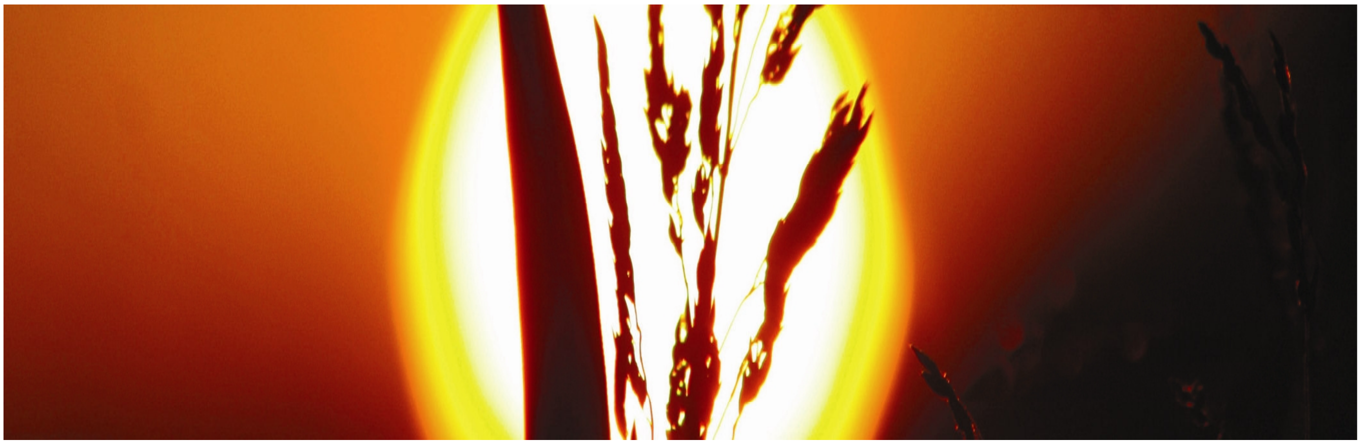

QA/QC Data Ratification and Intercalibration Report for the Automatic Urban and Rural Network, January-March 2008

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

Unrestricted

AEAT/ENV/R/2659

Issue 1

Title	QA/QC Data Ratification and Intercalibration Report for the Automatic Urban and Rural Network, January-March 2008
Customer	Department for Environment, Food and Rural Affairs, Scottish Government, Welsh Assembly Government and the DoE in Northern Ireland
Customer reference	RMP 1883
Confidentiality, copyright and reproduction	Unrestricted
File reference	AEAT/ENV/R/2659 Issue 1
Reference number	ED42523

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	Date	October 2008

Executive Summary

Part A Data Ratification for January-March 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 91.7% for all pollutants (O_3, NO_2, SO_2, CO, PM_{10} and $PM_{2.5}$) during the 3-month reporting period January-March 2008. Data capture rates for all pollutants were above 90%, with the exception of SO_2 (89.8%). There were 24 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 121, of which 61 are Local Authority owned sites affiliated to the national network. Significant changes have taken place in the network during this quarter.

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 Winter 2008 Intercalibration Exercise

A total of 104 sites in the AURN were calibrated by AEA during the January-March 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. One site (Southwark) was 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 48 out of 303 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 B1.

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PART A Data Ratification Report

January-March 2008

PART B Intercalibration Report

PART A – Data Ratification Report January - March 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 January-March 2008. During this period there were 121 monitoring sites in the Network of which there are 87 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 60 Defra-funded sites and 61 affiliate sites. Auchencorth Moss has both Partisol and FDMS analysers for both PM_{10} and PM_{25}; the FDMS instruments are listed as a separate site (Auchencorth Moss PM_{10} 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, January-March 2008

Site Name	Owner	Pollutants	Date started	Date closed
Bolton	Affiliate	NO_2 O_3		30/06/08
Brighton Roadside PM10	Affiliate	PM_{10}		29/05/08
Carlisle Roadside	Affiliate	NO_2 PM_{10}	14/02/2008	
Chesterfield	Affiliate	NO_2 PM_{10}	13/03/2008	
Chesterfield Roadside	Affiliate	NO_2 PM_{10}	11/03/2008	
Leeds Headingley Kerbside	Affiliate	NO_2 PM_{10}	17/02/2008	
Leominster	DEFRA	SO_2	06/02/2008	
Liverpool Queen's Drive Roadside	Affiliate	NO_2	01/01/2008	
London Bexley	Affiliate	$PM_{2.5}$	25/02/2008	
London Harlington	BAA	CO		30/03/08
Newcastle Cradlewell Roadside	Affiliate	NO_2	10/03/2008	
Norwich Centre	DEFRA	NO_2 O_3 SO_2		13/05/08
Oxford St Ebbes	Affiliate	NO_2 PM_{10}	01/01/2008	
Scunthorpe Town	Affiliate	NO2	10/01/2008	
Stanford-le-Hope Roadside	Affiliate	NO_2 O_3 SO_2	22/01/2008	
Sunderland Silkworth	Affiliate	SO_2	01/04/2008	
York Bootham	Affiliate	PM_{10}	01/01/2008	
York Fishergate	Affiliate	NO_2 PM_{10}	01/01/2008	
Derry	Affiliate	$PM_{2.5}$	21/02/2008	
Aberdeen Union Street Roadside	Affiliate	NO_2	01/01/2008	
Chepstow A48	Affiliate	NO_2 PM_{10}	01/01/2008	
Port Talbot Margam	Affiliate	CO $PM_{2.5}$	01/01/2008	

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 91.7 % for all pollutants (O_3, NO_2, SO_2, CO, PM_{10} and $PM_{2.5}$) during the 3-month reporting period January-March 2008 (see Table 1.4 below). All pollutants were 90% or higher data capture, except for SO_2 at 89.8%.

Table 1.4 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%

Overall, 280 out of the 335 analysers (83%) achieved data capture levels above the required 90% target during this reporting period (See Table 1.5).

Table 1.5 Number of Analysers with Data Capture below 90%

Total Number Of Analysers		Q1 Jan-Mar 2008 (No. below 90%)
CO	27	6
NO_2	107	16
O_3	79	12
PM_{10}	69[1]	13
$PM_{2.5}$	10[1]	2
SO_2	43	6
Total <90%	335	55

1. Includes TEOM, FDMS, and Partisol analysers.

In total, 24 out of the 121 operational network sites in the quarter (19%) had an average data capture rate below the required 90% level for the January-March 2008 period. These sites are listed in Table 1.6. The main site operational and QA/QC issues giving rise to data capture below the required 90% level are summarised in Section 4.

Table 1.6 Sites with Average Data Capture < 90%, January-March 2008

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Site	Owner	Site Average
England		
Barnsley Gawber	Affiliate	89.8
Birmingham Tyburn	Affiliate	85.8
Bolton	Affiliate	28.6
Chesterfield Roadside	Affiliate	63.5
Glazebury	DEFRA	79.0
High Muffles	DEFRA	83.4
Ladybower	DEFRA	59.5
Leominster	DEFRA	64.3
London Cromwell Road 2	DEFRA	81.6
Lullington Heath	DEFRA	63.4

Site	Owner	Site Average
Newcastle Centre	DEFRA	87.0
Oxford St Ebbes	Affiliate	85.4
Plymouth Centre	DEFRA	83.4
Salford Eccles	Affiliate	80.2
Sandwell West Bromwich	Affiliate	81.3
Sheffield Tinsley	DEFRA	0.0
Southend-on-Sea	DEFRA	84.0
Southwark Roadside	Affiliate	0.0
Wicken Fen	DEFRA	80.1
Yarner Wood	DEFRA	83.0
N Ireland		
Derry	Affiliate	80.7
Scotland		
Strath Vaich	DEFRA	78.0
Wales		
Aston Hill	DEFRA	65.8
Narberth	DEFRA	71.8
Number of sites < 90%		24

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.

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 manual, including the new TEOM and FDMS sections is available electronically on the following web sites:

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

The LSO manual is currently being updated to reflect recent developments in the network.

1.4 AURN Hub Updates

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.

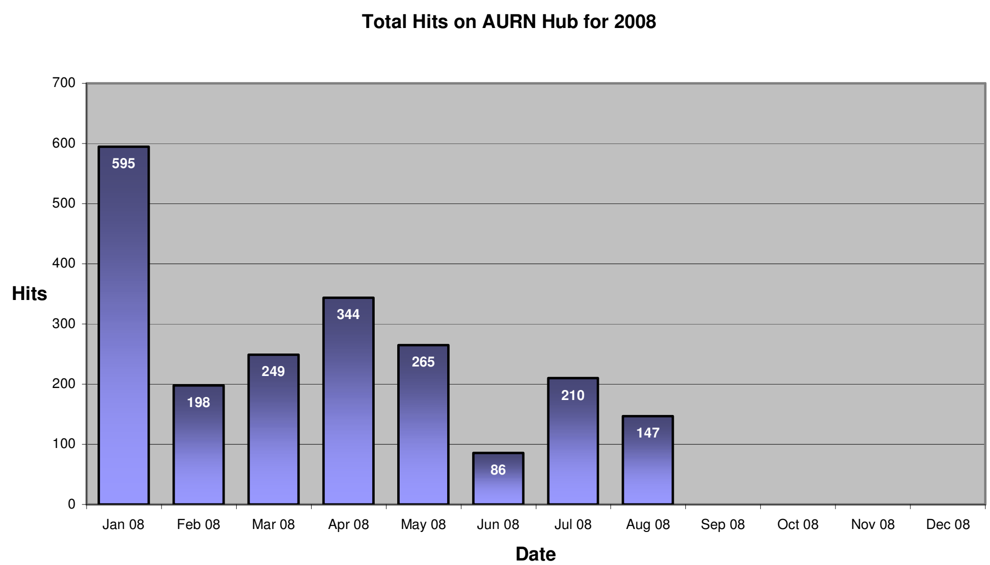
The site is regularly up-dated and some of the more recent information includes:

- Monthly PM_{10} (Gravimetric) exceedences up to March 2008;
- QA/QC Unit's Data Ratification and Intercalibration Report, October-December 2007, and Annual Review for 2007;
- Recent Management Unit reports (January-March 2008); and
- Updated version of the LSO manual.

The Hub has continued to provide a valuable source of information for interested organisations see Figure 1.4

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

Figure 1.4: AURN Hub Hits 2008



The contents of the AURN Hub is currently being reviewed and a user survey will be released shortly to assess how it may be improved.

2. Changes to 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 will be discontinued after this reporting period.

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

In many cases, there is also a requirement for measuring $PM_{2.5}$ at these and other sites affiliated since 1 October 2007, and the procurement exercise for these is underway.

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 (Partisols) are currently located at seven sites in the network (Bournemouth, Wrexham, Dumfries, Inverness, London Westminster, Auchencorth Moss (PM_{10} and $PM_{2.5}$) and Brighton Roadside PM_{10}). Northampton PM_{10} has been removed pending conversion to $PM_{2.5}$

Provisional data capture for the gravimetric PM_{10} (Partisol) analysers for the period January-March 2008 is given in Table 2.4. Three 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 2.4 Gravimetric PM_{10} and $PM_{2.5}$ Data Capture (%) January-March 2008

Site	3-months Data Capture January-March 2008
Auchencorth Moss PM_{10}	95.6
Auchencorth Moss $PM_{2.5}$	92.3
Bournemouth	98.9
Brighton Roadside PM_{10}	98.9
London Westminster	85.7
Dumfries	92.3
Inverness	97.8
Wrexham	98.9

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

A potential problem has been identified with the Partisol data from some of the AURN sites. This is 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 to include a travel (field) blank in the cannister, which should be treated exactly the same as the other filters in the batch, but not exposed.
- Each batch of pre-weighed filters should have an associated lab blank, which would not go to the site but would stay in a sealed container at the lab for the duration of the exposure period, and be weighed again when the final weighings are done.
- Both field and lab blank values should be 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 under way, and the outcome will be reported in future QA/QC reports.

3.2 Auto-Calibration Run-ons

Autocalibration ”run-on” is a generic problem affecting many analysers in the network and is due to autocalibration gas leaking into the sampling system during the ambient measurement period immediately after the autocalibration cycle. 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 19 sites (19 analysers) showing continuing problems with the autocalibration run-on during January-March 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.

There has been a notable improvement in the number of sites adversely affected by auto-calibration faults during this quarter, and the efforts of the ESUs to achieve this are acknowledged.

Table 2.5 Estimate of Spike or Dip due to Auto-calibration Run-on: January-March

Site	Pollutant	Run-On Conc	Autocal Conc	Hours lost per day	Months	
Aston Hill	NO_2	1.3	50	3	Jan	
				2	Mar	Problem less apparent in higher ambient data
Birmingham Centre	NO_2	2	350	1	Jan & Mar	
Bolton	NO_2	8	600	1	Feb & Mar	
Bournemouth	NO_2	3	600	1	Jan to Mar	
Bush Estate	NO_2	1.5	450	2	Jan & Mar	
				1	Feb	
Glazebury	NO_2	4.9	150	1	Jan & Feb	
				2	Mar	
Leominster	NO_2	2	500	1	Jan	
				2	Mar	
Liverpool Speke	NO_2	2	250	1	Jan to Mar	
London Cromwell Rd 2	NO_2	5	350	1	Jan to Mar	
Lullington Heath	NO_2	1	300	1	Jan to Mar	
Newcastle Centre	NO_2	2	300	1	Jan to Mar	
Oxford St Ebbes	NO_2	6	300	1	Jan to Mar	
Walsall Willenhall	NO_2	6	250	1	Jan to Mar	
Wicken Fen	NO_2	8.2	280	3	Jan	
				2	Feb	
				4	Mar	
Yarner Wood	NO_2	2.1	200	3	Jan to Feb	Fixed after Service on 28 Feb
Stoke-on-Trent Centre	O_3	-3	1000	1	Jan to Mar	Zero run-on
Derry	SO_2	0	500	1	Jan	
Stewartby	SO_2	0	350	1	Jan to Mar	Zero run-on
Wrexham	SO_2	0	600	1	Jan	

Recommendations

ESU to investigate and minimise effect where possible, especially at sites with large autocalibration run-ons or where data loss is in excess of 1 hour.
QA/QC Unit and CMCU have held meetings with the Equipment Support Units to discuss the autocalibration run-ons and to identify ways to resolve the problem. Solutions to the problems have been identified in many cases, and the necessary hardware upgrades are being installed either at routine services, or through call-outs.

