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QA/QC Data Ratification Report for the Automatic Urban and Rural Network, January-March 2012, and Intercalibration Report Winter 2012

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

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AEA Group
The Gemini Building
Fermi Avenue
Harwell
Didcot
Oxfordshire
OX11 0QR

Tel: 0870 190 6465
Fax: 0870 190 6608

AEA is a business name of AEA Technology plc

AEA is certificated to ISO9001 and ISO14001

Author	Name	Stewart Eaton and Brian Stacey
Approved by	Name	Alison Loader
	Signature	
	Date	01/10/2012

Executive summary

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 Government and Department of Environment (DoE) in Northern Ireland.

Ratified hourly average data capture for the network averaged 93.2% for all pollutants (O_3, NO_2, SO_2, CO, PM_{10} and $PM_{2.5}$) during the 3-month reporting period January-March 2012. Data capture for all pollutants except $PM_{2.5}$ was above 90%. There were 26 sites with data capture less than 90% for the period.

The number of monitoring sites in the AURN during this quarter was 134, of which 72 are Local Authority owned sites affiliated to the national network. Some are co-located and separately named gravimetric particulate analysers at sites with automatic analysers. Many affiliated sites have additional Defra-funded analysers installed on site.

The main reasons for data loss at the sites have been provided and these were predominantly due to instrument faults, response instability or problems associated with the replacement of analysers and infrastructure. A summary of recommendations to help improve network performance is given in Appendix 1.

Table of contents

Section 1 Data Ratification Report

Appendices

1 Introduction

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 2012. During this period there were 134 operational monitoring sites in the Network, consisting of 99 urban sites, 27 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 62 Defra-funded sites and 72 affiliate sites, although many affiliate sites have fully-funded PM_{10} and/or $PM_{2.5}$ analysers. Eleven sites have non-automatic particulate samplers (Partisols); some of these are co-located with FDMS analysers at Auchencorth Moss, Harwell, London North Kensington and Marylebone Road for both PM_{10} and $PM_{2.5}$.

1.1 Overview of Network Performance

Ratified hourly average data capture for the network averaged 93.2% for all pollutants (O_3, NO_2, SO_2, CO, PM_{10} and $PM_{2.5}$) during the 3 month reporting period January-March 2012 (see Table 1.1). All gaseous pollutants achieved 90% or higher data capture on average. Data capture rates are calculated using the actual data capture as hourly averages (daily for Partisol) against the total number of hours (or days) in the relevant period; service and maintenance are counted as lost data. It is permissible to discount routine service and calibration from achievable data capture targets, but this is not yet calculated. For sites starting or closing, the data capture is based on the actual date starting or closing..

Table 1.1: AURN Ratified Data Capture (%) by Quarter, 2012

	CO	PM_{10}	$PM_{2.5}$	NO_2	O_3	SO_2	Mean
Q1 2012	96.6	90.4	88.3	95.8	96.6	96.6	93.2

Overall, 344 out of the 411 analysers (84%) achieved data capture levels above the required 90% target during this reporting period (See Table 1.2).

Table 1.2: Number of Analysers with Data Capture below 90%

Total Number Of Analysers		Q1 Jan-Mar 2012 (No. below 90%)
CO	23	2
NO_2	116	14
O_3	81	7
PM_{10} [1]	68	14
$PM_{2.5}$ [1]	78	26
SO_2	45	4
Total <90%		67

1. Includes FDMS, FDMS, BAM and Partisol analysers.

In total, 26 out of the 134 operational network sites in the quarter (19%) had an average data capture rate below the required 90% level for the January-March 2012 period.

2 Changes in the Network for Directive Compliance

2.1 Additional Sites and Analysers

No new analysers were commissioned during the period January-March 2012

2.2 Upgrade of Non CEN-Compliant Analysers

A programme of upgrade on non CEN-compliant analysers at network sites has been undertaken. This commenced late in 2011, and was completed in Q1 of 2012. The existing analysers were audited by the QA/QC unit prior to replacement, and the new instruments audited before data were disseminated. The analysers replaced, and the dates of commissioning, are given in Table 2.2.

Table 2.2: Replacement of Noncompliant Analysers

Site	Installation Date	Analysers Upgraded	Data Dissemination Start
York Fishergate	16/12/2011	NOx	20/12/2011
Scunthorpe Town	19/12/2011	NOx	22/12/2011
Newcastle Cradlewell	20/12/2011	NOx	23/12/2011
Sunderland Silksworth	21/12/2011	NOx, SO_2	23/12/2011
Chepstow A48	22/12/2011	NOx	23/12/2011
Blackburn Darwen Roadside	21/12/2011	NOx	23/12/2011
Newport	21/12/2011	NOx	23/12/2011
Carlisle Roadside	10/01/2012	NOx	10/01/2012
Chesterfield	11/01/2012	NOx	13/02/2012
Chesterfield Roadside	13/01/2012	NOx	16/01/2012
Oxford St Ebbes	13/01/2012	NOx	01/02/2012
Oxford Centre Roadside	16/01/2012	NOx	06/02/2012
Salford Eccles	19/01/2012	NOx,SO_2,O_3,CO	30/01/2012
Warrington	24/01/2012	NOx	27/01/2012
Leamington Spa	26/01/2012	NOx,SO_2,O_3	30/01/2012
Cambridge Roadside	09/02/2012	NOx	13/02/2012
Grangemouth	09/02/2012	NOx, SO_2	13/02/2012
Grangemouth Moray	09/02/2012	NOx	13/02/2012
Charlton Mackrell	22/03/2012	O_3	26/03/2012
Dumbarton Roadside	22/03/2012	NOx	26/03/2012
Bottesford	08/03/2012	O_3	20/03/2012
Armagh Roadside	13/03/2012	NOx	23/03/2012
Bury Roadside	16/03/2012	NOx,CO	20/03/2012
Wigan	21/03/2012	NOx	23/03/2012

3 Generic Data Quality Issues

3.1 FDMS Performance Issues

At the time of writing, there are a number of FDMS performance issues being investigated by the QA/QC unit. Most significant is the apparent baseline offset, which can result in data being higher or lower than might be expected. In order to determine this, zero checks are being carried out by placing a zero filter over the inlet and leaving for several days. This method does allow the determination of the analyser "zero" but requires a visit by QA/QC staff and the LSO, and therefore it will take time to complete all sites. The findings and implications of these tests will be discussed in future QA/QC reports.

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, Northern Ireland and Wales. Note that where analysers were commissioned during the period, the stated data capture for these instruments is calculated from the date of commissioning.

4.1 London

4.1.1 Data Capture

The data capture for sites in London (within the M25) for the period January-March 2012 is given in Table 4.1:

Table 4.1: Data capture for London Jan – Mar 2012: (calculated from 01/01/2012 or start date of any new site, to 31/03/2012.)

Site	CO	PM_{10}	PM_{25}	NO_2	O_3	SO_2	Site Average
London							
Camden Kerbside	-	99.1	99.0	97.1	-	-	98.4
Haringey Roadside	-	82.8	89.1	89.6	-	-	87.2
London Bexley	99.0	-	81.8	96.9	-	98.7	94.1
London Bloomsbury	98.3	97.8	97.9	98.2	98.2	98.2	98.1
London Cromwell Road 2	95.1	-	-	81.3	-	95.7	90.7
London Eltham	-	-	79.2	89.6	99.3	-	89.3
London Haringey	-	-	-	98.5	87.0	-	92.8
London Harlington	-	89.8	92.9	97.6	98.4	-	94.7
London Harrow Stanmore	-	-	80.5	-	-	-	80.5
London Hillingdon	-	-	-	98.6	98.7	-	98.7
London Marylebone Road	95.8	90.4	97.4	94.2	98.4	98.8	95.8
London Marylebone Road PARTISOL	-	97.8	27.5	-	-	-	62.6
London N. Kensington	98.2	91.3	94.8	98.0	98.4	97.1	96.3
London N. Kensington PARTISOL	-	98.9	93.4	-	-	-	96.2
London Teddington	-	-	97.9	98.3	98.5	-	98.2
London Westminster	98.4	-	91.2	98.4	98.1	98.5	97.0
Southwark A2 Old Kent Road	-	89.1	-	98.9	-	-	94.0
Tower Hamlets Roadside	99.2	-	-	99.1	-	-	99.2
Number of sites	7	9	13	15	9	6	18
Number of sites < 90%	0	3	5	3	1	0	4
Network Mean (%)	97.7	93.0	86.4	95.6	97.2	97.8	92.4

Shaded boxes are for data capture < 90%.
Bold data captures are for data that are provisional and subject to further quality control.

4.1.2 Site Specific Issues

Haringey Roadside
A power cut affected the site from 7 to 16 March.

London Eltham
A switching valve fault resulted in the loss of data from 9 to 21 March and 27 to 29 March.

London Harrow Stanmore
A series of valve faults, leaks and high dewpoints resulted in several periods of lost $PM_{2.5}$ data.

London Marylebone Road Partisol
A power supply fault resulted in the instrument being out of service from 13 January to 14 March.

4.2 England (excluding London)

4.2.1 Data Capture

The data capture for sites in England for the period January-March 2012 is given in Table 4.2:

Table 4.2: Data capture for England excluding London, Jan – Mar 2012: (calculated from 01/01/2012 or start date of any new site, to 31/03/2012.)

Site	CO	PM_{10}	PM_{25}	NO_2	O_3	SO_2	Site Average
England							
Barnsley 12	-	-	-	-	-	93.6	93.6
Barnsley Gawber	-	-	-	91.0	98.1	98.1	95.7
Bath Roadside	-	-	-	97.2	-	-	97.2
Billingham	-	-	-	97.5	-	-	97.5
Birmingham Acocks Green	-	-	98.0	98.4	98.5	98.5	98.4
Birmingham Tyburn	-	95.1	98.8	99.5	99.1	98.9	98.3
Birmingham Tyburn Roadside	-	97.0	90.5	98.1	98.3	-	96.0
Blackburn Darwen Roadside	-	-	-	100.0	-	-	100.0
Blackpool Marton	-	-	70.4	93.3	97.3	-	87.0
Bottesford	-	-	-	-	99.6	-	99.6
Bournemouth	-	-	89.0	97.2	98.5	-	94.9
Brighton Preston Park	-	-	100.0	98.3	98.4	-	98.9
Bristol Old Market	-	-	-	73.7	-	-	73.7
Bristol St Paul's	95.1	78.6	89.8	96.9	95.0	97.3	92.1
Bury Roadside	98.4	99.3	99.2	98.4	-	-	98.8
Cambridge Roadside	-	-	-	77.1	-	-	77.1
Canterbury	-	-	-	81.6	87.5	-	84.6
Carlisle Roadside	-	90.7	82.0	96.9	-	-	89.9
Charlton Mackrell	-	-	-	89.9	99.2	-	94.6
Chatham Centre Roadside	-	94.6	99.0	92.1	-	-	95.2
Chesterfield	-	88.0	99.1	99.7	-	-	95.6
Chesterfield Roadside	-	99.3	99.0	96.6	-	-	98.3
Coventry Memorial Park	-	-	0.0	98.4	98.5	-	65.6
Eastbourne	-	90.8	96.1	99.8	-	-	95.6
Exeter Roadside	-	-	-	99.1	99.6	-	99.3
Glazebury	-	-	-	98.4	98.5	-	98.4
Great Dun Fell	-	-	-	-	97.3	-	97.3
Harwell	-	97.0	97.6	97.3	97.4	97.2	97.3
Harwell	-	85.7	72.5	-	-	-	79.1

