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QA/QC Data Ratification Report for the Automatic Urban and Rural Network, July-September 2011, and Intercalibration Report, Summer 2011

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

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Executive summary

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

Ratified hourly average data capture for the network averaged 89.8% for all pollutants (O_3, NO_2, SO_2, CO, PM_{10} and $PM_{2.5}$) during the 3-month reporting period July-September 2011. Data capture for all pollutants except PM_{10} and $PM_{2.5}$ were above 90%. There were 45 sites with data capture less than 90% for the period.

The number of monitoring sites in the AURN during this quarter was 135, of which 72 are Local Authority owned sites affiliated to the national network. Some are co-located and separately named gravimetric particulate analysers at sites with automatic analysers. Many affiliated sites have additional Defra-funded analysers installed on site.

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

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Section 1 Data Ratification Report

1 Introduction

This quarterly report covers the Quality Assurance and Control (QA/QC) activities undertaken by AEA to ratify automatic monitoring data from Defra and the Devolved Administrations' urban and rural air quality monitoring network (AURN) for the period July-September 2011. During this period there were 135 operational monitoring sites in the Network of which there are 100 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 63 Defra-funded sites and 72 affiliate sites, although many affiliate sites have fully-funded PM_{10} and/or $PM_{2.5}$ analysers. Eleven sites have non-automatic particulate samplers (Partisols); some of these are collocated with FDMS analysers at Auchencorth Moss, Harwell, London North Kensington and Marylebone Road for both PM_{10} and $PM_{2.5}$.Port Talbot Margam has a Partisol, which was converted from $PM_{2.5}$ to PM_{10} during February 2010.

1.1 Overview of Network Performance

Ratified hourly average data capture for the network averaged 89.8% for all pollutants (O_3, NO_2, SO_2, CO, PM_{10} and $PM_{2.5}$) during the 3 month reporting period July-September 2011 (see Table 1.1). All gaseous pollutants achieved 90% or higher data capture on average. Data capture rates are calculated using the actual data capture as hourly averages (daily for Partisol) against the total number of hours (or days) in the relevant period; service and maintenance are counted as lost data. It is permissible to discount routine service and calibration from achievable data capture targets, but this is not yet calculated. For sites starting or closing, the data capture is based on the actual date starting or closing. Some data remain provisional pending further investigation-see Section 1.3

Table 1.1: AURN Ratified Data Capture (%) by Quarter, 2011

	CO	PM_{10}	$PM_{2.5}$	NO_2	O_3	SO_2	Mean
Q1 2011	95.3	81.1	86.0	93.4	95.2	92.5	90.7
Q2 2011	97.8	86.4	88.4	93.2	96.2	97.1	92.7
Q3 2011	92.3	81.6	84.9	91.9	94.2	92.2	89.8

Overall, 314 out of the 412 analysers (76%) achieved data capture levels above the required 90% target during this reporting period (See Table 1.2), although as stated above, this may be subject to change.

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

Total Number Of Analysers		Q1 Jan-Mar 2011 (No. below 90%)	Q2 Apr-June (No. below 90%)	Q3 July-Sept (No. below 90%)
CO	24	3	1	3
NO_2	117	13	13	20
O_3	82	7	9	11
PM_{10} [1]	68	24	17	28
$PM_{2.5}$ [1]	76	25	19	29
SO_2	46	6	2	7
Total <90%		78	61	98

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

In total,45 out of the 135 operational network sites in the quarter (33.3%) had an average data capture rate below the required 90% level for the July-September 2011 period. This is influenced by the fact that new analysers at existing sites have data capture figures calculated from the start date of the quarter, not from the start of the analyser itself. The main site operational and QA/QC issues giving rise to data capture below the required 90% level are summarised in Section 4.

1.2 Status of Ratified Data

During ratification of the July-September data, a number of issues were discovered which affect data already reported as ratified in previous quarters. As a result, the following data already reported as ratified have been deleted or rescaled, or data previously deleted have been reinstated.

Site	Pollutant	Period	Comments
Birmingham Tyburn RS	$PM_{2.5}$ PM_{10}	Q1-Q2	Reinstate data; minor reprocessing
Blackpool Marton	$PM_{2.5}$	Mid June onwards	Deleted data. Air con problems
Derry	$PM_{2.5}$	March-July	Deleted
Haringey RS	PM_{10}	March-July	Flow 17% out, rescale between services
Newport	PM_{10}	June-July	Leave provisional. August-October deleted.

1.3 Data Remaining Provisional

At the time of writing, a number of sites are undergoing investigations into the quality of data from January-September 2011. Generic data quality issues which result in this are discussed in Section 3.

Birmingham Tyburn $PM_{2.5}$ PM_{10} January-July 2011

Chepstow A48 $PM_{2.5}$ PM_{10} January-June 2011

Glazebury NOx, July-September 2011

Leamington Spa $PM_{2.5}$ PM_{10} Jan-July 2011

London Harlington $PM_{2.5}$ July-September

London Marylebone Road $PM_{2.5}$ July-September

London Teddington $PM_{2.5}$ April-September

Newport $PM_{2.5}$ July-September

Nottingham Centre PM_{10} April-July 2011

Oxford St Ebbes $PM_{2.5}$ January-June 2011

Rochester Stoke PM_{10} $PM_{2.5}$ Jan-Sept 2011

Salford Eccles $PM_{2.5}$ July-September 2011

Sunderland Silkworth $PM_{2.5}$ April-September 2011

Swansea Roadside $PM_{2.5}$ PM_{10} July-September 2011

Thurrock PM_{10} April-September 2011

Wigan Centre $PM_{2.5}$ April-September 2011

York Bootham $PM_{2.5}$ June-September 2011

The results of these investigations will be reported in future quarterly QA/QC reports.

2 Changes in the Network for Directive Compliance

The following analysers were commissioned during the period July-September 2011:

Birmingham Acocks Green	$PM_{2.5}$	26/7/11
Lincoln Canwick Road	NO_2	21/8/11
York Fishergate	$PM_{2.5}$	1/9/11

The Bristol Old Market CO analyser was decommissioned on 15 July 2011 following failure of the instrument.

The Walsall Willenhall site was destroyed by fire on 3 February 2010. A replacement site was commissioned on 14 December 2011.

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 Hepa zero filter over the inlet and leaving for several days. This method does allow the determination of the analyser "zero" but requires a visit by QA/QC staff and the LSO, and therefore it will take time to complete all sites. The findings and implications of these tests will be discussed in future QA/QC reports. Sites affected remain provisional as discussed in Section 1.3.

3.2 Lack of Analyser Calibrations

For a number of sites, there have been no calibrations performed for a significant period of time. In many cases, this is due to a lack of calibration gas, and steps have been taken to alleviate this. In some cases, new LSO staff have taken responsibility for site duties, and have asked for training from the QA/QC Unit; some calibrations were therefore missed. In a limited number of cases, data have been lost as no suitable scaling factors could be determined.

4 Site Specific Issues

In this section, we now discuss in turn specific site issues for sites in the following geographic groupings – London, England (except London), Scotland, N. Ireland and Wales. Note that where analysers were commissioned during the period, the stated data capture for these instruments is calculated from the date of commissioning.

4.1 London

4.1.1 Data Capture

The data capture for sites in London (within the M25) for the period July-September 2011 is given in Table 4.1:

Table 4.1: Data capture for London: July-September 2011

Site	CO	PM_{10}	PM_{25}	NO_2	O_3	SO_2	Site Average
England							
Camden Kerbside	-	93.8	98.4	99.4	-	-	97.2
Haringey Roadside	-	41.5	41.0	41.3	-	-	41.3
London Bexley	95.1	-	96.9	96.7	-	5.9	73.6
London Bloomsbury	98.4	95.9	98.6	98.2	98.6	98.3	98.0
London Cromwell Road 2	98.1	-	-	97.6	-	95.4	97.0
London Eltham	-	-	63.3	99.2	98.5	-	87.0
London Haringey	-	-	-	94.0	99.5	-	96.7
London Harlington	-	92.5	**94.2**	96.2	98.7	-	**95.4**
London Harrow Stanmore	-	-	74.5	-	-	-	74.5
London Hillingdon	-	-	-	94.1	98.7	-	96.4
London Marylebone Road	93.8	93.3	**92.9**	98.0	56.9	55.8	**81.8**
London Marylebone Road PARTISOL	-	**90.2**	**77.2**	-	-	-	**83.7**
London N. Kensington	96.1	92.3	95.0	98.0	93.7	97.6	95.4
London N. Kensington PARTISOL	-	**91.3**	**92.4**	-	-	-	**91.8**
London Teddington	-	-	**88.3**	98.5	98.6	-	**95.1**
London Westminster	98.2	-	**88.0**	98.2	98.2	98.1	**96.2**
Southwark A2 Old Kent Road	-	62.3	-	60.2	-	-	61.3
Tower Hamlets Roadside	91.8	-	-	97.6	-	-	94.7
Number of sites	7	9	13	15	9	6	18
Number of sites < 90%	0	2	6	2	1	2	7
Network Mean (%)	95.9	83.7	84.7	91.2	93.5	75.2	86.5

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 power supply to the site was damaged as a result of civil disorder in the area on 8 August. Power supplies were restored at the end of October.

London Bexley
The SO_2 analyser on site was a loan instrument; however, the calibrations were erratic and unreliable and a total of 87 days data were lost as a result.

London Eltham
The $PM_{2.5}$ sample dewpoint was too high for much of the quarter; data have been deleted from 25 August to 27 September.

London Marylebone Road
The ozone analyser suffered from severe daily drift for much of the quarter; data have been deleted from 3 August to 10 September.

Southwark A2 Old Kent Road
The NOx converter was found to have a fault; data from 10 June to 28 July have been deleted. A power cut resulted in the loss of data from 7 to 15 August. Air conditioning faults occurred frequently during August and September.

4.2 England (excluding London)

4.2.1 Data Capture

The data capture for sites in England for the period July-September 2011 is given in Table 4.2:

Table 4.2 Data Capture July-September 2011: England

Site	CO	PM_{10}	PM_{25}	NO_2	O_3	SO_2	Site Average
England							
Barnsley 12	-	-	-	-	-	98.0	98.0
Barnsley Gawber	-	-	-	98.0	98.0	97.6	97.8
Bath Roadside	-	-	-	98.6	-	-	98.6
Billingham	-	-	-	95.5	-	-	95.5
Birmingham Acocks Green	-	-	76.1	93.1	97.6	97.5	91.1
Birmingham Tyburn	-	**86.0**	**92.3**	99.4	99.4	99.4	**95.3**
Birmingham Tyburn Roadside	-	**75.1**	**97.1**	98.4	98.6	-	**92.3**
Blackburn Darwen Roadside	-	-	-	79.4	-	-	79.4
Blackpool Marton	-	-	0.0	63.7	75.0	-	46.2
Bottesford	-	-	-	-	99.3	-	99.3
Bournemouth	-	-	**92.4**	80.7	99.7	-	**90.9**
Brighton Preston Park	-	-	**85.9**	**98.5**	98.7	-	**94.3**
Bristol Old Market	93.1	-	-	98.4	-	-	95.7
Bristol St Paul's	97.7	43.4	95.5	96.6	97.9	97.0	88.0
Bury Roadside	96.4	84.0	99.2	66.0	-	-	86.4
Cambridge Roadside	-	-	-	98.1	-	-	98.1
Canterbury	-	-	-	98.9	95.2	-	97.1
Carlisle Roadside	-	98.4	99.5	99.2	-	-	99.0
Charlton Mackrell	-	-	-	99.4	78.5	-	88.9
Chatham Centre Roadside	-	96.3	99.5	51.4	-	-	82.4
Chesterfield	-	83.6	98.1	99.6	-	-	93.8
Chesterfield Roadside	-	99.5	93.1	91.8	-	-	94.8
Coventry Memorial Park	-	-	66.8	93.3	98.1	-	86.0
Eastbourne	-	98.5	99.6	32.2	-	-	76.7
Exeter Roadside	-	-	-	99.4	99.8	-	99.6
Glazebury	-	-	-	**90.8**	98.6	-	**94.7**
Great Dun Fell	-	-	-	-	96.2	-	96.2
Harwell	-	90.8	93.2	94.4	97.6	97.2	94.6
Harwell PARTISOL	-	**94.6**	**64.1**	-	-	-	**79.3**
High Muffles	-	-	-	83.0	68.1	-	75.5
Horley	-	-	-	99.0	-	-	99.0
Hull Freetown	97.6	88.0	44.6	95.1	49.6	94.9	78.3
Ladybower	-	-	-	97.3	97.6	97.0	97.3

