the ±5% acceptance limits:

Glazebury (86%) has had four months of data rejected,
Leeds Headingley (90%) has lost ten weeks of data this year.
Manchester Piccadilly (89%) has lost two months of data
Newcastle Centre (92%) has lost 10 days of data.

The analyser at Manchester South developed a fault prior to the audit, preventing sensible results being obtained. Three weeks data were lost as a result of this fault.

The CO outliers at Bury and Hull appear to be due to the factors and processing used by CMCU, compared to those used by QA/QC. Ambient data are unaffected and data quality has not been compromised.

The CO outlier at Market Harborough was due to a small drift in the site cylinder concentration. This is a very low concentration cylinder (~1.5ppm), so small differences in calculated site cylinder concentrations will have a disproportionate effect on results. The outlier was corrected for with no rejection of data required.

Three of the five SO_2 outliers (Ladybower, Northampton, Stewartby) were found to be due to changes in analyser responses between LSO calibrations. Both of these outliers were corrected for with no rejection of data required.

The SO_2 outliers at Hull and Wicken Fen appears to be due to the factor and processing used by CMCU, compared to those used by QA/QC. Ambient data are unaffected and data quality has not been compromised.

The extreme Ozone outlier at Leeds Centre was found to be due to a poorly set up analyser. This was corrected by QA/QC unit during the audit and the data have been successfully rescaled.

Data from the remaining eleven Ozone outliers were successfully rescaled with no data rejection necessary.

The TEOM main flow outlier at Newcastle was carefully examined during ratification. The data have been successfully rescaled with no data rejection required.

The k_0 outlier at Oxford St Ebbes has been successfully rescaled with no loss of data.

10 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 16 of the 286 cylinders (~5%) used to scale analyser data into concentrations (NO, CO and SO_2) were outside the ±10% acceptance criterion. This is similar to the winter 2008 exercise, where 5% of the scaling cylinders were outside the acceptance limits.

In addition, the concentrations of 26 NO_2 cylinders appear to have drifted by more than 10%. NO_2 cylinders are not used for the scaling of data and so will not be replaced at this time. Hence, a total of 42 of the 286 cylinders (15%) were outside the acceptance limits. This is better than the previous intercalibration, where 17% of the cylinders were found to be out of specification.

The site cylinder evaluations are performed by calibrating the analysers with site and audit 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.

In determining which cylinders should be replaced or reanalysed, the analyser and audit performance is taken into account, as well as previous audit results for each cylinder. During this exercise, all 16 poorly performing site cylinders used to scale data were investigated further:

The contaminated NO cylinders at Camden Roadside, Marylebone Road, Middlesbrough, Southend, Yarm and Cwmbran were all replaced as a matter of course and data rescaled as necessary.

The majority of contaminated NO cylinders occurrences coincide at sites where the cylinders are used as daily functional checks. One of the possible causes for the contamination could be oxygen permeation through the PTFE tubing of the gas delivery system and thus into the cylinder. QA/QC have procured a length of high quality deactivated stainless steel tubing and requested it to be fitted to the NO cylinder at Cwmbran by the ESU at the summer 08 service exercise. We will examine the performance of the cylinder closely in the following months and provide recommendations as appropriate.

The NO cylinder results at Bristol St Paul's, Chesterfield and Preston were all compromised by poorly performing analysers. These results will be carefully examined at the Winter 09 intercomparison.

The remaining NO cylinders at Barnsley Gawber and Canterbury were just outside the 10% limits and will be rechecked at the Winter 09 intercalibration.

The SO_2 cylinder at Wicken Fen was again found to be just outside the 10% limit. However, because this response appears to be consistent and stable, the concentration of gas in this cylinder will be adjusted and data from the site rescaled accordingly.

The SO_2 cylinder at Leeds Centre was virtually empty. This will have compromised the reliability of this result.

The remaining three SO_2 cylinders at Bristol St Paul's, Leicester and Northampton were just outside the 10% limits and will be rechecked at the Winter 09 intercalibration.

The CO cylinder at Market Harborough had drifted slightly (1.4ppm to a calculated 1.2ppm). The performance of the cylinder will be carefully checked on an ongoing basis and data rescaled as necessary. The QA/QC Unit has obtained high-precision audit cylinders for the rural CO sites.

11 Site Information

All site information is now uploaded to CMCU and the AQ archive for dissemination using Google Earth. QA/QC unit make considerable effort in ensuring that site locations are accurate on the new Google Earth site information and AQ archive pages. All future additions to the AURN will include accurate positioning using Google Earth.

12 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; BS EN14211 (NOx), BS EN14212 (SO2), BS EN14626 (CO) and BS EN14625 (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 6% of the predicted value. AEA now reports maximum residuals from linearity tests, to evaluate the performance of current analysers against these tougher requirements.

- NOx Converter efficiency must be better than 95%. Data must be rescaled for efficiencies between 95 and 99.9%, but rejected if below 95%. Again, this is tighter than currently, where we accept "borderline" failures. AEA 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 pollutant to be analysed. AEA 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 and this is available on the AURN Hub and Air Quality Archive.

- The uncertainty of the site cylinder concentrations is, by and large, the largest single component of the entire measurement uncertainty budget. Recent intercalibrations have been used to evaluate a new methodology for calculating site cylinder concentrations and uncertainties. Unfortunately, it was discovered that analyser performance could not be relied upon to allow the scaling of cylinder concentrations with sufficient accuracy, particularly so for NOx analysers. It is likely that site environmental conditions (for example temperature variations) significantly affected these assessments. QA/QC are currently investigating alternative methodologies and will report on these in the future.

- The determination of an SO_2 analyser response to meta-xylene will not be required for ongoing field tests. For the AURN, QA/QC will continue to assess the performance of the hydrocarbon kickers, but action will not be recommended unless the result is very high (greater than 50ppb response to a 1ppm m xylene cylinder)

The CEN operating methodologies are now finalised and published and have been incorporated into the requirements of the new air quality Directive 2008/50/EC. Member States will have until June 2010 to ensure their monitoring networks are compliant. AEA are taking steps to ensure the procedures used in the UK comply with the requirements ahead of any imposed deadlines. To this end, the procedures used for the intercomparisons have been fully compliant with the CEN protocols since January 2006. It is planned to have a fully operational field evaluation system for type-tested instrumentation in time for the Winter 2009 intercalibration.

13 Safety

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

The most significant risk to field operators remains safe access to PM sample inlets to perform flow tests. This gains increased importance with FDMS analysers, where meaningful flow tests are impossible if access to the sample inlet cannot be achieved. It is not possible to measure flows at the sample inlet at the following sites:

Table 13.1 Actions Required for Safe Roof Access

Site	Action required
Camden Kerbside	Needs ladder restraints
Haringey Roadside	Needs ladder restraints
London Harlington	Needs ladder restraints
London North Kensington	Needs ladder restraints
London Westminster (Partisol)	Needs ladder restraints
Teddington	Will need ladder restraints
Birmingham Centre	Needs ladder restraints
Sandwell	Needs ladder restraints
Bury Roadside	Needs ladder restraints
Salford Eccles	Needs restraints
Liverpool Speke	Has half barrier - needs full barrier
Bristol St Paul's	Needs ladder restraints
Middlesborough	Roof access required, needs barrier
Bournemouth (Partisol)	Needs ladder restraints
Coventry Memorial Park	Sloping roof - access not possible
Hull Freetown	Needs ladder restraints
Southampton Centre	Needs ladder restraints
Southend on Sea	Sloping roof - access not possible
Glasgow Kerbside	Needs new ladder support or railings
Swansea Roadside (FDMS TEOM)	Needs restraints
Thurrock	Sloping roof - access not possible
Plymouth Centre	Roof access required, needs barrier
Northampton (TEOM + Partisol)	Needs ladder restraints
Scunthorpe Town	Needs ladder restraints
Leamington Spa	Needs ladder restraints
Sunderland Silksworth	Needs ladder restraints
Grangemouth	Needs ladder supports or railings
Aberdeen	Needs ladder supports or railings
Cwmbran	Needs ladder restraints

It is recommended that roof access to these sites is investigated, to determine whether safe access can be achieved.

In addition, all new $PM_{2.5}$ installations will need to be checked to ensure safe access to the inlets can be achieved. At present, none of the newly installed FDMS $PM_{2.5}$ analysers have had ladder restraints installed.

14 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 AEA using the audit cylinder standards, in accordance with our ISO17025 accreditation.

15 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 April to September 2008.

Appendices

Appendix 1

Recommendations for Upgrade or Replacement of Equipment

As requested by the Department, QA/QC Unit has provided a list of suggestions for equipment that may need replacing or upgrading in the network. The following provides a summary of the outstanding issues to date since July 2005. 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 2009	Priority	Action
29	None		
	Recommendations October 2008	**Priority**	**Action**
28	The analysers at Narberth should be replaced as soon as possible, as performance of the current analysers has been poor (Ozone replaced Feb 09)	High	CMCU
	Recommendations August 2008	**Priority**	**Action**
27	Many sites require modifications to permit safe roof access for measuring PM analyser flows	High	CMCU
	Recommendations January 2008	**Priority**	**Action**
26	It is recommended that the Bush NOx analyser be replaced.	High	CMCU
25	It is recommended that LSO's continue to 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	High	LSO
24	It is strongly recommended that ESU's clean all NOx analyser switching valves during servicing, and ensure the valve is leak checked afterwards.	High	ESU
	Recommendations August 2007		
	None		
	Recommendations April 2007		
22	Safe roof access needs to be provided for sites where FDMS TEOMs are to be deployed	High	ESU/CMCU
	Recommendations January 2007		
22	ESUs to ensure all NOx converter software settings to be 100%.	High	ESUs to check at service
	Recommendations July 2006		
19	Weybourne O_3 analyser should be upgraded to allow monthly LSO calibrations and daily autocalibrations	Medium	ESU to provide CMCU with quotation for necessary work

	Recommendations April 2006		
	None		
	Recommendations January 2006		
17	The performance of CO analysers needs close attention by all parties, and poorly performing analysers replaced or upgraded	High	LSOs and CMCU to check performance carefully; ESU's to action repairs promptly
	Recommendations July 2005		
13	Continuing problems with some autocal run-ons causing loss of up to 2 hours per day-see Section 3.2 **CMCU to ensure ESUs are asked to attend to offending sites (Action May 2008)**	High	Many sites now cured, but some need attention at next ESU visit

Appendix 2

Gaps listing July-September 2008

01/07/2008 to 30/09/2008 Gaps in 15-minute table >= 6 hours and data capture <= 90%

