From:	Foi Enquiries
To:	[redacted]
Subject:	EIR-17-1198 - Calibration Data
Date:	07 September 2017 15:09:29
Attachments:	Further Information - Right to Review & Appeal.pdf EIR-17-1198 - 2765.pdf EIR-17-1198 - 2853.pdf EIR-17-1198 - 2941.pdf EIR-17-1198 - 3089.pdf EIR-17-1198 - 3099.pdf EIR-17-1198 - 3305.pdf EIR-17-1198 - 3306.pdf EIR-17-1198 - 3744.pdf EIR-17-1198 - 3753.pdf EIR-17-1198 - QAQC_Ricardo_Q1_2013_Issue_1.pdf EIR-17-1198 - QAQC_Ricardo_Q1_2014_Issue_1.pdf EIR-17-1198 - QAQC_Ricardo_Q3_2013_Issue_1.pdf EIR-17-1198 - QAQC_Ricardo_Q3_2014_Issue_1.pdf EIR-17-1198 - Summer_2015.pdf EIR-17-1198 - Summer_2016.pdf EIR-17-1198 - Winter_2015.pdf EIR-17-1198 - Winter_2016.pdf EIR-17-1198 - Winter_2017.pdf EIR-17-1198 - Table.pdf

Dear [redacted],

Thank you for your information request of 21 August 2017. Aberdeen City Council (ACC) has completed the necessary search for the information requested.

Aberdeen City Council has several atmosphere monitoring stations which, amongst other things, measure particulates (pm10, pm2.5) and nitrous oxides. Such instruments are calibrated against standards periodically by experts to ensure that the data they provide is accurate and precise.

Please provide for each monitoring station and for each of the above analytes, in Aberdeen City:

a) The frequency of each calibration
6 monthly.

b) The actual values on calibration against standards
Calibration certificates for all monitoring equipment between 2013 and 2017 attached.

Please supply data for the last five years.

So for each monitoring station at each calibration we require the calibration for pm10, pm2.5 and NOx.

c) Please state if any of the instruments failed calibration. This is vital as it would call into question any data recorded whilst out of calibration.
Details of non-conformance and action taken in attached table. All data collected by instrumentation is independently audited by a third party. This entails data verification and ratification. Information on these processes is available at http://www.scottishairquality.co.uk/data/verification-ratification. Data must undergo this process prior to its inclusion in annual air quality progress reports in accordance with Environment Act 1995.

We hope this helps with your request.

Yours sincerely,

Grant Webster
Information Compliance Officer

INFORMATION ABOUT THE HANDLING OF YOUR REQUEST

As the information which you requested is environmental information, as defined under Regulation 2(1) of the Environmental Information (Scotland) Regulations 2004 (the EIRs), ACC considered that it was exempt from release through FOISA, and must therefore give you notice that we are refusing your request under Section 39(2) of FOISA (Freedom of Information (Scotland) Act 2002). However, you have a separate right to access the information which you have requested under Regulation 5 of the EIRs, under which ACC has handled your request. Please refer to the attached PDF for more information about your rights under the EIRs.

Information Compliance Team
Customer Service
Corporate Governance
Aberdeen City Council
3rd Floor North
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ABERDEEN AB10 1AQ

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*03000 numbers are free to call if you have 'free minutes' included in your mobile call plan.
Calls from BT landlines will be charged at the local call rate of 10.24p per minute (the same as 01224s).

www.aberdeencity.gov.uk

RICARDO-AEA

CERTIFICATE OF CALIBRATION

Glengarnock Technology Centre, Caledonian Road, Lochshore Business Park, Glengarnock, Ayrshire, KA14 3DD. Telephone 0870 1905269 Fax 0870 1905151

UKAS CALIBRATION
0401

Approved Signatories: D. Hector S. Stratton

Signed: Date: 18th March 2013

Cert No: 2765

Customer Name and Address:

Scottish Government
Water, Air, Soils and Flooding Division
Environmental Quality Directorate
Scottish Government
Victoria Quay
Edinburgh
EH6 6QQ

Description:

Calibration factors for Aberdeen City Council's Union Street (PM10), Anderson Drive, Market Street 2, Wellington Road, and Kings Street air monitoring stations.

Site / Date Test Carried Out	Species	Analyser Serial No.	Zero Response[1]	Uncertainty (ppb)	Calibration Factor[2]	Uncertainty %	Converter eff. (%)[3]
Anderson Drive 4 Feb 2013	NOx	215	11.78	2.6	0.9638	3.5	96.7
	NO	215	13.34	2.5	0.9150	3.5	N/A
Market Street 2 6 Feb 2013	NOx	3417	-0.34	2.5	1.0568	3.5	100.8
	NO	3417	-0.34	2.5	1.0568	3.5	N/A
Wellington Road 4 Feb 2013	NOx	2248	44.2		1.2022		
	NO	2248	46.2		1.1685		N/A
King Street 6 Feb 2013	NOx	2640	0.3	2.6	0.9450	3.5	98.6
	NO	2640	0.48	2.6	0.9924	3.5	N/A

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.

Site / Date Test Carried Out	Species	Analyser Serial No.	Parameter	Specified Value	Measured Value	Deviation %
Union Street 5 Feb 2013	TEOM PM_{10}	22936	Main Flow[4]	3.00	2.95	-1.5
			AuxFlow[4]	13.66		
			Total Flow[4]	16.67	15.76	-5.5
			k_0[5]	13170	12897	-2.1
Anderson Drive 4 Feb 2013	TEOM PM_{10}	24832	Main Flow[4]	3.00	2.98	-0.7
			Aux Flow[4]	13.67		
			Total Flow[4]	16.67	16.22	-2.7
			k_0[5]	13152	13063	-0.7
Market Street 2 6 Feb 2013	BAM PM_{10}	J6867	Main Flow	16.67	15.00	-10.0
Wellington Road 4 Feb 2013	TEOM PM_{10}	25544	Main Flow[4]	3.00	2.95	-1.8
			Aux Flow[4]	13.68		
			Total Flow[4]	16.67	16.03	-3.9
			k_0[5]	14499	14272	-1.6
King Street 6 Feb 2013	BAM PM_{10}	H4347	Main Flow	16.67	17.85	7.1

Uncertainties:

TEOM PM_{10}	Main Flow	±2.2%
	Total Flow	±2.2%
	Aux Flow	±2.2%
	k_0	±1.0%

The gaseous ambient analysers listed above have been tested for zero response, calibration factor, linearity and converter efficiency (NO_x analysers only) by documented methods. The factors have been calculated using certified gas standards. The particulate analysers listed above have been tested for sample flow rates and k_0 (where appropriate) by documented methods. Note that the test results are valid on the day of test only, as analyser drift over time cannot be quantified. All results for gaseous species are given in ppb (parts per billion) mole fractions or ppm (parts per million) mole fractions.

1The zero response is the zero reading on the data logging system of the analyser when audit zero gas was introduced to the analysers under test.

2The calibration factor is the multiplying factor required to scale the reading on the data logging system of the analyser into reported concentration units (ppb for NO, NO_x, SO_2, O_3 and ppm for CO. Where 1 ppm = 1000 ppb). It should be used in conjunction with the zero response. A corrected concentration is calculated using the following equation:

Concentration = F (Output - Zero Response)

Where F = Calibration Factor provided on this certificate
Output = Reading on the data logging system of the analyser
Zero Response = Zero Response provided on this certificate

3Converter eff. is the measured efficiency of the NO_2 to NO converter within the oxides of nitrogen analyser under test.

4The measured main flow rate (where applicable) is the flow rate through the sensor unit of the TEOM particulate analyser under test. The measured aux flow rate (where 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 $l.min^{-1}$. Where flow rates are highlighted in bold, it indicates that measurements were not made at the analyser sample inlet. These measurements therefore may not accurately reflect analyser performance in normal operation.

5The calculated k_0 value (TEOM analysers only) is the calculated k_0 spring constant based on tests undertaken with filters of known weight. The % deviation indicates the closeness of the calculated result to the manufacturer's specified k_0 value.

The calibration results shaded are those that fall within our scope of accreditation, all other results on this certificate are not UKAS accredited, but have been included for completeness.

CERTIFICATE OF CALIBRATION

18 Blythswood Square, Glasgow, G2 4AD
Telephone 01235 753642

0401

Approved Signatories: D. Hector S. Stratton

Signed:

Date of Issue:

Certificate Number: 2853

Customer Name and Address: Scottish Government
Water, Air, Soils and Flooding Division
Environmental Quality Directorate
Scottish Government
Victoria Quay
Edinburgh
EH6 6QQ

Description: Calibration factors for Aberdeen City Council's Union Street (PM10), Anderson Drive, Market Street 2, Wellington Road, and Kings Street air monitoring stations.

Site / Date Test Carried Out	Species	Analyser Serial No.	Zero Response[1]	Uncertainties ppb	Calibration Factor[2]	Uncertainties %	Converter eff. (%)[3]
Anderson Drive 6th August 2013	NO_x	697	1.4	2.5	1.0504	4.5	100.4
	NO		1.9	2.5	1.0465	5.3	
Market Street 2 6th August 2013	NO_x	3417	0.4	2.5	0.9815	3.6	98.5
	NO		0.5	2.5	0.9890	3.6	
Wellington Road 5th August 2013	NO_x	2248	0.9	2.5	1.0174	4.8	100.4
	NO		0.8	2.5	1.0172	4.3	
King Street 5th August 2013	NO_x	2640	0.2	2.5	0.9907	3.9	99.2
	NO		-0.1	2.5	0.9851	3.6	

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.

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

Site / Date Test Carried Out	Species	Analyser Serial No.	Parameter	Specified Value	Measured Value	Deviation %	Uncertainty %
Union Street 6th August 2013	TEOM PM_{10}	22936	Main Flow[4]	3.00	2.98	-0.6	±2.2
			Aux Flow[4]	13.66			±2.2
			Total Flow	16.67	15.83	-5.0	±2.2
			k_0[5]	13170	13104	-0.5	±1.0
Anderson Drive 6th August 2013	TEOM PM_{10}	24832	Main Flow[4]	3.00	3.02	0.7	±2.2
			Aux Flow[4]	13.67			±2.2
			Total Flow	16.67	16.26	-2.5	±2.2
			k_0[5]	13152	13039	-0.9	±1.0
Wellington Road 5th August 2013	TEOM PM_{10}	25544	Main Flow[4]	3.00	2.98	-0.8	±2.2
			Aux Flow[4]	13.66			±2.2
			Total Flow	16.67	15.84	-5.0	±2.2
			k_0[5]	14499	14237	-1.8	±1.0

Site / Date Test Carried Out	Species	Analyser Serial No.	Parameter	Specified Value	Measured Value	Deviation %	Uncertainty %
Market Street 2 6th August 2013	BAM PM10	J6867	Main Flow[4]	16.67	16.07	-3.6	±2.2
King Street 5th August 2013	BAM PM10	H4347	Main Flow[4]	16.67	16.87	1.2	±2.2

The gaseous ambient analysers listed above have been tested for zero response, calibration factor, linearity and converter efficiency (NO_x analysers only) by documented methods. The factors have been calculated using certified gas standards. The particulate analysers listed above have been tested for sample flow rates and k_0 (where appropriate) by documented methods. Note that the test results are valid on the day of test only, as analyser drift over time cannot be quantified. All results for gaseous species are given in ppb (parts per billion) mole fractions or ppm (parts per million) mole fractions.

[1]The zero response is the zero reading on the data 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 of the analyser into reported concentration units (ppb for NO, NO_x, SO_2, O_3 and ppm for CO. Where 1 ppm = 1000 ppb). It should be used in conjunction with the zero response. A corrected concentration is calculated using the following equation:

Concentration = F (Output - Zero Response)

Where F = Calibration Factor provided on this certificate
Output = Reading on the data logging system of the analyser
Zero Response = Zero Response provided on this certificate

[3]Converter eff. is the measured efficiency of the NO_2 to NO converter within the oxides of nitrogen analyser under test.

[4]The measured main flow rate (where applicable) is the flow rate through the sensor unit of the TEOM particulate analyser under test. The measured aux flow rate (where 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. Where flow rates are highlighted in bold, it indicates that measurements were not made at the analyser sample inlet. These measurements therefore may not accurately reflect analyser performance in normal operation.

[5]The calculated k0 value (TEOM analysers only) is the calculated k0 spring constant based on tests undertaken with filters of known weight. The % deviation indicates the closeness of the calculated result to the manufacturer's specified k0 value.

The calibration results shaded are those that fall within our scope of accreditation, all other results on this certificate are not UKAS accredited, but have been included for completeness.

RICARDO-AEA

CERTIFICATE OF CALIBRATION

18 Blythswood Square, Glasgow, G2 4AD
Telephone 01235 753642

0401

Approved Signatories: D. Hector S. Stratton

Signed:

Date of Issue: 4th April 2014

Certificate Number: 2941

Customer Name and Address: Scottish Government
Water, Air, Soils and Flooding Division
Environmental Quality Directorate
Scottish Government
Victoria Quay
Edinburgh
EH6 6QQ

Description: Calibration factors for Aberdeen City Council's Union Street (PM10), Anderson Drive, Market Street 2, Wellington Road, and Kings Street air monitoring stations.

Site / Date Test Carried Out	Species	Analyser Serial No.	Zero Response[1]	Uncertainties ppb	Calibration Factor[2]	Uncertainties %	Converter eff. (%)[3]
Market Street 2 10th February 2014	NO_x	3417	1.4	2.5	0.9793	3.5	99.6
	NO		1.3	2.5	0.9749	3.5	
Wellington Road 10th February 2014	NO_x	2248	1.1	2.5	0.9872	3.7	99.3
	NO		1.2	2.5	0.9768	3.6	
King Street 10th February 2014	NO_x	2640	-0.4	2.5	1.0523	3.5	99.6
	NO		-0.5	2.5	1.0425	3.5	

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

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

Site / Date Test Carried Out	Species	Analyser Serial No.	Parameter	Specified Value	Measured Value	Deviation %	Uncertainty %
Union Street 11th February 2014	TEOM PM_{10}	22936	Main Flow[4]	3.00	2.98	-0.5	±2.2
			Aux Flow[4]	13.67			±2.2
			Total Flow	16.67	16.13	-3.3	±2.2
			k_0[5]	13170	12959	-1.6	±1.0
Anderson Drive 11th February 2014	TEOM PM_{10}	24832	Main Flow[4]	3.00	2.99	-0.3	±2.2
			Aux Flow[4]	13.67			±2.2
			Total Flow	16.67	16.13	-3.3	±2.2
			k_0[5]	13152	13063	-0.7	±1.0
Wellington Road 10th February 2014	TEOM PM_{10}	25544	Main Flow[4]	3.00	2.95	-1.7	±2.2
			Aux Flow[4]	13.67			±2.2
			Total Flow	16.67	16.08	-3.5	±2.2
			k_0[5]	14499	14263	-1.6	±1.0

Site / Date Test Carried Out	Species	Analyser Serial No.	Parameter	Specified Value	Measured Value	Deviation %	Uncertainty %
Market Street 2 10th February 2014	BAM PM10	J6867	Main Flow[4]	16.67	16.90	1.4	±2.2
King Street 10th February 2014	BAM PM10	H4347	Main Flow[4]	16.67	17.10	2.6	±2.2

The gaseous ambient analysers listed above have been tested for zero response, calibration factor, linearity and converter efficiency (NO_x analysers only) by documented methods. The factors have been calculated using certified gas standards. The particulate analysers listed above have been tested for sample flow rates and k_0 (where appropriate) by documented methods. Note that the test results are valid on the day of test only, as analyser drift over time cannot be quantified. All results for gaseous species are given in ppb (parts per billion) mole fractions or ppm (parts per million) mole fractions.

[1]The zero response is the zero reading on the data 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 of the analyser into reported concentration units (ppb for NO, NO_x, SO_2, O_3 and ppm for CO. Where 1 ppm = 1000 ppb). It should be used in conjunction with the zero response. A corrected concentration is calculated using the following equation:

Concentration = F (Output - Zero Response)

Where F = Calibration Factor provided on this certificate
Output = Reading on the data logging system of the analyser
Zero Response = Zero Response provided on this certificate

[3]Converter eff. is the measured efficiency of the NO_2 to NO converter within the oxides of nitrogen analyser under test.

[4]The measured main flow rate (where applicable) is the flow rate through the sensor unit of the TEOM particulate analyser under test. The measured aux flow rate (where 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. Where flow rates are highlighted in bold, it indicates that measurements were not made at the analyser sample inlet. These measurements therefore may not accurately reflect analyser performance in normal operation.

[5]The calculated k0 value (TEOM analysers only) is the calculated k0 spring constant based on tests undertaken with filters of known weight. The % deviation indicates the closeness of the calculated result to the manufacturer's specified k0 value.

The calibration results shaded are those that fall within our scope of accreditation, all other results on this certificate are not UKAS accredited, but have been included for completeness.

RICARDO-AEA

0401

CERTIFICATE OF CALIBRATION

18 Blythswood Square, Glasgow, G2 4AD
Telephone 01235 753642

Approved Signatories: D. Hector S. Stratton

Signed:

Date of Issue: 1st April 2015

Certificate Number: 3089

Customer Name and Address: Scottish Government
Water, Air, Soils and Flooding Division
Environmental Quality Directorate
Scottish Government
Victoria Quay
Edinburgh
EH6 6QQ

Description: Calibration factors for Aberdeen City Council's Union Street (PM10), Anderson Drive, Market Street 2, Wellington Road, and Kings Street air monitoring stations.

Site / Date Test Carried Out	Species	Analyser Serial No.	Zero Response[1]	Uncertainties ppb	Calibration Factor[2]	Uncertainties %	Converter eff. (%)[3]
Anderson Drive 14th August 2014	NO_x	697	1.3	2.4	0.7384	10.9	99.6
	NO		2.5	2.4	0.7224	8.4	
Market Street 2 13th August 2014	NO_x	3417	7.0	2.6	1.2455	3.5	98.4
	NO		5.0	2.6	1.2233	3.5	
King Street 13th August 2014	NO_x	2640	0.0	2.6	1.2614	3.5	99.1
	NO		0.0	2.6	1.2559	3.5	
Wellington Road 3rd December 2014	NO_x	2248	-1.9	2.5	1.0192	3.5	99.2
	NO		-2.3	2.5	1.0271	3.5	

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

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

Site / Date Test Carried Out	Species	Analyser Serial No.	Parameter	Specified Value	Measured Value	Deviation %	Uncertainty %
Anderson Drive 14th August 2014	TEOM PM_{10}	24832	Main Flow[4]	3.00	1.52	-49.3	±2.2
			Aux Flow[4]	13.68			±2.2
			Total Flow	16.67	15.46	-7.2	±2.2
			k_0[5]	13152	13097	-0.4	±1.0
Union Street 14th August 2014	TEOM FDMS PM_{10}	1405A227 711402	Main Flow[4]	4.65	4.33	-6.8	±2.2
			Aux Flow[4]	11.99			±2.2
			Total Flow	16.67	15.26	-8.5	±2.2
			k_0[5]	16813	16727	-0.5	±1.0
Wellington Road	TEOM PM_{10}	25544	Main Flow[4]	3.00	2.95	-1.7	±2.2
			Aux Flow[4]	13.67			±2.2
			Total Flow	16.67	16.08	-3.5	±2.2
			k_0[5]	14499	14263	-1.6	±1.0

Site / Date Test Carried Out	Species	Analyser Serial No.	Parameter	Specified Value	Measured Value	Deviation %	Uncertainty %
Market Street 2 13th August 2014	BAM PM10	J6867	Main Flow[4]	16.67	16.95	1.7	±2.2
King Street 13th August 2014	BAM PM10	H4347	Main Flow[4]	16.67	Overrange		±2.2

The gaseous ambient analysers listed above have been tested for zero response, calibration factor, linearity and converter efficiency (NO_x analysers only) by documented methods. The factors have been calculated using certified gas standards. The particulate analysers listed above have been tested for sample flow rates and k_0 (where appropriate) by documented methods. Note that the test results are valid on the day of test only, as analyser drift over time cannot be quantified. All results for gaseous species are given in ppb (parts per billion) mole fractions or ppm (parts per million) mole fractions.

[1]The zero response is the zero reading on the data 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 of the analyser into reported concentration units (ppb for NO, NO_x, SO_2, O_3 and ppm for CO. Where 1 ppm = 1000 ppb). It should be used in conjunction with the zero response. A corrected concentration is calculated using the following equation:

Concentration = F (Output - Zero Response)

Where F = Calibration Factor provided on this certificate
Output = Reading on the data logging system of the analyser
Zero Response = Zero Response provided on this certificate

[3]Converter eff. is the measured efficiency of the NO_2 to NO converter within the oxides of nitrogen analyser under test.

[4]The measured main flow rate (where applicable) is the flow rate through the sensor unit of the TEOM particulate analyser under test. The measured aux flow rate (where 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. Where flow rates are highlighted in bold, it indicates that measurements were not made at the analyser sample inlet. These measurements therefore may not accurately reflect analyser performance in normal operation.

[5]The calculated k0 value (TEOM analysers only) is the calculated k0 spring constant based on tests undertaken with filters of known weight. The % deviation indicates the closeness of the calculated result to the manufacturer's specified k0 value.

The calibration results shaded are those that fall within our scope of accreditation, all other results on this certificate are not UKAS accredited, but have been included for completeness.

RICARDO-AEA

0401

CERTIFICATE OF CALIBRATION

18 Blythswood Square, Glasgow, G2 4AD
Telephone 01235 753642

Approved Signatories: D. Hector S. Stratton

Signed:

Date of Issue: 1st April 2015

Certificate Number: 3099

Customer Name and Address:

Scottish Government
Water, Air, Soils and Flooding Division
Environmental Quality Directorate
Scottish Government
Victoria Quay
Edinburgh
EH6 6QQ

Description:

Calibration factors for Aberdeen City Council's Union Street (PM10), Anderson Drive, Market Street 2, Wellington Road, and Kings Street air monitoring stations.

Site / Date Test Carried Out	Species	Analyser Serial No.	Zero Response[1]	Uncertainties ppb	Calibration Factor[2]	Uncertainties %	Converter eff. (%)[3]
Anderson Drive 22nd January 2015	NO_x	697	4.0	2.5	1.0294	3.5	99.3
	NO		3.8	2.5	1.0247	3.5	
Market Street 2 22nd January 2015	NO_x	3417	5.1	2.5	1.0789	3.8	100.1
	NO		3.9	2.6	1.0788	3.5	
King Street 21st January 2015	NO_x	2640	3.2	2.6	1.0984	3.5	100.1
	NO		3.4	2.6	1.1018	3.5	
Wellington Road 22nd January 2015	NO_x	2248	1.2	2.6	1.0877	3.5	99.2
	NO		0.1	2.6	1.0954	3.5	

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

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

Site / Date Test Carried Out	Species	Analyser Serial No.	Parameter	Specified Value	Measured Value	Deviation %	Uncertainty %
Anderson Drive 22nd January 2015	TEOM PM_{10}	24832	Main Flow[4]	3.00	**3.04**	-1.7	±2.2
			Aux Flow[4]	13.68	**13.21**	-1.7	±2.2
			Total Flow	16.67	16.24	-2.6	±2.2
			k_0[5]	13152	12984	-1.3	±1.0
Union Street 22nd January 2015	TEOM FDMS PM_{10}	22771	Main Flow[4]	4.68	4.35	-7.0	±2.2
			Aux Flow[4]	12.01			±2.2
			Total Flow	16.67	15.33	-8.0	±2.2
			k_0[5]	16813	16746	-0.4	±1.0
Wellington Road 22nd January 2015	TEOM PM_{10}	25544	Main Flow[4]	3.00	**3.02**	-0.5	±2.2
			Aux Flow[4]	13.68	**13.52**	-0.5	±2.2
			Total Flow	16.67	16.55	-0.7	±2.2
			k_0[5]	14499	14235	-1.8	±1.0

Site / Date Test Carried Out	Species	Analyser Serial No.	Parameter	Specified Value	Measured Value	Deviation %	Uncertainty %
Market Street 2 22nd January 2015	BAM PM10	J6867	Total Flow[4]	16.67	15.08	-9.5	±2.2
King Street 21st January 2015	BAM PM10	H4347	Total Flow[4]	16.67	16.34	-2.0	±2.2

The gaseous ambient analysers listed above have been tested for zero response, calibration factor, linearity and converter efficiency (NO_X analysers only) by documented methods. The factors have been calculated using certified gas standards. The particulate analysers listed above have been tested for sample flow rates and k_0 (where appropriate) by documented methods. Note that the test results are valid on the day of test only, as analyser drift over time cannot be quantified. All results for gaseous species are given in ppb (parts per billion) mole fractions or ppm (parts per million) mole fractions.

[1]The zero response is the zero reading on the data 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 of the analyser into reported concentration units (ppb for NO, NO_x, SO_2, O_3 and ppm for CO. Where 1 ppm = 1000 ppb). It should be used in conjunction with the zero response. A corrected concentration is calculated using the following equation:

Concentration = F (Output - Zero Response)

Where F = Calibration Factor provided on this certificate
Output = Reading on the data logging system of the analyser
Zero Response = Zero Response provided on this certificate

[3]Converter eff. is the measured efficiency of the NO_2 to NO converter within the oxides of nitrogen analyser under test.

[4]The measured main flow rate (where applicable) is the flow rate through the sensor unit of the TEOM particulate analyser under test. The measured aux flow rate (where 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. Where flow rates are highlighted in bold, it indicates that measurements were not made at the analyser sample inlet. These measurements therefore may not accurately reflect analyser performance in normal operation.

[5]The calculated k0 value (TEOM analysers only) is the calculated k0 spring constant based on tests undertaken with filters of known weight. The % deviation indicates the closeness of the calculated result to the manufacturer's specified k0 value.

The calibration results shaded are those that fall within our scope of accreditation, all other results on this certificate are not UKAS accredited, but have been included for completeness.

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Signed:

Date of Issue: 06 May 2016

Certificate Number: 03305

Customer Name and Address:
Scottish Government
Water, Air, Soils and Flooding Division
Environmental Quality Directorate
Scottish Government
Victoria Quay
Edinburgh
EH6 6QQ

Description: Calibration factors for Aberdeen City Council's Union Street (PM_{10}), Anderson Drive, Market Street 2, Wellington Road, and Kings Street air monitoring stations.

Ricardo Energy and Environment Calibration ID Number: ED57729/April 2016

Site / Date Test Carried Out	Species	Analyser Serial No.	Zero Response¹	Uncertainties ppb	Calibration Factor²	Uncertainties %	Converter eff. (%)³
Anderson Drive 14th July 2015	NO_x	697	1.0	2.5	1.0249	3.5	97.9
	NO		-0.1	2.5	1.0240	3.5	
Market Street 2 14th July 2015	NO_x	3417	2.7	2.6	1.2667	3.5	101.0
	NO		0.1	2.6	1.2362	3.5	
King Street 13th July 2015	NO_x	2640	-0.2	2.5	1.0338	3.5	100.4
	NO		0.4	2.5	1.0614	3.5	
Wellington Road 13th July 2015	NO_x	2248	9.3	2.6	1.1125	3.5	98.2
	NO		5.6	2.6	1.0897	3.5	

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

Site / Date Test Carried Out	Species	Analyser Serial No.	Parameter	Specified Value	Measured Value	Deviation %	Uncertainty %
Anderson Drive 14th July 2015	TEOM PM_{10}	24832	Main Flow[4]	3.00	3.09	3.1	±2.2
			Aux Flow[4]	13.67			±2.2
			Total Flow	16.67	16.71	0.2	±2.2
			k_0[5]	13152	13084	-0.5	±1.0
Wellington Road 13th July 2015	TEOM PM_{10}	25544	Main Flow[4]	3.00	3.14	4.8	±2.2
			Aux Flow[4]	13.67			±2.2
			Total Flow	16.67	16.98	1.8	±2.2
			k_0[5]	15750	15597	-1.0	±1.0

Site / Date Test Carried Out	Species	Analyser Serial No.	Parameter	Specified Value	Measured Value	Deviation %	Uncertainty %
King Street 13th July 2015	BAM PM10	H4347	Total Flow[4]	16.7	15.99	-4.1	±2.2
Market Street 2 14th July 2015	BAM PM10	J6867	Total Flow[4]	16.7	16.45	-1.3	±2.2

The gaseous ambient analysers listed above have been tested for zero response, calibration factor, linearity and converter efficiency (NO_x analysers only) by documented methods. The factors have been calculated using certified gas standards. The particulate analysers listed above have been tested for sample flow rates and k_0 (where appropriate) by documented methods. Note that the test results are valid on the day of test only, as analyser drift over time cannot be quantified. All results for gaseous species are given in ppb (parts per billion) mole fractions or ppm (parts per million) mole fractions.