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

The CMCU is asked to specifically instruct ESUs to address these autocalibration faults at the earliest opportunity

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

The data capture for sites in London (within the M25) for the period January-March is given in Table 4.1:

Table 4.1: Data capture for London: January-March 2008

Site	Owner	CO	PM_{10}	PM_{25}	NO_2	O_3	SO_2	Site Average
London								
Camden Kerbside	Affiliate	-	99.5	-	99.5	-	-	99.5
Haringey Roadside	Affiliate	-	97.0	-	99.0	-	-	98.0
London Bexley	Affiliate	95.9	93.7	93.2	95.7	-	96.1	94.9
London Bloomsbury	DEFRA	98.6	98.7	88.1	98.5	98.7	98.5	96.9
London Cromwell Road 2	DEFRA	82.1	-	-	79.8	-	82.9	81.6
London Eltham	Affiliate	-	-	-	99.4	99.5	-	99.5
London Haringey	Affiliate	-	-	-	99.7	99.6	-	99.7
London Harlington	Affiliate	98.7	95.1	-	97.8	96.5	-	97.0
London Hillingdon	DEFRA	-	-	-	98.4	98.4	-	98.4
London Marylebone Road	Affiliate	99.4	92.9	97.9	99.2	99.3	99.4	98.0
London N. Kensington	Affiliate	98.6	94.4	-	74.9	98.8	93.0	91.9
London Teddington	Affiliate	-	-	-	98.0	98.5	-	98.3
London Westminster	DEFRA	98.2	85.7	-	98.2	97.7	98.2	95.6
Southwark Roadside	Affiliate	-	-	-	0.0	-	-	0.0
Tower Hamlets Roadside	Affiliate	99.5	-	-	99.6	-	-	99.5
Number of sites		8	8	3	15	9	6	15
Number of sites < 90%		1	1	1	3	0	1	2

Site	Owner	CO	PM_{10}	PM_{25}	NO_2	O_3	SO_2	Site Average
Network Mean (%)		96.4	94.6	93.1	89.2	98.6	94.7	89.9

4.2 England (except London)

The data capture for sites in England for the period January-March is given in Table 4.2:

Table 4.2: Data capture for England: January-March 2008

Network Data Capture for 01/01/2008 to 31/03/2008 from start date of any new site

Site	Owner	CO	PM_{10}	PM_{25}	NO_2	O_3	SO_2	Site Average
England								
Barnsley 12	DEFRA	-	-	-	-	-	96.3	96.3
Barnsley Gawber	Affiliate	-	-	-	79.6	97.1	92.8	89.8
Bath Roadside	Affiliate	-	-	-	98.0	-	-	98.0
Billingham	DEFRA	-	-	-	96.2	-	-	96.2
Birmingham Centre	DEFRA	-	97.9	-	94.2	97.0	-	96.4
Birmingham Tyburn	Affiliate	-	45.5	-	99.1	99.3	99.3	85.8
Blackpool Marton	DEFRA	-	76.1	-	98.7	98.8	-	91.2
Bolton	Affiliate	-	22.1	-	20.3	43.5	-	28.6
Bottesford	Affiliate	-	-	-	-	99.5	-	99.5
Bournemouth	DEFRA	-	98.9	-	93.4	98.5	-	96.9
Brighton Preston Park	DEFRA	-	-	-	99.7	99.6	-	99.7
Brighton Roadside	Affiliate	-	-	-	99.5	-	-	99.5
Brighton Roadside PM_{10}	Affiliate	-	98.9	-	-	-	-	98.9
Bristol Old Market	Affiliate	99.5	-	-	99.3	-	-	99.4
Bristol St Paul's	DEFRA	89.2	97.3	-	98.2	92.5	98.3	95.1
Bury Roadside	Affiliate	98.2	98.7	-	99.3	-	-	98.7
Cambridge Roadside	Affiliate	-	-	-	99.5	-	-	99.5
Canterbury	Affiliate	-	-	-	98.4	-	-	98.4
Carlisle Roadside	Affiliate	-	97.7	-	98.5	-	-	98.1
Chesterfield	Affiliate	-	93.0	-	89.7	-	-	91.3
Chesterfield Roadside	Affiliate	-	75.6	-	51.4	-	-	63.5
Coventry Memorial Park	DEFRA	-	87.5	-	98.7	99.7	-	95.3
Exeter Roadside	Affiliate	-	-	-	98.1	98.1	-	98.1
Glazebury	DEFRA	-	-	-	38.6	97.7	-	68.2
Great Dun Fell	DEFRA	-	-	-	-	98.4	-	98.4
Harwell	DEFRA	-	96.0	96.1	95.8	95.0	92.1	95.0
High Muffles	DEFRA	-	-	-	97.2	69.7	-	83.4
Horley	Affiliate	-	-	-	99.5	-	-	99.5
Hull Freetown	DEFRA	94.4	96.7	-	92.1	94.5	94.6	94.4
Ladybower	DEFRA	-	-	-	81.5	97.1	0.0	59.5
Leamington Spa	Affiliate	-	96.3	-	98.0	98.4	98.3	97.8
Leeds Centre	DEFRA	99.4	99.4	-	99.3	99.3	99.4	99.3
Leeds Headingley Kerbside	Affiliate	-	99.1	-	90.6	-	-	94.8
Leicester Centre	DEFRA	99.4	99.0	-	99.5	99.4	98.3	99.1

Site	Owner	CO	PM_{10}	PM_{25}	NO_2	O_3	SO_2	Site Average
Leominster	DEFRA	-	-	-	94.3	98.6	0.0	64.3
Liverpool Queen's Drive Roadside	Affiliate	-	-	-	100.0	-	-	100.0
Liverpool Speke	DEFRA	94.1	96.5	-	92.9	97.0	97.0	95.5
Lullington Heath	DEFRA	-	-	-	93.0	97.2	0.0	63.4
Manchester Piccadilly	DEFRA	-	98.0	-	97.3	97.2	-	97.5
Manchester South	Affiliate	-	-	-	91.7	91.8	-	91.8
Market Harborough	DEFRA	96.4	-	-	98.3	98.3	-	97.7
Middlesbrough	Affiliate	84.1	94.3	-	99.2	99.4	99.1	95.2
Newcastle Centre	DEFRA	96.5	57.0	-	92.9	97.0	91.6	87.0
Newcastle Cradlewell Roadside	Affiliate	-	-	-	99.8	-	-	99.8
Northampton	Affiliate	-	99.6	-	99.5	99.6	99.4	99.5
Norwich Centre	DEFRA	-	98.4	-	99.5	99.4	99.5	99.2
Nottingham Centre	DEFRA	-	99.1	-	97.3	92.3	97.4	96.5
Oxford Centre Roadside	Affiliate	-	-	-	91.0	-	-	91.0
Oxford St Ebbes	Affiliate	-	93.0	-	77.8	-	-	85.4
Plymouth Centre	DEFRA	-	67.0	-	91.5	91.6	-	83.4
Portsmouth	Affiliate	-	91.6	-	98.7	98.7	-	96.3
Preston	DEFRA	-	84.9	-	97.1	97.4	-	93.1
Reading New Town	DEFRA	-	91.9	-	98.1	95.0	-	95.0
Rochester Stoke	Affiliate	-	94.7	98.8	98.5	98.5	98.6	97.8
Salford Eccles	Affiliate	74.3	81.7	-	82.2	79.4	83.4	80.2
Sandwell West Bromwich	Affiliate	-	-	-	83.5	83.5	77.1	81.3
Scunthorpe Town	Affiliate	-	90.1	-	98.0	-	83.3	90.5
Sheffield Centre	DEFRA	97.3	99.6	-	97.0	97.3	97.2	97.7
Sheffield Tinsley	DEFRA	-	-	-	0.0	-	-	0.0
Sibton	DEFRA	-	-	-	-	94.7	-	94.7
Somerton	Affiliate	-	-	-	92.1	92.2	-	92.2
Southampton Centre	DEFRA	80.4	99.3	-	96.3	96.5	96.3	93.7
Southend-on-Sea	DEFRA	-	53.3	-	99.4	99.3	-	84.0
St Osyth	DEFRA	90.5	-	-	98.5	98.5	-	95.8
Stanford-le-Hope Roadside	Affiliate	-	99.7	-	99.6	-	99.5	99.6
Stewartby	Affiliate	-	-	-	-	-	92.6	92.6
Stockton-on-Tees Yarm	Affiliate	-	95.7	-	95.8	-	-	95.8
Stoke-on-Trent Centre	DEFRA	-	99.4	-	93.2	89.4	-	94.0
Sunderland Silksworth	Affiliate	-	-	-	91.8	98.4	-	95.1
Thurrock	Affiliate	-	94.1	-	90.5	91.0	94.3	92.5
Walsall Willenhall	Affiliate	-	-	-	95.3	-	-	95.3
Weybourne	Affiliate	-	-	-	-	97.6	-	97.6
Wicken Fen	DEFRA	-	-	-	82.7	61.4	96.3	80.1
Wigan Centre	Affiliate	-	-	-	99.5	99.4	-	99.4

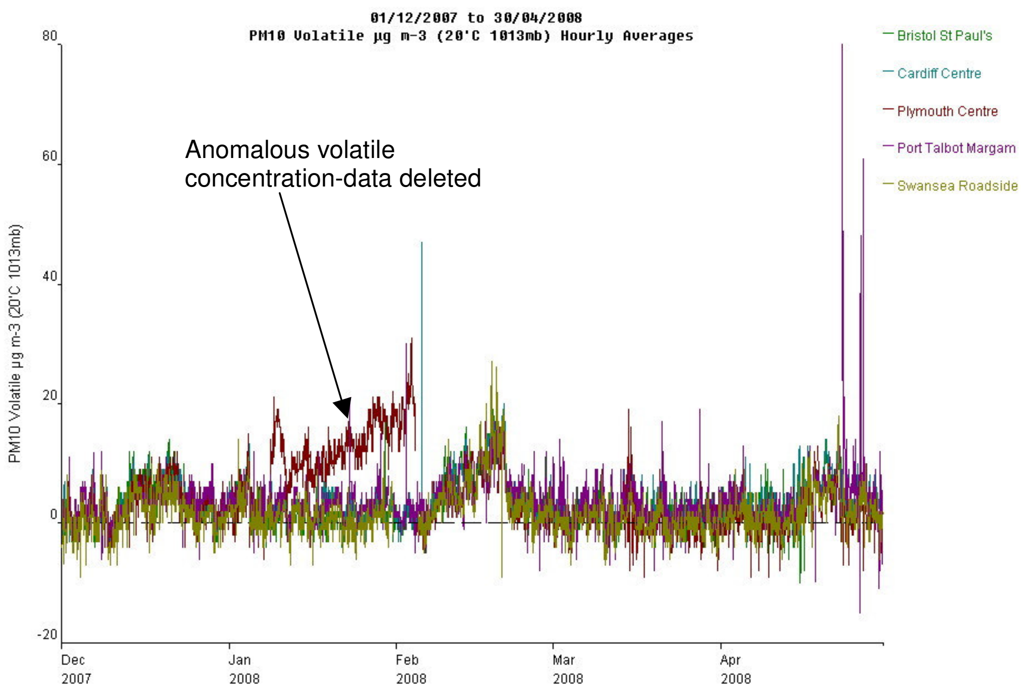
Site	Owner	CO	PM_{10}	PM_{25}	NO_2	O_3	SO_2	Site Average
Wirral Tranmere	DEFRA	-	87.5	-	98.4	98.5	-	94.8
Yarner Wood	DEFRA	-	-	-	81.7	84.4	-	83.0
York Bootham	Affiliate	-	93.0	-	-	-	-	93.0
York Fishergate	Affiliate	-	93.1	-	99.5	-	-	96.3
Number of sites		14	43	2	70	52	28	78
Number of sites < 90%		4	11	0	12	7	6	18
Network Mean (%)		92.4	89.0	97.4	91.2	93.9	84.7	90.4

Site Specific Issues

Plymouth PM_{10}

The volatile component of the Plymouth PM_{10} shows a gradual and anomalous rise in concentration during January-see Figure 4.1 The PM_{10} data have been deleted up to the audit in early February. The cause of this anomaly is not clear.

Figure 4.1: Plymouth PM_{10} Volatile Concentration



Ladybower and Leominster SO_2

There were no meaningful calibration data supplied to the QA/QC Unit for the SO_2 analysers at Ladybower and Leominster for the quarter. In addition, no service records have been received, and as a result, all SO_2 data have been deleted for the three-month period.

Sheffield Tinsley

A persistent fault with the analyser was identified during quarter 2; as a result, all data have been deleted from 1 January 2008. Full details will be given in the April-June QA/QC report.