Site	CO	PM_{10}	PM_{25}	NO_2	O_3	SO_2	Site Average
PARTISOL							
High Muffles	-	-	-	96.2	98.4	-	97.3
Horley	-	-	-	99.3	-	-	99.3
Hull Freetown	85.0	97.3	97.3	84.3	85.0	85.0	89.0
Ladybower	-	-	-	**98.4**	98.5	84.5	**93.8**
Leamington Spa	-	97.4	97.0	99.0	99.3	94.7	97.5
Leeds Centre	98.0	97.7	97.8	98.1	98.4	98.0	98.0
Leeds Headingley Kerbside	-	91.6	97.8	96.9	-	-	95.4
Leicester Centre	97.4	96.3	63.4	94.1	91.5	98.5	90.2
Leominster	-	-	-	97.8	98.3	97.6	97.9
Lincoln Canwick Road	-	-	-	93.8	-	-	93.8
Liverpool Queen's Drive Roadside	-	-	-	97.6	-	-	97.6
Liverpool Speke	98.3	95.7	86.3	94.2	92.2	97.7	94.1
Lullington Heath	-	-	-	98.4	98.6	82.1	93.0
Manchester Piccadilly	-	-	96.1	98.3	92.4	98.5	96.3
Manchester South	-	-	-	98.4	98.5	-	98.5
Market Harborough	-	-	-	89.3	93.3	-	91.3
Middlesbrough	97.0	96.7	95.5	97.2	87.9	97.4	95.3
Newcastle Centre	98.3	98.2	98.5	97.7	97.7	98.3	98.1
Newcastle Cradlewell Roadside	-	-	-	92.7	-	-	92.7
Northampton	-	-	90.1	99.5	**99.7**	99.5	**97.2**
Norwich Lakenfields	-	95.2	95.7	95.9	98.4	98.3	96.7
Nottingham Centre	-	96.5	96.8	97.3	97.3	97.2	97.0
Oxford Centre Roadside	-	-	-	78.3	-	-	78.3
Oxford St Ebbes	-	98.2	98.1	97.9	-	-	98.1
Plymouth Centre	-	83.2	78.7	97.0	98.6	-	89.4
Portsmouth	-	94.9	96.5	98.5	99.6	-	97.4
Preston	-	-	97.7	98.5	98.6	-	98.3
Reading New Town	-	94.2	96.3	94.3	98.5	-	95.8
Rochester Stoke	-	97.8	96.9	98.0	98.3	95.4	97.3
Salford Eccles	97.1	99.0	99.2	98.2	98.4	98.2	98.3
Sandy Roadside	-	73.9	55.3	99.6	-	-	76.3
Scunthorpe Town	-	99.1	-	99.5	-	99.7	99.4
Sheffield Centre	97.8	97.7	99.2	97.4	97.3	97.6	97.8
Sheffield Tinsley	-	-	-	98.6	-	-	98.6

Site	CO	PM_{10}	PM_{25}	NO_2	O_3	SO_2	Site Average
Sibton	-	-	-	-	99.9	-	99.9
Southampton Centre	98.4	98.1	90.0	98.2	98.5	98.3	96.9
Southend-on-Sea	-	-	76.8	97.6	98.4	-	90.9
St Osyth	-	-	-	97.7	98.0	-	97.8
Stanford-le-Hope Roadside	-	86.8	50.3	99.3	-	99.4	83.9
Stockton-on-Tees Eaglescliffe	-	94.9	92.1	88.7	-	-	91.9
Stoke-on-Trent Centre	-	95.5	73.3	97.2	97.5	-	90.9
Storrington Roadside	-	**91.0**	85.7	99.2	-	-	**92.0**
Sunderland Silksworth	-	-	84.5	92.5	96.7	97.2	92.7
Thurrock	-	98.7	-	99.0	95.8	98.0	97.9
Warrington	-	94.0	99.6	97.1	-	-	96.9
Weybourne	-	-	-	-	99.9	-	99.9
Wicken Fen	-	-	-	95.0	98.4	96.6	96.6
Wigan Centre	-	-	0.0	98.9	99.9	-	66.3
Wirral Tranmere	-	-	97.5	94.3	98.6	-	96.8
Yarner Wood	-	-	-	98.3	81.5	-	89.9
York Bootham	-	99.4	99.3	-	-	-	99.3
York Fishergate	-	97.8	87.5	99.5	-	-	94.9
Number of sites	11	39	49	74	52	29	81
Number of sites < 90%	1	6	17	8	4	3	14
Network Mean (%)	96.4	94.2	86.7	95.8	96.9	96.2	93.7

Shaded boxes are for data capture < 90%
Bold data captures are for data that are provisional and subject to further quality control

4.2.2 Site Specific Issues

Blackpool Marton
There was a period in February where the $PM_{2.5}$ data was flat and elevated for several days; this has been deleted.

Bristol Old Market
As a result of a defective NOx converter, the NO_2 data from 9 August 2011 to the service on 23 January 2012 have been deleted.

Cambridge Roadside
A suspected sampling fault resulted in the loss of NOx data from 8 to 27 March.

Canterbury
A faulty RCD caused loss of power from 19-30 January. In addition, the NOx analyser had a sampling fault up to 5 January.

Carlisle Roadside
Both $PM_{2.5}$ and PM_{10} were noisy and unstable throughout the quarter, resulting in some data loss.

Coventry Memorial Park
A suspected dryer fault resulted in an ESU callout on 2 September, but they were unable to fix and the instrument was removed for workshop repair. A replacement analyser was finally installed on 3 May though problems persist following replacement.

Hull Freetown
As a result of vandalism, the gaseous sample inlet was damaged, resulting in data loss for all gaseous pollutants from 14 to 25 March.

Oxford Centre Roadside
The NOx analyser was upgraded on 16 January. However, the data from the new analyser were poor, and the reaction cell was contaminated. A further replacement analyser was installed on 1 February.

Plymouth Centre
The $PM_{2.5}$ FDMS suffered a valve motor fault and a period of anomalously low data in February.Some low data also noted in PM_{10}; some data were deleted.

Sandy Roadside
The volatile fraction of both $PM_{2.5}$ and PM_{10} were noisy for a considerable part of the quarter, and a considerable quantity of data have been deleted.

Stanford le Hope Roadside
A callout was issued in January when the $PM_{2.5}$ data were higher than the PM_{10} for a considerable period; $PM_{2.5}$ data have been deleted from 5 December to 13 February, and again for several shorter periods. Noisy PM_{10} data were deleted from 22 December to 11 January.

Wigan Centre
The $PM_{2.5}$ data were deleted for the whole of 2011 due to elevated baseline. The drier was ultimately replaced on 22 March though data have been deleted up to the service on 2 April.

Yarner Wood
The ozone analyser had been removed for workshop repair in December, and was reinstalled on 9 January. However the sampling system was compromised due to a leak, and data up to repair up to 16 January have been lost.

4.3 Scotland

4.3.1 Data Capture

The data capture for sites in Scotland for the period January-March 2012 is given in Table 4.3.

Table 4.3: Data capture for Scotland, Jan – Mar 2012: (calculated from 01/01/2012 or start date of any new site, to 31/03/2012.)

Site	CO	PM_{10}	PM_{25}	NO_2	O_3	SO_2	Site Average
Scotland							
Aberdeen	-	99.1	97.8	95.7	95.6	-	97.0
Aberdeen Union Street Roadside	-	-	-	99.5	-	-	99.5
Auchencorth Moss	-	69.2	98.9	-	99.4	-	89.2
Auchencorth Moss PM_{10} PM_{25} (FDMS)	-	91.8	86.7	-	-	-	89.2
Bush Estate	-	-	-	51.1	98.4	-	74.7
Dumbarton Roadside	-	-	-	99.5	-	-	99.5
Dumfries	-	-	-	98.2	-	-	98.2
Edinburgh St Leonards	86.5	97.8	97.8	98.0	89.9	97.5	94.6
Eskdalemuir	-	-	-	96.6	98.7	-	97.6
Fort William	-	-	-	98.3	98.4	-	98.4
Glasgow Centre	97.2	97.2	96.2	97.2	97.5	97.2	97.1
Glasgow Kerbside	-	35.7	89.0	97.0	-	-	73.9
Grangemouth	-	89.0	96.6	85.8	-	85.7	89.3
Grangemouth Moray	-	-	-	97.4	-	-	97.4
Inverness	-	94.5	87.9	99.5	-	-	94.0
Lerwick	-	-	-	-	50.9	-	50.9
Peebles	-	-	-	98.6	98.8	-	98.7
Strath Vaich	-	-	-	-	99.3	-	99.3
Number of sites	2	8	8	14	10	3	18
Number of sites < 90%	1	3	3	2	2	1	6
Network Mean (%)	91.8	84.3	93.8	93.7	92.7	93.5	91.0

Shaded boxes are for data capture < 90%
Bold data captures are for data that are provisional and subject to further quality control

4.3.2 Site Specific Issues

Auchencorth Moss
The PM_{10} Partisol had a fault continuing from December 2011, where the filters passed through the sampler without being exposed. The $PM_{2.5}$ FDMS analyser suffered a succession of short failures resulting in data capture just below 90%

Bush Estate
Problems with the flow and pressure board in the NOx analyser resulted in the loss of data from 18 February to 23 April. Repairs were hampered by the lack of calibration gas at this site.

Glasgow Kerbside
The FDMS PM_{10} analyser has performed poorly for some time producing noisy data and negative volatile concentrations. Data up to 28 February have been deleted.

Grangemouth
Several power cuts were observed during the period; one of these caused the loss of the PM_{10} analyser firmware.

Lerwick
A step change in instrument response was observed from 14 February up to the LSO visit on 29 March. The reason for this is unknown, but data between these dates have been deleted.

4.4 Wales

4.4.1 Data Capture

The data capture for sites in Wales for the period January-March 2012 is given in Table 4.4.

Table 4.4: Data capture for Wales, Jan – Mar 2012: (calculated from 01/01/2012 or start date of any new site, to 31/03/2012.)

Site	CO	PM_{10}	PM_{25}	NO_2	O_3	SO_2	Site Average
Wales							
Aston Hill	-	-	-	98.1	98.5	-	98.3
Cardiff Centre	98.4	94.0	97.2	96.4	98.5	98.5	97.2
Chepstow A48	-	98.3	98.6	99.4	-	-	98.8
Cwmbran	-	-	-	99.5	99.8	-	99.6
Mold	-	-	-	98.5	98.7	-	98.6
Narberth	-	97.2	-	98.5	95.9	98.5	97.5
Newport	-	99.3	86.3	98.9	-	-	94.8
Port Talbot Margam	98.1	95.3	98.3	97.8	98.0	98.1	97.6
Port Talbot Margam PM_{10} $PM_{2.5}$ (Partisol)	-	90.1	-	-	-	-	90.1
Swansea Roadside	-	98.0	97.8	98.4	-	-	98.1
Wrexham	-	95.6	95.6	98.6	-	98.2	97.0
Number of sites	2	8	6	10	6	4	11
Number of sites < 90%	0	0	1	0	0	0	0
Network Mean (%)	98.2	96.0	95.6	98.4	98.2	98.3	97.1

Shaded boxes are for data capture < 90%
Bold data captures are for data that are provisional and subject to further quality control

4.4.2 Site Specific Issues

There were no specific problems during the quarter.

4.5 Northern Ireland (including Mace Head)

4.5.1 Data Capture

The data capture for sites in Northern Ireland (including Mace Head in the Republic of Ireland) for the period January-March 2012 is given in Table 4.5.

Table 4.5 Data capture for Northern Ireland, Jan – Mar 2012: (calculated from 01/01/2012 or start date of any new site, to 31/03/2012.)

Site	CO	PM_{10}	PM_{25}	NO_2	O_3	SO_2	Site Average
Ireland							
Mace Head	-	-	-	-	98.5	-	98.5
N Ireland							
Armagh Roadside	-	98.2	-	96.7	-	-	97.4
Ballymena Ballykeel	-	-	-	-	-	99.9	99.9
Belfast Centre	97.3	92.7	96.9	96.8	95.1	97.2	96.0
Derry	-	0.0	98.8	98.9	98.9	98.7	79.1
Lough Navar	-	5.7	-	-	99.4	-	52.5
Number of sites	1	4	2	3	3	3	5
Number of sites < 90%	0	2	0	0	0	0	2
Network Mean (%)	97.3	49.1	97.8	97.5	97.8	98.6	87.2

Shaded boxes are for data capture < 90%
Bold data captures are for data that are provisional and subject to further quality control

4.5.2 Site Specific Issues

Derry
The PM_{10} analyser had an elevated baseline and was consistently significantly higher than other sites in the area. This was confirmed by a zero check and as a result all PM_{10} data for the quarter have been deleted.

Lough Navar
At the ESU service on 6 February, the bypass flow on the FDMS was found to be disconnected from the splitter unit in the roofspace. As this is not accessed by the QA/QC Unit, it was deduced that the tube must have been removed at the last engineer's visit, which was during the summer. All PM_{10} data have therefore been deleted from 24 August 2011 to 14 February 2012, however on reconnection, the data were found to be excessively noisy and were deleted up to late March.

4.6 Overall Data Capture

Overall data capture for each pollutant across the network for the quarter is given in Table 4.6.

Table 4.6: Data Capture by Pollutant, Entire Network (Network Data Capture calculated from 01/01/2012 or start date of any new site, to 31/03/2012).

Site	CO	PM_{10}	PM_{25}	NO_2	O_3	SO_2	Site Average
Number of sites	23	68	78	116	81	45	134
Number of sites < 90%	2	14	26	13	7	4	26
Network Mean (%)	96.6	90.4	88.3	95.8	96.6	96.6	93.2

Note that data capture is calculated for the whole month for each pollutant (except for new sites, in which case it is calculated from the start date), so additional analysers installed during the period will have reduced data captures quoted.

