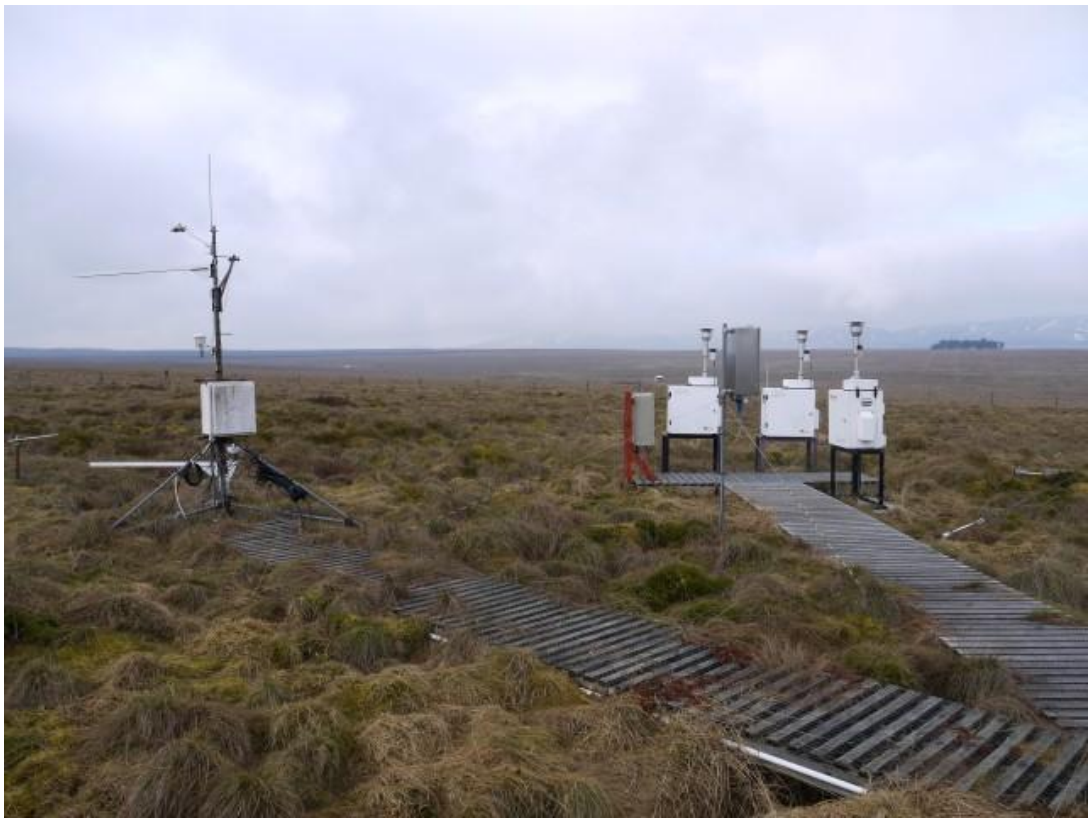
QA/QC Data Ratification Report for the Automatic Urban and Rural Network, July-September 2012, and Intercalibration Report, Summer 2012



Report for Department for Environment, Food and Rural Affairs, The Scottish Government, The Welsh Government, The Northern Ireland Department of Environment

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Executive summary

Ricardo-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 88.8 % for all pollutants (O_3, NO_2, SO_2, CO, PM_{10} and $PM_{2.5}$) during the 3-month reporting period July-September 2012. Data capture for all pollutants except O_3 were just below 90%. There were 41 sites with data capture less than 90% for the period. Many SO_2 and CO analysers were removed from the network during this quarter.

A total of 138 monitoring sites in the AURN operated during this quarter, of which 74 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.

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Table of contents

Appendices

Section A: Data Ratification Report, July-September 2012

1 Introduction

This quarterly report covers the Quality Assurance and Control (QA/QC) activities undertaken by Ricardo-AEA to ratify automatic monitoring data from Defra and the Devolved Administrations' automatic urban and rural air quality monitoring network (AURN) for the period 1st July – 30th September 2012. During this quarter there were a total of 138 operational monitoring sites in the Network of which there are 103 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 64 Defra-funded sites and 74 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 (daily average for Partisols) data capture for the network averaged 88.8% for all pollutants (O_3, NO_2, SO_2, CO, PM_{10} and $PM_{2.5}$) during the 3 month reporting period July-September 2012 (see Table 1.1). Only O_3 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 during the period, the data capture is based on the actual date starting or closing.

Table 1.1: AURN Ratified Data Capture (%) by Quarter, January-September 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
Q2 2012	98.8	87.6	87.1	94.7	97.5	94.4	92.9
Q3 2012	89.9	86.7	89.1	88.5	91.7	86.5	88.8

Overall, 320 out of the 421 analysers (76%) 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%)	Q2 Apr-Jun 2012 (No. below 90%)	Q3 July-Sept 2012 (No. below 90%)
CO	23	2	0	2
NO_2	120	13	12	29
O_3	83	7	4	15
PM_{10}[1]	69	14	22	21
$PM_{2.5}$[1]	80	26	27	22
SO_2	46	4	5	12
Total <90%		66	70	101

[1] Includes FDMS, BAM and Partisol analysers.

In total, 41 out of the 138 operational network sites in the quarter (19%) had an average data capture rate below the required 90% level for the July-September 2012 period.

1.2 Changes to Ratified Data

The following data from previous quarters have been changed as a result of the ratification process for this quarter:

Dumbarton Roadside

Due to the lack of calibrations during the period, the NOx data from Dumbarton Roadside have been deleted from the installation of the new analyser on 22 March up to the end of September; further data may be lost in the fourth quarter.

Glazebury

The NOx data shows an unexplained step change at the end of May; data have been deleted from 23 May to 30 June. The fault persists into July.

Plymouth Centre

As a result of calibration data received since ratification of the April-June data, the NOx data have been rescaled in June.

Port Talbot Margam

As a result of calibration data received since ratification of the April-June data, the NOx and SO_2 data have been rescaled in June.

Portsmouth

As a result of calibration data received since ratification of the April-June data, the NOx data have been rescaled in May and June.

St Osyth

As a result of calibration data received since ratification of the April-June data, the NOx data have been rescaled in June.

2 Changes in the Network for Directive Compliance

The following sites were commissioned during this period:

Northampton Kingsthorpe $PM_{2.5}$ NO_2 O_3 SO_2 09/07/12.

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 are described in Section 5.

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. 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 July-September 2012 is given in Table 4.1:

Table 4.1: Data capture for London: July-September 2012

Site	CO	PM_{10}	PM_{25}	NO_2	O_3	SO_2	
England							
Camden Kerbside	-	92.2	97.1	88.4	-	-	92.5
Haringey Roadside	-	95.4	68.9	35.6	-	-	66.6
London Bexley	94.0	-	99.5	98.1	-	50.9	85.6
London Bloomsbury	96.1	96.7	96.8	81.7	98.6	98.5	94.8
London Cromwell Road 2	97.6	-	-	97.9	-	0.0	65.1
London Eltham	-	-	99.4	92.9	99.6	-	97.3
London Haringey	-	-	-	41.7	99.9	-	70.8
London Harlington	-	99.3	96.8	98.3	70.3	-	91.2
London Harrow Stanmore	-	-	93.2	-	-	-	93.2
London Hillingdon	-	-	-	95.4	91.0	-	93.2
London Marylebone Road	90.7	62.7	94.0	95.2	99.0	99.1	90.1
London Marylebone Road PARTISOL	-	94.6	98.9	-	-	-	96.7
London N. Kensington	97.9	92.0	86.9	97.9	98.1	97.2	95.0
London N. Kensington PARTISOL	-	98.9	85.9	-	-	-	92.4
London Teddington	-	-	98.7	98.6	98.7	-	98.7
London Westminster	0.0	-	65.2	94.3	78.7	0.0	47.6
Southwark A2 Old Kent Road	-	76.6	-	64.4	-	-	70.5
Tower Hamlets Roadside	98.4	-	-	99.2	-	-	98.8
Number of sites	7	9	13	15	9	6	18
Number of sites < 90%	1	2	4	5	2	3	6
Network Mean (%)	82.1	89.8	90.9	85.3	92.7	57.6	85.6

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

The NOx analyser was found to be internally sampling at the LSO calibration on 10 August, and appears to have started on 18 July. The fault was not resolved until 11 September.

London Bexley

As reported in the April-June QA/QC report, The SO_2 analyser suffered excessive baseline drift due to a lamp fault in April. The SO_2 cylinder subsequently became empty and the lack of calibration data resulted in the loss of data from 10 May to early August when a replacement cylinder was delivered.

London Westminster

There were several power cuts in June and July which caused baseline shifts with no associated calibrations. The data for SO_2 and CO were deleted for July as these were deaffiliated on 19 July. In addition, pump failure on the Partisol resulted in the loss of $PM_{2.5}$ data from 1 July-1 August.

Southwark A2 Old Kent Road

An electrical supply fault resulted in a lengthy power cut; when power was restored, both analysers had lost programming and required an ESU callout to restore correct operation on 16 July. In addition, the sampling system was found to allow sampling through the excess flow at the audit on 24 July; NOx data from 6 June to 30 July have been deleted. A flow fault was identified on 23 September, the analyser was removed for repair until 12 October.

4.2 England (excluding London)

4.2.1 Data Capture

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

Table 4.2: Network Data Capture for England July-September (or from start date of any new site)

Site	CO	PM_{10}	PM_{25}	NO_2	O_3	SO_2	
England							
Barnsley 12	-	-	-	-	-	95.8	95.8
Barnsley Gawber	-	-	-	86.3	86.5	86.4	86.4
Bath Roadside	-	-	-	90.0	-	-	90.0
Billingham	-	-	-	94.3	-	-	94.3
Birmingham Acocks Green	-	-	96.1	98.0	58.6	98.1	87.7
Birmingham Tyburn	-	99.3	99.0	98.5	99.6	98.6	99.0
Birmingham Tyburn Roadside	-	45.8	72.2	98.1	98.1	-	78.6
Blackburn Darwen Roadside	-	-	-	99.2	-	-	99.2
Blackpool Marton	-	-	42.3	95.2	99.8	-	79.1
Bottesford	-	-	-	-	97.8	-	97.8

Site	CO	PM_{10}	PM_{25}	NO_2	O_3	SO_2	
Bournemouth	-	-	95.7	98.4	98.6	-	97.5
Brighton Preston Park	-	-	100.0	98.4	98.6	-	99.0
Bristol Old Market	-	-	-	96.4	-	-	96.4
Bristol St Paul's	96.2	98.5	94.7	98.4	98.5	96.2	97.1
Bury Roadside	98.6	98.5	86.6	58.3	-	-	85.5
Cambridge Roadside	-	-	-	98.4	-	-	98.4
Canterbury	-	-	-	98.5	98.7	-	98.6
Carlisle Roadside	-	70.6	87.4	52.6	-	-	70.2
Charlton Mackrell	-	-	-	98.6	99.9	-	99.3
Chatham Centre Roadside	-	99.6	99.8	98.8	-	-	99.4
Chesterfield	-	97.8	93.9	97.4	-	-	96.4
Chesterfield Roadside	-	99.3	98.9	90.7	-	-	96.3
Coventry Memorial Park	-	-	0.0	42.6	98.4	-	47.0
Eastbourne	-	80.9	99.2	89.1	-	-	89.8
Exeter Roadside	-	-	-	89.3	98.7	-	94.0
Glazebury	-	-	-	49.4	59.9	-	54.7
Great Dun Fell	-	-	-	-	25.4	-	25.4
Harwell	-	94.0	92.2	96.9	97.5	97.3	95.6
Harwell PARTISOL	-	93.5	98.9	-	-	-	96.2
High Muffles	-	-	-	98.1	94.3	-	96.2
Honiton	-	-	-	98.5	-	-	98.5
Horley	-	-	-	99.3	-	-	99.3
Hull Freetown	91.3	70.5	96.6	94.0	95.6	94.0	90.3
Ladybower	-	-	-	95.9	98.0	98.3	97.4
Leamington Spa	-	99.5	99.6	95.3	99.6	99.6	98.7
Leamington Spa Rugby Road	-	97.8	44.7	96.8	-	-	79.8
Leeds Centre	97.9	96.9	97.1	98.1	98.6	98.3	97.8
Leeds Headingley Kerbside	-	99.3	97.9	99.6	-	-	98.9
Leicester Centre	96.1	95.5	93.7	84.2	95.9	96.1	93.6
Leominster	-	-	-	92.3	93.7	49.2	78.4
Lincoln Canwick Road	-	-	-	99.6	-	-	99.6
Liverpool Queen's Drive Roadside	-	-	-	33.6	-	-	33.6
Liverpool Speke	96.1	96.7	94.9	71.4	98.3	97.2	92.4
Lullington Heath	-	-	-	97.8	98.7	72.8	89.8
Manchester Piccadilly	-	-	96.4	71.6	98.4	98.2	91.1