4.3 Scotland

Data Capture

The data capture for sites in Scotland for the period January-March is given in Table 4.3:

Table 4.2: Data capture for Scotland: January-March 2008

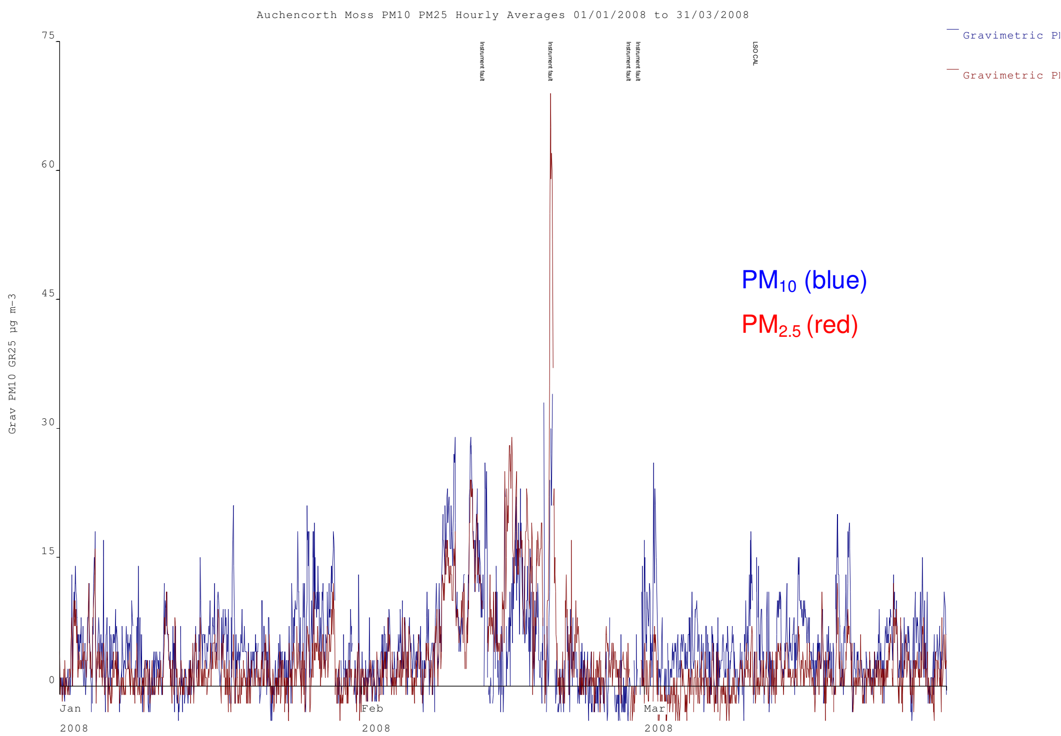
Site	Owner	CO	PM_{10}	PM_{25}	NO_2	O_3	SO_2	Site Average
Scotland								
Aberdeen	Affiliate	-	99.7	-	98.3	98.4	-	98.8
Aberdeen Union Street Roadside	Affiliate	-	-	-	99.2	-	-	99.2
Auchencorth Moss	DEFRA	-	94.5	92.3	-	92.1	-	93.0
Auchencorth Moss PM_{10} PM_{25} (FDMS)	DEFRA	-	95.1	97.8	-	-	-	96.5
Bush Estate	DEFRA	-	-	-	91.5	98.4	-	94.9
Dumfries	DEFRA	-	92.3	-	98.3	-	-	95.3
Edinburgh St Leonards	DEFRA	65.1	98.6	-	94.0	98.3	97.8	90.8
Eskdalemuir	DEFRA	-	-	-	95.3	86.2	-	90.8
Fort William	DEFRA	-	-	-	94.1	98.3	-	96.2
Glasgow Centre	DEFRA	96.7	96.7	-	96.7	97.1	96.1	96.7
Glasgow City Chambers	DEFRA	-	-	-	98.5	-	-	98.5
Glasgow Kerbside	DEFRA	-	94.0	-	93.4	-	-	93.7
Grangemouth	Affiliate	-	97.2	-	98.2	-	98.2	97.9
Inverness	DEFRA	-	97.8	-	98.4	-	-	98.1
Lerwick	DEFRA	-	-	-	-	98.9	-	98.9
Strath Vaich	DEFRA	-	-	-	-	78.0	-	78.0
Number of sites		2	9	2	12	9	3	16
Number of sites < 90%		1	0	0	0	2	0	1
Network Mean (%)		80.9	96.2	95.1	96.3	94.0	97.4	94.8

Site Specific Issues

Auchencorth Moss PM_{10}

The FDMS analysers at Auchencorth Moss recorded significant negative data during the quarter – see Figure 4.2. This reflects a degree of noise seen in the signal from these analyses and, in order to avoid biasing the data upwards, negative values down to -4ugm-3 are allowed to remain in the dataset. This is the same procedure as used previously for all TEOM analysers in the UK. The negative data are more noticeable at this site because the PM concentrations are very low due to the remote location of the site.

Figure 4.3: Auchencorth Moss PM_{10} and $PM_{2.5}$ (FDMS)



4.4 Northern Ireland

The data capture for sites in Northern Ireland for the period January-March is given in Table 4.4:

Table 4.4: Data Capture for Northern Ireland: January-March 2008

Site	Owner	CO	PM_{10}	PM_{25}	NO_2	O_3	SO_2	Site Average
N Ireland								
Belfast Centre	DEFRA	97.3	97.1	-	97.3	66.3	97.2	91.0
Derry	Affiliate	-	77.2	80.2	96.5	97.5	52.1	80.7
Lough Navar	DEFRA	-	97.6	-	-	98.6	-	98.1
Number of sites		1	3	1	2	3	2	3
Number of sites < 90%		0	1	1	0	1	1	1
Network Mean (%)		97.3	90.6	80.2	96.9	87.5	74.6	89.9

Site Specific Issues

Derry

The analysers at Derry were replaced with new equipment on 19 February. The old SO_2 analyser performance was very poor up to this date, and data have been deleted from 18 January. The PM_{10} became unstable following installation of the new equipment, and 20 days data have been lost.

4.5 Wales

Data Capture

The data capture for sites in Wales for the period January-March is given in Table 4.5:

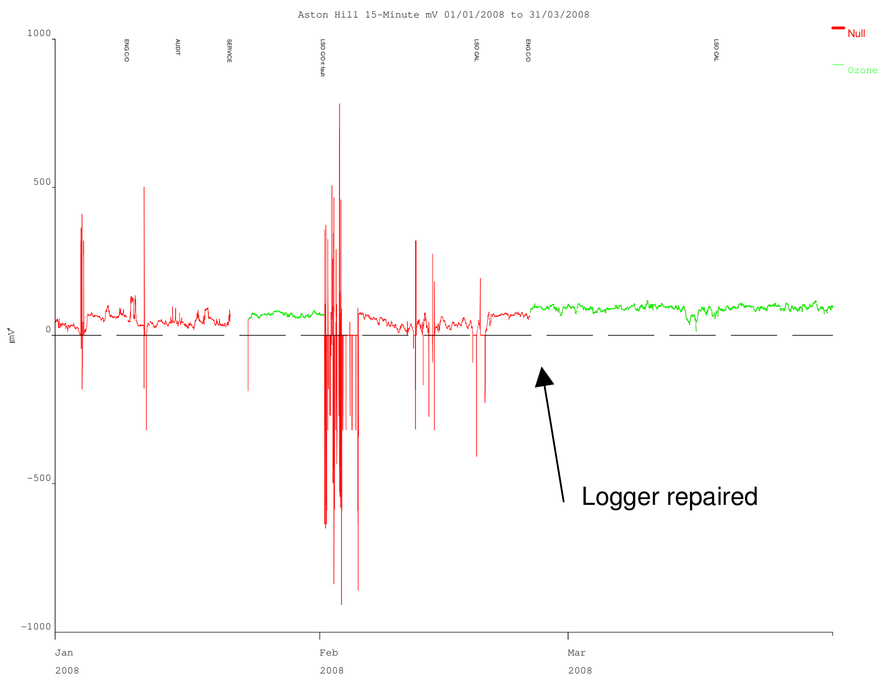
Table 4.5: Data capture for Wales: January-March 2008

Site	Owner	CO	PM_{10}	PM_{25}	NO_2	O_3	SO_2	Site Average
Wales								
Aston Hill	DEFRA	-	-	-	83.2	48.4	-	65.8
Cardiff Centre	DEFRA	97.7	98.2	-	98.3	98.5	93.5	97.3
Chepstow A48	Affiliate	-	93.0	-	97.8	-	-	95.4
Cwmbran	Affiliate	-	-	-	98.6	97.8	-	98.2
Narberth	DEFRA	-	96.0	-	95.5	0.0	95.6	71.8
Port Talbot Margam	Affiliate	96.9	98.3	90.1	97.1	97.1	97.2	96.1
Swansea Roadside	Affiliate	-	93.9	93.7	97.8	-	-	95.1
Wrexham	DEFRA	-	98.9	-	98.4	-	97.2	98.2
Number of sites		2	6	2	8	5	4	8
Number of sites < 90%		0	0	0	1	2	0	2
Network Mean (%)		97.3	96.4	91.9	95.8	68.4	95.9	89.7

Site Specific Issues

Aston Hill
The ozone analyser at Aston Hill produced very high signal noise during January and February-see Figure 4.4.

Figure 4.4: Aston Hill Ozone (mV)



The analyser was replaced by a spare in January, and there were problems with the data logger caused by a low battery voltage, causing erroneous data spikes. This fault was initially reported in the previous quarterly QA/QC report. This was repaired on 25 February. It is noted that the air conditioning is not working at this site.

The Aston Hill NOx analyser has also suffered from severe autocalibration run-on during this quarter- see Section 1.6.

Narberth
Following detailed scrutiny of the Narberth ozone data, the QA/QC unit have deleted the ozone data from 8 February 2007 to 31 March 2008. Full details will be provided in the Q2 report.

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
Cwmbran	NOx	Cylinders contaminated	ESU instructed to repair (effected in Q3)
Wicken Fen	O3	Ozone switching valve fault	Fixed 1 February
Sheffield Tinsley	NOx	Nox converter	Now fixed; substantial loss of data
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

Site	Analyser	Fault	Current status
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.

Recommendation

QA/QC Unit would like to seek clarification from the Equipment Support Unit/manufacturer as to the current situation regarding the reason for the problems and what plans are in place to resolve them. We recommend that immediate attention is given to the outstanding issues as the majority of these instruments are located at critical sites.

5. Sites with Data Capture Below 90%

5.1 Sites with Low Data Capture

A summary of the main site analyser operational problems, which have resulted in data capture below the required 90% level during the reporting period January-March 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 January-March 2008. Data capture values below 90% are shown in the shaded boxes.

Table 6.1 Ratified Network Data Summary Statistics: January-March 2008

Site	Owner	CO	PM_{10}	PM_{25}	NO_2	O_3	SO_2	Site Average
Number of sites		27	69	10	107	79	43	121
Number of sites < 90%		6	13	2	17	12	7	23
Network Mean (%)		93.3	91.3	92.8	92.4	93.6	89.8	91.7

PART B – Winter 2008 Intercalibration Exercise

7. Introduction

In January to March 2008, AEA undertook an intercalibration of 104 monitoring stations in operation in the Defra and the Devolved Administrations Automatic Urban and Rural Monitoring Network. 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. One site (Southwark)was not operational.

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, CMCUs, ESUs and LSOs 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 CMCU'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.

The 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 200µgm^{-3} 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; and

- Assessment of the area around the monitoring station: ie. 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:

1. Analyser accuracy and precision. These are basic checks to ensure analysers respond to known concentrations of gases in a reliable manner.
2. 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.
3. 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.
4. 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.
5. 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.
6. 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.
7. TEOM/FDMS 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.
8. 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.
9. 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.
10. 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.
11. Competence of Local Site Operators (LSO) in undertaking calibrations. As it is the calibrations by the LSO's that are used to scale pollution datasets, it is important to check that these are undertaken competently.

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 is broadly 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/teletext; and
- 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; and
- ±10% for the recalculation of site cylinder concentrations.

Thus, the intercalibration investigates the quality of provisional data output by the Management Units for use in forecasting, teletext and the web. It also provides essential 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. A list of findings from individual sites is given in Appendix

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 – 104 UK stations

Parameter	Number of outliers	Number in network	% outliers in total
NOx analyser	21	94	22%
CO analyser	4	25	16%
SO_2 analyser	5	39	13%
Ozone analyser	14	78	18%
TEOM and BAM analysers	0 k_0, 4 flow	34 TEOM PM_{10} 22 FDMS PM_{10} 4 TEOM $PM_{2.5}$ 1 FDMS $PM_{2.5}$	7%
Gravimetric PM analysers	0	5 PM_{10} 1 $PM_{2.5}$	0%
Total	48	303	16%

In addition to these results, 12 of the 252 site cylinders (~5%) used to scale instrument data into concentrations appeared to have drifted by more than 10% from their certificated values.

Two 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 summer 2007 intercalibration 17% 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 have been 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 104 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 remains off-line, pending redevelopment and planning permission.

9.2 Network Intercomparisons

- **Oxides of Nitrogen**

  A total of 21 outliers (22%) were identified during this intercalibration. This is slightly better than the Summer 07 exercise where 27% of the analysers were identified as outliers. In addition, there were two 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 3.4% 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 good 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 4 analysers (16%) were identified as outliers at this intercalibration. This result is worse than the Summer 07 exercise, when only 2 analysers fell outside the acceptance limits. An additional analyser was not available for test at the time of the audit. 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% 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 2%. This is an excellent 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 5 outliers (13%) were identified at this intercalibration. This is much better than the Summer 07 exercise, when 14 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 1.3% 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 14 outliers (18%) were identified during the Winter 08 exercise. This is much better than the previous intercalibration, where 25 analysers were found to be outside the ±5% acceptance criterion.

  Of the 14 outliers, 7 were within ±10%, 6 were within ±25% and one was significantly greater than ±25%. Individual outliers will be discussed in detail in the following sections.

- **Particulate Analysers**

  All calculated TEOM and FDMS PM_{10} k0 determinations were within ±2.5% of their stated values. A single k0 was identified as an outlier at the previous exercise.

  Three TEOM PM_{10} and one FDMS PM_{10} main flows were found to be outside the ±10% acceptance limits, compared to three in total at the Summer 07 exercise.