Site	CO	PM_{10}	PM_{25}	NO_2	O_3	SO_2	Site Average
Leamington Spa	-	99.0	91.0	96.9	98.7	89.3	95.0
Leeds Centre	97.2	93.2	93.8	92.9	97.5	97.3	95.3
Leeds Headingley Kerbside	-	81.8	92.5	94.3	-	-	89.6
Leicester Centre	82.6	89.9	80.6	97.5	97.6	97.3	90.9
Leominster	-	-	-	97.4	98.7	97.9	98.0
Lincoln Canwick Road	-	-	-	**93.4**	-	-	**93.4**
Liverpool Queen's Drive Roadside	-	-	-	97.6	-	-	97.6
Liverpool Speke	98.3	97.7	94.6	94.3	98.4	98.4	97.0
Lullington Heath	-	-	-	98.6	98.7	95.7	97.7
Manchester Piccadilly	-	-	81.8	94.1	98.5	98.4	93.2
Manchester South	-	-	-	98.5	98.6	-	98.6
Market Harborough	-	-	-	93.2	66.0	-	79.6
Middlesbrough	36.9	94.6	**97.6**	98.2	98.6	98.4	**87.4**
Newcastle Centre	98.2	98.7	99.5	98.4	98.5	98.6	98.6
Newcastle Cradlewell Roadside	-	-	-	98.3	-	-	98.3
Northampton	-	-	**97.8**	98.3	98.5	98.4	**98.2**
Norwich Lakenfields	-	45.5	99.1	82.8	98.9	98.5	85.0
Nottingham Centre	-	81.7	**97.2**	93.3	96.0	97.3	**93.1**
Oxford Centre Roadside	-	-	-	98.6	-	-	98.6
Oxford St Ebbes	-	98.5	99.4	88.7	-	-	95.5
Plymouth Centre	-	95.7	97.3	86.7	94.4	-	93.5
Portsmouth	-	97.5	95.5	99.5	99.8	-	98.1
Preston	-	-	79.3	94.2	98.7	-	90.7
Reading New Town	-	78.6	98.6	94.5	98.7	-	92.6
Rochester Stoke	-	**99.0**	**99.8**	94.2	94.3	94.2	**96.3**
Salford Eccles	91.0	85.7	**85.3**	68.2	89.0	83.2	**83.7**
Sandwell West Bromwich	-	-	-	99.6	99.7	99.5	99.6
Sandy Roadside	-	52.9	56.7	81.2	-	-	63.6
Scunthorpe Town	-	91.8	-	99.1	-	99.0	96.6
Sheffield Centre	66.5	56.6	60.5	92.6	97.1	64.6	73.0
Sheffield Tinsley	-	-	-	98.6	-	-	98.6
Sibton	-	-	-	-	99.8	-	99.8
Southampton Centre	97.6	97.4	97.2	97.3	97.6	97.6	97.4
Southend-on-Sea	-	-	92.4	98.6	98.6	-	96.5
St Osyth	-	-	-	80.7	97.5	-	89.1
Stanford-le-Hope Roadside	-	97.3	80.8	98.6	-	94.3	92.7
Stockton-on-Tees Eaglescliffe	-	94.4	92.5	98.6	-	-	95.2
Stoke-on-Trent Centre	-	96.3	92.8	97.3	97.5	-	96.0
Storrington Roadside	-	99.5	99.5	99.0	-	-	99.3
Sunderland Silksworth	-	-	**96.3**	96.5	96.6	68.5	**89.5**
Thurrock	-	90.8	-	96.7	97.2	96.8	95.4
Warrington	-	99.2	99.5	99.8	-	-	99.5
Weybourne	-	-	-	-	100.0	-	100.0
Wicken Fen	-	-	-	96.6	72.1	97.8	88.8
Wigan Centre	-	-	**77.6**	94.5	94.5	-	**88.9**
Wirral Tranmere	-	-	99.7	94.7	98.9	-	97.8
Yarner Wood	-	-	-	46.3	45.3	-	45.8
York Bootham	-	87.9	**90.6**	-	-	-	**89.2**
York Fishergate	-	32.6	96.3	99.6	-	-	76.2

Site	CO	PM_{10}	PM_{25}	NO_2	O_3	SO_2	Site Average
Number of sites	12	39	49	75	53	30	82
Number of sites < 90%	3	16	14	14	8	4	25
Network Mean (%)	87.8	86.5	88.0	92.0	93.5	94.7	91.3

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

Blackburn Darwen Roadside
The Blackburn site suffered an analyser configuration fault (14-19 July) and logger power supply fault (25 July-8 August)

Blackpool Marton
The FDMS suffered from high sample dewpoints ad temperature faults throughout the quarter; data from mid-June to at least the end of September have been deleted. The entire site was switched off on 9 September due to air conditioning failure.

Bristol St Pauls
The PM_{10} FDMS showed gradually rising sample dewpoint up to 14 September when the dryer was replaced. However, pump and shuttle valve problems also contributed to a total loss of 49 days data this quarter.

Bury Roadside
The PM_{10} volatiles were spuriously low in September upon comparison with PM_{25}. The data have been deleted between 8 to 21 September. In addition, the NOx analyser suffered a fault resulting in the data being deleted from 6 July to 4 August.

Norwich Lakenfields
The PM_{10} mass transducer suffered damage at the QA/QC audit on 28 July; a repair was carried out at the workshop and returned to site on 17 August.

Charlton Mackrell
The ozone analyser became noisy around 17 August which necessitated removal to the workshop for detector replacement; 14 days data were lost in total.

Chatham Centre Roadside
The NOx analyser was not reconnected to the sample inlet following audit on 14 July, resulting in the loss of 7 days data. A leak in the sample filter following LSO calibration on 15 August lost a further 8 days. Data were also compromised by a lack of calibrations caused by an empty cylinder for much of the summer, and by incorrect calibration procedures.

Coventry Memorial Park
A suspected dryer fault resulted in an ESU callout on 2 September, but they were unable to fix and the instrument was removed for workshop repair. The instrument had still not been reinstalled as at 31 December.

Eastbourne
The NOx data were deleted up to 18 August as no calibrations had taken place. Calibrations from audits and services were used from this date until 30 September.

Harwell Partisol
There was a faulty seal on the $PM_{2.5}$ Partisol-see Appendix 2 for details

High Muffles
Following a callout for an IZS fault on 7 July, an internal leak was found in the NOx analyser, resulting in a loss of 7 days data. The pump also tripped out 23 September up to callout on 30 September. There are no ozone data between LSO calibrations on 10 August and 7 September.

Hull Freetown
The ozone data were spuriously low between the IZS on 3 August to the ESU service 16 September- data have been deleted. In addition much of the $PM_{2.5}$ data were noisy, and data have been deleted from an ESU callout on 5 August to a further callout on 27 September.

Market Harborough
The ozone data were low between ESU service on 16 August up to the LSO visit on 16 September- data have been deleted.

Middlesbrough
The CO analyser has an intermittent fault causing tha analyser to periodically reboot. An ESU callout on 2 September failed to rectify the fault, and the analyser was removed for workshop repair. Data have been lost from 5 August to 30 September.

Norwich Lakenfields
The PM_{10} FDMS suffered a mass transducer fault during the QA/QC audit on 28 July. The instrument was removed for workshop repair; data to 17 August have been lost. Continuing dewpoint problems resulted in further data loss from 2 to 30 September.

Salford Eccles
Both FDMS units had high sample dewpoints during the quarter. The PM_{10} dryer was replaced on 23 September, and the $PM_{2.5}$ dryer in October. The $PM_{2.5}$ data remain provisional, but significant quantities of data from both analysers have been lost. There were also some gaps in July for all pollutants, possibly due to communications problems.

Sandy Roadside
The FDMS analysers were removed for workshop repair but still performed poorly when reinstalled on site, despite repeated efforts at repair from the ESU. The air conditioning has also been unreliable, and the continuing situation between the landowner and local authority has hampered access. PM_{10} measurements recommenced on 26 July (174 days lost) and the $PM_{2.5}$ on 9 August (40 days lost).

Sheffield Centre
The air conditioning unit failed on 2 September, and all instruments except NOx and O_3 were turned off to prevent damage. Operation recommenced normally on 30 September, although faults with the SO_2 persisted.

Sunderland Silkworth
The SO_2 analyser was unstable and ultimately failed on 12 August; 27 days data were lost.

St Osyth
A number of instrument faults resulted in the loss of NOx data from 2 to 18 August

Wicken Fen
The ozone analyser failed to restart following a power cut on 23 June. The analyser was removed for workshop repair, with measurements restarting on 27 July.

Wigan Centre
The $PM_{2.5}$ FDMS analyser has shown unexpectedly high volatile concentrations for some time compared to other local sites. Investigations are still ongoing.

Yarner Wood
The sample manifold fan was found switched off on 22 September, and faults with both NOx and O_3 analysers (the latter being removed for workshop repair) resulted in significant data loss this period.

York Bootham
The $PM_{2.5}$ data was observed to be higher than the PM_{10} data on several occasions from late May onwards. Data from 29 May to early July have been deleted, and several smaller periods have been deleted.

York Fishergate
York Fishergate was closed from mid February to early March while a new enclosure was installed. The NOx was promptly reinstalled but the PM_{10} and $PM_{2.5}$ FDMS took longer to install (Eventually installed and commissioned 1 September 2011)

4.3 Scotland

4.3.1 Data Capture

The data capture for sites in Scotland for the period July-September 2011 is given in Table 4.3.

Table 4.3 Data Capture July-September 2011: Scotland

Site	CO	PM_{10}	PM_{25}	NO_2	O_3	SO_2	Site Average
Scotland							
Aberdeen	-	97.1	96.7	96.9	96.6	-	96.8
Aberdeen Union Street Roadside	-	-	-	53.1	-	-	53.1
Auchencorth Moss	-	**91.3**	**95.7**	-	98.7	-	**95.2**
Auchencorth Moss PM_{10} PM_{25} (FDMS)	-	77.9	99.3	-	-	-	88.6
Bush Estate	-	-	-	98.4	98.5	-	98.5
Dumbarton Roadside	-	-	-	99.8	-	-	99.8
Dumfries	-	-	-	98.4	-	-	98.4
Edinburgh St Leonards	98.4	98.6	98.4	98.4	98.3	98.1	98.4
Eskdalemuir	-	-	-	86.2	86.6	-	86.4
Fort William	-	-	-	28.7	95.2	-	61.9
Glasgow Centre	97.2	93.3	89.3	97.1	97.4	97.1	95.2
Glasgow Kerbside	-	55.0	96.0	95.8	-	-	82.3
Grangemouth	-	99.4	84.5	98.5	-	92.4	93.7
Grangemouth Moray	-	-	-	98.5	-	-	98.5
Inverness	-	**95.7**	**80.4**	99.5	-	-	**91.9**
Lerwick	-	-	-	-	98.7	-	98.7
Peebles	-	-	-	67.7	94.9	-	81.3
Strath Vaich	-	-	-	-	99.7	-	99.7
Number of sites	2	8	8	14	10	3	18
Number of sites < 90%	0	2	3	4	1	0	6
Network Mean (%)	97.8	88.5	92.5	86.9	96.5	95.9	89.9

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

Aberdeen Union Street Roadside
Data have been deleted from 19 August to 4 October due to spurious data caused by a suspected sampling fault

Auchencorth Moss
The PM_{10} FDMS was removed from site for repair to the valve assembly on 27 May, and was returned to site on 20 July.

Eskdalemuir
There were several problems with communications to the site during the quarter, the largest being 12 days from 29 June.

Fort William
A leak was found in the sample inlet of the NOx analyser; data have been deleted from 26 July to 26 October

Glasgow Kerbside
Noisy and suspiciously low data resulted in a succession of engineers visits. The PM_{10} sensor was ultimately removed for workshop repair. The air conditioning unit has been a particular source of problems during this and previous quarters.

Peebles
High noisy data followed the service on 4 August; 30 days data were lost up to repair on 2 September.

4.4 Wales

4.4.1 Data Capture

The data capture for sites in Wales for the period July-September 2011 is given in Table 4.4.

Site	CO	PM_{10}	PM_{25}	NO_2	O_3	SO_2	Site Average
Wales							
Aston Hill	-	-	-	97.3	96.5	-	96.9
Cardiff Centre	97.3	2.6	21.2	97.1	97.1	78.8	65.7
Chepstow A48	-	83.7	**83.5**	99.3	-	-	**88.8**
Cwmbran	-	-	-	98.2	98.6	-	98.4
Mold	-	-	-	98.0	98.7	-	98.4
Narberth	-	0.0	-	97.5	97.6	94.0	72.3
Newport	-	58.4	**42.3**	96.3	-	-	**65.7**
Port Talbot Margam	98.4	97.4	98.1	98.4	88.3	98.4	96.5
Port Talbot Margam PM_{10} $PM_{2.5}$ (PM_{10} Partisol)	-	**98.9**	-	-	-	-	**98.9**
Swansea Roadside	-	17.9	17.8	98.6	-	-	44.8
Wrexham	-	**31.5**	**95.7**	98.6	-	98.5	**81.0**
Number of sites	2	8	6	10	6	4	11
Number of sites < 90%	0	6	4	0	1	1	6
Network Mean (%)	97.8	48.8	59.8	97.9	96.1	92.4	82.5

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

4.4.2 Site Specific Issues

Cardiff Centre
The PM_{10} FDMS performance was frequently poor during 2011. It was removed for workshop repair again in June, finally being returned to site on 28 September. The $PM_{2.5}$ FDMS was also a source of problems, being out of commission between 20 July and 19 October. Dew point faults persist into the fourth quarter. The SO_2 analyser also suffered a lamp fault, causing 17 days lost data.

Chepstow A48
The PM_{10} data from Chepstow has been unreliable and often below the $PM_{2.5}$ concentrations. Both analysers were removed for extensive workshop repair on 29 June, and reinstalled on 15 July

Narberth
The FDMS PM_{10} analyser proved unreliable during this period, persistently giving negative volatile data. The instrument was removed for workshop repair in August and again in September. As a result, data have been deleted from 1 July to at least 6 October.

Newport
Problems with the FDMS analysers continued during this quarter. The dryer in the PM_{10} was found to be incorrectly installed at the QA/QC audit on 5 August. Data have been deleted from 28 July to 31 August, then again briefly in September. The $PM_{2.5}$ dryer was replaced on 28 July following a period of high dewpoints. Further instability resulted in the loss of data from 12 August to 26 October.

Swansea Roadside
The Swansea Roadside FDMS instruments performed very poorly during the quarter. The instruments were removed for workshop repair by the ESU and the equipment supplier during 2011, and although some improvement was noted, it was short lived and the instruments were ultimately replaced in late 2011.

Wrexham
The PM_{10} Partisol flowrate was more than 10% from the expected flowrate at the audit in August. See Appendix 2 for details.

4.5 Northern Ireland (including Mace Head)

4.5.1 Data Capture

The data capture for sites in Northern Ireland (including Mace Head) for the period July-September 2011 is given in Table 4.5.