5 LSO Manual and AURN Hub

The QA/QC Unit has revised and reissued the LSO manual in light of procedural changes and the introduction of new types of analysers employed. This manual is available via the AURN Hub at http://uk-air.defra.gov.uk/reports/empire/lsoman/lsoman.html

Section 2 Intercalibration Report, Winter 2012

6 Introduction

In January to March 2012, AEA undertook an intercalibration of 134 monitoring stations in operation in the Defra and the Devolved Administrations Automatic Urban and Rural Monitoring Network.

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

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

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

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

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

ESU visits are normally undertaken within a three 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.

7 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; for example that a 200ppb NO_2 pollution episode in Belfast would be reported in exactly the same way at every other site in the UK, regardless of the location or the analyser used to record the event.
- Assessment of the area around the monitoring station: has the environment changed in the last six months? Is the location still representative of the site classification?

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

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 k_0 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/interactive TV services.
- These individual results are tabulated, and statistical analyses undertaken (e.g. network average result, network standard deviation, deviation of individual sites from the network mean etc.).

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

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

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

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

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

8 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.

8.1 National Network Overview

The results of the intercalibration are summarised in Table 8.1 below:

Table 8.1 - Summary of audited analyser performance – 136 UK stations

Parameter	Number of outliers	Number in network	% outliers in total
NOx analyser	22	117	19%
CO analyser	1	24	4%
SO_2 analyser	8	45	18%
Ozone analyser	11	82	13%
TEOM and BAM analysers	2 k_0, 3 flow	59 FDMS PM_{10} 1 BAM PM_{10} 67 FDMS $PM_{2.5}$ 1 BAM $PM_{2.5}$	4%
Gravimetric PM analysers	0 flow	9 PM_{10} 12 $PM_{2.5}$	0%
Total	46	417	11.0%

Three of the 134 sites were not in operation at the time of the intercalibration. The building housing Walsall Willenhall was destroyed in a fire in 2010 and at the time of the audit, the replacement site (Walsall Woodlands) had not been commissioned.

Barnsley 12 ceased operation in January 2012. The site at Sandwell West Bromwich was de-affiliated in December 2011 following the establishment of Birmingham Acocks Green.

There are currently no gravimetric measurements of PM_{10} or $PM_{2.5}$ at either of the Glasgow monitoring stations

The number of analyser outliers identified is better than the previous exercise. At the Summer 2011 intercalibration 12.8% of the analysers in use were identified as outliers.

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

8.2 Network Intercomparisons

The concentration of the audit cylinders was calculated averaged across all monitoring sites using the zero and scaling factors provided by the CMCU on the day of audit. How close the result is to the stated cylinder concentration is a good indication of the accuracy of the results across the entire network. The results are given in Table 8.2. Certified cylinder concentrations are normalised for this purpose as several cylinders are used.

Table 8.2. Network Performance Summary

Parameter	Network Mean	Audit reference concentration	Network Accuracy %	%Std Dev
NO	461 ppb	457 ppb	0.9	4.5
NO_2	430 ppb	435 ppb	1.1	5.0
CO	20.9 ppm	21.0 ppm	0.0	4.3
SO_2	161 ppb	166 ppb	2.5	4.7

- Oxides of Nitrogen.

  A total of 22 outliers (19%) were identified during this intercalibration. This is better than the previous exercise - 22% of the analysers were identified as outliers in the winter exercise.

  There were two converters which fell outside the ±5% acceptance limits, and a further three where the initial result was outside the ±2% trigger for NO_2 rescaling. Additional testing showed that the two outlier converters required rescaling to be undertaken.

- Carbon Monoxide

  Just one analyser was identified as an outlier at this intercalibration. This is the same as the previous exercise.

- Sulphur Dioxide

  A total of eight outliers (18%) were identified at this intercalibration. This is better than the summer exercise, when 14 analysers were found to be outside the acceptance limits. All m-xylene interference tests were less than 27ppb, compared to 28ppb in summer 2011.

- Ozone

  A total of 11 outliers (13%) were identified during the winter exercise. This is slightly worse than the previous intercalibration, where 9 analysers were found to be outside the ±5% acceptance criterion.

- Particulate Analysers

  Just two calculated k0 determinations were outside the required ±2.5% of their stated values. This is slightly worse than the previous exercise – a single outlier was identified in the summer intercalibration.

  Three TEOM main flows were found to be outside the ±10% acceptance limits, two analysers were identified in the summer exercise.
  All Partisol analyser total flows were within the acceptance limits.

- Site Cylinder Concentrations

  Eight of the 303 site cylinders (2.6%) used to scale ambient pollution data were found to be outside the ±10% acceptance limit, fewer than the 5.2% identified in the summer.

8.2.1 London Sites

The results of the intercomparison for the 16 London sites in operation at the time of the intercalibration are summarised in Table 8.3 below:

Table 8.3 - Summary of audited analyser performance – London Sites

Parameter	Number of outliers	Number in region
NOx analyser	2	14
NOx converter	0	
CO analyser	0	7
SO_2 analyser	1	6
Ozone analyser	3	9
TEOM and BAM analysers	0 k_0, 1 flow	6 FDMS PM_{10} 10 FDMS $PM_{2.5}$
Gravimetric PM analysers	0	2 PM_{10} 3 $PM_{2.5}$
Cylinders	0	41

8.2.2 Scottish Sites

The results of the intercomparison for the 18 Scottish sites are summarised in Table 8.4 below:

Table 8.4 - Summary of audited analyser performance – Scottish Sites

Parameter	Number of outliers	Number in region
NOx analyser	1	14
NOx converter	1	
CO analyser	0	2
SO_2 analyser	1	3
Ozone analyser	0	10
TEOM and BAM analysers	0 k_0, 0 flow	6 FDMS PM_{10} 6 FDMS $PM_{2.5}$
Gravimetric PM analysers	0	4 PM_{10} 4 $PM_{2.5}$
Cylinders	2	33

8.2.3 Welsh Sites

The results of the intercomparison for the ten Welsh sites are summarised in Table 8.5 below:

Table 8.5 - Summary of audited analyser performance – Welsh Sites

Parameter	Number of outliers	Number in region
NOx analyser	1	10
NOx converter	0	
CO analyser	0	2
SO_2 analyser	0	4
Ozone analyser	0	6
TEOM and BAM analysers	0 k_0, 0 flow	6 FDMS PM_{10} 4 FDMS $PM_{2.5}$
Gravimetric PM analysers	0	2 PM_{10} 1 $PM_{2.5}$
Cylinders	0	26

8.2.4 Northern Ireland Sites (incl. Mace Head)

The results of the intercomparison for the five Northern Irish and Mace Head sites are summarised in Table 8.6 below:

Table 8.6- Summary of audited analyser performance – Northern Irish Sites

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

8.2.5 English Sites

The results of the intercomparison for the 86 English sites are summarised in Table 8.7 below:

Table 8.7 - Summary of audited analyser performance – English Sites

Parameter	Number of outliers	Number in region
NOx analyser	13	76
NOx converter	4	
CO analyser	1	12
SO_2 analyser	6	29
Ozone analyser	8	53
TEOM and BAM analysers	2 k_0, 2 flow	37 FDMS PM_{10} 1 BAM PM_{10} 46 FDMS $PM_{2.5}$ 1 BAM $PM_{2.5}$
Gravimetric PM analysers	0	1 PM_{10} 4 $PM_{2.5}$
Cylinders	5	193

As noted earlier, the results from the intercalibration exercises are used to inform the entire data ratification process. Any actions required as a result of the intercalibration findings are discussed in the ratification section of this report.

9 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 eight of the 303 cylinders (~2.5%) used to scale analyser data into concentrations (NO, CO and SO_2) were outside the ±10% acceptance criterion. This is better than the summter exercise, where 5% (16) of the scaling cylinders were outside the acceptance limits. There were five NO cylinders and three SO_2 cylinders identified as outliers.

In addition, the concentrations of 23 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 31 of the 303 cylinders (10%) were outside the acceptance limits. This is better than the previous intercalibration, where 14% of the total cylinder population (42 in total) were found to be out of specification.

One of the five NO cylinders (Birmingham Tyburn) appears to have been contaminated; a significant oxidation of the NO into NO_2 has occurred since the last intercalibration. The cylinder has been replaced and the performance of the new cylinder will be closely monitored at subsequent audits.

The remainder of the cylinders will be checked at the summer audits and appropriate action taken if necessary.

10 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. Site location information is available in links from the AURNHUB and UK-Air websites.

11 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 EN14211:2005 (NOx), BS EN14212:2005 (SO_2), BS EN14626:2005 (CO) and BS EN14625:2005 (O_3) set out a series of performance criteria for analysers which must be achieved, both in the field and under laboratory conditions. The test requirements have been extensively reported in previous intercalibration summaries and should be referenced for further information.

The CEN operating methodologies are incorporated into the requirements of the air quality Directive 2008/50/EC. Member States had until June 2010 to ensure their monitoring networks are compliant. Older, non-compliant equipment still on site after this date will need to be replaced before June 2013. AEA have taken 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.

To comply with the Directive, the uncertainty for gaseous analyser measurements must be less than ±15%.

For sites that have CEN-compliant gaseous instrumentation, it is possible to calculate the overall uncertainty of measuring air quality. This information is site and analyser specific and presented in Table 11.1 below:

Table 11.1 – Analyser measurement uncertainties

Date	Site	O_3	CO	SO_2	NOx	NO	PM_{10}*	$PM_{2.5}$*
17-Jan	Barnsley Gawber	10.7		13.4	10	10		
11-Jan	Bath Roadside				13.5	14		
17-Jan	Billingham				13.5	14		
19-Jan	Birmingham Acocks Green	12.4		13.6	13.5	14		16.4
17-Jan	Birmingham Tyburn	8.7		17.5	11.8	11.8	8.7	16.4
18-Jan	Birmingham Tyburn Roadside	12.4			13.5	14	8.7	16.4
01-Mar	Blackpool Marton							16.4
21-Feb	Bottesford	0						
07-Feb	Bournemouth	12.4			13.5	14		11
17-Jan	Brighton Preston Park	12.4			13.5	14		11
10-Jan	Bristol Old Market				13.5	14		
10-Jan	Bristol St Paul's	12.4	9.5		13.5	14	8.7	16.4
08-Dec	Bury Roadside						8.7	16.4
01-Feb	Cambridge Roadside							
19-Dec	Camden Kerbside						8.7	16.4
18-Jan	Canterbury	12.4			13.5	14		
05-Dec	Carlisle Roadside				10.5	10.5	8.7	16.4
18-Jan	Charlton Mackrell	12.4			13.5	14		
19-Jan	Chatham Centre Roadside						8.7	16.4
08-Dec	Chesterfield						8.7	16.4
08-Dec	Chesterfield Roadside						8.7	16.4
05-Jan	Coventry Memorial Park	10.7			10	10		16.4
19-Jan	Eastbourne				13.8	14.3	8.7	16.4
12-Jan	Exeter Roadside	8.7			11.8	11.8		
23-Feb	Glazebury	12.4			13.5	14		
19-Jan	Great Dun Fell	12.4						
02-Dec	Haringey Roadside						8.7	16.4
05-Jan	Harwell	12.4		13.7	13.5	14	8.7	16.4
15-Feb	Harwell PARTISOL						8	11
19-Jan	High Muffles	12.4			13.5	14		
17-Jan	Horley				13.5	14		
16-Jan	Hull Freetown	10.7	9.5	13.4	10	10	8.7	16.4
18-Jan	Ladybower	12.4		13.4	13.5	14		
28-Nov	Leamington Spa						8.7	16.4
16-Jan	Leeds Centre						8.7	16.4
17-Jan	Leeds Headingley Kerbside						8.7	16.4
13-Feb	Leicester Centre	10.7	9.5	13.4	10	10	8.7	16.4
17-Jan	Leominster	12.4		16.2				
16-Feb	Lincoln Canwick Road				13.5	14		
17-Feb	Liverpool Queen's Drive Roadsi				13.5	14		
16-Feb	Liverpool Speke	10.7	9.5	13.4	10	10	8.7	16.4
26-Jan	London Bexley		9.5	13.4	16.1	16.6		16.4
07-Feb	London Bloomsbury	12.4	9.5	13.4	13.5	14	8.7	16.4
31-Jan	London Cromwell Road 2		9.5	13.4	13.5	14		
20-Dec	London Eltham						8.7	16.4
02-Dec	London Haringey				13.5	14		
02-Feb	London Harlington	12.4			13.5	14	8.7	16.4
02-Feb	London Hillingdon	10.7			10	10		