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

- Site Cylinder Concentrations

  12 of the 252 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 15 London sites are summarised in Table 9.2 below:

Table 9.2 - Summary of audited analyser performance – London Sites

Parameter	Number of outliers	Number in region
NOx analyser	2	14
CO analyser	0	9
SO_2 analyser	1	8
Ozone analyser	0	9
TEOM and BAM analysers	0 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	45

The NOx outliers at Haringey Roadside was attributed to changes in site cylinder concentrations, no data have been lost during ratification.

The NOx outlier at London Bexley was initially attributed to a change in the site cylinder concentration. However, subsequent recertification of the cylinder in the QA/QC calibration laboratory found that the cylinder was well within specification, thus the outlier was due to a poorly performing analyser on the day of the audit.

The CO analyser pump at London Cromwell Road had failed at the time of the audit, preventing any meaningful measurements being made.

The cause of the SO_2 outlier at Marylebone Road was identified as a drift in response between LSO calibrations. Again, no data have been rejected during ratification.

The NO cylinder at Haringey Roadside was found to have drifted by 16% from its stated value. 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 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 14 Scottish sites are summarised in Table 9.3 below:

Table 9.3 - Summary of audited analyser performance – Scottish Sites

Parameter	Number of outliers	Number in region
NOx analyser	1	12
CO analyser	0	4
SO_2 analyser	0	3
Ozone analyser	1	8
TEOM and BAM analysers	0 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	3 PM_{10} 1 $PM_{2.5}$
Cylinders	1	31

The NOx outlier at Edinburgh was traced to an analyser drift in response between LSO calibrations. No data were rejected during ratification.

The Ozone outlier at Aberdeen was successfully rescaled without data losses during ratification.

The Glasgow Centre site CO cylinder was calculated to have drifted by 20% at the audit. This result was immediately questioned and a repeat visit undertaken to evaluate this result. The second evaluation determined that the cylinder had not drifted, thus the initial outlier was attributed to a poor performing analyser on the day of the first audit.

9.5 Welsh Sites

The results of the intercomparison for the 7 Welsh sites are summarised in Table 9.4 below:

Table 9.4 - Summary of audited analyser performance – Welsh Sites

Parameter	Number of outliers	Number in region
NOx analyser	2	7
CO analyser	0	2
SO_2 analyser	0	4
Ozone analyser	0	5
TEOM and BAM analysers	0 k_0, 0 flow	1 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	1	20

The NOx outlier at Cardiff 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 NOx outlier at Narberth appears to be due to pressure sensitivity of the analyser to small changes in applied calibration gas flows. This could have significant implications for data quality, as calibrations may not accurately reflect ambient conditions. On this occasion, the data have been carefully examined and no data rejection was required.

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 calibration gas tubing system will resolve the problem. This modification will be undertaken at the summer service exercise.

The NOx analyser at Wrexham responded abnormally to NO_2 gas, giving an NO response of 20ppb. This suggests that the internal switching valve may have a slight leak, but as close examination of the timeseries data did not highlight any unusual behaviour, no data were rejected on this occasion.

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	1	2
CO analyser	0	1
SO_2 analyser	1	2
Ozone analyser	3	4
TEOM and BAM analysers	0 k_0, 0 flow	3 TEOM PM_{10} 0 FDMS PM_{10} 0 BAM PM_{10} 0 TEOM $PM_{2.5}$ 0 FDMS $PM_{2.5}$
Gravimetric PM analysers	0	0 PM_{10} 0 $PM_{2.5}$
Cylinders	0	7

The NOx outlier at Derry was found to be due to analyser sensitivity drift between LSO calibrations. No data were rejected as a result.

The SO_2 outlier at Derry was found to be due to an instrument fault, resulting in 6 weeks of data being rejected.

The Ozone outliers at Lough Navar (-9%) and Derry (-13%) were easily rescaled with no rejection of data required.

The ozone outlier at Belfast (-40% average) appears to be due to a malfunctioning analyser on the day of the audit. The timeseries data have been carefully checked and no data have been rejected on this occasion. A post-service calibration was also undertaken to confirm that the analyser was set up correctly.

9.7 English Sites

The results of the intercomparison for the 64 English sites are summarised below:

Table 9.6 - Summary of audited analyser performance – English Sites

Parameter	Number of outliers	Number in region
NOx analyser	15	59
CO analyser	4	9
SO_2 analyser	3	22
Ozone analyser	10	52
TEOM and BAM analysers	0 k_0, 3 flow	18 TEOM PM_{10} 17 FDMS PM_{10} 0 BAM PM_{10} 1 TEOM $PM_{2.5}$ 0 FDMS $PM_{2.5}$
Gravimetric PM analysers	0	1 PM_{10} 0 $PM_{2.5}$
Cylinders	8	7

Of the 15 NOx outliers, 6 can be attributed to changes in analyser responses between LSO calibrations (Brighton Preston Park, Lullington Heath, Bristol Old Market, Horley, Plymouth and Somerton). All of these outliers were corrected for with no rejection of data required.

The NOx outliers at Manchester South, Bournemouth and Market Harborough 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 any of the sites.

The NOx outlier at St Osyth 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 (Walsall Willenhall, Northampton, Sandwell, Blackpool and Norwich Centre). Data have been carefully examined and rescaled as necessary at all sites, no data were lost as a result of these adjustments (though two weeks of data at Sandwell West Bromwich were rejected for an unrelated fault).

Two NOx converters fell outside the ±5% acceptance limits: Barnsley Gawber (90%) has had two weeks of data rejected on 2008, while Sheffield Tinsley (80%) has lost six weeks of data this year.

Sheffield Tinsley also responded abnormally to NO_2 gas, giving an NO response of over 120ppb. This suggests that the internal switching valve may have a slight leak, which may well have influenced the converter test result at this site.

The four CO outliers were attributed to changes in analyser responses between LSO calibrations (Liverpool, Market Harborough, Salford Eccles, Sheffield Centre). All of these outliers were corrected for with no rejection of data required.

Two of the three SO_2 outliers (Lullington Heath, Wicken Fen) 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 outlier at Southampton was initially attributed to a change in the site cylinder concentration. However, subsequent recertification of the cylinder in the QA/QC calibration laboratory found that the cylinder was well within specification, thus the outlier was due to a poorly performing analyser on the day of the audit.

Three TEOM main flows were found to be outside the ±10% acceptance limits. Six weeks of data have been rejected from the Newcastle site, whilst the data from Norwich Centre and Portsmouth have been successfully rescaled with no data rejection required.

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 12 of the 252 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 summer 2007 exercise, where 5% of the scaling cylinders were outside the acceptance limits.

In addition, the concentrations of 30 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 252 cylinders (17%) were outside the acceptance limits. This is slightly worse than the previous intercalibration, where 15% 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 12 poorly performing site cylinders used to scale data were investigated further.

The contaminated NO cylinders at Blackpool Marton, Coventry Memorial Park, Leicester Centre and Cwmbran and the NO cylinder at Walsall Willenhall 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 SO_2 cylinders at Wicken Fen and Rochester and the NO cylinder at Haringey Roadside were allowed to remain in place and will be re-examined during the summer 08 intercalibration.

The CO cylinder at Glasgow Centre remains on site, following a repeat visit which confirmed it's stability. The poor performance of the CO analyser at the audit is, however, concerning.

The final three cylinders (NO from Bexley and Birmingham Tyburn, SO_2 from Southampton) were returned to AEA for evaluation. While the recalculation of the Birmingham Tyburn cylinder confirmed the audit result, the other two found that the concentrations had not changed significantly from the original certification values. This is of concern, as it suggests that the calibration of site cylinders, on site, is not as robust as could be hoped. It is likely that there are a number of contributing factors for this:

1. Contamination of the sampling systems;
2. Pressure sensitivity of the analyser to calibration gases;
3. Sensitivity of the analyser to physical conditions (eg. temperature, pressure, power etc);
4. Poor performance characteristics (noise, scaling factors etc); and
5. Other unidentified analyser performance issues.

In summary, of the 12 cylinders identified as outliers, 3 were found not to have drifted at all. This highlights the robustness of our approach to handling site cylinders (on site evaluation, as opposed to on site certification of concentrations, followed by recall and evaluation under controlled conditions), further enhancing the quality of data produced in the AURN.

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

Site	Action required
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 at these sites is investigated, to determine whether safe access can be achieved.

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 October 2007 to March 2008.

Appendices

Appendix A1: Recommendations for Upgrade or Replacement of Equipment

Appendix A2: Data gaps listing: January-March 2008

Appendix A3: Inventory of Defra-Owned Equipment

Appendix A4: Partisol Data Ratification Report

Appendix A5: Information for new Sites

Appendix A6: Site Intercalibration Results Winter 2008

Appendix B1: Certificate of Calibration

Appendix A1

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 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 A2

Gaps Listing January-March 2008

Pollutant	Data Capture (%)	Start date	End date	Reason	Comments	Number of days	Number of hours
England							
Barnsley Gawber							
NO2	79.60%	01-Jan-08	17-Jan-08	Instrument fault	NOx converter fault until service - leak found.	16.6	398
		18-Jan-08	18-Jan-08	Instrument fault	Logger not talking - ESU resolved.	0.5	12
		08-Mar-08	08-Mar-08	Instrument fault	Logger not talking - ESU resolved.	0.5	13
		31-Mar-08	01-Apr-08	No mV data collected	resolved at Eng C/O for SO2.	1	23
Birmingham Tyburn							
PM10	45.50%	15-Jan-08	04-Mar-08	ESU service	Teom away for repair 15/1-4/3	49.4	1185
Blackpool Marton							
PM10	76.10%	28-Feb-08	20-Mar-08	ESU service		21.1	507
Bolton							
NO2	20.30%	01-Jan-07	12-Mar-08	NO2 converter fault	Converter 110% + very unstable response	437	10478
O3	43.50%	21-Jan-08	12-Mar-08	Instrument fault	UV lamp fault	51	1225
PM10	22.10%	21-Jan-08	04-Apr-08	Pump fault		73.9	1773
Chesterfield							
NO2	89.70%		13-Mar-08		Site started		
		23-Mar-08	23-Mar-08	No mV data collected		0.3	7
Chesterfield Roadside							
NO2	51.40%		11-Mar-08		Site started		
		11-Mar-08	11-Mar-08	Power cut		0.3	6
		13-Mar-08	14-Mar-08	Power cut		1	24
		20-Mar-08	29-Mar-08	Flat response		8.6	207
PM10	75.60%		11-Mar-08		Site started		
		13-Mar-08	14-Mar-08	Power cut		1	24
		21-Mar-08	21-Mar-08	Power cut		0.4	10
		23-Mar-08	23-Mar-08	Power cut		0.5	12
		27-Mar-08	29-Mar-08	Power cut		2	47
		30-Mar-08	30-Mar-08	Power cut		0.3	6
Coventry Memorial Park							
PM10	87.50%	18-Jan-08	29-Jan-08	Instrument fault	Moisture in filter housing then unstable data - filter replaced.	10.9	261

Glazebury							
NO2	38.60%	29-Jan-08	30-Jan-08	QAQC audit		0.9	21
		01-Mar-08	29-Jul-08	NO2 converter fault	Data deleted by QA/QC	151	3612
High Muffles							
O3	69.70%	01-Feb-08	02-Feb-08	Power cut		0.8	18
		04-Feb-08	05-Feb-08	ESU service		1	25
		11-Feb-08	07-Mar-08	Instrument fault	ENG C/O Replaced faulty ML8810 with hotspare ML9810	25	600
		23-Mar-08	23-Mar-08	Power cut		0.3	7
Ladybower							
NO2	81.50%	01-Nov-07	17-Jan-08	Sampling fault	Serious leak - Data deleted by QC	77.1	1851
London Bloomsbury							
PM25	88.10%	30-Jan-08	31-Jan-08	ESU service		0.9	21
		22-Mar-08	02-Apr-08	Instrument fault	PM25 lost program	11.1	267
London Cromwell Road 2							
NO2	79.80%	17-Mar-08	02-Apr-08	Manifold fault	Manifold fan failure up to service on 1 April	16.2	388
London Harlington							
London N. Kensington							
NO2	74.90%	30-Jan-08	21-Feb-08	No mV data collected	Leak found in converter at service then pressure fault .	22.1	531
Lullington Heath							
SO2	0.00%	01-Jan-08	15-Jul-08	Instrument fault	QA/QC unit deleted SO2	197	4716
Newcastle Centre							
PM10	57.00%	22-Feb-08	10-Apr-08	Instrument fault	ENG C/O Fixed leaking main flow inline filter	48.2	1156
Oxford St Ebbes							
NO2	77.80%	01-Dec-06	01-Jan-08		Site started	396	9504
		16-Jan-08	17-Jan-08	No mV data collected		0.3	8
		30-Jan-08	15-Feb-08	Power cut		15.8	378
		31-Mar-08	28-Apr-08	Operator error		28.1	674
Plymouth Centre							
PM10	67.00%	08-Jan-08	04-Feb-08	Instrument fault	Volatile data spurious	27	649
		25-Feb-08	27-Feb-08	ESU service		2.3	56
Preston							
PM10	84.90%	05-Feb-08	11-Feb-08	Operator error		6.2	149
		13-Feb-08	13-Feb-08	QAQC audit		0.4	9
		20-Feb-08	27-Feb-08	ESU service		6.8	162
Salford Eccles							