Site	CO	PM_{10}	PM_{25}	NO_2	O_3	SO_2	
Manchester South	-	-	-	98.5	98.6	-	98.5
Market Harborough	-	-	-	99.5	98.7	-	99.1
Middlesbrough	97.2	94.8	96.3	96.4	97.5	97.4	96.6
Newcastle Centre	45.2	98.5	96.6	89.0	94.2	96.2	86.6
Newcastle Cradlewell Roadside	-	-	-	98.4	-	-	98.4
Northampton	-	-	100.0	**95.8**	6.0	95.8	74.4
Northampton Kingsthorpe	-	-	81.0	95.5	87.8	5.5	67.4
Norwich Lakenfields	-	72.3	91.3	98.4	90.2	98.3	90.1
Nottingham Centre	-	26.6	84.3	93.2	94.9	97.4	79.3
Oxford Centre Roadside	-	-	-	95.0	-	-	95.0
Oxford St Ebbes	-	90.6	90.5	84.4	-	-	88.5
Plymouth Centre	-	98.4	85.1	97.6	97.3	-	94.6
Portsmouth	-	71.7	96.2	94.1	99.4	-	90.3
Preston	-	-	96.6	**99.7**	99.8	-	**98.7**
Reading New Town	-	63.5	97.6	94.8	98.7	-	88.7
Rochester Stoke	-	78.4	73.7	63.1	76.2	76.1	73.5
Salford Eccles	97.0	83.0	91.4	80.9	97.2	82.7	88.7
Sandy Roadside	-	78.3	87.8	95.0	-	-	87.0
Scunthorpe Town	-	45.3	-	**96.8**	-	89.9	77.3
Sheffield Centre	91.7	95.9	95.7	9.6	97.2	91.7	80.3
Sheffield Tinsley	-	-	-	98.3	-	-	98.3
Sibton	-	-	-	-	99.5	-	99.5
Southampton Centre	98.2	99.4	99.0	97.9	97.7	88.7	96.8
Southend-on-Sea	-	-	91.1	87.5	91.7	-	90.1
St Osyth	-	-	-	97.6	97.7	-	97.7
Stanford-le-Hope Roadside	-	68.1	96.3	78.9	-	98.6	85.5
Stockton-on-Tees Eaglescliffe	-	97.4	96.0	96.2	-	-	96.5
Stoke-on-Trent Centre	-	97.1	74.5	98.4	98.6	-	92.2
Storrington Roadside	-	95.5	97.8	99.4	-	-	97.6
Sunderland Silksworth	-	-	64.1	98.9	98.0	69.8	82.7
Thurrock	-	97.9	-	97.2	97.4	97.2	97.5
Walsall Woodlands	-	-	-	96.6	97.0	-	96.8
Warrington	-	98.1	99.3	95.2	-	-	97.5
Weybourne	-	-	-	-	100.0	-	100.0
Wicken Fen	-	-	-	85.6	98.5	93.3	92.5

Site	CO	PM_{10}	PM_{25}	NO_2	O_3	SO_2	
Wigan Centre	-	-	99.3	99.5	98.8	-	99.2
Wirral Tranmere	-	-	97.3	0.0	0.0	-	32.4
Yarner Wood	-	-	-	92.0	87.2	-	89.6
York Bootham	-	91.9	96.1	-	-	-	94.0
York Fishergate	-	99.3	95.9	99.1	-	-	98.1
Number of sites	11	40	51	78	54	30	85
Number of sites < 90%	1	13	13	20	9	9	29
Network Mean (%)	91.4	86.9	89.2	88.9	90.4	88.5	89.0

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

Barnsley Gawber

Following the service on 18 July, the analysers were configured incorrectly resulting in loss of data up to 30 July.

Birmingham Acocks Green

The ozone analyser suffered a blockage resulting in anomalously high readings from 24 July; this was corrected at the service on 13 August. However, the flow fault continued up to 29 August.

Birmingham Tyburn Roadside

The PM_{10} analyser performed poorly on a number of occasions during the quarter. Unstable data from 3 to 19 July was eventually cured by cleaning the reference filter holder and changing the filters. However, following the service on 8 August, instability continued, despite replacement of the drier on 20 August. Further filter and v-seal replacements eventually resulted in acceptable data on 7 September.

The $PM_{2.5}$ analyser also proved unreliable, with intermittent faults from 1 July to 6 August, when ESU intervention at the service resulted in the fault condition becoming continuous. Data have been deleted from 8 to 26 August.

Blackpool Marton

The ESU found the bypass on the FDMS disconnected from the splitter unit at the service on 11 October. It is likely this occurred at the QA/QC audit on 15 August; data between these dates have been deleted.

Bury Roadside

The site was closed on 6 September in anticipation of relocation.

Carlisle Roadside

The site experienced unstable PM_{10} measurements followed by a power cut at the end of July. The PM_{10} remained unstable following restoration of power resulting in approximately 12 days PM_{10} data. Further data loss resulted from air conditioning problems soon after rectification of the PM_{10} problem

Coventry Memorial Park

Following a prolonged period of problems with the FDMS analyser, the $PM_{2.5}$ data remained unstable and noisy and have been deleted for the entire quarter. Repairs had been delayed by site access problems. In addition, an instrument fault with the NOx analyser resulted in substantial data loss.

Eastbourne

Poor quality PM_{10} data from 7-23 July have been deleted. In addition, the NOx analyser suffered an ozone generator failure resulting in the loss of 11-20 September.

Glazebury

A fault with the NOx onboard computer and motherboard prevented communication of data from the instrument; problems with communications equipment resulted in the loss of data from 19 July to 16 August. A central processor fault on the ozone analyser on 28 August resulted in data loss up to analyser replacement on 10 September.

Great Dun Fell

It was noticed that the ozone concentrations were unexpectedly low during the period. Investigations revealed that the design and construction of the inlet manifold was inappropriate, allowing high losses of ozone. This was rectified by the ESU on 7 September, when concentrations immediately returned to expected levels. A total of 68 days data were deleted.

Leamington Spa Rugby Road

The $PM_{2.5}$ analyser has persistently performed poorly, following on from problems in the previous quarter. This was not helped by temperature instability within the hut. Data have been deleted from 27 July to 8 August and from 23 August to 30 September.

Leominster

The SO_2 analyser developed a photomultiplier fault on 27 July, although the analyser was removed from the network at the service on 7 August as part of the SO_2 reduction programme.

Liverpool Queens Drive Roadside

A suspected sampling fault caused by a damaged inlet filter holder resulted in the loss of NOx data from 1 July to 4 February 2013.

Lullington Heath

The SO_2 analyser had a UV lamp fault and blocked zero/span valves; data from 1 to 23 July have been deleted.

Newcastle Centre

The CO analyser suffered an unspecified fault from 14 July to 7 August, resulting in flat data. The analyser was repaired but removed on 15 August as part of the CO reduction programme. Some NOx data were also lost due to a sampling fault.

Nottingham Centre

The Nottingham PM_{10} analyser shows an elevated baseline, and showed poor agreement with the $PM_{2.5}$; most of the PM_{10} data for this quarter have been deleted up to the dryer change on 6 September.

Northampton

The site was relocated on 9 July, but the ozone analyser had a lamp fault from 30 June. The loss of these few days means a data capture of only 6%.

Northampton Kingsthorpe

The Northampton site was relocated on 9 July; however the SO_2 analyser was deaffiliated a short time later and so only a few days' data are available.

Oxford St Ebbes

The site suffered from several power cuts during the quarter. Some NOx data was unstable, possibly due to instrument faults, and have been deleted.

Reading New Town

The PM_{10} volatile concentrations had been gradually rising up to a drier change on 7 September. This analyser also suffered a valve leak and low pump vacuum during the quarter.

Rochester Stoke

Data from all analysers were lost from 11 to 31 August as the analysers were turned off due to air conditioning faults. Additional NOx data were lost following restoration of power as the permeation tube had contaminated internal surfaces of the analyser.

Salford Eccles

The NOx analyser suffered an unspecified fault from 19 September to 17 October; data have been deleted.Some PM_{10} data in July have also been deleted due to anomalous volatile concentrations. The SO_2 suffered pump failure resulting in the loss of data.

Sandy Roadside

Ongoing poor performance of the FDMS analysers resulted in the loss of some data from both instruments; problems persist into the fourth quarter.

Scunthorpe Town

The PM_{10} FDMS analyser suffered from excessively high sample dewpoints and volatile concentrations; data from 7 August to 25 September have been deleted. The analyser was turned off on 28 August, and following repair, the software had been deleted. A fault with the SO_2 analyser also contributed to data loss.

Sheffield Centre

At the winter 2013 audit, it was found that the converter efficiency was 128%. At the subsequent service, the converter factor setting on the analyser was found to be incorrect. As concentrations of NO_2 appear to be elevated sinve July, data have been deleted from the service on 10 July up to the next service on 15 July 2013.

Stanford-le-Hope Roadside

The PM_{10} FDMS analyser suffered a broken mass transducer, resulting in data loss from 17 August to 13 September. In addition, a callout on 5 October found the sample manifold fan had been switched off; NOx data from 13 September have been lost.

Sunderland Silkworth

The SO_2 analyser suffered from a flow fault from 1 to 6 July when the ESU reset the instrument. The analyser was then accidentally removed from site as part of the SO_2 and CO reduction programme; however this was reinstalled on 29 August. Following a power cut on 24 September, the analyser became unstable, and a repair was not possible due to health & safety restrictions caused by a further roof leak.

The $PM_{2.5}$ analyser had been identified as having an elevated baseline and data have been deleted from 1 May up to drier replacement on 31 July.

Wirral Tranmere

Following concerns about anomalously high concentrations on NO_2 at Wirral Tranmere, investigations revealed the NOx and O_3 analysers were partly sampling internal air due to inadequate sealing of the inlet manifold. All NOx and O_3 data have been deleted from May 2010.

Yarner Wood

The NOx data was stuck on full scale from 20-27 July, and ozone data flat from June until 10 July, when a hotspare analyser was installed.

4.3 Scotland

4.3.1 Data Capture

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

Table 4.3: Data Capture July-September 2012: Scotland

Site	CO	PM_{10}	PM_{25}	NO_2	O_3	SO_2	
Scotland							
Aberdeen	-	89.0	90.4	96.2	99.6	-	93.8
Aberdeen Union Street Roadside	-	-	-	93.5	-	-	93.5
Auchencorth Moss	-	98.9	98.9	-	97.8	-	98.5
Auchencorth Moss PM_{10} PM_{25} (FDMS)	-	96.2	94.5	-	-	-	95.4
Bush Estate	-	-	-	93.6	98.7	-	96.1
Dumbarton Roadside	-	-	-	0.0	-	-	0.0
Dumfries	-	-	-	95.6	-	-	95.6
Edinburgh St Leonards	97.3	19.9	19.5	97.1	83.8	97.2	69.1
Eskdalemuir	-	-	-	99.5	99.8	-	99.6
Fort William	-	-	-	92.8	95.2	-	94.0
Glasgow Centre	98.3	94.9	95.8	98.3	98.4	98.2	97.3
Glasgow Kerbside	-	55.5	76.1	92.8	-	-	74.8
Grangemouth	-	87.0	94.2	95.6	-	99.7	94.1
Grangemouth Moray	-	-	-	94.6	-	-	94.6
Inverness	-	95.7	83.7	99.6	-	-	93.0
Lerwick	-	-	-	-	99.5	-	99.5
Peebles	-	-	-	99.4	87.6	-	93.5
Strath Vaich	-	-	-	-	92.8	-	92.8
Number of sites	2	8	8	14	10	3	18
Number of sites < 90%	0	4	3	1	2	0	3

Site	CO	PM_{10}	PM_{25}	NO_2	O_3	SO_2	
Network Mean (%)	97.8	79.6	81.6	89.2	95.3	98.4	87.5

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

Dumbarton Roadside

As a result of insufficient calibrations or filter changes having being carried out since March, all NOx data from 22 March have been deleted.

Edinburgh St Leonards

As reported in the April-June report, the $PM_{2.5}$ and PM_{10} volatile drifted upwards from May onwards up to drier replacement in September, becoming significantly higher than other local sites. Data from both instruments have been deleted from June to September. In addition, an ozone lamp fault was attended to in July, but the fault was not rectified, resulting in the power supply being replaced, eventually repaired on 26 July.

4.4 Wales

4.4.1 Data Capture

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

Table 4.4: Data Capture July-September 2012: Wales

Site	CO	PM_{10}	PM_{25}	NO_2	O_3	SO_2	
Wales							
Aston Hill	-	-	-	98.3	98.5	-	98.4
Cardiff Centre	96.3	94.3	74.5	96.0	97.3	96.6	92.5
Chepstow A48	-	99.1	99.3	91.6	-	-	96.6
Cwmbran	-	-	-	80.3	83.4	-	81.8
Mold	-	-	-	99.7	93.7	-	96.7
Narberth	-	96.7	-	77.2	97.3	97.1	92.1
Newport	-	97.4	95.5	95.5	-	-	96.1
Port Talbot Margam	97.7	96.7	98.1	98.1	98.1	98.0	97.8
Port Talbot Margam PM_{10} $PM_{2.5}$ (Partisol)	-	98.9	-	-	-	-	98.9
Swansea Roadside	-	95.8	95.2	98.4	-	-	96.5
Wrexham	-	83.7	97.8	99.4	-	99.6	95.1
Number of sites	2	8	6	10	6	4	11
Number of sites < 90%	0	1	1	2	1	0	1
Network Mean (%)	97.0	95.3	93.4	93.4	94.7	97.8	94.8

Shaded boxes indicate data capture < 90%

Data captures shown in **bold** indicate that the data are provisional and subject to further quality control.

4.4.2 Site Specific Issues

Cwmbran

A fault with the site power supply resulted in the loss of all data from 25 July to 9 August.

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 July-September 2012 is given in Table 4.5.

Table 4.5: Data Capture July-September 2012: Ireland

Site	CO	PM_{10}	PM_{25}	NO_2	O_3	SO_2	
Ireland							
Mace Head	-	-	-	-	91.4	-	91.4
N Ireland							
Armagh Roadside	-	90.5	-	96.8	-	-	93.7
Ballymena Ballykeel	-	-	-	-	-	96.1	96.1
Belfast Centre	98.5	95.6	95.9	98.3	98.6	98.4	97.6
Derry	-	11.2	88.8	98.7	98.7	98.4	79.2
Lough Navar	-	99.0	-	-	84.5	-	91.7
Number of sites	1	4	2	3	4	3	5
Number of sites < 90%	0	1	1	0	1	0	1
Network Mean (%)	98.5	74.1	92.3	97.9	93.9	97.6	91.6

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} drier was replaced on 11 July, but the analyser then lost its programming, and collected data were of poor quality and were deleted up to 23 September during ratification.