Date	Site	O_3	CO	SO_2	NOx	NO	PM_{10}*	$PM_{2.5}$*
20-Feb	London Marylebone Road						8.7	16.4
20-Feb	London Marylebone Road PARTISOL						8	11
21-Feb	London N. Kensington	12.4	9.5	13.4	13.5	14	8.7	16.4
21-Feb	London N. Kensington PARTISOL						8	11
31-Jan	London Teddington	12.4			13.5	14		16.4
01-Feb	London Westminster	12.4	9.5	13.4	13.5	14		11
16-Jan	Lullington Heath	12.4		13.4	13.5	14		
22-Feb	Manchester Piccadilly	10.7		13.5	10	10		16.4
22-Feb	Manchester South	12.4			13.5	14		
18-Jan	Middlesbrough	12.4	9.5	13.6	13.5	14	8.7	16.4
17-Jan	Newcastle Centre	10.7	9.5	14.1	10	10	8.7	16.4
05-Dec	Newcastle Cradlewell Roadside				10.5	10.5		
16-Feb	Northampton	8.7			11.8	11.8	8	
30-Jan	Norwich Lakenfields	10.7		14.7	10	10	8.7	16.4
15-Feb	Nottingham Centre	10.7		15	10	10	8.7	16.4
06-Jan	Oxford Centre Roadside				10.5	10.5		
06-Jan	Oxford St Ebbes						8.7	16.4
11-Jan	Plymouth Centre						8.7	16.4
06-Mar	Portsmouth						8.7	16.4
02-Mar	Preston							16.4
04-Jan	Reading New Town	10.7			10	10	8.7	16.4
18-Jan	Rochester Stoke	0		13.9	13.5	14	8.7	16.4
15-Dec	Salford Eccles						8.7	16.4
02-Feb	Sandy Roadside				13.5	14	8.7	16.4
06-Dec	Scunthorpe Town						8.7	
18-Jan	Sheffield Centre	10.7	9.5		10	10	8.7	16.4
17-Jan	Sheffield Tinsley				13.5	14		
31-Jan	Sibton	12.4						
06-Feb	Southampton Centre	10.7	9.5	13.5	10	10	8.7	16.4
23-Jan	Southend-on-Sea	10.7			18.2	18.2		16.4
30-Jan	Southwark A2 Old Kent Road				13.5	14	8.7	
24-Jan	St Osyth	10.7			10	10		
23-Jan	Stanford-le-Hope Roadside						8.7	16.4
18-Jan	Stockton-on-Tees Eaglescliffe				13.5	14	9.3	12.6
23-Jan	Stoke-on-Trent Centre	10.7			10	10	8.7	16.4
16-Jan	Storrington Roadside				10	10	8.7	16.4
06-Dec	Sunderland Silksworth	12.4			10.5	10.5		16.4
25-Jan	Thurrock	12.4		14.6	13.5	14	8.7	
22-Dec	Tower Hamlets Roadside		9.5					
12-Dec	Warrington				13.5	14	8.7	16.4
31-Jan	Weybourne	0						
01-Feb	Wicken Fen	12.4		19.9	13.5	14		
16-Feb	Wirral Tranmere	10.7			10	10		16.4
19-Jan	Yarner Wood	12.4						
11-Jan	York Bootham						8.7	16.4
06-Dec	York Fishergate						8.7	16.4
09-Feb	Armagh Roadside				10.5	10.5	8.7	
16-Feb	Belfast Centre	10.7	9.5	13.8			8.7	16.4
08-Feb	Derry	12.4		17.2	13.5	14	8.7	16.4
06-Feb	Lough Navar	12.4					8.7	
30-Jan	Aberdeen	12.4			13.5	14	8.7	16.4
31-Jan	Aberdeen Union Street				13.5	14		

Date	Site	O_3	CO	SO_2	NOx	NO	PM_{10}*	$PM_{2.5}$*
	Roadside							
25-Jan	Auchencorth Moss	12.4					8.7	16.4
25-Jan	Auchencorth Moss PM10 PM25						8	11
25-Jan	Bush Estate	12.4			13.5	14		
24-Jan	Edinburgh St Leonards	12.4	9.5	13.4	13.5	14	8.7	16.4
16-Jan	Eskdalemuir	15.6			13.5	14		
25-Jan	Fort William	12.4			13.5	14		
09-Jan	Glasgow Centre	10.7	9.5	13.4	13.5	14	8.7	16.4
09-Jan	Glasgow Kerbside				10	10	8.7	16.4
24-Jan	Grangemouth						8.7	16.4
02-Feb	Inverness				13.5	14	8	11
01-Feb	Lerwick	12.4						
24-Jan	Peebles	12.4			13.5	14		
02-Feb	Strath Vaich	12.4						
17-Jan	Aston Hill	12.4			13.5	14		
26-Jan	Cardiff Centre	12.4	9.5	14.5	13.5	14	8.7	16.4
07-Dec	Chepstow A48						8.7	16.4
26-Jan	Cwmbran	10.7			11.8	11.8		
24-Jan	Mold	12.4			13.5	14		
23-Jan	Narberth	12.4		13.9	13.5	14	8.7	
25-Jan	Newport						8.7	16.4
24-Jan	Port Talbot Margam	10.7	9.5	13.4	13.5	14	8.7	16.4
24-Jan	Port Talbot Margam PARTISOL (PM_{10})						8	
24-Jan	Swansea Roadside				13.5	14	9.3	12.6
24-Jan	Wrexham			13.4	13.5	14	8	11

This table is updated and extended after every intercalibration to include upgraded sites and replacement analysers. *Uncertainty calculations for PM_{10} and $PM_{2.5}$ are reported here for the first time, but only as best measurement capability (BMC); calculation of accurate measurement uncertainty will be undertaken in the summer intercalibration exercise..

12 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. We have successfully trialled a modified ladder design that does not require ladder restraints. We have rolled this out to all QA/QC field operators and recommended its use to all ESUs and MUs. There are now just a few sites where it is not currently possible to measure flows safely (Table 12.1):

Table 12.1 Actions Required for Safe Roof Access

Site	Action required
Coventry Memorial Park	Sloping roof - access not possible
Glasgow Kerbside	Needs new ladder support or railings. Relocation planned
Thurrock	Sloping roof - access not possible
Bristol St Pauls	Access to roof restricted by vegetation – needs removing

It is recommended that roof access at these sites is investigated, to determine whether safe access can be achieved. QA/QC unit will continue to review the risk assessments at all sites and highlight developments that change risks as soon as they become apparent.

Any safety related issues at AURN sites are reported through the Health & Safety database to ensure all interested parties are warned of the risks and may be advised not to attend the site until repairs are effected.

13 Certification

The Network Certificate of Calibration is presented in Appendix 4. 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.

14 Summary

The intercalibration exercise demonstrates its ongoing 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 2011 to March 2012.

Appendices

Appendix 1

Recommendations for Upgrade or Replacement of Equipment

As requested by Defra, 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.	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

Table A1 Recommendations.

	Recommendations February 2012	Priority	Action
32	ESUs are reminded of the importance of supplying service records for Partisol samplers to QA/QC Unit	High	ESU
31	Zero air scrubbers to be changed for zero air cylinders at all sites (where possible)	Medium	QA/QC ESU
	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**
25	It is recommended that LSOs 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 ESUs clean all NOx analyser switching valves during servicing, and ensure the valve is leak checked afterwards. Suspect leaking valves are highlighted by the QA/QC Unit during audits	High	ESU
	Recommendations January 2007		
22	ESUs to ensure all NOx converter software settings to be 100%.	High	ESUs to check at service

Appendix 2

Partisol Data: January-March 2012

The data capture from the Partisol samplers are given below:

Site	PM_{10}	PM_{25}	Site Average
England			
Bournemouth	-	89.0	89.0
Brighton Preston Park	-	100.0	100.0
Harwell	85.7	72.5	79.1
London Marylebone Road	97.8	27.5	62.6
London N. Kensington	98.9	93.4	96.2
London Westminster	-	91.2	91.2
Northampton	-	90.1	90.1
Scotland			
Auchencorth Moss	69.2	98.9	84.1
Inverness	94.5	87.9	91.2
Wales			
Port Talbot Margam PM_{10} $PM_{2.5}$ (PM_{10} Partisol)	90.1	-	90.1
Wrexham	95.6	95.6	95.6
Number of sites	7	10	11
Number of sites < 90%	2	4	4
Network Mean (%)	90.3	84.6	88.1

The results of the winter 2012 audit are given below:

Site Name		Audit Winter 2012		Post-service	
		Flow $Lmin^{-1}$	% out from 16.7	Flow $Lmin^{-1}$	% out from 16.7
Auchencorth Moss	$PM_{2.5}$	16.58	-2	16.70	0
	PM_{10}	Not working		16.70	0
Bournemouth	$PM_{2.5}$	16.51	-1	16.66	-0.2
Brighton Preston Park	$PM_{2.5}$	16.30	-5.2	16.67	-0.2
Harwell	$PM_{2.5}$	17.45	5.8	16.70	0
	PM_{10}	16.69	2	16.69	0
Inverness	$PM_{2.5}$	16.88	2.7	Not recorded	
	PM_{10}	16.80	0.6	Not recorded	
London Marylebone Road	$PM_{2.5}$	Not working			
	PM_{10}	16.76	0.3	16.60	-0.6
London North Kensington	$PM_{2.5}$	17.70	8	16.65	-0.3
	PM_{10}	16.71	0.1	16.71	0.1
London Westminster	$PM_{2.5}$	Not working		16.66	-0.2
Northampton	$PM_{2.5}$	16.47	-0.4	16.69	0
Port Talbot Margam	PM_{10}	16.70	0	16.70	0
Wrexham	$PM_{2.5}$	16.45	-2.1	16.70	0
	PM_{10}	16.54	-0.8	16.70	0

If the measured flowrate is within ±5% of 16.7 $lmin^{-1}$, no adjustment is made to measured concentrations. If the flowrate is between 5 and 10% out, a ramped correction is made from the last known good flowrate. If the flowrate is >10% out from 16.7$lmin^{-1}$, the data are deleted.

Appendix 3

Site Details

No new sites were installed in the period January-March 2012

Details of all site locations can be found at http://uk-air.defra.gov.uk/interactive-map

Appendix 4

Certificate of Calibration

CERTIFICATE OF CALIBRATION

The Gemini Building, Fermi Avenue, Harwell, Didcot, Oxfordshire OX11 0QR.
Telephone: 0870 1906465 Fax: 0870 1906377

Certificate Number: 02666
AEA Identification Number: ED57002030

0401

Approved Signatories: B Stacey
S. Eaton

Signed:

Date of issue: 20 September 2012

Customer Name and Address: Emily Connolly

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 = 2012	Site	Analyser number	[1]Zero output	Uncertainty (ppm)	[2]Calibration Factor	Uncertainty (%)	*Maximum Residual (%)
16-Feb	Belfast Centre	462	0	0.2	1.066	2.1	1.6

Sulphur Dioxide

Date Year =2012	Site	Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	*Max Residual (%)	*m-xylene interference (ppb)
14-Feb	Ballymena	4901234	1	2.6	1.102	5.3	1.9	16.5
16-Feb	Belfast Centre	1766	2	2.6	1.102	5.6	1.9	7.7
08-Feb	Derry	1697	2	2.6	1.096	11.8	3.2	5.2

Ozone

Date Year =2012	Site	Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	*Max Residual (%)
16-Feb	Belfast Centre	cm08060038	1	3	1.009	3.1	0.7
08-Feb	Derry	1586	1	3	1.032	3.1	0.3
06-Feb	Lough Navar	1640	2	3	1.008	3.1	0.3
07-Feb	Mace Head	77086-385	0	3	1.003	3.2	1.0

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

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Oxides of Nitrogen

Date Year =2012	Site		Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	[*]Max residual (%)	[*]Converter efficiency (%)
09-Feb	Armagh Roadside	NO	?	0	2.6	1.232	3.5	1.0	
		NOx		2	2.6	1.212	3.5	1.2	99.2
16-Feb	Belfast Centre	NO	08050074	0	2.7	1.381	3.5	1.8	
		NOx		0	2.7	1.385	3.5	2.1	100.5
08-Feb	Derry	NO	2130	4	2.6	1.096	3.5	0.4	
		NOx		10	2.6	1.084	3.5	2.4	100.9

Particulate Analysers

Date Year =2012	Site		Analyser number	Calculated Spring Constant k_0	Uncertainty (%)	[4]k_0 accuracy (%)	[3]Measured Main Flow (l/min)	Uncertainty (%)	[3]Measured Total Flow (l/min)	Uncertainty (%)
09-Feb	Armagh Roadside	PM10	2000	13391	1	-1.3	**2.99**	**2.2**	**16.65**	**2.2**
16-Feb	Belfast Centre	PM10	24423	14202	1	0.1	**2.98**	**2.2**	**16.25**	**2.2**
16-Feb	Belfast Centre	PM25	26565	15657	1	-0.5	**2.96**	**2.2**	**15.99**	**2.2**
08-Feb	Derry	PM10	2701	15967	1	1.0	2.97	2.2	16.06	2.2
08-Feb	Derry	PM25	21313	10930	1	0.4	2.93	2.2	16.06	2.2
06-Feb	Lough Navar	PM10	21196	12950	1	1.0	3.01	2.2	Not	measured