NO2	82.20%	30-Jan-08	31-Jan-08	QAQC audit		1	23
		04-Feb-08	07-Feb-08	ESU service		3.6	87
		14-Feb-08	21-Feb-08	Instrument fault	High erroneous data.CMCU deleted	7.1	170
		27-Feb-08	28-Feb-08	Unstable response		1	23
O3	79.40%	31-Jan-08	07-Feb-08	QAQC audit	Low data between audit and service	7.6	183
		14-Feb-08	21-Feb-08	Instrument fault	NOx fault suspected by ESU SO2 also suspicious.	7.1	171
		27-Feb-08	28-Feb-08	Unstable response	Flow issues and negative data	0.9	22
PM10	81.70%	31-Jan-08	31-Jan-08	QAQC audit		0.5	13
		04-Feb-08	07-Feb-08	ESU service		3.6	87
		15-Feb-08	21-Feb-08	Instrument fault	NOx fault suspected by ESU SO2 also suspicious.	6.5	155
		27-Feb-08	29-Feb-08	Unstable response	LSO on-site cleaning TEOM head 10.15 to 11.00	2.2	53
Sandwell West Bromwich							
NO2	83.50%	16-Jan-08	31-Jan-08	Monitoring suspended	LSO reports car park resurfacing from 7th Jan until early Feb	14.8	355
O3	83.50%	16-Jan-08	31-Jan-08	Monitoring suspended	LSO reports car park resurfacing from 7th Jan until early Feb	14.8	355
SO2	77.10%	14-Jan-08	31-Jan-08		LSO reports car park resurfacing from 7th Jan until early Feb	17.2	412
Sheffield Tinsley							
NO2	0.00%	01-Feb-08	31-Mar-08	Converter fault		60	1440
Somerton							
NO2	65.80%	01-Feb-08	02-Feb-08	Power cut		1.1	27
		27-Feb-08	01-Mar-08	Power cut		3.1	75
O3	65.90%	01-Feb-08	02-Feb-08	Power cut		1.1	27
		27-Feb-08	01-Mar-08	Power cut		3.1	75
Southend-on-Sea							
PM10	53.30%	18-Feb-08	24-Apr-08	Unstable response	No fault noted with FDMS at service.	66	1584
Southwark Roadside							
NO2	0.00%	01-Jan-07	08-May-08	No mV data collected		494	11856
Stoke-on-Trent Centre							
O3	89.40%	28-Jan-08	29-Jan-08	ESU service		0.9	22
		27-Mar-08	01-Apr-08	Communication fault		5.3	127
Wicken Fen							
NO2	82.70%	02-Feb-08	02-Feb-08	Logger fault	Faulty Modem Power Lead	0.7	17
		07-Feb-08	08-Feb-08	Logger fault	Faulty Modem Power Lead	0.6	15
		09-Feb-08	09-Feb-08	Logger fault	Faulty Modem Power Lead	0.4	10

		15-Feb-08	15-Feb-08	Logger fault	Faulty Modem Power Lead	0.3	7
		31-Mar-08	01-Apr-08	ESU service		1.3	30
O3	61.40%	05-Oct-07	02-Feb-08	Pump fault	Sample pump fault then leaking valve	120	2881
		07-Feb-08	08-Feb-08	Logger fault	Faulty Modem Power Lead	0.6	15
		09-Feb-08	09-Feb-08	Logger fault	Faulty Modem Power Lead	0.4	10
		15-Feb-08	15-Feb-08	Logger fault	Faulty Modem Power Lead	0.3	7
		31-Mar-08	01-Apr-08	ESU service		1.2	28
Wirral Tranmere							
PM10	87.50%	10-Feb-08	10-Feb-08	Unstable response		0.3	7
		12-Feb-08	21-Feb-08	Low flow rate	Flow faults 12/2-20/2 Service 20/2-21/2	8.7	208
		27-Feb-08	28-Feb-08	Instrument fault	Sensor faults	1.2	29
Yarner Wood							
NO2	81.70%	14-Jan-08	16-Jan-08	Unstable response	Unstable after LSO cal	1.9	45
		24-Jan-08	25-Jan-08	Power cut		0.9	21
		29-Jan-08	30-Jan-08	Power cut		0.8	19
		24-Feb-08	25-Feb-08	Power cut		0.4	9
		28-Feb-08	29-Feb-08	ESU service		1.2	29
		10-Mar-08	10-Mar-08	Switched out-of-service	Site off for ozone repair	0.3	8
		11-Mar-08	12-Mar-08	Power cut		1.1	26
		23-Mar-08	26-Mar-08	Power cut		2.7	65
O3	84.40%	24-Jan-08	25-Jan-08	Power cut		0.9	21
		29-Jan-08	30-Jan-08	Power cut		0.8	19
		06-Feb-08	12-Feb-08	Instrument fault	ENG C/O Replaced hotspare ML8810 O3 analyser with API 400E	5.9	142
		24-Feb-08	25-Feb-08	Power cut		0.4	9
		28-Feb-08	29-Feb-08	ESU service		1.2	28
		10-Mar-08	10-Mar-08	Instrument fault	ENG C/O Replaced IZS temp sensor PCB.	0.3	8
		11-Mar-08	12-Mar-08	Power cut		1.1	26
		23-Mar-08	26-Mar-08	Power cut		2.7	65
N Ireland							
Belfast Centre							
O3	66.30%	27-Feb-08	28-Mar-08	ESU service	Service and processor board fault (reprogr'd)	30.1	723
Derry							
PM10	77.20%	19-Feb-08	10-Mar-08	Temperature fault	Response instability following installation and QA/QC audit 3 Mar	20.4	489
PM25	80.20%	03-Mar-08	10-Mar-08	Temperature fault	Noisy and sample dew point high	7.1	171
Scotland							
Eskdalemuir							
O3	86.20%	01-Feb-08	01-Feb-08	Power cut		0.5	12
		10-Feb-08	11-Feb-08	Power cut		0.3	8

		12-Feb-08	13-Feb-08	ESU service		1	24
		21-Mar-08	01-Apr-08	Instrument fault	ENG C/O Changed input ranges. Reset after recent powercut	10.8	259
Strath Vaich							
O3	78.00%	24-Jan-08	11-Feb-08	Communication fault	ENG C/O Removed 9810B ANALYSER spikes. Hot spare installed .	18	432
		25-Mar-08	25-Mar-08	Power cut		0.3	8
Wales							
Aston Hill							
NO2	83.20%	21-Jan-08	01-Feb-08	ESU service	Zero line attached to sample inlet after service	11	263
O3	48.40%	12-Dec-07	23-Jan-08	Unstable response		42.5	1021
		01-Feb-08	25-Feb-08	Instrument fault	Unstable data deleted	24.1	579
Narberth							
O3	0.00%	08-Feb-07	31-Mar-08	Instrument fault	Concentrations too low compared to other sites	418	10028

Appendix A3
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, August 2007

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 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 A4

DD1 Partisol Data Ratification: January-March 2008

Final ratification of the Partisol data are delayed until the outcome of the current detailed investigations on all previous UK Partisol data are completed. The investigation focuses on a possible weighing anomaly which appears to have affected blank weighings, leading to over-estimation of PM concentration.

View at:
http://www.airquality.co.uk/archive/reports/cat09/0806161031_080528_Trends_in_Gravimetric_PM_Measurements_in_the_UK.pdf

Provisional data capture for the Partisol sites operational during this quarter are given in the following table:

Site	Start date	End date	Provisional Data Capture%
Auchencorth Moss PM_{10}	1st January	31st March	95.6
Auchencorth Moss $PM_{2.5}$	1st January	31st March	92.3
Bournemouth PM_{10}	1st January	31st March	98.9
Brighton Roadside PM_{10}	1st January	31st March	98.9
Dumfries PM_{10}	1st January	31st March	92.3
Inverness PM_{10}	1st January	31st March	97.8
London Westminster	1st January	31st March	85.7
Wrexham	1st January	31st March	98.9

Data Rejection

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 > $\pm 5^oC$	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 > $\pm 5^oC$, 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

Auchencorth Moss
PM_{10}: Data capture was 95.6% for this quarter. Data losses as follows:

- 1st, 4th & 10th Jan: $PM_{2.5} > PM_{10}$.
- 28th Mar, power failure resulted in < 18h valid sampling.

$PM_{2.5}$: Data capture was 92.3% for this quarter:

- 1st, 4th & 10th Jan: $PM_{2.5} > PM_{10}$ as above.
- 14th Jan – apparent weighing problem (exposed weight < pre-weight).
- 3rd, 4th & 6th Feb - filter exchange failures

Bournemouth
PM_{10} only: Data capture in this quarter was 98.9%. Data loss:
- 25th Feb: stop key pressed.

Brighton Roadside
PM_{10} only: Data capture in this quarter was 98.9%. Data loss:
- 30th Jan: delayed filter changeover. (This appears to be a common problem with this site).

Dumfries
PM_{10}: Data capture was 92.3%. Data losses were as follows:
- 1st Jan – deleted by BV as “far too large”. (102 µg m^{-3})
- 3rd Jan – error in initial weighing
- 21st Feb: PM2.5 > PM10
- 28th – 31st Mar: unit switched off.

Inverness
PM_{10}: Data capture = 97.8% Data losses:
- 22nd Jan: delayed filter changeover
- 7th Feb: routine service.

London Westminster
PM_{10} only: Data capture = 85.7%. Data losses:
- 2nd – 6th Jan: filter exchange failures. There are lots of these at this site.
- 7th Jan: engineer on site.
- 7th, 3rd – 5th Feb: filter exchange failures.
- 19th, 27th & 28th Mar: unexplained Partisol fault, looks like more of the above.

Wrexham
Data capture was 98.9%. Data losses:
- 5th Feb: inlet cleaning.

Appendix A5

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	NO2	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	

Appendix A6

Site Intercalibration Results Winter 2008

England

SITE	Date visited	NO_x	CO	SO_2	O_3	PM_{10}	$PM_{2.5}$
Barnsley 12	08-Jan			OK			
Barnsley Gawber	08-Jan	Converter 90%		OK	OK		
Bath Roadside	18-Feb	OK					
Billingham	27-Feb	OK					
Birmingham Centre	29-Jan	OK			OK	OK	
Birmingham Tyburn	12-Feb	OK		OK	Outlier +16%	OK	
Blackpool Marton	13-Feb	Outlier +14%			OK	OK	
Bolton	07-Jan	OK			OK	OK	
Bottesford	18-Feb				OK		
Bournemouth	07-Feb	Outlier –12%			OK	OK	
Brighton Preston Park	06-Mar	Outlier +35%			OK		
Brighton Roadside	06-Mar	OK				OK	
Bristol Old Market	21-Jan	Outlier +14%	OK				
Bristol St Paul's	21-Jan	OK	OK	OK	OK	OK	
Bury Roadside	10-Jan	OK	OK			OK	
Cambridge Roadside	11-Mar	OK					
Canterbury	03-Mar	OK				OK	
Coventry Memorial Park	16-Jan	OK			OK	OK	
Exeter Roadside	20-Feb	OK			OK		
Glazebury	29-Jan	OK			OK		
Great Dun Fell	29-Jan				OK		
Harwell	27-Feb	OK		OK	OK	OK	OK
High Muffles	29-Jan	OK			Outlier –8%		
Horley	05-Mar	Outlier – 12%					
Hull Freetown	05-Feb	OK	OK	OK	OK	OK	
Ladybower	10-Jan	OK		OK	OK		
Leamington Spa	20-Feb	OK		OK	OK	OK	
Leeds Centre	06-Feb	OK	OK	OK	Outlier +9%	OK	
Leicester Centre	05-Feb	OK	OK	OK	Outlier +20%	OK	
Leominster	14-Jan	OK			OK		
Liverpool Speke	12-Feb	OK	Outlier –26%	OK	OK	OK	
Lullington Heath	05-Mar	Outlier +21%		Outlier –24%	OK		
Manchester Piccadilly	30-Jan	OK			OK	OK	
Manchester South	30-Jan	Outlier –25%			OK		

SITE	Date visited	NO_x	CO	SO_2	O_3	PM_{10}	$PM_{2.5}$
Market Harborough	14-Jan	Outlier +22%	Outlier +20%		OK		
Middlesbrough	26-Feb	OK	OK	OK	OK	OK	OK
Newcastle Centre	25-Feb	OK	OK	OK	OK	Outlier – Main –40%	
Northampton	23-Jan	Outlier +12%		OK	OK	OK	
Norwich Centre	06-Mar	Outlier +14%		OK	OK	Outlier – Main +11%	
Nottingham Centre	14-Feb	OK		OK	OK	OK	
Oxford Centre Roadside	28-Feb	OK					
Plymouth Centre	19-Feb	Outlier – 18%			OK	OK	
Portsmouth	30-Jan	OK			OK	Outlier – Main +15%	
Preston	13-Feb	OK			Outlier +9%	OK	
Reading New Town	31-Jan	OK		OK	OK	OK	
Rochester Stoke	04-Mar	OK		OK	OK	OK	OK
Salford Eccles	31-Jan	OK	Outlier +13%	OK	Outlier –15%	OK	
Sandwell West Bromwich	04-Feb	Outlier –12%		OK	OK		
Scunthorpe Town	05-Feb	OK		OK		OK	
Sheffield Centre	04-Feb	OK	Outlier –16%	OK	Outlier +13%	OK	
Sheffield Tinsley	04-Feb	Converter 80%					
Sibton	12-Mar				Outlier –10%		
Somerton	21-Feb	Outlier –14%			OK		
Southampton Centre	26-Feb	OK	OK	Outlier –22%	OK	OK	OK
Southend-on-Sea	27-Feb	OK			OK	OK	
St Osyth	28-Feb	Outlier –38%	OK		OK		
Stoke-on-Trent Centre	15-Jan	OK			Outlier –23%	OK	
Sunderland Silksworth	26-Feb	OK					
Thurrock	28-Feb	OK		OK	OK	OK	OK
Walsall Willenhall	03-Mar	Outlier +22%					
Weybourne	06-Mar				OK		
Wicken Fen	11-Mar	OK		Outlier +27%	OK		
Wigan Centre	29-Jan	OK			Outlier +7%	OK	
Wirral Tranmere	12-Feb	OK			OK	OK	
Yarner Wood	21-Feb	OK			OK		