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 for July-September 2012 or from start date of any new site.

Site	CO	PM_{10}	PM_{25}	NO_2	O_3	SO_2	
Number of sites	23	69	80	120	83	46	138
Number of sites < 90%	2	21	22	29	15	12	41
Network Mean (%)	89.9	86.7	89.1	88.5	91.7	86.5	88.8

Note that many instruments have been removed from the network during this quarter as part of the SO_2 and CO reduction programme. Where data prior to the closure date have been lost, this may have a disproportionate effect on the data capture reported. An example of this is London Westminster, where the loss of 19 days data resulted in 0% data capture for these

species. The analysers removed are listed in Table 4.7; Defra funded instruments were removed in summer 2012, and affiliated instruments on 31 December.

Table 4.7: Analysers removed from Network, 2012

CO	SO_2
Bristol Old Market	Barnsley 12
Bristol St Paul's	Birmingham Acock's Green
Bury Roadside	Bristol St Paul's
Glasgow Centre	Glasgow Centre
Hull Freetown	Leamington Spa
Leicester Centre	Leicester Centre
Liverpool Speke	Leominster
London Bexley	London Cromwell Road 2
London Bloomsbury	London Westminster
London Cromwell Road 2	Newcastle Centre
London Westminster	Northampton
Middlesbrough	Norwich Lakenfields
Newcastle Centre	Salford Eccles
Salford Eccles	Sheffield Centre
Sheffield Centre	Stanford-le-Hope Roadside
Southampton Centre	Sunderland Silksworth
Tower Hamlets Roadside	

5 FDMS Baseline Checks

As part of the QA/QC remit for continuous improvement, an ad hoc study of PM analyser baseline response has been undertaken for the past 2 years. This study has been coordinated following investigations of issues identified both by CMCU during routine operation and by QA/QC unit during the ratification process.

The study initially concentrated on FDMS analysers, examining the baseline profile of the reference channels and the relationship with other neighbouring monitoring stations. It has become clear that, on a daily mean basis, regional reference PM concentrations regularly reach a minimum value that approaches 0 µg/m^3.

With this information, sites where this observation was not true were "zero calibrated" using high efficiency scrubbers installed on the sample inlets. The results of these calibrations have been used to compare against the analyser baseline responses and, in all comparisons, calibration and baseline show excellent agreement.

The tables below provide detail on a selection of zero tests undertaken to date:

Table 5.1 – PM_{10} Analyser Zero Test

	PM_{10} average	PM_{10}. Det Limit	PM_{10} Ref average	PM_{10} Ref Det. Limit
Aberdeen 10-13 July 12	1.8	8.6	-1.3	5.4
Aberdeen 17-21 November 11	1.6	8	-2	5.3
Bristol St Pauls 9-11 November 11	0.4	3.8	-1.3	3.3
Birmingham Tyburn RS 5-10 Apr 12	3.6	4.5	-2.8	4.5
Carlisle 16-18 May 12	-0.1	4.6	-0.8	4.2
Chesterfield 8-11 November 11	7.8	6	-4.5	3.8
Chesterfield QP 17-28 May 12	13	18.1	-6.4	5.6
Derry 25-28 May 12	5.2	6.3	-3.7	4.2
Eaglescliffe 25-28 May 12	3.8	6	na	na
Edinburgh 5-12 June 12	9	9.6	-4.1	11.6
Glasgow Centre 1-4 November 11	2.5	4.2	-2	3.3
Glasgow Kerbside 29 Sep – 4 Oct 11	-2.3	14.3	-0.7	10.9
Glasgow Kerbside 5-12 June 12	-0.1	4.5	-0.2	3.1
Harlington 27-30 August 11	3	4.5	-1.7	3.7
Harlington 3-7 February 12	1.9	9.8	0.3	8.3
Harwell 26-30 August 11	2.9	3.2	-1.8	2.7
Marylebone Road 23-26 September 11	7.4	5	-4.1	4.4
Narberth 24-27 April 12	1	7	12.3	13.5
Newcastle Centre 8-11 May 12	5.1	5	-2.6	4

	PM_{10} average	PM_{10}. Det Limit	PM_{10} Ref average	PM_{10} Ref Det. Limit
Newport St Julian's 5-8 September 11	-1.6	5.4	0.5	3.9
Norwich Lakenfields 24-28 November 11	0.1	5.5	0.6	5.9
Plymouth 21-28 February 12	3.3	4.4	-0.9	3.8
Port Talbot 30 Sep - 3 November 11	1.6	6.9	-1.7	4.8
Salford Eccles 13-16 September 11	1.4	4.2	-0.9	4.5
York Bootham 18-21 October 11	0.1	5.8	-0.3	4.5

Table 5.2 – $PM_{2.5}$ Analyser Zero Test Results

	$PM_{2.5}$ average	$PM_{2.5}$ Det Limit	$PM_{2.5}$ Ref average	$PM_{2.5}$ Ref Det Limit
Harlington 27-30 August 11	0.9	4.3	-1.1	3.2
Harwell 26-30 August 11	2	3.4	-1.8	2.9
Birmingham Tyburn 5-11 July 11	0.8		-0.3	3.8
Birmingham Acocks Green, 5-11 July 11	1		-0.9	3.6
Newport St Julian's 5-8 September 11	-1.6	10.7	0.3	6.3
Salford Eccles 13-16 September 11	10.3	4.8	-5.4	4.5
Marylebone Road 23-26 September 11	1.6	6.4	-0.4	4.3
Port Talbot 30 Sep- 3 Oct 11	0.5	11.6	-0.6	6.6
Glasgow Kerbside 29 Sep - 4 Oct 11	6.1	7.2	-3.9	5.5
York Bootham 18-21 October 11	6.2	6.1	-3.1	6.3
Glasgow Centre 1-4 November 11	0.7	6.8	-1.7	4.7
Chesterfield 8-11 November 11	2.9	4.2	-1.3	3.8
Wigan 9-11 November 11	6.6	5	-4.2	3.8
Bristol St Pauls 9-11 November 11	2.7	6.1	-1.6	3.5
Aberdeen 17-21 November 11	2	8.2	-1.2	4.7
Norwich Lakenfields 24-28 November 11	-0.6	5.9	-0.2	5.5
Harlington 3-7 February 12	3.1	4.3	1.4	4.1
Plymouth 21-28 February 12	-2.1	4.4	0.6	3.3
Birmingham Tyburn RS 5-10 Apr 12	-0.8	4.3	-0.3	4.5
Newcastle Centre 8-11 May 12	1.6	4.3	-0.6	4
Carlisle 16-18 May 12	0.1	5.6	-1	4.6
Chesterfield 17-28 May 12	4.5	12.7	-3.7	8.5
Derry 25-28 May 12	3.1	3.2	-2.3	2.8
Wigan 15-17 May 12	0.3	5.5	-1	5.1
Eaglescliffe 25-28 May 12	2.2	6.1	na	na

The detection limit is calculated by multiplying the standard deviation of the zero calibration by 3.3. Typical results show that a healthy FDMS should have a detection limit of less than 5µgm^{-3}.

Recent European guidance (CEN TS16450) provides a recommendation that zero tests on PM analysers should yield a result no higher than 3 µgm^{-3}, which provides the AURN with a robust performance limit for data ratification.

As the zero calibration and baseline correlation is so strong, QA/QC will be setting up a mechanism for calibration of PM analysers, to coincide with the routine 6 month service exercise. It is likely that this will require careful coordination of LSO CMCU and ESU effort to achieve this cost effectively, so it will not be rolled out until the summer service round.

6 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

Current versions of the LSO calibrations spreadsheet are also available to download from the LSO manual page of the Hub.

Section B Summer 2012 Intercalibration

7 Introduction

During July to September 2012, Ricardo-AEA undertook an intercalibration of 137 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. One site, Lincoln Canwick Road, was not audited due to problems arranging access to the site.

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 Ricardo-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.

8 Scope of Intercalibration Exercise

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

- A "health check" on the production of provisionally scaled data, which is rapidly disseminated to the public soon after collection.
- Identification of poorly performing analysers and infrastructure, together with recommendations for corrective action.
- A measure of network performance, by examining for example, how different NOx analysers around the network respond to a common gas standard. This test checks how "harmonised" UK measurements are; ie that a 200ppb NO_2 pollution episode in 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. FDMS 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 Ricardo-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 Ricardo-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 FDMS 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.

9 Results

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

9.1 National Network Overview

9.1.1 Summary

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

Table 9.1 - Summary of audited analyser performance – 137 UK stations

Parameter	Number of outliers	Number in network	% outliers in total
NOx analyser	20	119	17%
CO analyser	1	23	4%
SO_2 analyser	9	44	20%
Ozone analyser	17	82	21%
FDMS and BAM analysers	2 k_0, 1 flow	58 FDMS PM_{10} 2 BAM PM_{10} 69 FDMS $PM_{2.5}$ 2 BAM $PM_{2.5}$	2%
Gravimetric PM analysers	0 flow	9 PM_{10} 9 $PM_{2.5}$	0%
Total	50	417	12.0%

One of the 137 sites was not in operation at the time of the intercalibration. The site at Saltash had to be removed as a result of site development plans, a replacement in the SW zone was commissioned early in 2013.

A new site at Honiton was established in the spring, while a site to replace Walsall Willenhall was established at Walsall Woodlands. The site at Nottingham was moved to a new position on the university campus and has been renamed Nottingham Kingsthorpe.

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 worse than the previous exercise. At the Winter 2012 intercalibration 11.0% of the analysers in use were identified as outliers.

The procedures used to determine network performance are documented in Ricardo-AEA Work Instructions. These methods are regularly updated and improved and are evaluated by the United Kingdom Accreditation Service (UKAS). Ricardo-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 FDMS k_0 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.

9.1.2 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 9.2. Certified cylinder concentrations are normalised for this purpose as several cylinders are used.

Table 9.2 Audit Cylinder Results

Parameter	Network Mean	Audit reference concentration	Network Accuracy %	%Std Dev
NO	466 ppb	461 ppb	1.1	4.6
NO_2	453 ppb	456 ppb	-0.8	4.9
CO	20.2 ppm	20.0 ppm	0.7	3.7
SO_2	454 ppb	444 ppb	2.3	4.4

- Oxides of Nitrogen.

  A total of 20 outliers (17%) were identified during this intercalibration. This is better than the previous exercise - 19% of the analysers were identified as outliers in the winter exercise.

  There were no converters which fell outside the ±5% acceptance limits. However, there were 6 converters identified where the initial result was outside the ±2% trigger for NO_2 rescaling. Additional testing showed that three 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 nine outliers (18%) were identified at this intercalibration. This is similar to the winter exercise, when 8 analysers were found to be outside the acceptance limits. All m-xylene interference tests were less than 26ppb, compared to 27ppb in winter 2012.

- Ozone

  A total of 17 outliers (13%) were identified during the winter exercise. This is worse than the previous intercalibration, where 11 analysers were found to be outside the ±5% acceptance criterion.

- Particulate Analysers

  Just two calculated k_0 determinations were outside the required ±2.5% of their stated values. This is the same result as the previous exercise.

  One FDMS main flow was found to be outside the ±10% acceptance limits. This is better than the previous exercise; three analysers were identified in the winter. All Partisol analyser total flows were within the acceptance limits.

- Site Cylinder Concentrations

  13 of the 305 site cylinders (4.3%) used to scale ambient pollution data were found to be outside the ±10% acceptance limit, more than the 2.6% identified in the winter.

9.2 London Sites

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

Table 9.3 - Summary of audited analyser performance – London Sites

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

9.3 Scottish Sites

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

Table 9.4 - Summary of audited analyser performance – Scottish Sites

Parameter	Number of outliers	Number in region
NOx analyser	1	14
NOx converter	0	
CO analyser	0	2
SO_2 analyser	1	3
Ozone analyser	2	10
FDMS 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	1	33

9.4 Welsh Sites

The results of the intercomparison for the 10 Welsh sites are summarised below:

Table 9.5 - Summary of audited analyser performance – Welsh Sites

Parameter	Number of outliers	Number in region
NOx analyser	2	10
NOx converter	0	
CO analyser	0	2
SO_2 analyser	2	4
Ozone analyser	1	6
FDMS and BAM analysers	0 k_0, 0 flow	5 FDMS PM_{10} 1 BAM PM_{10} 3 FDMS $PM_{2.5}$ 1 BAM $PM_{2.5}$
Gravimetric PM analysers	0	2 PM_{10} 1 $PM_{2.5}$
Cylinders	1	26

9.5 Northern Ireland Sites (incl. Mace Head)

The results of the intercomparison for the 5 Northern Irish sites and Mace Head are summarised below:

Table 9.6 - Summary of audited analyser performance – Northern Irish Sites

Parameter	Number of outliers	Number in region
NOx analyser	0	3
NOx converter	0	
CO analyser	0	1
SO_2 analyser	0	3
Ozone analyser	0	4
FDMS 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	0	9

9.6 English Sites

The results of the intercomparison for the 87 English sites are summarised below:

Table 9.7 - Summary of audited analyser performance – English Sites

Parameter	Number of outliers	Number in region
NOx analyser	11	77
NOx converter	2	
CO analyser	1	12
SO_2 analyser	6	29
Ozone analyser	12	53
FDMS and BAM analysers	2 k_0, 1 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	10	195

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.

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 13 of the 303 cylinders (~34.3%) used to scale analyser data into concentrations (NO, CO and SO_2) were outside the ±10% acceptance criterion. This is worse than the winter exercise, where 2.6% (8) of the scaling cylinders were outside the acceptance limits. There were eight NO cylinders and five SO_2 cylinders identified as outliers.

In addition, the concentrations of 31 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 44 of the 305 cylinders (14%) were outside the acceptance limits. This is better than the previous intercalibration, where 10% of the total cylinder population (31 in total) were found to be out of specification.