[1]The zero response is the zero reading on the data 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 of the analyser into reported concentration units (ppb for NO, NO_x, SO_2, O_3 and ppm for CO. Where 1 ppm = 1000 ppb). It should be used in conjunction with the zero response. A corrected concentration is calculated using the following equation:

Concentration = F (Output - Zero Response)

Where F = Calibration Factor provided on this certificate
Output = Reading on the data logging system of the analyser
Zero Response = Zero Response provided on this certificate

[3]Converter eff. is the measured efficiency of the NO_2 to NO converter within the oxides of nitrogen analyser under test.

[4]The measured main flow rate (where applicable) is the flow rate through the sensor unit of the TEOM particulate analyser under test. The measured aux flow rate (where 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. Where flow rates are highlighted in bold, it indicates that measurements were not made at the analyser sample inlet. These measurements therefore may not accurately reflect analyser performance in normal operation.

[5]The calculated k0 value (TEOM analysers only) is the calculated k0 spring constant based on tests undertaken with filters of known weight. The % deviation indicates the closeness of the calculated result to the manufacturer's specified k0 value.

The calibration results shaded are those that fall within our scope of accreditation, all other results on this certificate are not UKAS accredited, but have been included for completeness.

0401

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Date of Issue: 06 May 2016

Certificate Number: 03306

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Environmental Quality Directorate
Scottish Government
Victoria Quay
Edinburgh
EH6 6QQ

Description: Calibration factors for Aberdeen City Council's Union Street (PM_{10}), Anderson Drive, Market Street 2, Wellington Road, and Kings Street air monitoring stations.

Ricardo Energy and Environment Calibration ID Number: ED57729/April 2016

Site / Date Test Carried Out	Species	Analyser Serial No.	Zero Response[1]	Uncertainties ppb	Calibration Factor[2]	Uncertainties %	Converter eff. (%)[3]
Anderson Drive 20th January 2016	NO_x	697	3.7	2.6	1.1304	3.5	88.0
	NO		2.1	2.6	1.1342	3.5	
Market Street 2 19th January 2016	NO_x	3417	2.7	2.6	1.1466	3.5	97.2
	NO		1.6	2.6	1.1450	3.5	
King Street 19th January 2016	NO_x	2640	-1.0	2.5	0.9576	3.5	101.0
	NO		-2.9	2.5	0.9438	3.5	
Wellington Road 20th January 2016	NO_x	2248	1.1	2.6	1.0902	3.5	99.2
	NO		-0.5	2.6	1.1045	3.5	

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

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Site / Date Test Carried Out	Species	Analyser Serial No.	Parameter	Specified Value	Measured Value	Deviation %	Uncertainty %
Anderson Drive 20th January 2016	TEOM PM_{10}	24832	Main Flow[4]	3.00	2.86	-4.8	±2.2
			Aux Flow[4]	13.67			±2.2
			Total Flow	16.67	15.71	-5.8	±2.2
			k_0[5]	13152	13092	-0.5	±1.0
Wellington Road 20th January 2016	TEOM PM_{10}	25544	Main Flow[4]	3.00	2.95	-1.7	±2.2
			Aux Flow[4]	13.67			±2.2
			Total Flow	16.67	16.16	-3.1	±2.2
			k_0[5]	15750	15666	-0.5	±1.0

Site / Date Test Carried Out	Species	Analyser Serial No.	Parameter	Specified Value	Measured Value	Deviation %	Uncertainty %
Union Street 19th January 2016	FDMS PM_{10}	1405A2277 11402	Main Flow[4]	4.67	4.46	-4.6	±2.2
			Aux Flow[4]	12.00			±2.2
			Total Flow	16.67	15.06	-9.7	±2.2
			k_0[5]	16813	16700	-0.7	±1.0
Union Street 19th January 2016	FDMS $PM_{2.5}$	1405A2277 11402	Main Flow[4]	4.67	4.46	-4.6	±2.2
			Aux Flow[4]	12.00			±2.2
			Total Flow	16.67	15.06	-9.7	±2.2
			k_0[5]	15654	15587	-0.4	±1.0

Site / Date Test Carried Out	Species	Analyser Serial No.	Parameter	Specified Value	Measured Value	Deviation %	Uncertainty %
Market Street 2 14th October 2015	FIDAS	6653	Total Flow[4]	4.8	4.02	-16.2	±2.2
Market Street 2 19th January 2016	FIDAS	6653	Total Flow[4]	4.80	4.04	-15.8	±2.2

Site / Date Test Carried Out	Species	Analyser Serial No.	Parameter	Specified Value	Measured Value	Deviation %	Uncertainty %
King Street 19th January 2016	BAM PM10	H4347	Total Flow[4]	16.67	15.80	-5.2	±2.2

The gaseous ambient analysers listed above have been tested for zero response, calibration factor, linearity and converter efficiency (NO_x analysers only) by documented methods. The factors have been calculated using certified gas standards. The particulate analysers listed above have been tested for sample flow rates and k_0 (where appropriate) by documented methods. Note that the test results are valid on the day of test only, as analyser drift over time cannot be quantified. All results for gaseous species are given in ppb (parts per billion) mole fractions or ppm (parts per million) mole fractions.

[1]The zero response is the zero reading on the data 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 of the analyser into reported concentration units (ppb for NO, NO_x, SO_2, O_3 and ppm for CO. Where 1 ppm = 1000 ppb). It should be used in conjunction with the zero response. A corrected concentration is calculated using the following equation:

Concentration = F (Output - Zero Response)

Where F = Calibration Factor provided on this certificate
Output = Reading on the data logging system of the analyser
Zero Response = Zero Response provided on this certificate

No

[3]Converter eff. is the measured efficiency of the NO_2 to NO converter within the oxides of nitrogen analyser under test.

[4]The measured main flow rate (where applicable) is the flow rate through the sensor unit of the TEOM particulate analyser under test. The measured aux flow rate (where 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. Where flow rates are highlighted in bold, it indicates that measurements were not made at the analyser sample inlet. These measurements therefore may not accurately reflect analyser performance in normal operation.

[5]The calculated k0 value (TEOM analysers only) is the calculated k0 spring constant based on tests undertaken with filters of known weight. The % deviation indicates the closeness of the calculated result to the manufacturer's specified k0 value.

The calibration results shaded are those that fall within our scope of accreditation, all other results on this certificate are not UKAS accredited, but have been included for completeness.

CERTIFICATE OF CALIBRATION

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Signed:

Date of Issue: 12th July 2017

Certificate Number: 3744

Customer Name and Address:

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Water, Air, Soils and Flooding Division
Environmental Quality Directorate
Scottish Government
Victoria Quay
Edinburgh
EH6 6QQ

Description: Calibration factors for Aberdeen City Council's Union Street (PM_{10}), Anderson Drive, Market Street 2 and Kings Street air monitoring stations.

Site / Date Test Carried Out	Species	Analyser Serial No.	Zero Response [1]	Uncertainties ppb	Calibration Factor[2]	Uncertainties %	Converter eff. (%)[3]
Anderson Drive 19th July 2016	NO_x	697	2.9	2.6	1.1483	3.5	99.1
	NO		2.2	2.6	1.1452	3.5	
King Street 18th July 2016	NO_x	2640	6.0	2.6	1.1593	3.9	101.0
	NO		3.3	2.6	1.1280	3.5	
Market Street 2 19th July 2016	NO_x	3417	8.7	2.6	1.1825	3.5	99.1
	NO		1.0	2.6	1.1429	3.5	

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

Site / Date Test Carried Out	Species	Analyser Serial No.	Parameter	Specified Value	Measured Value	Deviation %	Uncertainty %
Anderston Drive 19th July 2016	TEOM PM_{10}	24832	Main Flow[4]	3.02	3.19	5.5	2.25
			Aux Flow[4]	13.74			
			Total Flow	16.67	16.95	1.7	2.25
			k_0[5]	13152	13430	2.1	1.00

King Street 18th July 2016	BAM	H4347	Total Flow[4]	16.67	20.25	21.5	2.25

Market Street 2 19th July 2016	BAM	G6212	Total Flow[4]	16.67	16.70	0.2	2.25

Market Street 2 19th July 2016	FIDAS	6653	Total Flow[4]	4.77	4.34	9.0	2.25

The gaseous ambient analysers listed above have been tested for zero response, calibration factor, linearity and converter efficiency (NO_x analysers only) by documented methods. The factors have been calculated using certified gas standards. The particulate analysers listed above have been tested for sample flow rates and k_0 (where appropriate) by documented methods. Note that the test results are valid on the day of test only, as analyser drift over time cannot be quantified. All results for gaseous species are given in ppb (parts per billion) mole fractions or ppm (parts per million) mole fractions.

[1]The zero response is the zero reading on the data 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 of the analyser into reported concentration units (ppb for NO, NO_x, SO_2, O_3 and ppm for CO. Where 1 ppm = 1000 ppb). It should be used in conjunction with the zero response. A corrected concentration is calculated using the following equation:

Concentration = F (Output - Zero Response)

Where F = Calibration Factor provided on this certificate
Output = Reading on the data logging system of the analyser
Zero Response = Zero Response provided on this certificate

[3]Converter eff. is the measured efficiency of the NO_2 to NO converter within the oxides of nitrogen analyser under test.

[4]The measured main flow rate (where applicable) is the flow rate through the sensor unit of the TEOM particulate analyser under test. The measured aux flow rate (where 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. Where flow rates are highlighted in bold, it indicates that measurements were not made at the analyser sample inlet. These measurements therefore may not accurately reflect analyser performance in normal operation.

[5]The calculated k0 value (TEOM analysers only) is the calculated k0 spring constant based on tests undertaken with filters of known weight. The % deviation indicates the closeness of the calculated result to the manufacturer's specified k0 value.

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Description: Calibration factors for Aberdeen City Council's Union Street (PM_{10}), Anderson Drive, Market Street 2, Wellington Road, and Kings Street air monitoring stations.

Site / Date Test Carried Out	Species	Analyser Serial No.	Zero Response [1]	Uncertainties ppb	Calibration Factor[2]	Uncertainties %	Converter eff. (%)[3]
Anderson Drive 26th January 2017	NO_x	697	2.0	2.7	1.3139	3.5	98.5
	NO		0.8	2.7	1.3096	3.5	
King Street 26th January 2017	NO_x	2640	4.0	2.6	1.0606	3.5	100.0
	NO		1.6	2.5	1.0588	3.5	
Market Street 2 26th January 2017	NO_x	3417	4.2	2.5	0.9733	3.5	98.5
	NO		1.0	2.5	0.9862	3.5	

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

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Site / Date Test Carried Out	Species	Analyser Serial No.	Parameter	Specified Value	Measured Value	Deviation %	Uncertainty %
Anderston Drive 26th January 2017	TEOM PM_{10}	24832	Main Flow[4]	3.00	3.07	2.5	2.25
			Aux Flow[4]	13.67		2.5	
			Total Flow	16.67	15.84	2.5	2.25
			k_0[5]	13105	13305	1.2	1.00

Union Street 27th January 2017	FDMS PM_{10}	1405A227 711402	Main Flow[4]	4.67	4.33	-7.2	2.25
			Aux Flow[4]	11.98			
			Total Flow	16.67	14.93	-10.4	2.25
			k_0[5]	16813	16830	0.1	1.00

Union Street 27th January 2017	FDMS $PM_{2.5}$	1405A227 711402	Main Flow[4]	4.67	4.33	-7.2	2.25
			Aux Flow[4]	11.98			
			Total Flow	16.67	14.93	-10.4	2.25
			k_0[5]	15654	15675	0.1	1.00

King Street 26th January 2017	BAM	H4347	Total Flow[4]	16.67	16.00	-4	2.25

Market Street 2 26th January 2017	BAM	G6212	Total Flow[4]	16.67	16.13	-3.3	2.25

The gaseous ambient analysers listed above have been tested for zero response, calibration factor, linearity and converter efficiency (NO_x analysers only) by documented methods. The factors have been calculated using certified gas standards. The particulate analysers listed above have been tested for sample flow rates and k_0 (where appropriate) by documented methods. Note that the test results are valid on the day of test only, as analyser drift over time cannot be quantified. All results for gaseous species are given in ppb (parts per billion) mole fractions or ppm (parts per million) mole fractions.

[1]The zero response is the zero reading on the data logging system of the analyser when audit zero gas was introduced to the analysers under test.

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Where F = Calibration Factor provided on this certificate
Output = Reading on the data logging system of the analyser
Zero Response = Zero Response provided on this certificate

[3]Converter eff. is the measured efficiency of the NO_2 to NO converter within the oxides of nitrogen analyser under test.

[4]The measured main flow rate (where applicable) is the flow rate through the sensor unit of the TEOM particulate analyser under test. The measured aux flow rate (where 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. Where flow rates are highlighted in bold, it indicates that measurements were not made at the analyser sample inlet. These measurements therefore may not accurately reflect analyser performance in normal operation.

[5]The calculated k0 value (TEOM analysers only) is the calculated k0 spring constant based on tests undertaken with filters of known weight. The % deviation indicates the closeness of the calculated result to the manufacturer's specified k0 value.

The calibration results shaded are those that fall out with our scope of accreditation, all other results on this certificate are not UKAS accredited, but have been included for completeness.

QA/QC Data Ratification Report for the Automatic Urban and Rural Network, January-March 2013, and Intercalibration Report, Winter 2013

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

Ricardo-AEA/R/3382
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Report no. Ricardo-AEA/R/3382 Issue 1

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Date:

18 November 2013

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Executive summary

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

Ratified hourly average data capture for the network averaged 92.8% for all pollutants (O_3, NO_2, SO_2, CO, PM_{10} and $PM_{2.5}$) during the 3-month reporting period January-March 2013. Data capture for all pollutants were above 90%. There were 21 sites with data capture less than 90% for the period.

A total of 133 monitoring sites in the AURN operated during this quarter, of which 74 are Local Authority owned sites affiliated to the national network. Some are co-located and separately named gravimetric particulate analysers at sites with automatic analysers. Many affiliated sites have additional Defra-funded analysers installed on site.

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

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Appendices

SECTION A Data Ratification Report, January-March 2013

1 Introduction

This quarterly report covers the Quality Assurance and Control (QA/QC) activities undertaken by Ricardo-AEA to ratify automatic monitoring data from Defra and the Devolved Administrations' urban and rural air quality monitoring network (AURN) for the period 1 January-31 March 2013. During this quarter there were a total of 133 operational monitoring sites in the Network of which there were 98 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 were 61 Defra-funded sites and 72 affiliate sites, although many affiliate sites have fully-funded PM_{10} and/or $PM_{2.5}$ analysers. Eleven sites have non-automatic particulate samplers (Partisols); some of these are co-located with FDMS analysers at Auchencorth Moss, Harwell, London North Kensington and Marylebone Road for both PM_{10} and $PM_{2.5}$, plus PM_{10} at Port Talbot Margam.

1.1 Overview of Network Performance

Ratified hourly average (daily average for Partisols) data capture for the network averaged 92.8% for all pollutants (O_3, NO_2, SO_2, CO, PM_{10} and $PM_{2.5}$) during the 3 month reporting period January-March 2013 (see Table 1.1). All species achieved 90% or higher data capture on average. Data capture rates are calculated using the actual data capture as hourly averages (daily for Partisol) against the total number of hours (or days) in the relevant period; service and maintenance are counted as lost data. It is permissible to discount routine service and calibration from achievable data capture targets, but this is not yet calculated. For sites starting or closing during the period, the data capture is based on the actual date starting or closing.

Table 1.1: AURN Ratified Data Capture (%) by Quarter, January-December 2013

	CO	PM_{10}	$PM_{2.5}$	NO_2	O_3	SO_2	Mean
Q1 2013	95.6	91.6	94.3	92.9	93.9	92.9	92.8

Overall, 320 out of the 379 analysers (84%) achieved data capture levels above the required 90% target during this reporting period. Table 1.2 shows the number of analysers which did not meet the target.

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

Total Number Of Analysers		Q1 Jan-Mar 2013 (No. below 90%)
CO	11	1
NO_2	116	16
O_3	82	10
PM_{10} [1]	67	15
$PM_{2.5}$ [1]	77	13
SO_2	33	4
Total <90%		59

[1] Includes FDMS, BAM and Partisol analysers.

In total, 21 out of the 133 operational network sites in the quarter (16%) had an average data capture rate below the required 90% level for the January-March 2013 period. Of these, 13 were below 85%.

1.2 Changes to Ratified Data

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

Market Harborough	NOx deleted from 26 July 2012, sampling fault
	O_3 deleted from 1 January 2012, sampling fault

2 Changes in the Network for Directive Compliance

No new sites were commissioned during this period:

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 filter over the inlet and leaving for several days. This method does allow the determination of the analyser “zero” but requires a visit by QA/QC staff and the LSO, and therefore it will take time to complete all sites. The findings and implications of these tests are described in Section 5.

3.2 Internal Sampling

Following recommendations made by the QA/QC Unit in 2010, many sites had the sample inlet manifold removed and individual PTFE sample lines for each analyser fitted inside the sample inlet. It had come to light that under certain circumstances at some sites, air from inside the hut was being blown up the inlet tube and affecting the air being sampled. At the time, Equipment Support Units (ESUs) were instructed to seal the inlet tube around the sample lines to prevent this; however, considerable data loss occurred at Mold and Preston, and Wirral Tranmere as described on the October-December 2012 report.

During the ratification of the January-March 2013 Market Harborough dataset, elevated levels of NO_2 were noticed since 2010. Investigations on site revealed that the sample tubes had slipped down inside the inlet pipe allowing partial sampling of cabin air. Unfortunately, it is likely that both the NO_2 and ozone sampling had been compromised and both datasets have been deleted since 2010 up to the repair in June 2013.

It is recommended that ESUs check the integrity of sample inlets at services, particularly following the replacement of the sample lines.

4 Site Specific Issues

In this section, we now discuss in turn specific site issues for sites in the following geographic groupings – London, England (excluding London), Scotland, Northern Ireland and Wales. Where analysers were commissioned during the period, the stated data capture for these instruments is calculated from the date of commissioning. Further details on individual analyser performance issues are given in the relevant CMCU reports.

4.1 London

4.1.1 Data Capture

The data capture for sites in London (within the M25) for the period January-March 2013 is given in Table 4.1:

Table 4.1 Data Capture for London, January-March 2013

Name	CO	PM_{10}	PM_{25}	NO_2	O_3	SO_2	Average
Camden Kerbside		99.5	98.6	99.4			99.2
Haringey Roadside		93.3	99.6	99.3			97.4
London Bexley			99.3	96.9		94.1	96.8
London Bloomsbury		98.4	95.8	98.6	98.2	98.2	97.9
London Eltham			82.2	99.2	99.6		93.7
London Harlington		97.8	98.4	97.2	96.7		97.5
London Harrow Stanmore			99.6				99.6
London Hillingdon				97.8	98.2		98.0
London Marylebone Road	99.6	90.4	99.1	98.2	97.2	98.3	97.1
London Marylebone Road Partisol		96.7	98.9				97.8
London N. Kensington	98.4	96.2	96.9	98.4	98.1	98.5	97.7
London N. Kensington Partisol		98.9	98.9				98.9
London Teddington			96.9	98.1	92.6		95.8
London Westminster			87.8	98.1	98.5		98.1
Southwark A2 Old Kent Road		98.9		99.4			99.1
Tower Hamlets Roadside				99.5			99.5
Number Of Sites	**2**	**9**	**13**	**13**	**8**	**4**	**16**
Number Of Sites < 90%	**0**	**0**	**2**	**0**	**0**	**0**	**0**
Network Mean	**99.0**	**96.7**	**96.3**	**98.5**	**97.4**	**97.3**	**97.8**

4.1.2 Site Specific Issues

.All sites reported data capture above 90% this quarter.

4.2 England (excluding London)

4.2.1 Data Capture

The data capture for sites in England for the period January-March 2013 is given in Table 4.2:

Table 4.2 Data Capture for England, January-March 2013

Name	CO	PM_{10}	PM_{25}	NO_2	O_3	SO_2	Average
Barnsley Gawber				97.4	98.2	97.9	97.9
Bath Roadside				97.6			97.6
Billingham				98.6			98.6
Birmingham Acocks Green			87.7	98.5	98.6		94.9
Birmingham Tyburn		97.4	99.0	99.4	99.4	99.4	98.9
Birmingham Tyburn Roadside		65.6	98.5	98.3	98.3		90.2
Blackburn Darwen Roadside				93.1			93.1
Blackpool Marton			95.4	98.6	98.6		97.5
Bottesford					99.6		99.6
Bournemouth			97.8	98.3	98.5		98.4
Brighton Preston Park			100.0	97.5	92.4		95.1
Bristol St Paul's		94.1	98.0	97.9	98.0		97.0
Cambridge Roadside				98.5			98.5
Canterbury				98.3	98.6		98.4
Carlisle Roadside		82.1	99.6	98.7			93.5
Charlton Mackrell				94.7	98.7		96.7
Chatham Centre Roadside		92.3	98.6	98.4			96.4
Chesterfield		89.6	85.8	87.6			87.7
Chesterfield Roadside		87.7	76.1	96.9			86.9
Coventry Memorial Park			79.4	49.3	98.7		75.8
Eastbourne		99.5	99.1	89.8			96.1
Exeter Roadside				98.5	98.8		98.6
Glazebury				98.6	98.4		98.5
Great Dun Fell					93.4		93.4
Harwell		93.8	99.2	93.2	97.4	96.7	96.1
Harwell		95.6	98.9				97.2
High Muffles				98.1	98.5		98.3
Honiton				98.6			98.6
Horley				94.1			94.1
Hull Freetown		97.1	97.0	95.0	95.3	90.1	94.9
Ladybower				98.7	98.7	98.7	98.7
Leamington Spa		99.3	99.2	99.3	99.5	99.4	99.3
Leamington Spa Rugby Road		97.4	98.0	97.1			97.5
Leeds Centre	97.2	92.1	92.0	97.3	97.5	97.1	95.5
Leeds Headingley		29.0	98.2	99.7			75.6

Name	CO	PM_{10}	PM_{25}	NO_2	O_3	SO_2	Average
Kerbside							
Leicester Centre		97.5	22.6	87.3	80.8		72.0
Leominster				97.3	96.5		96.9
Lincoln Canwick Road				99.6			99.6
Liverpool Queen's Drive Roadside				61.0			61.0
Liverpool Speke		97.0	97.0	96.9	97.2	97.1	97.0
London Haringey Priory Park South				99.2	97.8		98.5
Lullington Heath				96.5	97.2	96.5	96.7
Manchester Piccadilly			80.2	97.7	97.7	97.6	93.3
Manchester South				98.7	98.8		98.7
Market Harborough				0.0	0.0		0.0
Middlesbrough		98.4	99.2	93.9	97.6	97.0	97.2
Newcastle Centre		95.6	96.9	97.3	97.3		96.8
Newcastle Cradlewell Roadside				98.1			98.1
Northampton Kingsthorpe			92.2	98.4	98.5		98.3
Norwich Lakenfields		84.9	97.3	98.7	98.7		94.9
Nottingham Centre		96.2	94.5	97.0	97.1	97.1	96.4
Oxford Centre Roadside				98.4			98.4
Oxford St Ebbes		93.9	96.4	97.6			96.0
Plymouth Centre		66.7	98.6	98.6	98.7		90.6
Portsmouth		70.9	95.4	78.6	100.0		86.2
Preston			98.0	98.6	98.6		98.4
Reading New Town		98.5	98.2	98.8	98.8		98.6
Rochester Stoke		99.2	99.5	66.9	95.9	96.1	91.5
Salford Eccles		98.6	98.8	94.9	95.1		96.8
Saltash Callington Road		99.0	98.4				98.7
Sandy Roadside		87.0	95.7	98.6			93.8
Scunthorpe Town		90.8		96.7		89.6	92.4
Sheffield Centre		97.0	89.6	81.3	96.5		91.1
Sheffield Tinsley				97.3			97.3
Sibton					82.1		82.1
Southampton Centre		91.6	98.3	96.6	97.1	97.2	96.2
Southend-on-Sea			72.8	84.8	84.0		80.5
St Osyth				98.4	98.6		98.5
Stanford-le-Hope Roadside		99.3	98.2	99.0			98.9
Stockton-on-Tees Eaglescliffe		97.4	95.4	97.8			96.9
Stoke-on-Trent Centre		89.2	95.1	94.0	97.5		94.0
Storrington Roadside		98.9	95.4	99.8			98.0
Sunderland Silksworth			99.1	99.7	97.3		98.7
Thurrock		99.2		97.9	98.0	97.7	98.2
Walsall Woodlands				66.8	99.4		83.1
Warrington		75.2	99.4	99.4			91.4

Name	CO	PM_{10}	PM_{25}	NO_2	O_3	SO_2	Average
Weybourne					89.4		89.4
Wicken Fen				98.6	99.8	0.0	66.1
Wigan Centre			98.3	98.6	98.3		98.4
Wirral Tranmere			98.3	63.1	65.9		75.8
Yarner Wood				98.1	94.5		96.3
York Bootham		93.0	99.4				96.2
York Fishergate		99.3	96.8	99.6			98.6
No of Sites	**1**	**40**	**50**	**76**	**54**	**17**	**83**
No <90%	**0**	**11**	**8**	**12**	**6**	**2**	**14**
No <85%	**0**	**7**	**5**	**9**	**5**	**1**	**10**
Average	**97.2**	**90.7**	**93.8**	**93.0**	**94.4**	**90.9**	**92.6**

4.2.2 Site Specific Issues

Birmingham Tyburn Roadside

The PM_{10} FDMS was fond to have a very low flowrate (~1litre/min) at an engineer's visit on 8 February, caused by a leaking filter holder. Data have been deleted from 8 January-8 February.

Chesterfield

During early January, the NOx data was unstable up to the LSO calibration on 17 January, and have been deleted. In addition, both FDMS units required attention on 24 January; the $PM_{2.5}$ received a replacement drier. Some data have been lost from both instruments.

Chesterfield Roadside

The $PM_{2.5}$ FDMS was unstable from 8 to 27 January, with some large spurious peaks; these data have been deleted. Some periods of PM_{10} data have also been lost

Coventry Memorial Park

An unspecified NOx analyser fault produced n elevated baseline which could not be corrected by ratification. Data from 18 October to 15 February have been deleted. In addition, some $PM_{2.5}$ data were lost due to instrument instability.

Leeds Headingly Kerbside

Throughout the quarter, $PM_{2.5}$ concentrations were consistently higher than the PM_{10} concentrations. The PM_{10} data have been deleted from 27 January up to (and beyond) the end of the quarter.