Pollutant	Data Capture (%)	Start date	End date	Reason	Comments	Number of days	Number of hours
England							
Birmingham Tyburn							
PM10	69.50%	19-Jul-08	21-Jul-08	Communication fault	power cut plus comms	1.6	38
		26-Jul-08	08-Aug-08	Low flow rate		13.3	320
		18-Aug-08	19-Aug-08	ESU service		1	24
		23-Aug-08	03-Sep-08	Low flow rate	intermmitent low flow. New seal fitted	11.4	273
Bristol St Paul's							
PM25	72.00%	01-Dec-07	12-Aug-08	No mV data collected	Missing data/not collected?	256	6133
		26-Aug-08	03-Sep-08	No mV data collected	Missing data/not collected?	8.2	196
		23-Sep-08	28-Sep-08	No mV data collected	Missing data/not collected?	5.2	125
SO2	87.50%	31-Jul-08	01-Aug-08	ESU service		1.2	29
		02-Sep-08	11-Sep-08	Pump fault	Pump failure	10	240
Bury Roadside							
CO	43.10%	03-Jul-08	15-Jul-08	Unstable response	Unstable baseline	12.2	292
		22-Aug-08	06-Nov-08	Unstable response	Deleted data because unstable baseline	76.6	1839
Camden Kerbside							
PM10	77.70%	02-Jul-08	07-Jul-08	Instrument fault	ENG C/O Checked pump vaccum this was 19in Hg. Now 26in Hg	5	120
		10-Jul-08	22-Jul-08	High noise	noisy data resolved by re seat filter	12	289
		26-Aug-08	28-Aug-08	High noise	noisy data after audit reolved by filter reseat	2.1	50
		15-Sep-08	16-Sep-08	ESU service		1.1	26
Chesterfield							
NO2	79.80%	22-Jul-08	09-Aug-08	Instrument fault	Chopper failure	18.3	438
Chesterfield Roadside							
NO2	87.40%	22-Aug-08	02-Sep-08	NO2 converter fault	Molycon replaced and tested.	10.9	261
Exeter Roadside							
NO2	76.90%	10-Sep-08	23-Oct-08	Switched out-of-service	Offline during construction work	43.2	1037
O3	76.90%	10-Sep-08	23-Oct-08	Switched out-of-service	Offline during construction work	43.2	1037
Glazebury							
NO2	64.60%	06-Feb-08	29-Jul-08	NO2 converter fault	Data nulled by QC - Converter fault	174	4179
O3	89.30%	27-Jun-08	03-Jul-08	Logger fault	Loose connection between logger and analyser 16.45 to 14.30 on 30	5.8	139
		28-Jul-08	29-Jul-08	ESU service		1.1	27
		22-Aug-08	26-Aug-08	Instrument fault	ENG C/O O3 gen temp fail. Fixed heater connections	4.1	98
		07-Sep-08	09-Sep-08	Instrument fault	flat data resolved by lso 19.45 to 10.45 on 9 Sep	1.5	37
Great Dun Fell							
O3	89.60%	15-Jul-08	16-Jul-08	ESU service		0.9	21
		26-Aug-08	26-Aug-08	Logger fault		0.3	6

		17-Sep-08	17-Sep-08	Logger fault		0.5	12
		17-Sep-08	17-Sep-08	Logger fault		0.3	6
		18-Sep-08	18-Sep-08	Logger fault		0.5	12
		20-Sep-08	21-Sep-08	Logger fault		1	24
		23-Sep-08	23-Sep-08	Logger fault		0.5	12
		23-Sep-08	23-Sep-08	Logger fault		0.3	6
		24-Sep-08	24-Sep-08	Logger fault		0.3	6
		25-Sep-08	26-Sep-08	Logger fault		1.3	30
		27-Sep-08	27-Sep-08	Logger fault		0.3	6
		28-Sep-08	28-Sep-08	Logger fault		0.5	12
		29-Sep-08	30-Sep-08	Logger fault	Logger problems - ultimately fixed by new modem	1.8	42
Haringey Roadside							
PM10	66.50%	16-Aug-08	16-Aug-08	Power cut		0.4	10
		31-Aug-08	11-Oct-08	Instrument fault	Leaks identified in TEOM	40.8	978
Hull Freetown							
PM25	88.40%	01-Dec-07	02-Sep-08	ESU service		277	6645
		25-Sep-08	27-Sep-08	Instrument fault	Stabilising after filter change.	2.5	60
Leamington Spa							
NO2	87.90%	21-Jul-08	30-Jul-08	Instrument fault	NOx converter fault	9.3	223
		03-Sep-08	04-Sep-08	ESU service		1.2	29
O3	88.00%	21-Jul-08	30-Jul-08	Logger fault	Envidas looger fault	9.3	223
		03-Sep-08	04-Sep-08	ESU service		1.2	28
PM10	38.50%	22-May-08	23-Aug-08	Instrument fault	Noisy data deleted by QA/QC Unit	92.8	2228
		03-Sep-08	04-Sep-08	ESU service		1	24
		15-Sep-08	17-Sep-08	High noise	High noise	2.1	50
SO2	87.90%	21-Jul-08	30-Jul-08	Logger fault	Logger fault	9.3	223
		03-Sep-08	04-Sep-08	ESU service		1.2	28
Leeds Headingley Kerbside							
NO2	10.40%	10-Jul-08	02-Oct-08	NO2 converter fault	Converter failure at audit .	84	2017
Leominster							
NO2	85.90%	24-Jul-08	25-Jul-08	Operator error	Left OOS after cal	0.6	15
		20-Aug-08	21-Aug-08	Operator error	Left OOS after cal	0.7	17
		08-Sep-08	09-Sep-08	ESU service		1.3	31
Liverpool Speke							
CO	81.70%	16-Jul-08	30-Jul-08	Instrument fault	ENG C/O Was in start-up mode. New microprocessor board fitted	14.5	348
		01-Sep-08	03-Sep-08	ESU service		1.9	46
SO2	89.30%	24-Jul-08	24-Jul-08	Rapid zero or sensitivity drift	Rapid offset drift	0.3	6
		30-Jul-08	06-Aug-08	Operator error	Left pump off after visit	7.1	171
		01-Sep-08	03-Sep-08	ESU service		1.9	46
London Bloomsbury							
PM10	73.40%	06-Aug-08	07-Aug-08	ESU service		1.1	27
		03-Sep-08	26-Sep-08	Sampling fault	Unstable following LSO cal then mass transducer V ring problem	23	551
PM25	70.00%	06-Aug-08	07-Aug-08	ESU service		1.1	27
		22-Aug-08	17-Sep-08	Instrument fault	Instrument Fault Leak in the Sensor Unit	26.3	631
London Cromwell Road 2							
NO2	80.10%	27-Jul-08	13-Aug-08	NO2 converter fault	Rejection of NO2 data as a result of quality O action	17.5	420
		27-Aug-08	27-Aug-08	No mV data collected	Possible comms problem	0.3	8

London Harlington							
PM25	0.00%	01-Dec-07	30-Sep-08	Analyser fault-removed for repair		305	7320
Lullington Heath							
SO2	67.50%	01-Jan-08	15-Jul-08	Instrument fault	photomultiplier fault-data deleted	197	4716
		15-Sep-08	03-Nov-08	Instrument fault	photomultiplier fault-data deleted	49	1177
Manchester Piccadilly							
NO2	88.40%	08-May-08	11-Jul-08	NO2 converter fault	Converter fault-NO2 deleted to service.	64.4	1546
Manchester South							
NO2	83.30%	24-Jun-08	15-Jul-08	ESU service		21.2	508
Middlesbrough							
CO	74.70%	04-Jul-08	23-Jul-08	ESU service	Serviced analyser-replacement analyser installed	18.9	453
		18-Sep-08	22-Sep-08	Instrument fault	Analyser returned	4	97
PM10	3.60%	04-Jul-08	01-Oct-08	Instrument fault	Removed to fix flow fault	89	2137
Newcastle Centre							
NO2	86.10%	07-Jul-08	16-Jul-08	NO2 converter fault	QA/QC rejected data from audit to service	9.1	219
O3	89.90%	07-Jul-08	07-Jul-08	QAQC audit		0.7	16
		08-Jul-08	16-Jul-08	ESU service		8.5	203
Northampton							
O3	88.90%	14-Jul-08	14-Jul-08	Instrument fault	Flow meter fault intermittent	0.4	10
		14-Jul-08	15-Jul-08	Instrument fault	Flow meter fault intermittent	0.5	13
		15-Jul-08	16-Jul-08	Instrument fault	Flow meter fault intermittent	0.4	9
		28-Jul-08	29-Jul-08	ESU service		1.3	30
		08-Aug-08	11-Aug-08	No mV data collected	no data collected	3.1	74
		13-Aug-08	14-Aug-08	Communication fault	comms fault with ozone analyser	0.6	15
		15-Aug-08	18-Aug-08	Vandalism	ENG C/O Fixed comms problem and reset flow	3.3	78
PM10	0.00%	07-Apr-08	30-Nov-08	Monitoring suspended	Analyser de-affiliated	238	5703
Nottingham Centre							
PM10	89.10%	01-Jul-08	02-Jul-08	FDMS dew point too high	Sample dew point >=2.0	0.5	13
		23-Jul-08	01-Aug-08	FDMS dew point too high	Sample dew point >=2.0	8.7	209
Plymouth Centre							
PM10	77.40%	19-Aug-08	08-Sep-08	Instrument fault	Off after service	20.1	482
Portsmouth							
PM10	85.40%	26-Mar-08	07-Jul-08	Instrument fault	Analyser Fault	103	2470
		02-Aug-08	02-Aug-08	Instrument fault	Recurring FDMS perfrormance issue - site operating temperature 15	0.4	10
		08-Aug-08	09-Aug-08	Instrument fault	Analyser unstable	0.5	13
		10-Aug-08	11-Aug-08	Instrument fault	Analyser unstable	1.4	34
		14-Aug-08	15-Aug-08	Instrument fault	Analyser unstable	0.5	12
		15-Aug-08	16-Aug-08	Instrument fault	Analyser unstable	0.6	14
		16-Aug-08	17-Aug-08	Instrument fault	Analyser unstable	0.5	13
		17-Aug-08	17-Aug-08	Instrument fault	Analyser unstable	0.4	10
		19-Aug-08	19-Aug-08	Instrument fault	Analyser unstable	0.4	9
		20-Aug-08	20-Aug-08	Instrument fault	Analyser unstable	0.4	9
		31-Aug-08	01-Sep-08	Instrument fault	Analyser unstable	0.6	14
		03-Sep-08	04-Sep-08	Instrument fault	Analyser Temp Fault from A/C	0.5	13
Preston							
PM10	79.50%	12-Aug-08	21-Aug-08	High noise	Spurious data rejected between audit and service.	9.2	220

		31-Aug-08	10-Sep-08	Instrument fault	FDMS spurious data - potential filter leak	9.5	228
Rochester Stoke							
SO2	43.30%	28-Jul-08	15-Aug-08	Instrument fault	UV lamp warning (chopper motor fault)	18.3	440
		28-Aug-08	01-Oct-08	Instrument fault	Chopper motor fault - data nulled by QC	34	816
Salford Eccles							
SO2	86.70%	14-Jul-08	21-Jul-08	Instrument fault	Baseline too low after service and no zero calibrations	7	169
		11-Sep-08	15-Sep-08	No mV data collected	communications fault	4	97
		16-Sep-08	16-Sep-08	No mV data collected	communications fault	0.4	10
Saltash Roadside							
PM10	66.70%		29-Jul-08	Site started			
		27-Aug-08	17-Sep-08	No mV data collected	Power supply fault	20.9	501
Sandy Roadside							
NO2	84.00%	01-Dec-07	05-Aug-08	Air Conditioning or Temp fault		249	5965
		12-Aug-08	14-Aug-08	High noise	Unusually high NOX and NO	1.5	36
Scunthorpe Town							
SO2	86.80%	18-Aug-08	19-Aug-08	ESU service		1.2	28
		06-Sep-08	11-Sep-08	Pump fault	Low SO2 flowrate	5.2	124
Sheffield Tinsley							
NO2	43.80%	01-Dec-07	21-Aug-08	Instrument fault	Switching valve/converter fault	265	6351
Southwark Roadside							
NO2	0.00%	01-Dec-07	30-Nov-08	Switched out-of-service		366	8784
St Osyth							
CO	41.90%	03-May-08	12-Aug-08	Air Conditioning or Temp fault	Aircon fault - affecting data - Nulled by QC	102	2436
		22-Aug-08	01-Sep-08	Power cut	Electrical work on site & erratic data upto 1/9/08	9.8	234
		17-Sep-08	18-Sep-08	ESU service		1	25
NO2	58.80%	22-Jul-08	12-Aug-08	Air Conditioning or Temp fault	Air conditioning faulty	21	504
		22-Aug-08	01-Sep-08			9.8	236
		17-Sep-08	18-Sep-08	ESU service		1	25
O3	61.80%	01-Jul-08	01-Jul-08	Air Conditioning or Temp fault	Air conditioning faulty	0.3	6
		03-Jul-08	04-Jul-08	Air Conditioning or Temp fault	Air conditioning faulty	1.4	33
		14-Jul-08	15-Jul-08	Air Conditioning or Temp fault	Air conditioning faulty	1.4	33
		22-Jul-08	12-Aug-08	Air Conditioning or Temp fault	Air conditioning faulty	21	504
		22-Aug-08	01-Sep-08	Power cut	Electrical work on site & erratic data upto 1/9/08	9.8	234
		17-Sep-08	18-Sep-08	ESU service		1	25
Stockton-on-Tees Yarm							
NO2	65.90%	02-Sep-08	30-Nov-08	Monitoring suspended	Site closed	89.5	2149
PM10	68.70%	02-Sep-08	30-Nov-08	Monitoring suspended	Site closed	89.5	2149
Tower Hamlets Roadside							
CO	47.30%	07-Jul-08	18-Jul-08	Rapid zero or sensitivity drift	Call out for dropping baseline and possible temp problems	10.3	248
		24-Aug-08	03-Oct-08	High noise	Rejection of noisy data	40.5	973