Three of the eight NO cylinders (Camden Kerbside, Chesterfield Roadside and Chepstow A48) appear to have been contaminated; significant oxidation of the NO into NO_2 has occurred since the last intercalibration. The cylinders have been replaced and the performance of the new cylinders will be closely monitored at subsequent audits.

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

11 Site Information

All site information is now uploaded to CMCU and UK-Air archive for dissemination using Google Earth. Ricardo-AEA makes considerable effort in ensuring that site locations are accurate on the new Google Earth site information and UK-Air 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 EN14211:2005 (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. Ricardo-AEA has 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 the table below:

Table 12.1 – Analyser measurement uncertainties

Date	Site	O_3	CO	SO_2	NO_x	NO	PM_{10}*	$PM_{2.5}$*
04-Jul	Barnsley 12			13.4				
04-Jul	Barnsley Gawber	10.7		13.4	10	10		
11-Jul	Bath Roadside				13.5	14		
10-Jul	Billingham				13.5	14		
25-Jul	Birmingham Acocks Green	12.4		13.5	13.5	14		16.4
25-Jul	Birmingham Tyburn	8.7		12.3	11.8	11.8	8.7	16.4
24-Jul	Birmingham Tyburn Roadside	12.4			13.5	14	8.7	16.4
25-Jul	Blackburn Darwen Roadside				10.5	10.5		
15-Aug	Blackpool Marton	10.7			10	10		16.4
25-Jul	Bottesford	10.7						
08-Aug	Bournemouth	12.4			13.5	14		11
30-Jul	Brighton Preston Park	12.4			13.5	14		11
09-Jul	Bristol Old Market				13.5	14		
09-Jul	Bristol St Paul's	12.4	9.7	13.4	13.5	14	8.7	16.4
26-Jul	Bury Roadside		13.9		10.5	10.5	8.7	16.4
01-Aug	Cambridge Roadside				10.5	10.5		
03-Jul	Camden Kerbside				10.5	10.5	8.7	16.4
17-Jul	Canterbury	12.4			13.5	14		
22-Aug	Carlisle Roadside				10.5	10.5	8.7	16.4
01-Aug	Charlton Mackrell	11.8			13.7	14.1		
28-Jun	Chatham Centre Roadside				13.5	14	8.7	16.4
03-Jul	Chesterfield				10.5	10.5	8.7	16.4
03-Jul	Chesterfield Roadside				10.5	10.5	8.7	16.4
27-Jul	Coventry Memorial Park	10.7			10	10		16.4
31-Jul	Eastbourne				13.5	14	8.7	16.4
10-Jul	Exeter Roadside	8.7			11.8	11.8		

Date	Site	O_3	CO	SO_2	NO_x	NO	PM_{10}*	$PM_{2.5}$*
25-Jul	Glazebury	12.4			13.5	14		
14-Aug	Great Dun Fell	12.4						
05-Jul	Haringey Roadside				10.5	10.5	8.7	16.4
16-Aug	Harwell	12.4		13.4	13.5	14	8.7	16.4
16-Aug	Harwell PARTISOL						8	11
15-Aug	High Muffles	12.4			13.5	14		
20-Jun	Honiton				13.5	14		
09-Aug	Horley				10.5	10.5		
22-Aug	Hull Freetown	10.7	11	13.4	10	10	8.7	16.4
04-Jul	Ladybower	12.4		13.4	13.5	14		
23-Jul	Leamington Spa	11.8		12.3	10.5	10.5	8.7	16.4
23-Jul	Leamington Spa Rugby Road				13.5	14		
21-Aug	Leeds Centre	10.7	9.5	13.4	10	10	8.7	16.4
21-Aug	Leeds Headingley Kerbside				13.5	14	8.7	16.4
16-Jul	Leicester Centre	10.7	9.5	13.4	10	10	8.7	16.4
31-Jul	Leominster	12.4		no test	13.5	14		
	Lincoln Canwick Road	Not audited						
13-Aug	Liverpool Queen's Drive Roadside				13.5	14		
14-Aug	Liverpool Speke	10.7	9.5	13.4	10	10	8.7	16.4
28-Jun	London Bexley		9.5	13.4	13.5	14		16.4
26-Jun	London Bloomsbury	12.4	9.5	13.4	13.5	14	8.7	16.4
26-Jun	London Cromwell Road 2		9.5	13.4	13.5	14		
29-Jun	London Eltham	8.7			10.5	10.5	8.7	16.4
27-Jun	London Haringey	8.7			13.5	14		
06-Jul	London Harlington	12.4			13.5	14	8.7	16.4
03-Jul	London Harrow Stanmore							
04-Jul	London Hillingdon	10.7			10	10		
03-Jul	London Marylebone Road	12.4	9.5	13.4	13.5	14	8.7	16.4
03-Jul	London Marylebone						8	11

Date	Site	O_3	CO	SO_2	NO_x	NO	PM_{10}*	$PM_{2.5}$*
	Road PARTISOL							
05-Jul	London N. Kensington	12.4	9.5	13.4	13.5	14	8.7	16.4
05-Jul	London N. Kensington PARTISOL						8	11
25-Jun	London Teddington	12.4			13.5	14		16.4
02-Jul	London Westminster	12.4	9.5	13.4	13.5	14		11
02-Aug	Lullington Heath	12.4		13.6	15.5	15.9		
24-Jul	Manchester Piccadilly	10.7		13.4	10.4	10.4		16.4
24-Jul	Manchester South	12.4			13.5	14		
19-Jul	Market Harborough	10.7			10	10		
11-Jul	Middlesbrough	12.4	9.5	13.4	13.5	14	8.7	16.4
09-Jul	Newcastle Centre	10.7	9.5	13.4	10	10	8.7	16.4
09-Jul	Newcastle Cradlewell Roadside				10.5	10.5		
19-Jul	Northampton Kingsthorpe	8.7			11.8	11.8	8	
31-Jul	Norwich Lakenfields	10.7		13.4	10	10	8.7	16.4
23-Jul	Nottingham Centre	10.7		13.4	10	10	8.7	16.4
09-Aug	Oxford Centre Roadside				10.5	10.5		
09-Aug	Oxford St Ebbes				10.5	10.5	8.7	16.4
10-Jul	Plymouth Centre	10.7			10	10	8.7	16.4
17-Aug	Portsmouth	10.7			11.8	11.8	8.7	16.4
13-Aug	Preston	10.7			10	10		16.4
10-Aug	Reading New Town	10.7			10	10	8.7	16.4
28-Jun	Rochester Stoke	not approved		13.4	13.5	14	8.7	16.4
23-Jul	Salford Eccles	11.8	13.9	11	10.5	10.5	8.7	16.4
03-Aug	Sandy Roadside				13.5	14	8.7	16.4
22-Aug	Scunthorpe Town			13.4	10.5	10.5	8.7	
02-Jul	Sheffield Centre	10.7	9.5	13.4	10	10	8.7	16.4
02-Jul	Sheffield Tinsley				13.5	14		
31-Jul	Sibton	12.4						
07-Aug	Southampton Centre	10.7	9.5	13.4	10	10	8.7	16.4
27-Jun	Southend-on-Sea	10.7			10	10		16.4
24-Jul	Southwark A2 Old				13.5	14	8.7	

Date	Site	O_3	CO	SO_2	NO_x	NO	PM_{10}*	$PM_{2.5}$*
	Kent Road							
04-Jul	St Osyth	10.7			10	10		
04-Jul	Stanford-le-Hope Roadside			13.4	13.5	14	8.7	16.4
10-Jul	Stockton-on-Tees Eaglescliffe				13.5	14	9.3	12.6
26-Jul	Stoke-on-Trent Centre	10.7			10	10	8.7	16.4
09-Aug	Storrington Roadside				10	10	8.7	16.4
10-Jul	Sunderland Silksworth	12.4		11	10.5	10.5		16.4
27-Jun	Thurrock	12.4		13.4	13.5	14	8.7	
02-Jul	Tower Hamlets Roadside		9.5		13.5	14		
25-Jul	Walsall Woodlands	12.4			13.5	14		
20-Jul	Warrington				10.5	10.5	8.7	16.4
30-Jul	Weybourne	not approved						
01-Aug	Wicken Fen	55.6		13.4	13.5	14		
23-Jul	Wigan Centre	12.4			10.5	10.5		
14-Aug	Wirral Tranmere	10.7			10	10		16.4
01-Aug	Yarner Wood	12.4			13.5	14		
20-Aug	York Bootham						8.7	16.4
20-Aug	York Fishergate				10.5	10.5	8.7	16.4
07-Aug	Mace Head	not approved						
15-Aug	Armagh Roadside				13.5	14	8.7	
10-Aug	Ballymena Ballykeel			11				
14-Aug	Belfast Centre	10.7	9.5	13.4	10	10	8.7	16.4
08-Aug	Derry	12.4		13.4	13.8	14.3	8.7	16.4
06-Aug	Lough Navar	12.4					8.7	
06-Aug	Aberdeen	12.4			13.5	14	8.7	16.4
07-Aug	Aberdeen Union Street Roadside				13.5	14		
01-Aug	Auchencorth Moss	12.4					8.7	16.4
01-Aug	Auchencorth Moss PM_{10} PM_{25} (FDMS)						8	11
01-Aug	Bush Estate	12.4			13.5	14		
24-Jul	Dumbarton Roadside				10.5	10.5		

Date	Site	O_3	CO	SO_2	NO_x	NO	PM_{10}*	$PM_{2.5}$*
15-Aug	Dumfries				13.5	14		
31-Jul	Edinburgh St Leonards	12.4	11.1	13.4	13.5	14	8.7	16.4
15-Aug	Eskdalemuir	12.4			13.5	14		
25-Jul	Fort William	12.4			13.5	14		
02-Jul	Glasgow Centre	10.7	9.5	14.1	13.5	14	8.7	16.4
02-Jul	Glasgow Kerbside				10	10	8.7	16.4
26-Jul	Grangemouth			11	10.5	10.5	8.7	16.4
26-Jul	Grangemouth Moray				10.5	10.5		
09-Aug	Inverness				13.5	14	8	11
08-Aug	Lerwick	12.4						
31-Jul	Peebles	12.4			13.5	14		
	Strath Vaich							
31-Jul	Aston Hill	12.4			13.5	14		
11-Jul	Cardiff Centre	12.4	9.5	13.4	13.5	14	8.7	16.4
12-Jul	Chepstow A48				10.5	10.5	8.7	16.4
13-Jul	Cwmbran	10.7			11.8	11.8		
27-Jul	Mold	12.4			13.9	14.4		
09-Jul	Narberth	12.4		13.4	13.5	14	8.7	
13-Jul	Newport				13.5	14	8.7	16.4
10-Jul	Port Talbot Margam	10.7	9.5	13.4	13.5	14	8.7	16.4
10-Jul	Port Talbot Margam PM_{10} $PM_{2.5}$						8	
10-Jul	Swansea Roadside				13.5	14	9.3	12.6
18-Jul	Wrexham			0	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 as best measurement capability (BMC).

The ozone analysers at Rochester Stoke, Mace Head and Weybourne are not CEN compliant models and therefore no generic performance data have been calculated.

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 Ricardo-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 April to September 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. 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
ESUs are reminded of the importance of supplying service records for Partisol samplers to QA/QC Unit.	High	ESU
Zero air scrubbers to be changed for zero air cylinders at all sites (where possible).	Medium	QA/QC ESU
Recommendations August 2008	**Priority**	**Action**
Many sites require modifications to permit safe roof access for measuring PM analyser flows.	High	CMCU
Recommendations January 2008	**Priority**	**Action**
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
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		
ESUs to ensure all NOx converter software settings to be 100%.	High	ESUs to check at service

Appendix 2

Partisol Data: July-September 2012

The data capture from the Partisol samplers are given below:

Site	PM_{10}	PM_{25}	Site Average
England			
Bournemouth	-	95.7	95.7
Brighton Preston Park	-	100.0	100.0
Harwell PARTISOL	93.5	98.9	96.2
London Marylebone Road PARTISOL	94.6	98.9	96.7
London N. Kensington PARTISOL	98.9	85.9	92.4
London Westminster	-	65.2	65.2
Northampton[1]	-	100.0	100.0
Northampton Kingsthorpe[2]	-	81.0	81.0
Scotland			
Auchencorth Moss	98.9	98.9	98.9
Inverness	95.7	83.7	89.7
Wales			
Port Talbot Margam PM_{10}	98.9	-	98.9
Wrexham	83.7	97.8	90.8
Number of sites	7	11	12
Number of sites < 90%	1	4	3
Network Mean (%)	94.9	91.5	92.1

Shaded boxes are for data capture < 90%

1. Northampton up to 09/07/2012
2. Northampton Kingsthorpe,from,09/07/2012

Site Specific Problems

London Westminster

The $PM_{2.5}$ Partisol was off from 9 June to 1 August due to pump failure.

Inverness

The $PM_{2.5}$ Partisol suffered filter exchange faults resulting in the loss of data from 17-31 July.

Site		Audit Summer 2012		Post service	
		Flow Lmin^{-1}	% out from 16.7	Flow Lmin^{-1}	% out from 16.7
Auchencorth Moss	$PM_{2.5}$	16.57	-0.6	16.70	0.2
	PM_{10}	16.44	-1.4	16.64	-0.2
Bournemouth	$PM_{2.5}$	16.04	-3.3	16.35	-2
Brighton Preston Park	$PM_{2.5}$	16.98	2.2	16.68	-0.1
Harwell	$PM_{2.5}$	16.52	0.7	16.62	-0.3
	PM_{10}	15.99	-4.3	16.70	0
Inverness	$PM_{2.5}$	15.84	-5.2	16.78	0.5
	PM_{10}	17.01	3.5	16.73	0.2
London Marylebone Road	$PM_{2.5}$	16.93	1.6	16.70	0
	PM_{10}	16.19	-2.9	16.70	0
London North Kensington	$PM_{2.5}$	16.14	-3.2	16.67	-0.2
	PM_{10}	16.11	-3.4	16.69	-0.1
London Westminster	$PM_{2.5}$	16.31	-2.2	16.65	-0.3
Northampton	$PM_{2.5}$	-	-	16.69	0
Port Talbot Margam	PM_{10}	16.55	-0.7	16.7	0
Wrexham	$PM_{2.5}$	16.39	-1.4	16.54	-0.8
	PM_{10}	18.28	9.7	-	-

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 16.7lmin^{-1}, the data are deleted.