Site	CO	PM_{10}	PM_{25}	NO_2	O_3	SO_2	Site Average
Ireland							
Mace Head	-	-	-	-	97.7	-	97.7
N Ireland							
Armagh Roadside	-	93.2	-	98.1	-	-	95.7
Ballymena	-	-	-	-	-	99.8	99.8
Belfast Centre	98.5	46.0	40.9	98.5	97.7	98.4	80.0
Derry	-	98.6	70.9	98.7	97.2	97.0	92.5
Lough Navar	-	84.9	-	-	97.9	-	91.4
Number of sites	1	4	2	3	4	3	6
Number of sites < 90%	0	2	2	0	0	0	1
Network Mean (%)	98.5	80.7	55.9	98.4	97.6	98.4	92.8

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

Belfast Centre
The PM_{10} and $PM_{2.5}$ sampling heads were vandalised on 31 July, resulting in considerable damage to the roof and the analysers themselves. The instruments were removed from site for repair, with measurements recommencing on 21 September; however stability issues persist into the fourth quarter.

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

Metric	CO	PM_{10}	PM_{25}	NO_2	O_3	SO_2	Total
Number of sites	24	68	78	117	82	46	135
Number of sites < 90%	3	28	29	20	11	7	45
Network Mean (%)	92.3	81.6	84.9	91.9	94.2	92.2	89.8

Section 2 Intercomparison Results Summer 2011

5 Introduction

In July to September 2011, AEA undertook an intercalibration of 135 monitoring stations in operation in the Defra and the Devolved Administrations Automatic Urban and Rural Monitoring Network.

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

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

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

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

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

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

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

6 Scope of Intercalibration Exercise

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

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

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

1. Analyser accuracy and precision. These are 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 ko evaluation. The analyser uses this factor to calculate mass concentrations, so the value is calculated to determine its accuracy compared to the stated value.
8. Particulate analyser flow rate checks. These tests ensure that the flow rates through critical parts of the analyser are within specified limits. There are specific analyser flow rates that are set to make sure particle size fractions and mass concentration calculations are performed correctly.
9. SO_2 analyser hydrocarbon interference. This test evaluates the analyser's ability to remove interfering hydrocarbon gases from the sample gas. A failed test could have significant implications for analyser data.
10. Evaluation of site cylinder concentrations. These tests use a set of AEA certified cylinders that are taken to all the sites. The concentrations of the site cylinders are used to scale pollution datasets, so it is important to ensure that the concentrations of gases in the cylinders do not change.
11. Competence of Local Site Operators (LSO) in undertaking calibrations. As it is the calibrations by the LSOs that are used to scale pollution datasets, it is important to check that these are undertaken competently.

Once all data have been collected, a "Network Intercomparison" is conducted. This utilises the audit gas cylinders transported to each site in the Network. These cylinders are recently calibrated by the Calibration Laboratory at AEA, and allow us to examine how different site analysers respond when they are supplied with the same gas used at other sites. For ozone analysers, the calibration is undertaken with recently calibrated ozone photometers.

The technique used to process the intercomparison results is broadly as follows:

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

7 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.

7.1 National Network Overview

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

Table 7.1 - Summary of audited analyser performance – 135 UK stations

Parameter	Number of outliers	Number in network	% outliers in total
NOx analyser	26	118	22%
CO analyser	1	24	4%
SO_2 analyser	14	46	30%
Ozone analyser	9	83	11%
FDMS and BAM analysers	1 k_0, 2 flow	60 FDMS PM_{10} 1 BAM PM_{10} 67 FDMS $PM_{2.5}$ 1 BAM $PM_{2.5}$	2%
Gravimetric PM analysers	1 flow	9 PM_{10} 12 $PM_{2.5}$	5%
Total	54	421	12.8%

The number of analyser outliers identified is very similar to the previous exercise. At the Winter 2011 intercalibration 12.5% of the analysers in use were identified as outliers.

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

7.2 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 7.2. Certified cylinder concentrations are normalised for this purpose as several cylinders are used.

Table 7.2 Audit Cylinder Concentrations

Parameter	Network Mean	Audit reference concentration	Network Accuracy %	%Std Dev
NO	471 ppb	467 ppb	0.8	4.5
NO_2	440 ppb	451 ppb	2.4	4.9
CO	20.3 ppm	20.2 ppm	0.5	2.6
SO_2	141 ppb	135 ppb	4.2	4.9

- Oxides of Nitrogen.

  A total of 26 outliers (22%) were identified during this intercalibration. This is worse than the previous exercise - 17% of the analysers were identified as outliers in the winter exercise.

  Two analysers were unavailable for testing at the audit

  There were five converters which fell outside the ±5% acceptance limits, and a further 4 where the initial result was outside the ±2% trigger for NO_2 rescaling. Additional testing showed that the 5 outlier converters required rescaling to be undertaken.

- Carbon Monoxide

  Just one analyser was identified as an outlier at this intercalibration. Two analysers were outliers at the winter exercise.

  One analyser was unavailable for testing at the audit

- Sulphur Dioxide

  A total of 14 outliers (30%) were identified at this intercalibration. This is worse than the winter exercise, when 16% of the analysers were found to be outside the acceptance limits. All m-xylene interference tests were less than 28ppb.

- Ozone

  A total of nine outliers (11%) were identified during the Summer exercise. This is better than the previous intercalibration, where 16 analysers were found to be outside the ±5% acceptance criterion.

- Particulate Analysers

  Just one single calculated k0 determination was outside the required ±2.5% of their stated values. This is better than the previous exercise - three outliers were identified in the Winter intercalibration

  Two FDMS main flows were found to be outside the ±10% acceptance limits. Four were identified in the winter exercise.
  A single Partisol analyser total flow was outside the acceptance limits.

- Site Cylinder Concentrations

16 of the 306 site cylinders used to scale ambient pollution data were found to be outside the ±10% acceptance limit.

7.3 London Sites

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

Table 7.3 - Summary of audited analyser performance – London Sites

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

7.4 Scottish Sites

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

Table 7.4 - Summary of audited analyser performance – Scottish Sites

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

7.5 Welsh Sites

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

Table 7.5 - Summary of audited analyser performance – Welsh Sites

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

7.6 Northern Ireland Sites (incl. Mace Head)

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

Table 7.6 - Summary of audited analyser performance – Northern Irish Sites

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

7.7 English Sites

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

Table 7.7 - Summary of audited analyser performance – English Sites

Parameter	Number of outliers	Number in region
NOx analyser	16	77
NOx converter	4	
CO analyser	1	12
SO_2 analyser	8	30
Ozone analyser	6	54
FDMS and BAM analysers	1 k_0, 1 flow	38 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	196

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.

8 Site Cylinder Concentrations

During the intercalibration, the concentrations of the on-site cylinders were evaluated using the audit cylinder standards. The calculated results showed that 16 of the 306 cylinders (~5%) 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 3.5% (11) of the scaling cylinders were outside the acceptance limits. There were six NO cylinders and 10 SO_2 cylinders identified as outliers.

In addition, the concentrations of 26 NO_2 cylinders appear to have drifted by more than 10%. NO_2 cylinders are not used for the scaling of data and so will not be replaced at this time. Hence, a total of 42 of the 306 cylinders (14%) were outside the acceptance limits. This is slightly worse than the previous intercalibration, where 13% of the total cylinder population (40 in total) were found to be out of specification.

Three of the six NO cylinders (Armagh, Liverpool Queen's Drive, London Eltham) appear to have been contaminated; a significant oxidation of the NO into NO_2 has occurred since the last intercalibration. These have been replaced and the performance of the new cylinders will be closely monitored at subsequent audits. Liverpool Queen's Drive has again apparently become contaminated – the calibration system will be investigated at the next audit visit.

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

9 Site Information

All site information is now uploaded to CMCU and the AQ archive for dissemination using Google Earth. QA/QC unit make considerable effort in ensuring that site locations are accurate on the new Google Earth site information and http://uk-air.defra.gov.uk/. All future additions to the AURN will include accurate positioning using Google Earth. Site location information is available in links from the AURNHUB and http://uk-air.defra.gov.uk/.

10 CEN

The European Committee for Normalisation (CEN) have prepared a series of documents prescribing how analysers must be operated, to produce datasets that conform to the Data Quality Objectives of the EC Directives. The CEN documents for operation of air pollution analysers; BS EN14211:2005 (NOx), BS EN14212:2005 (SO_2), BS EN14626:2005 (CO) and BS EN14625:2005 (O_3) set out a series of performance criteria for analysers which must be achieved, both in the field and under laboratory conditions. The test requirements have been extensively reported in previous intercalibration summaries and should be referenced for further information.

The CEN operating methodologies are incorporated into the requirements of the air quality Directive 2008/50/EC. Member States had until June 2010 to ensure their monitoring networks are compliant. Older, non-compliant equipment still on site after this date will need to be replaced before June 2013. AEA have taken steps to ensure the procedures used in the UK comply with the requirements ahead of any imposed deadlines. To this end, the procedures used for the intercomparisons have been fully compliant with the CEN protocols since January 2006.

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

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

Table 10.1 – Analyser measurement uncertainties

Date	Site	O_3	CO	SO_2	NO_x	NO
09-Aug	Barnsley 12			13.5		
09-Aug	Barnsley Gawber	10.7		13.4	10	10
08-Aug	Bath Roadside				13.5	14
12-Jul	Billingham				13.5	14
10-Aug	Birmingham Acocks Green	12.4		13.7	13.5	14
17-Aug	Birmingham Tyburn	8.7		13.1	11.8	11.8
17-Aug	Birmingham Tyburn Roadside	12.4			13.5	14
15-Aug	Blackburn Darwen Roadside				13.9	14.4
24-Aug	Blackpool Marton	10.7			10	10
21-Jul	Bournemouth	12.4			13.5	14
02-Aug	Brighton Preston Park	12.4			13.5	14
09-Aug	Bristol Old Market				13.5	14
09-Aug	Bristol St Paul's	12.4	9.5	13.4	13.5	14
15-Jul	Canterbury	12.4			13.5	14
03-Aug	Charlton Mackrell	12.4			13.5	14
14-Jul	Chatham Centre Roadside				13.5	14
10-Aug	Chesterfield Roadside				10.5	10.5
16-Aug	Coventry Memorial Park	10.7			10	10
02-Aug	Eastbourne				13.5	14
11-Aug	Exeter Roadside	8.7			11.8	11.8
15-Aug	Glazebury	12.4			13.5	14
27-Jul	Great Dun Fell	12.4				
16-Aug	Harwell	12.4		14.7	13.5	14
19-Aug	Harwell PARTISOL					
26-Jul	High Muffles	12.4			13.5	14
23-Aug	Hull Freetown	10.7	9.5	13.5	10	10
09-Aug	Ladybower	12.4		13.5	13.5	14
24-Aug	Leeds Centre	10.7	9.5	13.4	10	10
04-Aug	Leicester Centre	10.7			10	10
10-Aug	Leominster	12.4		13.4	13.5	14
23-Aug	Liverpool Queen's Drive Roadside				13.5	14
23-Aug	Liverpool Speke	10.7	9.5	13.5	10	10
06-Jul	London Bexley		9.5	13.5	13.5	14
12-Jul	London Bloomsbury	12.4	9.5	14	13.5	14
07-Jul	London Cromwell Road 2			14.8	13.5	14
19-Jul	London Haringey				13.5	14
07-Jul	London Harlington	12.4			13.5	14
09-Aug	London Hillingdon	10.7			10	10
21-Jul	London Marylebone Road	12.4	9.5	14	13.5	14
14-Jul	London N. Kensington	12.4	9.5	14.6	13.5	14
06-Jul	London Teddington	12.4			13.5	14
06-Jul	London Westminster	12.4	9.5	13.4	13.5	14
01-Aug	Lullington Heath	12.4		13.4	13.5	14
16-Aug	Manchester Piccadilly	10.7		13.5	10	10
16-Aug	Manchester South	12.4			24.3	24.6
02-Aug	Market Harborough	10.7			10	10
13-Jul	Middlesbrough	12.4	9.5	13.4	13.5	14
11-Jul	Newcastle Centre	10.7	9.5	17.5	10	10
11-Jul	Newcastle Cradlewell Roadside				10.5	10.5
11-Jul	Northampton	8.7			11.8	11.8
28-Jul	Norwich Lakenfields	10.7		13.4	10	10
30-Aug	Nottingham Centre	10.7		13.4	10	10
19-Aug	Oxford St Ebbes				10.5	10.5
11-Aug	Plymouth Centre	10.7			10	10
18-Jul	Portsmouth	10.7			11.8	11.8
24-Aug	Preston	10.7			10	10
15-Aug	Reading New Town	10.7			10	10
14-Jul	Rochester Stoke				13.5	14
18-Aug	Sandwell West Bromwich	8.7		13	11.8	11.8
05-Aug	Sandy Roadside				13.5	14
23-Aug	Scunthorpe Town			11.7		
08-Aug	Sheffield Centre	10.7	9.5	15.3	10	10
08-Aug	Sheffield Tinsley				13.5	14
27-Jul	Sibton	12.4				
19-Jul	Southampton Centre	10.7	9.5	13.4	10	10

Date	Site	O_3	CO	SO_2	NO_x	NO
05-Jul	Southend-on-Sea	10.7			10	10
01-Sep	Southwark A2 Old Kent Road				13.5	14
06-Jul	St Osyth	10.7			10	10
05-Jul	Stanford-le-Hope Roadside			13.4	13.5	14
12-Jul	Stockton-on-Tees Eaglescliffe				13.5	14
08-Aug	Stoke-on-Trent Centre	10.7			10	10
01-Aug	Storrington Roadside				10	10
12-Jul	Sunderland Silksworth	12.4				
13-Jul	Thurrock	12.4		15.2	13.5	14
07-Jul	Tower Hamlets Roadside		9.5			
27-Jul	Weybourne	10.7				
26-Jul	Wicken Fen	12.4		13.4	13.5	14
15-Aug	Wigan Centre	10.7				
22-Aug	Wirral Tranmere	10.7			10	10
04-Aug	Yarner Wood	12.4			13.5	14
11-Aug	Armagh Roadside				10.5	10.5
16 Aug	Ballymena			13.5		
22-Aug	Belfast Centre	10.7	9.5	13.6	10	10
15-Aug	Derry	12.4		14.5	13.5	14
09-Aug	Lough Navar	12.4				
01-Jul	Aberdeen	12.4			13.5	14
01-Jul	Aberdeen Union Street Roadside				13.5	14
13-Jul	Auchencorth Moss	12.4				
13-Jul	Bush Estate	12.4			13.5	14
28-Jul	Dumfries				13.5	14
12-Jul	Edinburgh St Leonards	12.4	9.5	13.5	13.5	14
25-Jul	Eskdalemuir	12.4			13.5	14
27-Jul	Fort William	12.4			13.5	14
04-Jul	Glasgow Centre	10.7	11.8	13.8	13.5	14
04-Jul	Glasgow Kerbside				10	10
04-Aug	Inverness				13.5	14
03-Aug	Lerwick	12.4				
12-Jul	Peebles	12.4			13.5	14
04-Aug	Strath Vaich	12.4				
10-Aug	Aston Hill	12.4			13.5	14
26-Jul	Cardiff Centre	12.4	9.5	14.5	13.5	14
28-Jul	Cwmbran	10.7			11.8	11.8
09-Aug	Mold	12.4			13.5	14
27-Jul	Narberth	12.4		13.4	13.5	14
05-Aug	Newport				10.5	10.5
26-Jul	Port Talbot Margam	10.7	9.5	16.2	13.5	14
27-Jul	Swansea Roadside				13.5	14
09-Aug	Wrexham			13.4	13.5	14

This table is updated and extended after every intercalibration to include upgraded sites and replacement analysers. Uncertainty calculations for PM_{10} and $PM_{2.5}$ analysers will be added in due course.