Walsall Willenhall							
NO2	87.70%	26-Jul-08	26-Jul-08	No mV data collected		0.3	6
		30-Jul-08	07-Aug-08	Instrument fault	NOx baseline skipped no zeros	7.8	186
		12-Aug-08	12-Aug-08	No mV data collected		0.4	10
Yarner Wood							
NO2	86.60%	01-Jul-08	02-Jul-08	Power cut		0.8	19
		04-Jul-08	04-Jul-08	Power cut		0.3	8
		29-Jul-08	30-Jul-08	Power cut		0.9	21
		04-Aug-08	05-Aug-08	Power cut		0.5	13
		20-Aug-08	21-Aug-08	Power cut		0.7	17
		29-Aug-08	01-Sep-08	Power cut		3	72
		17-Sep-08	19-Sep-08	ESU service		2	49
York Fishergate							
PM10	87.90%	01-Sep-08	11-Sep-08	High noise	Noisy response	10.5	252
N Ireland							
Belfast Centre							
CO	0.00%	30-Apr-08	31-Oct-08	Instrument fault	IR Source correlation wheel & chopper motor faults	184	4413
Derry							
NO2	88.90%	18-Aug-08	28-Aug-08	Instrument fault	Possible leak between audit and service	10	239
PM10	32.40%	04-Jul-08	04-Sep-08	No mV data collected	No data collected followed by unstable response	61.9	1486
PM25	32.70%	04-Jul-08	04-Sep-08	No mV data collected	No data collected followed by unstable response	61.9	1486
Scotland							
Auchencorth Moss PM10 PM25							
PM25	68.30%	23-Jul-08	19-Aug-08	FDMS drier	Call out: PM2.5 drier fault	28	672
Bush Estate							
NO2	79.70%	31-Jul-08	04-Aug-08	Power cut		4.2	101
		08-Aug-08	08-Aug-08	Power cut		0.3	8
		02-Sep-08	03-Sep-08	ESU service		1	25
		27-Sep-08	30-Sep-08	Pump fault	Faulty pump - replaced	3.2	76
Dumfries							
NO2	85.80%	09-Jul-08	10-Jul-08	ESU service		1.2	29
		01-Sep-08	02-Sep-08	High noise	Noisy	0.8	19
		06-Sep-08	07-Sep-08	High noise	Noisy	0.5	12
		19-Sep-08	29-Sep-08	Instrument fault	Analyser lost DAS config	10	240
Edinburgh St Leonards							
O3	86.90%	08-Jul-08	10-Jul-08	ESU service		2	49
		01-Aug-08	11-Aug-08	Instrument fault	ENG C/O Lots of warnings. Replaced UV source	9.9	238
Fort William							
NO2	83.20%	09-Jul-08	23-Jul-08	No calibrations	step change in NOx baseline - no zero at new level.	14.1	339
		12-Aug-08	13-Aug-08	ESU service		1.1	27
Glasgow Centre							
CO	82.90%	18-Jun-08	16-Jul-08	Instrument fault	Call out: NOx and CO calibration reading low.	27.8	668
Glasgow Kerbside							
NO2	89.20%	13-Jul-08	22-Jul-08	ESU service		9	215

Lerwick							
O3	87.10%	01-Jul-08	10-Jul-08	Instrument fault	ENG C/O Erractic readings	9.7	233
		11-Aug-08	12-Aug-08	Power cut	Possible UPS fault.	0.8	18
		28-Aug-08	29-Aug-08	Operator error	LSO left analyser in zero mode.	0.8	19
		04-Sep-08	04-Sep-08	ESU service		0.3	7
Wales							
Aston Hill							
NO2	81.50%	10-Jul-08	11-Jul-08	Power cut		0.8	18
		07-Aug-08	07-Aug-08	Power cut		0.4	10
		24-Sep-08	24-Sep-08	ESU service		0.3	6
Cardiff Centre							
PM25	84.30%	23-Sep-08	29-Sep-08	Filter overloaded		5.7	136
Newport							
PM10	12.30%	09-Jul-08	10-Jul-08	High noise	Noisy data deleted	0.5	11
		12-Jul-08	23-Oct-08	FDMS volatiles noisy	atile fraction very unstable	103	2470
Port Talbot Margam							
PM10	82.50%	23-Jul-08	24-Jul-08	ESU service		1.2	28
		30-Aug-08	01-Sep-08	Instrument fault	ENG C/O Base/ref valve not switching. Replaced 8500 module	2.4	58
		14-Sep-08	26-Sep-08	Instrument fault	V10 out of range	12	289

Appendix 3

Inventory of Defra owned Equipment

An up-to-date inventory of Department-owned equipment used by the QA/QC Unit is provided below:

QA/QC Unit's inventory of Department-owned equipment, March 2009

Computer software	The HIS (Heuristic Information System) software suite used for all data management. A few specific capabilities of HIS were developed in order to meet specific Department deliverables or requirements (examples include software for annual report analysis/compilation, for formatting/transmitting network data to archive or DDU and for reporting Directive compliance data to the EC).
Field support equipment	Field support equipment: 1 intercalibration equipment set (includes mass flow controllers and read-out unit) A second intercalibration (commissioned January 2001) UV photometers: API model M401 s/n 123- purchased April 1999 API model 401 s/n 151 - purchased October 2000 (now beyond economic repair) API model 401 s/n 176 – purchased December 2002 API model 401 s/n 290 – purchased May 2004 API model 401 s/n 291 – purchased May 2004 API model 401 s/n 292 purchased May 2004 API model 401 s/n 293 purchased May 2004 Mass flow controllers - purchased April 2002 (incorporated into existing audit dilution apparatus) 3 Drycal flow meters - purchased September 2002 1 Mass flow controller read-out unit to be incorporated in the audit dilution apparatus – purchased September 2002. A third intercalibration kit (commissioned May 2004) Drycal flow meter – purchased March 2004 Sabio 2010 dilution calibrator – purchased February 2005 Sabio 2020 zero air generator – purchased February 2005 Sabio 2030 ozone photometer – purchased February 2005 Sabio 2010 dilution calibrator – purchased June 2006 Sabio 2020 zero air generator – purchased June 2006 Sabio 2030 ozone photometer – purchased June 2006 Sabio 2020 zero air generator – purchased March 2008 Sabio 2030 ozone photometer – purchased March 2008 Sabio 2010 dilution calibrator – purchased March 2008
Zero air pumps	6 spare zero air pumps for routine maintenance/repair of zero air generators in the AURN.
Analysers	AC31 dual chamber NO_x analyser TEI 43C SO_2 analyser TEI 48C CO analyser M265 chemiluminescent ozone analyser (All of the above purchased on behalf of Defra by Casella Stanger in March 2003 and transferred to QA/QC Unit)

Appendix 4

Partisol Data Ratification: July-September 2008

Site	Start date	End date	Ratified Data Capture, %
Auchencorth Moss PM_{10}	1st Jul	30th Sep	86%
Auchencorth Moss $PM_{2.5}$	1st Jul	30th Sep	84%
Bournemouth PM_{10}	1st Jul	30th Sep	97%
Brighton Preston Park $PM_{2.5}$	1st Jul	30th Sep	61%
Harwell $PM_{2.5}$	4th Jul	30th Sep	100%
Inverness PM_{10}	1st Jul	30th Sep	99%
London Marylebone Road PM_{10}	1st Jul	30th Sep	90%
London Marylebone Road $PM_{2.5}$	1st Jul	30th Sep	93%
London N Kens PM_{10}	1st Jul	30th Sep	79%
London N Kens $PM_{2.5}$	1st Jul	30th Sep	89%
London Westminster PM_{10}	1st Jul	30th Sep	97%
Port Talbot Margam	1st Jul	30th Sep	82%
Wrexham	1st Jul	30th Sep	83%

Measured data and ambient concentrations are supplied by Bureau Veritas. Data is now ratified using the Foxpro-based HIS system. The ratification process includes checking of BV's calculated ambient PM_{10} concentration. It is noted that BV now carry out more detailed checks on the data, including checking for matching of filter numbers, dates and weights, also comparison of data with that from other nearby sites.

(Note: a possible weighing anomaly at BV is currently under investigation. This appears to have affected blank weighings, leading to over-estimation of PM concentration. ALL PARTISOL DATA REMAIN PROVISIONAL PENDING COMPLETION OF THIS INVESTIGATION.)

The following sites changes have taken place:

- Harwell $PM_{2.5}$: started as of 4th July, for $PM_{2.5}$ only.

Data Ratification

Data codes are recorded during ambient measurement, and filter faults are recorded during filter weighings. Some codes indicate a fatal fault and are used to automatically reject data during ratification.

Measurement codes are shown below.

The measurement codes reported by BV are as follows:

New Code	Meaning	Reject
0	OK	No
8	Power Failure	Yes
4	System re-set	Only if < 18h data.
10	Flow 1out of range	Yes
20	Flow 2 out of range	Yes
40	Flow 3 out of range	Yes
2000	Difference between ambient T and filter T > $\pm 5^{o}C$	No
10000	Elapsed sample period out of range/out of filters	Reject if < 18h data.
40000	Coefficient of variation of average flow too high (i.e. too much variation in flow)	If not caused by "audit" status e.g. inlet cleaning. Or if < 18h data.
100000	Elapsed Sample Period out of range (< 23 hours or >25 hours).	Reject if < 18h data.
102000	Difference between ambient T and filter T > $\pm 5^{o}C$, causing Elapsed Sample Period out of range (< 23 hours or >25 hours).	Reject only if < 18h valid data or vol < 18 m3.
100008	Elapsed Sample Period out of range (< 23 hours or >25 hours), *and* Power Failure.	Yes (power failure)

The following faults should also be recorded during filter weighings and should be indicated by BV in their spreadsheet under "Lab Comments". All are fatal except "filter inverted".

Filter Faults

Filter exposed inverted
Filter cut inside edge
Filter damaged some missing
Filter appears unexposed
Filter not returned
Filter inverted and in reverse order in canister

Site Audits

Site audit results for the AURN Partisols are shown in the table below. Audits take place every 6 months, so there may not necessarily have been an audit during the "quarter" currently being ratified. The table below therefore shows the two most recent audits.

The flowrate must be within +/-10% of the nominal value (16.7 m^3/h) and the leakage must be < 5%.

Site Audits – Winter 2008 and Summer 2008 periods.