Appendix 3

Site Details

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

Appendix 4

Certificate of Calibration

0401

RICARDO-AEA

CERTIFICATE OF CALIBRATION

Ricardo-AEA, 551.11 Harwell, Didcot, Oxfordshire OX11 0QJ
Telephone 0870 190 6465 Fax 01235 832 262

Certificate Number: 02750
Ricardo-AEA Calibration ID Number: ED57002030

Authorised Signatories: S Eaton
B Stacey

Signed:

Date of Issue: 21 January 2013

Customer Name and Address: Emily Connolly

Science and Evidence Team
Atmosphere and Local Environment (ALE) Programme
Department for Environment, Food and Rural Affairs
Area 5E Ergon House, 17 Smith Square, London, SW1P 3JR

Date of Calibration: July to September 2012

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

The reported expanded uncertainties are 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.

This certificate is issued in accordance with the laboratory accreditation requirements of the United Kingdom Accreditation Service. It provides traceability of measurement to the SI system of units and/or to units of measurement realised at the National Physical Laboratory or other recognised national metrology institutes. This certificate may not be reproduced other than in full, except with the prior written approval of the issuing laboratory.

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1. Northern Ireland Sites (including Mace Head)

Carbon Monoxide

Date Year = 2012						(%)	
14-Aug	Belfast Centre	462	0	0.2	0.995	2.6	2.7

Sulphur Dioxide

Date Year =2012								
10-Aug	Ballymena Ballykeel	4901234	0	2.5	0.779	4.9	4.5	17.9
14-Aug	Belfast Centre	1766	4	2.8	0.979	3.6	3.3	10.3
08-Aug	Derry	1697	0	2.5	1.013	3.7	1.5	1.6

Ozone

Date Year =2012				(ppb)			
14-Aug	Belfast Centre	cm08060038	0	3	1.008	3.2	0.4
08-Aug	Derry	1586	-1	3	1.044	3.1	1.1
06-Aug	Lough Navar	1640	2	3	0.997	3.1	0.9
07-Aug	Mace Head	77086-385	0	3	0.994	3.1	0.4

Oxides of Nitrogen

Date Year =2012							(%)		
15-Aug	Armagh Roadside	NO	1011845	0	2.6	1.222	3.5	3.3	
		NOx		1	4.8	1.238	3.6	3.5	97.9
14-Aug	Belfast Centre	NO	08050074	0	2.8	1.401	4.1	3.7	
		NOx		-1	2.7	1.425	4.2	4.2	98.9
08-Aug	Derry	NO	2130	1	2.6	1.204	3.9	5.2	
		NOx		3	2.6	1.192	5.8	5.6	100.9

Particulate Analysers

Date Year =2012										
15-Aug	Armagh Roadside	PM10	2000	13554	1	-0.1	2.90	2.2	16.06	2.2

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0401

Certificate Number: 02750
Ricardo-AEA Calibration ID Number: ED57002030

Date Year =2012										
14-Aug	Belfast Centre	PM10	24423	14082	1	-0.8	3.03	2.2	15.81	2.2
14-Aug	Belfast Centre	PM25	26565	15435	1	-1.9	3.02	2.2	15.71	2.2
08-Aug	Derry	PM10	2701	15942	1	0.9	3.22	2.2	16.39	2.2
08-Aug	Derry	PM25	21313	10734	1	-1.4	3.02	2.2	16.10	2.2
06-Aug	Lough Navar	PM10	21196	12888	1	0.6	2.96	2.2	15.57	2.2

2. Scottish Sites

Carbon Monoxide

Date Year = 2012						(%)	
31-Jul	Edinburgh St Leonards	159	0	0.8	0.990	4.7	3.1
02-Jul	Glasgow Centre	241	1	0.3	0.901	2.7	2.6

Sulphur Dioxide

Date Year =2012								
31-Jul	Edinburgh St Leonards	84	7	3.8	0.977	3.9	2.1	15.4
02-Jul	Glasgow Centre	1630	5	2.7	1.014	6.6	5.4	20.3
26-Jul	Grangemouth	1211322	3	2.5	0.882	3.1	0.7	17.6

Ozone

Date Year =2012				(ppb)			
06-Aug	Aberdeen	800	1.2	3	1.029	3.1	2.1
01-Aug	Auchencorth Moss	1646	-2	3	1.039	3.1	0.4
01-Aug	Bush Estate	1645	0	3	1.008	3.1	0.4
31-Jul	Edinburgh St Leonards	136	3	3	1.025	3.1	0.7
15-Aug	Eskdalemuir	158	1	3	1.055	3.1	1.5
25-Jul	Fort William	1023	-1	3	1.047	3.1	1.7
02-Jul	Glasgow Centre	cm08060029	1	3	1.074	3.2	1.5
08-Aug	Lerwick	1643	0	3	1.292	3.1	1.2
31-Jul	Peebles	437	1	3	1.026	3.1	1.4
	Strath Vaich	not audited	power	fault			

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Ricardo-AEA Registered Office: Shoreham • Technical Centre • Shoreham-by-Sea • West Sussex, BN43 5FG, UK
Registered in England No: 08229264 • VAT Registration No. GB 144024745

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Telephone 0870 190 6465 Fax 01235 832 262

Certificate Number: 02750
Ricardo-AEA Calibration ID Number: ED57002030

Oxides of Nitrogen

Date Year =2012							(%)		
06-Aug	Aberdeen	NO	2640	3	2.5	1.009	3.5	1.9	
		NOx		7	2.5	0.987	3.5	1.4	101.6
07-Aug	Aberdeen Union	NO	299	2	2.6	1.117	3.5	0.6	
	Street Roadside	NOx		1	2.7	1.110	3.5	0.9	101.9
01-Aug	Bush Estate	NO	2244	0	2.5	0.924	3.5	0.4	
		NOx		-1	2.5	0.919	3.5	0.7	98.2
24-Jul	Dumbarton	NO	1011833	0	2.5	1.072	3.5	1.8	
	Roadside	NOx		0	2.5	1.077	3.5	1.6	98.6
15-Aug	Dumfries	NO	1494	2	2.7	1.335	3.5	0.5	
		NOx		2	2.7	1.330	3.5	0.1	96.8
31-Jul	Edinburgh St	NO	73	-1	2.8	1.186	3.5	0.4	
	Leonards	NOx		-1	3.2	1.152	3.5	0.6	98.8
15-Aug	Eskdalemuir	NO	347	1	2.6	0.865	3.5	0.5	
		NOx		-2	2.5	0.866	3.5	0.4	100.7
25-Jul	Fort William	NO	344	1	2.9	0.941	3.5	0.4	
		NOx		2	2.6	0.951	3.5	0.8	100.4
02-Jul	Glasgow Centre	NO	1713	1	2.7	1.204	3.5	1.3	
		NOx		1	3.0	1.201	3.5	1.1	100.9
02-Jul	Glasgow Kerbside	NO	08050061	1	2.6	1.031	3.5	1.5	
		NOx		2	2.5	1.028	3.5	1.5	100.0
26-Jul	Grangemouth	NO	1011836	-1	2.5	1.053	3.5	0.7	
		NOx		0	2.5	1.062	3.5	0.7	98.7
26-Jul	Grangemouth	NO	1011852	-1	2.6	1.090	3.5	0.6	
	Moray	NOx		0	2.6	1.097	3.5	0.5	99.6
09-Aug	Inverness	NO	1489	0	2.6	1.215	3.5	1.6	
		NOx		1	2.6	1.218	3.5	2.3	101.0
31-Jul	Peebles	NO	2213	2	2.6	1.089	3.5	1.1	
		NOx		2	2.5	1.076	3.5	0.5	99.6

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0401

Certificate Number: 02750
Ricardo-AEA Calibration ID Number: ED57002030

Particulate Analysers

Date Year =2012										
06-Aug	Aberdeen	PM10	24427	11602	1	1.8	**3.05**	**2.2**	**16.75**	**2.2**
06-Aug	Aberdeen	PM25	27368	12094	1	-1.1	**2.97**	**2.2**	**16.66**	**2.2**
01-Aug	Auchencorth Moss	PM10	26039	12906	1	-2.2	2.97	2.2	15.77	2.2
01-Aug	Auchencorth Moss	PM25	26033	13681	1	-2.4	3.07	2.2	15.56	2.2
01-Aug	Auchencorth Moss Partisol	PM10	21550						16.44	2.2
01-Aug	Auchencorth Moss Partisol	PM25	21548						16.57	2.2
31-Jul	Edinburgh St Leonards	PM10	27227	13439	1	-1.8	**3.05**	**2.2**	**16.12**	**2.2**
31-Jul	Edinburgh St Leonards	PM25	27233	16952	1	-0.4	3.07	2.2	16.08	2.2
02-Jul	Glasgow Centre	PM10	27331	10071	1	1.1	**3.15**	**2.2**	**17.12**	**2.2**
02-Jul	Glasgow Centre	PM25	22980	13033	1	-0.8	**3.14**	**2.2**	**16.78**	**2.2**
02-Jul	Glasgow Kerbside	PM10	27344	14737	1	1.1	**3.00**	**2.2**	**16.87**	**2.2**
02-Jul	Glasgow Kerbside	PM25	27337	14956	1	-1.1	**3.02**	**2.2**	**17.10**	**2.2**
26-Jul	Grangemouth	PM10	27228	15778	1	-0.9	3.02	2.2	16.06	2.2
26-Jul	Grangemouth	PM25	27259	13516	1	-1.8	3.04	2.2	15.44	2.2
09-Aug	Inverness	PM10	21255						17.26	2.2
09-Aug	Inverness	PM25	21861						15.81	2.2

3. Welsh Sites

Carbon Monoxide

Date Year = 2012						(%)	
11-Jul	Cardiff Centre	14333	0	0.2	0.990	2.3	3.3
10-Jul	Port Talbot Margam	25	1	0.2	1.007	2.1	1.1

Sulphur Dioxide

Certificate Number: 02750
Ricardo-AEA Calibration ID Number: ED57002030

Date Year =2012								
11-Jul	Cardiff Centre	143419	6	2.6	1.093	3.9	3.0	9.9
09-Jul	Narberth	14896	1	2.5	0.898	3.6	0.4	13.5
10-Jul	Port Talbot Margam	27	1	2.5	0.974	3.9	3.4	0.0
18-Jul	Wrexham	1181	-1	not tested	0.911	not	tested	22.4

Ozone

Date Year =2012				(ppb)			
31-Jul	Aston Hill	144	1	3	1.019	3.1	1.7
11-Jul	Cardiff Centre	14348	-2	3	1.079	3.3	0.9
13-Jul	Cwmbran	2	1	3	1.017	3.3	0.9
27-Jul	Mold	17499	0	3	1.011	3.7	1.3
09-Jul	Narberth	10280	1	3	1.019	3.3	0.6
10-Jul	Port Talbot Margam	29	0	3	1.030	3.3	0.7

Oxides of Nitrogen

Date Year =2012							(%)		
31-Jul	Aston Hill	NO	2302	0	2.6	1.096	3.5	2.7	
		NOx		2	2.7	1.110	3.9	2.4	101.4
11-Jul	Cardiff Centre	NO	14325	0	2.6	1.212	3.5	0.7	
		NOx		1	2.6	1.199	3.5	0.5	101.6
12-Jul	Chepstow A48	NO	1011828	0	2.7	1.363	3.5	0.9	
		NOx		1	2.7	1.373	3.5	0.1	99.4
13-Jul	Cwmbran	NO	1	1	2.5	1.021	3.5	0.9	
		NOx		5	2.5	1.024	3.5	1.2	100.4
27-Jul	Mold	NO	345	1	2.7	1.481	3.5	1.3	
		NOx		1	2.8	1.493	6.0	5.4	98.2
09-Jul	Narberth	NO	14311	-3	2.9	1.764	3.7	3.7	
		NOx		-6	2.9	1.762	3.7	3.3	101.5
13-Jul	Newport	NO	1011829	2	2.5	0.914	3.5	0.9	
		NOx		3	2.5	0.915	3.5	0.8	99.3
10-Jul	Port Talbot	NO	12811	-1	2.5	1.054	3.5	1.3	
	Margam	NOx		3	2.5	1.070	3.5	1.8	99.1
10-Jul	Swansea	NO	16695	1	2.6	1.129	3.5	0.8	

Certificate Number: 02750
Ricardo-AEA Calibration ID Number: ED57002030

Date Year =2012							(%)		
	Roadside	NOx		1	2.6	1.093	3.5	1.3	100.4
18-Jul	Wrexham	NO	1149	0	2.6	0.996	3.5	0.8	
		NOx		1	2.6	1.006	3.5	1.4	95.8