London

SITE	Date visited	NO_x	CO	SO_2	O_3	PM_{10}	$PM_{2.5}$
Camden Kerbside	18-Feb	OK				OK	
Haringey Roadside	15-Feb	Outlier –13%				Flow outlier - both 15%	

SITE	Date visited	NO_x	CO	SO_2	O_3	PM_{10}	$PM_{2.5}$
London Bexley	25-Feb	Outlier –23%	OK	OK		OK	
London Bloomsbury	24-Jan	OK	OK	OK	OK	OK	OK
London Cromwell Road 2	17-Mar	OK			OK	OK	
London Eltham	04-Feb	OK	OK	OK	OK	OK	
London Haringey	20-Mar	OK			OK		
London Harlington	26-Feb	OK			OK	OK	
London Hillingdon	28-Jan	OK			OK		
London Marylebone Road	21-Feb	OK	OK	Outlier +12%	OK	OK	OK
London N. Kensington	30-Jan	OK	OK	OK	OK	OK	
London Teddington	28-Jan	OK			OK		
London Westminster	13-Jan	OK	OK	OK	OK	not tested	
Tower Hamlets Roadside	25-Feb	OK	OK				

Wales

SITE	Date visited	NO_x	CO	SO_2	O_3	PM_{10}	$PM_{2.5}$
Aston Hill	15-Jan	OK			OK		
Cardiff Centre	24-Jan	Outlier –30%	OK	OK	OK	OK	
Cwmbran	23-Jan	OK			OK		
Narberth	21-Jan	Outlier –18%		OK	OK	OK	
Port Talbot	23-Jan	OK		OK	OK	OK	
Swansea Roadside	22-Jan	OK				OK	OK
Wrexham	11-Feb	OK		OK		OK	

Scotland

SITE	Date visited	NO_x	CO	SO_2	O_3	PM_{10}	$PM_{2.5}$
Aberdeen	21-Jan	OK			OK	OK	
Auchencorth Moss	13-Feb				OK	OK	OK
Auchencorth Moss Partisols	13 Feb					OK	OK
Bush Estate	13-Feb	OK			OK		
Dumfries	30-Jan	OK					
Edinburgh St Leonards	11-Feb	Outlier –13%	OK	OK	OK	OK	
Eskdalemuir	28-Jan	OK			OK		
Fort William	09-Jan	OK			OK	OK	
Glasgow Centre	14-Jan	OK	OK	OK	OK	OK	
Glasgow City Chambers	15-Jan	OK					
Glasgow Kerbside	17-Jan	OK				OK	
Grangemouth	07-Feb	OK		OK		OK	
Inverness	23-Jan	OK				OK	

SITE	Date visited	NO_x	CO	SO_2	O_3	PM_{10}	$PM_{2.5}$
Lerwick	06-Feb				OK		
Strath Vaich	23-Jan				OK		

Northern Ireland (inc. Mace Head)

SITE	Date visited	NO_x	CO	SO_2	O_3	PM_{10}	$PM_{2.5}$
Belfast Centre	13-Feb	OK	OK	OK	Outlier –40%	OK	
Derry	11-Feb	Outlier +12%		Outlier +18%	Outlier –13%	OK	
Lough Navar	19-Feb				Outlier –9%	OK	
Mace Head	20-Feb				OK		

Appendix B1

Certificate of Calibration

CERTIFICATE OF CALIBRATION

UKAS CALIBRATION

0401

Certificate Number: 01963
AEA Identification Number: ED42523030

Approved Signatories: K. Stevenson
S. Eaton ✓

Signed: Date:

Date of issue: 01 September 2008

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 (%)
13-Feb	Belfast Centre	m491	63	0.3	0.049	3	0.9

Sulphur Dioxide

Date Year =2008	Site	Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	*Max Residual (%)	*m-xylene interference (ppb)
13-Feb	Belfast Centre	m637	261	4.2	0.182	8	9.4	19.5
11-Feb	Derry	j-ar-009	28	4.8	2.516	5.5	2.8	0

Ozone

Date Year =2008	Site	Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	*Max Residual (%)
13-Feb	Belfast Centre	m335	245	5	0.203	5.7	15.1
11-Feb	Derry	j-ar-009	0	5	1.149	3.2	1.2
19-Feb	Lough Navar	337	8	5	0.575	3.1	2
20-Feb	Mace Head	77086_385	1	5	1.024	3.1	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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Registered office 329 Harwell, Didcot, Oxfordshire OX11 0QJ
Registered in England and Wales no 3095862

Oxides of Nitrogen

Date Year =2008	Site		Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	*Max residual (%)	*Converter efficiency (%)
13-Feb	Belfast Centre	NO	m1804-	249	5	0.462	5	1.4	
		NOx	m733	252	6.9	0.475	5.2	0.5	98.3
11-Feb	Derry	NO	j-ar-009	34	5	2.318	5	0.7	
		NOx		34	6.2	2.398	5.1	0.6	95.3

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 (%)
13-Feb	Belfast Centre	24432	14158	1	-0.3	2.17	2.2	16.98	2.2
11-Feb	Derry	49608	10870	1	-0.2	2.11	2.2	17.09	2.2
19-Feb	Lough Navar	21196	12880	1	0.5	3.06	2.2	16.78	2.2

2. Scottish Sites

Carbon Monoxide

Date Year = 2008	Site	Analyser number	[1]Zero output	Uncertainty (ppm)	[2]Calibration Factor	Uncertainty (%)	*Maximum Residual (%)
11-Feb	Edinburgh St Leonards	240	-3	0.3	1.179	3	0.8
14-Jan	Glasgow Centre	0410-009	2	0.3	0.047	3.8	1.7

Sulphur Dioxide

Date Year =2008	Site	Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	*Max Residual (%)	*m-xylene interference (ppb)
11-Feb	Edinburgh St Leonards	71	9	4.1	0.761	6.8	5	9.9
14-Jan	Glasgow Centre	43C	9	4.3	0.207	5	2.4	-0.4
07-Feb	Grangemouth	703b-274	1	4.3	1.001	5	1.3	13.8

Ozone

Date Year =2008	Site	Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	*Max Residual (%)
21-Jan	Aberdeen	13073	1	5	0.925	3.1	1
13-Feb	Auchencorth Moss	292	0	5	0.993	3.1	0.4
13-Feb	Bush Estate	77087-385	14	5	0.503	3.1	0.1
11-Feb	Edinburgh St Leonards	136	-1	5	1.058	3.1	0.3
28-Jan	Eskdalemuir	145	5	5	0.567	3.4	1

Date Year =2008	Site	Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	*Max Residual (%)
09-Jan	Fort William	1023	-7	5	0.974	3.1	0.7
06-Feb	Lerwick	841B-176	2	5	0.961	3.1	1.2
23-Jan	Strath Vaich	M512	0	5	0.998	3.3	3

Oxides of Nitrogen

Date Year =2008	Site		Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	*Max residual (%)	*Converter efficiency (%)
21-Jan	Aberdeen	NO NOx	10268	2 2	5 5.7	2.226 2.247	5 5.5	2.3 1.4	99.1
13-Feb	Bush Estate	NO NOx	42c- 58112	12 12	5 5.3	1.165 1.179	5 5.4	0.5 1.1	98.5
30-Jan	Dumfries	NO NOx	1494	3 0	5 5.4	1.396 1.412	5 5	1.2 1.6	96.4
11-Feb	Edinburgh St Leonards	NO NOx	73	3 2	5 5.6	2.032 2.01	5 5.1	0.8 0.4	99.2
28-Jan	Eskdalemuir	NO NOx	347	-1 -2	5 5.3	1.236 1.137	5 5	1.4 1.1	100.4
09-Jan	Fort William	NO NOx	344	2 -3	5 5.3	1.126 1.096	5 5	0.6 1.6	98.1
14-Jan	Glasgow Centre	NO NOx	gra447	8 2	5 5.6	0.564 0.559	5.4 6	0.7 1.6	97.1
15-Jan	Glasgow City Chambers	NO NOx	10441	0 2	5 5.4	1.017 1.051	5 5	0.8 0.8	97.7
17-Jan	Glasgow Kerbside	NO NOx	h-ar-002	-10 -12	5 6.2	2.153 2.225	5 5.1	1.2 1.3	99.1
07-Feb	Grangemouth	NO NOx	700b-312	0 1	5 5.3	0.98 0.996	5 5.5	0.9 1.2	98.8
23-Jan	Inverness	NO NOx	1489	2 3	5 5.3	1.043 1.075	5 5	0.9 0.4	100.1

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 (%)
21-Jan	Aberdeen	24427	11587	1	0.2	**2.86**	**2.2**	**13.34**	**2.2**
13-Feb	Auchencorth Moss FDMS$_{10}$	26039	12951	1	-1.8	2.94	2.2	15.35	2.2
13-Feb	Auchencorth Moss FDMS$_{2.5}$	26033	13823	1	-1.4	2.95	2.2	15.18	2.2
13-Feb	Auchencorth Moss Partisol$_{10}$	21550						16.77	2.2
13-Feb	Auchencorth Moss Partisol$_{2.5}$	21548						16.35	2.2
30-Jan	Dumfries	21221						16.05	2.2

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 (%)
11-Feb	Edinburgh St Leonards	21308	11559	1	-0.1	2.99	2.2	15.59	2.2
14-Jan	Glasgow Centre	22980	13030	1	-0.9	2.05	2.2	16.58	2.2
17-Jan	Glasgow K'Side	21264	12588	1	-0.3	**2.1**	**2.2**	**14.44**	**2.2**
07-Feb	Grangemouth	22763	12344	1	-2.4	**3.16**	**2.2**	**14.36**	**2.2**
23-Jan	Inverness	21255						16.71	2.2

3. Welsh Sites

Carbon Monoxide

Date Year = 2008	Site	Analyser number	[1]Zero output	Uncertainty (ppm)	[2]Calibration Factor	Uncertainty (%)	*Maximum Residual (%)
24-Jan	Cardiff Centre	242	1	0.3	0.981	3	1.1

Sulphur Dioxide

Date Year =2008	Site	Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	*Max Residual (%)	*m-xylene interference (ppb)
24-Jan	Cardiff Centre	70	3	4.2	1.031	6.4	5.1	11.3
21-Jan	Narberth	aea26	35	4.1	0.563	5.4	1.8	42.8
23 Jan	Port Talbot	11669	-1	4.2	1.015	5.1	2.9	5.1
11-Feb	Wrexham	12183	1	4.2	0.997	5.7	2.6	3

Ozone

Date Year =2008	Site	Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	*Max Residual (%)
15-Jan	Aston Hill	158	-25	5	0.503	3.1	0.6
24-Jan	Cardiff Centre	168	0	5	0.996	3.2	0.6
23-Jan	Cwmbran	aea29	-1	5	1.01	3.2	0.9
21-Jan	Narberth	aea27	0	5	0.998	3.2	2
23 Jan	Port Talbot	94754	4	5	0.525	3.2	0.7

Oxides of Nitrogen

Date Year =2008	Site		Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	*Max residual (%)	*Converter efficiency (%)
15-Jan	Aston Hill	NO	m2068-	102	5	1.165	5.9	4.8	
		NOx	m853	101	5.3	1.156	6.6	5.3	97
24-Jan	Cardiff Centre	NO	71	1	5	1.623	5.4	3.5	

Date Year =2008	Site		Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	*Max residual (%)	*Converter efficiency (%)
		NOx		2	5.5	1.646	5.8	3.4	103.1
23-Jan	Cwmbran	NO NOx	aea28	2 3	5 5.3	0.996 0.994	5 5	0.6 1.4	95.7
21-Jan	Narberth	NO NOx	aea 25	42 43	5 5.3	0.821 0.853	5 5.3	2.5 2.6	95.5
24-Jan	Newport	NO NOx	m1639- m671	-1 1	5 5.4	1.036 1.061	5 5.7	1.3 1.6	100.8
23 Jan	Port Talbot	NO NOx	94617	1 2	5 5.3	1.155 1.178	5 5.3	2.8 2.2	98.5
22-Jan	Swansea Roadside	NO NOx	16695	2 2	5 5.3	1.097 1.075	5 5	0.9 1.1	97.7
11-Feb	Wrexham	NO NOx	12185	1 2	5 5.4	1.416 1.423	5 5.6	3.1 3.2	96.1

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 (%)
24-Jan	Cardiff Centre	24449	14280	1	-0.2	**2.95**	**2.2**	**13**	**2.2**
21-Jan	Narberth	21143	12609	1	1	**3.26**	**2.2**	**14.54**	**2.2**
24-Jan	Newport	2000	11785	1	-1.7	**3.06**	**2.2**	**13.45**	**2.2**
23-Jan	Port Talbot	22588	14552	1	0.4	**3.01**	**2.2**	**13.07**	**2.2**
22-Jan	Swansea Roadside PM_{10}	26293	15444	1	-1	**2.82**	**2.2**	**12.69**	**2.2**
22-Jan	Swansea Roadside $PM_{2.5}$	26292	14281	1	-1	**2.94**	**2.2**	**12.70**	**2.2**
11-Feb	Wrexham	2025a21 2240001						16.03	2.2

4. London Sites

Carbon Monoxide

Date Year = 2008	Site	Analyser number	[1]Zero output	Uncertainty (ppm)	[2]Calibration Factor	Uncertainty (%)	*Maximum Residual (%)
25-Feb	London Bexley	14871	0	0.3	0.976	3	0.4
24-Jan	London Bloomsbury	14330	0	0.3	1.031	3	2.1
26-Feb	London Harlington	1045	1	0.3	1.001	3	1.2
21-Feb	London Marylebone Road	651	0	0.3	0.985	3	1.1
30-Jan	London N. Kensington	360	3	0.3	0.967	3	0.6
13-Jan	London Westminster	10777	25	0.3	0.052	3	2.2
25-Feb	Tower Hamlets	306	11	0.3	0.987	3	4.4