Leicester Centre

The site suffered a number of power failures during the period 1-8 January (and during the preceding month). As a result of this, a number of communication problems were encountered, and in addition, the $PM_{2.5}$ FDMS lost its programming. The ESU ultimately removed the analyser for workshop repair, and monitoring was not restarted until 11 March.

Liverpool Queens Drive Roadside

The poor analyser performance of the NOx analyser seen in the last quarter of 2012 continued into this quarter. The sample flowrate was found to be close to zero at the audit in January; a leak caused by a chipped sample filter glass was found at the service. Data from this site have therefore been deleted from 25 July 2012 to 4 February 2013.

Market Harborough

See section 3.2

Sibton

A failure of the sample pump resulted in the loss of data from 16 to 31 January.

Southend-on-Sea

The site was turned off for seven days for safety reasons due to a water leak on 14 February. On 21 March, the power tripped out, and the $PM_{2.5}$ FDMS analyser lost its programming. This was not repaired until 12 April.

Walsall Woodlands

A suspected sample leak in the Nox analyser resulted in the data being deleted from the service on 19 February to the LSO calibration on 20 March.

Weybourne

The site suffered a power failure on 22 January; upon restoration on 25 January, the modem was corrupted and could not be fixed by the LSO. The problem was compounded by the telephone cable being cut. Data from 22 January to 31 January.

Wicken Fen

Poor quality SO_2 data continued to be observed following on from December 2012. As of 31 March the fault had not been rectified, and hence all SO_2 data have been deleted for the quarter.This fault persists onto the second quarter of 2013

Wirral Tranmere

During the ratification of the January-March 2012 Wirral Tranmere dataset, elevated levels of NO_2 were noticed since 2010. Investigations on site revealed a sealing plug of Blu-Tac had dropped out allowing cabin air to leak out. Unfortunately, it is likely that both the NO_2 and ozone sampling had been compromised and both datasets have been deleted since 2010 up to the repair in January.

4.3 Scotland

4.3.1 Data Capture

The data capture for sites in Scotland for the period January-March 2013 is given in Table 4.3.

Table 4.3 Data Capture for Scotland, January-March 2013

Name	CO	PM_{10}	PM_{25}	NO_2	O_3	SO_2	Average
Aberdeen		99.6	99.6	0.0	99.8		74.8
Aberdeen Union Street Roadside				99.9			99.9
Auchencorth Moss		40.0	96.7		97.5		95.3
Auchencorth Moss		97.1	97.1				97.1
Bush Estate				98.8	98.8		98.8
Dumbarton Roadside				92.3			92.3
Dumfries				98.2			98.2

Name	CO	PM_{10}	PM_{25}	NO_2	O_3	SO_2	Average
Edinburgh St Leonards	98.3	95.1	96.7	98.0	92.9	89.7	95.1
Eskdalemuir				98.1	99.6		98.8
Fort William				69.8	98.7		84.2
Glasgow Kerbside		94.9	89.2	95.7			93.3
Grangemouth		93.4	99.1	98.6		98.6	97.4
Grangemouth Moray				99.4			99.4
Inverness		93.3	93.3	92.5			92.5
Lerwick					99.6		99.6
Peebles				93.7	98.6		96.1
Strath Vaich					86.1		86.1
No of Sites	**1**	**7**	**7**	**13**	**9**	**2**	**17**
No <90%	**0**	**1**	**1**	**2**	**1**	**1**	**3**
No <85%	**0**	**1**	**0**	**2**	**0**	**0**	**2**
Average	**98.3**	**87.6**	**95.9**	**87.3**	**96.8**	**94.1**	**94.0**

4.3.2 Site Specific Issues

Aberdeen

The NOx converter was found to be less than 90% efficient at the winter 2013 audit on 6 February. The ESU did not attend to repair until 28 March, and then the engineer discovered he had the incorrect part to repair it. The analyser was then removed for workshop repair. The analyser was reinstalled on 8 April; all NO_2 data have been lost from 12 December to 8 April.

Fort William

An unspecified analyser fault resulted in poor quality NOx data from 24 January to 19 February; these have been deleted.

Strath Vaich

Data have been deleted between 29 January and 9 February due to low sample flow and ozone generator faults.

4.4 Wales

4.4.1 Data Capture

The data capture for sites in Wales for January-March 2013 is given in Table 4.4.

Table 4.4 Data Capture for Wales, January-March 2013

Name	CO	PM_{10}	PM_{25}	NO_2	O_3	SO_2	Average
Aston Hill				94.7	98.7		96.7
Cardiff Centre	83.1	87.4	91.1	90.5	93.2	84.4	88.3
Chepstow A48		99.5	99.7	99.3			99.5
Cwmbran				99.6	94.9		97.3
Mold				35.8	98.0		66.9
Narberth		91.2		96.7	96.6	96.5	95.3
Newport		97.0	94.6	99.8			97.1
Port Talbot Margam		96.7					96.7
Port Talbot Margam	98.1	99.4	99.6	98.2	86.5	98.1	96.7
Swansea Roadside		97.2	98.1	98.4			97.9
Wrexham		97.8	91.1	97.6		97.6	97.5
No of Sites	**2**	**8**	**6**	**10**	**6**	**4**	**11**
No <90%	**1**	**1**	**0**	**1**	**1**	**1**	**2**
No <85%	**1**	**0**	**0**	**1**	**0**	**1**	**1**
Average	**90.6**	**95.8**	**95.7**	**91.1**	**94.7**	**94.2**	**93.6**

Shaded boxes are for data capture < 90%

4.4.2 Site Specific Issues

Cardiff Centre

The site suffered a number of power cuts due to a wiring fault.

.**Mold**

The NOx converter was found to have failed at the audit on 21 January 2013. The converter was found to be partially blocked at the following service. Data have been deleted from 8 October (where a step change in response was noted) up to the service on 21 February.

4.5 Northern Ireland (including Mace Head)

4.5.1 Data Capture

The data capture for sites in Northern Ireland (including Mace Head in the Republic of Ireland) for the period January-March 2013 is given in Table 4.5.

Table 4.5 Data Capture for Ireland, January-March 2013

Name	CO	PM_{10}	PM_{25}	NO_2	O_3	SO_2	Average
Armagh Roadside		76.1		96.0			86.1
Ballymena Ballykeel						91.4	91.4
Belfast Centre	94.5	91.9	83.6	90.0	89.6	93.6	90.5
Derry		96.1	83.4	98.5	98.9	97.5	94.9

Name	CO	PM_{10}	PM_{25}	NO_2	O_3	SO_2	Average
Lough Navar		85.9			99.9		92.9
Mace Head					99.9		99.9
No of Sites	**1**	**4**	**2**	**3**	**4**	**3**	**6**
No <90%	**0**	**2**	**2**	**1**	**1**	**0**	**1**
No <85%	**0**	**1**	**2**	**0**	**0**	**0**	**0**
Average	**94.5**	**87.5**	**83.5**	**94.8**	**97.1**	**94.2**	**92.6**

4.5.2 Site Specific Issues

Armagh Roadside

The PM_{10} analyser has historically been a source of problems and much of the data from the quarter have been deleted. Problems continue early in 2013 with anomalously low sample dewpoints being recorded.

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 Overall Data Capture, January-March 2013

Site	CO	PM_{10}	PM_{25}	NO_2	O_3	SO_2	Site Average
Number of sites	7	68	78	115	81	30	133
Number of sites < 90%	1	15	13	16	10	4	21
Number of sites < 85%	1	9	8	12	5	2	13
Network Mean (%)	95.6	91.5	94.3	92.9	93.9	92.8	92.8

5 FDMS Baseline Checks

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

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

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

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

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

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

6 LSO Manual and AURN Hub

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

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Section B – Intercomparison Report, Winter 2013

7 Introduction

During January to March 2013, Ricardo-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. There has been some restructuring of the network since the summer intercalibration:

- Glasgow Centre is closed pending relocation
- Bury Roadside is closed pending relocation
- Barnsley 12, Bristol Old Market and London Cromwell Road 2 have all permanently closed, following reassessment of network requirements
- Saltash Callington Road commenced operation

The intercalibration requires the coordination and close cooperation of QA/QC unit, Management Units, ESU's and LSO's in making sure the entire operation runs smoothly and is the result of many months of planning. Leading up to the intercalibration, a draft schedule of visits is prepared and circulated to MU's and ESU's for approval. ESU ozone photometers are calibrated at Ricardo-AEA and all QA/QC equipment and cylinders are tested, calibrated and verified before use.

QA/QC visits are always undertaken before any ESU visits, to allow the performance of the sites to be quantified for the six month period prior to the visit. During the QA/QC visit, the LSO usually attends to demonstrate their competence in performing routine calibrations. The audits are used to transport independent calibration standard gases and test apparatus to all of the sites, to quantify the performance of the entire measurement process at the monitoring stations. The results obtained from these tests are fed into the ratification process, where any correction of datasets can be applied to account for any performance anomalies.

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

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

8 Scope of Intercalibration Exercise

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

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

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

1. Analyser accuracy and precision. These are basic checks to ensure analysers respond to known concentrations of gases in a reliable manner.
2. Instrument linearity. This test refines the response checks on analysers, by assessing whether doubling a concentration of gas to the analyser results in a doubling of the analyser signal response. If an analyser's response characteristics are not linear, data cannot be reliably scaled into concentrations.
3. Instrument signal noise. This test checks that an analyser responds to calibration gases in a stable manner with time. A "noisy" analyser may not provide high quality data which may be difficult to process at lower concentrations.
4. Analyser response time. This test checks that the analyser responds quickly to a change in gas concentrations. If analyser response is too slow, data may not accurately reflect ambient concentrations.
5. Leak and flow checks. These tests ensure that ambient air reaches the analysers, without being compromised in any way. Leaks in the sampling system can affect the ability of the analyser to sample ambient air reliably.
6. NOx analyser converter efficiency. This test evaluates the ability of the analyser to measure NO_2. An inefficient converter severely compromises the data from the analyser.
7. FDMS k_0 evaluation. The analyser uses this factor to calculate mass concentrations, so the value is calculated to determine its accuracy compared to the stated value.
8. Particulate analyser flow rate checks. These tests ensure that the flow rates through critical parts of the analyser are within specified limits. There are specific analyser flow rates that are set to make sure particle size fractions and mass concentration calculations are performed correctly.
9. SO_2 analyser hydrocarbon interference. This test evaluates the analyser's ability to remove interfering hydrocarbon gases from the sample gas. A failed test could have significant implications for analyser data.
10. Evaluation of site cylinder concentrations. These tests use a set of Ricardo-AEA certified cylinders that are taken to all the sites. The concentrations of the site cylinders are used to scale pollution datasets, so it is important to ensure that the concentrations of gases in the cylinders do not change.

11. Competence of Local Site Operators (LSO) in undertaking calibrations. As it is the calibrations by the LSO's that are used to scale pollution datasets, it is important to check that these are undertaken competently.

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

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

- The analyser responses to audit gas are converted into concentrations, using provisional calibration factors obtained from the Management Units on the day of the intercalibration. These factors are also used for the provisional data supplied to the web/interactive TV services.
- These individual results are tabulated, and statistical analyses undertaken (e.g. network average result, network standard deviation, deviation of individual sites from the network mean etc.).

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

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

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

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

- Drift of an analyser between scheduled LSO calibrations. This is by far the most common cause of an outlier result, and one that is simply corrected for during ratification of data.
- Drift of site cylinder concentrations between intercalibrations. Site cylinders can sometimes become unstable, especially at low pressures. All site cylinder concentrations are checked every six months, and are replaced as necessary.
- Erroneous calibration factors. It can occasionally happen that an analyser calibration is unsuccessful, and results in unsuitable scaling factors being used to produce pollution datasets. These are identified and corrected during ratification.
- Pressurisation of the sampling system at the audit. Occasionally, an analyser can be very sensitive to small changes in applied flow rates of calibration gas. This is more difficult to identify and correct, and may have consequences for data quality.
- Leaks, sample switching valves, etc. Outliers can be generated if an analyser is not sampling ambient air properly. It is likely that if a leaking analyser is identified, data losses will result.

9 Results

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

9.1 National Network Overview

9.1.1 Summary

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

Table 9.1 - Summary of audited analyser performance – 135 UK stations

Parameter	Number of outliers	Number in network	% outliers in total
NOx analyser	26	117	22%
CO analyser	0	9	0%
SO_2 analyser	6	30	20%
Ozone analyser	17	82	21%
FDMS and BAM analysers	1 k_0, 4 flow	58 FDMS PM_{10} 2 BAM PM_{10} 69 FDMS $PM_{2.5}$ 2 BAM $PM_{2.5}$	4%
Gravimetric PM analysers	0 flow	9 PM_{10} 9 $PM_{2.5}$	0%
Total	54	387	14.0%

Two of the 135 sites were not in operation at the time of the intercalibration. Replacement locations are currently being sought for the sites at Bury Roadside and Glasgow Centre.

A new site at Saltash Callington Road was commissioned, to replace the old Saltash Roadside location.

Great Dun Fell was not visited, due to the cold winter – the site was snowbound from November 2012 until May 2013

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

The number of analyser outliers identified is worse than the previous exercise. At the Summer 2012 intercalibration 12.0% of the analysers in use were identified as outliers.

The procedures used to determine network performance are documented in Ricardo-AEA Work Instructions. These methods are regularly updated and improved and are evaluated by the United Kingdom Accreditation Service (UKAS). Ricardo-AEA holds ISO17025 accreditation for the on-site calibration of all the analyser types (NOx, CO, SO_2, O_3) and for the determination of the FDMS k_0 factor and particulate analyser flow rates used in the network. An ISO17025 certificate of calibration (Calibration Laboratory number 0401) for the analysers in the AURN is appended to this report.

9.1.2 Network Intercomparisons

The concentration of the audit cylinders was calculated averaged across all monitoring sites using the zero and scaling factors provided by the CMCU on the day of audit. How close the result is to the stated cylinder concentration is a good indication of the accuracy of the provisional results across the entire network. The results are given in Table 9.2. Certified cylinder concentrations are normalised for this purpose as several cylinders are used.

Table 9.2 Audit Cylinder Results

Parameter	Network Mean	Audit reference concentration	Network Accuracy %	%Std Dev
NO	458 ppb	452 ppb	1.3	4.2
NO_2	447 ppb	429 ppb	-4.0	4.9
CO	19.9 ppm	20.2 ppm	-1.6	2.7
SO_2	469 ppb	456 ppb	2.9	4.4

- 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 summer exercise.

  There were three converters which fell outside the ±5% acceptance limits. In addition, there were 7 converters identified where the initial result was outside the ±2% trigger for NO_2 rescaling. Additional analysis showed that a total of four outlier converters required rescaling or data deletion to be undertaken.

- Carbon Monoxide

  There were no outliers identified at this intercalibration. Just one outlier was identified at the previous exercise.

- Sulphur Dioxide

  A total of six outliers (21%) were identified at this intercalibration. This is an improvement from the summer exercise, when 9 analysers were found to be outside the acceptance limits. All m-xylene interference tests were less than 16ppb, compared to 26ppb in summer 2012.

- Ozone

  A total of 17 outliers (21%) were identified during the summer exercise. This is identical to the previous intercalibration, where 17 analysers were also found to be outside the ±5% acceptance criterion.

- Particulate Analysers

  Just one calculated k_0 determination was outside the required ±2.5% of the stated values. Two outliers were identified at the previous exercise.

  Four FDMS main flows were found to be outside the ±10% acceptance limits. This is worse than the previous exercise; just one analyser was identified in the summer.

  All Partisol analyser total flows were within the acceptance limits.

- Site Cylinder Concentrations

  9 of the 273 site cylinders (3.3%) used to scale ambient pollution data were found to be outside the ±10% acceptance limit, an improvement over the 4.3% identified in the summer.

9.2 London Sites

The results of the intercomparison for the 15 London sites in operation at the time of the intercalibration are summarised below:

Table 9.3 - Summary of audited analyser performance – London Sites

Parameter	Number of outliers	Number in region
NOx analyser	1	13
NOx converter	0	
CO analyser	0	3
SO_2 analyser	2	4
Ozone analyser	2	9
FDMS and BAM analysers	0 k_0, 1 flow	6 FDMS PM_{10} 10 FDMS $PM_{2.5}$
Gravimetric PM analysers	0	2 PM_{10} 3 $PM_{2.5}$
Cylinders	1	37

9.3 Scottish Sites

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

Table 9.4 - Summary of audited analyser performance – Scottish Sites

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

9.4 Welsh Sites

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

Table 9.5 - Summary of audited analyser performance – Welsh Sites

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

9.5 Northern Ireland Sites (incl. Mace Head)

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

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

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

9.6 English Sites

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

Table 9.7 - Summary of audited analyser performance – English Sites

Parameter	Number of outliers	Number in region
NOx analyser	20	76
NOx converter	6	
CO analyser	0	1
SO_2 analyser	4	16
Ozone analyser	12	53
FDMS and BAM analysers	1 k_0, 2 flow	37 FDMS PM_{10} 1 BAM PM_{10} 46 FDMS $PM_{2.5}$ 1 BAM $PM_{2.5}$
Gravimetric PM analysers	0	1 PM_{10} 4 $PM_{2.5}$
Cylinders	6	191

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

10 Site Cylinder Concentrations

During the intercalibration, the concentrations of the on-site cylinders were evaluated using the audit cylinder standards. The calculated results showed that 9 of the 273 cylinders (3.3%) used to scale analyser data into concentrations (NO, CO and SO_2) were outside the ±10% acceptance criterion. This is better than the summer exercise, where 4.3% (13) of the scaling cylinders were outside the acceptance limits. There were six NO cylinders and three SO_2 cylinders identified as outliers.

In addition, the concentrations of 35 NO_2 cylinders appear to have drifted by more than 10%. NO_2 cylinders are not used for the scaling of data and so will not be replaced at this time. Hence, a total of 44 of the 273 cylinders (16.2%) were outside the acceptance limits. This is worse than the previous intercalibration, when 14.8% of cylinders were found to be outside the 10% acceptance.

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

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

11 Site Information

All site information is now uploaded to CMCU and UK-Air archive for dissemination using Google Earth. Ricardo-AEA makes considerable effort in ensuring that site locations are accurate on the new Google Earth site information and UK-Air archive pages. All future additions to the AURN will include accurate positioning using Google Earth.

12 CEN

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

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

To comply with the Directive, the uncertainty for gaseous analyser measurements must be less than ±15%. For sites that have CEN-compliant gaseous instrumentation, it is possible to calculate the overall uncertainty of measuring air quality. This information is site and analyser specific and presented in the table below:

Table 12.1 – Analyser measurement uncertainties (%)

Date	Site	O_3	CO	SO_2	NO_2 hour	NO_2 ann	PM_{10}*	$PM_{2.5}$*
09-Jan	Barnsley Gawber	10.7		13.4	10	10		
15-Feb	Bath Roadside				13.5	14		
22-Jan	Billingham				13.5	14		
16-Jan	Birmingham Acocks Green	12.4			13.5	14		16.4
17-Jan	Birmingham Tyburn	8.7		12.3	11.8	11.8	8.7	16.4
17-Jan	Birmingham Tyburn Roadside	12.4			14.4	14.8	8.7	16.4
08-Jan	Blackburn Darwen Roadside				10.5	10.5		
07-Jan	Blackpool Marton	10.7			10	10		16.4
18-Feb	Bottesford	10.7						
05-Feb	Bournemouth	12.4			13.5	14		11
26-Feb	Brighton Preston Park	12.4			13.5	14		11
15-Feb	Bristol St Paul's	12.4			13.5	14	8.7	16.4
07-Feb	Cambridge Roadside				10.5	10.5		
06-Feb	Camden Kerbside				10.5	10.5	8.7	16.4
21-Feb	Canterbury	12.4			13.5	14		
08-Jan	Carlisle Roadside				14.6	14.6	8.7	16.4
15-Jan	Charlton Mackrell	11.8			13.5	14		
18-Feb	Chatham Centre Roadside				13.5	14	8.7	16.4
08-Jan	Chesterfield				13.5	14	8.7	16.4
08-Jan	Chesterfield Roadside				13.5	14	8.7	16.4
15-Jan	Coventry Memorial Park	10.7			10	10		16.4
27-Feb	Eastbourne				13.5	14	8.7	16.4
13-Feb	Exeter Roadside	8.7			11.8	11.8		
30-Jan	Glazebury	12.4			13.5	14		
	Great Dun Fell	No test						
05-Feb	Haringey Roadside				10.5	10.5	8.7	16.4
08-Jan	Harwell	12.4		13.4	13.5	14	8.7	16.4
08-Jan	Harwell PARTISOL						8	11
29-Jan	High Muffles	12.4			13.5	14		

Date	Site	O_3	CO	SO_2	NO_2 hour	NO_2 ann	PM_{10}*	$PM_{2.5}$*
14-Feb	Honiton				13.5	14		
25-Feb	Horley				10.5	10.5		
18-Jan	Hull Freetown	10.7		13.4	10	10	8.7	16.4
30-Jan	Ladybower	12.4		13.4	13.5	14		
15-Jan	Leamington Spa	12.4		13.4	13.5	14	8.7	16.4
14-Jan	Leamington Spa Rugby Road				13.5	14	8.7	16.4
17-Jan	Leeds Centre	10.7	9.5	13.4	10	10	8.7	16.4
17-Jan	Leeds Headingley Kerbside				13.5	14	8.7	16.4
16-Jan	Leicester Centre	10.7			10	10	8.7	16.4
14-Jan	Leominster	12.4			13.5	14		
19-Feb	Lincoln Canwick Road				13.5	14		
24-Jan	Liverpool Queen's Drive Roadside				13.5	14		
23-Jan	Liverpool Speke	10.7		13.4	13.5	14	8.7	16.4
11-Feb	London Bexley			13.4	13.5	14		16.4
12-Feb	London Bloomsbury	12.4		13.4	13.5	14	8.7	16.4
24-Jan	London Eltham	11.8			10.5	10.5	8.7	16.4
05-Dec	London Haringey	11.8			13.5	14		
31-Jan	London Harlington	12.4			13.5	14	8.7	16.4
06-Feb	London Harrow Stanmore							16.4
30-Jan	London Hillingdon	10.7			10	10		
21-Jan	London Marylebone Road	12.4	9.5	13.4	14.3	14.8	8.7	16.4
21-Jan	London Marylebone Road PARTISOL						8	11
22-Jan	London N. Kensington	12.4	9.5	13.4	13.5	14	8.7	16.4
22-Jan	London N. Kensington PARTISOL						8	11
08-Feb	London Teddington	12.4			13.5	14		16.4
28-Jan	London Westminster	12.4			13.5	14		11
17-Jan	Lullington Heath	12.4		13.4	13.5	14		
31-Jan	Manchester Piccadilly	10.7		13.4	10	10		16.4

Date	Site	O_3	CO	SO_2	NO_2 hour	NO_2 ann	PM_{10}*	$PM_{2.5}$*
30-Jan	Manchester South	12.4			13.5	14		
17-Jan	Market Harborough	10.7			10	10		
22-Jan	Middlesbrough	12.4		13.4	13.5	14	8.7	16.4
21-Jan	Newcastle Centre	10.7			10	10	8.7	16.4
21-Jan	Newcastle Cradlewell Roadside				13.5	14		
14-Jan	Northampton Kingsthorpe	8.7			11.8	11.8	8	
05-Feb	Norwich Lakenfields	10.7			10	10	8.7	16.4
18-Feb	Nottingham Centre	10.7		13.4	10	10	8.7	16.4
09-Jan	Oxford Centre Roadside				13.5	14		
09-Jan	Oxford St Ebbes				13.5	14	8.7	16.4
14-Feb	Plymouth Centre	10.7			10	10	8.7	16.4
28-Feb	Portsmouth	10.7			11.8	11.8	8.7	16.4
07-Jan	Preston	10.7			10	10		16.4
07-Jan	Reading New Town	10.7			10	10	8.7	16.4
18-Feb	Rochester Stoke	Not approved		13.4	13.5	14	8.7	16.4
29-Jan	Salford Eccles	11.8			10.5	10.5	8.7	16.4
23-Jan	Saltash Callington Road						8.7	16.4
06-Feb	Sandy Roadside				13.5	14	8.7	16.4
18-Jan	Scunthorpe Town			11	10.5	10.5	8.7	
07-Jan	Sheffield Centre	10.7			10	10	8.7	16.4
08-Jan	Sheffield Tinsley				13.5	14		
04-Feb	Sibton	12.4						
13-Feb	Southampton Centre	10.7		**22.2**	**23.9**	**23.9**	8.7	16.4
07-Mar	Southend-on-Sea	10.7			10	10		16.4
29-Jan	Southwark A2 Old Kent Road				13.5	14	8.7	
20-Feb	St Osyth	10.7			10	10		
19-Feb	Stanford-le-Hope Roadside				Not approved		8.7	16.4
23-Jan	Stockton-on-Tees Eaglescliffe				13.5	14	9.3	12.6
29-Jan	Stoke-on-Trent Centre	10.7			10	10	8.7	16.4

Date	Site	O_3	CO	SO_2	NO_2 hour	NO_2 ann	PM_{10}*	$PM_{2.5}$*
26-Feb	Storrington Roadside				10	10	8.7	16.4
23-Jan	Sunderland Silksworth	12.4			13.5	14		16.4
19-Feb	Thurrock	Analysers not approved					8.7	
13-Feb	Tower Hamlets Roadside		13.9		10.5	10.5		
23-Jan	Walsall Woodlands	12.4			13.5	14		
24-Jan	Warrington				10.5	10.5	8.7	16.4
05-Feb	Weybourne	10.7						
06-Feb	Wicken Fen	12.5		13.4	13.5	14		
28-Jan	Wigan Centre	10.7			10.5	10.5		16.4
22-Jan	Wirral Tranmere	10.7			10	10		16.4
07-Feb	Yarner Wood	12.4			13.5	14		
08-Jan	York Bootham						8.7	16.4
08-Jan	York Fishergate				10.5	10.5	8.7	16.4
08-Feb	Mace Head	Not approved						
15-Feb	Armagh Roadside				13.5	14	8.7	
04-Feb	Ballymena Ballykeel			No test				
06-Mar	Belfast Centre	No test	9.5	13.4	10	10	8.7	16.4
06-Feb	Derry	12.4		13.4	13.5	14	8.7	16.4
07-Feb	Lough Navar	12.4					8.7	
06-Feb	Aberdeen	12.4			13.5	14	8.7	16.4
05-Feb	Aberdeen Union Street Roadside				13.5	14		
30-Jan	Auchencorth Moss	12.4					8	11
30-Jan	Auchencorth Moss PM_{10} PM_{25} (FDMS)						8.7	16.4
30-Jan	Bush Estate	12.4			13.5	14		
23-Jan	Dumbarton Roadside				10.5	10.5		
28-Jan	Dumfries				13.5	14		
01-Feb	Edinburgh St Leonards	12.4	9.5	13.4	13.5	14	8.7	16.4
28-Jan	Eskdalemuir	12.4			13.5	14		
23-Jan	Fort William	12.4			13.5	14		
14-Jan	Glasgow Kerbside				10	10	8.7	16.4

Date	Site	O_3	CO	SO_2	NO_2 hour	NO_2 ann	PM_{10}*	$PM_{2.5}$*
22-Jan	Grangemouth			11	10.5	10.5	8.7	16.4
22-Jan	Grangemouth Moray				10.5	10.5		
08-Feb	Inverness				13.5	14	8	11
07-Feb	Lerwick	12.4						
29-Jan	Peebles	12.4			13.5	14		
08-Feb	Strath Vaich	12.4						
06-Feb	Aston Hill	12.4			13.5	14		
28-Feb	Cardiff Centre	12.4	9.5	13.4	13.5	14	8.7	16.4
04-Mar	Chepstow A48				11.6	11.7	8.7	16.4
01-Mar	Cwmbran	10.7			11.8	11.8		
20-Feb	Mold	No test			13.5	14		
25-Feb	Narberth	12.4		13.4	13.5	14	8.7	
26-Feb	Newport				13.5	14	8.7	16.4
27-Feb	Port Talbot Margam	10.7	9.5	13.4	13.5	14	8.7	16.4
27-Feb	Port Talbot Margam PM_{10} $PM_{2.5}$						8	
27-Feb	Swansea Roadside				13.5	14	9.3	12.6
21-Jan	Wrexham			13.4	13.5	14	8	11

This table is updated and extended after every intercalibration to include upgraded sites and replacement analysers. *Uncertainty calculations for PM_{10} and $PM_{2.5}$ are reported as best measurement capability (BMC).