11 Safety

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

The most significant risk to field operators remains safe access to PM sample inlets to perform flow tests. This gains increased importance with FDMS analysers, where meaningful flow tests are impossible if access to the sample inlet cannot be achieved. We have successfully trialled a modified ladder design that does not require ladder restraints. We have rolled this out to all QA/QC field operators and recommended its use to all ESUs and MUs. There are now just a few sites where it is not currently possible to measure flows safely:

Table 11.1 Actions Required for Safe Roof Access

Site	Action required
Coventry Memorial Park	Sloping roof - access not possible
Glasgow Kerbside	Needs new ladder support or railings
Thurrock	Sloping roof - access not possible

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

12 Certification

The Network Certificate of Calibration is presented in Appendix B1. This certificate presents the results of the individual analyser scaling factors on the day of the audit, as calculated by AEA using the audit cylinder standards, in accordance with our ISO17025 accreditation.

13 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 2011.

Appendices

Appendix 1

Recommendations for Upgrade or Replacement of Equipment

As requested by Defra, QA/QC Unit has provided a list of suggestions for equipment that may need replacing or upgrading in the network. The following provides a summary of the outstanding issues to date since July 2005. Recommendations have been prioritised as follows:

Priority	Definition	Time-scale
High*	Immediate action necessary to avoid compromising data capture/quality or safety.	Within 2 weeks
Medium	Essential but not immediate	3-6 months
Low	Desirable but not essential	As appropriate

*Note – QA/QC Unit's practice is to notify CMCU immediately of any high priority issues at the time of the event

Table A1 Recommendations.

	Recommendations February 2012	Priority	Action
32	ESUs are reminded of the importance of supplying service records for Partisol samplers to QA/QC Unit	High	ESU
31	Zero air scrubbers to be changed for zero air cylinders at all sites (where possible)	Medium	QA/QC ESU
	Recommendations August 2008	**Priority**	**Action**
27	Many sites require modifications to permit safe roof access for measuring PM analyser flows	High	CMCU
	Recommendations January 2008	**Priority**	**Action**
25	It is recommended that LSOs continue to pay particular attention to the NO_2 calibration results, to see whether the NO response is significantly higher (>10ppb) than that obtained for the zero calibration. These observations should be reported to CMCU as soon as possible	High	LSO
24	It is strongly recommended that ESUs clean all NOx analyser switching valves during servicing, and ensure the valve is leak checked afterwards. Suspect leaking valves are highlighted by the QA/QC Unit during audits	High	ESU
	Recommendations January 2007		
22	ESUs to ensure all NOx converter software settings to be 100%.	High	ESUs to check at service

Appendix 2

Partisol Data: July-September 2011

A summary of measured flowrates from the summer audit and subsequent ESU service is given in Table A2:

Table A2 Partisol Flowrates, Summer 2011

Site Name		Audit Summer 2011		Post-service	
		Flow $Lmin^{-1}$	% out from 16.7	Flow $Lmin^{-1}$	% out from 16.7
Northampton	$PM_{2.5}$	16.60	0.60	16.65	0.30
Bournemouth	$PM_{2.5}$	16.15	3.29	16.56	0.84
Inverness	$PM_{2.5}$	16.63	0.42	16.00	4.19
	PM_{10}	16.56	0.84	18.80	-12.57
London Westminster	$PM_{2.5}$	17.12	-2.51	16.85	-0.90
Wrexham	$PM_{2.5}$	17.10	-2.40	16.70	0.00
	PM_{10}	19.72	-18.08	16.70	0.00
Brighton Preston Park	$PM_{2.5}$	16.45	1.50	16.70	0.00
Auchencorth Moss	$PM_{2.5}$	17.03	-1.98	16.69	0.06
	PM_{10}	16.55	0.90	16.73	-0.18
Port Talbot Margam PM_{10} $PM_{2.5}$	PM_{10}	17.00	-1.80	16.70	0.00
London Marylebone Road	$PM_{2.5}$	16.47	1.38	16.70	0.00
	PM_{10}	16.65	0.30	16.70	0.00
London N. Kensington	$PM_{2.5}$	16.26	2.63	16.66	0.24
	PM_{10}	16.02	4.07	16.70	0.00
Harwell	$PM_{2.5}$	14.21	14.91	16.63	0.42
	PM_{10}	16.41	1.74	16.28	2.51

Where measured flowrates are >5% from the required 16.7 $lmin^{-1}$ using either audit or service measurements, the measured concentrations are corrected.

In some cases, there have been no service recordsavailable for Partisols, and the ESUs have been requested to ensure these are forwarded to the QA/QC Unit as soon as possible following service.

The major reasons for data loss at sites with Partisol data capture <90% are given in Table A3:

Table A3: Principal Reasons for Data Loss

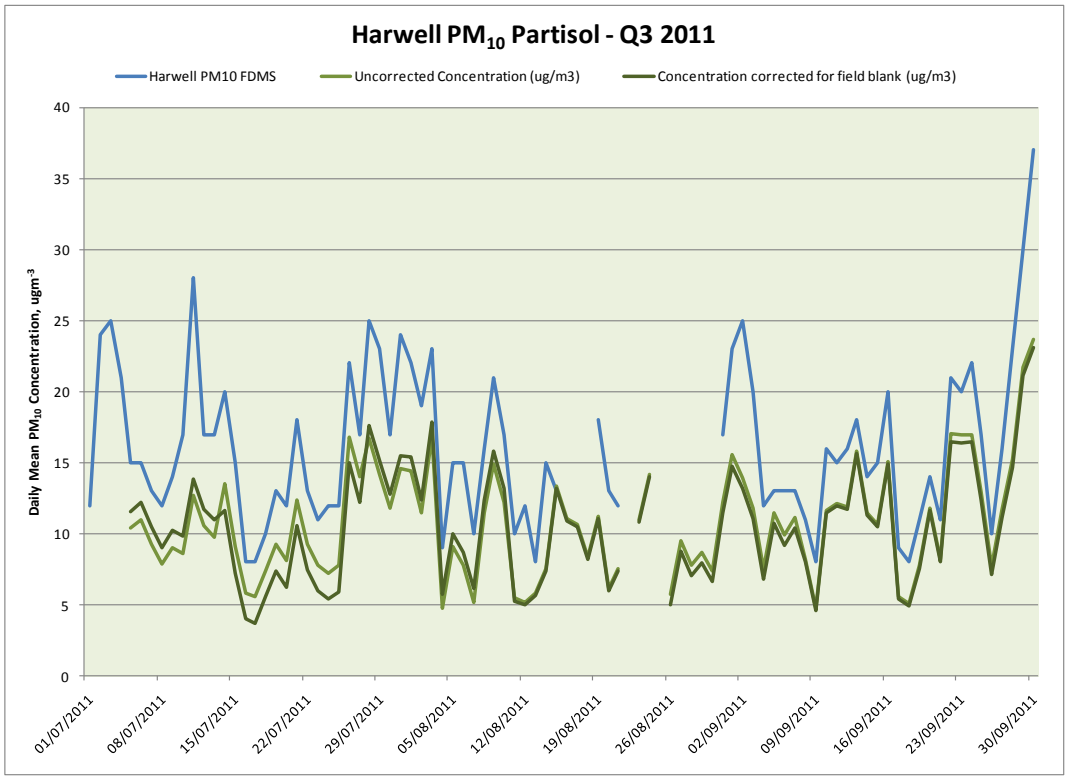
Site	Data capture	Principal reasons for loss
Brighton Preston Park $PM_{2.5}$	85.9%	01-04 Aug: power failure. Time needed re-setting. 13-16 Aug: critical faults, < 18h sampled. 09-14 Sep: Filter exchange fault with split diaphragm replaced by ESU
Harwell $PM_{2.5}$	63.0%	Data deleted from 19 July-23 August due to faulty seal
Inverness $PM_{2.5}$	80.4%	Data lost 31 July to 17 August due to persistent filter exchange faults

Site	Data capture	Principal reasons for loss
London Marylebone Road PM_{10}	84.7%	Filter change delayed 8-13 July Filters exposed twice 4-8 August Error codes halted sampling 9-11 Aug, followed by service
London Marylebone Road $PM_{2.5}$	77.2%	Filter change delayed 8-13 July Filters exposed twice 29 July-10 August, plus repeated filter exchange faults
London North Kensington PM_{10}	62%	Filter change delayed 7-14 July Flowrate fault 3-30 September
London Westminster $PM_{2.5}$	88.0%	Filter exchange faults 26 July, 1-3 August Records corrupted 9-13 September
Wrexham PM_{10}		The audit on 9th Aug found a very high flowrate (+18%) and data back to 4th Jun (the date when the flowrate went over 10% out) have been provisionally rejected. The subsequent service on 16th Aug also found the flowrate out, but only by 9% which would not lead to data rejection. As flowrates don't usually appear to go up then down spontaneously, data have therefore been rejected from 4th Jun – 16th Aug. Shortly after this, there was another period of lost data due to a filter exchange failure.

Agreement with FDMS

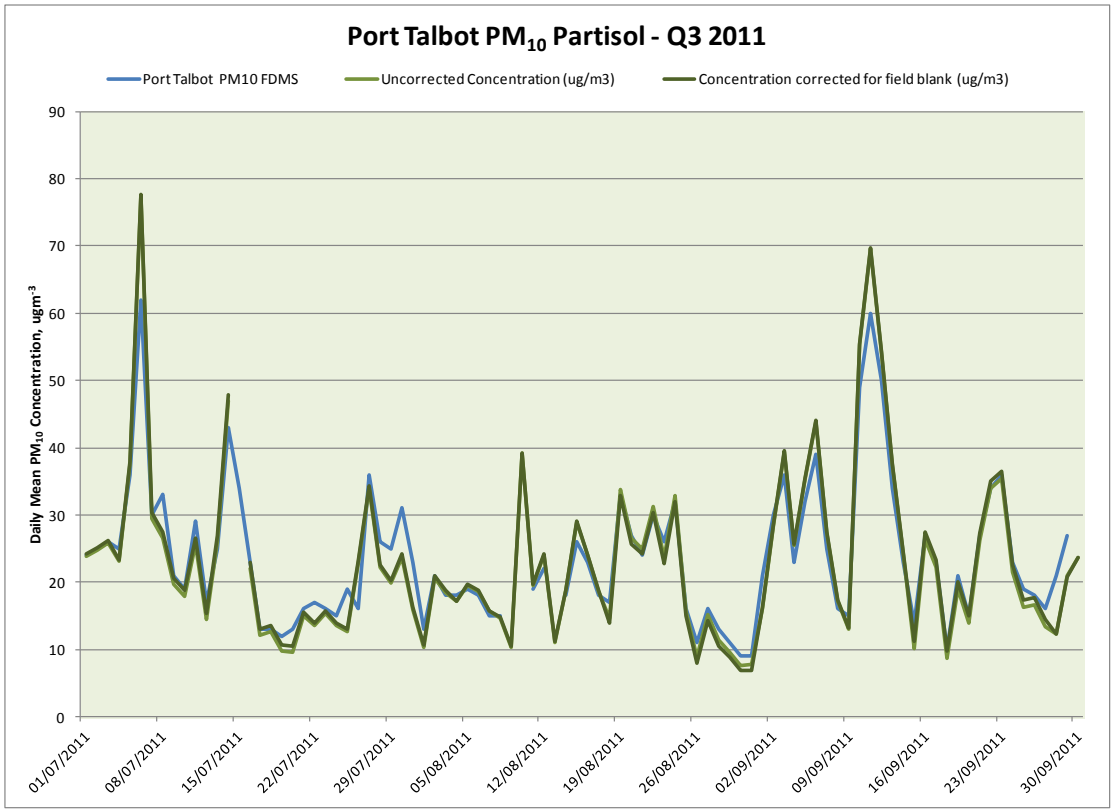
Im several instances, the Partisol is collocated with an FDMS analyser, and thus allows comparison between the methods. In general;, agreement is good, however for Harwell PM_{10}, the agreement is less good-see Figure A1:

Figure A1 Partisol vs FDMS, Harwell PM_{10}



Agreement between the methods is significantly better at Port Talbot Margam

Figure A2 Partisol vs FDMS, Port Talbot Margam PM_{10}



Appendix 3

Site Details for New Sites

Site	Start date	Latitude	Longitude	Grid ref	Elevation
Lincoln Canwick Road	01/08/2011	53deg 13min 17.0sec N	0deg 32min 10sec W	53.221373, -0.534189	7m

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

Appendix 4

Certificate of Calibration

CERTIFICATE OF CALIBRATION

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

0401

Certificate Number: 02533
AEA Identification Number: ED57002030

Approved Signatories: B Stacey
S. Eaton

Signed:

Date of issue: 1 February 2012

Customer Name and Address: Dr Emily Connolly

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

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

1. Northern Ireland Sites (including Mace Head)

Carbon Monoxide

Date Year = 2011	Site	Analyser number	[1]Zero output	Uncertainty (ppm)	[2]Calibration Factor	Uncertainty (%)	[*]Maximum Residual (%)
22-Aug	Belfast Centre	462	0	0.2	1.005	2.2	2.6

Sulphur Dioxide

Date Year =2011	Site	Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	[*]Max Residual (%)	[*]m-xylene interference (ppb)
16-Aug	Ballymena	4901234	0	2.5	1.143	5.0	0.9	7.5
22-Aug	Belfast Centre	1766	3	2.5	1.028	6.0	3.6	7.7
15-Aug	Derry	1697	15	2.5	1.040	7.0	3.2	7.2

Ozone

Date Year =2011	Site	Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	[*]Max Residual (%)
22-Aug	Belfast Centre	cm08060038	1	3.0	1.009	3.1	0.6
15-Aug	Derry	1586	2	3.0	0.982	3.1	1.1
09-Aug	Lough Navar	1640	2	3.0	1.023	3.1	0.6
10-Aug	Mace Head	77086-385	0	3.0	1.006	3.1	1.2

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

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Registered in England and Wales no 3095862

AEA

CERTIFICATE OF CALIBRATION

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UKAS CALIBRATION 0401

Certificate Number: 02533
AEA Identification Number: ED57002030

Oxides of Nitrogen

Date Year =2011	Site		Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	[*]Max residual (%)	[*]Converter efficiency (%)
11-Aug	Armagh Roadside	NO		0	2.8	0.938	3.5	1.0	
		NOx		-17	2.9	0.946	3.5	0.9	100.4
22-Aug	Belfast Centre	NO	08050074	0	2.5	1.074	3.5	2.4	
		NOx		0	2.5	1.069	3.5	1.9	101.3
15-Aug	Derry	NO	2130	1	2.6	1.173	3.5	0.5	
		NOx		2	2.6	1.136	3.5	0.4	101.8

Particulate Analysers

Date Year =2011	Site		Analyser number	Calculated Spring Constant k_0	Uncertainty (%)	[4]k_0 accuracy (%)	[3]Measured Main Flow (l/min)	Uncertainty (%)	[3]Measured Total Flow (l/min)	Uncertainty (%)
11-Aug	Armagh Roadside	PM10	2000	13438	1	-1.0	3.00	2.2	16.18	2.2
22-Aug	Belfast Centre	PM10	not	tested						
22-Aug	Belfast Centre	PM25	not	tested						
15-Aug	Derry	PM10	2701	15912	1	0.7	2.98	2.2	16.04	2.2
15-Aug	Derry	PM25	21313	10830	1	-0.6	2.98	2.2	15.76	2.2
09-Aug	Lough Navar	PM10	21196	12877	1	0.5	2.89	2.2	14.43	2.2

2. Scottish Sites

Carbon Monoxide

Date Year = 2011	Site	Analyser number	[1]Zero output	Uncertainty (ppm)	[2]Calibration Factor	Uncertainty (%)	[*]Maximum Residual (%)
12-Jul	Edinburgh St Leonards	240	0	0.2	0.995	2.3	3.1
04-Jul	Glasgow Centre	241	-1	1.0	0.860	5.3	4.8

Sulphur Dioxide

Date Year =2011	Site	Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	[*]Max Residual (%)	[*]m-xylene interference (ppb)
12-Jul	Edinburgh St Leonards	84	8	2.6	1.333	4.4	1.1	10.7
04-Jul	Glasgow Centre	1630	1	2.5	0.899	5.7	2.3	10.8
02-Aug	Grangemouth	703b-274	1	2.6	0.978	4.7	0.4	12.9

Ozone

Date Year =2011	Site	Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	[*]Max Residual (%)
01-Aug	Aberdeen	800	0	3.0	0.994	4.2	4.7
13-Jul	Auchencorth Moss	646	-2	3.0	1.040	3.1	0.6
13-Jul	Bush Estate	1645	0	3.0	1.004	3.1	0.3
12-Jul	Edinburgh St Leonards	136	2	3.0	1.006	3.1	0.8
25-Jul	Eskdalemuir	158	1	3.0	1.050	3.3	0.7
27-Jul	Fort William	1023	0	3.0	1.017	3.1	0.2
04-Jul	Glasgow Centre	cm0860029	0	3.0	1.018	3.3	0.8
03-Aug	Lerwick	1643	-1	3.0	1.019	3.1	0.7
12-Jul	Peebles	437	4	3.0	0.959	3.1	1.0
04-Aug	Strath Vaich	721	0	3.0	1.042	3.1	0.4

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

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Certificate Number: 02533 0401
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Oxides of Nitrogen

Date Year =2011	Site		Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	*Max residual (%)	*Converter efficiency (%)
01-Aug	Aberdeen	NO NOx	519	0 -3	2.7 2.7	1.334 1.316	3.5 3.9	3.2 3.5	99.5
01-Jul	Aberdeen Union Street Roadside	NO NOx	984	24 38	2.8 2.8	1.588 1.526	3.5 3.5	1.5 2.1	98.8
13-Jul	Bush Estate	NO NOx	2244	1 1	2.8 2.7	1.046 1.045	3.5 3.5	0.9 1.3	100.4
28-Jul	Dumbarton Roadside	NO NOx	311001	1 1	2.5 2.5	0.971 0.951	3.5 3.5	1.2 1.2	99.6
28-Jul	Dumfries	NO NOx	12189	2 2	2.7 2.7	1.295 1.298	3.5 3.5	0.8 0.3	98.5
12-Jul	Edinburgh St Leonards	NO NOx	73	0 -1	2.7 2.7	1.340 1.355	3.5 3.5	0.9 0.4	98.4
25-Jul	Eskdalemuir	NO NOx	347	-4 -5	2.5 2.9	1.019 0.996	3.5 3.5	1.7 1.9	101.6
27-Jul	Fort William	NO NOx	344	1 1	2.5 2.5	1.013 0.999	3.8 3.8	2.6 2.6	100.4
04-Jul	Glasgow Centre	NO NOx	1713	1 2	2.6 2.6	1.117 1.111	3.5 3.8	2.2 4.2	98.4
04-Jul	Glasgow Kerbside	NO NOx	08050061	0 2	2.5 2.5	0.985 0.964	3.5 3.5	0.5 0.6	100.8
02-Aug	Grangemouth	NO NOx	700b-312	1 1	2.7 2.5	0.997 1.002	3.5 3.5	0.6 1.9	98.5
01-Aug	Grangemouth Moray	NO NOx	912011	0 0	2.5 2.6	1.014 0.996	3.5 3.5	1.5 1.1	98.1
04-Aug	Inverness	NO NOx	1489	0 -3	2.6 2.6	1.112 1.107	3.5 3.5	1.4 1.6	100.0
12-Jul	Peebles	NO NOx	2213	4 2	2.6 2.6	1.143 1.109	3.5 3.5	0.5 1.0	99.6

Particulate Analysers

Date Year =2011	Site		Analyser number	Calculated Spring Constant k_0	Uncertainty (%)	[4]k_0 accuracy (%)	[3]Measured Main Flow (l/min)	Uncertainty (%)	[3]Measured Total Flow (l/min)	Uncertainty (%)
01-Jul	Aberdeen	PM10	24427	11591	1	0.2	3.00	2.2	16.21	2.2
01-Jul	Aberdeen	PM25	27368	12046	1	-1.4	Not	Measured	Lock	Rusted
31-Aug	Auchencorth Moss	PM10	20639	12876	1	-2.4	2.95	2.2	16.46	2.2
13-Jul	Auchencorth Moss	PM25	26033	13679	1	-2.4	3.07	2.2	15.81	2.2
13-Jul	Auchencorth Moss Partisol	PM10	21550						17.65	2.2
13-Jul	Auchencorth Moss Partisol	PM25	21548						17.11	2.2
12-Jul	Edinburgh St Leonards	PM10	27227	13575	1	-0.8	3.02	2.2	15.31	2.2
12-Jul	Edinburgh St Leonards	PM25	27233	16935	1	-0.5	3.07	2.2	15.79	2.2
04-Jul	Glasgow Centre	PM10	27331	9869	1	-1.0	2.98	2.2	15.53	2.2
04-Jul	Glasgow Centre	PM25	22980	13072	1	-0.6	2.98	2.2	15.84	2.2
04-Jul	Glasgow Kerbside	PM10	not	present	at	site				
04-Jul	Glasgow Kerbside	PM25	27337	14992	1	-0.9	**3.05**	**2.2**	**16.48**	**2.2**
02-Aug	Grangemouth	PM10	27228	15791	1	-0.8	**2.89**	**2.2**	**15.75**	**2.2**
02-Aug	Grangemouth	PM25	27259	13526	1	-1.7	**2.88**	**2.2**	**15.32**	**2.2**

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

Date Year =2011	Site		Analyser number	Calculated Spring Constant k_0	Uncertainty (%)	[4]k_0 accuracy (%)	[3]Measured Main Flow (l/min)	Uncertainty (%)	[3]Measured Total Flow (l/min)	Uncertainty (%)
04-Aug	Inverness	PM10	21255						17.23	2.2
04-Aug	Inverness	PM25	21861						17.30	2.2

3. Welsh Sites

Carbon Monoxide

Date Year = 2011	Site	Analyser number	[1]Zero output	Uncertainty (ppm)	[2]Calibration Factor	Uncertainty (%)	*Maximum Residual (%)
26-Jul	Cardiff Centre	14333	0	0.2	1.036	2.1	1.6
26-Jul	Port Talbot Margam	ch0	1	0.2	0.981	2.1	0.5

Sulphur Dioxide

Date Year =2011	Site	Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	*Max Residual (%)	*m-xylene interference (ppb)
26-Jul	Cardiff Centre	14325	2	2.6	1.252	7.1	3.1	15.5
27-Jul	Narberth	14896	1	2.6	1.283	5.4	1.3	22.4
26-Jul	Port Talbot Margam	ch1	2	2.6	1.095	10.1	5.5	7.7
09-Aug	Wrexham	1181	5	2.5	0.905	4.5	2.4	20.1

Ozone

Date Year =2011	Site	Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	*Max Residual (%)
10-Aug	Aston Hill	14337	1	3.0	1.002	3.1	0.6
26-Jul	Cardiff Centre	14348	-3	3.0	1.010	3.1	0.6
28-Jul	Cwmbran		0	3.0	0.956	3.1	0.3
09-Aug	Mold	17499	1	3.0	1.001	3.1	1.1
27-Jul	Narberth	10280	1	3.0	1.044	3.1	0.4
26-Jul	Port Talbot Margam	ch3	fault	not	tested	at	audit

Oxides of Nitrogen

Date Year =2011	Site		Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	*Max residual (%)	*Converter efficiency (%)
10-Aug	Aston Hill	NO NOx	17677	2 2	2.6 2.6	1.169 1.168	3.5 3.5	3.0 3.1	101.5
26-Jul	Cardiff Centre	NO NOx	14319	1 4	2.6 2.6	1.182 1.175	3.5 3.5	3.5 3.8	100.0
05-Aug	Chepstow A48	NO NOx	517144	98 102	2.6 2.7	1.292 1.319	3.5 3.5	3.6 2.3	96.0
28-Jul	Cwmbran	NO NOx		0 0	2.5 2.5	1.038 1.036	3.5 3.5	3.5 3.5	99.1
09-Aug	Mold	NO NOx	345	9 6	2.6 2.6	1.282 1.257	3.5 3.5	2.0 0.3	99.5
27-Jul	Narberth	NO NOx	14311	1 2	2.6 2.6	1.217 1.201	3.5 3.7	2.4 2.3	99.5
05-Aug	Newport	NO NOx	not	tested					
26-Jul	Port Talbot Margam	NO NOx	12811	1 1	2.5 2.5	1.029 1.018	3.5 3.5	1.7 1.0	97.9
27-Jul	Swansea Roadside	NO NOx	16695	2 5	2.6 2.6	1.224 1.188	4.1 3.6	2.9 1.9	100.0

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

CERTIFICATE OF CALIBRATION

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Certificate Number: 02533 0401
AEA Identification Number: ED57002030

Date Year =2011	Site		Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	[*]Max residual (%)	[*]Converter efficiency (%)
09-Aug	Wrexham	NO NOx	1490	-1 0	2.5 2.5	1.003 1.012	3.5 3.5	3.4 3.0	 98.4