Site	Audit date	Flowrate m3/h	% out from 16.7 m^3/h	Leak test %
Auchencorth Moss PM_{10} (serial no. 21550)	13 Feb 2008 19 Jun 2008	16.77 16.96	0.6 1.74	"pass" "pass"
Auchencorth Moss $PM_{2.5}$ (serial no. 21548)	13 Feb 2008 19 Jun 2008	16.35 16.56	-1.92 -0.66	"pass" "pass"
Bournemouth PM_{10} (serial no. 21257)	07 Feb 2008 06 Aug 2008	15.71 16.64	-5.76 -0.18	"pass" NOT RECORDED
Brighton Preston Park $PM_{2.5}$	02 Sep 2008	Partisol not audited.	-	-
Harwell $PM_{2.5}$	26 Aug 2008	16.7	-	-
Inverness PM_{10} (serial no. 21255)	23 Jan 2008 25 Jun 2008	16.71 16.76	0.24 0.54	"pass" "pass"
Inverness $PM_{2.5}$ (serial no. 21861)	23 Jan 2008 25 Jun 2008	16.58 16.80	-0.54 0.78	"pass" "pass"
London Marylebone Road PM_{10} (serial no. 21306)	11 Aug 2008	Partisols appeared not working.	-	-
London Marylebone Road $PM_{2.5}$ (serial no. 21493)	11 Aug 2008	Partisols appeared not working.	-	-
London N Kens PM_{10} (serial no. 21722)	22 Jul 2008	Partisol not audited	-	-
London N Kens $PM_{2.5}$	22 Jul 2008	Partisol not audited?	-	-
London Westminster PM_{10}	13 Jan 2008 13 Aug 2008	Partisol not audited 16.10	? -3.42	? NOT RECORDED
Port Talbot Margam $PM_{2.5}$	15 Jul 2008	17.17	2.80	"pass"
Wrexham (serial no. 212240)	11 Feb 2008 11 Aug 2008	16.03 15.93	-3.84 -4.44	NOT RECORDED NOT RECORDED

All audit results normal except –

- Bournemouth PM_{10}: leak test result not recorded at August audit
- Brighton Preston Park: Partisol not included in August site audit, on advice of LSO.
- London Marylebone Rd. Partisols not working at time of August site audit.
- London N. Ken. Partisols apparently not checked at August site audit.
- London Westminster: not audited in Jan 2008 as building work prevented access to site. Leak test result not recorded at August audit.
- Wrexham: leak test result not recorded at either audit.

It is recommended that if a test is missed for any reason, the reason should be recorded on the audit sheet. Also, leak test results should be recorded, not just pass/fail.

Auchencorth Moss

PM_{10}: Data capture was 86% for this quarter. Data losses as follows:

- 4th Jul, unspecified fault.
- 31st Jul – 13th Aug: 8 days lost, reason not specified.
- 19th Aug: < 18h sampling.
- 5th – 8th Sep: pneumatic line failure.

$PM_{2.5}$: Data capture was 84% for this quarter.

- 4th Jul., unspecified fault.
- 24th – 30th, unspecified fault
- 4th – 12th Aug, 8 days lost due to unspecified fault.

Bournemouth

PM_{10}: Data capture was 97% for this quarter. Data losses as follows:

- 20th – 21st July: filter exchange failure.
- 5th Sep - < 18h sampling.

Brighton Preston Park

$PM_{2.5}$ only: Data capture was 61% for this quarter.

- 25th Jul – 12th Aug: range of faults – modem failure, then power failure as result of BT visit, then filter exchange failure.
- 18th Aug – 4th Sep: filter exchange failure, then flow halted, then pump problem.

Harwell

$PM_{2.5}$ only: site started up 4th July, data capture has been 100% for this quarter.

Inverness

PM_{10}: Data capture = 99% Data losses:

- 24th Jul: < 18h sampling.

London Marylebone Road

PM_{10}: Data capture = 90%. Data losses:

- 11th Jul - filter exchange failure.
- 16th – 17th Jul – unexplained.
- 7th Aug - filter exchange failure.
- 11th – 13th Aug – unexplained.
- 31st Aug – 1st Sep - < 18m3 sampled.

$PM_{2.5}$: Data capture 93%. Data losses:

- 6th Aug filter exchange failure
- 9th – 13th Aug unexplained.

London North Kensington

PM_{10}: data capture of 79%. Data losses:

- 1st – 9th Jul: 8 days lost due to filter exchange failure.
- 11th Jul: low sample volume.
- 28th Jul – 4th Aug – valve solenoid failure.
- 27th – 28th Aug - filter exchange failure.

$PM_{2.5}$: Data capture was 89%. Data losses:

- 22nd – 27th Aug - filter exchange failure.
- 28th Aug – 1st Sep: failed vacuum seal.

London Westminster

PM_{10} only: Data capture = 97%. Data losses:

- 4th Sep: routine service.
- 22nd & 24th Sep: errors in initial weighings.

Port Talbot Margam

$PM_{2.5}$ only: data capture = 82%. Data losses:

- 22nd Jul – low sample volume
- 21st – 29th Aug: 8 days lost due to filter exchange failure.
- 24th Sep; 2 filters exposed on same day.
- 25th – 30th Sep; flow halted.

Wrexham

Data capture was 83%. Data losses:

- 17th Jul: inlet cleaning reduced valid sampling time to < 18h. (note- this happened last quarter - does not appear to cause problems at other sites).
- 8th Sep – damaged filter.
- 16th – 29th Sep - filters lost in post.

Appendix 5

Site Details for New Sites

Site Name	Pollutants		Grid	East	North	Latitude	Longtitude	Altitude m	Sample Ht m
Horley	NO_2	SE England	TQ 28203 42431	528203	142431	51 09 57N	00 10 04W	57	3
Stewartby*	SO_2	East Anglia	TL 02165 42570	502165	242570	52 04 19N	00 30 40W	38	3
York Bootham	PM_{10}	NE England	SE 59974 52278	459974	452278	53 57 47N	1 5 14W	11	3
York Fishergate	NO_2 PM_{10}	NE England	SE 60744 51133	460744	451133	53 57 07N	1 4 33W	11	3
Oxford St Ebbes	NO_2 PM_{10}	Midlands	SP 51200 05400	451200	205400			--	--
Newport	NO_2 PM_{10}	Wales	ST 32471 89615	332471	189615	51 36 04N	02 58 37W	24	3
Chepstow A48	NO_2 PM_{10}	Wales	ST 53126 93461	353126	193461	51 38 17N	02 40 43W	67	--
Aberdeen Union Street Roadside	NO_2	Scotland	NJ 93660 05947	393660	805947	57 08 40N	02 06 23W	26	2
Stanford-le-Hope Roadside	NO_2 PM_{10} SO_2	SE England	TQ 69400 82710	569400	182710	51 31 5N	00 26 22E	18	3
Carlisle Roadside	NO_2 PM_{10}	NW England	NY 39442 55956	339442	555956	54 53 41N	02 56 45W	11	3
Leeds Headingley Kerbside	NO_2 PM_{10}	NE England	SE 27991 36071	427991	436071	53 49 12N	01 34 35W	85	3
Newcastle Cradlewell Roadside	NO_2	NE England	NZ 25989 65850	425989	565850	54 59 11N	01 35 55W	42	3
Chesterfield Roadside	NO_2 PM_{10}	Midlands	SK 36349 70657	436349	370657	53 13 54N	1 27 25W	94	--
Chesterfield (Queens Park)	NO_2 PM_{10}	Midlands	SK 37909 70545	437909	370545	53 13 50N	1 26 1 W	98	--
Sandy	NO_2 PM_{10} $PM_{2.5}$	Eastern	TL165496	516450	249616	52 07 56N	0 18 1 W	22	
Saltash	PM_{10} $PM_{2.5}$	South West	SX416594	241613	659402	50 24 47N	4 13 49W	61	
Charlton Mackrell	NO_2 O_3	South West	ST 52235 28853						
Warrington	NO_2 PM_{10}								
Liverpool Queen's Drive Roadside	NO_2	NW England	SJ 36171 94956	336171	394956	53 26 49N	02 57 45W		

* Closed 31 January 2009

Appendix 6

Outliers Identified at Summer 2008 Intercalibration Exercise

6.1. Summary of results for AURN intercalibration, Jul - Sep 2008

England

SITE	Date visited	NO_x	CO	SO_2	O_3	PM_{10}	$PM_{2.5}$
Barnsley 12	09-Jul			OK			
Barnsley Gawber	08-Jul	Outlier +13%		OK	OK		
Bath Roadside	20-Aug	OK					
Billingham	08-Jul	OK					
Birmingham Centre	21-Jul	OK			OK	OK	
Birmingham Tyburn	12-Aug	OK		OK	Outlier +12%	OK	
Blackpool Marton	12-Aug	OK			OK	OK	
Bolton	07-Jul	OK			OK	OK	
Bottesford	24-Jul				OK		
Bournemouth	06-Aug	OK			Outlier -6%	OK	
Brighton Preston Park	02-Sep	OK			OK		
Brighton Roadside	03-Sep	OK				OK	
Bristol Old Market	24-Jul	OK	OK				
Bristol St Paul's	14-Jul	Outlier -13%	OK	OK	OK	OK	
Bury Roadside	07-Jul	OK	Outlier -12%			OK	
Cambridge Roadside	04-Sep	OK					
Canterbury	02-Sep	Outlier -11%					
Carlisle Roadside	30-Jun	OK				OK	
Chesterfield	28-Jul	OK				OK	
Chesterfield Roadside	28-Jul	OK				OK	
Coventry Memorial Park	09-Jul	OK			Outlier -26%	OK	
Exeter Roadside	19-Aug	OK			Outlier +13%		
Glazebury	07-Jul	Converter 86%			OK		
Great Dun Fell	01-Jul				OK		
Harwell	26-Aug	OK		OK	OK	OK	OK
High Muffles	01-Jul	OK			OK		
Horley	08-Jul	OK					
Hull Freetown	07-Aug	Outlier +27%	Outlier +30%	Outlier +28%	OK	OK	
Ladybower	01-Sep	OK		Outlier -16%	Outlier +16%		
Leamington Spa	18-Aug	OK		OK	OK	OK	

SITE	Date visited	NO_x	CO	SO_2	O_3	PM_{10}	$PM_{2.5}$
Leeds Centre	12-Sep	OK	OK	OK	Outlier +66%	OK	
Leeds Headingley Roadside	05-Aug	Converter 90%				OK	
Leicester Centre	05-Aug	OK	OK	OK	Outlier +10%	OK	
Leominster	07-Aug	Outlier +22%			OK		
Liverpool Queen's Drive Roadside	13-Aug	OK					
Liverpool Speke	13-Aug	OK	OK	OK	OK	OK	
Lullington Heath	04-Sep	Outlier -11%		OK	OK		
Manchester Piccadilly	07-Jul	Converter 89%			OK	OK	
Manchester South	07-Jul	Fault identified			OK		
Market Harborough	07-Jul	OK	Outlier +15%		OK		
Middlesbrough	09-Jul	Outlier +35%	OK	OK	OK	OK	OK
Newcastle Centre	07-Jul	Converter 92%	OK	OK	OK	Flows -12%	
Newcastle Cradlewell RS	07-Jul	OK					
Northampton	18-Jul	Outlier +26%		Outlier -11%	Outlier -25%	OK	
Norwich Centre	Not	Operational					
Nottingham Centre	31-Jul	OK		OK	OK	OK	
Oxford Centre Roadside	19-Aug	OK					
Oxford St Ebbes	19-Aug	OK			OK	ko -3.6%	
Plymouth Centre	18-Aug	OK			OK	OK	
Portsmouth	21-Jul	OK			Outlier +6%	OK	
Preston	12-Aug	Outlier -13%			OK	OK	
Reading New Town	28-Jul	OK		OK	OK	OK	
Rochester Stoke	16-Sep	OK		OK	OK	OK	OK
Salford Eccles	08-Jul	OK	OK	OK	Outlier +12%	OK	
Sandwell West Bromwich	15-Jul	Outlier +17%		OK	OK		
Scunthorpe Town	06-Aug	OK		OK		OK	
Sheffield Centre	04-Aug	Outlier -17%	OK	OK	Outlier +8%	OK	
Sheffield Tinsley	04-Aug	OK					
Sibton	02-Sep				OK		
Somerton	03-Sep	Outlier -14%			OK		
Southampton Centre	01-Sep	OK	OK	OK	OK	OK	OK
Southend-on-Sea	27-Aug	Outlier +29%			OK	OK	
St Osyth	18-Sep	Outlier +15%	OK		OK		
Stanford-le-Hope Roadside	26-Aug	OK		OK		OK	
Stewartby	17-Jul			Outlier -32%			
Stockton-on-Tees Yarm	09-Jul	Outlier +15%				OK	
Stoke-on-Trent Centre	09-Jul	Outlier -12%			OK	OK	
Sunderland Silksworth	10-Jul	OK			OK		
Thurrock	08-Jul	OK		OK	OK	OK	OK