The poor results for the SO_2 and NOx analysers at Southampton are believed to be due to failed linearity tests, rather than genuine non-linear responses from the instruments. This will be checked at the next intercalibration visit.

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

The NOx analyser at Stanford-Le-Hope and the NOx, SO_2 and O_3 analysers at Thurrock are reported to be Environnement analysers, which are not CEN compliant models and therefore no generic performance data have been calculated. These observations will be confirmed at the next intercalibration and fully assessed during ratification.

13 Certification

The Network Certificate of Calibration is presented in Appendix 4. This certificate presents the results of the individual analyser scaling factors on the day of the audit, as calculated by Ricardo-AEA using the audit cylinder standards, in accordance with our ISO17025 accreditation.

14 Summary

The intercalibration exercise demonstrates its ongoing value as an effective tool in determining overall site performance and assessing the reliability and traceability of air quality measurements from a large scale network. The results from this intercalibration have been used to assess data quality during the ratification of the network datasets for the period October 2012 to March 2013.

Appendices

Appendix 1: Recommendations for Upgrade or Replacement of Equipment
Appendix 2: Partisol Data – October – December 2013
Appendix 3: Information for New Sites
Appendix 4: Certificate of Calibration

Appendix 1 - Recommendations for Upgrade or Replacement of Equipment

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

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

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

Table A1 Recommendations.

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

Appendix 2

Partisol Data: January-March 2013

Table A2: Principal Reasons for Data Loss (below 90%), Partisols

Site	PM_{10}	PM_{25}	Reason
Auchencorth Moss	40%		Repeated water ingress
London Westminster		88%	Filter exchange failures

Appendix 3

Site Details

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

Appendix 4

Certificate of Calibration

0401 **CERTIFICATE OF CALIBRATION**

Ricardo-AEA, Gemini Building, Fermi Avenue Harwell, Didcot, Oxfordshire OX11 0QJ

Telephone 01235 753212

Certificate Number: 02824
Ricardo-AEA Calibration ID Number: ED57002030

Authorised Signatories: S Eaton

B Stacey

Signed:

Date of Issue: 21 2013

Customer Name and Address: Emily Connolly

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

Date of Calibration: January-March 2013

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

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

1. Northern Ireland Sites (including Mace Head)

Carbon Monoxide

2013	Site	Analyser number	[1]Zero output	Uncertainty (ppm)	[2]Calibration Factor	Uncertainty (%)	*Maximum Residual (%)
06-Mar	Belfast Centre	462	1	0.2	1.077	2.2	1.7

Sulphur Dioxide

2013	Site	Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	Max Residual (%)	m-xylene interference (ppb)
04-Feb	Ballymena Ballykeel	632		analyser	fault	at	audit	
06-Mar	Belfast Centre	1766	14	2.6	0.722	3	1.8	-0.6
06-Feb	Derry	1697	2	2.5	0.967	3.7	3.1	12.1

Ozone

2013	Site	Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	*Max Residual (%)
06-Mar	Belfast Centre	cm08060038	analyser	not present	at audit		
06-Feb	Derry	1586	-2	3	1.040	3.1	0.6
07-Feb	Lough Navar	1640	2	3	1.020	3.1	0.8
08-Feb	Mace Head	77086-385	0	3	1.026	3.1	0.5

Oxides of Nitrogen

2013	Site		Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	Max residual (%)	Converter efficiency (%)
15-Feb	Armagh Roadside	NO	1011845	0	2.7	1.105	3.5	0.7	
		NOx		1	2.7	1.106	3.5	0.4	99.5
06-Mar	Belfast Centre	NO	08050074	0	2.6	1.084	3.6	2.8	
		NOx		0	2.6	1.082	3.6	2.5	98.7
06-Feb	Derry	NO	2130	2	3.4	2.506	4.1	6.1	
		NOx		2	3.4	2.527	4.1	6.1	99.0

Particulate Analysers

2013	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 (%)
15-Feb	Armagh Roadside	PM10	2000	13532	1	-0.3	2.80	2.2	15.74	2.2
06-Mar	Belfast Centre	PM10	24423	14226	1	0.2	2.91	2.2	15.39	2.2
06-Mar	Belfast Centre	PM25	26565	15598	1	-0.8	2.89	2.2	15.32	2.2
06-Feb	Derry	PM10	2701	16071	1	1.7	3.05	2.2	16.31	2.2
06-Feb	Derry	PM25	21313	10827	1	-0.6	2.99	2.2	15.95	2.2
07-Feb	Lough Navar	PM10	21196	12977	1	1.2	not	tested	18.19	2.2

2. Scottish Sites

Carbon Monoxide

2013	Site	Analyser number	[1]Zero output	Uncertainty (ppm)	[2]Calibration Factor	Uncertainty (%)	*Maximum Residual (%)
01-Feb	Edinburgh St Leonards	159	1	0.2	1.000	2.1	0.9

Sulphur Dioxide

Date Year =2013	Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	*Max Residual (%)	m-xylene interference (ppb)	Analyser number
01-Feb	Edinburgh St Leonards	84	-3	2.5	0.985	3.4	1.9	9.2
22-Jan	Grangemouth	1211322	0	2.5	0.914	3	1.0	11.0

Ozone

2013	Site	Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	Max Residual (%)
06-Feb	Aberdeen	800	6	3	1.031	3.2	1.7
30-Jan	Auchencorth Moss	1646	-3	3	1.044	3.1	1.5
30-Jan	Bush Estate	1645	2	3	0.998	3.1	0.4
01-Feb	Edinburgh St Leonards	136	4	3	1.110	3.1	1.0
28-Jan	Eskdalemuir	158	1	3	1.038	4.0	0.5
23-Jan	Fort William	1023	0	3	1.063	3.1	0.7
07-Feb	Lerwick	2433	4	3	1.016	3.2	3.9
29-Jan	Peebles	2449	-3	3	1.010	3.1	1.6
08-Feb	Strath Vaich	279	-1	3	1.118	3.8	3.4

Oxides of Nitrogen

2013	Site		Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	*Max residual (%)	*Converter efficiency (%)
06-Feb	Aberdeen	NO	519	4	2.7	1.340	3.5	0.5	
		NOx		5	2.8	1.329	3.5	0.3	88.4
05-Feb	Aberdeen Union	NO	299	0	2.7	1.187	3.5	0.5	
	Street Roadside	NOx		0	2.7	1.187	3.5	0.6	99.1
30-Jan	Bush Estate	NO	2244	1	2.5	1.043	3.5	1.5	
		NOx		2	2.5	1.031	3.5	1.5	100.8
23-Jan	Dumbarton	NO	1011833	0	2.6	1.102	3.5	1.9	
	Roadside	NOx		1	2.6	1.118	3.5	1.3	99.1
28-Jan	Dumfries	NO	1494	1	2.5	1.028	3.5	0.9	
		NOx		1	2.6	1.030	3.5	0.8	98.0
01-Feb	Edinburgh St	NO	73	0	2.6	1.066	3.5	3.2	
	Leonards	NOx		0	2.6	1.047	3.5	3.1	98.8
28-Jan	Eskdalemuir	NO	347	1	2.5	0.953	3.5	0.7	
		NOx		0	2.5	0.955	3.5	0.4	98.6
23-Jan	Fort William	NO	344	0	2.5	1.019	3.5	1.4	
		NOx		-2	2.5	0.965	3.5	1.4	100.8
14-Jan	Glasgow Kerbside	NO	08050061	0	2.6	1.279	3.5	1.1	
		NOx		1	2.7	1.282	3.5	1.0	98.2
22-Jan	Grangemouth	NO	1011836	0	2.5	1.039	3.6	2.0	

2013	Site		Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	[*]Max residual (%)	[*]Converter efficiency (%)
		NOx		1	2.7	1.052	3.5	2.1	98.5
22-Jan	Grangemouth	NO	1011852	0	2.5	1.061	3.5	0.6	
	Moray	NOx		0	2.5	1.079	3.5	0.7	98.7
08-Feb	Inverness	NO	1489	0	2.9	1.590	3.5	1.4	
		NOx		1	2.9	1.577	3.5	0.4	96.5
29-Jan	Peebles	NO	2213	1	2.5	1.043	3.5	1.4	
		NOx		2	2.7	1.037	3.5	0.7	101.8

Particulate Analysers

2013	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 (%)
06-Feb	Aberdeen	PM10	24427	11644	1	0.7	3.31	2.2	16.04	2.2
06-Feb	Aberdeen	PM25	27368	12101	1	-1.0	2.94	2.2	15.57	2.2
30-Jan	Auchencorth Moss	PM10	26039	13009	1	-1.4	**2.75**	**2.2**	**16.41**	**2.2**
30-Jan	Auchencorth Moss	PM25	26033	13694	1	-2.3	**2.93**	**2.2**	**16.76**	**2.2**
30-Jan	Auchencorth Moss Partisol	PM10							analyser	fault
30-Jan	Auchencorth Moss Partisol	PM25	21548						16.16	2.2
01-Feb	Edinburgh St Leonards	PM10	27227	13547	1	-1.1	3.01	2.2	15.84	2.2
01-Feb	Edinburgh St Leonards	PM25	27233	16940	1	-0.4	3.07	2.2	15.45	2.2
14-Jan	Glasgow Kerbside	PM10	27344	14435	1	-1.0	**2.92**	**2.2**	**16.39**	**2.2**
14-Jan	Glasgow Kerbside	PM25	27337	15086	1	-0.2	**2.97**	**2.2**	**16.42**	**2.2**
22-Jan	Grangemouth	PM10	27228	15842	1	-0.5	3.06	2.2	16.46	2.2
22-Jan	Grangemouth	PM25	27259	13644	1	-0.9	2.99	2.2	15.74	2.2
08-Feb	Inverness	PM10	21555						16.86	2.2
08-Feb	Inverness	PM25	21861						16.69	2.2

3. Welsh Sites

Carbon Monoxide

2013	Site	Analyser number	[1]Zero output	Uncertainty (ppm)	[2]Calibration Factor	Uncertainty (%)	[*]Maximum Residual (%)
28-Feb	Cardiff Centre	14333	0	0.2	0.990	2.2	3.1
27-Feb	Port Talbot Margam	ch0	1	0.2	0.976	2.1	0.0

Sulphur Dioxide

Date Year =2013	Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	*Max Residual (%)	m-xylene interference (ppb)	Analyser number
28-Feb	Cardiff Centre	14319	-1	2.6	1.151	3.2	0.9	2.4
25-Feb	Narberth	14896	2	2.5	0.889	3.4	2.6	2.7
27-Feb	Port Talbot Margam	ch1	0	2.5	0.953	3.1	1.2	1.0
21-Jan	Wrexham	1181	-1	2.5	0.826	3	0.9	3.5

Ozone

2013	Site	Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	Max Residual (%)
06-Feb	Aston Hill	14337	-1	3	0.990	3.3	0.4
28-Feb	Cardiff Centre	14348	-4	3	0.964	3.1	0.7
01-Mar	Cwmbran	2	0	3	0.963	3.1	1.9
20-Feb	Mold	17499		analyser	fault		
25-Feb	Narberth	10280	0	3	1.008	3.2	1.2
27-Feb	Port Talbot Margam	ch3	1	3	1.077	3.1	0.7

Oxides of Nitrogen

2013	Site		Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	*Max residual (%)	*Converter efficiency (%)
06-Feb	Aston Hill	NO	17677	1	2.6	1.129	3.5	0.8	
		NOx		1	2.6	1.123	3.5	0.6	98.6
28-Feb	Cardiff Centre	NO	14325	1	2.5	0.906	3.5	1.9	
		NOx		1	2.5	0.914	3.5	0.9	97.9
04-Mar	Chepstow A48	NO	1011828	0	2.7	1.156	3.5	1.1	
		NOx		1	2.6	1.223	3.5	0.7	100.0
01-Mar	Cwmbran	NO	1	1	2.5	0.992	3.5	0.9	
		NOx		1	2.5	0.993	3.5	0.4	94.5
20-Feb	Mold	NO	345	9	3.3	2.005	3.6	2.3	
		NOx		9	3.6	2.485	3.5	1.2	92.5
25-Feb	Narberth	NO	14311	0	2.5	0.995	3.5	1.6	
		NOx		-1	2.5	0.979	3.5	0.6	99.2
26-Feb	Newport	NO	1011829	0	2.6	1.132	3.5	0.6	
		NOx		0	2.6	1.134	3.5	0.9	97.9
27-Feb	Port Talbot	NO	ch2	2	2.5	1.009	3.5	1.3	
	Margam	NOx		2	2.5	0.991	3.5	1.7	99.7
27-Feb	Swansea	NO	16695	1	3.4	2.480	3.5	1.2	
	Roadside	NOx		1	3.4	2.432	3.5	1.4	98.3
21-Jan	Wrexham	NO	1490	0	2.5	1.027	3.5	1.3	
		NOx		1	2.6	1.039	3.5	0.4	98.3

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Particulate Analysers

2013	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 (%)
28-Feb	Cardiff Centre	PM10	25499	13793	1	-0.6	2.91	2.2	15.23	2.2
28-Feb	Cardiff Centre	PM25	24449	11048	1	0.5	2.00	2.2	13.52	2.2
04-Mar	Chepstow A48	PM10	27242	14123	1	-0.4	**2.92**	**2.2**	**16.06**	**2.2**
04-Mar	Chepstow A48	PM25	27223	15976	1	-0.1	**2.80**	**2.2**	**15.37**	**2.2**
25-Feb	Narberth	PM10	26563	13880	1	0.1	3.00	2.2	15.70	2.2
26-Feb	Newport	PM10	22589	13752	1	-1.7	**3.02**	**2.2**	**16.72**	**2.2**
26-Feb	Newport	PM25	27252	16604	1	-0.1	analyser	fault	10.06	2.2
27-Feb	Port Talbot Margam	PM10	27217	13957	1	0.2	2.99	2.2	15.36	2.2
27-Feb	Port Talbot Margam	PM25	25081	10523	1	-0.3	not	tested	15.86	2.2
	Port Talbot Margam Partisol	PM10							not	tested
27-Feb	Swansea Roadside	PM10	20072						13.88	2.2
27-Feb	Swansea Roadside	PM25	20071						14.98	2.2
21-Jan	Wrexham	PM10	21224						13875	2.2
21-Jan	Wrexham	PM25	21011						12108	2.2

4. London Sites

Carbon Monoxide

2013	Site	Analyser number	[1] Zero output	Uncertainty (ppm)	[2] Calibration Factor	Uncertainty (%)	* Maximum Residual (%)
21-Jan	London Marylebone Road	652	1	0.2	1.116	2.3	3.7
22-Jan	London N. Kensington	2313	0	0.2	1.000	2.7	2.7

Sulphur Dioxide

Date Year =2013	Analyser number	[1] Zero output	Uncertainty (ppb)	[2] Calibration Factor	Uncertainty (%)	* Max Residual (%)	m-xylene interference (ppb)	Analyser number
11-Feb	London Bexley	318	9	2.5	0.813	3.4	2.5	-8.4
12-Feb	London Bloomsbury	74	10	2.5	0.825	3.3	3.5	5.4
21-Jan	London Marylebone Rd	2644	1	2.5	1.030	3.5	2.3	10.5
22-Jan	London N. Kensington	2576	2	2.5	0.979	3.1	0.9	9.2

Ozone

2013	Site	Analyser number	[1] Zero output	Uncertainty (ppb)	[2] Calibration Factor	Uncertainty (%)	* Max Residual (%)
12-Feb	London Bloomsbury	435	0	3	1.079	3.2	1.2
24-Jan	London Eltham	1111938	0	3	1.024	3.1	1.0
05-Dec-12	London Haringey Priory Park South	953	0	3	0.953	3.1	1.5
31-Jan	London Harlington	107	-1	3	0.992	3.2	0.8

2013	Site	Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	[*]Max Residual (%)
30-Jan	London Hillingdon	8060034	0	3	1.028	3.1	0.4
21-Jan	London Marylebone Road	2432	2	3	1.020	3.1	1.8
22-Jan	London N. Kensington	189	5	3	1.055	3.1	0.1
08-Feb	London Teddington	2447	-2	3	1.053	3.1	0.9
28-Jan	London Westminster	879	0	3	0.994	3.1	1.0

Oxides of Nitrogen

2013	Site		Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	Max residual (%)	Converter efficiency (%)
06-Feb	Camden Kerbside	NO	1011846	-1	2.8	1.067	3.5	0.2	
		NOx		2	2.9	1.079	3.5	0.3	100.0
05-Feb	Haringey	NO	1011827	0	2.5	1.074	3.5	0.7	
	Roadside	NOx		2	2.7	1.077	3.5	0.8	100.4
11-Feb	London Bexley	NO	327	0	2.6	1.110	3.5	0.4	
		NOx		0	2.6	1.099	3.5	0.7	100.3
12-Feb	London	NO	74	1	2.9	1.711	3.5	0.4	
	Bloomsbury	NOx		2	3.0	1.711	3.5	0.1	101.0
24-Jan	London Eltham	NO	1011834	0	2.5	1.045	3.5	1.8	
		NOx		2	2.8	1.054	3.5	2.4	98.8
05-Dec-12	London Haringey	NO	11392	0	2.5	1.013	3.5	3.1	
	Priory Park South	NOx		0	2.5	0.994	3.5	3.3	98.7
31-Jan	London Harlington	NO	1090	0	2.6	1.173	3.8	5.2	
		NOx		-1	3.3	1.164	3.7	4.9	99.0
30-Jan	London Hillingdon	NO	8050017	0	2.5	0.918	3.5	2.7	
		NOx		0	2.5	0.911	3.5	2.3	100.0
21-Jan	London	NO	3366	4	2.7	1.337	3.8	1.7	
	Marylebone Road	NOx		2	2.7	1.315	6.9	5.2	100.1
22-Jan	London N.	NO	3273	2	2.6	1.191	3.5	1.6	
	Kensington	NOx		3	2.6	1.205	3.5	2.2	99.1
08-Feb	London	NO	3406	1	2.6	1.212	3.5	0.5	
	Teddington	NOx		-1	3.3	1.232	3.5	1.5	100.9
28-Jan	London	NO	571	2	2.8	1.496	3.5	1.0	
	Westminster	NOx		3	2.8	1.512	3.5	0.8	99.8
29-Jan	Southwark A2	NO	1954	-12	3.3	1.057	3.5	3.4	
	Old Kent Road	NOx		-29	4.0	1.044	3.5	1.0	98.6
13-Feb	Tower Hamlets	NO	1011838	0	2.6	1.267	3.5	0.3	
	Roadside	NOx		1	3.4	1.287	3.5	0.3	100.0

Particulate Analysers

2013	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 (%)
06-Feb	Camden Kerbside	PM10	21159	11996	1	0.1	3.05	2.2	16.19	2.2
06-Feb	Camden Kerbside	PM25	21391	12956	1	1.6	3.08	2.2	15.83	2.2
05-Feb	Haringey Roadside	PM10	27338	15291	1	0.2	3.26	2.2	16.86	2.2
05-Feb	Haringey Roadside	PM25	27278	13713	1	-0.6	3.04	2.2	17.95	2.2
11-Feb	London Bexley	PM25	25007	11511	1	-0.7	2.90	2.2	15.08	2.2
12-Feb	London Bloomsbury	PM10	24446	13650	1	-0.7	3.03	2.2	15.50	2.2
12-Feb	London Bloomsbury	PM25	27240	14729	1	-0.2	3.03	2.2	15.71	2.2
24-Jan	London Eltham	PM25	2000	13849	1	0.2	2.98	2.2	16.54	2.2
31-Jan	London Harlington	PM10	24902	12168	1	-1.0	2.94	2.2	15.85	2.2
31-Jan	London Harlington	PM25	23959	12811	1	0.0	2.95	2.2	15.77	2.2
06-Feb	London Harrow Stanmore	PM25	27274	16081	1	-1.0	3.03	2.2	15.82	2.2
21-Jan	London Marylebone Road	PM10	27230	16770	1	-1.0	3.11	2.2	16.38	2.2
21-Jan	London Marylebone Road	PM25	27239	12977	1	1.3	3.03	2.2	17.29	2.2
21-Jan	London Marylebone Road PARTISOL	PM10	20943						16.55	2.2
21-Jan	London Marylebone Road PARTISOL	PM25	21221						16.35	2.2
22-Jan	London N. Kensington	PM10	27391	12822	1	1.2	2.95	2.2	16.38	2.2
22-Jan	London N. Kensington	PM25	21342	15788	1	0	2.95	2.2	16.32	2.2
22-Jan	London N. Kensington PARTISOL	PM10	21015						16.44	2.2
22-Jan	London N. Kensington PARTISOL	PM25	21019						16.55	2.2
08-Feb	London Teddington	PM25	25023	15297	1	-0.5	3.15	2.2	16.65	2.2
28-Jan	London Westminster	PM25	20939						16.53	2.2
29-Jan	Southwark A2 Old Kent Road	PM10	2000	14932	1	-1.3	0.98	2.2	16.23	2.2

5. English Sites

Carbon Monoxide

2013	Site	Analyser number	[1] Zero output	Uncertainty (ppm)	[2] Calibration Factor	Uncertainty (%)	Maximum Residual (%)
17-Jan	Leeds Centre	1501	2	0.2	1.111	2.2	1.3

Sulphur Dioxide

Date Year =2013	Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	[*]Max Residual (%)	m-xylene interference (ppb)	Analyser number
09-Jan	Barnsley Gawber	08050082	-3	2.7	0.798	3.1	1.9	4.6
17-Jan	Birmingham Tyburn	EH937000	2	2.4	0.648	3.1	0.1	0.4
08-Jan	Harwell	14350	11	2.5	1.020	3.2	1.1	6.4
18-Jan	Hull Freetown	342	2	2.6	1.082	3.6	7.9	9.7
30-Jan	Ladybower	1178	-22	3.3	1.266	3.2	1.4	11.8
17-Jan	Leeds Centre	08050084	-2	3.3	1.152	3.1	2.7	3.5
23-Jan	Liverpool Speke	1765	9	2.8	0.963	3.1	0.9	16.1
17-Jan	Lullington Heath	12181	2	2.5	1.037	3.2	4.4	11.4
31-Jan	Manchester Piccadilly	19216	0	2.6	0.932	3.2	3.3	12.1
22-Jan	Middlesbrough	1660	7	2.5	1.048	4.1	3.2	0.9
18-Feb	Nottingham Centre	1629	0	2.6	0.621	4.0	2.8	3.8
18-Feb	Rochester Stoke	2800	9	4.0	1.129	4.5	4.0	14.7
18-Jan	Scunthorpe Town	1108-70	55	4.1	1.004	3.4	5.7	0.0
13-Feb	Southampton Centre	343	1	2.6	1.139	18.3	21.6	7.7
19-Feb	Thurrock	20092	2	2.6	0.846	3.1	1.9	3.8
06-Feb	Wicken Fen	11689	-2	2.6	0.984	3.3	2.8	9.5

Ozone

2013	Site	Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	Max Residual (%)
09-Jan	Barnsley Gawber	cm08060030	0	3	1.051	3.1	0.4
16-Jan	Birmingham Acocks Green	2435	-3	3	1.017	3.1	0.6
17-Jan	Birmingham Tyburn	WB6AG7TM	0	3	1.032	3.1	1.2
17-Jan	Birmingham Tyburn Roadside	2434	0	3	1.045	3.2	0.8
07-Jan	Blackpool Marton	080060037	0	3	0.977	3.1	1.9
18-Feb	Bottesford	CM08060022	1	3	0.959	3.3	0.9
05-Feb	Bournemouth	17503	-1	3	0.993	3.2	0.6
26-Feb	Brighton Preston Park	12461	-2	3	0.953	3.1	0.6
15-Feb	Bristol St Paul's	14358	-2	3	1.042	3.1	0.5
21-Feb	Canterbury	19194	6	3	0.912	3.1	0.1
15-Jan	Charlton Mackrell	1111957	0	3	1.065	3.1	1.6
15-Jan	Coventry Memorial Park	CM08060044	0	3	1.014	3.1	1.2
13-Feb	Exeter Roadside	2	3	3	0.915	3.1	0.9
30-Jan	Glazebury	19751	1	3	1.006	3.1	0.2
08-Jan	Harwell	17497	-1	3	1.010	3.1	0.5
29-Jan	High Muffles	1641	1	3	1.046	3.1	2.5
18-Jan	Hull Freetown	cm08060045	0	3	1.043	3.1	0.6
30-Jan	Ladybower	1651	-1	3	0.969	3.1	0.3
15-Jan	Leamington Spa	411790	0	3	1.015	3.5	2.1
17-Jan	Leeds Centre	cm08060036	0	3	1.076	3.1	0.8
16-Jan	Leicester Centre	CM08060020	1	3	1.062	3.1	1.8

2013	Site	Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	[*]Max Residual (%)
14-Jan	Leominster	#014470	0	3	0.993	3.1	0.1
23-Jan	Liverpool Speke	CM08060041	1	3	0.990	3.2	0.4
17-Jan	Lullington Heath	17494	0	3	1.035	3.1	0.3
31-Jan	Manchester Piccadilly	cm08060039	0	3	0.998	3.1	0.4
30-Jan	Manchester South	16954	-1	3	1.024	3.1	0.5
17-Jan	Market Harborough	CM08060031	-1	3	1.059	3.1	0.8
22-Jan	Middlesbrough	944	-2	3	1.013	3.1	2.3
21-Jan	Newcastle Centre	cm08060033	-1	3	0.968	3.1	1.1
14-Jan	Northampton Kingsthorpe	47R76STR	0	3	1.032	3.1	0.4
05-Feb	Norwich Lakenfields	CM08060028	0	3	1.036	3.1	0.2
18-Feb	Nottingham Centre	60032	0	3	1.095	3.1	0.9
14-Feb	Plymouth Centre	2	0	3	1.085	3.1	0.6
28-Feb	Portsmouth	CM08060023	-1	3	1.038	3.2	0.9
07-Jan	Preston	cm8060042	1	3	1.006	3.1	0.6
07-Jan	Reading New Town	CM08060025	0	3	1.014	3.1	0.7
18-Feb	Rochester Stoke	378	2	3	1.007	3.2	0.7
29-Jan	Salford Eccles	1111956	0	3	0.853	3.1	1.1
07-Jan	Sheffield Centre	cm08060024	0	3	1.055	3.2	1.0
04-Feb	Sibton	14339	-1	3	1.007	3.1	0.2
13-Feb	Southampton Centre	cm08060021	0	3	1.088	3.4	1.2
07-Mar	Southend-on-Sea	CM08060017	0	3	1.166	3.2	0.7
20-Feb	St Osyth	cm08050073	0	3	0.994	3.1	0.9
29-Jan	Stoke-on-Trent Centre	CM08060026	0	3	1.042	3.1	0.8
23-Jan	Sunderland Si ksworth	436	1	3	1.352	4.9	1.4
19-Feb	Thurrock	20094	0	3	1.037	3.2	3.1
23-Jan	Walsall Woodlands	19222	0	3	1.179	3.1	0.7
05-Feb	Weybourne	AEA0030	-3	3	1.038	3.2	0.4
06-Feb	Wicken Fen	14345	-2	3	1.055	5.4	0.7
28-Jan	Wigan Centre	cm08060018	-2	3	1.011	3.3	1.3
22-Jan	Wirral Tranmere	CM08060040	-1	3	1.014	3.1	0.9
07-Feb	Yarner Wood	19192	-2	3	1.049	3.3	1.9