2. Scottish Sites

Carbon Monoxide

Date Year = 2012	Site	Analyser number	[1]Zero output	Uncertainty (ppm)	[2]Calibration Factor	Uncertainty (%)	[*]Maximum Residual (%)
24-Jan	Edinburgh St Leonards	159	0	0.2	1.058	2.4	3.4
09-Jan	Glasgow Centre	241	0	0.2	0.905	2.2	1.8

Sulphur Dioxide

Date Year =2012	Site	Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	[*]Max Residual (%)	[*]m-xylene interference (ppb)
24-Jan	Edinburgh St Leonards	84	-6	2.5	1.021	3.9	1.1	7.1
09-Jan	Glasgow Centre	1630	3	2.8	1.538	3.5	4.0	20.5
24-Jan	Grangemouth	703b-m274	-1	2.4	0.753	6.3	3.4	15.1

Ozone

Date Year =2012	Site	Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	[*]Max Residual (%)
30-Jan	Aberdeen	800	2	3	1.026	3.2	1.0
25-Jan	Auchencorth Moss	646	-2	3	1.039	3.1	0.2
25-Jan	Bush Estate	1645	0	3	1.003	3.1	0.7
24-Jan	Edinburgh St Leonards	136	1	3	1.013	3.1	1.1
16-Jan	Eskdalemuir	158	0	19.8	1.041	10.8	2.9

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

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Date Year =2012	Site	Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	*Max Residual (%)
25-Jan	Fort William	1023	0	3	1.011	3.1	0.4
09-Jan	Glasgow Centre	cm08060029	-1	3	0.993	3.1	2.3
01-Feb	Lerwick	1643	0	3	1.018	3.1	0.4
24-Jan	Peebles	437	-1	3	1.042	3.1	1.5
02-Feb	Strath Vaich	721	-1	3	1.033	3.1	0.2

Oxides of Nitrogen

Date Year =2012	Site		Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	*Max residual (%)	*Converter efficiency (%)
30-Jan	Aberdeen	NO NOx	519	0 1	2.7 2.7	1.447 1.433	3.8 3.5	2.2 1.6	 98.9
31-Jan	Aberdeen Union Street Roadside	NO NOx	984	2 2	2.4 2.5	0.816 0.830	4.4 4.6	3.5 3.5	 99.2
25-Jan	Bush Estate	NO NOx	2244	0 -1	3.0 3.0	1.924 1.929	3.5 3.5	1.0 0.9	 99.3
26-Jan	Dumbarton Roadside	NO NOx	311001	0 0	2.5 2.5	1.053 1.041	3.5 3.5	1.3 1.4	 99.5
16-Jan	Dumfries	NO NOx	1494	1 0	2.5 2.5	0.953 0.953	3.5 3.5	0.3 0.5	 94.6
24-Jan	Edinburgh St Leonards	NO NOx	73	1 1	2.6 2.6	1.223 1.212	3.5 3.5	0.2 1.2	 100.3
16-Jan	Eskdalemuir	NO NOx	347	1 0	2.6 2.5	1.073 1.050	3.5 3.5	1.3 2.0	 100.9
25-Jan	Fort William	NO NOx	344	0 1	2.5 2.5	1.048 1.041	3.5 3.5	1.6 1.8	 100.0
09-Jan	Glasgow Centre	NO NOx	1713	0 1	2.6 2.6	1.281 1.280	3.5 3.5	0.7 0.9	 99.5
09-Jan	Glasgow Kerbside	NO NOx	08050061	0 0	2.5 2.5	0.896 0.896	3.5 3.5	2.5 1.2	 100.4
24-Jan	Grangemouth	NO NOx	m700b-m312	0 1	2.5 2.5	0.979 0.981	3.5 3.5	1.1 0.7	 99.6
24-Jan	Grangemouth Moray	NO NOx	912011	0 0	2.5 2.5	0.991 0.977	3.8 3.5	1.1 1.2	 99.6
02-Feb	Inverness	NO NOx	1489	1 0	2.6 2.6	1.122 1.102	3.5 3.5	0.5 0.6	 98.2
24-Jan	Peebles	NO NOx	2213	0 0	2.7 2.5	1.025 0.998	3.5 3.5	0.6 1.2	 100.4

Particulate Analysers

Date Year =2012	Site		Analyser number	Calculated Spring Constant k_0	Uncertainty (%)	[4]k_0 accuracy (%)	[3]Measured Main Flow (l/min)	Uncertainty (%)	[3]Measured Total Flow (l/min)	Uncertainty (%)
30-Jan	Aberdeen	PM10	24427	11672	1	0.9	2.94	2.2	16.12	2.2
30-Jan	Aberdeen	PM25	27368	12138	1	-0.7	2.97	2.2	16.06	2.2
25-Jan	Auchencorth Moss	PM10	20639	13020	1	-1.3	2.90	2.2	15.89	2.2
25-Jan	Auchencorth Moss	PM25	26033	13726	1	-2.1	2.92	2.2	16.02	2.2

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Date Year =2012	Site		Analyser number	Calculated Spring Constant k_0	Uncertainty (%)	[4]k_0 accuracy (%)	[3]Measured Main Flow (l/min)	Uncertainty (%)	[3]Measured Total Flow (l/min)	Uncertainty (%)
25-Jan	Auchencorth Moss Partisol	PM10	21550						Not	operating
25-Jan	Auchencorth Moss Partisol	PM25	21548						16.40	2.2
24-Jan	Edinburgh St Leonards	PM10	27227	13541	1	-1.1	**3.14**	**2.2**	**16.62**	**2.2**
24-Jan	Edinburgh St Leonards	PM25	27233	16963	1	-0.3	3.17	2.2	16.03	2.2
09-Jan	Glasgow Centre	PM10	27331	9963	1	0.0	**3.10**	**2.2**	**16.81**	**2.2**
09-Jan	Glasgow Centre	PM25	22980	13160	1	0.1	3.08	2.2	Not	measured
09-Jan	Glasgow Kerbside	PM10	27344	15025	1	0.0	**3.00**	**2.2**	**16.64**	**2.2**
09-Jan	Glasgow Kerbside	PM25	27337	15185	1	0.4	**3.01**	**2.2**	**16.70**	**2.2**
24-Jan	Grangemouth	PM10	27228	16040	1	0.8	**3.01**	**2.2**	**16.61**	**2.2**
24-Jan	Grangemouth	PM25	27259	13578	1	-1.3	**2.86**	**2.2**	**15.68**	**2.2**
02-Feb	Inverness	PM10	21255						16.80	2.2
02-Feb	Inverness	PM25	21861						16.22	2.2

3. Welsh Sites

Carbon Monoxide

Date Year = 2012	Site	Analyser number	[1]Zero output	Uncertainty (ppm)	[2]Calibration Factor	Uncertainty (%)	[*]Maximum Residual (%)
26-Jan	Cardiff Centre	14333	0	0.2	1.005	2.1	2.4
24-Jan	Port Talbot Margam	Ch0	1	0.2	1.008	2.0	0.5

Sulphur Dioxide

Date Year =2012	Site	Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	[*]Max Residual (%)	[*]m-xylene interference (ppb)
26-Jan	Cardiff Centre	14319	1	2.6	1.090	7.2	4.0	8.7
23-Jan	Narberth	14896	-1	2.6	1.092	5.9	2.6	14.0
24-Jan	Port Talbot Margam	CH1	2	2.5	1.021	4.1	0.8	6.1
24-Jan	Wrexham	1181	6	2.5	0.997	4.2	2.5	11.2

Ozone

Date Year =2012	Site	Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	[*]Max Residual (%)
17-Jan	Aston Hill	14337	0	3	0.984	3.2	0.8
26-Jan	Cardiff Centre	14348	-2	3	1.039	3.1	0.9
26-Jan	Cwmbran	2	0	3	0.974	3.1	0.3
24-Jan	Mold	1642	2	3	1.030	3.1	0.4

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

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0401

Date Year =2012	Site	Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	*Max Residual (%)
23-Jan	Narberth	19190	-3	3	1.010	3.1	0.7
24-Jan	Port Talbot Margam	CH3	0	3	1.021	3.1	0.7

Oxides of Nitrogen

Date Year =2012	Site		Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	*Max residual (%)	*Converter efficiency (%)
17-Jan	Aston Hill	NO	17677	2	2.6	1.128	3.5	1.5	
		NOx		3	2.6	1.130	3.5	1.1	99.6
26-Jan	Cardiff Centre	NO	14325	1	2.5	1.043	3.5	0.6	
		NOx		2	2.5	1.034	3.5	0.1	98.2
07-Dec	Chepstow A48	NO	517144	98	2.9	1.225	3.5	0.8	
		NOx		102	2.6	1.255	3.5	0.9	100.0
26-Jan	Cwmbran	NO	1	2	2.5	1.000	3.5	0.5	
		NOx		1	2.5	0.970	3.5	0.4	98.5
24-Jan	Mold	NO	345	1	2.6	1.182	3.5	2.9	
		NOx		2	2.6	1.179	3.5	3.0	99.6
23-Jan	Narberth	NO	14311	1	2.6	1.245	3.5	0.9	
		NOx		1	2.6	1.220	3.5	1.5	98.1
25-Jan	Newport	NO	1011829	-1	2.7	1.421	3.5	1.1	
		NOx		2	2.7	1.455	3.5	1.1	98.9
24-Jan	Port Talbot Margam	NO	12811	1	2.5	1.043	3.5	0.8	
		NOx		1	2.5	1.036	3.5	0.7	99.6
24-Jan	Swansea Roadside	NO	16695	1	2.5	1.063	3.5	1.0	
		NOx		1	2.5	1.016	3.5	1.0	100.0
24-Jan	Wrexham	NO	1490	1	2.6	1.080	3.5	2.5	
		NOx		1	2.6	1.077	3.5	2.3	99.7

Particulate Analysers

Date Year =2012	Site		Analyser number	Calculated Spring Constant k_0	Uncertainty (%)	[4]k_0 accuracy (%)	[3]Measured Main Flow (l/min)	Uncertainty (%)	[3]Measured Total Flow (l/min)	Uncertainty (%)
26-Jan	Cardiff Centre	PM10			Analyser	not	operating			
26-Jan	Cardiff Centre	PM25	24449	10949	1	-0.4	2.99	2.2	17.44	2.2
07-Dec	Chepstow A48	PM10	27242	14108	1	-0.5	**3.03**	**2.2**	**16.64**	**2.2**
07-Dec	Chepstow A48	PM25	27223	15943	1	-0.3	**2.83**	**2.2**	**16.01**	**2.2**
23-Jan	Narberth	PM10	12721	12625	1	0.7	2.96	2.2	15.76	2.2
25-Jan	Newport	PM10	22589	13768	1	-1.6	**3.04**	**2.2**	**16.59**	**2.2**
25-Jan	Newport	PM25	27252	15984	1	-0.3	2.85	2.2	15.64	2.2
24-Jan	Port Talbot Margam	PM10	27217	13992	1	0.4	2.94	2.2	15.05	2.2
24-Jan	Port Talbot Margam	PM25	25081	10508	1	-0.5	Not	measured	15.02	2.2
24-Jan	Port Talbot Margam Partisol	PM10	21038						16.67	2.2
24-Jan	Swansea Roadside	PM10	20071						not	tested
24-Jan	Swansea Roadside	PM25	20072						not	tested
24-Jan	Wrexham	PM10	21224						16.53	2.2
24-Jan	Wrexham	PM25	21011						16.32	2.2

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4. London Sites

Carbon Monoxide

Date Year = 2012	Site	Analyser number	[1]Zero output	Uncertainty (ppm)	[2]Calibration Factor	Uncertainty (%)	*Maximum Residual (%)
26-Jan	London Bexley	443	0	0.2	1.028	3.6	3.7
07-Feb	London Bloomsbury	239	0	0.2	1.010	2.5	3.3
31-Jan	London Cromwell Road 2	10776	0	0.2	1.050	2.2	2.1
20-Feb	London Marylebone Road	651	0	0.2	0.990	2.1	1.0
21-Feb	London N. Kensington	19097	0	0.2	1.005	2.0	0.8
01-Feb	London Westminster	10777	-1	0.2	1.010	2.1	2.1
22-Dec	Tower Hamlets Roadside	14728	0	0.2	0.966	2.2	2.6

Sulphur Dioxide

Date Year =2012	Site	Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	*Max Residual (%)	*m-xylene interference (ppb)
26-Jan	London Bexley	318	0	2.4	0.613	4.6	3.0	8.0
07-Feb	London Bloomsbury	74	0	2.6	1.054	3.7	0.6	13.6
31-Jan	London Cromwell Rd 2	10779	0	2.6	1.186	4.2	1.7	22.5
20-Feb	London Marylebone Rd	2644	0	2.5	1.051	3.4	0.9	18.9
21-Feb	London N. Kensington	19095	4	2.5	1.024	4.2	1.5	26.3
01-Feb	London Westminster	10780	2	2.5	0.982	4.7	1.2	11.8