SITE	Date visited	NO_x	CO	SO_2	O_3	PM_{10}	$PM_{2.5}$
Walsall Willenhall	26-Aug	OK					
Weybourne	07-Aug						
Wicken Fen	01-Sep	OK		Outlier +20%	OK		
Wigan Centre	02-Sep	OK			Outlier +16%	OK	
Wirral Tranmere	09-Jul	OK			OK	OK	
Yarner Wood	03-Sep	OK			OK		
York Bootham	29-Jul				OK		
York Fishergate	29-Jul	OK			OK		

London

SITE	Date visited	NO_x	CO	SO_2	O_3	PM_{10}	$PM_{2.5}$
Camden Kerbside	26-Aug	Outlier +13%				OK	
Haringey Roadside	18-Sep	OK				Flows -16%	
London Bexley	23-Jul	OK	OK	OK		OK	
London Bloomsbury	20-Jul	OK	OK	OK	OK	OK	OK
London Cromwell Road 2	30-Jul	Converter 92%	OK	Outlier +14%			
London Eltham	04-Aug	OK		OK	OK	ko -3.3%	
London Haringey	18-Sep	OK			OK		
London Harlington	14-Aug	OK			OK	OK	
London Hillingdon	23-Jul	Outlier -12%			OK		
London Marylebone Road	11-Aug	Outlier +17%	OK	Outlier +23%	OK	OK	OK
London N. Kensington	22-Jul	OK	OK	Outlier +36%	OK	OK	
London Teddington	22-Jul	Outlier -18%			OK		
London Westminster	13-Aug	OK	OK	OK	OK	OK	
Southwark Roadside	Not	Operational					
Tower Hamlets Roadside	28-Aug	OK	OK				

Wales

SITE	Date visited	NO_x	CO	SO_2	O_3	PM_{10}	$PM_{2.5}$
Aston Hill	02-Sep	OK			OK		
Cardiff Centre	17-Jul	OK	OK	OK	OK	Flows -20%	
Chepstow A48	30-Jun	OK				OK	
Cwmbran	14-Jul	OK			Outlier +12%		
Narberth	16-Jul	OK		Outlier -14%	OK	OK	
Newport St Julian's	30-Jun	Outlier +20%				OK	
Port Talbot Margam	15-Jul	OK		OK	OK	OK	
Swansea Roadside	15-Jul	Outlier -14%				OK	OK
Wrexham	11-Aug	Outlier -28%		OK		OK	

SITE	Date visited	NO_x	CO	SO_2	O_3	PM_{10}	$PM_{2.5}$
Aberdeen	23-Jun	OK			OK	OK	
Aberdeen Union St Roadside	24-Jun	OK					
Auchencorth Moss	19-Jun	OK			OK	OK	OK
Auchencorth Moss Partisols	19-Jun					OK	OK
Bush Estate	19-Jun	Outlier +19%			OK		
Dumfries	30-Jun	OK					
Edinburgh St Leonards	17-Jun	OK	OK	OK	OK	OK	
Eskdalemuir	02-Jul	OK			Outlier +9%		
Fort William	23-Jul	OK			OK		
Glasgow Centre	01-Jul	Outlier -18%	OK	OK	Outlier -6%	OK	
Glasgow City Chambers	02-Jul	Outlier -16%					
Glasgow Kerbside	02-Jul	OK				OK	
Grangemouth	22-Jul	OK		OK		ko -5.6%	
Inverness	25-Jun	OK				OK	
Lerwick	31-Jul				OK		
Strath Vaich	01-Aug				OK		

Ireland

SITE	Date visited	NO_x	CO	SO_2	O_3	PM_{10}	$PM_{2.5}$
NORTHERN IRELAND							
Belfast Centre	29-Jul	OK	OK	OK	OK	OK	
Derry	18-Aug	OK		OK	OK	OK	OK
Lough Navar	05-Aug				OK	OK	
IRELAND							
Mace Head	06-Aug				OK		

Appendix 7

Certificate of Calibration

AEA

UKAS CALIBRATION

0401

CERTIFICATE OF CALIBRATION

551.11, Harwell, Didcot, Oxfordshire OX11 0QJ. Telephone 0870 1906465 Fax 0870 1906377

Certificate Number: 02066
AEA Identification Number: ED42523030

Approved Signatories: K. Stevenson
S. Eaton ✓

Signed:

Date of issue: 20 March 2009

Customer Name and Address: Dr Janet Dixon

AEQ Division
Department for Environment, Food and Rural Affairs
Ashdown House (Zone E14)
123 Victoria Street
London SW1E 6DE

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

1. Northern Ireland Sites (including Mace Head)

Carbon Monoxide

Date Year = 2008	Site	Analyser number	[1]Zero output	Uncertainty (ppm)	[2]Calibration Factor	Uncertainty (%)	*Maximum Residual (%)
29-Jul	Belfast Centre	m491	59	0.3	0.055	3	10.5

Sulphur Dioxide

Date Year =2008	Site	Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	*Max Residual (%)	*m-xylene interference (ppb)
29-Jul	Belfast Centre	m637	233	4	0.196	5	1.1	23.0
18-Aug	Derry	1697	11	4.2	1.141	5	0.8	14.8

Ozone

Date Year =2008	Site	Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	*Max Residual (%)
29-Jul	Belfast Centre	m412	280	5	0.096	3.4	5.8
18-Aug	Derry	1586	0	5	0.963	3.3	0.5
05-Aug	Lough Navar	337	-1	5	0.547	3.8	4.0
06-Aug	Mace Head	77086-385	1	5	0.997	3.3	0.7

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

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Oxides of Nitrogen

Date Year =2008	Site		Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	*Max residual (%)	*Converter efficiency (%)
29-Jul	Belfast Centre	NO	m733	255	5	0.409	5	1.3	
		NOx		257	5.4	0.423	5	1.4	98.3
18-Aug	Derry	NO	2130	1	5	1.111	6.2	2.4	
		NOx		2	5.3	1.131	7.5	3.0	96.4

Particulate Analysers

Date Year =2008	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 (%)
29-Jul	Belfast Centre	24423	14235	1	0.3	2.03	2.2	16.06	2.2
18-Aug	Derry PM_{10}	21313	10946	1	0.5	Not	Tested	Access	Unsafe
18-Aug	Derry $PM_{2.5}$	27016	12746	1	-1.1	Not	Tested	Access	Unsafe

2. Scottish Sites

Carbon Monoxide

Date Year = 2008	Site	Analyser number	[1]Zero output	Uncertainty (ppm)	[2]Calibration Factor	Uncertainty (%)	*Maximum Residual (%)
17-Jun	Edinburgh St Leonards	240	0	0.3	0.985	3	3.9
01-Jul	Glasgow Centre	0410-009	-4	0.3	0.049	3	1.5

Sulphur Dioxide

Date Year =2008	Site	Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	*Max Residual (%)	*m-xylene interference (ppb)
17-Jun	Edinburgh St Leonards	71	8	4.2	1.012	6.0	1.7	11.6
01-Jul	Glasgow Centre	43C	8	4	0.203	6.7	4.1	1.0
22-Jul	Grangemouth	703B-274	-1	4.3	1.000	5.3	1.3	21.8

Ozone

Date Year =2008	Site	Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	*Max Residual (%)
23-Jun	Aberdeen	800	1.7	5	0.915	3.3	2.8
19-Jun	Auchencorth Moss	721	0	5	1.011	3.3	3.6
19-Jun	Bush Estate	77087-385	15	5	0.492	3.3	0.4
17-Jun	Edinburgh St Leonards	136	0	5	1.008	3.3	0.4
02-Jul	Eskdalemuir	158	21	5	0.460	3.3	0.7
23-Jul	Fort William	1023	-1	5	0.996	3.3	1.3
01-Jul	Glasgow Centre		0	5	0.215	3.3	0.3
31-Jul	Lerwick	841b-176	2	5	1.047	3.2	1.4
01-Aug	Strath Vaich	801	0	5	0.982	3.1	0.8

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Oxides of Nitrogen

Date Year =2008	Site		Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	*Max residual (%)	*Converter efficiency (%)
23-Jun	Aberdeen	NO	519	1	5	1.316	5	1.3	
		NOx		1	5.4	1.335	5.3	1.0	94.8
24-Jun	Aberdeen Union Street Roadside	NO	984	1	5	1.435	5.2	1.0	
		NOx		2	5.4	1.416	5.2	0.5	97.7
19-Jun	Bush Estate	NO	58112-316	12	5	1.039	5	1.7	
		NOx		13	5.3	1.057	5	1.8	98.7
30-Jun	Dumfries	NO	1494	0	5	1.133	5	1.6	
		NOx		-2	5.3	1.091	5	0.9	94.5
17-Jun	Edinburgh St Leonards	NO	73	1	5	1.210	5	2.0	
		NOx		2	5.3	1.231	5	1.5	99.5
02-Jul	Eskdalemuir	NO	347	13	5	1.204	5	0.2	
		NOx		11	5.6	1.092	5	0.3	99.5
23-Jul	Fort William	NO	344	0	5	1.030	5	1.2	
		NOx		-1	5.3	1.050	5.1	0.9	97.9
01-Jul	Glasgow Centre	NO		-42	5	0.515	6.4	2.2	
		NOx		-44	5.4	0.521	6.3	2.8	95.6
02-Jul	Glasgow City Chambers	NO	575	0	5	1.678	5	2.0	
		NOx		3	5.5	1.759	5	1.6	98.6
02-Jul	Glasgow Kerbside	NO		16	5	1.867	5	1.9	
		NOx		15	5.5	1.891	5.2	1.8	100.0
22-Jul	Grangemouth	NO	700B-312	-1	5	0.890	5	0.4	
		NOx		2	5.3	0.904	5	0.4	100.8
25-Jun	Inverness	NO	1489	0	5	0.995	5	1.2	
		NOx		1	5.3	1.016	5.1	0.8	99.6

Particulate Analysers

Date Year =2008	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 (%)
23-Jun	Aberdeen	24427	11615	1	0.4	**2.93**	**2.2**	**13.51**	**2.2**
19-Jun	Auchencorth Moss $FDMS_{10}$	26039	12997	1	-1.5	2.96	2.2	15.70	2.2
19-Jun	Auchencorth Moss $FDMS_{2.5}$	26033	13766	1	-1.8	2.95	2.2	14.98	2.2
19-Jun	Auchencorth Moss $Partisol_{10}$	21550						16.96	2.2
19-Jun	Auchencorth Moss $Partisol_{2.5}$	21548						16.56	2.2
17-Jun	Edinburgh St Leonards	21308	11492	1	-0.7	3.02	2.2	15.75	2.2
01-Jul	Glasgow Centre	22980	13153	1	0.1	1.99	2.2	16.06	2.2
02-Jul	Glasgow Kerbside	21264	12590	1	-0.3	2.07	2.2	**14.51**	2.2
22-Jul	Grangemouth	22763	11944	1	-5.6	3.28	2.2	17.86	2.2
25-Jun	Inverness	21255						16.76	2.2