Particulate Analysers

Date Year =2011	Site		Analyser number	Calculated Spring Constant k_0	Uncertainty (%)	[4]k_0 accuracy (%)	[3]Measured Main Flow (l/min)	Uncertainty (%)	[3]Measured Total Flow (l/min)	Uncertainty (%)
26-Jul	Cardiff Centre	PM10	26499	13624	1	-1.8	2.83	2.2	15.69	2.2
26-Jul	Cardiff Centre	PM25		not	present					
05-Aug	Chepstow A48	PM10	27242	14053	1	-0.9	**2.95**	**2.2**	**17.01**	**2.2**
05-Aug	Chepstow A48	PM25	27223	15917	1	-0.5	**2.92**	**2.2**	**16.48**	**2.2**
27-Jul	Narberth	PM10		fault	not	tested				
05-Aug	Newport	PM10	dryer	fault	not	tested				
05-Aug	Newport	PM25	27252	15898	1	-0.9	2.97	2.2	15.75	2.2
26-Jul	Port Talbot Margam	PM10	27212	13860	1	-0.6	2.98	2.2	16.29	2.2
26-Jul	Port Talbot Margam	PM25	25081	10449	1	-1.0	not	tested	16.14	2.2
26-Jul	Port Talbot Margam Partisol	PM10	21038						17.17	2.2
27-Jul	Swansea Roadside	PM10	no	analyser	at	site				
27-Jul	Swansea Roadside	PM25	no	analyser	at	site				
09-Aug	Wrexham	PM10	21224						19.89	2.2
09-Aug	Wrexham	PM25	21011						17.20	2.2

4. London Sites

Carbon Monoxide

Date Year = 2011	Site	Analyser number	[1]Zero output	Uncertainty (ppm)	[2]Calibration Factor	Uncertainty (%)	[*]Maximum Residual (%)
06-Jul	London Bexley	14871	0	0.2	0.953	2.2	1.9
12-Jul	London Bloomsbury	14330	0	0.2	1.010	2.2	0.7
07-Jul	London Cromwell Road 2	10776	1	0.2	1.025	2.3	1.6
21-Jul	London Marylebone Road	10073	1	0.2	1.039	2.7	3.9
14-Jul	London N. Kensington	19097	0	0.2	1.005	2.3	3.7
06-Jul	London Westminster	867	0	0.2	1.020	2.2	2.6
07-Jul	Tower Hamlets Roadside	14728	0	0.2	0.953	2.1	1.0

Sulphur Dioxide

Date Year =2011	Site	Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	[*]Max Residual (%)	[*]m-xylene interference (ppb)
06-Jul	London Bexley	11669	10	2.6	1.142	5.0	1.1	10.5
12-Jul	London Bloomsbury	14323	9	2.7	0.970	6.3	3.3	17.7
07-Jul	London Cromwell Rd 2	10779	0	2.5	1.045	7.8	3.7	19.0
21-Jul	London Marylebone Rd	19220	0	3.4	2.446	5.8	1.7	4.4
14-Jul	London N. Kensington	19095	4	2.6	1.123	7.4	4.0	27.7
06-Jul	London Westminster	705	3	2.5	0.926	4.5	0.9	17.9

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Ozone

Date Year =2011	Site	Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	[*]Max Residual (%)
12-Jul	London Bloomsbury	14907	0	3.0	1.063	3.3	3.2
18-Aug	London Eltham	375	0	3.0	1.009	3.3	1.1
19-Jul	London Haringey	538	20	3.0	1.612	3.4	2.6
07-Jul	London Harlington	14309	-2	3.0	0.984	3.2	0.5
09-Aug	London Hillingdon	8060034	1	3.0	1.039	3.3	0.2
21-Jul	London Marylebone Road	19223	9	3.0	1.058	3.2	1.2
14-Jul	London N. Kensington	19098	1	3.0	0.920	3.1	0.4
06-Jul	London Teddington	#19191	-2	3.0	1.194	3.1	0.8
06-Jul	London Westminster	879	0	3.0	0.998	3.1	1.4

Oxides of Nitrogen

Date Year =2011	Site		Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	[*]Max residual (%)	[*]Converter efficiency (%)
18-Jul	Camden Kerbside	NO NOx	623	1 2	2.7 2.8	0.950 1.012	3.5 3.8	1.5 3.8	99.6
19-Jul	Haringey Roadside	NO NOx	397	3 4	2.6 2.8	1.140 1.073	3.5 3.5	2.3 3.2	95.6
06-Jul	London Bexley	NO NOx	14870	1 1	2.6 2.6	1.184 1.175	3.5 3.5	0.7 1.0	100.0
12-Jul	London Bloomsbury	NO NOx	14328	1 0	2.6 2.6	1.152 1.134	3.5 3.5	3.1 2.9	98.3
07-Jul	London Cromwell Road 2	NO NOx	10755	1 3	2.6 2.6	1.126 1.138	3.5 3.5	2.8 2.7	98.5
18-Aug	London Eltham	NO NOx	307	1 3	2.8 2.8	1.572 1.494	3.5 3.5	2.1 1.5	100.0
19-Jul	London Haringey	NO NOx	11392	7 12	2.7 2.6	1.237 1.227	3.5 3.5	2.7 1.9	96.0
07-Jul	London Harlington	NO NOx	11491	0 0	2.7 2.7	1.279 1.282	3.5 3.5	0.4 0.3	99.5
09-Aug	London Hillingdon	NO NOx	8050017	-8 -8	2.5 2.5	0.949 0.948	3.5 3.5	3.4 3.0	100.0
21-Jul	London Marylebone Road	NO NOx	19210	0 1	2.6 2.6	1.179 1.173	3.5 3.5	0.7 1.2	98.5
14-Jul	London N. Kensington	NO NOx	19096	1 -2	2.6 2.6	1.117 1.115	3.5 3.5	2.9 2.9	100.0
06-Jul	London Teddington	NO NOx	#19205	1 3	2.6 2.6	1.159 1.151	3.6 3.5	2.8 2.5	99.9
06-Jul	London Westminster	NO NOx	573	0 0	2.6 2.6	1.201 1.180	3.5 3.5	0.8 0.3	99.0
01-Sep	Southwark A2 Old Kent Road	NO NOx	1954	0 -1	2.5 2.5	0.947 0.949	3.5 3.5	0.9 1.3	99.3
07-Jul	Tower Hamlets Roadside	NO NOx	306	2 3	2.6 2.6	1.187 1.127	3.5 3.5	0.8 0.2	100.0

Particulate Analysers

Date Year =2011	Site		Analyser number	Calculated Spring Constant k_0	Uncertainty (%)	[4]k_0 accuracy (%)	[3]Measured Main Flow (l/min)	Uncertainty (%)	[3]Measured Total Flow /**Aux Flow** (l/min)	Uncertainty (%)
18-Jul	Camden Kerbside	PM10	21159	11920	1	-0.6	3.02	2.2	16.40	2.2
18-Jul	Camden Kerbside	PM25	21391	12848	1	0.7	3.06	2.2	16.12	2.2
19-Jul	Haringey Roadside	PM10	2000	15182	1	-0.5	3.52	2.2	16.74	2.2
19-Jul	Haringey Roadside	PM25	27278	13601	1	-1.4	3.00	2.2	15.48	2.2
06-Jul	London Bexley	PM25	25007	11586	1	-0.1	3.03	2.2	16.22	2.2

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Date Year =2011	Site		Analyser number	Calculated Spring Constant k_0	Uncertainty (%)	[4]k_0 accuracy (%)	[3]Measured Main Flow (l/min)	Uncertainty (%)	[3]Measured Total Flow /**Aux Flow** (l/min)	Uncertainty (%)
12-Jul	London Bloomsbury	PM10	24446	13593	1	-1.1	**3.01**	**2.2**	**16.52**	**2.2**
12-Jul	London Bloomsbury	PM25	27240	13764	1	0.2	**2.97**	**2.2**	**16.14**	**2.2**
18-Aug	London Eltham	PM25	2000	13833	1	0.1	3.00	2.2	16.58	2.2
07-Jul	London Harlington	PM10	24902	12185	1	-0.8	3.01	2.2	15.66	2.2
07-Jul	London Harlington	PM25	23959	12760	1	-0.4	2.87	2.2	15.51	2.2
27-Jul	London Harrow Stanmore	PM25	27274	16025	1	-1.4	2.99	2.2	15.97	2.2
21-Jul	London Marylebone Road	PM10	27230	16698	1	-1.4	3.11	2.2	16.66	2.2
21-Jul	London Marylebone Road	PM25	27239	12948	1	-9.5	2.91	2.2	16.87	2.2
21-Jul	London Marylebone Road Partisol	PM10	20943						16.44	2.2
21-Jul	London Marylebone Road Partisol	PM25	21036						16.25	2.2
14-Jul	London N. Kensington	PM10	27391	12598	1	-0.6	2.93	2.2	15.77	2.2
14-Jul	London N. Kensington	PM25	21342	15696	1	-0.6	**2.92**	**2.2**	**16.33**	**2.2**
14-Jul	London N. Kensington Partisol	PM10	21015						15.91	2.2
14-Jul	London N. Kensington Partisol	PM25	21019						16.19	2.2
06-Jul	London Teddington	PM25	25023	15183	1	-1.2	2.99	2.2	16.59	2.2
06-Jul	London Westminster	PM25	209399 811						17.63	2.2
01-Sep	Southwark A2 Old Kent Road	PM10	2000	15047	1	-0.5	2.95	2.2	16.41	2.2

5. English Sites

Carbon Monoxide

Date Year = 2011	Site	Analyser number	[1]Zero output	Uncertainty (ppm)	[2]Calibration Factor	Uncertainty (%)	[*]Maximum Residual (%)
09-Aug	Bristol Old Market	analyser	not	present			
09-Aug	Bristol St Paul's	14417	0	0.2	1.000	2.2	0.9
17-Aug	Bury Roadside	1357	0	0.2	0.907	2.1	1.7
23-Aug	Hull Freetown	50045	1	0.2	0.962	2.1	1.2
24-Aug	Leeds Centre	501	0	0.2	0.990	2.3	3.6
04-Aug	Leicester Centre	14868	0	0.2	0.996	2.4	3.7
23-Aug	Liverpool Speke	238	0	0.2	0.990	2.2	1.7
13-Jul	Middlesbrough	14202	0	0.2	0.971	2.3	0.7
11-Jul	Newcastle Centre	461	0	0.2	0.995	2.2	0.4
17-Aug	Salford Eccles	2386	0	0.2	0.902	2.2	1.2
08-Aug	Sheffield Centre	459	0	0.2	1.000	2.1	1.4
19-Jul	Southampton Centre	1661	1	0.2	1.156	2.4	5.7

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Sulphur Dioxide

Date Year =2011	Site	Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	*Max Residual (%)	*m-xylene interference (ppb)
09-Aug	Barnsley 12	706	0	2.5	0.947	5.0	0.8	15.1
09-Aug	Barnsley Gawber	90	10	2.5	0.934	4.1	0.7	9.4
10-Aug	Birmingham Acocks Green	#019239	-1	2.5	1.045	5.4	3.2	15.3
17-Aug	Birmingham Tyburn		4	2.5	0.799	6.8	1.6	0.0
09-Aug	Bristol St Paul's	14322	25	2.6	1.116	4.2	0.5	3.8
16-Aug	Harwell	14350	3	2.6	1.055	7.9	2.0	9.5
23-Aug	Hull Freetown	14894	9	2.9	1.570	5.0	0.7	14.1
09-Aug	Ladybower	1178	4	2.7	1.420	4.9	1.4	19.9
15-Aug	Leamington Spa	1793	-1	2.6	0.875	4.0	1.2	17.3
24-Aug	Leeds Centre	84	11	2.7	1.216	4.6	1.2	11.0
04-Aug	Leicester Centre	14321	4	2.5	0.860	8.7	2.8	8.6
10-Aug	Leominster	14352	1	2.5	0.952	3.7	0.2	19.7
23-Aug	Liverpool Speke	1765	2	2.5	1.073	4.6	1.0	11.1
01-Aug	Lullington Heath	12181	1	2.5	1.007	3.7	0.4	0.0
16-Aug	Manchester Piccadilly	2648	0	2.5	0.904	5.0	1.2	20.8
13-Jul	Middlesbrough	14166	-3	2.5	0.875	4.1	0.5	2.9
11-Jul	Newcastle Centre	345	1	2.5	1.004	12.1	3.1	16.3
11-Jul	Northampton		-4	2.8	1.047	77.9	25.1	24.7
28-Jul	Norwich Lakenfields	08050083	0	2.5	0.970	4.4	2.5	20.2
30-Aug	Nottingham Centre	1629	-2	2.5	0.850	5.1	2.4	14.2
14-Jul	Rochester Stoke	#19446	0	Not tested	1.045	not	tested	17.2
17-Aug	Salford Eccles	1581	0	2.9	1.671	14.0	4.9	20.0
18-Aug	Sandwell West Bromwich	2	1	2.5	0.915	6.7	3.1	2.6
23-Aug	Scunthorpe Town	2	54	2.7	1.262	6.4	2.5	15.6
08-Aug	Sheffield Centre	1180	38	2.5	0.968	8.7	5.3	10.2
19-Jul	Southampton Centre	343	5	2.5	0.986	3.8	1.1	17.2
05-Jul	Stanford-le-Hope Roadside	14188	13	2.5	1.006	4.3	0.8	23.1
12-Jul	Sunderland Silksworth	996b382	4	2.5	0.934	4.6	1.2	12.1
13-Jul	Thurrock	10554	6	2.5	0.931	8.5	5.8	13.6
26-Jul	Wicken Fen	#014349	1	2.5	0.717	5.5	2.8	12.7

Ozone

Date Year =2011	Site	Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	*Max Residual (%)
09-Aug	Barnsley Gawber	70	0	3.0	1.011	3.3	0.6
10-Aug	Birmingham Acocks Green	#019224	0	3.0	1.030	3.3	0.4
17-Aug	Birmingham Tyburn	878001g	0	3.0	1.024	3.1	0.1
17-Aug	Birmingham Tyburn Roadside	19188	0	3.0	1.048	3.1	0.2
24-Aug	Blackpool Marton	cm08060037	1	3.0	0.963	3.4	1.7
30-Aug	Bottesford	ea357	1	3.0	1.017	3.1	0.2
21-Jul	Bournemouth	17503	-1	3.0	0.991	3.3	1.0
02-Aug	Brighton Preston Park	12461	0	3.0	1.022	3.3	0.1
09-Aug	Bristol St Paul's	143358	-1	3.0	1.032	3.3	0.2
15-Jul	Canterbury	#019194	2	3.0	0.960	3.3	0.4
03-Aug	Charlton Mackrell	95249	0	3.0	0.953	3.2	1.8
16-Aug	Coventry Memorial Park	cmo8060044	0	3.0	1.011	3.1	1.0
11-Aug	Exeter Roadside	e201	-1	3.0	0.851	3.1	0.4
15-Aug	Glazebury	138	-2	3.0	1.005	3.3	1.0