Ozone

Date Year =2012	Site	Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	*Max Residual (%)
07-Feb	London Bloomsbury	435	0	3	1.055	3.1	0.3
20-Dec	London Eltham	375	8	3	1.088	3.4	2.4
02-Dec	London Haringey	538	20	4.0	1.923	6.1	8.4
02-Feb	London Harlington	14309	-1	3	0.987	3.1	1.2
02-Feb	London Hillingdon	8060034	0	3	1.011	3.1	0.4
20-Feb	London Marylebone Road	145	1	3	1.057	3.1	0.5
21-Feb	London N. Kensington	19098	0	3	0.996	3.2	0.4
31-Jan	London Teddington	19191	-3	3	1.070	3.2	1.1
01-Feb	London Westminster	10444	0	3	1.007	3.1	1.2

Oxides of Nitrogen

Date Year =2012	Site		Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	*Max residual (%)	*Converter efficiency (%)
19-Dec-11	Camden Kerbside	NO NOx	67	20 21	2.8 3.2	1.569 1.526	4.4 3.5	2.5 1.4	100.0
02-Dec-11	Haringey Roadside	NO NOx	397	4 6	2.6 2.6	1.120 1.173	4.1 4.3	3.4 3.8	98.2
26-Jan	London Bexley	NO NOx	327	1 1	3.7 3.7	2.908 2.908	10.0 10.1	4.7 4.7	99.8
07-Feb	London Bloomsbury	NO NOx	74	0 2	2.8 2.9	1.522 1.516	3.5 3.5	1.1 0.4	100.3

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Date Year =2012	Site		Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	*Max residual (%)	*Converter efficiency (%)
31-Jan	London Cromwell Road 2	NO NOx	10775	1 1	2.5 2.5	0.956 0.958	3.5 3.5	0.2 0.2	98.6
20-Dec-11	London Eltham	NO NOx	307	2 2	2.5 2.5	1.031 1.064	3.5 3.5	0.3 1.0	100.0
02-Dec-11	London Haringey	NO NOx	11392	0 0	2.5 2.5	1.024 1.031	3.5 3.5	2.2 2.1	98.4
02-Feb	London Harlington	NO NOx	11491	2 0	2.6 2.6	1.293 1.281	3.5 3.5	1.5 1.4	99.5
02-Feb	London Hillingdon	NO NOx	8050017	0 0	2.5 2.5	0.980 0.981	3.5 3.5	1.0 0.6	98.4
20-Feb	London Marylebone Road	NO NOx	3366	9 13	2.7 2.9	1.292 1.304	3.6 3.5	3.1 1.4	101.2
21-Feb	London N. Kensington	NO NOx	19096	5 1	2.6 2.7	1.159 1.152	3.5 3.5	1.3 2.4	98.6
31-Jan	London Teddington	NO NOx	19205	5 -4	2.5 2.5	1.051 1.020	3.5 3.5	0.9 1.5	100.5
01-Feb	London Westminster	NO NOx	10439	1 1	3.0 3.0	1.970 1.957	3.5 3.5	0.9 0.9	100.8
30-Jan	Southwark A2 Old Kent Road	NO NOx	1954	-2 -3	2.7 2.7	1.404 1.394	3.5 3.5	0.4 0.6	98.8
22-Dec-11	Tower Hamlets Roadside	NO NOx	306	2 2	2.8 2.8	1.609 1.668	3.5 3.5	0.3 0.7	100.0

Particulate Analysers

Date Year =2012	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 (%)
19-Dec-11	Camden Kerbside	PM10	21159	11957	1	-0.3	3.08	2.2	16.76	2.2
19-Dec-11	Camden Kerbside	PM25	21391	12877	1	1.0	2.78	2.2	15.21	2.2
02-Dec-11	Haringey Roadside	PM10	2000	15289	1	0.2	2.99	2.2	16.31	2.2
02-Dec-11	Haringey Roadside	PM25	27278	13774	1	-0.2	3.01	2.2	15.99	2.2
26-Jan	London Bexley	PM25	25007	11385	1	-1.8	2.98	2.2	16.49	2.2
07-Feb	London Bloomsbury	PM10	24446	13637	1	-0.8	**3.17**	**2.2**	**17.49**	**2.2**
07-Feb	London Bloomsbury	PM25	27240	14600	1	-1.1	**3.05**	**2.2**	**17.27**	**2.2**
20-Dec-11	London Eltham	PM25	2000	14072	1	1.9	3.14	2.2	16.24	2.2
02-Feb	London Harlington	PM10	24902	12166	1	-1.0	2.96	2.2	15.89	2.2
02-Feb	London Harlington	PM25	23959	12663	1	-1.1	2.76	2.2	15.88	2.2
	London Harrow Stanmore	PM25	27274			analyser	not	tested		
20-Feb	London Marylebone Road	PM10	27230	16783	1	-0.9	3.16	2.2	16.89	2.2

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Date Year =2012	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 (%)
20-Feb	London Marylebone Road	PM25	27239	13056	1	1.9	3.45	2.2	17.72	2.2
20-Feb	London Marylebone Road Partisol	PM10	20943						16.73	2.2
20-Feb	London Marylebone Road Partisol	PM25							Not	present
21-Feb	London N. Kensington	PM10	27391	12673	1	0.0	**2.96**	**2.2**	**16.40**	**2.2**
21-Feb	London N. Kensington	PM25	21342	15940	1	1.0	**3.06**	**2.2**	**16.54**	**2.2**
21-Feb	London N. Kensington Partisol	PM10	1						17.07	2.2
21-Feb	London N. Kensington Partisol	PM25	2						18.00	2.2
31-Jan	London Teddington	PM25	25023	15298	1	-0.5	2.85	2.2	14.90	2.2
01-Feb	London Westminster	PM25	1						Not	present
30-Jan	Southwark A2 Old Kent Road	PM10	2000	14995	1	-0.9	2.95	2.2	16.34	2.2

5. English Sites

Carbon Monoxide

Date Year = 2012	Site	Analyser number	[1]Zero output	Uncertainty (ppm)	[2]Calibration Factor	Uncertainty (%)	[*]Maximum Residual (%)
10-Jan	Bristol Old Market	analyser	not	present			
10-Jan	Bristol St Paul's	14417	0	0.2	1.000	2	0.9
08-Dec-11	Bury Roadside	1357	0	0.2	0.917	2.2	2.4
16-Jan	Hull Freetown	342	0	0.2	1.035	2.1	0.8
16-Jan	Leeds Centre	1501	1	0.2	0.857	2.1	2.2
13-Feb	Leicester Centre	14868	0	0.2	1.010	2.1	1.0
16-Feb	Liverpool Speke	238	0	0.2	1.002	2.4	3.1
18-Jan	Middlesbrough	204	0	0.2	0.986	2.1	1.3
17-Jan	Newcastle Centre	461	-1	0.2	0.955	2.1	0.8
15-Dec-11	Salford Eccles	2366	0	0.2	0.937	2.2	3.1
18-Jan	Sheffield Centre	459	0	0.2	1.066	2.1	2.2
06-Feb	Southampton Centre	1661	0	0.2	1.091	2.9	3.9

Sulphur Dioxide

Date Year =2012	Site	Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	[*]Max Residual (%)	[*]m-xylene interference (ppb)
02-Mar	Barnsley 12	706	3	2.5	0.875	3.4	0.1	7.9
17-Jan	Barnsley Gawber	08050082	0	2.5	0.886	3.6	0.4	4.7

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Date Year =2012	Site	Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	*Max Residual (%)	*m-xylene interference (ppb)
19-Jan	Birmingham Acocks Green	19239	1	2.5	1.030	5.2	1.4	19.9
17-Jan	Birmingham Tyburn	2	3	2.5	0.924	13.3	4.9	0.9
10-Jan	Bristol St Paul's	14322			not	operating		
05-Jan	Harwell	#014350	6	2.5	1.045	5.5	3.8	6.3
16-Jan	Hull Freetown	1499	1	2.8	1.650	3.5	4.6	10.9
18-Jan	Ladybower	1178	1	2.7	0.967	3.7	0.8	13.2
28-Nov-11	Leamington Spa	1793	3	2.5	0.917	4.2	0.9	0.0
16-Jan	Leeds Centre	08050084	0	2.5	1.008	3.4	2.9	6.4
13-Feb	Leicester Centre	14321	8	2.5	1.021	4.5	0.7	3.4
17-Jan	Leominster	14352	0	2.6	1.145	10.3	4.3	3.4
16-Feb	Liverpool Speke	1765	1	2.5	1.008	3.6	0.5	10.9
16-Jan	Lullington Heath	12181	1	2.6	1.221	3.6	0.5	4.9
22-Feb	Manchester Piccadilly	2648	0	2.5	1.015	4.9	1.5	20.3
18-Jan	Middlesbrough	1660	2	2.5	1.079	5.0	1.7	0.8
17-Jan	Newcastle Centre	345	1	2.5	1.001	6.3	3.0	17.6
16-Feb	Northampton	8512250407	1	2.5	0.927	4.3	2.1	3.6
30-Jan	Norwich Lakenfields	12	1	2.6	1.129	7.6	4.2	5.9
15-Feb	Nottingham Centre	1629	6	2.5	0.896	8.1	1.9	24.9
18-Jan	Rochester Stoke	#19446	3	2.4	0.699	6.0	4.7	5.7
15-Dec-11	Salford Eccles	1581	0	2.6	1.131	6.9	3.0	22.6
06-Dec-11	Scunthorpe Town	110B-70	49	2.5	1.000	4.7	2.6	21.0
18-Jan	Sheffield Centre	1180	2	2.9	1.150	4.1	1.4	8.0
06-Feb	Southampton Centre	343	3	2.6	1.110	4.9	2.6	9.7
23-Jan	Stanford-le-Hope Roadside	api t series 02	-4	2.9	1.133	4.9	1.3	26.6
06-Dec-11	Sunderland Silksworth	99b382	1	2.5	1.022	4.5	0.6	6.1
25-Jan	Thurrock	189	0	2.5	1.045	7.4	4.0	12.4
01-Feb	Wicken Fen	14349	13	2.4	0.700	15.4	5.8	5.0

Ozone

Date Year =2012	Site	Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	*Max Residual (%)
17-Jan	Barnsley Gawber	CM06080030	0	3	1.028	3.1	1.0
19-Jan	Birmingham Acocks Green	19224	0	3	1.015	3.2	2.9
17-Jan	Birmingham Tyburn	wb6ag7tm	0	3	1.000	3.2	0.8
18-Jan	Birmingham Tyburn Roadside	19188	-1	3	1.041	3.1	0.3
01-Mar	Blackpool Marton		0	3	0.983	3.1	0.7
21-Feb	Bottesford	357	-1	3	0.987	3.1	0.3
07-Feb	Bournemouth	17503	-1	3	1.018	3.1	1.0
17-Jan	Brighton Preston Park	12461	0	3	0.986	3.2	2.5
10-Jan	Bristol St Paul's	14358	-2	3	1.038	3.1	0.5
18-Jan	Canterbury	#019194	0	3	1.033	3.1	0.9
18-Jan	Charlton Mackrell	95249	-1	3	0.966	3.1	0.5
05-Jan	Coventry Memorial Park	cm08060044	0	3	1.024	3.3	1.2
12-Jan	Exeter Roadside	2	2	3	0.898	3.1	0.7