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3. Welsh Sites

Carbon Monoxide

Date Year = 2008	Site	Analyser number	[1]Zero output	Uncertainty (ppm)	[2]Calibration Factor	Uncertainty (%)	*Maximum Residual (%)
17-Jul	Cardiff Centre	14333	1	0.3	0.990	3	0.5

Sulphur Dioxide

Date Year =2008	Site	Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	*Max Residual (%)	*m-xylene interference (ppb)
17-Jul	Cardiff Centre	14319	4	4.2	1.000	6.8	4.3	10.0
16-Jul	Narberth	aea26	36	4.1	0.548	7.5	5.1	
15-Jul	Port Talbot Margam	11669	5	4.2	1.025	5.9	2.9	
11-Aug	Wrexham	12183	5	4.2	0.984	5	1.4	9.8

Ozone

Date Year =2008	Site	Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	*Max Residual (%)
02-Sep	Aston Hill	144	8	5	0.488	3.1	0.2
17-Jul	Cardiff Centre	14348	0	5	0.995	3.1	1.0
14-Jul	Cwmbran	aea29	0	5	0.888	3.4	1.5
16-Jul	Narberth	aea27	0	5	0.989	3.1	1.0
15-Jul	Port Talbot Margam	94754	5	5	0.496	3.1	1.0

Oxides of Nitrogen

Date Year =2008	Site		Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	*Max residual (%)	*Converter efficiency (%)
02-Sep	Aston Hill	NO NOx	m853	102 102	5 5.3	1.185 1.218	5 5	0.8 0.2	97.1
17-Jul	Cardiff Centre	NO NOx	14325	0 0	5 5.3	1.239 1.247	5 5	0.8 1.1	102.2
30-Jun	Chepstow A48	NO NOx		99 104	5 5.5	1.132 1.182	5 5	1.5 0.9	100.0
14-Jul	Cwmbran	NO NOx	1	-2 1	5 5.3	1.020 0.970	5 5	4.8 5.0	98.8
16-Jul	Narberth	NO NOx	aea25	87 85	5 5.2	0.571 0.585	5 5	2.8 0.7	97.3
30-Jun	Newport St Julian's	NO NOx	M671	0 5	5 5.3	0.973 1.022	5 5	1.5 2.1	96.8
15-Jul	Port Talbot Margam	NO NOx	94617	4 4	5 5.3	1.170 1.179	5 5	0.8 0.7	99.5
15-Jul	Swansea Roadside	NO NOx	16695	2 3	5 5.3	1.255 1.254	5 5	1.5 2.3	98.4
11-Aug	Wrexham	NO NOx	12185	1 2	5 5.3	1.191 1.198	5 5	0.9 0.9	99.0

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Particulate Analysers

Date Year =2008	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 (%)
17-Jul	Cardiff Centre	24449	10968	1	-0.3	2.98	2.2	14.22	2.2
30-Jun	Chepstow A48	2128	10655	1	0.2	2.95	2.2	16.46	2.2
16-Jul	Narberth	21143	12563	1	0.6	**3.07**	**2.2**	**14.04**	**2.2**
30-Jun	Newport St Julian's	22589	11875	1	-0.9	2.89	2.2	16.12	2.2
15-Jul	Port Talbot PM_{10}	22588	14558	1	0.5	**3.10**	**2.2**	**13.52**	**2.2**
15-Jul	Port Talbot $PM_{2.5}$	25081	10483	1	-0.7	**3.14**	**2.2**	**13.73**	**2.2**
15-Jul	Swansea Roadside PM_{10}	26293	15410	1	-1.2	**3.05**	**2.2**	**13.33**	**2.2**
15-Jul	Swansea Roadside $PM_{2.5}$	26292	14232	1	-1.4	**2.99**	**2.2**	**13.07**	**2.2**
11-Aug	Wrexham	4001						15.93	2.2

4. London Sites

Carbon Monoxide

Date Year = 2008	Site	Analyser number	[1]Zero output	Uncertainty (ppm)	[2]Calibration Factor	Uncertainty (%)	*Maximum Residual (%)
23-Jul	London Bexley	14871	1	0.3	1.024	3	2.1
20-Jul	London Bloomsbury	14330	0	0.3	1.015	3	5.5
30-Jul	London Cromwell Road 2	10776	11	0.3	0.307	3.1	0.6
11-Aug	London Marylebone Rd	10073	0	0.3	0.981	3	0.5
22-Jul	London N. Kensington	360	2	0.3	0.969	3	2.3
13-Aug	London Westminster	10777	18	0.3	0.053	3	3.2
28-Aug	Tower Hamlets Roadside	272	9	0.3	1.105	3.1	2.3

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Date Year =2008	Site	Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	*Max Residual (%)	*m-xylene interference (ppb)
23-Jul	London Bexley	14869	11	4.2	0.936	8.4	5.3	24.7
20-Jul	London Bloomsbury	14323	-2	4.2	1.052	5	3.6	19.3
30-Jul	London Cromwell Rd 2	10779	-30	4.1	0.927	6.5	3.6	47.3
11-Aug	London Marylebone Rd	10071	0	4.2	1.091	5	0.7	
22-Jul	London N. Kensington	1020	44	4.3	0.917	7.8	4	21.6
13-Aug	London Westminster	10780	9	4.4	1.113	16	5.8	40.6

Ozone

Date Year =2008	Site	Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	*Max Residual (%)
20-Jul	London Bloomsbury	14907	0	5	1.005	3.3	1.5
04-Aug	London Eltham	375	8	5	0.974	3.1	0.9
18-Sep	London Haringey	538	10	5	0.966	3.1	1.8
14-Aug	London Harlington	14309	0	5	0.981	3.1	0.7
23-Jul	London Hillingdon	427-012	4	5	0.096	3.1	2.3
11-Aug	London Marylebone Rd	10074	0	5	1.027	3.5	2.5
22-Jul	London N. Kensington	497	10	5	0.981	3.1	1.9
22-Jul	London Teddington	58811	0	5	0.978	3.1	0.4
13-Aug	London Westminster	10444	4	5	0.519	3.1	1.0

Oxides of Nitrogen

Date Year =2008	Site		Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	*Max residual (%)	*Converter efficiency (%)
26-Aug	Camden Kerbside	NO NOx	623	3 3	5 5.3	1.009 0.907	5 5	1.6 0.8	96.4
18-Sep	Haringey Roadside	NO NOx	397	2 2	5 5.3	0.899 0.969	5 5	1.9 3.1	100.8
23-Jul	London Bexley	NO NOx	14870	-1 -1	5 5.3	1.025 1.043	5 5	3.3 3.2	102.2
20-Jul	London Bloomsbury	NO NOx	14328	1 1	5 5.3	1.226 1.226	8.3 7.7	4.2 3.6	102.1
30-Jul	London Cromwell Rd 2	NO NOx	10775	1 1	5 5.7	2.414 2.343	5.5 6.3	2.8 3.5	92.0
04-Aug	London Eltham	NO NOx	307	2 2	5 5.3	1.088 1.240	5 5	3.9 3.3	100.0
18-Sep	London Haringey	NO NOx	11392	1 2	5 5.3	1.091 1.122	5 5	0.5 1.4	100.9
14-Aug	London Harlington	NO NOx	11491	0 0	5 5.4	1.348 1.390	5 5	0.7 1.2	98.8
23-Jul	London Hillingdon	NO NOx	447-0007	-1 -10	5 5.2	0.457 0.444	5 5	2.3 2.4	99.2

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0401

CERTIFICATE OF CALIBRATION

551.11, Harwell, Didcot, Oxfordshire OX11 0QJ. Telephone 0870 1906465 Fax 0870 1906377

Certificate Number: 02066
AEA Identification Number: ED42523030

Date Year =2008	Site		Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	*Max residual (%)	*Converter efficiency (%)
11-Aug	London Marylebone Rd	NO NOx	10072	0 0	5 5.5	1.531 1.659	5 5	0.5 1.4	 98.7
22-Jul	London N. Kensington	NO NOx	459	2 3	5 5.4	1.101 1.108	5 5.3	3.2 2.8	 100.9
22-Jul	London Teddington	NO NOx	287	3 1	0 0	1.230 1.221	0 0	1.3 1.3	 99.0
13-Aug	London Westminster	NO NOx	10439	3 2	5 6.5	3.714 3.922	5.7 5	3.3 3.9	 101.4
28-Aug	Tower Hamlets Roadside	NO NOx	306	3 5	5 5.3	0.971 0.922	5 5	3.9 3.6	 96.3

Particulate Analysers

Date Year =2008	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 (%)
26-Aug	Camden Kerbside	21152	16530	1	0.7	3.07	2.2	**14.02**	2.2
18-Sep	Haringey Roadside	9407	11415	1	-0.4	2.55	2.2	14.00	2.2
23-Jul	London Bexley PM_{10}	2000	10612	1	1.4	3.00	2.2	16.69	2.2
23-Jul	London Bexley $PM_{2.5}$	25007	11746	1	1.3	2.77	2.2	15.72	2.2
20-Jul	London Bloomsbury PM_{10}	24446	13781	1	0.3	**2.82**	**2.2**	**13.76**	**2.2**
20-Jul	London Bloomsbury $PM_{2.5}$	2000	14964	1	0.1	**3.08**	**2.2**	**14.23**	**2.2**
4-Aug	London Eltham $PM_{2.5}$	27048	13981	1	-3.3	3.02	2.2	15.82	2.2
14-Aug	London Harlington	22835	14222	1	0.1	2.03	2.2	**14.9**	2.2
11-Aug	London Marylebone Road PM_{10}	21306	13383	1	0.3	3.09	2.2	16.26	2.2
11-Aug	London Marylebone Road $PM_{2.5}$	21493	13830	1	-1.4	3.32	2.2	16.68	2.2
22-Jul	London N. Kensington	21722	11291	1	-0.4	2.98	2.2	17.23	2.2
13-Aug	London Westminster							16.1	2.2

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5. English Sites

Carbon Monoxide

Date Year = 2008	Site	Analyser number	[1]Zero output	Uncertainty (ppm)	[2]Calibration Factor	Uncertainty (%)	*Maximum Residual (%)
24-Jul	Bristol Old Market	10429	-2	0.3	0.861	3	2.5
14-Jul	Bristol St Paul's	14417	-1	0.3	1.033	3	2.9
7-Jul	Bury Roadside	277	0	0.3	1.247	3.3	3.9
7-Aug	Hull Freetown	m489	54	0.3	0.039	3	2.1
12-Sep	Leeds Centre	5	0	0.3	1.000	3	2.5
5-Aug	Leicester Centre	5	0	0.3	1.171	3	3.7
13-Aug	Liverpool Speke	487	50	0.3	0.049	3	2.9
7-Jul	Market Harborough	60983	-23	0.3	0.005	29.8	2.6
9-Jul	Middlesbrough	204	2	0.3	1.044	5.6	6.8
7-Jul	Newcastle Centre	M488	55	0.3	0.049	3	2.6
8-Jul	Salford Eccles	2386	0	0.3	0.993	3	1.2
4-Aug	Sheffield Centre	8	11	0.3	0.098	5.7	2.7
1-Sep	Southampton Centre	1810	47	0.3	0.051	4.1	4.7
18-Sep	St Osyth	60872	0	0.4	1.197	25.6	3.5