Date Year = 2008	Site	Analyser number	[1]Zero output	Uncertainty (ppm)	[2]Calibration Factor	Uncertainty (%)	*Maximum Residual (%)
	Roadside						

Sulphur Dioxide

Date Year =2008	Site	Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	*Max Residual (%)	*m-xylene interference (ppb)
25-Feb	London Bexley	14869	-1	4.2	0.994	5	0.7	20.4
24-Jan	London Bloomsbury	14323	-4	4.2	1.063	7.9	4.8	32.9
21-Feb	London Marylebone Rd	411	3	4.1	0.914	5.1	2.3	6.7
30-Jan	London N. Kensington	1020	49	4.3	0.973	5	2.4	29.9
13-Jan	London Westminster	10780	31	4.2	1.036	13.6	4.9	-12.4

Ozone

Date Year =2008	Site	Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	*Max Residual (%)
24-Jan	London Bloomsbury	14907	1	5	1.034	3.1	2.3
04-Feb	London Eltham	375	9	5	0.989	3.5	2.3
26-Feb	London Harlington	107	0	5	1.014	3.6	0.6
20-Mar	London Haringey	538	9	5	0.956	3.1	0.8
28-Jan	London Hillingdon	12	14	5	0.098	4	2.2
21-Feb	London Marylebone Rd	769	-1	5	1.018	3.4	0.7
30-Jan	London N. Kensington	497	10	5	1.021	3.1	0.5
28-Jan	London Teddington	58811-320	2	5	0.252	3.1	0.6
13-Jan	London Westminster	10444	3	5	0.531	3.6	2

Oxides of Nitrogen

Date Year =2008	Site		Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	*Max residual (%)	*Converter efficiency (%)
18-Feb	Camden Kerbside	NO	623	2	5	1.538	5	0.8	
		NOx		4	5.5	1.881	6	4	100
15-Feb	Haringey Roadside	NO	397	2	5	1.387	5.5	4.6	
		NOx		2	5.4	1.275	6	4.3	99.5
25-Feb	London Bexley	NO	14870	0	5	1.412	5	0.2	
		NOx		1	5.4	1.363	5.1	0.1	103.8
24-Jan	London Bloomsbury	NO	14328	2	5	1.997	6.1	3.1	
		NOx		2	5.6	1.954	6.6	3.8	96.8
04-Feb	London Eltham	NO	307	3	5	1.143	5.4	1.4	
		NOx		6	5.7	1.064	5.7	2.1	97.5

Date Year =2008	Site		Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	*Max residual (%)	*Converter efficiency (%)
20-Mar	London Haringey	NO NOx	11392	0 0	5 5.4	1.400 1.418	7.5 8.2	4.0 3.3	97.7
26-Feb	London Harlington	NO NOx	1090	1 3	5 5.5	1.366 1.365	5 5	0.6 0.6	100
28-Jan	London Hillingdon	NO NOx	10	-32 -28	5 5.2	0.447 0.45	6.2 6.1	5.3 4.4	99.2
21-Feb	London Marylebone Rd	NO NOx	439	3 3	5 5.4	1.393 1.4	5.7 6.2	4.9 4.9	97.4
30-Jan	London N. Kensington	NO NOx	459	2 4	5 5.4	1.101 1.127	5 5.1	0.8 0.3	100.9
28-Jan	London Teddington	NO NOx	287	-2 -4	5 5.6	2.08 2.128	5 5.6	1.4 1.1	100.8
13-Jan	London Westminster	NO NOx	10439	5 5	5 6	2.82 2.937	5.8 5.8	2 1.7	101.1
25-Feb	Tower Hamlets Roadside	NO NOx	272	2 2	5 5.3	1.092 1.086	5 5.5	1 1.3	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 (%)
18-Feb	Camden Kerbside	21152	16648	1	1.4	**3.16**	**2.2**	**13.93**	**2.2**
15-Feb	Haringey Roadside	9407	11494	1	0.3	**2.68**	**2.2**	**11.71**	**2.2**
25-Feb	London Bexley	2000	10509	1	0.4	3.1	2.2	16.78	2.2
24-Jan	London Bloomsbury PM_{10}	24446	13847	1	0.8	**3.21**	**2.2**	**14.44**	**2.2**
24-Jan	London Bloomsbury $PM_{2.5}$	21492	15015	1	0.4	**3.14**	**2.2**	**14.15**	**2.2**
04-Feb	London Eltham	5144	8273	1	0.9	**2.95**	**2.2**	**13.49**	**2.2**
26-Feb	London Harlington	22835	14139	1	-0.5	**2.12**	**2.2**	**14.81**	**2.2**
21-Feb	London Marylebone Road PM_{10}	21306	13492	1	1.2	**3.13**	**2.2**	**14.07**	**2.2**
21-Feb	London Marylebone Road $PM_{2.5}$	21493	13827	1	-1.4	**3.02**	**2.2**	**13.62**	**2.2**
30-Jan	London N. Kensington	20715	10798	1	-0.2	**2.9**	**2.2**	**13.15**	**2.2**

5. English Sites

Carbon Monoxide

Date Year = 2008	Site	Analyser number	[1]Zero output	Uncertainty (ppm)	[2]Calibration Factor	Uncertainty (%)	*Maximum Residual (%)
21-Jan	Bristol Old Market	10429	0	0.3	1	3	4.9
21-Jan	Bristol St Paul's	14417	1	0.3	0.994	3	1.3
10-Jan	Bury Roadside	1357	1	0.3	0.987	3	1
05-Feb	Hull Freetown	489	52	0.3	0.05	3	2.7
06-Feb	Leeds Centre	207003	0	0.3	1.055	3	2.4
05-Feb	Leicester Centre	207004	1	0.3	1.169	3	1.4
12-Feb	Liverpool Speke	m478	49	0.3	0.062	3	2.9
14-Jan	Market Harborough	60983	211	0.3	0.004	27.9	3.2
26-Feb	Middlesbrough	486	-1	0.3	0.952	3	1.5
25-Feb	Newcastle Centre	m488	51	0.3	0.049	3	1.6
31-Jan	Salford Eccles	2386	0	0.3	0.107	3	1.6
04-Feb	Sheffield Centre	ra-006	4	0.3	0.066	3	3.5
26-Feb	Southampton Centre	9830	42	0.3	0.051	3.7	3.8

Sulphur Dioxide

Date Year =2008	Site	Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	*Max Residual (%)	*m-xylene interference (ppb)
08-Jan	Barnsley 12	10781	3	4.2	1.118	5	0.9	3.4
08-Jan	Barnsley Gawber	1	82	4.2	0.974	6.3	1.9	14.6
12-Feb	Birmingham Tyburn	h	1	4.2	0.992	5	1.2	2
21-Jan	Bristol St Paul's	14322	6	4.2	1.08	5	2.4	16.6
27-Feb	Harwell	14350	15	4.1	0.337	5	2.2	10.3
05-Feb	Hull Freetown	686	250	4	0.208	7.8	2.5	9.8
10-Jan	Ladybower	m2154-m793	50	4.3	1.322	5	2.4	38.3
20-Feb	Leamington Spa	1793	21	4.1	0.884	5	2.5	8
06-Feb	Leeds Centre	214004	2	4.4	1.086	5	1.7	13.6
05-Feb	Leicester Centre	21500	0	4.2	1.106	5	1.9	23.2
17-Apr	Leominster	14352	7	0	1.238	0	3.3	12.4
12-Feb	Liverpool Speke	m626	230	4.1	0.436	5.5	3.3	8.7
05-Mar	Lullington Heath	690	99	4.3	1.474	18.4	4.9	29.5
26-Feb	Middlesbrough	1660	-6	4.2	0.954	7.7	5.6	2.7
25-Feb	Newcastle Centre	m1814-m689	53	4.2	0.96	5	0.4	3.8
23-Jan	Northampton	29628003	1	4.2	0.948	8.8	4	21.8
06-Mar	Norwich Centre	214005	1	4.2	1.078	6	3.8	0.5
14-Feb	Nottingham Centre	none stated	15	4	0.207	5.1	1.4	17.8
04-Mar	Rochester Stoke	414	4	4.3	1.076	5	2	6.7
31-Jan	Salford Eccles	2346	0	4.2	1.147	5	0.1	17.2
04-Feb	Sandwell West	none	0	4.1	0.937	9.4	3.1	29.8

Date Year =2008	Site	Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	*Max Residual (%)	*m-xylene interference (ppb)
	Bromwich	stated						
05-Feb	Scunthorpe Town	468	-13	4.2	1.143	11.9	3.7	11.4
04-Feb	Sheffield Centre	ra-015	57	4.1	0.224	5	2.3	9.3
26-Feb	Southampton Centre	9850	200	4	0.257	15.9	5.4	-18.8
28-Feb	Thurrock	10554	17	4.1	0.584	5.1	5.9	15.8
11-Mar	Wicken Fen	82	-12	4.1	0.541	5	2.2	1.6

Ozone

Date Year =2008	Site	Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	*Max Residual (%)
08-Jan	Barnsley Gawber	1	0	5	1.004	3.1	1.5
29-Jan	Birmingham Centre	14357	0	5	0.106	3.1	1
12-Feb	Birmingham Tyburn	h	1	5	0.864	3.6	0.4
13-Feb	Blackpool Marton	2	2	5	1.004	3.2	1.4
07-Jan	Bolton	195	3	5	1.052	3.5	4
18-Feb	Bottesford	ea357	8	5	1.299	3.6	1.1
07-Feb	Bournemouth	10280	1	5	0.957	3.1	0.5
06-Mar	Brighton Preston Park	12461	2	5	0.506	3.6	0.6
21-Jan	Bristol St Paul's	14358	1	5	1.015	3.1	0.7
16-Jan	Coventry Memorial Park	elec4	2	5	1.009	3.1	1.5
20-Feb	Exeter Roadside	100e0s	0	5	0.952	3.4	2.2
29-Jan	Glazebury	138	12	5	0.457	3.2	3.9
29-Jan	Great Dun Fell	163	3	5	0.51	3.1	0.5
27-Feb	Harwell	1018	1	5	0.489	3.7	1.4
29-Jan	High Muffles	346	-12	5	0.554	3.4	3.6
05-Feb	Hull Freetown	356	235	5	0.094	3.4	2.3
10-Jan	Ladybower	125b-101	52	5	0.497	3.2	1.3
20-Feb	Leamington Spa	1409	20	5	1.003	3.2	1.2
06-Feb	Leeds Centre	206003	0	5	0.923	3.1	0.5
05-Feb	Leicester Centre	215001	0	5	0.833	3.6	1.2
17-Apr	Leominster	et14470	0	5	0.98	3.2	1.8
12-Feb	Liverpool Speke	m331	222	5	0.097	3.4	2.1
05-Mar	Lullington Heath	1	100	5	0.509	3.6	0.6
30-Jan	Manchester Piccadilly	0427-003	8	5	0.191	3.2	1.7
30-Jan	Manchester South	1317	0	5	0.959	3.2	0.9
14-Jan	Market Harborough	60894	-2	5	0.945	3.2	1
26-Feb	Middlesbrough	944	-1	5	1.03	3.1	0.8
25-Feb	Newcastle Centre	m1820-m357	52	5	0.477	3.1	1.2
23-Jan	Northampton	2625010	-1	5	1.011	3.3	2.6
06-Mar	Norwich Centre	206002	1	5	0.954	3.1	0.8
14-Feb	Nottingham Centre	gra0927011	-15	5	0.102	3.6	1.9
19-Feb	Plymouth Centre	chanf02	20	5	0.051	3.3	1.6

Date Year =2008	Site	Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	*Max Residual (%)
30-Jan	Portsmouth	205002	2	5	0.963	3.5	0.2
13-Feb	Preston	2	0	5	0.926	3.2	1.9
31-Jan	Reading New Town	ambirak	3	5	1.012	3.3	3.6
04-Mar	Rochester Stoke	378	1	5	1.025	3.2	0.6
31-Jan	Salford Eccles	2363	1	5	1.176	3.1	1.2
04-Feb	Sandwell West Bromwich	none stated	1	5	0.994	3.7	0.8
04-Feb	Sheffield Centre	ra-010	8	5	0.088	3.1	0.9
12-Mar	Sibton	219	32	5	0.567	3.6	0.5
21-Feb	Somerton	95349	3	5	0.515	3.2	0.4
26-Feb	Southampton Centre	9810	233	5	0.096	3.2	1.3
27-Feb	Southend-on-Sea	Apref4	1	5	0.999	3.1	0.7
28-Feb	St Osyth	60869	-1	5	0.984	3.1	0.8
15-Jan	Stoke-on-Trent Centre	0	4	5	1.248	8.4	19.1
26-Feb	Sunderland Silksworth	436	-4	5	1.007	3.1	0.3
28-Feb	Thurrock	10788	3	5	0.12	3.5	0.8
06-Mar	Weybourne	1	1	5	0.99	3.2	0.5
11-Mar	Wicken Fen	165	-10	5	0.524	3.6	1.1
29-Jan	Wigan Centre	4009	0	5	0.932	3.1	1.8
12-Feb	Wirral Tranmere	2	-1	5	1.011	3.3	3
21-Feb	Yarner Wood	14456	34	5	0.499	3.1	1.6