Particulate Analysers

Date Year =2012										
11-Jul	Cardiff Centre	PM10	25499	13601	1	-2.0	analyser	fault	8.99	2.2
11-Jul	Cardiff Centre	PM25	24449	10903	1	-0.8	2.92	2.2	15.78	2.2
12-Jul	Chepstow A48	PM10	27242	14074	1	-0.8	2.99	2.2	15.55	2.2
12-Jul	Chepstow A48	PM25	27223	15899	1	-0.6	2.91	2.2	15.50	2.2
09-Jul	Narberth	PM10	26563	13681	1	-1.4	3.06	2.2	16.64	2.2
13-Jul	Newport	PM10	22589	13687	1	-2.1	**2.82**	**2.2**	**15.60**	**2.2**
13-Jul	Newport	PM25	27252	16436	1	-1.1	2.79	2.2	14.66	2.2
10-Jul	Port Talbot Margam	PM10	27217	13879	1	-0.4	2.97	2.2	15.51	2.2
10-Jul	Port Talbot Margam	PM25	20581	10460	1	-0.9	not	measured	15.39	2.2
10-Jul	Port Talbot Margam Partisol	PM10	1						16.55	2.2
10-Jul	Swansea Roadside	PM10	20072						17.30	2.2
10-Jul	Swansea Roadside	PM25	20071						14.10	2.2
18-Jul	Wrexham	PM10	21224						18.29	2.2
18-Jul	Wrexham	PM25	21011						16.43	2.2

4. London Sites

Carbon Monoxide

Date Year = 2012						(%)	
28-Jun	London Bexley	14871	0	0.2	0.918	2.2	2.4
26-Jun	London Bloomsbury	14330	0	0.2	0.976	2.3	3.8
26-Jun	London Cromwell Road 2	10776	1	0.2	0.959	2.5	3.6
03-Jul	London Marylebone Road	10073	1	0.4	1.000	3.0	3.7
05-Jul	London N. Kensington	19097	0	0.2	0.985	2.2	0.8

Certificate Number: 02750
Ricardo-AEA Calibration ID Number: ED57002030

Date Year = 2012						(%)	
02-Jul	London Westminster	867	0	0.2	1.047	2.9	2.5
02-Jul	Tower Hamlets Roadside	911341	0	0.2	0.962	2.1	1.3

Sulphur Dioxide

Date Year =2012								
28-Jun	London Bexley	14873	3	2.4	0.773	3.6	1.1	8.5
26-Jun	London Bloomsbury	14323	2	2.5	0.983	3.6	0.6	8.8
26-Jun	London Cromwell Rd 2	10779	1	2.5	0.956	3.6	0.4	13.8
03-Jul	London Marylebone Rd	19220	1	2.5	1.032	3.6	1.6	0.0
05-Jul	London N. Kensington	19095	4	2.5	0.980	3.7	1.0	21.1
02-Jul	London Westminster	705	-7	2.8	0.989	3.6	1.4	18.7

Ozone

Date Year =2012				(ppb)			
26-Jun	London Bloomsbury	14907	0	3	1.077	3.3	0.8
29-Jun	London Eltham	1111958	3	3	1.053	3.1	0.4
27-Jun	London Haringey	ml 2010 03	-1	3	1.002	3.3	0.8
06-Jul	London Harlington	107	1	3	0.994	3.1	1.0
04-Jul	London Hillingdon	8060034	0	3	1.044	3.1	1.7
03-Jul	London Marylebone Road	19223	12	3	1.202	3.6	6.6
05-Jul	London N. Kensington	19098	1	3	1.052	3.3	1.0
25-Jun	London Teddington	19191	-1	3	1.043	3.3	1.6
02-Jul	London Westminster	879	1	3	1.004	3.1	0.3

Oxides of Nitrogen

Date Year =2012							(%)		
03-Jul	Camden Kerbside	NO	1011846	0	2.6	1.143	3.5	3.2	
		NOx		3	2.7	1.134	3.5	3.5	99.1
05-Jul	Haringey	NO	1011827	-1	2.5	1.075	3.5	2.2	
	Roadside	NOx		3	3.1	1.093	3.5	1.3	98.2
28-Jun	London Bexley	NO	14870	0	2.6	1.186	3.7	1.7	
		NOx		-3	2.8	1.165	3.5	0.4	98.2
26-Jun	London	NO	14328	1	2.7	1.330	3.5	0.6	

Certificate Number: 02750
Ricardo-AEA Calibration ID Number: ED57002030

Date Year =2012							(%)		
	Bloomsbury	NOx		3	2.9	1.322	3.5	0.9	99.5
26-Jun	London Cromwell	NO	#019204	3	2.5	0.956	3.5	1.0	
	Road 2	NOx		10	2.5	0.953	3.5	1.8	99.9
29-Jun	London Eltham	NO	1011834	-1	2.6	0.985	3.5	1.3	
		NOx		3	2.6	0.996	3.5	1.6	99.2
27-Jun	London Haringey	NO	11392	1	2.7	1.098	3.9	2.2	
		NOx		1	2.7	1.111	3.8	2.2	98.3
06-Jul	London Harlington	NO	1090	1	2.6	1.165	3.8	2.8	
		NOx		1	2.6	1.170	3.8	2.7	99.0
04-Jul	London Hillingdon	NO	8050017	0	2.5	0.995	3.5	0.5	
		NOx		0	2.5	0.996	3.5	0.6	98.4
03-Jul	London	NO	19210	2	2.6	1.215	3.5	0.9	
	Marylebone Road	NOx		3	2.6	1.201	3.5	0.3	99.0
05-Jul	London N.	NO	19096	2	2.6	1.149	3.5	1.1	
	Kensington	NOx		3	2.6	1.173	3.5	0.7	100.9
25-Jun	London	NO	19205	3	2.6	1.205	3.5	1.1	
	Teddington	NOx		8	2.6	1.220	3.5	2.6	99.6
02-Jul	London	NO	523	3	2.6	1.081	5.7	5.7	
	Westminster	NOx		4	2.5	1.001	3.5	2.5	98.9
24-Jul	Southwark A2 Old	NO	1954	7	2.5	0.968	3.5	0.7	
	Kent Road	NOx		7	2.5	0.968	3.5	0.8	97.0
02-Jul	Tower Hamlets	NO	1011838	1	2.6	1.284	3.5	1.0	
	Roadside	NOx		1	2.6	1.281	3.5	0.7	99.5

Particulate Analysers

Date Year =2012										
03-Jul	Camden Kerbside	PM10	21159	11957	1	-0.3	2.98	2.2	16.57	2.2
03-Jul	Camden Kerbside	PM25	21391	12865	1	0.9	3.00	2.2	16.66	2.2
05-Jul	Haringey Roadsid	PM10	10	15190	1	-0.5	3.20	2.2	16.53	2.2
05-Jul	Haringey Roadsid	PM25	2.5	13611	1	-1.4	3.01	2.2	15.88	2.2
28-Jun	London Bexley	PM25	25007	11595	1	0.0	2.90	2.2	16.31	2.2
26-Jun	London Bloomsbury	PM10	24446	13608	1	-1.0	**2.92**	**2.2**	**15.30**	**2.2**
26-Jun	London Bloomsbury	PM25	27240	14532	1	-1.6	**2.97**	**2.2**	**15.65**	**2.2**

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0401

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Date Year =2012										
29-Jun	London Eltham	PM25	2000	13818	1	0.0	2.93	2.2	16.29	2.2
06-Jul	London Harlington	PM10	24902	12231	1	-0.5	2.97	2.2	16.49	2.2
06-Jul	London Harlington	PM25	23959	12796	1	-0.1	2.98	2.2	16.57	2.2
03-Jul	London Harrow Stanmore	PM25	27274	16017	1	-1.4	2.97	2.2	16.47	2.2
03-Jul	London Marylebone Road	PM10	27230	16910	1	-0.2	3.08	2.2	16.18	2.2
03-Jul	London Marylebone Road	PM25	27239	13114	1	2.4	3.25	2.2	17.34	2.2
03-Jul	London Marylebone Road Partisol	PM10	20943						16.19	2.2
03-Jul	London Marylebone Road Partisol	PM25	21221						16.93	2.2
05-Jul	London N. Kensington	PM10	27391	12729	1	0.5	**2.91**	**2.2**	**16.08**	**2.2**
05-Jul	London N. Kensington	PM25	21342	15820	1	0.2	**3.01**	**2.2**	**16.3**	**2.2**
05-Jul	London N. Kensington Partisol	PM10	21015						16.11	2.2
05-Jul	London N. Kensington Partisol	PM25	21019						16.14	2.2
25-Jun	London Teddington	PM25	25023	15583	1	1.4	3.03	2.2	15.79	2.2
02-Jul	London Westminster	PM25	1						16.31	2.2
24-Jul	Southwark A2 Old Kent Road	PM10	2000	14863	1	-1.7	2.96	2.2	15.51	2.2

5. English Sites

Carbon Monoxide

Date Year = 2012						(%)	
09-Jul	Bristol St Paul's	14417	1	0.6	1.026	3.3	0.0
26-Jul	Bury Roadside	911343	0	not tested	0.996	not	tested
22-Aug	Hull Freetown	342	0	0.8	0.976	4.6	2.1
21-Aug	Leeds Centre	1501	0	0.2	1.046	2.2	0.5
16-Jul	Leicester Centre	458	0	0.2	0.962	2.2	2.5
14-Aug	Liverpool Speke	238	0	0.2	1.011	2.4	4.0

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0401

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Date Year = 2012						(%)	
11-Jul	Middlesbrough	204	0	0.2	1.010	2.2	1.1
09-Jul	Newcastle Centre	461	-1	0.2	0.976	2.2	0.4
23-Jul	Salford Eccles	911340	7	1.3	1.512	6.3	1.4
02-Jul	Sheffield Centre	459	0	0.2	0.980	2.3	2.4
09-Jul	Bristol St Paul's	14417	1	0.6	1.026	3.3	0.0

Sulphur Dioxide

Date Year =2012								
04-Jul	Barnsley 12	706	2	2.5	0.814	3.6	1.1	3.5
04-Jul	Barnsley Gawber	08050082	6	2.7	0.882	3.7	1.3	5.0
25-Jul	Birmingham Acocks Green	#019239	3	2.6	1.017	5.1	3.9	13.8
25-Jul	Birmingham Tyburn	EH937000	4	2.6	0.846	3.6	1.5	6.3
09-Jul	Bristol St Paul's	14322	6	2.6	1.078	3.7	1.7	25.8
16-Aug	Harwell	83	23	2.5	0.954	3.6	0.4	13.0
22-Aug	Hull Freetown	1499	5	3.1	2.124	3.8	1.1	17.0
04-Jul	Ladybower	1178	9	2.5	0.902	3.7	3.0	-1.9
23-Jul	Leamington Spa	1111979	-2	2.5	0.973	5.3	4.0	12.9
21-Aug	Leeds Centre	08050084	0	2.6	1.240	3.7	1.0	6.2
16-Jul	Leicester Centre	72	8	2.7	1.015	3.6	0.7	19.3
31-Jul	Leominster	analyser	fault	not	tested			
14-Aug	Liverpool Speke	1765	6	2.6	1.059	4.0	1.4	7.4
02-Aug	Lullington Heath	1179	1	2.5	0.939	5.3	4.5	24.1
24-Jul	Manchester Piccadilly	19216	1	2.5	0.928	3.7	4.4	23.3
11-Jul	Middlesbrough	1660	4	2.6	0.971	3.5	0.5	9.0
09-Jul	Newcastle Centre	345	3	3.9	1.343	4.0	4.8	0.5
19-Jul	Northampton Kingsthorpe	8512250407	1	2.5	0.817	3.9	0.8	2.0
31-Jul	Norwich Lakenfields	12	2	2.5	1.009	3.7	1.0	5.0
23-Jul	Nottingham Centre	1629	1	2.5	0.835	4.2	1.8	15.5
28-Jun	Rochester Stoke	2600	1	not tested	1.032	not	tested	12.2
23-Jul	Salford Eccles	1211323	4	3.8	0.969	4.3	5.0	17.1
22-Aug	Scunthorpe Town	110B-70	49	2.5	0.969	3.7	0.8	4.8
02-Jul	Sheffield Centre	1180	6	2.9	1.669	3.7	1.2	8.3

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0401

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Date Year =2012								
07-Aug	Southampton Centre	343	22	2.5	0.824	3.7	2.4	10.9
04-Jul	Stanford-le-Hope Roadside	20089	2	2.5	0.993	3.8	1.2	11.9
10-Jul	Sunderland Silksworth	1211324	0	2.6	0.894	3.5	0.5	7.2
27-Jun	Thurrock	189	4	2.5	1.006	3.9	1.4	9.9
01-Aug	Wicken Fen	14349	13	2.6	1.106	3.8	1.1	3.4

Ozone

Date Year =2012				(ppb)			
04-Jul	Barnsley Gawber	cm08060030	0	3	1.038	3.1	1.2
25-Jul	Birmingham Acocks Green	#019224	3	3	1.009	3.1	0.5
25-Jul	Birmingham Tyburn	WB6AG7TM	0	3	1.041	3.1	1.8
24-Jul	Birmingham Tyburn Roadside	#019188	1	3	1.029	3.2	4.5
15-Aug	Blackpool Marton	cm08060037	0	3	0.978	3.1	0.6
25-Jul	Bottesford	CM08060022	1	3	0.954	3.3	0.4
08-Aug	Bournemouth	1650	-1	3	1.033	3.3	1.1
30-Jul	Brighton Preston Park	12461	-2	3	0.971	3.1	0.3
09-Jul	Bristol St Paul's	14358	-1	3	1.055	3.2	1.4
17-Jul	Canterbury	#019194	7	3	0.901	3.1	0.9
01-Aug	Charlton Mackrell	1111957	1	3	0.864	3.3	1.7
27-Jul	Coventry Memorial Park	8060044	0	3	1.019	3.2	1.2
10-Jul	Exeter Roadside	horiba	-2	3	1.006	3.1	0.5
25-Jul	Glazebury	14335	-1	3	1.054	3.1	1.5
14-Aug	Great Dun Fell	17496	0	3	1.095	3.2	4.2
16-Aug	Harwell	1648	-1	3	1.068	3.6	2.5
15-Aug	High Muffles	17502	0	3	1.194	3.1	1.2
22-Aug	Hull Freetown	CM08060045	0	3	0.947	3.1	0.5
04-Jul	Ladybower	1651	-1	3	0.964	3.1	0.9
23-Jul	Leamington Spa	#0411770	-1	3	0.974	3.1	2.5
21-Aug	Leeds Centre	CM08060036	0	3	1.235	3.1	0.5
16-Jul	Leicester Centre	8060020	0	3	1.040	3.3	1.3
31-Jul	Leominster	170	2	3	0.980	3.1	1.2