Sulphur Dioxide

Date Year =2008	Site	Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	*Max Residual (%)	*m-xylene interference (ppb)
9-Jul	Barnsley 12	10781	1	4.2	1.125	5	1.4	27
8-Jul	Barnsley Gawber	65928	111	4.2	1.125	10.3	5.3	38.3
12-Aug	Birmingham Tyburn		2	4.3	1.023	6.5	3.8	44.5
14-Jul	Bristol St Paul's	14322	6	4.2	1.004	5	0.5	12.7
26-Aug	Harwell	83	41	4.1	0.525	5	2.8	2.4
7-Aug	Hull Freetown	m686	246	4.1	0.141	5	2.4	38.7
1-Sep	Ladybower	793	49	4.2	0.828	5	1.8	41.2
18-Aug	Leamington Spa	53	4	4.3	0.887	6.5	4.0	18.2
12-Sep	Leeds Centre	6	2	4.2	1.138	5.1	2.3	1.1
5-Aug	Leicester Centre	6	3	4.2	0.988	5	3.6	0
7-Aug	Leominster	85	4	4.3	1.542	5.2	2.4	17.3
13-Aug	Liverpool Speke	626	262	4.1	0.394	5.1	4.0	13.8
4-Sep	Lullington Heath	690	104	4.1	0.468	5	1.2	18.3
9-Jul	Middlesbrough	1660	7	4.2	1.010	5	0.7	14.5
7-Jul	Newcastle Centre	M689	50	4.2	1.012	5	1.5	23.3
18-Jul	Northampton	33	2	4.1	0.895	5	1.7	21.7
31-Jul	Nottingham Centre		9	4	0.220	5	4.8	29.5
16-Sep	Rochester Stoke	203	-5	4.2	0.958	5.7	2.9	6.7
8-Jul	Salford Eccles	2346	3	4.4	1.139	5	0.1	15.7
15-Jul	Sandwell West Bromwich	14322	2	4.1	0.863	5	1.2	16.4
6-Aug	Scunthorpe Town	10276	0	Not tested	0.978	Not tested		33.3
4-Aug	Sheffield Centre	15	18	4	0.190	5.4	4.4	11.8
1-Sep	Southampton Centre	9810	210	4	0.219	9.3	3.8	14.9

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Date Year =2008	Site	Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	*Max Residual (%)	*m-xylene interference (ppb)
26-Aug	Stanford-le-Hope Roadside	14188	12	4.2	1.038	5.5	1.8	7.3
17-Jul	Stewartby	819	2	4.8	1.688	6.7	5	11
8-Jul	Sunderland Silksworth	996B-382	1	4.2	1.114	5	1.8	14.5
26-Aug	Thurrock	10554	7	4.2	1.041	5	1.4	6.2
2-Sep	Wicken Fen	14349	-17	4.1	0.422	5	3.5	0

Ozone

Date Year =2008	Site	Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	*Max Residual (%)
8-Jul	Barnsley Gawber	65928	0	5	0.947	3.7	3.3
21-Jul	Birmingham Centre	14327	3	5	0.096	3.1	0.7
12-Aug	Birmingham Tyburn		0	5	0.874	3.4	2.6
12-Aug	Blackpool Marton		2	5	0.972	3.2	2.4
7-Jul	Bolton	195	0	5	0.977	3.1	0.3
24-Jul	Bottesford	357	0	5	1.249	3.1	1.0
6-Aug	Bournemouth	17503	0	5	1.058	3.1	1.0
2-Sep	Brighton Preston Park	12461	2	5	0.514	3.2	0.8
14-Jul	Bristol St Paul's	14358	1	5	1.024	3.1	1.7
3-Sep	Charlton Mackrell	95249	2	5	0.490	3.1	0.5
9-Jul	Coventry Memorial Park	7	0	5	1.348	3.2	2.2
19-Aug	Exeter Roadside	1	3	5	0.887	3.1	1.6
7-Jul	Glazebury	138	11	5	0.489	3.4	1.1
1-Jul	Great Dun Fell	163	-2	5	0.522	3.3	0.6
26-Aug	Harwell	hsp00023	-1	5	0.493	3.4	1.1
1-Jul	High Muffles	713b-158	2	5	0.956	3.7	1.3
7-Aug	Hull Freetown	m356	251	5	0.102	3.4	3.8
1-Sep	Ladybower	101	51	5	0.432	3.1	1.2
18-Aug	Leamington Spa	1459	1	5	0.993	3.1	1.8
12-Sep	Leeds Centre	4	0	5	0.604	3.1	1.2
5-Aug	Leicester Centre	4	0	5	0.915	3.1	1.7
7-Aug	Leominster	170	-1	5	0.969	3.2	1.6
13-Aug	Liverpool Speke	331	238	5	0.096	3.1	2.7
4-Sep	Lullington Heath	337	97	5	0.509	3.2	0.3
7-Jul	Manchester Piccadilly		8	5	0.202	5.1	2.1
7-Jul	Manchester South	1317	0	5	0.985	3.6	1.3
7-Jul	Market Harborough	60894	2	5	0.478	3.4	1.9
9-Jul	Middlesbrough	944	0	5	0.999	3.4	1.0
7-Jul	Newcastle Centre	M357	Analyser fault				
18-Jul	Northampton	110	0	5	1.349	3.2	0.9
31-Jul	Nottingham Centre	11	0	5	0.241	3.1	1.0
18-Aug	Plymouth Centre		500	5	0.051	3.1	1.0
21-Jul	Portsmouth	205002	3	5	0.947	3.1	1.0
12-Aug	Preston		0	5	1.013	3.1	0.8
28-Jul	Reading New Town	h/ah/001	2	5	0.985	3.1	0.4
16-Sep	Rochester Stoke	378	0	5	0.978	3.2	0.5
8-Jul	Salford Eccles	2363	3	5	0.890	3.3	1.1
15-Jul	Sandwell West Bromwich	14358	-1	5	1.028	3.2	1.5

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Date Year =2008	Site	Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	*Max Residual (%)	*m-xylene interference (ppb)
4-Aug	Sheffield Centre	10	-8	5	0.093	3.1	2.1	2.1
2-Sep	Sibton	219	25	5	0.481	3.1	0.4	0.4
1-Sep	Southampton Centre	1768	228	5	0.095	3.1	0.4	0.4
27-Aug	Southend-on-Sea	4	0	5	0.946	3.1	2.1	2.1
18-Sep	St Osyth	60869	0	5	0.946	3.3	4.4	4.4
10-Jul	Stoke-on-Trent Centre	1	1	5	1.030	3.2	3.0	3.0
8-Jul	Sunderland Silksworth	436	-3	5	0.972	3.1	0.7	0.7
26-Aug	Thurrock	10788	2	5	0.498	3.1	0.7	0.7
1-Sep	Weybourne	aea30	0	5	0.995	3.1	0.8	0.8
2-Sep	Wicken Fen	14345	-9	5	0.515	3.1	1.5	1.5
9-Jul	Wigan Centre	4009	-1	5	0.854	3.4	0.5	0.5
11-Aug	Wirral Tranmere		1	5	1.023	3.2	1.1	1.1
3-Sep	Yarner Wood	14456	31	5	0.525	3.1	0.7	0.7

Oxides of Nitrogen

Date Year =2008	Site		Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	*Max residual (%)	*Converter efficiency (%)
8-Jul	Barnsley Gawber	NO NOx	65928	15 16	5 5.6	1.266 1.288	5.2 5.1	3.8 3.8	102.8
20-Aug	Bath Roadside	NO NOx	12758	7 12	5 5.4	1.235 1.276	5 5	3.6 3.5	102.6
8-Jul	Billingham	NO NOx	574	-1 0	5 5.4	1.363 1.412	5 5	0.6 0.9	101.1
21-Jul	Birmingham Centre	NO NOx	14324	-8 -8	5 5.2	0.555 0.565	5 5	3.0 2.9	100.8
12-Aug	Birmingham Tyburn	NO NOx		1 0	5 5.3	1.066 1.100	5 5	2.2 2.0	98.2
12-Aug	Blackpool Marton	NO NOx		43 44	5 6.0	1.913 1.937	5 5	2.1 3.9	97.7
7-Jul	Bolton	NO NOx	433	-2 4	5 5.3	1.117 1.097	5 5	2.0 2.5	96.2
6-Aug	Bournemouth	NO NOx	17507	8 7	5 5.5	1.071 1.079	5 5	2.0 1.8	97.3
2-Sep	Brighton Preston Park	NO NOx	13068	3 2	5 5.3	1.138 1.168	5 5	3.5 3.5	97.5
3-Sep	Brighton Roadside	NO NOx	11885	0 -2	5 5.6	1.414 1.406	5 5	2.1 1.8	98.2
24-Jul	Bristol Old Market	NO NOx	10510	1 2	5 5.5	1.180 1.187	5 5	1.0 1.0	98.5
14-Jul	Bristol St Paul's	NO NOx	14353	1 1	5 5.4	1.579 1.591	5 5	1.2 1.3	101.8
7-Jul	Bury Roadside	NO NOx	1710	1 1	5 5.4	1.228 1.275	5 5	1.6 3.2	101.6
4-Sep	Cambridge Roadside	NO NOx	303	-2 -2	5 5.3	0.973 0.984	5 5	0.4 0.4	100.4
2-Sep	Canterbury	NO NOx	1781	-1 -1	5 5.4	1.331 1.363	5 5	3.9 3.2	99.0
30-Jun	Carlisle Roadside	NO NOx	m2223-m906	6 -1	5 5.3	1.026 1.063	5 5	0.6 0.4	97.6
3-Sep	Charlton	NO	12895	4	5	0.467	5	0.5	

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	Mackrell	NOx		3	5.2	0.438	5	0.3	99.8
28-Jul	Chesterfield	NO	528	0	5	0.955	5	1.3	
		NOx		5	5.3	0.987	5	0.5	96.6
28-Jul	Chesterfield Roadside	NO	7645b-342	100	5	0.950	9.8	14.3	
		NOx		102	5.4	0.983	10.7	15.1	97.9
9-Jul	Coventry Memorial Park	NO	4	0	5	1.045	5	0.9	
		NOx		0	5.3	1.026	5	0.7	97.0
19-Aug	Exeter Roadside	NO	d19	1	5	1.099	5	3.2	
		NOx		-3	5.3	1.062	5	2.4	99.6
7-Jul	Glazebury	NO	78	9	5	0.522	5	1.1	
		NOx		12	5.4	0.525	5	1.7	86.1
26-Aug	Harwell	NO	79	11	5	1.228	5	2.2	
		NOx		10	5.3	1.222	5	1.6	97.4
1-Jul	High Muffles	NO	1783	-1	5	0.538	5	1.2	
		NOx		0	5.2	0.556	5	0.9	98.4
8-Jul	Horley	NO	m1224-m525	0	5	1.084	5	1.2	
		NOx		1	5.3	1.095	5	0.8	97.5
7-Aug	Hull Freetown	NO	m732	264	5	0.363	5	2.9	
		NOx		257	5.4	0.373	5	2.0	99.4
1-Sep	Ladybower	NO	72	1	5	1.114	5	1.4	
		NOx		-1	5.3	1.105	5	0.1	96.3
18-Aug	Leamington Spa	NO	1705	0	5	1.008	5	0.5	
		NOx		1	5.3	1.034	5	0.6	98.1
12-Sep	Leeds Centre	NO	7	0	5	0.987	5	2.8	
		NOx		0	5.3	0.976	5	2.5	100.4
5-Aug	Leeds Headingley Kerbside	NO	696b308	52	5	0.993	11.9	6.9	
		NOx		55	5.3	1.012	10.6	5.7	89.5
5-Aug	Leicester Centre	NO	7	0	5	1.026	5	3.2	
		NOx		-1	5.3	1.039	5	3.5	97.0
7-Aug	Leominster	NO	346	1	5	0.817	5	1.4	
		NOx		2	5.3	0.823	5	2.4	99.0
13-Aug	Liverpool Queen's Drive Roadside	NO	16727	2	5	1.377	5	1.9	
		NOx		2	5.4	1.392	5	2.1	99.4
13-Aug	Liverpool Speke	NO	734	244	5	0.423	5	2.8	
		NOx		249	5.2	0.435	5	3.0	99.6
4-Sep	Lullington Heath	NO	675	100	5	1.085	5	0.2	
		NOx		102	5.3	1.062	5	0.9	99.6
7-Jul	Manchester Piccadilly	NO	447-011	0	5	0.540	5	3.8	
		NOx		-6	5.5	0.547	5	4.7	88.9
7-Jul	Manchester South	NO	292	Analyser fault					
		NOx							
7-Jul	Market Harborough	NO	61963	-5	5	0.491	5	1.3	
		NOx		-3	5.2	0.498	5	0.8	97.8
9-Jul	Middlesbrough	NO	2287	1	5	1.192	5	1.1	
		NOx		1	5.3	1.207	5	1.1	97.3
7-Jul	Newcastle Centre	NO	M730	50	5	2.071	5.5	2.1	
		NOx		52	6	2.155	5.4	1.7	92.1
7-Jul	Newcastle Cradlewell Road	NO	M860	0	5	1.038	5	1.8	
		NOx		3	5.4	1.069	5	1.3	96.4
18-Jul	Northampton	NO	611	1	5	1.047	5	2.9	
		NOx		2	5.3	1.027	5	3.0	97.4
31-Jul	Nottingham	NO	9	4	5	0.491	6.6	3.4	