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27-Jul	Great Dun Fell	17496	0	3.0	1.134	3.5	1.2
16-Aug	Harwell	17497	-1	3.0	1.011	3.1	0.3
26-Jul	High Muffles	17502	3	3.0	1.132	3.4	1.4
23-Aug	Hull Freetown	12556	1	3.0	1.254	3.1	0.8
09-Aug	Ladybower	1651	-1	3.0	1.016	3.3	1.1
15-Aug	Leamington Spa	1469	-11	3.0	0.965	3.1	0.8
24-Aug	Leeds Centre	36	15	3.0	1.099	3.1	0.4
04-Aug	Leicester Centre	70096	0	3.0	1.011	3.3	0.2
10-Aug	Leominster	14470	3	3.0	0.988	3.1	1.8
23-Aug	Liverpool Speke	cm08060041	0	3.0	0.957	3.3	0.5
01-Aug	Lullington Heath	17494	0	3.0	1.013	3.1	0.5
16-Aug	Manchester Piccadilly	cm08060039	0	3.0	0.972	3.3	0.7
16-Aug	Manchester South	1317	-2	3.0	1.022	3.4	0.2
02-Aug	Market Harborough	cm08060031	0	3.0	1.022	3.3	0.1
13-Jul	Middlesbrough	14203	-2	3.0	0.999	3.3	0.8
11-Jul	Newcastle Centre	cm08060033	0	3.0	1.000	3.3	0.4
11-Jul	Northampton	apoa	1	3.0	0.978	3.1	1.2
28-Jul	Norwich Lakenfields	CM08060028	1	3.0	1.028	3.3	0.8
30-Aug	Nottingham Centre	60032	0	3.0	0.916	3.2	0.8
11-Aug	Plymouth Centre	2	0	3.0	1.040	3.1	0.4
18-Jul	Portsmouth	cm08060023	0	3.0	1.004	3.4	1.7
24-Aug	Preston	cm08060042	1	3.0	1.019	3.3	1.1
15-Aug	Reading New Town	#018505	0	3.0	1.020	3.1	0.6
14-Jul	Rochester Stoke	95063	0	3.0	0.958	3.3	0.1
17-Aug	Salford Eccles	2363	0	3.0	0.984	3.3	2.1
18-Aug	Sandwell West Bromwich	3	0	3.0	0.959	3.1	0.3
08-Aug	Sheffield Centre	cm08060024	0	3.0	0.997	3.3	0.3
27-Jul	Sibton	#014339	1	3.0	0.990	3.3	0.2
19-Jul	Southampton Centre	cm08060021	0	3.0	1.051	3.3	0.3
05-Jul	Southend-on-Sea	8060017	0	3.0	1.039	3.1	0.7
06-Jul	St Osyth	8060035	0	3.0	0.986	3.1	1.0
08-Aug	Stoke-on-Trent Centre	cm08060026	0	3.0	1.025	3.1	0.3
12-Jul	Sunderland Silksworth	436	0	3.0	0.980	3.6	1.8
13-Jul	Thurrock	10788	2	3.0	0.513	3.1	0.3
27-Jul	Weybourne		-4	3.0	0.948	3.3	0.4
26-Jul	Wicken Fen	#014345	0	3.0	1.016	3.3	0.4
15-Aug	Wigan Centre	cm08060018	0	3.0	1.000	3.3	0.9
22-Aug	Wirral Tranmere	cm08060040	-1	3.0	1.003	3.4	0.7
04-Aug	Yarner Wood	14456	-1	3.0	1.012	3.1	0.4

Oxides of Nitrogen

Date Year =2011	Site		Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	*Max residual (%)	*Converter efficiency (%)
09-Aug	Barnsley Gawber	NO	75	0	2.5	0.894	3.5	0.9	
		NOx		0	2.5	0.935	3.5	0.7	99.0
08-Aug	Bath Roadside	NO	12758	7	2.5	1.059	3.5	0.3	
		NOx		10	2.7	1.064	3.5	0.3	99.6
12-Jul	Billingham	NO	574	0	2.5	1.036	3.5	0.7	
		NOx		4	2.8	1.048	3.5	0.7	98.2
10-Aug	Birmingham	NO	#019212	1	2.5	1.038	3.8	3.5	
	Acocks Green	NOx		-1	2.5	1.031	3.5	3.5	99.6
17-Aug	Birmingham	NO	878100j	-1	2.5	1.026	3.5	1.0	
	Tyburn	NOx		-1	2.5	1.009	3.5	1.3	98.7
17-Aug	Birmingham	NO	14324	1	2.7	1.344	3.5	0.4	
	Tyburn Roadside	NOx		2	2.7	1.348	3.5	0.1	95.4

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Date Year =2011	Site		Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	*Max residual (%)	*Converter efficiency (%)
15-Aug	Blackburn Darwen Roadside	NO NOx	688b-303	0 -1	2.5 2.5	0.934 0.932	5.6 5.9	4.8 5.2	99.3
24-Aug	Blackpool Marton	NO NOx	08050075	2 2	2.5 2.6	0.913 0.903	3.5 3.5	0.6 0.4	100.7
21-Jul	Bournemouth	NO NOx	17507	2 2	2.6 2.6	1.126 1.085	3.5 4.0	3.2 3.7	99.6
02-Aug	Brighton Preston Park	NO NOx	130689	0 1	2.5 2.5	0.956 0.955	3.5 3.5	2.5 2.5	100.0
09-Aug	Bristol Old Market	NO NOx	10510	1 1	2.6 2.6	1.243 1.223	3.5 3.5	0.9 0.6	95.8
09-Aug	Bristol St Paul's	NO NOx	13459	0 1	3.2 3.2	2.185 2.180	3.5 3.5	0.2 0.4	101.9
17-Aug	Bury Roadside	NO NOx	1710	0 0	2.5 2.5	1.050 1.057	3.5 3.5	0.9 1.8	99.8
26-Jul	Cambridge Roadside	NO NOx	55355-303	0 1	2.7 2.7	1.452 1.447	3.5 3.5	0.3 0.4	98.3
15-Jul	Canterbury	NO NOx	11666	0 1	2.6 2.6	1.256 1.262	3.5 3.5	2.2 2.0	99.3
27-Jul	Carlisle Roadside	NO NOx	m906	-1 12	2.5 2.5	0.996 1.029	3.5 3.5	1.4 1.8	100.0
03-Aug	Charlton Mackrell	NO NOx	12895	3 4	2.6 2.6	1.235 1.190	4.5 3.5	4.6 3.4	99.5
14-Jul	Chatham Centre Roadside	NO NOx	#109206	1 2	3.0 3.0	1.887 1.865	3.5 3.5	0.8 1.2	98.5
10-Aug	Chesterfield	NO NOx	M1228-M528	1 6	2.7 2.7	1.321 1.346	3.5 3.5	0.3 0.7	100.0
10-Aug	Chesterfield Roadside	NO NOx	765B-342	100 100	2.6 2.6	1.084 1.094	3.5 3.5	1.1 1.0	99.6
16-Aug	Coventry Memorial Park	NO NOx	08030109	1 1	2.6 2.6	1.201 1.198	3.5 3.5	2.2 2.4	101.5
02-Sep	Eastbourne	NO NOx	19209	-2 -3	2.6 2.6	1.098 1.104	3.5 3.5	1.2 1.3	100.5
11-Aug	Exeter Roadside	NO NOx	e209	1 -1	2.6 2.5	1.112 1.020	3.5 3.5	0.5 0.7	99.6
15-Aug	Glazebury	NO NOx	78	0 -1	3.2 3.2	2.204 2.182	3.5 3.5	2.7 2.1	99.3
16-Aug	Harwell	NO NOx	14355	1 2	2.6 2.6	1.106 1.103	3.5 3.5	0.8 1.2	100.5
26-Jul	High Muffles	NO NOx	12553	0 0	2.6 2.7	1.244 1.246	3.5 3.5	0.5 0.7	101.0
20-Jul	Horley	NO NOx	1401954	0 3	2.5 2.8	1.013 1.019	3.5 3.5	3.0 2.7	98.5
23-Aug	Hull Freetown	NO NOx	50056	1 1	2.6 2.6	1.124 1.158	3.5 3.5	1.3 1.2	99.0
09-Aug	Ladybower	NO NOx	72	1 1	2.7 2.7	1.431 1.441	3.5 3.5	0.9 1.4	100.6
15-Aug	Leamington Spa	NO NOx	1705	2 2	2.7 2.7	1.475 1.447	3.5 3.5	1.0 0.9	98.3
24-Aug	Leeds Centre	NO NOx	66	1 2	2.5 2.5	1.064 1.055	3.5 3.5	1.5 1.7	99.6
24-Aug	Leeds Headingley Kerbside	NO NOx	696b-308	52 52	2.6 2.6	1.112 1.117	3.5 3.5	1.0 1.2	101.5
04-Aug	Leicester Centre	NO NOx	70093	1 1	2.5 2.5	0.927 0.928	3.5 3.5	1.3 1.8	99.7
10-Aug	Leominster	NO NOx	14863	1 2	2.5 2.5	0.904 0.914	3.5 3.5	0.4 0.4	100.0
23-Aug	Liverpool Queen's Drive Roadside	NO NOx	16927	0 3	2.5 2.6	1.011 1.141	3.5 3.5	1.1 0.5	99.6

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Telephone: 0870 1906465 Fax: 0870 1906377

Certificate Number: 02533 0401
AEA Identification Number: ED57002030

Date Year =2011	Site		Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	*Max residual (%)	*Converter efficiency (%)
23-Aug	Liverpool Speke	NO	080050069	0	2.5	0.998	3.5	1.0	
		NOx		-1	2.5	1.007	3.5	1.1	99.6
01-Aug	Lullington Heath	NO	14313	1	2.6	1.087	3.5	1.7	
		NOx		1	2.5	1.072	3.5	1.3	100.5
16-Aug	Manchester Piccadilly	NO	08050065	0	2.5	0.927	3.5	0.3	
		NOx		0	2.5	0.996	3.5	0.4	99.7
16-Aug	Manchester South	NO	2115	1	2.5	0.938	3.5	0.2	
		NOx		2	2.5	0.926	3.5	0.2	96.5
02-Aug	Market Harborough	NO	08050068	0	2.5	0.956	3.7	3.2	
		NOx		1	2.5	0.955	3.7	3.1	99.6
13-Jul	Middlesbrough	NO	19160	-4	2.6	1.115	3.5	2.0	
		NOx		-6	2.8	1.104	3.5	1.4	98.7
11-Jul	Newcastle Centre	NO	08050065	0	2.7	1.027	3.5	1.3	
		NOx		0	2.7	1.027	3.5	1.5	101.9
11-Jul	Newcastle Cradlewell Road	NO	m2106-m860	1	3.2	1.010	3.7	0.9	
		NOx		12	2.9	1.049	3.5	1.9	97.2
11-Jul	Northampton	NO		0	2.5	1.011	3.7	3.4	
		NOx		-1	2.5	1.011	3.7	3.4	99.6
28-Jul	Norwich Lakenfields	NO	08060067	0	2.5	0.879	3.5	0.7	
		NOx		1	2.5	0.875	3.5	0.4	100.0
30-Aug	Nottingham Centre	NO	50072	0	2.5	0.999	3.5	2.8	
		NOx		-2	2.5	1.018	3.5	2.1	99.6
19-Aug	Oxford Centre Roadside	NO		103	2.7	1.396	3.5	1.7	
		NOx		110	2.8	1.512	3.5	0.8	100.7
19-Aug	Oxford St Ebbes	NO	946	0	2.7	1.387	3.8	2.5	
		NOx		1	2.7	1.393	3.7	2.4	99.4
11-Aug	Plymouth Centre	NO		0	2.5	0.827	3.5	1.1	
		NOx		0	2.5	0.822	3.5	1.0	99.1
18-Jul	Portsmouth	NO	p0t7cya5	1	2.8	1.059	3.5	1.3	
		NOx		0	2.5	1.039	3.5	1.0	99.5
24-Aug	Preston	NO	08050064	0	2.5	0.945	3.5	1.3	
		NOx		-2	2.5	0.928	3.5	0.9	101.8
15-Aug	Reading New Town	NO	#018504	1	2.6	1.090	3.6	2.1	
		NOx		-2	2.6	1.082	3.5	1.9	99.6
14-Jul	Rochester Stoke	NO	#018593	0	2.6	1.124	3.5	2.8	
		NOx		1	2.6	1.128	3.5	2.9	99.7
17-Aug	Salford Eccles	NO	2381	0	2.5	0.932	3.5	3.2	
		NOx		0	2.5	1.043	3.5	2.3	99.7
18-Aug	Sandwell West Bromwich	NO		0	2.5	1.010	3.5	0.9	
		NOx		0	2.5	0.984	3.5	1.1	98.8
05-Aug	Sandy Roadside	NO	#018006	1	2.6	1.106	3.6	3.7	
		NOx		2	2.6	1.109	3.6	3.7	99.5
23-Aug	Scunthorpe Town	NO		32	3.3	2.333	3.5	0.7	
		NOx		44	3.3	2.376	3.5	1.1	100.9
08-Aug	Sheffield Centre	NO	08050055	0	2.5	1.011	3.5	0.4	
		NOx		0	2.5	0.961	3.5	0.4	98.1
08-Aug	Sheffield Tinsley	NO	847	0	2.6	1.202	3.5	0.6	
		NOx		3	2.6	1.219	3.5	1.2	98.4
19-Jul	Southampton Centre	NO	08030106	1	2.5	0.998	3.5	0.9	
		NOx		3	2.5	0.978	3.5	2.5	100.4
05-Jul	Southend-on-Sea	NO	8050071	0	2.5	0.969	3.5	0.7	
		NOx		1	2.5	0.964	3.5	0.6	102.0
06-Jul	St Osyth	NO	8050073	0	2.5	1.074	3.5	0.7	
		NOx		3	2.5	1.047	3.5	0.7	99.6
05-Jul	Stanford-le-Hope Roadside	NO	14189	1	2.6	1.122	3.5	0.6	
		NOx		0	2.6	1.128	3.5	0.6	91.4
12-Jul	Stockton-on-Tees Eaglescliffe	NO	10445	2	2.7	1.407	3.5	0.5	
		NOx		2	2.7	1.408	3.5	0.4	99.5