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Date Year =2012	Site	Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	*Max Residual (%)
23-Feb	Glazebury	138	-1	3	0.955	3.3	2.9
19-Jan	Great Dun Fell	1647	0	3	1.117	3.2	1.1
05-Jan	Harwell	#017497	0	3	1.031	3.1	1.1
19-Jan	High Muffles	1641	0	3	1.065	3.1	1.0
16-Jan	Hull Freetown	CM08060045	0	3	0.984	3.1	0.9
18-Jan	Ladybower	1651	-2	3	1.014	3.1	0.4
28-Nov-11	Leamington Spa	1705	-2	3	0.962	3.1	0.3
16-Jan	Leeds Centre	CM08060036	1	3	1.079	3.1	1.7
13-Feb	Leicester Centre	2	0	3	1.086	3.1	0.4
17-Jan	Leominster	14470	2	3	1.000	3.1	0.5
16-Feb	Liverpool Speke	60041	0	3	0.952	3.1	0.9
16-Jan	Lullington Heath	17494	0	3	1.003	3.1	0.8
22-Feb	Manchester Piccadilly	CM08060039	0	3	0.960	3.2	0.9
22-Feb	Manchester South	1317	-3	3	1.003	3.1	0.5
14-Feb	Market Harborough	2	-1	3	1.038	3.1	0.7
18-Jan	Middlesbrough	944	-1	3	0.999	3.1	1.4
17-Jan	Newcastle Centre	CM08060033	0	3	0.999	3.2	1.0
16-Feb	Northampton	47r76str	1	3	0.903	3.1	0.6
30-Jan	Norwich Lakenfields	10	0	3	1.037	3.1	0.7
15-Feb	Nottingham Centre	8060032	1	3	1.088	3.5	1.1
11-Jan	Plymouth Centre	860027	0	3	1.055	3.1	0.3
06-Mar	Portsmouth	cm08060023	-1	3	1.012	3.5	0.8
02-Mar	Preston	cm08060042	0	3	1.012	3.1	0.4
04-Jan	Reading New Town	cm08060025	0	3	1.030	3.2	1.7
18-Jan	Rochester Stoke	95063	0	3	1.023	3.2	1.7
15-Dec-11	Salford Eccles	2363	0	3	1.023	3.3	5.3
18-Jan	Sheffield Centre	cm08060024	0	3	0.991	3.1	0.5
31-Jan	Sibton	146	-1	3	0.974	3.1	1.1
06-Feb	Southampton Centre	60021	0	3	0.979	3.1	0.2
23-Jan	Southend-on-Sea	CM08060017	0	3	1.094	3.2	0.6
24-Jan	St Osyth	60035	0	3	1.000	3.1	0.4
23-Jan	Stoke-on-Trent Centre	60026	1	3	0.984	3.1	0.1
06-Dec-11	Sunderland Silksworth	436	0	3	0.962	3.1	1.1
25-Jan	Thurrock	221	22	3	0.605	3.1	0.9
31-Jan	Weybourne	aea0030	1	3	1.011	3.2	2.3
01-Feb	Wicken Fen	14345	-2	3	1.035	3.1	1.1
01-Mar	Wigan Centre		0	3	1,021	3.1	0.4
16-Feb	Wirral Tranmere	60040	-1	3	0.989	3.3	0.7
19-Jan	Yarner Wood	14456	0	3	0.969	3.1	0.7

Oxides of Nitrogen

Date Year =2012	Site		Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	*Max residual (%)	*Converter efficiency (%)
17-Jan	Barnsley Gawber	NO NOx	08050057	3 4	2.7 2.7	0.911 0.917	3.5 3.5	0.8 1.0	 100.4
11-Jan	Bath Roadside	NO NOx	12758	5 6	2.5 2.5	1.043 1.063	3.5 3.5	0.5 0.2	 98.1
17-Jan	Billingham	NO NOx	574	8 3	2.5 2.5	1.045 1.019	3.5 3.5	0.9 0.2	 98.9

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19-Jan	Birmingham Acocks Green	NO	19212	0	2.6	1.137	3.5	0.3	
		NOx		1	2.6	1.131	3.5	0.2	99.8
17-Jan	Birmingham Tyburn	NO	1	-1	2.6	0.961	3.5	0.7	
		NOx		0	2.5	0.944	3.5	0.8	98.8
18-Jan	Birmingham Tyburn Roadside	NO	14324	2	2.9	1.774	3.5	1.3	
		NOx		4	2.9	1.785	3.5	0.7	97.6
08-Dec-11	Blackburn Darwen Roadside	NO	688b-303	-4	3.1	1.030	3.5	0.6	
		NOx		0	2.7	1.016	3.5	0.6	98.8
01-Mar	Blackpool Marton	NO	08050075	2	2.6	1.090	3.5	4.1	
		NOx		2	2.6	1.088	4.4	4.0	99.2
07-Feb	Bournemouth	NO	17507	1	2.5	1.029	3.5	0.9	
		NOx		1	2.5	1.000	3.5	1.1	101.3
17-Jan	Brighton Preston Park	NO	13068	-1	2.5	1.029	3.7	3.3	
		NOx		-1	2.5	1.029	3.5	3.2	101.6
10-Jan	Bristol Old Market	NO	10510	1	2.6	1.222	3.5	0.7	
		NOx		1	2.6	1.218	3.5	0.5	93.1
10-Jan	Bristol St Paul's	NO	14353	1	2.5	1.051	3.5	0.5	
		NOx		1	2.5	1.053	3.5	0.5	100.0
08-Dec-11	Bury Roadside	NO	1710	1	2.6	1.113	3.8	1.8	
		NOx		5	2.6	1.143	3.5	0.9	99.5
01-Feb	Cambridge Roadside	NO	55355-303	0	2.4	0.540	3.8	4.9	
		NOx		2	2.4	0.538	3.9	5.2	98.1
18-Jan	Canterbury	NO	11666	2	3.2	2.182	4.7	3.7	
		NOx		3	3.2	2.198	4.6	3.5	100.0
05-Dec-11	Carlisle Roadside	NO		0	2.5	1.048	3.5	3.1	
		NOx		2	2.5	1.046	3.5	2.2	97.4
18-Jan	Charlton Mackrell	NO	12895	2	2.6	1.120	3.5	0.3	
		NOx		2	2.6	1.096	3.5	0.1	99.2
19-Jan	Chatham Centre Roadside	NO	#109206	0	2.5	1.011	3.5	2.3	
		NOx		0	2.5	1.011	3.5	1.9	98.8
08-Dec-11	Chesterfield	NO	528	3	2.6	1.224	3.5	0.9	
		NOx		8	2.6	1.239	3.5	0.5	99.5
08-Dec-11	Chesterfield Roadside	NO	24	98	2.6	1.192	3.5	1.1	
		NOx		100	2.6	1.188	3.5	0.3	98.5
05-Jan	Coventry Memorial Park	NO	08030109	1	2.7	1.402	4.0	5.1	
		NOx		1	2.7	1.405	4.0	4.9	98.2
19-Jan	Eastbourne	NO	#019209	5	2.6	1.126	5.5	5.5	
		NOx		6	2.6	1.125	5.7	5.9	98.9
12-Jan	Exeter Roadside	NO	1	1	2.6	1.157	3.5	0.6	
		NOx		-4	2.6	1.114	3.5	2.9	98.2
23-Feb	Glazebury	NO	78	2	3.0	1.974	3.5	1.0	
		NOx		3	3.1	1.987	3.6	1.6	99.2
05-Jan	Harwell	NO	#014355	4	2.6	1.189	3.5	3.2	
		NOx		7	2.7	1.172	3.5	2.5	100.3
19-Jan	High Muffles	NO	1783	1	2.6	1.141	3.5	0.2	
		NOx		1	2.6	1.141	3.5	0.2	101.5
17-Jan	Horley	NO	#01934	1	2.5	1.013	3.5	0.9	
		NOx		2	2.5	1.015	3.5	0.9	99.8
16-Jan	Hull Freetown	NO	50056	1	2.5	1.016	3.5	4.2	
		NOx		0	2.5	1.039	3.5	3.9	100.0
18-Jan	Ladybower	NO	72	0	3.0	1.342	3.5	0.8	
		NOx		0	2.7	1.340	3.5	0.9	98.9

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0401

Date Year =2012	Site		Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	*Max residual (%)	*Converter efficiency (%)
28-Nov-11	Leamington Spa	NO	53	1	2.5	1.031	3.5	0.2	
		NOx		1	2.5	1.026	3.5	1.3	96.6
16-Jan	Leeds Centre	NO	08050066	1	2.5	1.043	3.6	4.7	
		NOx		1	2.7	1.037	3.5	4.0	99.2
17-Jan	Leeds Headingley Kerbside	NO	696b-308			analyser	malfunction		
		NOx							
13-Feb	Leicester Centre	NO	1	0	2.5	1.057	3.5	1.0	
		NOx		-1	2.5	1.056	3.5	1.1	98.4
17-Jan	Leominster	NO	14863	8	3.7	2.929	3.5	1.6	
		NOx		8	3.8	2.955	3.5	1.0	101.2
16-Feb	Lincoln Canwick Road	NO	19203	0	2.7	1.341	3.5	0.9	
		NOx		-1	2.7	1.329	3.5	0.5	98.9
17-Feb	Liverpool Queen's Drive Roadside	NO	1734	1	2.5	0.976	3.5	0.2	
		NOx		2	2.5	0.976	3.5	0.3	99.3
16-Feb	Liverpool Speke	NO	50069	1	2.5	1.022	3.5	3.2	
		NOx		1	2.5	1.022	3.5	2.6	99.6
16-Jan	Lullington Heath	NO	14313	1	2.6	1.108	3.5	0.3	
		NOx		1	2.5	1.078	3.5	0.3	98.7
22-Feb	Manchester Piccadilly	NO	08050045	0	2.5	0.939	3.5	2.0	
		NOx		-1	2.5	0.994	3.5	2.2	102.0
22-Feb	Manchester South	NO	2115	1	2.5	0.934	3.5	0.5	
		NOx		1	2.5	0.922	3.5	0.5	100.0
14-Feb	Market Harborough	NO	1	2	2.5	0.974	3.5	1.3	
		NOx		1	2.5	0.966	3.5	1.5	100.4
18-Jan	Middlesbrough	NO	2287	-2	2.7	1.176	3.5	0.9	
		NOx		-9	2.6	1.154	3.5	0.7	99.5
17-Jan	Newcastle Centre	NO	08050063	1	2.5	1.057	3.5	1.7	
		NOx		1	2.6	1.058	3.5	1.8	100.4
05-Dec-11	Newcastle Cradlewell Road	NO	m2106-m860	-2	2.6	0.976	3.5	2.5	
		NOx		3	2.5	1.011	3.5	1.9	99.1
16-Feb	Northampton	NO	8atj6apr	-1	2.6	1.011	3.5	0.3	
		NOx		-1	2.6	0.989	3.5	0.1	99.3
30-Jan	Norwich Lakenfields	NO	13	0	2.5	1.007	3.8	5.1	
		NOx		-1	2.5	0.993	3.8	5.0	101.3
15-Feb	Nottingham Centre	NO	8050072	1	2.5	0.984	3.5	1.5	
		NOx		0	2.5	0.987	3.5	1.9	100.4
06-Jan	Oxford Centre Roadside	NO	nox123	102	2.6	1.149	3.5	1.7	
		NOx		102	2.6	1.219	3.5	1.0	98.0
06-Jan	Oxford St Ebbes	NO	1	101	3.0	1.224	4.0	3.5	
		NOx		101	2.8	1.225	4.1	3.7	100.5
11-Jan	Plymouth Centre	NO	860062	0	2.5	0.868	3.5	0.5	
		NOx		0	2.5	0.863	3.5	0.5	98.0
06-Mar	Portsmouth	NO	p0t7cya5	0	2.5	0.975	3.5	0.8	
		NOx		1	2.5	0.972	3.5	0.8	99.6
02-Mar	Preston	NO	08050064	0	2.5	1.026	3.5	3.4	
		NOx		1	2.5	1.018	3.5	3.1	99.2
04-Jan	Reading New Town	NO	08050059	-1	2.5	0.931	3.5	2.4	
		NOx		-1	2.5	0.929	3.5	2.8	100.3
18-Jan	Rochester Stoke	NO	#018593	1	2.6	1.216	4.5	3.6	
		NOx		2	2.6	1.221	4.4	3.4	99.5
15-Dec-11	Salford Eccles	NO	2356	-1	2.5	1.022	3.5	1.6	
		NOx		1	2.5	1.018	3.7	2	99.6