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0401

Certificate Number: 02750
Ricardo-AEA Calibration ID Number: ED57002030

Date Year =2012				(ppb)			
14-Aug	Liverpool Speke	CM08060041	0	3	0.978	3.1	1.1
02-Aug	Lullington Heath	1644	-1	3	1.046	3.1	1.1
24-Jul	Manchester Piccadilly	8060039	0	3	0.993	3.1	0.9
24-Jul	Manchester South	16954	-2	3	1.016	3.1	0.7
19-Jul	Market Harborough	CM08060031	0	3	1.027	3.1	1.1
11-Jul	Middlesbrough	944	0	3	0.995	3.1	0.7
09-Jul	Newcastle Centre	CM08060033	0	3	0.984	3.1	0.6
19-Jul	Northampton Kingsthorpe	47R76STR	1	3	0.965	3.1	0.4
31-Jul	Norwich Lakenfields	10	0	3	1.045	3.3	0.3
23-Jul	Nottingham Centre	CM08060032	1	3	0.964	3.3	0.5
10-Jul	Plymouth Centre	8060027	-1	3	1.022	3.2	0.7
17-Aug	Portsmouth	cm08060023	-1	3	0.976	3.3	0.4
13-Aug	Preston	CM08060042	0	3	1.019	3.1	0.4
10-Aug	Reading New Town	cm08060025	0	3	0.984	3.2	1.4
28-Jun	Rochester Stoke	378	0	3	1.027	3.1	0.4
23-Jul	Salford Eccles	411771	-3	3	0.756	3.1	1.7
02-Jul	Sheffield Centre	cm08060024	0	3	0.879	3.1	1.2
31-Jul	Sibton	14339	0	3	1.027	3.3	1.0
07-Aug	Southampton Centre	cmo8060021	0	3	1.108	3.5	1.3
27-Jun	Southend-on-Sea	CM08060017	0	3	1.041	3.3	5.5
04-Jul	St Osyth	60035	0	3	0.995	3.3	0.5
26-Jul	Stoke-on-Trent Centre	8060026	0	3	0.960	3.1	1.7
10-Jul	Sunderland Silksworth	436	1	3	1.112	3.1	0.7
27-Jun	Thurrock	221	3	3	1.025	3.1	2.9
25-Jul	Walsall Woodlands	19222	10	3	1.051	3.3	0.7
30-Jul	Weybourne	30	-1	3	0.998	3.3	0.8
01-Aug	Wicken Fen	14345	0	3	1.102	3.3	0.7
23-Jul	Wigan Centre	cm08060018	-1	3	0.995	3.2	3.2
14-Aug	Wirral Tranmere	CM08060040	0	3	1.028	3.2	1.3
01-Aug	Yarner Wood	2437	-2	3	1.049	3.1	1.1

CERTIFICATE OF CALIBRATION

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0401

Certificate Number: 02750
Ricardo-AEA Calibration ID Number: ED57002030

Oxides of Nitrogen

Date Year =2012							(%)		
04-Jul	Barnsley	NO	08050057	1	2.7	1.330	3.5	0.2	
	Gawber	NOx		1	2.7	1.340	3.5	0.7	100.6
11-Jul	Bath Roadside	NO	12758	7	2.6	1.110	3.5	1.0	
		NOx		8	2.7	1.112	3.5	1.2	98.3
10-Jul	Billingham	NO	574	1	2.6	1.167	3.5	0.4	
		NOx		3	3.2	1.181	3.5	0.6	98.6
25-Jul	Birmingham	NO	#019212	0	2.6	1.156	4.7	3.9	
	Acocks Green	NOx		3	2.7	1.198	4.7	3.9	99.6
25-Jul	Birmingham	NO	Y7ACC7MC	1	2.6	1.003	3.5	0.9	
	Tyburn	NOx		1	2.5	1.004	3.5	0.7	99.7
24-Jul	Birmingham	NO	#014324	0	2.7	1.389	3.5	1.4	
	Tyburn Roadside	NOx		-1	2.7	1.383	3.5	0.6	99.3
25-Jul	Blackburn Darwen	NO	204002	0	2.5	1.027	3.5	1.6	
	Roadside	NOx		6	3.6	1.045	3.5	1.0	98.3
15-Aug	Blackpool	NO	08050075	1	2.5	0.966	3.5	1.4	
	Marton	NOx		0	2.5	0.967	3.5	2.0	100.3
08-Aug	Bournemouth	NO	2214	3	2.7	1.186	3.5	1.4	
		NOx		8	3.5	1.197	3.5	1.4	100.9
30-Jul	Brighton Preston	NO	13068	2	2.6	1.208	3.5	0.7	
	Park	NOx		2	2.6	1.212	3.5	0.6	98.0
09-Jul	Bristol Old	NO	10510	1	2.6	1.188	3.5	0.8	
	Market	NOx		2	2.6	1.197	3.5	0.2	100.5
09-Jul	Bristol St Paul's	NO	14353	0	2.7	1.311	3.5	0.5	
		NOx		1	2.7	1.295	3.5	0.7	97.1
26-Jul	Bury Roadside	NO	1011850	0	2.5	1.029	3.6	2.0	
		NOx		4	2.5	1.043	3.5	1.6	102.0
01-Aug	Cambridge	NO	843	0	2.6	1.082	3.5	1.1	
	Roadside	NOx		2	2.6	1.098	3.5	1.1	99.2
17-Jul	Canterbury	NO	11666	1	2.7	1.287	3.5	0.2	
		NOx		3	2.6	1.249	3.5	1.2	101.5
22-Aug	Carlisle	NO	1011849	-1	2.6	0.892	3.5	0.5	
	Roadside	NOx		1	2.5	0.894	3.5	0.1	101.4

Certificate Number: 02750
Ricardo-AEA Calibration ID Number: ED57002030

Date Year =2012							(%)		
01-Aug	Charlton	NO	2120	1	2.5	0.934	3.5	1.1	
	Mackrell	NOx		1	2.5	0.913	4.5	1.8	99.2
28-Jun	Chatham Centre	NO	3393	6	3.4	1.145	3.9	2.6	
	Roadside	NOx		7	3.6	1.152	3.5	0.6	98.9
03-Jul	Chesterfield	NO	1011837	0	2.5	1.000	3.5	0.8	
		NOx		2	2.5	1.009	3.5	0.8	100.5
03-Jul	Chesterfield	NO	1011835	-1	2.6	1.155	3.5	0.1	
	Roadside	NOx		0	2.6	1.160	3.5	0.1	97.9
27-Jul	Coventry	NO	1	-1	2.5	0.903	3.5	1.3	
	Memorial Park	NOx		-2	2.5	0.910	3.5	1.2	99.6
31-Jul	Eastbourne	NO	19209	6	2.8	1.061	3.5	1.2	
		NOx		6	3.2	1.054	3.5	0.8	99.5
10-Jul	Exeter Roadside	NO	horiba	-1	2.6	1.065	3.5	0.5	
		NOx		3	2.6	1.062	3.5	0.5	100.8
25-Jul	Glazebury	NO	14354	0	2.6	1.256	3.5	0.8	
		NOx		9	4.5	1.292	3.5	1.5	98.8
16-Aug	Harwell	NO	79	3	2.7	1.405	3.5	0.4	
		NOx		4	2.9	1.422	3.5	0.8	98.7
15-Aug	High Muffles	NO	12553	1	2.6	1.140	3.5	0.3	
		NOx		5	4.4	1.154	3.5	0.4	99.4
20-Jun	Honiton	NO	19214	0	2.5	1.039	3.5	0.4	
		NOx		4	2.5	1.042	3.5	0.2	101.1
09-Aug	Horley	NO	1401954	0	2.6	1.104	3.5	2.0	
		NOx		4	2.7	1.119	3.5	1.8	99.5
22-Aug	Hull Freetown	NO	50056	1	2.7	1.027	3.5	0.6	
		NOx		1	2.5	1.058	3.5	0.7	99.2
04-Jul	Ladybower	NO	72	0	2.7	1.338	3.5	0.2	
		NOx		1	2.7	1.340	3.5	0.7	96.6
23-Jul	Leamington Spa	NO	1011842	0	2.7	1.382	3.5	2.2	
		NOx		3	2.7	1.405	3.5	1.6	99.7
23-Jul	Leamington Spa	NO	19211	2	2.5	1.007	3.5	1.5	
	Rugby Road	NOx		2	2.5	1.033	3.5	2.0	99.5
21-Aug	Leeds Centre	NO	08050066	2	2.6	1.214	3.5	1.4	
		NOx		2	2.6	1.204	3.5	1.5	99.6
21-Aug	Leeds Headingley	NO	342	0	2.6	1.110	3.5	0.7	

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0401

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Date Year =2012							(%)		
	Kerbside	NOx		1	2.6	1.089	3.5	0.8	98.4
16-Jul	Leicester Centre	NO	8050021	0	2.5	1.023	3.5	1.1	
		NOx		-1	2.6	1.051	3.5	0.8	99.6
31-Jul	Leominster	NO	346	0	2.6	0.966	3.5	0.9	
		NOx		0	2.5	0.969	3.5	0.8	98.1
	Lincoln Canwick Road	NO	not audited						
		NOx							
13-Aug	Liverpool Queen's Drive Roadside	NO	1734	-2	2.8	1.443	3.5	0.4	
		NOx		0	2.8	1.487	3.5	0.5	99.4
14-Aug	Liverpool Speke	NO	08050069	-2	2.5	1.066	3.5	0.4	
		NOx		-2	2.6	1.071	3.5	0.5	101.3
02-Aug	Lullington Heath	NO	2579	0	2.6	1.105	9.6	5.6	
		NOx		1	2.5	1.063	9.1	5.5	98.6
24-Jul	Manchester Piccadilly	NO	8050065	3	2.6	1.083	5.4	5.3	
		NOx		2	2.6	1.137	5.8	5.8	100.5
24-Jul	Manchester South	NO	17311	2	2.5	0.962	3.7	3.9	
		NOx		2	2.5	0.945	3.5	3.0	99.3
19-Jul	Market Harborough	NO	08050068	0	2.5	0.975	3.5	1.7	
		NOx		1	2.5	0.969	3.5	1.5	99.2
11-Jul	Middlesbrough	NO	2287	1	2.6	1.216	3.5	0.5	
		NOx		1	2.7	1.221	3.5	0.4	98.8
09-Jul	Newcastle Centre	NO	08050063	0	2.5	0.966	3.5	3.2	
		NOx		0	2.5	1.015	4.5	3.5	98.7
09-Jul	Newcastle Cradlewell Road	NO	1011853	-1	2.5	0.964	3.5	1.0	
		NOx		1	2.6	0.979	3.5	0.8	98.4
19-Jul	Northampton Kingsthorpe	NO	8ATJ6APR	1	2.7	1.007	3.5	0.7	
		NOx		0	2.7	1.006	3.5	1.0	98.5
31-Jul	Norwich Lakenfields	NO	13	0	2.5	0.976	3.5	1.1	
		NOx		2	2.5	0.968	3.5	1.2	100.8
23-Jul	Nottingham Centre	NO	08050072	1	2.5	0.980	3.5	1.4	
		NOx		0	2.5	0.981	3.5	1.8	100.4
09-Aug	Oxford Centre Roadside	NO	1011844	0	3.3	1.310	3.5	0.4	
		NOx		1	3.0	1.322	3.5	0.7	100.0
09-Aug	Oxford St Ebbes	NO	1011830	0	2.8	1.047	3.5	0.2	
		NOx		2	3.1	1.041	3.5	0.2	100.8

Certificate Number: 02750
Ricardo-AEA Calibration ID Number: ED57002030

Date Year =2012							(%)		
10-Jul	Plymouth Centre	NO	8050062	1	2.4	0.752	3.5	0.9	
		NOx		1	2.4	0.749	3.5	0.6	99.7
17-Aug	Portsmouth	NO	24819	1	2.5	1.019	3.5	0.4	
		NOx		2	2.5	1.020	3.5	0.4	99.6
13-Aug	Preston	NO	08050064	0	2.5	0.978	3.5	0.5	
		NOx		0	2.6	0.979	3.5	0.3	100.4
10-Aug	Reading New	NO	08050059	0	2.5	0.923	3.5	0.3	
	Town	NOx		0	2.5	0.930	3.5	0.5	99.7
28-Jun	Rochester Stoke	NO	3095	1	2.5	0.984	3.5	0.7	
		NOx		1	2.5	0.987	3.5	0.6	98.7
23-Jul	Salford Eccles	NO	1011831	-1	2.6	1.126	3.5	0.5	
		NOx		3	2.6	1.145	3.5	0.6	101.8
03-Aug	Sandy Roadside	NO	18006	10	2.6	1.143	3.5	1.1	
		NOx		10	2.6	1.173	3.5	1.3	94.9
22-Aug	Scunthorpe	NO	1011847	50	3.3	2.359	3.5	1.4	
	Town	NOx		53	3.3	2.377	3.5	1.0	101.8
02-Jul	Sheffield Centre	NO	08050055	0	2.5	0.966	3.5	0.9	
		NOx		0	2.5	0.953	3.5	0.1	98.6
02-Jul	Sheffield Tinsley	NO	847	2	2.6	1.126	3.5	0.5	
		NOx		3	2.8	1.138	3.5	0.8	99.0
07-Aug	Southampton	NO	08030106	0	2.5	0.925	3.5	2.9	
	Centre	NOx		0	2.5	0.926	3.5	2.0	101.6
27-Jun	Southend-on-	NO	08050071	0	2.5	1.045	3.5	0.9	
	Sea	NOx		-2	2.5	1.048	3.5	0.1	98.7
04-Jul	St Osyth	NO	50073	0	2.5	0.927	3.5	1.2	
		NOx		-1	2.5	0.928	3.5	1.5	100.7
04-Jul	Stanford-le-	NO	20093	3	2.6	1.266	3.5	1.3	
	Hope Roadside	NOx		3	2.6	1.267	3.5	1.4	98.2
10-Jul	Stockton-on-Tees	NO	335	1	2.5	1.043	3.5	0.6	
	Eaglescliffe	NOx		1	2.5	1.029	3.5	0.8	100.0
26-Jul	Stoke-on-Trent	NO	8050070	1	2.6	1.132	3.5	1.0	
	Centre	NOx		1	2.6	1.126	3.5	1.3	100.0
09-Aug	Storrington	NO	09040022	-2	2.7	1.319	3.5	2.0	
	Roadside	NOx		-3	2.7	1.364	3.5	1.5	98.5
10-Jul	Sunderland	NO	1011854	-1	2.6	0.991	3.5	1.0	