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Date Year =2011	Site		Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	*Max residual (%)	*Converter efficiency (%)
08-Aug	Stoke-on-Trent Centre	NO NOx	08050070	0 0	2.6 2.6	1.223 1.259	3.5 3.5	0.1 0.2	 100.0
01-Aug	Storrington Roadside	NO NOx	22	0 -1	2.7 2.7	1.491 1.487	3.7 3.5	1.7 2.2	 99.4
12-Jul	Sunderland Silksworth	NO NOx	734b-322	0 6	2.5 3.0	0.979 1.003	3.5 3.5	0.5 0.5	 100.0
13-Jul	Thurrock	NO NOx	11004	1 3	2.6 2.6	1.262 1.254	3.5 3.8	3.2 3.6	 93.9
	Walsall Willenhall	NO NOx	Site	not	in	operation	at	audit	visit
22-Aug	Warrington	NO NOx	450b-198	0 3	2.8 2.6	1.078 1.109	3.5 3.5	1.9 1.7	 100.9
26-Jul	Wicken Fen	NO NOx	13069	1 1	2.6 2.6	1.284 1.270	3.5 3.5	2.6 2.0	 99.5
15-Aug	Wigan Centre	NO NOx	analyser	not	operational				
22-Aug	Wirral Tranmere	NO NOx	08050060	1 2	2.5 2.6	0.945 1.016	3.5 3.5	1.5 2.0	 101.1
04-Aug	Yarner Wood	NO NOx	12554	1 1	2.6 2.6	1.129 1.118	3.5 3.5	1.5 1.6	 98.6
	York Fishergate	NO NOx	Site	not	in	operation	at	audit	visit

Particulate Analysers

Date Year =2011	Site		Analyser number	Calculated Spring Constant k_0	Uncertainty (%)	[4]k_0 accuracy (%)	[3]Measured Main Flow (l/min)	Uncertainty (%)	[3]Measured Total Flow (l/min)	Uncertainty (%)
10-Aug	Birmingham Acocks Green	PM25	20203	15598	1	0.0	3.00	2.2	16.37	2.2
17-Aug	Birmingham Tyburn	PM10	27255	14842	1	-0.7	2.88	2.2	15.39	2.2
17-Aug	Birmingham Tyburn	PM25	21372	14697	1	0.1	2.82	2.2	14.99	2.2
17-Aug	Birmingham Tyburn Roadside	PM10	26034	12138	1	-1.9	2.98	2.2	16.02	2.2
17-Aug	Birmingham Tyburn Roadside	PM25	26567	13924	1	-1.1	3.01	2.2	16.21	2.2
24-Aug	Blackpool Marton	PM25	24424	12878	1	-0.1	2.30	2.2	16.52	2.2
21-Jul	Bournemouth	PM25							16.50	2.2
02-Aug	Brighton Preston Park	PM25							16.61	2.2
09-Aug	Bristol St Paul's	PM10	24426	analyser	fault	not	tested			
09-Aug	Bristol St Paul's	PM25	264395	13647	1	-2.0	**3.02**	**2.2**	**16.27**	**2.2**
17-Aug	Bury Roadside	PM10	27335	16088	1	-0.7	3.07	2.2	16.84	2.2
17-Aug	Bury Roadside	PM25	27334	15024	1	-0.3	3.14	2.2	16.93	2.2
27-Jul	Carlisle Roadside	PM10	27257	14356	1	-0.9	3.04	2.2	15.91	2.2
27-Jul	Carlisle Roadside	PM25	27320	13805	1	-0.9	2.97	2.2	15.44	2.2
14-Jul	Chatham Centre Roadside	PM10	27271	14306	1	-1.5	2.98	2.2	16.55	2.2
14-Jul	Chatham Centre Roadside	PM25	27343	15834	1	-1.0	2.97	2.2	16.65	2.2
10-Aug	Chesterfield	PM10	27316	16256	1	0.1	2.93	2.2	15.71	2.2
10-Aug	Chesterfield	PM25	27314	12500	1	0.5	2.88	2.2	16.13	2.2
10-Aug	Chesterfield Road	PM10	22299	11428	1	0.7	2.98	2.2	15.95	2.2
10-Aug	Chesterfield Road	PM25	27339	15349	1	-0.5	2.90	2.2	15.88	2.2
16-Aug	Coventry Memorial Park	PM25		analyser	not	present				

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0401

Date Year =2011	Site		Analyser number	Calculated Spring Constant k_0	Uncertainty (%)	[4]k_0 accuracy (%)	[3]Measured Main Flow (l/min)	Uncertainty (%)	[3]Measured Total Flow (l/min)	Uncertainty (%)
02-Aug	Eastbourne	PM10		14231	1	-1.9	3.03	2.2	16.91	2.2
02-Aug	Eastbourne	PM25		14718	1	-0.8	3.01	2.2	16.77	2.2
16-Aug	Harwell	PM10	27333	14792	1	-1.0	2.99	2.2	15.42	2.2
16-Aug	Harwell	PM25	21366	12365	1	-0.2	2.76	2.2	15.34	2.2
19-Aug	Harwell Partisol	PM10	21257						16.90	2.2
19-Aug	Harwell Partisol	PM25	21020						14.48	2.2
23-Aug	Hull Freetown	PM10	24445	14320	1	1.5	**3.23**	**2.2**	**17.13**	**2.2**
23-Aug	Hull Freetown	PM25		not	on	site	for	audit		
15-Aug	Leamington Spa	PM10	27295	14865	1	-0.9	3.05	2.2	16.53	2.2
15-Aug	Leamington Spa	PM25	27248	14078	1	-0.7	2.97	2.2	16.17	2.2
24-Aug	Leeds Centre	PM10	24451	13402	1	0.1	3.03	2.2	16.07	2.2
24-Aug	Leeds Centre	PM25	27254	16981	1	-0.4	3.05	2.2	15.90	2.2
24-Aug	Leeds Headingley Kerbside	PM10	27287	15132	1	-0.3	2.96	2.2	16.38	2.2
24-Aug	Leeds Headingley Kerbside	PM25	27249	14623	1	-0.5	3.12	2.2	16.27	2.2
04-Aug	Leicester Centre	PM10	24442	14122	1	-2.3	2.97	2.2	16.54	2.2
04-Aug	Leicester Centre	PM25	26500	14638	1	-2.2	2.95	2.2	16.49	2.2
23-Aug	Liverpool Speke	PM10	24450	15693	1	-0.8	3.03	2.2	15.46	2.2
23-Aug	Liverpool Speke	PM25	28607	14672	1	-1.6	2.90	2.2	15.13	2.2
16-Aug	Manchester Piccadilly	PM25	h7353	13822	1	-1.5	3.00	2.2	15.62	2.2
13-Jul	Middlesbrough	PM10	24325	13793	1	-2.4	**2.85**	**2.2**	**16.57**	**2.2**
13-Jul	Middlesbrough	PM25	27195	15733	1	-1.7	2.90	2.2	15.86	2.2
11-Jul	Newcastle Centre	PM10	24448	13767	1	-0.4	3.06	2.2	15.69	2.2
11-Jul	Newcastle Centre	PM25	24447	14800	1	-0.3	3.05	2.2	15.30	2.2
11-Jul	Northampton	PM25							16.60	2.2
28-Jul	Norwich Lakenfields	PM10		14071	1	-0.3	3.01	2.2	16.85	2.2
28-Jul	Norwich Lakenfields	PM25		15474	1	-0.8	3.01	2.2	16.69	2.2
30-Aug	Nottingham Centre	PM10	25025	15393	1	-1.2	2.99	2.2	16.66	2.2
30-Aug	Nottingham Centre	PM25	27369	12580	1	-1.8	3.01	2.2	16.63	2.2
19-Aug	Oxford St Ebbes	PM10		14927	1	0.8	3.01	2.2	16.69	2.2
19-Aug	Oxford St Ebbes	PM25		17304	1	0.8	2.98	2.2	16.56	2.2
11-Aug	Plymouth Centre	PM10	24428	12283	1	0.0	3.13	2.2	16.61	2.2
11-Aug	Plymouth Centre	PM25	27221	12760	1	-1.4	3.01	2.2	16.45	2.2
18-Jul	Portsmouth	PM10	7628	16747	1	-1.4	3.09	2.2	16.46	2.2
18-Jul	Portsmouth	PM25	21358	18308	1	-1.3	2.89	2.2	16.25	2.2
24-Aug	Preston	PM25	22881	12775	1	-1.4	**3.09**	**2.2**	**16.85**	**2.2**
15-Aug	Reading New Town	PM10		13090	1	-0.8	3.00	2.2	16.52	2.2
15-Aug	Reading New Town	PM25		13849	1	-2.0	2.98	2.2	16.48	2.2
14-Jul	Rochester Stoke	PM10	27241	14677	1	-1.6	3.07	2.2	16.95	2.2
14-Jul	Rochester Stoke	PM25	27258	15776	1	-1.1	3.02	2.2	16.90	2.2
17-Aug	Salford Eccles	PM10	21168	14540	1	0.9	**2.97**	**2.2**	**16.73**	**2.2**
17-Aug	Salford Eccles	PM25	27272	14381	1	-1.8	**2.96**	**2.2**	**15.88**	**2.2**
05-Aug	Sandy Roadside	PM10	22018	12950	1	-1.3	2.99	2.2	16.68	2.2
05-Aug	Sandy Roadside	PM25	27260	15838	1	-1.5	2.97	2.2	16.73	2.2
23-Aug	Scunthorpe Town	PM10	27366	15013	1	0.1	2.94	2.2	16.20	2.2
08-Aug	Sheffield Centre	PM10	25024	12123	1	-1.0	3.03	2.2	15.48	2.2
08-Aug	Sheffield Centre	PM25	27253	15468	1	-1.1	**2.81**	**2.2**	**15.20**	**2.2**
19-Jul	Southampton Centre	PM10	24448	13895	1	0.2	2.99	2.2	16.89	2.2
19-Jul	Southampton Centre	PM25	27256	16492	1	-0.2	2.98	2.2	16.67	2.2

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05-Jul	Southend-on-Sea	PM25	22927	12428	1	0.0	**2.93**	**2.2**	**15.95**	**2.2**
05-Jul	Stanford-le-Hope Roadside	PM10	24397	13527	1	0.7	2.69	2.2	16.61	2.2
05-Jul	Stanford-le-Hope Roadside	PM25	11292	11272	1	-0.2	3.13	2.2	16.72	2.2
12-Jul	Stockton-on-Tees Eaglescliffe	PM10	17691						15.60	2.2
12-Jul	Stockton-on-Tees Eaglescliffe	PM25	17805						16.00	2.2
08-Aug	Stoke-on-Trent Centre	PM10	25028	12314	1	-1.5	3.12	2.2	17.33	2.2
08-Aug	Stoke-on-Trent Centre	PM25	27262	13297	1	-1.5	3.10	2.2	17.25	2.2
01-Aug	Storrington Roadside	PM10	272679	15547	1	-0.8	3.02	2.2	16.72	2.2
01-Aug	Storrington Roadside	PM25	27229	12717	1	-0.2	3.02	2.2	16.79	2.2
12-Jul	Sunderland Silksworth	PM25	27247	15508	1	-1.9	**2.82**	**2.2**	**14.63**	**2.2**
13-Jul	Thurrock	PM10	27329	13808	1	-1.7	**3.01**	**2.2**	**16.68**	**2.2**
22-Aug	Warrington	PM10	27183	17177	1	-1.4	2.84	2.2	14.95	2.2
22-Aug	Warrington	PM25	27269	16186	1	-1.1	2.90	2.2	14.62	2.2
15-Aug	Wigan Centre	PM25	27291	15070	1	-1.0	**2.96**	**2.2**	**16.16**	**2.2**
22-Aug	Wirral Tranmere	PM25	22883	13192	1	-0.8	2.85	2.2	16.05	2.2
22-Aug	York Bootham	PM10		dryer	fault	not	tested			
22-Aug	York Bootham	PM25		dryer	fault	not	tested			
	York Fishergate	PM10	22101	Analyser	failed	during	test			

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

The calibration results for NOx, NO, CO, SO_2, O_3 and Particulates are those that fall within our scope of accreditation. Results marked with an asterisk (*) on this certificate fall outside our accreditation, but have been included for completeness.

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

Concentration = (output – zero response) x Calibration factor

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

[3] The measured main flow rate (where this is applicable) is the flow rate through the sensor unit of a TEOM analyser. The measured aux flow rate (where this is applicable) is the flow rate through the bypass tubing of the TEOM particulate analyser under test. The measured total flow rate is the total flow rate through the particulate analyser under test. Units of flow are $l.min^{-1}$. Measurements shown in **bold** are not made at the normal sample inlet and may not therefore accurately represent the actual flow through the inlet.
[4] The k_0 accuracy value (specifically for TEOM analysers) indicates the closeness of the calculated result (in g/s^2 units) to the manufacturer's specified value of k_0.

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

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

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

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