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02-Feb	Sandy Roadside	NO	2585	0	2.6	1.146	3.9	4.3	
		NOx		0	2.6	1.140	4.0	4.4	99.7
06-Dec-11	Scunthorpe Town	NO	M1125-M526	33	3.8	2.057	3.5	0.5	
		NOx		46	3.1	2.077	3.5	2.2	99.2
18-Jan	Sheffield Centre	NO	08050055	0	2.5	1.075	3.5	0.7	
		NOx		0	2.5	1.025	3.5	0.6	99.2
17-Jan	Sheffield Tinsley	NO	847	2	2.6	1.178	3.5	0.5	
		NOx		1	2.6	1.16	3.5	0.4	98.6
06-Feb	Southampton Centre	NO	30106	3	2.6	1.097	3.9	3.1	
		NOx		4	2.6	1.096	3.8	2.9	99.7
23-Jan	Southend-on-Sea	NO	08050071	1	2.6	1.161	15.9	17.4	
		NOx		1	2.6	1.157	16.0	17.5	98.1
24-Jan	St Osyth	NO	50073	-1	2.5	0.884	3.5	2.4	
		NOx		-2	2.5	0.879	3.5	3.0	99.6
23-Jan	Stanford-le-Hope Roadside	NO	api t series 02	1	2.5	1.058	4.3	6.1	
		NOx		2	2.5	1.041	4.5	6.5	99.1
18-Jan	Stockton-on- Tees Eaglescliffe	NO	579	1	2.7	1.484	3.5	0.9	
		NOx		0	2.8	1.488	3.5	1.0	100.6
23-Jan	Stoke-on-Trent Centre	NO	50070	1	2.4	0.775	3.5	3.0	
		NOx		1	2.4	0.776	3.5	3.0	99.4
16-Jan	Storrington Roadside	NO	2078	0	2.5	1.056	4.4	4.2	
		NOx		0	2.5	1.051	4.6	4.6	101.7
06-Dec-11	Sunderland Silksworth	NO	734b-322	0	2.5	1.020	3.5	0.9	
		NOx		2	2.7	1.025	3.5	0.1	99.6
25-Jan	Thurrock	NO	192	-1	2.6	1.086	4.4	4.2	
		NOx		-2	2.6	1.078	4.5	4.3	99.8
	Walsall Woodlands	NO	Site	not	in	operation	at	audit	visit
		NOx							
12-Dec-11	Warrington	NO	98417000-1	-1	2.6	1.101	4.2	3.5	
		NOx		0	2.6	1.123	3.6	2.1	99.0
01-Feb	Wicken Fen	NO	13069	4	2.5	0.818	3.8	4.8	
		NOx		4	2.5	0.789	3.5	3.2	100.3
01-Mar	Wigan Centre	NO		1	2.5	1.009	3.5	0.2	
		NOx		1	2.5	1.011	3.5	0.4	99.6
16-Feb	Wirral Tranmere	NO	50060	1	2.5	0.972	3.5	1.7	
		NOx		2	2.5	0.977	3.5	1.9	99.2
19-Jan	Yarner Wood	NO	12554	1		1.066	not	tested	due to
		NOx		0		1.049	audit	kit	fault
06-Dec-11	York Fishergate	NO	622B-272	1	2.5	0.938	3.5	1.1	
		NOx		1	2.5	0.942	3.5	1.2	100.7

Particulate Analysers

Date Year =2012	Site		Analyser number	Calculated Spring Constant k_0	Uncertainty (%)	[4]k_0 accuracy (%)	[3]Measured Main Flow (l/min)	Uncertainty (%)	[3]Measured Total Flow (l/min)	Uncertainty (%)
19-Jan	Birmingham Acocks Green	PM25	20203	15480	1	-0.8	2.69	2.2	16.05	2.2
17-Jan	Birmingham Tyburn	PM10	27255	14776	1	-1.1	2.95	2.2	15.71	2.2
17-Jan	Birmingham Tyburn	PM25	21372	14849	1	1.1	2.97	2.2	16.01	2.2

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18-Jan	Birmingham Tyburn Roadside	PM10	26034	12134	1	-2.0	2.98	2.2	16.64	2.2
18-Jan	Birmingham Tyburn Roadside	PM25	2000	14089	1	0.1	3.04	2.2	15.88	2.2
01-Mar	Blackpool Marton	PM25	24424	13059	1	1.3	3.01	2.2	16.60	2.2
07-Feb	Bournemouth	PM25	1						16.51	2.2
17-Jan	Brighton Preston Park	PM25	123						15.81	2.2
10-Jan	Bristol St Paul's	PM10		analyser	not	present				
10-Jan	Bristol St Paul's	PM25	26495	13718	1	-1.5	**3.03**	**2.2**	**16.27**	**2.2**
8/12/11	Bury Roadside	PM10	27335	16044	1	-0.9	3.01	2.2	16.45	2.2
8/12/11	Bury Roadside	PM25	27334	14977	1	-0.6	3.03	2.2	16.53	2.2
5/12/11	Carlisle Roadside	PM10	27257	14364	1	-0.9	3.01	2.2	16.21	2.2
5/12/11	Carlisle Roadside	PM25	27320	13787	1	-1.0	3.11	2.2	15.53	2.2
19-Jan	Chatham Centre Roadside	PM10	27271	14416	1	-0.7	3.00	2.2	16.74	2.2
19-Jan	Chatham Centre Roadside	PM25	27343	15901	1	-0.6	3.01	2.2	16.80	2.2
8/12/11	Chesterfield	PM10	27316	16385	1	0.4	**2.96**	**2.2**	**16.18**	**2.2**
8/12/11	Chesterfield	PM25	27314	12577	1	1.1	**2.97**	**2.2**	**16.28**	**2.2**
28-Feb	Chesterfield Roadside	PM10	22299	11527	1	1.6	2.98	2.2	16.57	2.2
28-Feb	Chesterfield Roadside	PM25	27339	15465	1	-1.3	2.97	2.2	16.46	2.2
05-Jan	Coventry Memorial Park	PM25		analyser	not	present				
19-Jan	Eastbourne	PM10	2000	14283	1	-1.5	2.97	2.2	16.57	2.2
19-Jan	Eastbourne	PM25	27244	14736	1	-0.7	3.01	2.2	16.64	2.2
05-Jan	Harwell	PM10	27333	14665	1	-1.8	2.97	2.2	16.17	2.2
05-Jan	Harwell	PM25	21366	12321	1	-0.6	2.99	2.2	16.07	2.2
15-Feb	Harwell Partisol	PM10	21257						17.00	2.2
15-Feb	Harwell Partisol	PM25	21859						17.64	2.2
16-Jan	Hull Freetown	PM10	24445	14228	1	0.9	2.84	2.2	15.88	2.2
16-Jan	Hull Freetown	PM25	26498	13911	1	-2.0	2.99	2.2	16.14	2.2
28/11/11	Leamington Spa	PM10	27295	15032	1	0.2	2.97	2.2	15.91	2.2
28/11/11	Leamington Spa	PM25	27248	14217	1	0.3	2.95	2.2	15.62	2.2
16-Jan	Leeds Centre	PM10	24451	13322	1	-0.6	3.04	2.2	15.68	2.2
16-Jan	Leeds Centre	PM25	27254	16857	1	-1.1	2.99	2.2	15.33	2.2
17-Jan	Leeds Headingley Kerbside	PM10	27287	17357	1	-1.3	**2.95**	**2.2**	**16.16**	**2.2**
17-Jan	Leeds Headingley Kerbside	PM25	27249	14528	1	-1.2	**3.00**	**2.2**	**16.31**	**2.2**
13-Feb	Leicester Centre	PM10	24442	14428	1	-0.2	**3.06**	**2.2**	**17.10**	**2.2**
13-Feb	Leicester Centre	PM25	26500	14953	1	-0.1	3.02	2.2	16.11	2.2
16-Feb	Liverpool Speke	PM10	24450	15747	1	-0.4	**2.99**	**2.2**	**16.75**	**2.2**
16-Feb	Liverpool Speke	PM25	28607	14768	1	-0.9	**2.98**	**2.2**	**16.59**	**2.2**
22-Feb	Manchester Piccadilly	PM25	26038	13773	1	-1.8	2.96	2.2	16.06	2.2
18-Jan	Middlesbrough	PM10	24325	13951	1	-1.3	3.01	2.2	16.81	2.2
18-Jan	Middlesbrough	PM25	27195	15722	1	-1.8	2.90	2.2	16.32	2.2
17-Jan	Newcastle Centre	PM10	24448	13769	1	-0.4	2.85	2.2	15.34	2.2
17-Jan	Newcastle Centre	PM25	24447	14843	1	0.1	2.88	2.2	16.18	2.2
16-Feb	Northampton	PM25	21013						16.60	2.2

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30-Jan	Norwich Lakenfields	PM10	2000	15529	1	-1.1	3.11	2.2	16.69	2.2
30-Jan	Norwich Lakenfields	PM25	27328	15628	1	0.2	2.85	2.2	15.53	2.2
15-Feb	Nottingham Centre	PM10	25025	15567	1	-0.1	2.88	2.2	16.41	2.2
15-Feb	Nottingham Centre	PM25	27369	12193	1	0.1	2.88	2.2	16.67	2.2
06-Jan	Oxford St Ebbes	PM10	3	14689	1	-0.9	3.00	2.2	16.64	2.2
06-Jan	Oxford St Ebbes	PM25	4	17060	1	-0.6	2.98	2.2	16.45	2.2
11-Jan	Plymouth Centre	PM10	24428	12289	1	0.1	**3.11**	**2.2**	**17.67**	**2.2**
11-Jan	Plymouth Centre	PM25	27221	12769	1	-1.4	**3.04**	**2.2**	**17.53**	**2.2**
06-Mar	Portsmouth	PM10	7628	16978	1	0.0	2.85	2.2	14.76	2.2
06-Mar	Portsmouth	PM25	21358	18668	1	0.7	**2.91**	**2.2**	**15.92**	**2.2**
02-Mar	Preston	PM25	22881	12843	1	-0.9	2.95	2.2	16.56	2.2
04-Jan	Reading New Town	PM10	21315	13211	1	0.1	2.91	2.2	16.08	2.2
04-Jan	Reading New Town	PM25	25090	13991	1	-1.0	not	measured	16.04	2.2
18-Jan	Rochester Stoke	PM10	27241	14670	1	-1.6	2.86	2.2	16.20	2.2
18-Jan	Rochester Stoke	PM25	27258	15825	1	-0.8	3.00	2.2	16.51	2.2
15/12/11	Salford Eccles	PM10	21168	17731	1	23.0	**2.87**	**2.2**	**16.05**	**2.2**
15/12/11	Salford Eccles	PM25	27272	14468	1	-1.2	**2.77**	**2.2**	**15.29**	**2.2**
02-Feb	Sandy Roadside	PM10	22018	11148	1	-1.3	3.02	2.2	16.64	2.2
02-Feb	Sandy Roadside	PM25	27632	15888	1	-1.2	2.97	2.2	16.60	2.2
6/12/11	Scunthorpe Town	PM10	27366	14911	1	-0.6	2.76	2.2	15.17	2.2
18-Jan	Sheffield Centre	PM10	25024	12107	1	-1.2	3.09	2.2	16.69	2.2
18-Jan	Sheffield Centre	PM25	27253	15617	1	-0.1	**3.08**	**2.2**	**16.42**	**2.2**
06-Feb	Southampton Centre	PM10	24448	11683	1	-15.8	3.01	2.2	16.61	2.2
06-Feb	Southampton Centre	PM25	2000	16554	1	0.2	2.99	2.2	16.52	2.2
23-Jan	Southend-on-Sea	PM25	22927	12373	1	-0.5	3.06	2.2	16.16	2.2
23-Jan	Stanford-le-Hope Roadside	PM10	24397	13376	1	-0.4	2.99	2.2	16.30	2.2
23-Jan	Stanford-le-Hope Roadside	PM25	27226	15398	1	-0.7	3.08	2.2	16.68	2.2
18-Jan	Stockton-on-Tees Eaglescliffe	PM10	H4554						15.79	2.2
18-Jan	Stockton-on-Tees Eaglescliffe	PM25	H4553						15.40	2.2
23-Jan	Stoke-on-Trent Centre	PM10	25028	12449	1	-0.4	3.01	2.2	16.57	2.2
23-Jan	Stoke-on-Trent Centre	PM25	27262	13253	1	-1.9	2.99	2.2	16.59	2.2
16-Jan	Storrington Roadside	PM10	27236	15613	1	-0.4	2.98	2.2	16.49	2.2
16-Jan	Storrington Roadside	PM25	27229	12764	1	0.1	3.00	2.2	16.68	2.2
6/12/11	Sunderland Silksworth	PM25	27320	15541	1	-1.7	2.87	2.2	14.56	2.2
25-Jan	Thurrock	PM10	27329	13837	1	-1.5	3.00	2.2	16.54	2.2

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12/12/11	Warrington	PM10	27183	17189	1	-1.4	**2.87**	**2.2**	**15.70**	**2.2**
12/12/11	Warrington	PM25	27269	16225	1	-0.8	**2.77**	**2.2**	**15.62**	**2.2**
01-Mar	Wigan Centre	PM25	27291	14773	1	-0.6	3.00	2.2	16.71	2.2
16-Feb	Wirral Tranmere	PM25	22883	13205	1	-0.7	3.01	2.2	16.71	2.2
11-Jan	York Bootham	PM10	21877	14590	1	-1.0	3.02	2.2	15.38	2.2
11-Jan	York Bootham	PM25	27209	16245	1	-0.2	2.96	2.2	15.05	2.2
6/12/11	York Fishergate	PM10	27232	15699	1	0.0	2.96	2.2	15.80	2.2
6/12/11	York Fishergate	PM25	27348	18161	1	-0.4	2.94	2.2	15.81	2.2

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

The calibration results for NOx, NO, CO, SO_2, O_3 and Particulates are those that fall within our scope of accreditation. Results marked with an asterisk (*) on this certificate 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 (in g/s^2 units) to the manufacturer's specified value of k_0.

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

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

AEA group
The Gemini Building
Fermi Avenue
Harwell
Didcot
Oxfordshire
OX11 0QR
Tel: 0870 190 6465
Fax: 0870 190 6608