Certificate Number: 02750
Ricardo-AEA Calibration ID Number: ED57002030

Date Year =2012							(%)		
	Silksworth	NOx		0	3.0	0.991	3.5	0.9	98.7
27-Jun	Thurrock	NO	192	-1	2.6	1.187	3.5	1.0	
		NOx		1	2.6	1.194	3.5	0.6	98.0
25-Jul	Walsall	NO	19213	2	2.5	1.003	3.5	1.8	
	Woodlands	NOx		2	2.5	0.987	3.5	1.6	99.0
20-Jul	Warrington	NO	1011826	-1	2.9	0.926	3.5	1.8	
		NOx		2	5.2	0.938	3.5	2.4	98.1
01-Aug	Wicken Fen	NO	13069	0	2.5	0.957	3.5	0.5	
		NOx		0	2.5	0.953	3.5	0.8	99.7
23-Jul	Wigan Centre	NO	204002c	0	2.5	1.000	3.5	1.1	
		NOx		4	2.5	1.009	3.5	0.6	98.1
14-Aug	Wirral Tranmere	NO	08050060	0	2.5	0.956	3.5	0.8	
		NOx		1	2.6	1.003	3.5	0.8	100.8
01-Aug	Yarner Wood	NO	2627	1	2.5	0.942	3.5	0.4	
		NOx		1	2.5	0.933	3.5	0.8	98.9
20-Aug	York Fishergate	NO	622B-272	0	2.5	1.068	3.5	1.6	
		NOx		3	2.5	1.078	3.5	1.1	98.3

Particulate Analysers

Date Year =2012										
25-Jul	Birmingham Acocks Green	PM25	20203	15414	1	-1.2	2.92	2.2	16.21	2.2
25-Jul	Birmingham Tyburn	PM10	27255	14709	1	-1.6	2.98	2.2	16.53	2.2
25-Jul	Birmingham Tyburn	PM25	21372	14557	1	-0.9	2.91	2.2	16.17	2.2
24-Jul	Birmingham Tyburn Roadside	PM10	26034	12098	1	-2.3	2.91	2.2	16.21	2.2
24-Jul	Birmingham Tyburn Roadside	PM25	2000	13808	1	-1.9	2.97	2.2	16.47	2.2
15-Aug	Blackpool Marton	PM25	24424	12835	1	-0.5	3.06	2.2	16.85	2.2
08-Aug	Bournemouth	PM25	21863						16.12	2.2
30-Jul	Brighton Preston Park	PM25	21865						17.04	2.2
09-Jul	Bristol St Paul's	PM10	24426	13122	1	-0.4	2.99	2.2	16.49	2.2
09-Jul	Bristol St Paul's	PM25	26495	13550	1	-2.7	2.98	2.2	16.11	2.2
26-Jul	Bury Roadside	PM10	27335	16155	1	-0.3	2.82	2.2	15.79	2.2

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0401

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26-Jul	Bury Roadside	PM25	27334	15089	1	0.2	2.93	2.2	15.78	2.2
22-Aug	Carlisle Roadside	PM10	27257	14327	1	-1.1	2.99	2.2	15.86	2.2
22-Aug	Carlisle Roadside	PM25	27320	14918	1	-1.7	2.98	2.2	15.91	2.2
28-Jun	Chatham Centre Roadside	PM10	27271	14586	1	0.4	2.99	2.2	16.51	2.2
28-Jun	Chatham Centre Roadside	PM25	27343	16056	1	0.4	2.95	2.2	16.37	2.2
03-Jul	Chesterfield	PM10	27316	16249	1	-0.5	2.84	2.2	16.32	2.2
03-Jul	Chesterfield	PM25	27314	12466	1	0.3	2.82	2.2	15.88	2.2
03-Jul	Chesterfield Roadside	PM10	22299	11428	1	0.7	2.97	2.2	15.96	2.2
03-Jul	Chesterfield Roadside	PM25	27339	15333	1	-0.6	2.94	2.2	16.27	2.2
27-Jul	Coventry Memorial Park	PM25	26445	14705	1	-1.8	**2.82**	**2.2**	**16.04**	**2.2**
31-Jul	Eastbourne	PM10	2000	14239	1	-1.8	3.22	2.2	17.73	2.2
31-Jul	Eastbourne	PM25	27244	14727	1	-0.7	3.08	2.2	17.09	2.2
16-Aug	Harwell	PM10	27333	14607	1	-2.2	3.00	2.2	15.75	2.2
16-Aug	Harwell	PM25	21366	12199	1	-1.6	3.04	2.2	15.46	2.2
16-Aug	Harwell Partisol	PM10	21257						15.96	2.2
16-Aug	Harwell Partisol	PM25	21859						16.79	2.2
22-Aug	Hull Freetown	PM10	24445	14146	1	0.3	2.99	2.2	15.98	2.2
22-Aug	Hull Freetown	PM25	26498	14055	1	-1.0	3.03	2.2	16.26	2.2
23-Jul	Leamington Spa	PM10	27295	14828	1	-1.1	3.00	2.2	16.63	2.2
23-Jul	Leamington Spa	PM25	27248	14115	1	-0.5	2.97	2.2	16.46	2.2
23-Jul	Leamington Spa Rugby Road	PM10	27205	13801	1	-0.9	2.99	2.2	16.53	2.2
23-Jul	Leamington Spa Rugby Road	PM25	26566	15794	1	-1.5	2.94	2.2	16.48	2.2
21-Aug	Leeds Centre	PM10	24451	13229	1	-1.3	2.70	2.2	15.00	2.2
21-Aug	Leeds Centre	PM25	27254	16841	1	-1.2	3.02	2.2	16.18	2.2
21-Aug	Leeds Headingley Kerbside	PM10	27287	17355	1	-1.3	**2.90**	**2.2**	**16.19**	**2.2**
21-Aug	Leeds Headingley Kerbside	PM25	27249	14554	1	-1.0	**2.86**	**2.2**	**15.92**	**2.2**
16-Jul	Leicester Centre	PM10	24442	14133	1	-2.2	**3.09**	**2.2**	**16.22**	**2.2**
16-Jul	Leicester Centre	PM25	26500	14638	1	-2.2	**3.08**	**2.2**	**16.68**	**2.2**
14-Aug	Liverpool Speke	PM10	24450	15724	1	-0.6	2.96	2.2	15.00	2.2
14-Aug	Liverpool Speke	PM25	28607	14636	1	-1.8	2.98	2.2	14.82	2.2

Certificate Number: 02750
Ricardo-AEA Calibration ID Number: ED57002030

Date Year =2012										
24-Jul	Manchester Piccadilly	PM25	h7353	13882	1	-1.0	2.77	2.2	15.17	2.2
11-Jul	Middlesbrough	PM10	24325	13750	1	-2.7	2.93	2.2	16.49	2.2
11-Jul	Middlesbrough	PM25	27195	15739	1	-1.7	3.00	2.2	17.30	2.2
09-Jul	Newcastle Centre	PM10	24448	13793	1	-0.2	3.16	2.2	16.93	2.2
09-Jul	Newcastle Centre	PM25	24447	14777	1	-0.4	2.81	2.2	16.99	2.2
19-Jul	Northampton	PM25	21013						17.67	2.2
31-Jul	Norwich Lakenfields	PM10	2000	15413	1	-1.9	3.02	2.2	16.50	2.2
31-Jul	Norwich Lakenfields	PM25	27328	15617	1	0.1	2.94	2.2	15.88	2.2
23-Jul	Nottingham Centre	PM10	27369	15391	1	-1.2	2.76	2.2	15.56	2.2
23-Jul	Nottingham Centre	PM25	25025	12051	1	-1.1	3.03	2.2	16.17	2.2
09-Aug	Oxford St Ebbes	PM10	27296	14676	1	-1.0	3.03	2.2	16.37	2.2
09-Aug	Oxford St Ebbes	PM25	27235	16810	1	-2.1	**2.88**	**2.2**	**16.32**	**2.2**
10-Jul	Plymouth Centre	PM10	24428	12172	1	-0.9	3.07	2.2	17.37	2.2
10-Jul	Plymouth Centre	PM25	27221	14136	1	-1.4	2.79	2.2	16.25	2.2
17-Aug	Portsmouth	PM10	7628	17086	1	0.6	2.86	2.2	14.70	2.2
17-Aug	Portsmouth	PM25	21358	18144	1	-2.2	2.91	2.2	14.70	2.2
13-Aug	Preston	PM25	22881	12752	1	-1.6	3.10	2.2	16.14	2.2
10-Aug	Reading New Town	PM10	21315	13082	1	-0.9	2.96	2.2	16.56	2.2
10-Aug	Reading New Town	PM25	25090	13989	1	-1.0	2.92	2.2	17.11	2.2
28-Jun	Rochester Stoke	PM10	27241	14700	1	-1.4	2.92	2.2	16.19	2.2
28-Jun	Rochester Stoke	PM25	27258	15642	1	-1.9	2.97	2.2	16.49	2.2
23-Jul	Salford Eccles	PM10	21168	14588	1	1.2	2.89	2.2	15.77	2.2
23-Jul	Salford Eccles	PM25	27272	14589	1	-0.3	2.81	2.2	15.19	2.2
03-Aug	Sandy Roadside	PM10	22018	11181	1	-1.0	2.83	2.2	15.42	2.2
03-Aug	Sandy Roadside	PM25	27632	16003	1	-0.5	2.83	2.2	14.81	2.2
22-Aug	Scunthorpe Town	PM10	2000	12434	1	-1.8	**3.10**	**2.2**	**3.73**	**2.2**
02-Jul	Sheffield Centre	PM10	25024	12114	1	-1.1	**3.14**	**2.2**	**16.85**	**2.2**
02-Jul	Sheffield Centre	PM25	27253	15560	1	-0.5	**2.94**	**2.2**	**16.54**	**2.2**
07-Aug	Southampton Centre	PM10	24448	13673	1	-1.5	2.96	2.2	16.05	2.2
07-Aug	Southampton Centre	PM25	2000	16433	1	-0.6	2.96	2.2	15.81	2.2

Certificate Number: 02750

Ricardo-AEA Calibration ID Number: ED57002030

Date Year =2012										
27-Jun	Southend-on-Sea	PM25	22927	12675	1	2.0	2.98	2.2	16.56	2.2
04-Jul	Stanford-le-Hope Roadside	PM10	24937	13428	1	-0.1	2.98	2.2	15.85	2.2
04-Jul	Stanford-le-Hope Roadside	PM25	27226	13182	1	1.1	3.06	2.2	16.13	2.2
10-Jul	Stockton-on-Tees Eaglescliffe	PM10	H4554						16.25	2.2
10-Jul	Stockton-on-Tees Eaglescliffe	PM25	H4553						16.48	2.2
26-Jul	Stoke-on-Trent Centre	PM10	25208	12392	1	-0.9	2.79	2.2	15.28	2.2
26-Jul	Stoke-on-Trent Centre	PM25	27262	13417	1	-0.6	2.88	2.2	15.55	2.2
09-Aug	Storrington Roadside	PM10	27236	15563	1	-0.7	3.11	2.2	15.63	2.2
09-Aug	Storrington Roadside	PM25	27229	12719	1	-0.2	3.02	2.2	15.36	2.2
10-Jul	Sunderland Silksworth	PM25	27247	15507	1	-1.9	**2.97**	**2.2**	**16.14**	**2.2**
27-Jun	Thurrock	PM10	27329	13894	1	-1.1	2.98	2.2	16.52	2.2
20-Jul	Warrington	PM10	27426	17271	1	-0.9	2.30	2.2	16.11	2.2
20-Jul	Warrington	PM25	27269	16175	1	-1.1	2.95	2.2	15.06	2.2
23-Jul	Wigan Centre	PM25	27291	14784	1	-0.5	2.88	2.2	15.78	2.2
14-Aug	Wirral Tranmere	PM25	22883	13232	1	-0.5	3.06	2.2	16.20	2.2
20-Aug	York Bootham	PM10	21877	14584	1	-1.0	**2.93**	**2.2**	**15.52**	**2.2**
20-Aug	York Bootham	PM25	27209	16002	1	-1.7	2.93	2.2	15.27	2.2
20-Aug	York Fishergate	PM10	27232	15617	1	-0.5	2.92	2.2	15.47	2.2
20-Aug	York Fishergate	PM25	27348	18058	1	-1.0	2.91	2.2	15.62	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.

Certificate Number: 02750
Ricardo-AEA Calibration ID Number: ED57002030

[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** and held by Ricardo-AEA at the above address. Hard copies are available on request.

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