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	Centre	NOx		-8	5.2	0.490	6.6	3.2	98.6
19-Aug	Oxford Centre Roadside	NO	m2350-	101	5	1.146	5	1.7	
		NOx	m947	102	5.3	1.184	5	0.5	98.8
19-Aug	Oxford St Ebbes	NO	m2347-	104	5	1.061	5	0.5	
		NOx	m0946	103	5.5	1.093	5	0.6	96.7
18-Aug	Plymouth Centre	NO	iv2000	8	5	0.217	5	3.7	
		NOx		10	5.2	0.223	5	3.6	99.3
21-Jul	Portsmouth	NO	903005	0	5	1.045	5	2.7	
		NOx		0	5.3	1.083	5.1	2.7	99.6
12-Aug	Preston	NO		57	5	2.079	5	1.8	
		NOx		61	5.7	2.228	5	3.2	100.0
28-Jul	Reading New Town	NO	h/ah/001	-3	5	1.522	8.2	3.7	
		NOx		-2	5.6	1.564	5.5	2.4	101.9
16-Sep	Rochester Stoke	NO	473	-5	5	1.302	5	2.7	
		NOx		-3	5.4	1.344	5.1	2.6	102.1
8-Jul	Salford Eccles	NO	2381	-1	5	1.073	5	0.3	
		NOx		1	5.4	1.124	5	0.8	99.5
15-Jul	Sandwell West Bromwich	NO	14353	0	5	1.131	5	1.0	
		NOx		0	5.3	1.123	5	0.9	101.5
6-Aug	Scunthorpe Town	NO	m1225	30	5	2.353	8.9	3.5	
		NOx	m526	47	8.3	2.544	10	3.8	98.0
4-Aug	Sheffield Centre	NO	8	8	5	0.612	10.5	5.6	
		NOx		5	5.2	0.609	9.8	4.8	95.4
4-Aug	Sheffield Tinsley	NO	10772	-1	5	1.995	6.6	3.4	
		NOx		-1	5.9	2.019	6.8	3.6	97.9
1-Sep	Southampton Centre	NO	1781	487	5	0.125	5	2.7	
		NOx		488	5.2	0.127	5	2.7	99.1
27-Aug	Southend-on-Sea	NO	7	1	5	1.013	5	2.1	
		NOx		2	5.3	0.996	5	1.8	100.0
18-Sep	St Osyth	NO	60988	-1	5	1.040	5	3.5	
		NOx		-1	5.7	1.027	5.2	3.4	96.1
26-Aug	Stanford-le-Hope Roadside	NO	14189	2	5	1.241	5	0.6	
		NOx		2	5.3	1.268	5	1.7	98.9
9-Jul	Stockton-on-Tees Yarm	NO	448	7	5	0.938	5	1.8	
		NOx		10	5.4	0.999	5	0.4	97.0
10-Jul	Stoke-on-Trent Centre	NO	1	30	5	1.144	5	4.2	
		NOx		30	5.3	1.219	5	3.8	101.6
8-Jul	Sunderland Silksworth	NO	734B-322	1	5	1.004	5	1.4	
		NOx		2	5.3	1.015	5	1.7	100.4
26-Aug	Thurrock	NO	11004	2	5	1.277	5	0.4	
		NOx		4	5.4	1.284	5	0.3	100.5
7-Aug	Walsall Willenhall	NO	1337	0	5	0.922	5	0.6	
		NOx		3	5.3	0.985	5	1.0	98.8
2-Sep	Wicken Fen	NO	13069	22	5	0.509	5	1.1	
		NOx		21	5.2	0.513	5	1.0	102.0
9-Jul	Wigan Centre	NO	805005	0	5	1.004	5	0.7	
		NOx		-3	5.4	0.963	5	0.8	97.5
11-Aug	Wirral Tranmere	NO		15	5	2.049	5	2.4	
		NOx		15	5.6	2.118	5	2.3	97.5
3-Sep	Yarner Wood	NO	12554	6	5	1.028	5	0.2	
		NOx		3	5.3	1.040	5	0.7	98.6
29-Jul	York Fishergate	NO	272	-1	5	0.999	5	1.7	

The reported 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.

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CERTIFICATE OF CALIBRATION

551.11, Harwell, Didcot, Oxfordshire OX11 0QJ. Telephone 0870 1906465 Fax 0870 1906377

Certificate Number: 02066
AEA Identification Number: ED42523030

Date Year =2008	Site		Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	*Max residual (%)	*Converter efficiency (%)
		NOx		1	5.3	1.037	5	1.6	97.4

Particulate Analysers

Date Year =2008	Site	Analyser number	Calculated Spring Constant k_0	Uncertainty (%)	$^4k_0$ accuracy (%)	[3]Measured Main Flow (l/min)	Uncertainty (%)	[3]Measured Total Flow / **Aux Flow** (l/min)	Uncertainty (%)
21-Jul	Birmingham Centre	26034	12078	1	-2.4	3.04	2.2	16.20	2.2
12-Aug	Birmingham Tyburn	24637	13886	1	0.9	**2.93**	**2.2**	**13.46**	**2.2**
12-Aug	Blackpool Marton	24424	12947	1	0.4	3.05	2.2	16.98	2.2
7-Jul	Bolton	21197	15268	1	0.7	**2.74**	**2.2**	**13.47**	**2.2**
6-Aug	Bournemouth	21257						16.64	2.2
14-Jul	Bristol St Paul's	24426	13264	1	0.7	3.01	2.2	17.69	2.2
7-Jul	Bury Roadside	658	11614	1	0.2	**2.06**	**2.2**	**14.95**	**2.2**
30-Jun	Carlisle Roadside	25560	13894	1	-2.4	2.93	2.2	16.52	2.2
28-Jul	Chesterfield	22989	12571	1	-2.3	3.19	2.2	17.06	2.2
28-Jul	Chesterfield Roadside	22299	11186	1	-1.4	2.86	2.2	15.54	2.2
9-Jul	Coventry Memorial Park	25026	13083	1	-0.8	**3.03**	**2.2**	**13.35**	**2.2**
26-Aug	Harwell PM_{10}	21489	14594	1	-2.2	2.98	2.2	16.65	2.2
26-Aug	Harwell $PM_{2.5}$	21490		1					
7-Aug	Hull Freetown	2400	13832	1	-2	3.19	2.2	15.00	2.2
18-Aug	Leamington Spa	20705	11017	1	0.7	**3.10**	**2.2**	**13.79**	**2.2**
12-Sep	Leeds Centre	24451	13332	1	-0.5	3.27	2.2	18.23	2.2
5-Aug	Leeds Headingley Kerbside	22048	13178	1	1	**1.98**	**2.2**	**14.26**	**2.2**
5-Aug	Leicester Centre	24442	14257	1	-1.4	**2.88**	**2.2**	**12.70**	**2.2**
13-Aug	Liverpool Speke	24450	15767	1	-0.5	**2.99**	**2.2**	**13.61**	**2.2**
7-Jul	Manchester Piccadilly	26038	12797	1	-2.2	2.80	2.2	15.65	2.2
9-Jul	Middlesbrough	Analyser removed for repair							
7-Jul	Newcastle Centre	24448	13766	1	-0.4	2.80	2.2	15.04	2.2
18-Jul	Northampton	21621	14267	1	-1.7	**2.96**	**2.2**	**13.83**	**2.2**
31-Jul	Nottingham Centre	25025	12146	1	-0.3	3.02	2.2	16.76	2.2
19-Aug	Oxford St Ebbes	26145	13172	1	-3.6	**2.93**	**2.2**	**13.34**	**2.2**
18-Aug	Plymouth Centre	24428	12827	1	-0.9	2.99	2.2	16.11	2.2
21-Jul	Portsmouth	2000	13330	1	0.1	2.89	2.2	15.72	2.2
12-Aug	Preston	22881	12836	1	-0.9	3.05	2.2	17.16	2.2
28-Jul	Reading New Town	21315	13270	1	0.5	3.11	2.2	16.45	2.2
16-Sep	Rochester Stoke PM_{10}	21489	12018	1	-0.3	3.11	2.2	13.61	2.2
16-Sep	Rochester Stoke $PM_{2.5}$	21490	13733	1	-1.5	**3.07**	**2.2**	**13.40**	**2.2**
8-Jul	Salford Eccles	21168	14521	1	0.7	2.01	2.2	16.27	2.2
6-Aug	Scunthorpe Town	2000	12555	1	-0.8	**3.23**	**2.2**	**14.97**	**2.2**
4-Aug	Sheffield Centre	25024	12229	1	-0.2	3.06	2.2	17.34	2.2
1-Sep	Southampton Centre	24448	13752	1	-0.9	3.11	2.2	16.77	2.2
27-Aug	Southend-on-Sea	22927	12183	1	-2.0	**3.12**	**2.2**	**13.65**	**2.2**
26-Aug	Stanford-le-Hope Roadside	24397	13337	1	-1.6	3.27	2.2	**14.65**	2.2
9-Jul	Stockton-on-Tees Yarm	22885	14189	1	-0.7	3.02	2.2	16.08	2.2

The reported 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.

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Certificate Number: 02066
AEA Identification Number: ED42523030

Date Year =2008	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								
10-Jul	Stoke-on-Trent Centre	25028	12454	1	-0.4	2.95	2.2	15.8	2.2
26-Aug	Thurrock	25039	12738	1	-1.8	**2.99**	**2.2**	**13.84**	**2.2**
11-Aug	Wirral Tranmere	22883	13214	1	-0.6	3	2.2	17.23	2.2
29-Jul	York Bootham	22125	14560	1	-1.2	**3.01**	**2.2**	**13.99**	**2.2**
29-Jul	York Fishergate	22101	13294	1	0.8	**3.06**	**2.2**	**14.01**	**2.2**

The reported 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.

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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 fall outside our accreditation, but have been included for completeness.

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

Concentration = (output – zero response) x Calibration factor

The scaling factor for gaseous analysers is calculated using mole fraction concentrations.

3 The measured main flow rate (where this is applicable) is the flow rate through the sensor unit of a TEOM analyser. The measured aux flow rate (where this is applicable) is the flow rate through the bypass tubing of the TEOM particulate analyser under test. The measured total flow rate is the total flow rate through the particulate analyser under test. Units of flow are $l.min^{-1}$. Measurements shown in **bold** are not made at the normal sample inlet and may not therefore accurately represent the actual flow through the inlet.
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.

* The maximum residual is the percentage maximum deviation of the worst linearity point from the line of best fit
* Converter is the measured efficiency of the NO_2 to NO converter in the Nitrogen Oxides analyser
* meta-xylene interference is the response of the SO_2 analyser when supplied with approx 1ppm meta-xylene.

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