Oxides of Nitrogen

2013	Site		Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	[*]Max residual (%)	[*]Converter efficiency (%)
09-Jan	Barnsley	NO	08050057	1	2.6	1.217	3.5	1.7	
	Gawber	NOx		1	2.6	1.209	3.5	1.7	100.9
15-Feb	Bath Roadside	NO	12758	1	2.6	1.116	3.5	1.8	
		NOx		1	2.6	1.102	3.5	1.4	95.8
22-Jan	Billingham	NO	574	1	2.7	1.300	3.5	0.4	
		NOx		1	2.7	1.289	3.5	0.1	99.5

2013	Site		Analyser number	1 Zero output	Uncertainty (ppb)	2 Calibration Factor	Uncertainty (%)	* Max residual (%)	* Converter efficiency (%)
16-Jan	Birmingham	NO	3364	0	2.6	1.131	3.5	0.6	
	Acocks Green	NOx		2	2.8	1.126	3.5	0.7	100.2
17-Jan	Birmingham	NO	Y7ACC7MC	0	2.5	0.958	3.5	0.6	
	Tyburn	NOx		0	2.5	0.951	3.5	0.5	99.5
17-Jan	Birmingham	NO	68	1	3.0	1.869	7.2	4.8	
	Tyburn Roadside	NOx		1	3.1	1.879	6.9	4.6	99.1
08-Jan	Blackburn	NO	1011851	-1	2.5	0.962	3.5	1.3	
	Darwen Roadside	NOx		6	3.0	0.972	3.5	1.4	98.7
07-Jan	Blackpool	NO	08050075	0	2.5	0.925	4.9	3.6	
	Marton	NOx		0	2.5	0.877	3.5	1.4	100.0
05-Feb	Bournemouth	NO	17507	3	2.6	1.154	3.5	0.4	
		NOx		1	2.6	1.095	3.5	1.1	96.0
26-Feb	Brighton Preston	NO	13068	3	2.6	1.194	3.5	0.2	
	Park	NOx		2	2.6	1.184	3.5	0.1	98.8
15-Feb	Bristol St Paul's	NO	14353	0	2.6	1.244	3.5	0.3	
		NOx		2	2.7	1.252	3.5	0.2	98.6
07-Feb	Cambridge	NO	1011843	-1	2.7	1.327	3.5	1.1	
	Roadside	NOx		2	2.7	1.327	3.5	0.3	101.0
21-Feb	Canterbury	NO	11666	1	3.5	1.312	3.5	1.8	
		NOx		0	3.8	1.243	3.5	0.6	99.0
08-Jan	Carlisle	NO	1011849	26	2.6	1.293	3.5	1.4	
	Roadside	NOx		29	2.7	1.304	3.5	0.9	99.5
15-Jan	Charlton	NO	12895	1	2.6	1.201	3.5	2.9	
	Mackrell	NOx		1	2.6	1.198	3.5	2.7	101.1
18-Feb	Chatham Centre	NO	3393	1	2.6	1.198	3.5	1.3	
	Roadside	NOx		0	3.0	1.165	3.5	0.6	99.6
08-Jan	Chesterfield	NO	1011837	0	2.5	0.996	3.5	1.8	
		NOx		2	2.5	1.013	3.5	1.2	100.9
08-Jan	Chesterfield	NO	1011835	0	2.8	1.202	3.5	3.7	
	Roadside	NOx		3	3.3	1.210	3.5	3.4	101.0
15-Jan	Coventry	NO	08030109	0	2.5	0.896	3.5	0.8	
	Memorial Park	NOx		-1	2.5	0.895	3.5	0.9	100.0
27-Feb	Eastbourne	NO	19209	8	2.6	1.128	3.5	0.9	
		NOx		9	2.9	1.122	3.5	0.9	99.0
13-Feb	Exeter Roadside	NO	1	-1	2.6	1.150	3.5	1.6	
		NOx		-2	2.6	1.133	3.5	1.8	98.7
30-Jan	Glazebury	NO	14354	2	2.6	1.124	3.5	0.2	
		NOx		6	2.6	1.142	3.5	1.2	99.5
08-Jan	Harwell	NO	14355	2	2.6	1.281	3.5	0.4	
		NOx		0	2.7	1.267	3.5	0.2	98.7
29-Jan	High Muffles	NO	1783	1	2.6	1.169	3.5	1.0	
		NOx		0	3.0	1.184	3.5	1.1	99.6

2013	Site		Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	*Max residual (%)	*Converter efficiency (%)
14-Feb	Honiton	NO	19214	0	2.6	1.175	3.5	1.1	
		NOx		10	9.8	1.189	3.7	0.8	101.0
25-Feb	Horley	NO	1401954	0	2.5	1.056	3.5	1.8	
		NOx		11	6.7	1.089	3.5	1.8	99.5
18-Jan	Hull Freetown	NO	08050056	0	2.5	0.895	4.6	8.8	
		NOx		0	2.5	0.933	4.6	8.8	98.9
30-Jan	Ladybower	NO	*072	0	2.6	1.136	3.5	2.2	
		NOx		-1	2.8	1.154	3.5	1.9	99.6
15-Jan	Leamington Spa	NO	1011842	0	2.5	1.012	3.6	2.7	
		NOx		2	2.5	1.023	3.7	3.2	99.5
14-Jan	Leamington Spa	NO	19211	2	2.7	1.165	3.5	0.7	
	Rugby Road	NOx		4	2.7	1.173	3.5	0.3	98.4
17-Jan	Leeds Centre	NO	08050066	0	4.1	1.474	3.6	3.6	
		NOx		0	6.0	1.475	3.7	3.8	100.0
17-Jan	Leeds Headingley	NO	342	0	2.6	1.162	3.5	0.7	
	Kerbside	NOx		2	2.6	1.180	3.5	0.1	98.2
16-Jan	Leicester Centre	NO	08050021	-1	2.5	0.916	3.5	0.8	
		NOx		0	2.5	0.913	3.5	0.5	96.9
14-Jan	Leominster	NO	#014863	0	3.6	2.695	4.4	3.5	
		NOx		1	3.6	2.729	4.5	3.6	103.2
19-Feb	Lincoln Canwick	NO	19203	1	2.6	1.182	3.5	0.4	
	Road	NOx		0	3.8	1.173	3.5	0.9	98.9
24-Jan	Liverpool Queen's	NO	1734	-1	2.5	1.024	3.5	0.5	
	Drive Roadside	NOx		0	2.5	1.009	3.5	0.9	100.7
23-Jan	Liverpool Speke	NO	356	0	2.6	1.119	3.5	1.3	
		NOx		-9	2.6	1.087	3.5	2.4	98.6
17-Jan	Lullington Heath	NO	14313	1	2.5	0.994	3.5	1.9	
		NOx		1	2.5	0.965	3.5	2.1	98.7
31-Jan	Manchester	NO	08050065	2	2.5	0.950	3.5	0.1	
	Piccadilly	NOx		2	2.5	0.995	3.5	0.5	97.7
30-Jan	Manchester	NO	17311	2	2.6	1.089	3.5	0.9	
	South	NOx		2	2.6	1.060	3.5	1.2	99.8
17-Jan	Market	NO	08050068	0	2.4	0.760	3.5	1.2	
	Harborough	NOx		1	2.4	0.776	3.5	1.3	101.3
22-Jan	Middlesbrough	NO	2287	2	2.6	1.273	3.5	0.3	
		NOx		12	2.6	1.254	3.5	2.0	101.0
21-Jan	Newcastle	NO	08050063	1	2.5	0.849	3.5	1.2	
	Centre	NOx		1	2.5	0.877	3.5	1.2	99.7
21-Jan	Newcastle	NO	1011853	0	2.7	1.117	3.5	1.1	
	Cradlewell Road	NOx		2	3.2	1.125	3.5	0.8	100.5
14-Jan	Northampton	NO	8ATJ6APR	0	2.5	0.988	3.5	1.1	

2013	Site		Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	*Max residual (%)	*Converter efficiency (%)
	Kingsthorpe	NOx		0	2.6	0.963	3.5	1.1	98.2
05-Feb	Norwich	NO	08050067	-1	2.5	0.989	3.5	1.2	
	Lakenfields	NOx		-1	2.5	0.978	3.5	1.3	101.1
18-Feb	Nottingham	NO	50072	1	2.6	1.202	3.5	0.4	
	Centre	NOx		0	2.6	1.207	3.5	0.6	100.8
09-Jan	Oxford Centre	NO	11844	1	2.6	1.091	3.5	1.6	
	Roadside	NOx		2	2.6	1.089	3.5	1.7	98.6
09-Jan	Oxford St Ebbes	NO	1011830	-1	2.6	0.973	3.5	2.0	
		NOx		1	3.0	0.978	3.5	1.7	100.8
14-Feb	Plymouth Centre	NO	1	1	2.4	0.721	3.5	0.1	
		NOx		1	2.4	0.724	3.5	0.5	99.7
28-Feb	Portsmouth	NO	p0t7cya5	-1	2.5	0.961	3.5	0.5	
		NOx		2	2.5	0.953	3.5	0.8	101.0
07-Jan	Preston	NO	cm0860064	0	2.5	0.966	3.5	1.0	
		NOx		0	2.5	0.950	3.5	1.0	98.9
07-Jan	Reading New	NO	08050059	0	2.5	0.913	3.5	1.0	
	Town	NOx		0	2.5	0.938	3.5	1.2	100.4
18-Feb	Rochester Stoke	NO	3095	1	2.9	1.209	3.5	2.2	
		NOx		1	2.8	1.226	3.5	1.7	99.1
29-Jan	Salford Eccles	NO	1011831	0	2.5	1.010	3.5	0.5	
		NOx		1	2.5	1.016	3.5	0.3	100.4
06-Feb	Sandy Roadside	NO	18006	1	2.6	1.172	3.5	1.8	
		NOx		2	2.6	1.167	3.5	1.3	100.2
18-Jan	Scunthorpe	NO	1011847	51	3.2	2.194	3.5	3.4	
	Town	NOx		52	3.2	2.198	3.5	3.4	98.2
07-Jan	Sheffield Centre	NO	08050055	0	2.5	0.911	3.5	1.8	
		NOx		-1	2.5	0.904	3.5	1.6	128.1
08-Jan	Sheffield Tinsley	NO	847	1	2.7	1.341	3.5	3.2	
		NOx		2	2.7	1.374	3.5	2.8	101.7
13-Feb	Southampton	NO	08030106	1	2.5	0.967	21.8	25.4	
	Centre	NOx		0	2.5	0.969	22.3	25.7	99.6
07-Mar	Southend-on-	NO	08050071	1	2.5	0.946	3.5	0.5	
	Sea	NOx		1	2.5	0.946	3.5	0.3	99.6
20-Feb	St Osyth	NO	08060035	-1	2.6	1.008	3.5	0.9	
		NOx		-2	2.7	0.993	3.5	1.6	100.4
19-Feb	Stanford-le-	NO	20093	1	2.6	1.220	3.5	0.1	
	Hope Roadside	NOx		2	2.6	1.223	3.5	0.3	100.7
23-Jan	Stockton-on-Tees	NO	335	1	2.6	1.138	3.5	0.8	
	Eaglescliffe	NOx		1	2.6	1.125	3.5	0.9	100.5
29-Jan	Stoke-on-Trent	NO	08050070	1	2.5	0.950	4.2	3.7	
	Centre	NOx		0	2.5	0.948	4.2	3.7	99.2
26-Feb	Storrington	NO	09040022	0	3.0	1.971	3.5	1.2	

2013	Site		Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	*Max residual (%)	*Converter efficiency (%)
	Roadside	NOx		0	3.0	1.962	3.5	1.5	100.0
23-Jan	Sunderland	NO	1011854	0	2.4	0.656	3.8	5.1	
	Si ksworth	NOx		1	2.5	0.650	3.6	3.3	97.5
19-Feb	Thurrock	NO	20090	1	2.7	1.370	3.5	0.6	
		NOx		1	2.8	1.392	3.5	1.2	100.6
23-Jan	Walsall	NO	19213	1	2.6	1.116	3.5	1.3	
	Woodlands	NOx		5	2.6	1.132	3.5	1.7	99.7
24-Jan	Warrington	NO	1011826	-1	2.6	0.944	3.5	1.0	
		NOx		1	2.6	0.952	3.5	1.0	98.4
06-Feb	Wicken Fen	NO	13069	2	2.5	1.010	3.5	0.8	
		NOx		0	3.1	0.982	3.5	1.6	98.5
28-Jan	Wigan Centre	NO	1011832	1	2.5	0.986	3.5	2.6	
		NOx		2	2.5	0.986	3.5	0.9	95.0
22-Jan	Wirral Tranmere	NO	08050060	-1	2.5	0.908	3.5	0.5	
		NOx		-1	2.5	0.927	3.5	0.8	100.6
07-Feb	Yarner Wood	NO	14406	1	2.6	1.031	3.5	0.4	
		NOx		0	2.5	1.009	3.5	1.2	100.0
08-Jan	York Fishergate	NO	1011848	-1	2.7	0.992	3.5	0.9	
		NOx		2	3.0	1.000	3.5	1.0	99.4

Particulate Analysers

2013	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 (%)
16-Jan	Birmingham Acocks Green	PM25	27304	15350	1	-1.6	2.90	2.2	15.53	2.2
17-Jan	Birmingham Tyburn	PM10	27255	14854	1	-0.6	2.86	2.2	15.49	2.2
17-Jan	Birmingham Tyburn	PM25	21372	14612	1	-0.5	3.05	2.2	15.95	2.2
17-Jan	Birmingham Tyburn Roadside	PM10	26034	12092	1	-2.3	2.55	2.2	15.09	2.2
17-Jan	Birmingham Tyburn Roadside	PM25	2000	14173	1	-1.8	2.94	2.2	15.77	2.2
07-Jan	Blackpool Marton	PM25	24424	12893	1	0.0	**2.99**	**2.2**	**16.55**	**2.2**
05-Feb	Bournemouth	PM25	21863						16.34	2.2
26-Feb	Brighton Preston Park	PM25	21865						16.70	2.2
15-Feb	Bristol St Paul's	PM10	24426	13297	1	0.9	**3.01**	**2.2**	**16.88**	**2.2**
15-Feb	Bristol St Paul's	PM25	2000-004	13682	1	-1.7	**2.95**	**2.2**	**16.30**	**2.2**
08-Jan	Carlisle Roadside	PM10	27257	14765	1	1.9	3.00	2.2	16.57	2.2
08-Jan	Carlisle Roadside	PM25	27320	14892	1	-1.8	2.99	2.2	16.16	2.2
18-Feb	Chatham Centre Roadside	PM10	27108	14450	1	-0.5	2.95	2.2	15.90	2.2
18-Feb	Chatham Centre Roadside	PM25	27343	15957	1	-0.3	2.86	2.2	15.19	2.2
08-Jan	Chesterfield	PM10	27316	16290	1	-0.2	2.87	2.2	15.64	2.2

2013	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 (%)
08-Jan	Chesterfield	PM25	27314	12505	1	0.6	2.95	2.2	16.15	2.2
08-Jan	Chesterfield Roadside	PM10	22299	11472	1	1.1	3.01	2.2	16.08	2.2
08-Jan	Chesterfield Roadside	PM25	27339	17866	1	-2.4	2.96	2.2	16.14	2.2
15-Jan	Coventry Memorial Park	PM25	26445	14783	1	-1.2	**2.80**	**2.2**	**15.75**	**2.2**
27-Feb	Eastbourne	PM10	2000	14358	1	-1.0	3.07	2.2	16.19	2.2
27-Feb	Eastbourne	PM25	27244	14873	1	0.3	2.98	2.2	15.94	2.2
08-Jan	Harwell	PM10	27333	14783	1	-1.1	2.64	2.2	15.20	2.2
08-Jan	Harwell	PM25	21366	12418	1	0.2	3.01	2.2	15.69	2.2
08-Jan	Harwell Partisol	PM10	21257						16.22	2.2
08-Jan	Harwell Partisol	PM25	21859						15.91	2.2
18-Jan	Hull Freetown	PM10	24445	14116	1	0.1	2.92	2.2	15.73	2.2
18-Jan	Hull Freetown	PM25	26498	13973	1	-1.6	3.02	2.2	16.38	2.2
15-Jan	Leamington Spa	PM10	27295	15001	1	0.0	2.83	2.2	15.02	2.2
15-Jan	Leamington Spa	PM25	27248	14217	1	0.3	2.87	2.2	15.32	2.2
14-Jan	Leamington Spa Rugby Road	PM10	27205	13909	1	-0.2	**3.06**	**2.2**	**16.80**	**2.2**
14-Jan	Leamington Spa Rugby Road	PM25	26566	15854	1	-1.1	**3.05**	**2.2**	**17.08**	**2.2**
17-Jan	Leeds Centre	PM10	24451	13293	1	-0.8	3.14	2.2	15.93	2.2
17-Jan	Leeds Centre	PM25	27254	16929	1	-0.7	3.17	2.2	15.96	2.2
17-Jan	Leeds Headingley Kerbside	PM10	27287	17521	1	-0.4	2.95	2.2	15.88	2.2
17-Jan	Leeds Headingley Kerbside	PM25	27249	14607	1	-0.6	2.83	2.2	15.19	2.2
16-Jan	Leicester Centre	PM10	24442	14247	1	-1.5	2.9	2.2	15.34	2.2
16-Jan	Leicester Centre	PM25		analyser	not	present				
23-Jan	Liverpool Speke	PM10	24450	15765	1	-0.3	3.01	2.2	15.30	2.2
23-Jan	Liverpool Speke	PM25	28607	14733	1	-1.2	2.96	2.2	15.31	2.2
31-Jan	Manchester Piccadilly	PM25	26038	13770	1	-1.8	2.97	2.2	15.60	2.2
22-Jan	Middlesbrough	PM10	24325	13816	1	-2.2	**2.95**	**2.2**	**17.29**	**2.2**
22-Jan	Middlesbrough	PM25	27195	15813	1	-1.2	**2.96**	**2.2**	**17.61**	**2.2**
21-Jan	Newcastle Centre	PM10	24448	13868	1	0.3	**3.11**	**2.2**	**17.11**	**2.2**
21-Jan	Newcastle Centre	PM25	24447	14866	1	0.2	**3.05**	**2.2**	**17.32**	**2.2**
14-Jan	Northampton Kingsthorpe	PM25	21013						16.13	2.2
05-Feb	Norwich Lakenfields	PM10	21495	15549	1	-1.0	2.89	2.2	15.86	2.2
05-Feb	Norwich Lakenfields	PM25	27328	15732	1	0.8	2.86	2.2	15.26	2.2
18-Feb	Nottingham Centre	PM10	27369	15495	1	-0.6	2.93	2.2	15.51	2.2
18-Feb	Nottingham Centre	PM25	25025	12207	1	0.2	2.88	2.2	15.87	2.2
09-Jan	Oxford St Ebbes	PM10	27296	14819	1	0.0	3.01	2.2	16.36	2.2
09-Jan	Oxford St Ebbes	PM25	27235	17121	1	-0.3	2.87	2.2	15.85	2.2

2013	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 (%)
14-Feb	Plymouth Centre	PM10	24428	12308	1	0.2	2.88	2.2	15.61	2.2
14-Feb	Plymouth Centre	PM25	27221	14306	1	-0.2	3.02	2.2	15.71	2.2
28-Feb	Portsmouth	PM10	7628	16814	1	-1.0	3.01	2.2	16.14	2.2
28-Feb	Portsmouth	PM25	21358	18405	1	-0.7	2.88	2.2	15.26	2.2
07-Jan	Preston	PM25	228810001	12784	1	-1.3	**3.03**	**2.2**	**16.61**	**2.2**
07-Jan	Reading New Town	PM10	21315	13212	1	0.1	2.93	2.2	15.77	2.2
07-Jan	Reading New Town	PM25	25090	14022	1	-0.8	2.97	2.2	15.63	2.2
18-Feb	Rochester Stoke	PM10	27241	14788	1	-0.8	2.97	2.2	15.58	2.2
18-Feb	Rochester Stoke	PM25	27258	15982	1	0.2	2.89	2.2	15.42	2.2
29-Jan	Salford Eccles	PM10	2000	13650	1	-0.3	2.95	2.2	16.11	2.2
29-Jan	Salford Eccles	PM25	27272	14487	1	-1.0	2.89	2.2	15.20	2.2
06-Feb	Sandy Roadside	PM10	22018	11170	1	-1.1	2.90	2.2	15.87	2.2
06-Feb	Sandy Roadside	PM25	27632	15928	1	-0.9	2.90	2.2	15.72	2.2
18-Jan	Scunthorpe Town	PM10	27366	14987	1	-0.1	2.84	2.2	15.39	2.2
07-Jan	Sheffield Centre	PM10	25024	12148	1	-3.6	2.91	2.2	16.05	2.2
07-Jan	Sheffield Centre	PM25	27253	15795	1	1.0	2.96	2.2	15.54	2.2
13-Feb	Southampton Centre	PM10	24448	13952	1	0.6	2.92	2.2	15.83	2.2
13-Feb	Southampton Centre	PM25	27258	16558	1	0.2	3.05	2.2	16.24	2.2
07-Mar	Southend-on-Sea	PM25	22927	12503	1	0.6	**2.95**	**2.2**	**16.63**	**2.2**
19-Feb	Stanford-le-Hope Roadside	PM10	12667	12628	1	-0.3	3.05	2.2	15.83	2.2
19-Feb	Stanford-le-Hope Roadside	PM25	13043	13205	1	1.2	3.19	2.2	16.36	2.2
23-Jan	Stockton-on-Tees Eaglescliffe	PM10	h4554						14.57	2.2
23-Jan	Stockton-on-Tees Eaglescliffe	PM25	h4553						15.51	2.2
29-Jan	Stoke-on-Trent Centre	PM10	25028	12533	1	0.2	2.88	2.2	15.92	2.2
29-Jan	Stoke-on-Trent Centre	PM25	27262	13602	1	0.7	2.90	2.2	16.03	2.2
26-Feb	Storrington Roadside	PM10	15679	15721	1	0.3	3.01	2.2	15.75	2.2
26-Feb	Storrington Roadside	PM25	27229	12838	1	0.7	2.97	2.2	15.56	2.2
23-Jan	Sunderland Si ksworth	PM25	27247	15612	1	-1.2	2.98	2.2	15.81	2.2
19-Feb	Thurrock	PM10	27329	13934	1	-0.8	2.90	2.2	14.45	2.2
24-Jan	Warrington	PM10	27183	11884	1	-1.0	2.91	2.2	15.03	2.2
24-Jan	Warrington	PM25	27269	16234	1	-0.8	2.93	2.2	15.16	2.2
28-Jan	Wigan Centre	PM25	27291	14711	1	-1.0	2.83	2.2	14.71	2.2
22-Jan	Wirral Tranmere	PM25	22883	13249	1	-0.3	3.02	2.2	16.08	2.2
08-Jan	York Bootham	PM10	21877	14585	1	-1.0	2.95	2.2	15.14	2.2

2013	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 (%)
08-Jan	York Bootham	PM25	27209	15999	1	-1.7	2.91	2.2	15.25	2.2
08-Jan	York Fishergate	PM10	27232	15600	1	-0.6	2.91	2.2	15.70	2.2
08-Jan	York Fishergate	PM25	27330	18062	1	-1.0	2.86	2.2	15.50	2.2

The above factors have been calculated using certified standards. The analysers listed above have been tested for zero response, cal bration 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 Ricardo AEA at the above address. Hard copies are available on request.

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QA/QC Data Ratification Report for the Automatic Urban and Rural Network, January-March 2014, and Intercalibration Report, Winter 2014

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

Ricardo-AEA/R/3433
Issue 1
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Date:

02/12/2014

Signed:

Alison Loader

Executive summary

Ricardo-AEA carries out the quality assurance and quality 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), the Scottish Government, Welsh Government and Department of Environment (DoE) in Northern Ireland.

Ratified hourly average data capture for the network averaged 89.72% for all pollutants (O_3, NO_2, SO_2, CO, PM_{10} and $PM_{2.5}$) during the 3-month reporting period January-March 2014. Average data capture for all pollutants except $PM_{2.5}$ were above 85%. There were 24 stations with data capture less than 85% for the period (34 below 90%).

A total of 135 monitoring stations in the AURN operated during this quarter, of which 74 were Local Authority owned stations affiliated to the national network. Some are co-located and separately named gravimetric particulate analysers at stations with automatic analysers. Many affiliated stations have additional Defra-funded analysers installed on site.

The main reasons for data loss at the stations have been provided and these were predominantly due to instrument faults, response instability or problems associated with the replacement of analysers and infrastructure.

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Section A Data Ratification Report, January-March 2014

1 Introduction Data Ratification Report

This quarterly report covers the Quality Assurance and Quality Control (QA/QC) activities undertaken by Ricardo-AEA to ratify automatic monitoring data from Defra and the Devolved Administrations' Automatic Urban and Rural air quality monitoring Network (AURN) for the period 1 January – 31 March 2014. During this quarter there was a total of 135 operational monitoring stations in the network, at which 381 automatic analysers were in use. Eleven stations have non-automatic gravimetric particulate samplers (Partisols); at four stations (Auchencorth Moss, Harwell, London North Kensington and Marylebone Road) these are co-located with FDMS analysers for both PM_{10} and $PM_{2.5}$.

1.1 Overview of Network Performance

Ratified hourly average (daily average for Partisols) data capture for the network averaged 89.72% for all pollutants (O_3, NO_2, SO_2, CO, PM_{10} and $PM_{2.5}$) during the three-month reporting period January-March 2014 (see Table 1.1). All species except $PM_{2.5}$ achieved 85 % or higher data capture on average. Data capture statistics 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 stations starting or closing during the period, the data capture is based on the actual date starting or closing.

Table 1.1: AURN Ratified Data Capture (%) by Quarter, January-March 2014

	CO	PM_{10}	$PM_{2.5}$	NO_2	O_3	SO_2	Mean
Q1 2014	95.35	85.45	83.51	94.31	95.01	90.02	89.72

Overall, 301 out of the 381 analysers (79%) achieved data capture levels above the required 85% target during this reporting period. Table 1.2 shows the number of analysers which did not meet the target.

Table 1.2: Number of Analysers with Data Capture below 85%

Total Number Of Analysers		Q1 Jan-Mar 2014 (No. below 85%)
CO	7	1
NO_2	116	8
O_3	79	6
PM_{10}[1]	70	24
$PM_{2.5}$[1]	80	35
SO_2	29	6
Total <85%		80

[1] Includes FDMS, BAM and Partisol analysers.

In total, 30 out of the 136 operational network stations in the quarter (18%) had an average data capture rate below the required 90% level for the January-March 2014 period.