Oxides of Nitrogen

Date Year =2008	Site		Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	*Max residual (%)	*Converter efficiency (%)
08-Jan	Barnsley	NO	1	12	5	2.074	5	2.4	
	Gawber	NOx		12	5.6	2.073	6.2	2.4	90.5
18-Feb	Bath Roadside	NO	12758	2	5	1.233	5	2.2	
		NOx		4	5.3	1.236	5.1	1.8	95.8
27-Feb	Billingham	NO	574	-2	5	1.797	5	1.4	
		NOx		-2	5.5	1.8	5	0.6	100
29-Jan	Birmingham	NO	14324	-10	5	0.454	5	2	
	Centre	NOx		-13	5.2	0.456	5.4	2.4	99.1
12-Feb	Birmingham	NO	h	-7	5	0.971	5	0.9	
	Tyburn	NOx		-12	5.3	0.974	5.3	2.2	96.1
13-Feb	Blackpool	NO	1	30	5	2.403	5.4	3.7	
	Marton	NOx		30	5.7	2.39	5.8	4	101
07-Jan	Bolton	NO	433	-1	0	1.126	0	0	
		NOx		6	0	1.171	0	0	0
07-Feb	Bournemouth	NO	10279	0	5	1.223	5	0.4	
		NOx		0	5.3	1.176	5.2	0.7	100.5
06-Mar	Brighton	NO	13068	2	5	1.189	5.9	5.6	
	Preston Park	NOx		3	5.3	1.182	6	4.9	97.8
06-Mar	Brighton	NO	11885	8	5	1.362	5.4	2.6	
	Roadside	NOx		5	5.4	1.341	7.5	2.2	101

Date Year =2008	Site		Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	*Max residual (%)	*Converter efficiency (%)
21-Jan	Bristol Old Market	NO	10510	1	5	1.256	7.9	3.8	
		NOx		1	5.4	1.26	9.3	4.5	103.8
21-Jan	Bristol St Paul's	NO	14353	1	5	1.209	5	2.8	
		NOx		1	5.3	1.208	5.4	2.6	103.5
10-Jan	Bury Roadside	NO	1710	1	5	1.237	5	0.8	
		NOx		3	5.6	1.282	5.2	0.9	96.4
11-Mar	Cambridge Roadside	NO	55355-303	-2	5	1.108	5	2.5	
		NOx		-2	5.3	1.108	5.3	2.5	100.9
03-Mar	Canterbury	NO	11666	3	5	1.336	5.5	1.7	
		NOx		4	5.4	1.34	5.6	1.4	98.3
16-Jan	Coventry Memorial Park	NO	elec7	-1	5	1.061	5	1.3	
		NOx		-6	5.3	1.043	5.2	1.5	100
20-Feb	Exeter Roadside	NO	d1s	3	5	1.017	9.8	5.2	
		NOx		6	5.3	1.03	10.4	5.6	100.4
29-Jan	Glazebury	NO	78	44	5	0.952	5	1.2	
		NOx		53	5.4	1.017	5	0.7	98.5
27-Feb	Harwell	NO	14355	6	5	1.298	5	0.5	
		NOx		5	5.4	1.318	5.1	1.5	96.8
29-Jan	High Muffles	NO	1783	6	5	0.561	5	1	
		NOx		5	5.2	0.577	5	0.8	99.6
05-Mar	Horley	NO	M525	0	5	1.062	5	1.5	
		NOx		1	5.3	1.073	5.5	2.4	96.5
05-Feb	Hull Freetown	NO	732	258	5	0.408	5.1	2.8	
		NOx		261	5.2	0.434	5.3	1.9	98.8
10-Jan	Ladybower	NO	72	-1	5	0.813	5	1.5	
		NOx		-9	5.3	0.807	5	1.8	98.2
20-Feb	Leamington Spa	NO	1705	21	5	1.145	5.2	3.9	
		NOx		22	5.3	1.164	5.9	4.2	98.1
06-Feb	Leeds Centre	NO	210005	2	5	1.032	5	1.8	
		NOx		7	5.4	1.064	5.2	2	99.2
06-Feb	Leeds Headingley Kerbside	NO	969b-308	50	5	1.195	5.1	2.3	
		NOx		53	5.5	1.206	5.2	1.5	98.1
05-Feb	Leicester Centre	NO	210004	0	5	1.281	5	2.2	
		NOx		-1	5.3	1.102	5	1.7	99.5
17-Apr	Leominster	NO	et14863	1	5	1.094	5	0.2	
		NOx		0	5.3	1.067	5	0.4	96.8
12-Feb	Liverpool Speke	NO	m734	244	5	0.465	5.9	3.4	
		NOx		240	5.2	0.455	5.5	1.5	99.2
05-Mar	Lullington Heath	NO	675	100	5	0.834	5	2.2	
		NOx		104	5.3	0.799	5	1.8	97.7
30-Jan	Manchester Piccadilly	NO	g-ra0447-0011	3	5	0.494	5.5	1.1	
		NOx		-5	5.2	0.495	6.6	1.2	103.7
30-Jan	Manchester South	NO	2115	1	5	1.026	5	1.5	
		NOx		2	5.3	1.041	5.1	1.6	98.5
14-Jan	Market Harborough	NO	61963	1	5	0.519	7.1	5	
		NOx		-1	5.2	0.519	7.5	4.9	97.1
26-Feb	Middlesbrough	NO	2283	-55	5	1.15	5	0.8	

0401

Certificate Number: 01963
AEA Identification Number: ED42523030

Date Year =2008	Site		Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	*Max residual (%)	*Converter efficiency (%)
		NOx		-78	9.3	1.063	6.6	1.8	99.5
25-Feb	Newcastle Centre	NO	m1800-m730	50	5	1.92	5.2	2.7	
		NOx		52	6.8	1.941	6.1	2.4	98.3
25-Feb	Newcastle Cradlewell Road	NO	m2106-m860	0	5	1.124	6.2	2.3	
		NOx		4	5.5	1.145	5.9	2.1	100
23-Jan	Northampton	NO	2522011	0	5	1.012	5.6	2.3	
		NOx		-1	5.3	0.994	6.2	2.4	103.6
06-Mar	Norwich Centre	NO	211001	1	5	1.03	5	0.5	
		NOx		2	5.3	1.013	5	0.6	99.2
14-Feb	Nottingham Centre	NO	gra0447009	3	5	0.458	5.1	2.9	
		NOx		8	5.2	0.456	6.7	4.5	96.7
28-Feb	Oxford Centre Roadside	NO	m2350-m947	102	5	1.021	5	2.2	
		NOx		106	5.5	1.077	5.2	2.7	97.7
19-Feb	Plymouth Centre	NO	iv2000	12	5	0.228	5	2.6	
		NOx		23	5.3	0.23	5.6	1.3	96.6
30-Jan	Portsmouth	NO	903005	0	5	0.999	5	2.9	
		NOx		0	5.3	1.013	5.4	2.9	99.1
13-Feb	Preston	NO	1	55	5	2.136	5.2	3.7	
		NOx		54	5.6	2.117	5.8	3.4	99.1
31-Jan	Reading New Town	NO	ambirak	0	5	1.375	5	2.2	
		NOx		0	5.4	1.382	5.7	2.5	98.9
04-Mar	Rochester Stoke	NO	473	-1	5	1.294	5.3	2.6	
		NOx		-4	5.6	1.309	5.4	2.3	95.8
31-Jan	Salford Eccles	NO	2381	1	5	1.251	5.3	1.9	
		NOx		1	5.5	1.283	5.3	1.4	98.9
04-Feb	Sandwell West Bromwich	NO		-1	5	1.009	5	3.6	
		NOx		1	5.3	1.015	5.9	2.8	101.2
05-Feb	Scunthorpe Town	NO	526	32	5	2.19	5.9	3.2	
		NOx		46	5.7	2.314	6.2	1.8	98.1
04-Feb	Sheffield Centre	NO	ra0447-008	3	5	0.436	5	1.7	
		NOx		3	5.2	0.447	5.7	3	99.6
04-Feb	Sheffield Tinsley	NO	10772	-3	5	2.34	5.9	3.4	
		NOx		-3	6.4	2.412	6.2	3.3	80.2
21-Feb	Somerton	NO	12895	0	5	0.484	7.6	4.7	
		NOx		9	5.2	0.497	7.4	4.3	99.2
26-Feb	Southampton Centre	NO	9841	523	5	0.14	5.8	1.8	
		NOx		548	5.2	0.143	7.2	1.4	99.3
27-Feb	Southend-on-Sea	NO	APref7	1	5	1.06	6.1	5	
		NOx		3	5.4	1.078	6.5	4.8	99.6
28-Feb	St Osyth	NO	60988	-11	5	0.851	8.2	5.8	
		NOx		-12	5.3	0.845	6	5.6	99.3
15-Jan	Stoke-on-Trent Centre	NO	0	29	5	1.207	6.1	4.8	
		NOx		30	5.9	1.216	6	3.8	96.4
26-Feb	Sunderland Silksworth	NO	734b-322	0	5	1.1	5	1.9	
		NOx		3	5.3	1.118	5.7	2.9	99.5

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

Date Year =2008	Site		Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	*Max residual (%)	*Converter efficiency (%)
28-Feb	Thurrock	NO	11004	-1	5	1.393	6.4	4.6	
		NOx		-2	5.5	1.36	6.9	4.8	97.9
03-Mar	Walsall Willenhall	NO	1337	0	5	1.027	5	3.5	
		NOx		3	5.4	1.047	5.4	3.3	99.5
11-Mar	Wicken Fen	NO	2223	20	5	0.532	5	3.8	
		NOx		18	5.2	0.508	5.1	3.9	97.9
29-Jan	Wigan Centre	NO	805005	-1	5	0.951	5	1.5	
		NOx		0	5.3	0.914	5	0.9	96.1
12-Feb	Wirral Tranmere	NO	1	19	5	1.786	5.8	4.8	
		NOx		20	5.5	1.801	6.9	5.2	102.3
21-Feb	Yarner Wood	NO	12554	13	5	1.202	5.9	1.1	
		NOx		10	5.3	1.17	6.9	2.7	97.4

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-Jan	Birmingham Centre	26034	12112	1	-2.1	3.07	2.2	16.78	2.2
12-Feb	Birmingham Tyburn	not here							
13-Feb	Blackpool Marton	24424	13005	1	0.9	**2.88**	**2.2**	**12.9**	**2.2**
07-Jan	Bolton	15166	15276	1	0.7	**3**	**2.2**	**13.53**	**2.2**
07-Feb	Bournemouth	21257						15.71	2.2
06-Mar	Brighton Roadside							16.72	2.2
21-Jan	Bristol St Paul's	24426	13357	1	1.4	3.11	2.2	16.57	2.2
10-Jan	Bury Roadside	658	11724	1	1.1	**2.02**	**2.2**	**14.43**	**2.2**
16-Jan	Coventry Memorial Park	25026	13196	1	0.1	2.98	2.2	17.25	2.2
27-Feb	Harwell PM_{10}	21489	14651	1	-1.8	3.1	2.2	17.15	2.2
27-Feb	Harwell $PM_{2.5}$	21490	10821	1	-0.6	3.14	2.2	17.05	2.2
05-Feb	Hull Freetown	24445	14012	1	-0.7	3.01	2.2	17.03	2.2
20-Feb	Leamington Spa	2075	11092	1	1.4	**2.97**	**2.2**	**13.58**	**2.2**
06-Feb	Leeds Centre	24451	13153	1	-1.8	3.16	2.2	17.45	2.2
06-Feb	Leeds Headingley Kerbside	22048	13117	1	0.6	1.88	2.2	0	2.2
05-Feb	Leicester Centre	24442	14288	1	-1.2	2.96	2.2	16.81	2.2
12-Feb	Liverpool Speke	24450	15863	1	0.3	3.05	2.2	16.3	2.2
30-Jan	Manchester Piccadilly	26038	12832	1	-1.9	**3.04**	**2.2**	**13.4**	**2.2**
26-Feb	Middlesbrough	24325	13931	1	-1.4	**2.03**	**2.2**	**14.82**	**2.2**
25-Feb	Newcastle Centre	24448	13744	1	-0.6	1.65	2.2	15.08	2.2
23-Jan	Northampton	21621	14260	1	-1.8	**3.05**	**2.2**	**13.99**	**2.2**
06-Mar	Norwich Centre	21495	14199	1	0.7	**2.22**	**2.2**	**14.89**	**2.2**
14-Feb	Nottingham Centre	25025	12129	1	-0.4	3.01	2.2	17.21	2.2
19-Feb	Plymouth Centre	24428	13047	1	0.8	2.98	2.2	16.78	2.2
30-Jan	Portsmouth	21578	10604	1	0.3	**3.43**	**2.2**	**13.53**	**2.2**

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 (%)
13-Feb	Preston	22881	12911	1	-0.3	3.02	2.2	15.9	2.2
31-Jan	Reading New Town	21315	13331	1	1	**3.01**	**2.2**	**13.68**	**2.2**
04-Mar	Rochester Stoke PM_{10}	21489	14651	1	-1.8	3.10	2.2	17.15	2.2
04-Mar	Rochester Stoke $PM_{2.5}$	21490	10821	1	-0.6	3.14	2.2	17.05	2.2
31-Jan	Salford Eccles	21168	14626	1	1.5	**2.13**	**2.2**	**15.06**	**2.2**
05-Feb	Scunthorpe Town	2000	12495	1	-1.3	3.2	2.2	17.77	2.2
04-Feb	Sheffield Centre	25024	12073	1	-1.4	3.02	2.2	16.88	2.2
26-Feb	Southampton Centre	24448	13971	1	0.7	2.98	2.2	16.87	2.2
27-Feb	Southend-on-Sea	22927	13284	1	-0.8	3.01	2.2	16.57	2.2
15-Jan	Stoke-on-Trent Centre	25028	12460	1	-0.4	3.01	2.2	16.99	2.2
28-Feb	Thurrock	25039	12924	1	-0.4	**3.12**	**2.2**	**14.19**	**2.2**
12-Feb	Wirral Tranmere	22883	13316	1	0.2	0	2.2	12.43	2.2

A business name of AEA Technology plc.
Registered office 329 Harwell, Didcot, Oxfordshire OX11 0QJ
Registered in England and Wales no 3095862

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
* R^2 is the correlation coefficient of linearity
* 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.

This certificate is an electronic representation of a certificate signed by Stewart Eaton on 15 September 2007 and held by AEA at the above address. Hard copies are available on request.