1.2 Changes to Ratified Data

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

- Middlesbrough PM_{10}, deleted 1 November-31 December 2013; high volatiles.
- Oxford St Ebbes PM_{10}, deleted 6 Oct-31 December 2013, low volatiles possibly due to drier fault.
- Rochester Stoke $PM_{2.5}$, deleted 5-31 December 2013, $PM_{2.5}$ higher than PM_{10}.
- Swansea Roadside, PM_{10} and $PM_{2.5}$, rescaled 1 August-31 December 2013, low flowrates.

A list of changes to ratified data is given at http://uk-air.defra.gov.uk/data/changes-to-ratified-data .

1.1 Changes to the Network for Directive Compliance

An ongoing programme of changes to the AURN is under way, to ensure it continues to be compliant with the requirements of the European Union’s Air Quality Directive (EU Directive 3008/50/EC). However, no new stations were commissioned during the period covered by this report.

2 Background Information

2.1 AURN Hub and LSO Manual

The AURN Hub is a password protected website for the use of AURN contractors including Local Site Operators (LSOs) and Equipment Support units.

The LSO manual is available via the AURN Hub at http://uk-air.defra.gov.uk/reports/empire/lsoman/lsoman.html. Current versions of the LSO calibrations spreadsheet are also available to download from the LSO manual page of the Hub.

2.2 Monitoring Station Information

All information on monitoring stations is now uploaded to Central Management and Control Unit (CMCU)'s database and Defra's online air quality archive UK-AIR for dissemination using Google Earth. Ricardo-AEA makes considerable effort in ensuring that site locations are accurate on the new Google Earth site information and UK-Air archive pages. All future additions to the AURN will include accurate positioning using Google Earth.

3 Generic Data Quality Issues

3.1 FDMS Performance Issues

Several FDMS analysers continued to give problems during the quarter. Out of 150 operational analysers, 59 had data capture less than 90% (39 less than 85%). However, *average* data capture for both $PM_{2.5}$ and PM_{10} were above 90% for this quarter.

3.2 Precision of Gaseous Data

During 2013, the data logging systems of sites in the AURN were updated (where necessary) to provide raw data to one decimal place (two for carbon monoxide), rather than as integers (one decimal place for CO) as had previously been the case. As of 1 January, raw data from the following sites were still being supplied as integer values to the QA/QC Unit:

1. Carlisle Roadside
2. Chesterfield (though this is currently closed)
3. Horley
4. Newcastle Cradlewell Roadside
5. Newport
6. Rochester Stoke (currently to 0.5 ppb)
7. Scunthorpe (0.5 ppb)
8. Sunderland Silksworth
9. Warrington
10. Salford Eccles
11. York Fishergate

It is anticipated that, where necessary, these sites will be upgraded during the summer 2014 service round.

4 Station Specific Issues

In this section, we discuss in turn specific station issues for the following geographic groupings – London, England (excluding London), Scotland, Northern Ireland and Wales. Where analysers were commissioned during the period, the stated data capture for these instruments is calculated from the date of commissioning. In the following tables, analysers with data capture less than 90% are highlighted in yellow and those with data capture less than 85% are highlighted in orange.

4.1 London

4.1.1 Data Capture

The data capture for stations in London (within the M25) for the period January-March 2014 is given in Table 4.1:

Table 4.1 Data Capture for London, January-March 2014 (%)

Name	CO	PM_{10}	PM_{25}	NO_2	O_3	SO_2	Average
Camden Kerbside		96.85	97.59	99.63			98.02
Haringey Roadside		81.25	81.94	99.44			87.55
London Bexley			74.12	99.58		86.02	86.57
London Bloomsbury		90.97	91.06	98.29	98.38	97.92	95.32
London Eltham			83.98	98.75	99.77		94.17
London Haringey Priory Park South				99.40	99.49		99.44
London Harlington		91.67	94.44	94.26	95.28		93.91
London Harrow Stanmore			55.23				55.23
London Hillingdon				94.40	98.47		96.44
London Marylebone Road	97.31	91.11	95.83	96.57	91.76	93.70	94.38
London Marylebone Road Partisols		94.44	97.78				96.11
London N. Kensington	98.24	87.64	92.22	92.08	98.29	97.50	94.33
London N. Kensington Partisols		100.00	100.00				100.00
London Teddington				98.56	42.13		70.35
London Teddington Bushy Park			12.41				12.41
London Westminster			100.00	98.33			98.40
Southwark A2 Old Kent Road		86.81		59.40			73.10
Tower Hamlets Roadside				99.68			99.68
Number of Sites	**2**	**9**	**13**	**14**	**8**	**4**	**18**
Number of sites < 85 %	**0**	**1**	**5**	**1**	**1**	**0**	**4**
Number of sites < 90%	**0**	**3**	**5**	**1**	**1**	**1**	**6**
Network mean	**97.78**	**91.19**	**82.82**	**94.88**	**90.45**	**93.78**	**85.86**

4.1.2 Station Specific Issues

Haringey Roadside

The PM_{10} FDMS suffered several flow or leak-related faults during the quarter Both FDMS instruments also had an extended zero check from 18 February to 6 March while checks on instrument performance were made post-repair.

London Bexley

The analyser was found to have a valve position fault on 9 February, once repaired a zero check was carried out until 25 February.

London Harrow Stanmore

A zero filter was installed at the audit on 19 February. The LSO was unable to access the site until 31 March to remove it.

London Teddington

At the winter QA/QC audit on 20 February 2014, the ozone sample inlet was found to be connected to the wrong port on the analyser. Data have been deleted back to the autumn 2014 audit on 2 October 2014.

London Teddington Bushy Park

The FDMS $PM_{2.5}$ data have been very noisy since installation of other equipment in the cabin. This is believed to be due to inadequate air conditioning in the cabin.

Southwark A2 Old Kent Road

The NOx converter was found to have failed at the audit on 5 February. The ESU did not effect repairs at the subsequent service, and it was not until 11 March that a new converter was fitted.

4.2 England (excluding London)

4.2.1 Data Capture

The data capture for stations in England for the period January-March 2014 is given in Table 4.2:

Table 4.2 Data Capture for England, January-March 2014

Name	CO	PM_{10}	$PM_{2.5}$	NO_2	O_3	SO_2	Average
Barnsley Gawber				98.06	98.10	46.94	81.03
Barnstaple A39		93.10	98.61				95.86
Bath Roadside				98.29			98.29
Billingham				77.92			77.92
Birmingham Acocks Green			97.13	97.92	97.69		97.58
Birmingham Tyburn		95.69	94.40	98.70	89.81	98.89	95.50
Birmingham Tyburn Roadside		84.58	60.14	97.82	96.44		84.75
Blackburn Darwen Roadside				99.44			99.44
Blackpool Marton			41.71	94.12	95.32		77.05
Bottesford					99.07		99.07

Name	CO	PM_{10}	PM_{25}	NO_2	O_3	SO_2	Average
Bournemouth			96.67	98.43	98.52		98.44
Brighton Preston Park			97.78	98.43	98.33		98.37
Bristol St Paul's		85.09	86.30	98.10	98.38		91.97
Cambridge Roadside				98.61			98.61
Canterbury				98.47	99.81		99.14
Carlisle Roadside		70.19	70.37	72.27			70.94
Charlton Mackrell				98.52	99.31		98.91
Chatham Centre Roadside		99.17	99.26	95.51			97.98
Chesterfield		85.56	89.49	99.68			91.57
Chesterfield Roadside		97.45	97.18	93.80			96.14
Coventry Memorial Park			87.64	95.42	96.16		93.07
Eastbourne		92.96	90.60	98.84			94.14
Exeter Roadside				98.70	99.77		99.24
Glazebury				94.17	98.56		96.37
Great Dun Fell					93.70		93.70
Harwell		90.23	92.87	97.31	97.50	97.36	95.06
Harwell		96.67	94.44				95.56
High Muffles				98.52	98.52		98.52
Honiton				98.66			98.66
Horley				98.75			98.75
Hull Freetown		90.05	90.19	97.08	90.60	58.33	85.25
Ladybower				98.38	98.66	98.47	98.50
Leamington Spa		93.66	93.56	83.24	95.79		91.56
Leamington Spa Rugby Road		88.38	88.66	94.03			90.35
Leeds Centre	97.31	94.03	94.12	92.87	97.50	97.31	95.52
Leeds Headingley Kerbside		96.34	96.57	99.63			97.52
Leicester University			89.31	98.24	98.33		95.29
Leominster				96.34	98.52		97.43
Lincoln Canwick Road				96.99			96.99
Liverpool Queen's Drive Roadside				98.06			98.06
Liverpool Speke		92.18	92.18	97.13	97.08	96.34	94.98
Lullington Heath				93.75	98.66	94.54	95.65
Manchester Piccadilly			91.71	92.73	96.90	97.31	94.66
Manchester South				98.38	82.18		90.28
Market Harborough				98.10	97.78		97.94
Middlesbrough		13.01	80.37	91.48	91.20	96.94	74.60
Newcastle Centre		92.87	92.59	97.08	96.81		94.84
Newcastle Cradlewell Roadside				91.90			91.90
Northampton Kingsthorpe			92.22	99.40	99.54		99.32
Norwich Lakenfields		71.11	67.13	98.47	98.66		83.84
Nottingham Centre		94.95	91.53	97.22	97.13	43.15	84.80
Oxford Centre Roadside				92.04			92.04
Oxford St Ebbes		0.00	61.39	98.43			53.27

Name	CO	PM_{10}	PM_{25}	NO_2	O_3	SO_2	Average
Plymouth Centre		64.35	45.83	98.19	98.33		76.68
Portsmouth		83.80	81.67	33.19	98.75		74.35
Preston			89.40	98.15	98.52		95.35
Reading New Town		95.88	84.21	98.33	98.47		94.22
Rochester Stoke		99.40	46.76	93.56	98.15	97.78	87.13
Salford Eccles		95.93	95.88	98.15			96.65
Saltash Callington Road		95.93	81.71				88.82
Sandy Roadside		82.59	95.14	98.80			92.18
Scunthorpe Town		95.42		96.99		59.44	83.95
Sheffield Devonshire Green		70.23	85.60	97.13	97.13		87.52
Sheffield Tinsley				98.15			98.15
Sibton					99.86		99.86
Southampton Centre		95.19	91.02	92.59	96.85	97.22	94.57
Southend-on-Sea			97.55	96.39	97.31		97.08
St Osyth				97.96	97.78		97.87
Stanford-le-Hope Roadside		97.04	96.25	98.15			97.15
Stockton-on-Tees Eaglescliffe		95.37	95.42	98.47			96.42
Stoke-on-Trent Centre		97.04	75.74	97.31	97.55		91.91
Storrington Roadside		96.25	94.07	59.68			83.33
Sunderland Silksworth			92.64	99.58	91.11		94.44
Thurrock		99.63		95.32	98.47	98.24	97.92
Walsall Woodlands				99.68	99.68		99.68
Warrington		93.80	94.07	99.44			95.77
Weybourne					99.95		99.95
Wicken Fen				82.82	97.36	82.73	87.64
Wigan Centre			92.69	97.36	98.75		96.27
Wirral Tranmere			6.16	98.33	98.47		67.65
Yarner Wood				96.16	98.61		97.38
York Bootham		90.60	96.90				93.75
York Fishergate		97.31	97.36	90.65			95.11
Number of Sites	**1**	**40**	**50**	**75**	**51**	**15**	**82**
Number of sites < 85 %	0	10	13	7	1	4	14
Number of sites < 90%	0	13	20	7	2	4	19
Network mean	**97.31**	**84.25**	**85.07**	**93.44**	**97.12**	**87.60**	**91.32**

4.2.2 Station Specific Issues

Barnsley Gawber

The SO_2 data for much of the quarter was noisy and erratic; data from 1 January to 15 February have been deleted.

Billingham

A leak was found in the analyser, which required workshop repair, Data have been lost from 12 February to 3 March, where a "hot spare" analyser was installed.

Birmingham Tyburn Roadside

Both $PM_{2.5}$ and PM_{10} analysers were identified as regional outliers for much of this quarter; data have been deleted.

Blackpool Marton

Following an extended period of poor performance, the FDMS was removed for workshop repair on 8 January, and returned to site on 20 February.

Carlisle Roadside

The power supply to the site was disconnected on 9 February and reconnected again on 3 March.

Hull Freetown

SO_2 data between 12 February and 19 March were lost due to a backing paper being installed in the analyser along with the particulate filter.

Middlesbrough

The sample inlet was changed on 30 January resulting in a strep change in the NOx data; investigations are ongoing. During ratification the PM_{10} volatile concentrations were found to be excessively high compared to the $PM_{2.5}$ volatiles; PM_{10} data have been deleted from 1 January to 14 March, where concentrations returned to more acceptable levels.

Norwich Lakenfields

The $PM_{2.5}$ FDMS analyser suffered from loss of firmware on 24 February and ultimately had to be removed for workshop repair, returning to site on 3 April. The PM_{10} data became unstable on start of the zero check on 7 February; the subsequent service failed to improve the data and problems continued up to 3 March when a leak was found in the flow controller.

Nottingham Centre

The site SO_2 analyser performed very poorly during the quarter due to failure of the main control board, which caused multiple temperature faults.

Oxford St Ebbes

Both $PM_{2.5}$ and PM_{10} volatile data appeared low up to the drier replacement in May 2014. The air conditioning fault may be a contributory factor in this quarter. PM_{10} data have been deleted for the entire quarter (as well as back into 2013, and into the second quarter of 2014), and $PM_{2.5}$ from 25 February to the end of the quarter.

Plymouth Centre

Both FDMS analysers, particularly the $PM_{2.5}$, have suffered from poor performance during this quarter, and ongoing into subsequent months. Despite several visits from the ESU, data remained noisy with frequent spikes in the volatile fraction or negative volatile concentrations.

Rochester Stoke

A step change in the $PM_{2.5}$ data occurred at the LSO visit on 5 December, which was rectified at the service on 17 February. Data between these dates have been deleted.

Saltash Callington Road

Following the zero check on 17 January, the $PM_{2.5}$ analyser became unstable and noisy, and data have been deleted up to 31 January.

Scunthorpe Town

The SO_2 analyser suffered a lamp failure on 26 February, which was not resolved until mid-May.

Sheffield Devonshire Green

Flow sensor and pump faults with the $PM_{2.5}$ FDMS, and a drier replacement in the PM_{10} FDMS resulted in the loss of some data this quarter.

Storrington Roadside

The NOx analyser experienced a blocked capillary on 26 February, then a leaking converter and a processor fault was diagnosed. The analyser was eventually removed for workshop repair resulting in considerable data loss in this and the subsequent quarter.

Wicken Fen

The NOx analyser suffered a photomultiplier failure in January, along with a faulty auto calibration valve. Although a replacement SO_2 analyser was installed in December to rectify very poor data, this analyser also proved unreliable in this quarter and further data was lost due to unspecified failures.

Wirral Tranmere

The zero filter was installed onto the sample head on 6 January at the audit, but when the filter was removed and head replaced, the sharp cut cyclone was not reattached to the inlet, meaning the analyser was measuring PM_{10} instead of $PM_{2.5}$. This was discovered by the QA/QC unit at the subsequent on 8 April, data between the audits have been deleted.

4.3 Scotland

4.3.1 Data Capture

The data capture for stations in Scotland for the period January-March 2014 is given in Table 4.3.

Table 4.3 Data Capture for Scotland, January-March 2014

Name	CO	PM_{10}	PM_{25}	NO_2	O_3	SO_2	Average
Aberdeen		72.64	75.51	97.87	88.94		83.74
Aberdeen Union Street Roadside				97.82			97.82
Auchencorth Moss		98.89	98.89		98.33		98.38
Auchencorth Moss (FDMS)		90.65	77.27				83.96
Bush Estate				95.60	98.70		97.15
Dumbarton Roadside				94.49			94.49
Dumfries				98.19			98.19
Edinburgh St Leonards	97.22	88.10	83.24	91.53	97.04	97.96	92.52
Eskdalemuir				96.90	98.66		97.78
Fort William				98.56	98.70		98.63
Glasgow Kerbside		85.88	74.63	97.27			85.93
Glasgow Townhead		58.80	88.38	97.31	97.31		85.45
Grangemouth		94.68	87.31	93.33		96.76	93.02
Grangemouth Moray				97.59			97.59
Inverness		97.78	80.00	99.40			98.59
Lerwick					0.00		0.00
Peebles				98.56	98.61		98.59
Strath Vaich					74.40		74.40
Number of Sites	**1**	**8**	**8**	**14**	**10**	**2**	**18**

Name	CO	PM_{10}	PM_{25}	NO_2	O_3	SO_2	Average
Number of sites < 85 %	0	2	5	0	2	0	4
Number of sites < 90%	**0**	**4**	**7**	**0**	**3**	**0**	**6**
Network mean	97.22	85.93	83.15	96.75	85.07	97.36	87.57

4.3.2 Station Specific Issues

Aberdeen

The PM_{10} data was noisy for some of the period and has been deleted during ratification. In addition the ozone analyser had a lamp failure, and the $PM_{2.5}$ FDMS a failed valve motor during March.

Auchencorth Moss

Problems with the air conditioning continued during the quarter. The $PM_{2.5}$ volatile concentrations were significantly higher than the PM_{10} volatiles; $PM_{2.5}$ data for the period 25 January-6 February were deleted during ratification.

Glasgow Kerbside

Continuing problems with the air conditioning unit resulted in the loss of data from both FDMS units.

Glasgow Townhead

The $PM_{2.5}$ analyser became very noisy following the zero checks on 23 January; this was cured on 26 February following replacement of the mass transducer. The PM_{10} analyser had periods of instability following the service in January.

Lerwick

The station is temporarily closed due to building works at the Observatory.

Strath Vaich

The ozone analyser and ancillary equipment were damaged by a lightning strike in December. The repaired analyser was reinstalled on 22 January.

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4.4 Wales

4.4.1 Data Capture

The data capture for stations in Wales for January-March 2014 is given in Table 4.4.

Table 4.4 Data Capture for Wales, January-March 2014

Name	CO	PM_{10}	PM_{25}	NO_2	O_3	SO_2	Average
Aston Hill				90.60	98.38		94.49
Cardiff Centre	96.99	92.27	92.69	97.36	95.37	96.02	95.12
Chepstow A48		88.47	85.46	99.40			91.11
Cwmbran				98.43	99.81		99.12
Narberth		96.16		95.69	98.47	97.87	97.05
Newport		86.53	86.34	97.87			90.25
Port Talbot Margam (PM_{10} Partisol)		94.44					94.44
Port Talbot Margam	83.06	98.43	30.05	94.54	98.24	98.33	83.77
Swansea Roadside		96.44	96.11	98.33			96.96
Wrexham		97.78	91.11	95.23		96.90	96.00
Number of Sites	**2**	**8**	**6**	**9**	**5**	**4**	**10**
Number of sites < 85 %	**1**	**0**	**1**	**0**	**0**	**0**	**1**
Number of sites < 90%	**1**	**2**	**3**	**0**	**0**	**0**	**1**
Network mean	**90.02**	**93.81**	**80.29**	**96.38**	**98.06**	**97.28**	**93.76**

4.4.2 Station Specific Issues

Port Talbot Margam

The CO analyser was removed from site for a workshop repair to the infrared source from 17 to 26 March. The $PM_{2.5}$ data was send to be higher than the PM_{10} during this quarter; $PM_{2.5}$ data have been deleted from the audit on 22 January up to the new drier being fitted on 26 March.

4.5 Northern Ireland (including Mace Head)

4.5.1 Data Capture

The data capture for stations in Northern Ireland (including Mace Head in the Republic of Ireland) for the period October to December 2014 is given in Table 4.5.

Table 4.5 Data Capture for Ireland, January-March 2014

Name	CO	PM_{10}	PM_{25}	NO_2	O_3	SO_2	Average
Armagh Roadside		80.74		95.56			88.15
Ballymena Ballykeel						99.77	99.77
Belfast Centre	97.31	95.42	96.34	88.98	96.62	97.27	95.32
Derry		78.06	91.99	98.80	99.54	93.52	92.38
Lough Navar		90.60			97.13		93.87
Mace Head					97.61		
Number of Sites	**1**	**4**	**2**	**3**	**4**	**3**	**5**
Number of sites < 85 %	**0**	**2**	**0**	**0**	**0**	**0**	**0**
Number of sites < 90%	**0**	**2**	**0**	**1**	**0**	**0**	**1**
Network mean	**97.31**	**86.20**	**94.17**	**94.44**	**97.76**	**96.85**	**93.90**

4.5.2 Station Specific Issues

Armagh Roadside

The zero check was carried out for 12 days which is longer than usual; in addition, some noisy data were deleted during ratification.

4.6 Overall Data Capture

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

Table 4.6 Overall Data Capture, January-March 2014

	CO	PM_{10}	PM_{25}	NO_2	O_3	SO_2	Average
Number of Stations	7	70	80	116	79	29	135
Number of stations < 85 %	1	14	24	7	4	5	23
Number of stations < 90%	1	23	35	8	6	6	33
Network mean	95.35	85.45	83.51	94.31	95.01	90.02	89.72

Section B – Winter 2014 Intercalibration Report

5 Introduction to Intercalibration Exercise

During January to March 2014, Ricardo-AEA undertook an intercalibration of 135 monitoring stations in operation in the Defra and the Devolved Administrations Automatic Urban and Rural Monitoring Network (AURN). The intercalibration exercise is a vital step in the process of data ratification. The monitoring station 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, both Central Management and Control Units, ESU's and LSO's in making sure the entire operation runs smoothly. This 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 (MU')s and ESU's for approval. All QA/QC equipment and cylinders to be used in the intercalibration are first tested, calibrated and verified before use. The QA/QC unit's ozone photometers (used in checking and calibration of ozone analysers) are tested independently against national standards, by the National Physical Laboratory. ESU ozone photometers are calibrated at Ricardo-AEA using Ricardo-AEA's photometers as a transfer standard.

QA/QC visits are always undertaken before any ESU service 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 may attend, 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.

There is some ongoing restructuring of the network, but none since the summer intercalibration.

6 Scope of Intercalibration Exercise

6.1 QA/QC Site Visits

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

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

1. Analyser accuracy and precision. These are basic checks to ensure analysers respond to known concentrations of gases in a reliable manner.
2. Instrument linearity. This test refines the response checks on analysers, by assessing whether doubling a concentration of gas to the analyser results in a doubling of the analyser signal response. If an analyser's response characteristics are not linear, data cannot be reliably scaled into concentrations.
3. Instrument signal noise. This test checks that an analyser responds to calibration gases in a stable manner with time. A "noisy" analyser may not provide high quality data which may be difficult to process at lower concentrations.
4. Analyser response time. This test checks that the analyser responds quickly to a change in gas concentrations. If analyser response is too slow, data may not accurately reflect ambient concentrations.
5. Leak and flow checks. These tests ensure that ambient air reaches the analysers, without being compromised in any way. Leaks in the sampling system can affect the ability of the analyser to sample ambient air reliably.
6. NOx analyser converter efficiency. This test evaluates the ability of the analyser to measure NO_2. An inefficient converter severely compromises the data from the analyser.
7. FDMS k_0 evaluation. The analyser uses this factor to calculate mass concentrations, so the value is calculated to determine its accuracy compared to the stated value.
8. Particulate analyser flow rate checks. These tests ensure that the flow rates through critical parts of the analyser are within specified limits. There are specific analyser flow rates that are set to make sure particle size fractions and mass concentration calculations are performed correctly.
9. SO_2 analyser hydrocarbon interference. This test evaluates the analyser's ability to remove interfering hydrocarbon gases from the sample gas. A failed test could have significant implications for analyser data.
10. Evaluation of site cylinder concentrations. These tests use a set of Ricardo-AEA certified cylinders that are taken to all the sites. The concentrations of the site cylinders are used to scale pollution datasets, so it is important to ensure that the concentrations of gases in the cylinders do not change.
11. Competence of Local Site Operators (LSO) in undertaking calibrations. As it is the calibrations by the LSO's that are used to scale pollution datasets, it is important to check that these are undertaken competently.

12. Zero “calibration” of all automatic PM analysers. This test allows the baseline performance of PM analysers to be evaluated, to determine whether any remedial action is required.

6.2 Network Intercomparison Exercise

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

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

- The analyser responses to audit gas are converted into concentrations, using provisional calibration factors obtained from the Management Units on the day of the intercalibration. These factors are also used for the provisional data supplied to the web/interactive TV services.
- These individual results are tabulated, and statistical analyses undertaken (e.g. network average result, network standard deviation, deviation of individual sites from the network mean etc.).

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

- ±10% of the network average for NOx, CO and SO_2 analysers,
- ±5% of the reference standard photometer for Ozone analysers,
- ±2.5 % of the stated ko value for FDMS analysers,
- ±10% for particulate analyser flow rates,
- Particulate analyser average zero response within ±3.0 $\mu g/m^3$.
- ±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.

6.3 FDMS Baseline Checks

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

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

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

The detection limit is calculated by multiplying the standard deviation of the zero calibration by 3.3. Typical results show that a ‘healthy’ FDMS should have a detection limit of less than 5 µg m^{-3}.Recent European guidance (CEN TS16450) provides a recommendation that zero tests on PM analysers should yield a result no higher than 3 µg m^{-3}, which provides the AURN with a robust performance limit for data ratification.

A list of stations where the analysers gave an average zero response of more than 3 µg m^{-3} is given in the subsequent section.

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

7.1.1 Summary

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	18	117	15 (31)%
CO analyser	0	9	0%
SO_2 analyser	6	30	20 (27)%
Ozone analyser	23	82	28 (17)%
FDMS and BAM analysers	3 k_0, 6 flow, (12 zero)	58 FDMS PM_{10} 2 BAM PM_{10} 69 FDMS $PM_{2.5}$ 2 BAM $PM_{2.5}$	7 (3)%
Gravimetric PM analysers	0 flow	9 PM_{10} 9 $PM_{2.5}$	0%
Total	56	387	14.5%

Two of the 135 sites were not in operation at the time of the intercalibration. Replacement locations are currently being sought for the sites at Bury Roadside and Glasgow Centre.

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

The number of analyser outliers identified is better than the previous exercise. At the Summer 2013 intercalibration 16.0% of the analysers in use were identified as outliers.

The procedures used to determine network performance are documented in Ricardo-AEA Work Instructions. These methods are regularly updated and improved and are evaluated by the United Kingdom Accreditation Service (UKAS). Ricardo-AEA holds ISO17025 accreditation for the on-site calibration of all the analyser types (NOx, CO, SO_2, O_3) and for the determination of the FDMS k_0 factor and particulate analyser flow rates used in the network. An ISO17025 certificate of calibration (Calibration Laboratory number 0401) for the analysers in the AURN is appended to this report.

7.1.2 Network Intercomparisons

The concentration of the audit cylinders was calculated averaged across all monitoring sites using the zero and scaling factors provided by the CMCU on the day of audit. How close the result is to the stated cylinder concentration is a good indication of the accuracy of the provisional 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 Results

Parameter	Network Mean	Audit reference concentration	Network Accuracy %	%Std Dev
NO	469 ppb	462 ppb	1.6	4.3
NO_2	402 ppb	411 ppb	-2.3	4.9
CO	21.6 ppm	21.3 ppm	1.4	4.2
SO_2	467 ppb	448 ppb	4.2	4.8

- Oxides of Nitrogen.

  A total of 18 outliers (15%) were identified during this intercalibration. This is significantly better than the previous exercise - 31% of the analysers were identified as outliers in the summer exercise. Of these outliers, 9 can be attributed to analyser drift, 6 to changes in site cylinder concentration and 3 to issues experienced during the audit which compromised the results.

  There were 2 converters which fell outside the ±5% acceptance limits. There were 3 further converters identified where the initial result was outside the ±2% trigger for NO_2 rescaling. Additional analysis showed that a total of two outlier converters required rescaling or data deletion to be undertaken.

- Carbon Monoxide

  There were no outliers identified at this intercalibration. No outliers were identified at the previous exercise.

- Sulphur Dioxide

  A total of 6 outliers (20%) were identified at this intercalibration. This is slightly worse than the winter exercise, when 8 analysers were found to be outside the acceptance limits. All m-xylene interference tests were less than 20ppb, compared to 18ppb in summer 2013.

- Ozone

  A total of 23 outliers (28%) were identified during the winter exercise. This is worse than the previous intercalibration, where 14 analysers were found to be outside the ±5% acceptance criterion.

- Particulate Analysers

  There were three calculated k_0 determinations outside the required ±2.5% of the stated values. No outliers were identified at the previous exercise.

Three FDMS main flows were found to be outside the ±10% acceptance limits. Three BAM total flows were found to be outside this limit. This total is worse than the previous exercise; four analyser flow outliers were identified in the summer.

All Partisol analyser total flows were within the acceptance limits.

- PM analyser zero tests

A total of 21 analysers gave average responses to particle-free air that were higher than ±3 µg m^{-3}. This is much better than the previous exercise, where 33 responses were higher than 3 µg m^{-3}. These results will be fed into the ratification process to determine appropriate action. A list of analysers failing this test is given in Table 7.3

Table 7.3 Particle Analysers with Zero Above 3 µg m^{-3}, Winter 2014

Site		Zero average µg m^{-3}
Birmingham Tyburn Roadside 21-23 Jan 14	$PM_{2.5}$	4.4
Derry 20-24 Feb 14	$PM_{2.5}$	4.2
Edinburgh St Leonards 4-7 Feb 14	PM_{10}	3.7
Glasgow Townhead 21-23 Jan 14	PM_{10}	3.4
Leeds Headingley Kerbside 14-16 Jan 14	PM_{10}	3.1
Liverpool Speke 9-13 Jan 14	PM_{10}	4
London Bexley 14-25 Feb 14	$PM_{2.5}$	3
London N Kensington 31 Jan-3 Feb 14	PM_{10}	8.9
London Teddington Bushy Park 24-28 Feb 14	$PM_{2.5}$	3.1
Lough Navar 19-24 Feb 14	PM_{10}	5
Middlesbrough 29-31 Jan 14	PM_{10}	3.8
Newport St Julians 23-27 Jan 14	PM_{10}	3.3
Newport St Julians 23-27 Jan 14	$PM_{2.5}$	4.7
Norwich Lakenfields 5-7 Feb 14	PM_{10}	3.1
Oxford St Ebbes 25 Feb - 4 Mar 14	PM_{10}	4.8
Oxford St Ebbes 25 Feb - 4 Mar 14	$PM_{2.5}$	5.4
Portsmouth 25-28 Feb 14	PM_{10}	6
Salford Eccles 14-17 Jan 14	$PM_{2.5}$	3
Southampton Centre 26-28 Feb 14	PM_{10}	3.1
Storrington Roadside 28-31 Jan 14	PM_{10}	6.2
Warrington 9-13 Jan 14	$PM_{2.5}$	3.2

- Site Cylinder Concentrations

17 of the 273 site cylinders (6.2%) used to scale ambient pollution data were found to be outside the ±10% acceptance limit, worse than the 4.3% identified in the summer.

7.2 London Sites

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

Table 97.4 - Summary of audited analyser performance – London Sites

Parameter	Number of outliers	Number in region
NOx analyser	4	13
NOx converter	1	
CO analyser	0	3
SO_2 analyser	2	4
Ozone analyser	1	9
FDMS and BAM analysers	0 k_0, 0 flow (1 zero)	6 FDMS PM_{10} 10 FDMS $PM_{2.5}$
Gravimetric PM analysers	0	2 PM_{10} 3 $PM_{2.5}$
Cylinders	4	37

7.3 Scottish Sites

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

Table 7.5 - Summary of audited analyser performance – Scottish Sites

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

7.4 Welsh Sites

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

Table 7.6 - Summary of audited analyser performance – Welsh Sites

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

7.5 Northern Ireland Sites (incl. Mace Head)

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

Table 7.7 - Summary of audited analyser performance – Northern Irish Sites

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

7.6 English Sites

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

Table 7.8 - Summary of audited analyser performance – English Sites

Parameter	Number of outliers	Number in region
NOx analyser	10	76
NOx converter	1	
CO analyser	0	1
SO_2 analyser	3	16
Ozone analyser	19	53
FDMS and BAM analysers	2 k_0, 3 flow (7 zero)	37 FDMS PM_{10} 1 BAM PM_{10} 46 FDMS $PM_{2.5}$ 1 BAM $PM_{2.5}$
Gravimetric PM analysers	0	1 PM_{10} 4 $PM_{2.5}$
Cylinders	11	191

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 17 of the 273 cylinders (6.2%) 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 4.3% (12) of the scaling cylinders were outside the acceptance limits. There were 9 NO cylinders identified as outliers.

In addition, the concentrations of 28 NO_2 cylinders appeared 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 45 of the 273 cylinders (16.5%) were outside the acceptance limits. This is worse than the previous intercalibration, when 13.5% of cylinders were found to be outside the 10% acceptance.

Of the 9 NO cylinders, two appeared to have been contaminated (Birmingham Tyburn and Edinburgh St Leonards); significant oxidation of the NO into NO_2 has occurred since the last intercalibration. The cylinders have been replaced and the performance of the new cylinders will be closely monitored at subsequent audits.

Three cylinders showed significant drift and have been replaced.

The remaining four NO cylinders and the 8 SO_2 cylinders will be checked at the next audits and appropriate action taken if necessary.

9 Measurement Uncertainties

The European Committee for Normalisation (CEN) has 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 referred to 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 needed to be replaced before June 2013. Ricardo-AEA has taken steps to ensure the procedures used in the UK comply with the requirements ahead of any imposed deadlines. To this end, the procedures used for the intercomparisons have been fully compliant with the CEN protocols since January 2006.

To comply with the Directive, the uncertainty for gaseous analyser measurements must be less than ±15%. For sites that have CEN-compliant gaseous instrumentation, it is possible to calculate the overall uncertainty of measuring air quality. This information is site- and analyser-specific and presented in the table below:

Table 9.1 – Analyser measurement uncertainties

Date	Site	O_3	CO	SO_2	NO_2 annual	NO_2 hour	PM_{10}	$PM_{2.5}$
20-Jan	Barnsley Gawber	10.7		13.4	10	10		
16-Jan	Bath Roadside				13.5	14		
28-Jan	Billingham				13.5	14		
20-Jan	Birmingham Acocks Green	12.4			13.5	14		16.4
21-Jan	Birmingham Tyburn	8.7		12.3	11.8	11.8	8.7	16.4
21-Jan	Birmingham Tyburn Roadside	12.4			13.5	14	8.7	16.4
15-Jan	Blackburn Darwen Roadside				10.5	10.5		
14-Jan	Blackpool Marton	10.7			10	10		No test
25-Feb	Bottesford	10.7						
27-Feb	Bournemouth	12.4			13.5	14		11
28-Jan	Brighton Preston Park	12.4			13.5	14		11
16-Jan	Bristol St Paul's	12.4			13.5	14	8.7	No test
04-Feb	Cambridge Roadside				10.5	10.5		
19-Feb	Camden Kerbside				10.5	10.5	8.7	16.4
10-Feb	Canterbury	12.4			13.5	14		
13-Jan	Carlisle Roadside				10.5	10.5	8.7	16.4
11-Feb	Charlton Mackrell	11.8			13.5	14		
11-Feb	Chatham Centre Roadside				13.5	14	8.7	16.4
21-Jan	Chesterfield				10.5	10.5	8.7	16.4
21-Jan	Chesterfield Roadside				10.5	10.5	8.7	16.4

Date	Site	O_3	CO	SO_2	NO_2 annual	NO_2 hour	PM_{10}	$PM_{2.5}$
18-Feb	Coventry Memorial Park	10.7			10	10		No test
29-Jan	Eastbourne				13.5	14	8.7	16.4
15-Jan	Exeter Roadside	8.7			11.8	11.8		
16-Jan	Glazebury	12.4			failed	test		
02-Jul	Great Dun Fell	12.4						
18-Feb	Haringey Roadside				10.5	10.5	8.7	16.4
12-Aug	Harwell	12.4		13.4	13.5	14	8.7	16.4
28-Jan	Harwell PARTISOL						8	11
29-Jan	High Muffles	12.4			13.5	14		
15-Jan	Honiton				13.5	14		
27-Jan	Horley				10.5	10.5		
14-Jan	Hull Freetown	10.7		13.4	10	10	8.7	16.4
22-Jan	Ladybower	12.4		13.4	13.5	14		
26-Feb	Leamington Spa	11.8			10.5	10.5	8.7	16.4
27-Feb	Leamington Spa Rugby Road				13.5	14	8.7	16.4
13-Jan	Leeds Centre	10.7	9.5	13.4	10	10	8.7	16.4
13-Jan	Leeds Headingley Kerbside				13.5	14	8.7	16.4
19-Feb	Leicester University	10.7			10	10		16.4
10-Feb	Leominster	12.4			13.5	14		
25-Feb	Lincoln Canwick Road				13.5	14		
09-Jan	Liverpool Queen's Drive Roadside				13.5	14		
09-Jan	Liverpool Speke	10.7		13.4	10	10	8.7	16.4
14-Feb	London Bexley			13.4	13.5	14		16.4
12-Feb	London Bloomsbury	12.4		13.4	13.5	14	10.38	26.38
27-Jan	London Eltham	11			10.5	10.5		16.4
18-Feb	London Haringey Priory Park South	11.8			13.5	14		
03-Jan	London Harlington	12.4			13.5	14	8.7	16.4
19-Feb	London Harrow Stanmore							16.4
06-Feb	London Hillingdon	33.72			10	10		
29-Jan	London Marylebone Road	12.4	9.5	13.4	13.5	14	8.7	16.4
29-Jan	London Marylebone Road PARTISOL						8	11
31-Jan	London N. Kensington	12.4	9.5	13.4	13.5	14	8.7	16.4
31-Jan	London N. Kensington PARTISOL						8	11
20-Feb	London Teddington	12.4			13.5	14		
20-Feb	London Teddington Bushy Park							16.4
04-Feb	London Westminster	No test			13.5	14		11
13-Feb	Lullington Heath	12.4		13.4	13.5	14		
15-Jan	Manchester Piccadilly	12.4		13.4	13.5	14		16.4
15-Jan	Manchester South	12.4			13.5	14		
20-Feb	Market Harborough	10.7			10	10		
29-Jan	Middlesbrough	12.4		13.4	13.5	14	8.7	16.4
27-Jan	Newcastle Centre	10.7			9.99	9.99	8.7	16.4
27-Jan	Newcastle Cradlewell Roadside				10.5	10.5		
17-Feb	Northampton Kingsthorpe	8.7			11.8	11.8		11

Date	Site	O_3	CO	SO_2	NO_2 annual	NO_2 hour	PM_{10}	$PM_{2.5}$
05-Feb	Norwich Lakenfields	10.7			10	10	8.7	16.4
24-Feb	Nottingham Centre	10.7		13.4	10	10	8.7	16.4
28-Feb	Oxford Centre Roadside				10.5	10.5		
25-Feb	Oxford St Ebbes				10.5	10.5	8.7	16.4
14-Jan	Plymouth Centre	10.7			10	10	8.7	16.4
25-Feb	Portsmouth	10.7			11.8	11.8	8.7	16.4
15-Jan	Preston	10.7			10	10		16.4
24-Feb	Reading New Town	10.7			10	10	8.7	16.4
11-Feb	Rochester Stoke			13.4	13.5	14	8.7	16.4
14-Jan	Salford Eccles	11.8			10.5	10.5	8.7	20.56
14-Jan	Saltash Callington Road						8.7	16.4
03-Feb	Sandy Roadside				13.5	14	11.48	16.4
13-Jan	Scunthorpe Town			11	10.5	10.5	8.7	
20-Jan	Sheffield Devonshire Green	10.7			10	10	8.7	16.4
21-Jan	Sheffield Tinsley				13.5	14		
05-Feb	Sibton	12.4						
26-Feb	Southampton Centre	10.7		13.4	10	10	8.7	16.4
13-Feb	Southend-on-Sea	10.7			10	10		16.4
05-Feb	Southwark A2 Old Kent Road				13.5	14	8.7	
13-Feb	St Osyth	10.7			10	10		
12-Feb	Stanford-le-Hope Roadside				13.5	14	36.48	16.4
28-Jan	Stockton-on-Tees Eaglescliffe				13.5	14	9.3	12.6
23-Jan	Stoke-on-Trent Centre	10.7			10	10	8.7	16.4
28-Jan	Storrington Roadside				10	10	8.7	16.4
28-Jan	Sunderland Si ksworth	12.4			10.5	10.5		16.4
12-Feb	Thurrock	12.4		13.4	13.5	14	8.7	
13-Feb	Tower Hamlets Roadside				10.5	10.5		
22-Jan	Walsall Woodlands	12.4			13.5	14		
08-Jan	Warrington				10.5	10.5	8.7	16.4
06-Feb	Weybourne	10.7						
04-Feb	Wicken Fen	12.4		13.4	13.5	14		
14-Jan	Wigan Centre	12.4			10.5	10.5		16.4
06-Jan	Wirral Tranmere	10.7			10	10		31.6
12-Feb	Yarner Wood	12.4			13.5	14		
14-Jan	York Bootham						8.7	16.4
14-Jan	York Fishergate				10.5	10.5	8.7	16.4
26-Feb	Mace Head	Not approved						
19-Feb	Armagh Roadside				10.5	10.5	8.7	
18-Feb	Ballymena Ballykeel			11				
24-Feb	Belfast Centre	10.7	9.5	13.4	10	10	8.7	16.4
20-Feb	Derry	12.4		13.4	13.5	14	8.7	16.4
19-Feb	Lough Navar	12.4					8.7	
11-Feb	Aberdeen	12.4			13.5	14	8.7	16.4
11-Feb	Aberdeen Union Street Roadside				13.5	14		
05-Feb	Auchencorth Moss	12.4					8.7	16.4
05-Feb	Auchencorth Moss Partisol						8	11
05-Feb	Bush Estate	12.4			13.5	14		
20-Jan	Dumbarton Roadside				10.5	10.5		

Date	Site	O_3	CO	SO_2	NO_2 annual	NO_2 hour	PM_{10}	$PM_{2.5}$
13-Jan	Dumfries				13.5	14		
04-Feb	Edinburgh St Leonards	12.4	9.5	13.4	13.5	14	8.7	16.4
16-Jan	Eskdalemuir	12.4			13.5	14		
22-Jan	Fort William	12.4			13.5	14		
21-Jan	Glasgow Kerbside				15.3	15.3	8.7	16.4
21-Jan	Glasgow Townhead	10.7			13.76	14.24	8.7	16.4
03-Feb	Grangemouth			11	10.5	10.5	8.7	16.4
03-Feb	Grangemouth Moray				10.5	10.5		
12-Feb	Inverness				13.5	14	8	11
	Lerwick	No test						
04-Feb	Peebles	12.4			13.5	14		
05-Mar	Strath Vaich	12.4						
10-Feb	Aston Hill	12.4			13.5	14		
23-Jan	Cardiff Centre	12.4	9.5	13.4	13.5	14	8.7	16.4
24-Jan	Chepstow A48				10.5	10.5	8.7	16.4
23-Jan	Cwmbran	10.7			11.8	11.8		
07-Jan	Mold	12.4			13.5	14		
21-Jan	Narberth	12.4		13.4	13.5	14	10.02	
23-Jan	Newport				10.5	10.5	16.43	16.4
	Port Talbot Margam	10.7	9.5	13.4	13.5	14	8.7	16.4
22-Jan	Port Talbot Margam Partisol						8	
22-Jan	Swansea Roadside				13.5	14	36.44	13.33
07-Jan	Wrexham			13.4	13.5	14	8	11

This table is updated and extended after every intercalibration to include upgraded sites and replacement analysers.

The poor measurement uncertainty reported for the PM analysers at London Bloomsbury, Salford Eccles, Stanford-le-Hope Roadside, Wirral Tranmere and Swansea Roadside arose as a result of the very low measured flow rates at the audit. The significance of this will be examined fully during ratification.

The ozone analyser at Mace Head is not a CEN compliant model and therefore no generic performance data have been calculated.

10 Certification

The Network Certificate of Calibration is presented in Appendix 1. This certificate presents the results of the individual analyser scaling factors on the day of the audit, as calculated by Ricardo-AEA using the audit cylinder standards, in accordance with our ISO17025 accreditation.

Appendix 1 Certificate of Calibration

0401

Authorised Signatories: S Eaton

B Stacey

Signed:

Date of Issue: 04 August 2014

Customer Name and Address: John Newington

Atmosphere and Noise
Resource, Atmosphere and Sustainability
Department for Environment, Food and Rural Affairs
Area 2C Nobel House, 17 Smith Square, London, SW1P 3JR

Date of Calibration: January to March 2014

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

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

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

1. Carbon Monoxide

Site	Date Year = 2014	Analyser number	[1]Zero output	Uncertainty (ppm)	[2]Calibra ion Factor	Uncertainty (%)	'Maximum Residual (%)
English Sites							
Leeds Centre	13-Jan	458	-0.4	0.2	0.937	2.9	3.3
London Sites							
London Marylebone Road	29-Jan	10073	1.0	0.2	1.009	2.2	1.8
London N. Kensington	31-Jan	2313	0.1	0.2	1.024	2.1	1.3
Northern Irish Sites							
Belfast Centre	24-Feb	462	-0.4	0.2	1.062	2.1	2.0
Scottish Sites							
Edinburgh St Leonards	04-Feb	159	0.1	0.2	1.040	2.5	1.7
Welsh Sites							
Cardiff Centre	23-Jan	1502	0.9	0.2	0.990	2.3	1.9
Port Ta bot Margam	22-Jan	605214618	0.6	0.2	1.032	2.3	1.1

2. Sulphur Dioxide

Site	Date Year =2014	Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibra ion Factor	Uncertainty (%)	'Max Residual (%)	'm-xylene interference (ppb)
English Sites								
Barnsley Gawber	20-Jan	8050082	0.4	2.5	0.990	4.4	3.1	3.6
Birmingham Tyburn	21-Jan	EH937000	2.3	2.5	0.881	3.4	1.2	0.5
Harwell	28-Jan	83	3.6	2.5	0.833	3.3	1.1	4.3
Hull Freetown	14-Jan	342	1.2	2.4	0.702	3.3	3.1	0.6
Ladybower	22-Jan	1176	-0.7	2.4	0.544	3.3	3.6	3.1
Leamington Spa	26-Feb	Analyser	not	present				
Leeds Centre	13-Jan	8050084	0.2	2.5	0.989	3.7	3.6	1.8
Liverpool Speke	09-Jan	1765	7.2	2.6	0.996	3.4	1.3	14.3
Lullington Heath	13-Feb	1179	0.2	2.5	0.952	3.2	1.6	9.6
Manchester Piccadilly	15-Jan	19216	-1.2	2.5	0.946	3.4	1.4	6.7
Middlesbrough	29-Jan	1660	5.4	2.5	0.935	3.2	2.7	7.2
Nottingham Centre	24-Feb	1629	-1.5	2.5	0.931	3.2	0.8	9.1
Rochester Stoke	11-Feb	2800	14	2.6	0.770	3.2	1.1	10.2
Scunthorpe Town	13-Jan	110870	32	2.5	0.725	4.2	2.5	-13.1
Southampton Centre	26-Feb	343	17.2	2.5	0.990	3.5	1.8	9.0
Thurrock	12-Feb	189	1.3	2.6	0.833	3.2	0.5	6.1
Wicken Fen	04-Feb	73	0.3	2.5	0.914	3.2	0.5	14.8
London Sites								
London Bexley	14-Feb	318	7.8	2.5	0.817	3.3	0.9	-0.7
London Bloomsbury	12-Feb	74	3.1	2.5	0.861	3.4	2.1	9.3
London Marylebone Road	29-Jan	19220	0.8	2.5	0.996	3.3	1.0	10.8

London N. Kensington	31-Jan	2576	9.5	2.7	0.877	3.4	0.9	10.1
Northern Irish Sites								
Ballymena Ballykeel	18-Feb	4901234	-1.9	2.7	1.007	3.3	1.4	9.1
Belfast Centre	24-Feb	1766	13.3	2.5	0.940	3.3	1.2	-6.9
Derry	20-Feb	1697	0.8	2.6	1.100	3.7	2.2	4.8
Scottish Sites								
Edinburgh St Leonards	04-Feb	84	6	2.5	0.983	3.9	3.2	7.7
Grangemouth	03-Feb		1	2.5	0.836	3.1	1.3	19.2
Welsh Sites								
Cardiff Centre	23-Jan	#070	4.2	2.5	0.954	3.5	2.5	8.3
Narberth	21-Jan	344	7.3	2.5	0.832	3.4	1.1	12.3
Port Talbot Margam	22-Jan	605214617	2.0	2.5	0.937	3.3	1.3	6.1
Wrexham	07-Jan		14.9	2.5	1.000	3.6	2.2	10.4

3. Ozone

English Sites

Site	Date Year =2014	Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	[*]Max Residual (%)
Barnsley Gawber	20-Jan	8060030	0.4	3	1.022	3.1	1.2
Birmingham Acocks Green	20-Jan	2435	-1.3	3	1.046	3.1	0.5
Birmingham Tyburn	21-Jan	WB6AG7TM	0.3	3	0.977	3.2	1.3
Birmingham Tyburn Roadside	21-Jan	2434	0.8	3	1.041	3.1	1.1
Blackpool Marton	14-Jan	cm08060037	0.2	3	0.998	3.1	0.5
Bottesford	25-Feb	CM08060022	-0.1	3	0.943	3.2	1.0
Bournemouth	27-Feb	17503	0.0	3	0.987	3.1	1.2
Brighton Preston Park	28-Jan	542	3.4	3	0.947	3.1	0.5
Bristol St Paul's	16-Jan	155	-1.2	3	1.008	3.3	0.2
Canterbury	10-Feb	2448	0.0	3	0.950	3.1	0.5
Charlton Mackrell	11-Feb	1111957	0.0	3	0.972	3.1	0.8
Coventry Memorial Park	18-Feb	CM08060044	0.1	3	1.030	3.2	1.7
Exeter Roadside	15-Jan	F0100E0S	3.2	3	0.983	3.2	0.8
Glazebury	16-Jan	19751	0.8	3	0.994	3.1	0.3
Great Dun Fell	02-Jul	1647	0.3	3	1.104	3.1	0.9
Harwell	28-Jan	1648	-1.5	3	1.019	3.1	0.1
High Muffles	29-Jan	1641	-0.1	3	1.064	3.1	0.2
Hull Freetown	14-Jan	8060045	0.8	3	0.954	3.1	1.6
Ladybower	22-Jan	1651	0.3	3	1.024	3.1	2.3
Leamington Spa	26-Feb	411770	0.3	3	0.936	3.3	0.8
Leeds Centre	13-Jan	8060036	0.6	3	0.966	3.1	1.0
Leicester University	19-Feb	CM08060020	-0.1	3	1.110	3.2	0.3
Leominster	10-Feb	170	1.9	3	1.043	3.1	0.5
Liverpool Speke	09-Jan	CM0806004	0.0	3	1.142	3.2	0.6

Lullington Heath	13-Feb	1644	-0.7	3	1.002	3.1	0.6
Manchester Piccadilly	15-Jan	0	0.3	3	1.068	3.1	0.3
Manchester South	15-Jan	16954	0.3	3	1.031	3.1	0.5
Market Harborough	20-Feb	CM08060031	0.5	3	1.116	3.3	0.6
Middlesbrough	29-Jan	944	0.4	3	0.986	3.1	0.5
Newcastle Centre	27-Jan	CM08060033	-0.3	3	0.984	3.3	1.3
Northampton Kingsthorpe	17-Feb	47R76STR	0.6	3	0.925	3.1	0.4
Norwich Lakenfields	05-Feb	CM08060028	0.4	3	1.078	3.1	0.2
Nottingham Centre	24-Feb	CM08060032	0.3	3	1.195	3.2	0.5
Plymouth Centre	14-Jan	CM08060027	0.0	3	1.009	3.2	0.5
Portsmouth	25-Feb	CM08060023	-0.7	3	0.992	3.0	0.3
Preston	15-Jan	cm08060042	0.6	3	1.028	3.1	0.9
Reading New Town	24-Feb	CM08060025	0.0	3	1.011	3.1	0.4
Rochester Stoke	11-Feb	378	-0.8	3	0.970	3.2	0.8
Salford Eccles	14-Jan	4117771	2.3	3	0.964	3.3	5.3
Sheffield Devonshire Green	20-Jan	8060024	0.6	3	1.019	3.1	0.8
Sibton	05-Feb	146	-0.8	3	1.021	3.2	0.4
Southampton Centre	26-Feb	CM08060021	0.2	3	1.157	3.1	0.7
Southend-on-Sea	13-Feb	CM08060017	0.1	3	1.027	3.1	1.1
St Osyth	13-Feb	CM08060035	0.5	3	0.992	3.2	0.3
Stoke-on-Trent Centre	23-Jan	CM08060026	1.0	3	1.022	3.3	1.5
Sunderland Silksworth	28-Jan	436	1.5	3	0.964	3.1	1.2
Thurrock	12-Feb	221	0.3	3	1.104	3.2	1.2
Walsall Woodlands	22-Jan	2431	2.8	3	0.941	3.1	0.6
Weybourne	06-Feb	CM10180038	-0.8	3	1.026	3.1	0.5
Wicken Fen	04-Feb	165	-1.0	3	1.057	3.1	0.5
Wigan Centre	14-Jan	0	-1.5	3	1.030	3.1	0.8
Wirral Tranmere	06-Jan	CM08060040	0.2	3	1.016	3.2	0.4
Yarner Wood	12-Feb	2437	-1.2	3	1.017	3.1	0.7
London Sites							
London Bloomsbury	12-Feb	435	-0.9	3	1.012	3.1	0.4
London Eltham	27-Jan	1111958	0.0	3	0.967	3.1	0.8
London Haringey????	18-Feb	1111953	0.0	3	1.174	3.2	1.5
London Harlington	03-Jan	107	0.8	3	1.105	3.1	0.1
London Hillingdon	06-Feb	8060034	-0.1	3	1.066	3.1	1.5
London Marylebone Road	29-Jan	19223	6.2	3	1.162	3.2	2.8
London N. Kensington	31-Jan	2372	2.8	3	1.026	3.2	0.4
London Teddington	20-Feb	2447	0.5	3	1.052	3.2	1.2
London Westminster							
Northern Ireland Sites (plus Mace Head)							
Belfast Centre	24-Feb	cm08060038	0.1	3	1.068	3.2	2.9
Derry	20-Feb	1586	1.6	3	1.011	3.1	0.4
Lough Navar	19-Feb	1640	0.2	3	1.010	3.1	0.2
Mace Head	26-Feb	77086-385	0.4	3	1.037	3.1	3.0

Scottish Sites							
Aberdeen	11-Feb	800	0.7	3	1.024	3.1	0.1
Auchencorth Moss	05-Feb	1646	-0.2	3	1.062	3.2	1.0
Bush Estate	05-Feb	1645	-0.3	3	1.021	3.1	0.3
Edinburgh St Leonards	04-Feb	136	0.2	3	1.013	3.1	0.6
Eskdalemuir	16-Jan	158	-1.0	3	1.367	3.1	1.9
Fort William	22-Jan	1023	0.5	3	0.999	3.1	2.1
Glasgow Townhead	21-Jan	CM08060029	-0.2	3	1.025	3.1	0.5
Lerwick							
Peebles	04-Feb	2449	-2.3	3	1.031	3.1	0.8
Strath Vaich	05-Mar	170	0.7	3	1.068	3.1	1.2
Welsh Sites							
Aston Hill	10-Feb	144	-0.7	3	1.019	3.1	1.0
Cardiff Centre	23-Jan	168	-1.3	3	1.022	3.1	0.7
Cwmbran	23-Jan	CM0860043	0.7	3	0.981	3.1	0.4
Mold	07-Jan	1642	-0.1	3	0.996	3.2	0.1
Narberth	21-Jan	824	1.2	3	0.999	3.1	0.6
Port Talbot Margam	22-Jan	CM10140049	0.1	3	0.982	3.2	1.0

4. Oxides of Nitrogen

English Sites

Site	Date Year =2014	Analyser number		[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	[*]Max residual (%)	[*]Converter efficiency (%)
Barnsley Gawber	20-Jan	8050057	NOx	1.2	2.5	0.910	3.5	2.1	98.5
			NO	1.4	2.5	0.914	3.5	1.7	
Bath Roadside	16-Jan	12758	NOx	1.7	2.6	1.202	3.5	1.1	96.5
			NO	1.8	2.6	1.208	3.5	0.7	
Billingham	28-Jan	574	NOx	-1.0	3.8	1.383	3.7	4.8	101.0
			NO	0.5	2.7	1.384	3.5	3.4	
Birmingham Acocks Green	20-Jan	3364	NOx	0.9	2.6	1.132	3.5	1.3	98.4
			NO	-0.1	2.6	1.132	3.5	1.0	
Birmingham Tyburn	21-Jan	Y7ACC7MC	NOx	0.6	2.6	0.985	3.5	0.9	99.2
			NO	-0.3	2.6	0.999	3.5	0.8	
Birmingham Tyburn Roadside	21-Jan	68	NOx	0.8	2.9	1.713	3.5	0.9	98.1
			NO	0.0	2.9	1.700	3.5	1.4	
Blackburn Darwen Roadside	15-Jan	1011851	NOx	2.0	2.5	1.013	3.7	2.4	100.8
			NO	-1.0	2.5	1.004	3.5	1.0	
Blackpool Marton	14-Jan	08050075	NOx	0.6	2.5	0.913	3.5	1.3	100.3
			NO	0.0	2.5	0.948	3.5	0.8	
Bournemouth	27-Feb	17507	NOx	2.0	2.6	1.164	3.5	2.6	99.1
			NO	0.1	2.6	1.203	3.5	1.9	
Brighton Preston Park	28-Jan	2222	NOx	1.8	2.7	1.150	3.5	0.4	98.2
			NO	2.0	2.8	1.162	3.5	0.2	
Bristol St Paul's	16-Jan	77	NOx	0.0	2.7	1.293	3.5	0.7	92.9
			NO	0.1	2.7	1.286	3.5	0.4	

Cambridge Roadside	04-Feb	1011843	NOx	3.0	2.7	1.387	3.5	1.5	101.4
			NO	0.0	2.8	1.375	3.5	0.8	
Canterbury	10-Feb	11666	NOx	-2.4	3.0	1.289	3.5	1.6	97.9
			NO	-1.9	2.8	1.311	3.5	1.4	
Carlisle Roadside	13-Jan	1011849	NOx	0.0	3.0	1.417	3.5	2.0	98.7
			NO	-2.0	2.7	1.406	3.5	1.2	
Charlton Mackrell	11-Feb	2120	NOx	0.8	2.5	1.048	3.5	1.5	98.4
			NO	0.5	2.5	1.061	3.5	1.4	
Chatham Centre Roadside	11-Feb	3393	NOx	1.8	2.6	1.105	3.5	0.4	100.1
			NO	-0.1	2.6	1.106	3.5	0.3	
Chesterfield	21-Jan	1011837	NOx	0.6	2.6	1.080	3.5	4.3	100.8
			NO	0.8	2.6	1.080	3.5	4.1	
Chesterfield Roadside	21-Jan	1011835	NOx	0.2	2.6	1.069	3.5	1.4	100.4
			NO	0.2	2.5	1.064	3.5	2.1	
Coventry Memorial Park	18-Feb	08030109	NOx	-0.5	2.5	0.792	3.5	0.9	98.2
			NO	0.2	2.4	0.783	3.5	0.9	
Eastbourne	29-Jan	3363	NOx	0.0	2.6	1.129	3.5	1.2	99.8
			NO	0.7	2.6	1.139	3.5	2.0	
Exeter Roadside	15-Jan	G0000D1S	NOx	0.6	2.6	1.023	3.5	0.9	98.0
			NO	0.4	2.6	1.029	3.5	0.7	
Glazebury	16-Jan	14354	NOx		analyser	failed	during	audit	
			NO						
Harwell	28-Jan	79	NOx	4.3	2.6	1.259	3.5	0.7	93.0
			NO	5.7	2.6	1.261	3.5	0.1	
High Muffles	29-Jan	1783	NOx	1.6	2.6	1.237	3.5	3.8	99.2
			NO	1.7	2.6	1.244	3.5	4.8	
Honiton	15-Jan	3392	NOx	0.6	2.7	1.230	3.5	0.5	99.6
			NO	1.4	2.7	1.209	3.5	1.4	
Horley	27-Jan	1401954	NOx	5.0	2.7	1.016	3.5	1.0	101.1
			NO	-2.0	2.7	0.985	3.5	1.0	
Hull Freetown	14-Jan	8050056	NOx	-3.8	2.5	0.994	3.9	3.3	100.7
			NO	-0.8	2.5	1.048	3.9	3.2	
Ladybower	22-Jan	72	NOx	-0.6	2.6	1.276	3.5	1.8	100.5
			NO	-0.5	2.6	1.266	3.5	1.8	
Leamington Spa	26-Feb	1011842	NOx	0.0	2.6	1.201	3.5	0.4	101.0
			NO	0.0	2.6	1.192	3.5	0.9	
Leamington Spa Rugby Road	27-Feb	3365	NOx	2.9	2.4	0.781	3.5	0.9	99.6
			NO	3.1	2.4	0.689	3.5	1.1	
Leeds Centre	13-Jan	8050066	NOx	-1.2	2.5	0.966	3.6	3.0	101.6
			NO	-1.4	2.5	0.966	3.8	3.4	
Leeds Headingley Kerbside	13-Jan	342	NOx	-0.6	2.6	1.096	3.5	3.0	100.5
			NO	-0.4	2.6	1.083	3.5	2.2	
Leicester University	19-Feb	08050021	NOx	0.0	2.4	0.786	3.5	1.1	98.8
			NO	0.5	2.4	0.725	3.5	0.9	
Leominster	10-Feb	346	NOx	0.8	2.6	0.984	3.5	1.0	100.1
			NO	0.7	2.5	0.953	3.5	0.2	

Lincoln Canwick Road	25-Feb	3394	NOx	0.6	2.6	1.165	3.5	0.5	99.2
			NO	0.7	2.6	1.162	3.5	0.8	
Liverpool Queen's Drive Roadside	09-Jan	1734	NOx	-0.8	2.6	1.222	3.5	0.7	98.8
			NO	1.1	2.6	1.260	3.5	1.1	
Liverpool Speke	09-Jan	08050069	NOx	-0.4	2.5	0.918	3.5	1.7	100.3
			NO	0.1	2.5	0.936	3.5	1.6	
Lullington Heath	13-Feb	787	NOx	-0.3	2.5	0.995	3.5	1.0	98.1
			NO	0.6	2.5	0.994	3.5	1.3	
Manchester Piccadilly	15-Jan	12190	NOx	1.0	2.6	1.055	3.9	2.9	98.8
			NO	1.3	2.5	1.039	3.9	2.9	
Manchester South	15-Jan	17311	NOx	0.5	2.6	1.140	3.5	2.1	99.5
			NO	0.0	2.6	1.149	3.5	2.3	
Market Harborough	20-Feb	08050068	NOx	0.9	2.4	0.519	3.5	1.0	101.3
			NO	1.0	2.4	0.493	3.5	1.2	
Middlesbrough	29-Jan	2287	NOx	-5.5	2.6	1.103	3.5	2.9	98.5
			NO	-1.6	2.6	1.115	3.5	4.7	
Newcastle Centre	27-Jan	08050063	NOx	0.8	2.5	0.948	4.1	0.6	98.5
			NO	0.6	2.5	0.978	3.7	0.7	
Newcastle Cradlewell Roadside	27-Jan	1011853	NOx	2.0	2.8	1.044	3.5	2.3	98.9
			NO	0.0	2.7	1.039	3.5	4.9	
Northampton Kingsthorpe	17-Feb	8ATJ6APR	NOx	1.0	2.6	1.000	3.5	0.3	99.2
			NO	0.0	2.6	1.007	3.5	0.5	
Norwich Lakenfields	05-Feb	08050067	NOx	-0.3	2.5	0.892	3.5	1.1	98.6
			NO	0.0	2.5	0.885	3.5	0.9	
Nottingham Centre	24-Feb	08050072	NOx	0.3	2.5	0.932	3.5	0.2	98.9
			NO	0.7	2.5	0.929	3.5	0.5	
Oxford Centre Roadside	28-Feb	1011844	NOx	2.0	2.6	1.222	3.5	1.3	99.5
			NO	0.0	2.6	1.215	3.5	1.9	
Oxford St Ebbes	25-Feb	1011830	NOx	0.0	2.6	1.136	3.5	5.3	99.5
			NO	-1.0	2.6	1.134	3.5	5.4	
Plymouth Centre	14-Jan	08050062	NOx	-0.1	2.5	0.899	3.5	1.0	100.9
			NO	0.1	2.5	0.870	3.5	0.7	
Portsmouth	25-Feb	P0T7CYA5	NOx	-0.1	2.7	1.088	3.5	0.4	99.2
			NO	-1.1	2.8	1.101	3.5	0.4	
Preston	15-Jan	08050664	NOx	2.2	2.5	0.893	3.5	0.5	98.9
			NO	1.8	2.5	0.899	3.5	0.5	
Reading New Town	24-Feb	08050059	NOx	-0.2	2.5	0.853	3.5	3.0	99.3
			NO	0.0	2.5	0.829	3.5	1.8	
Rochester Stoke	11-Feb	3095	NOx	-3.0	2.8	1.167	3.5	0.4	99.5
			NO	1.0	2.8	1.173	3.5	0.4	
Salford Eccles	14-Jan	1011831	NOx	3.0	2.7	1.108	3.5	1.6	101.8
			NO	-1.0	2.7	1.086	3.5	1.8	
Sandy Roadside	03-Feb	2585	NOx	0.3	2.8	1.324	3.5	0.1	98.4
			NO	-0.1	2.7	1.298	3.5	0.5	
Scunthorpe Town	13-Jan	1011847	NOx	41.0	3.4	2.450	3.5	2.1	98.2
			NO	44.0	3.4	2.444	3.5	2.3	

Sheffield Devonshire Green	20-Jan	8050055	NOx	0.8	2.5	0.890	3.8	3.1	99.7
			NO	0.6	2.5	0.895	3.8	3.2	
Sheffield Tinsley	21-Jan	571	NOx	0.4	2.6	1.095	3.8	3.3	100.0
			NO	0.6	2.6	1.112	3.6	2.8	
Southampton Centre	26-Feb	08030106	NOx	0.4	2.5	0.999	3.5	1.0	100.0
			NO	0.4	2.5	1.001	3.5	1.5	
Southend-on-Sea	13-Feb	08050071	NOx	0.2	2.5	0.968	3.5	0.5	100.0
			NO	0.4	2.5	0.962	3.5	0.4	
St Osyth	13-Feb	08050073	NOx	-5.4	2.4	0.668	3.5	0.3	100.5
			NO	-1.7	2.4	0.673	3.5	0.4	
Stanford-le-Hope Roadside	12-Feb	191	NOx	0.8	2.6	1.223	3.5	0.7	98.6
			NO	1.6	2.6	1.251	3.5	0.7	
Stockton-on-Tees Eaglescliffe	28-Jan	0	NOx	-0.1	2.7	1.315	3.5	1.2	92.2
			NO	0.8	2.7	1.327	3.5	2.0	
Stoke-on-Trent Centre	23-Jan	08050070	NOx	-0.2	2.5	0.971	3.5	2.4	99.3
			NO	0.7	2.5	0.966	3.5	2.0	
Storrington Roadside	28-Jan	09040022	NOx	0.3	2.6	1.153	3.5	1.0	100.4
			NO	0.6	2.6	1.157	3.5	1.0	
Sunderland Si ksworth	28-Jan	1011854	NOx	1.0	2.6	1.161	3.5	4.1	100.0
			NO	0.0	2.7	1.149	3.5	2.9	
Thurrock	12-Feb	192	NOx	0.6	2.7	1.233	3.5	0.6	99.9
			NO	0.6	2.6	1.227	3.5	0.3	
Walsall Woodlands	22-Jan	3391	NOx	0.9	2.6	1.173	3.5	0.7	98.0
			NO	-0.8	2.6	1.193	3.5	0.5	
Warrington	08-Jan	1011826	NOx	1.0	2.6	0.987	3.5	0.6	99.0
			NO	0.0	2.6	0.973	3.5	0.4	
Wicken Fen	04-Feb	2223	NOx	-1.3	2.5	0.965	3.5	0.4	97.0
			NO	0.5	2.5	0.984	3.5	0.3	
Wigan Centre	14-Jan	1011832	NOx	1.0	2.5	0.902	3.5	0.9	98.6
			NO	0.0	2.5	0.902	3.5	0.5	
Wirral Tranmere	06-Jan	08050060	NOx	-1.6	2.5	0.832	3.5	0.9	101.6
			NO	-0.8	2.5	0.831	3.5	1.2	
Yarner Wood	12-Feb	1784	NOx	-0.1	2.5	0.912	3.5	1.0	99.5
			NO	-0.2	2.5	0.918	3.5	0.9	
York Fishergate	14-Jan	1011848	NOx	-1.2	2.5	0.997	3.5	2.5	99.3
			NO	-0.8	2.5	1.058	3.5	3.1	
London Sites									
Camden Kerbside	19-Feb	1011846	NOx	4.0	2.8	1.176	3.5	0.2	100.5
			NO	3.0	2.6	1.176	3.5	0.4	
Haringey Roadside	18-Feb	1011827	NOx	4.0	3.0	1.443	3.6	3.8	101.7
			NO	1.0	3.0	1.424	3.7	4.4	
London Bexley	14-Feb	327	NOx	0.1	2.6	1.230	3.5	1.2	98.9
			NO	0.2	2.7	1.335	3.5	1.0	
London Bloomsbury	12-Feb	74	NOx	6.3	2.7	1.290	3.5	1.9	94.8
			NO	6.7	2.7	1.296	3.5	1.4	

London Eltham	27-Jan	1011834	NOx	2.0	3.1	0.996	3.5	0.9	99.3
			NO	-1.0	3.1	0.993	3.5	1.1	
London Haringey Priory Park South	18-Feb	1084	NOx	-0.5	2.7	1.244	3.5	1.5	98.2
			NO	0.5	2.6	1.266	3.5	1.3	
London Harlington	03-Jan	1090	NOx	0.5	2.8	1.168	3.5	2.9	100.9
			NO	1.6	2.7	1.175	3.5	2.7	
London Hillingdon	06-Feb	8050017	NOx	-0.3	2.5	0.901	3.5	0.7	99.3
			NO	-0.1	2.5	0.905	3.5	0.8	
London Marylebone Road	29-Jan	19210	NOx	1.3	2.7	1.306	3.5	0.8	97.2
			NO	0.6	2.7	1.296	3.5	0.9	
London N. Kensington	31-Jan	3273	NOx	0.9	4.9	1.094	3.5	0.7	95.2
			NO	0.6	3.0	1.096	3.5	0.6	
London Teddington	20-Feb	3406	NOx	1.6	2.8	1.300	3.6	1.0	99.7
			NO	3.3	2.7	1.297	3.5	0.8	
London Westminster	04-Feb	573	NOx	0.8	3.2	1.288	3.5	1.5	90.3
			NO	0.5	2.7	1.334	3.7	3.0	
Southwark A2 Old Kent Road	05-Feb	1954	NOx	0.7	2.7	1.406	3.5	1.2	89.2
			NO	-0.2	2.8	1.399	3.5	0.1	
Tower Hamlets Roadside	13-Feb	1011838	NOx	1.0	3.1	1.419	3.5	1.0	98.9
			NO	0.0	2.9	1.419	3.5	1.1	
Northern Irish Sites									
Armagh Roadside	19-Feb	1011845	NOx	-0.2	2.6	1.148	3.6	2.5	98.5
			NO	-0.3	2.6	1.133	3.5	2.1	
Belfast Centre	24-Feb	08050074	NOx	-0.6	2.5	0.996	3.5	0.5	99.6
			NO	-0.4	2.5	0.961	3.5	0.9	
Derry	20-Feb	2130	NOx	1.1	2.6	1.064	3.5	1.0	99.6
			NO	0.9	2.5	1.056	3.5	1.1	
Scottish Sites									
Aberdeen	11-Feb	519	NOx	0.1	2.6	1.077	3.5	0.9	99.1
			NO	0.2	2.6	1.078	3.5	1.3	
Aberdeen Union Street Roadside	11-Feb	299	NOx	1.2	2.8	1.513	4.6	4.4	101.4
			NO	1.3	2.8	1.535	3.5	3.8	
Bush Estate	05-Feb	2244	NOx	1.6	2.5	1.030	3.5	0.7	99.7
			NO	0.7	2.5	1.015	3.5	0.3	
Dumbarton Roadside	20-Jan	1011833	NOx	1.0	2.6	1.158	3.5	0.7	100.4
			NO	0.0	2.9	1.167	3.5	1.2	
Dumfries	13-Jan	1494	NOx	-6.5	2.6	1.070	3.5	2.7	99.1
			NO	-6.5	8.4	1.071	3.5	1.9	
Edinburgh St Leonards	04-Feb	73	NOx	1.7	2.7	1.428	3.5	1.5	98.0
			NO	1.7	2.7	1.434	3.5	1.3	
Eskdalemuir	16-Jan	347	NOx	2.3	2.4	0.786	3.5	1.3	99.2
			NO	1.7	2.4	0.783	3.5	0.2	
Fort William	22-Jan	344	NOx	4.2	2.6	1.078	3.5	1.2	102.1
			NO	4.2	2.6	1.078	3.5	0.4	
Glasgow Kerbside	21-Jan	08050061	NOx	0.5	32.6	1.277	7.6	0.6	101.9

			NO	0.1	34.3	1.273	8.0	0.7	
Glasgow Townhead	21-Jan	1713	NOx	0.5	2.6	1.209	4.6	1.5	101.6
			NO	0.7	2.6	1.209	4.5	1.6	
Grangemouth	03-Feb		NOx	0.0	2.5	1.034	3.5	1.0	100.0
			NO	-1.0	2.7	1.039	3.5	2.0	
Grangemouth Moray	03-Feb		NOx	1.0	2.8	1.112	3.5	0.5	98.8
			NO	0.0	2.7	1.115	3.5	0.9	
Inverness	12-Feb	1489	NOx	-1.4	2.6	1.119	3.5	2.3	100.8
			NO	-1.4	2.6	1.113	3.5	1.4	
Peebles	04-Feb	2213	NOx	-0.8	2.6	1.073	3.5	0.3	99.4
			NO	-0.1	2.6	1.086	3.5	0.3	
Welsh Sites									
Aston Hill	10-Feb	2302	NOx	0.0	2.7	1.153	3.5	1.0	99.9
			NO	0.1	2.6	1.161	3.5	0.2	
Cardiff Centre	23-Jan	#071	NOx	1.0	2.6	1.028	3.5	2.0	99.6
			NO	0.5	2.5	1.027	3.5	1.7	
Chepstow A48	24-Jan	1011828	NOx	2.0	3.2	1.570	3.5	1.2	100.6
			NO	-1.0	2.8	1.568	3.5	1.4	
Cwmbran	23-Jan		NOx	0.1	2.5	0.976	3.5	0.2	99.8
			NO	0.4	2.5	1.008	3.5	0.5	
Mold	07-Jan	345	NOx	0.5	2.6	1.094	3.5	1.3	98.4
			NO	0.5	2.6	1.099	3.5	0.7	
Narberth	21-Jan	2577	NOx	1.0	2.5	0.934	3.5	0.7	99.4
			NO	0.5	2.5	0.958	3.5	0.6	
Newport	23-Jan	1011829	NOx	3.0	2.5	1.067	3.5	2.3	99.4
			NO	0.0	2.5	1.057	3.5	0.6	
Port Talbot Margam	22-Jan	2036	NOx	0.3	2.5	0.985	3.5	0.2	99.0
			NO	0.1	2.5	0.983	3.5	0.1	
Swansea Roadside	22-Jan	1160	NOx	1.1	2.6	1.142	3.5	0.4	100.1
			NO	0.0	2.6	1.189	3.5	0.2	
Wrexham	07-Jan	1490	NOx	0.1	2.6	1.146	3.5	1.0	98.8
			NO	-0.2	2.6	1.160	3.5	0.5	

5. Particulate Analysers

English Sites

Site	Date Year =2014		Analyser number	Calculated Spring Constant k_0	[4]k_0 accuracy (%)	Uncertainty (%)	[3]Measured Main Flow (l/min)	Uncertainty (%)	[3]Measured Total Flow (l/min)	Uncertainty (%)
Barnstaple	11/12/13	PM10	300811	17217	-0.3	1	2.91	2.2	16.17	2.2
A39		PM2.5	821002	14134	-0.2	1	2.98	2.2	15.93	2.2
Birmingham Acocks Green	20-Jan	PM2.5	900702	15770	0.17	1	3.04	2.2	15.70	2.2
Birmingham	21-Jan	PM10	200390809	14826	-0.77	1	2.82	2.2	15.96	2.2
Tyburn		PM2.5	200860809	14742	0.39	1	2.91	2.2	15.97	2.2
Birmingham Tyburn	21-Jan	PM10	20603	12069	-2.48	1	2.92	2.2	16.17	2.2
Roadside		PM2.5	220606	14237	-1.35	1	2.96	2.2	16.50	2.2

Blackpool Marton	14-Jan	PM2.5		analyser	not	present				
Bournemouth	27-Feb	GR2.5	21863						16.58	2.2
Brighton Preston Park	28-Jan	GR2.5	650603						16.08	2.2
Bristol St	16-Jan	PM10	420209	13237	0.45	1	3.10	2.2	16.06	2.2
Paul's		PM2.5	540701	13513	-2.93	1	**3.18**	**2.2**	**17.75**	**2.2**
Carlisle	13-Jan	PM10	27257	14292	-1.36	1	**3.04**	**2.2**	**17.10**	**2.2**
Roadside		PM2.5	27320	14948	-1.46	1	**3.01**	**2.2**	**16.96**	**2.2**
Chatham Centre	11-Feb	PM10	840809	14446	-0.53	1	3.07	2.2	16.61	2.2
Roadside		PM2.5	90810	15878	-0.76	1	3.00	2.2	16.36	2.2
Chesterfield	21-Jan	PM10	27316	16187	-0.82	1	2.99	2.2	16.20	2.2
		PM2.5	27341	15536	0.47	1	2.95	2.2	16.05	2.2
Chesterfield	21-Jan	PM10	22299	11309	-0.32	1	3.05	2.2	16.36	2.2
Roadside		PM2.5	27339	10961	-1.12	1	3.04	2.2	16.40	2.2
Coventry Memorial Park	18-Feb	PM2.5	192890 702	14863	-0.70	1	**2.83**	**2.2**	**15.86**	**2.2**
Eastbourne	29-Jan	PM10	380809	14323	-1.25	1	3.06	2.2	17.22	2.2
		PM2.5	440809	14816	-0.12	1	3.04	2.2	16.75	2.2
Harwell	28-Jan	PM10	670811	14847	-0.6	1	3.19	2.2	16.84	2.2
		PM2.5	570401	12340	-0.4	1	3.01	2.2	16.26	2.2
		GR10	39802						16.41	2.2
		GR2.5	90603						16.97	2.2
Hull Freetown	14-Jan	PM10	24445	14245	0.96	1	3.09	2.2	16.29	2.2
		PM2.5	26498	14385	1.35	1	3.00	2.2	16.13	2.2
Leamington	26-Feb	PM10	510809	15071	0.50	1	2.84	2.2	15.76	2.2
Spa		PM2.5	110310	14198	0.12		2.92	2.2	16.04	2.2
Leamington Spa	27-Feb	PM10	320808	13983	0.38	1	3.00	2.2	16.48	2.2
Rugby Road		PM2.5	440809	15942	-0.58	1	3.01	2.2	16.79	2.2
Leeds Centre	13-Jan	PM10	24451	13329	-0.50	1	3.07	2.2	16.68	2.2
		PM2.5	27254	17212	1.01	1	3.24	2.2	17.77	2.2
Leeds Headingley	13-Jan	PM10	27287	17660	0.43	1	3.05	2.2	16.59	2.2
Kerbside		PM2.5	27249	14542	-1.09	1	2.98	2.2	16.01	2.2
Leicester Uni	19-Feb	PM2.5	192490701	14796	-1.13	1	2.99	2.2	16.38	2.2
Liverpool	09-Jan	PM10	172220302	15758	-0.34	1	3.04	2.2	16.27	2.2
Speke		PM2.5	192860702	14761	-0.98	1	3.01	2.2	16.30	2.2
Manchester Piccadilly	15-Jan	PM2.5	26038	14044	0.14	1	2.86	2.2	17.10	2.2
Middlesbrough	29-Jan	PM10	250210	13737	-2.80	1	2.97	2.2	16.99	2.2
		PM2.5	950806	15687	-2.01	1	2.84	2.2	15.93	2.2
Newcastle	27-Jan	PM10	244480302	13777	-0.33		3.00	2.2	17.25	2.2
Centre		PM2.5	244470302	14839	0.02	1	3.01	2.2	16.62	2.2
Northampton Kingsthorpe	17-Feb	PM2.5							0.00	2.2
Norwich	05-Feb	PM10	204981105	15623	-0.54	1	3.06	2.2	16.78	2.2
Lakenfields		PM2.5	201180810	15719	0.74	1	3.06	2.2	16.65	2.2
Nottingham	24-Feb	PM10	201580811	15513	-0.43	1	2.77	2.2	16.35	2.2

Centre		PM2.5	177400401	12191	0.06	1	3.01	2.2	16.61	2.2
Oxford St	25-Feb	PM10	200870809	14786	-0.20	1	2.98	2.2	16.58	2.2
Ebbes		PM2.5	160808	16999	-0.99	1	3.01	2.2	16.53	2.2
Plymouth	14-Jan	PM10		12311	0.26	1	3.05	2.2	16.74	2.2
Centre		PM2.5		14213	-0.89	1	2.92	2.2	16.14	2.2
Portsmouth	25-Feb	PM10	276281101	16750	-1.38	1	2.95	2.2	15.92	2.2
		PM2.5	272500809	18305	-1.28	1	2.91	2.2	15.30	2.2
Preston	15-Jan	PM2.5	22881	12773	-1.40	1	3.06	2.2	17.05	2.2
Reading New	24-Feb	PM10	154940003	13181	-0.14	1	3.00	2.2	16.62	2.2
Town		PM2.5	265750702	14012	-0.88	1	3.00	2.2	16.37	2.2
Rochester	11-Feb	PM10	200750809	14725	-1.26	1	2.93	2.2	16.42	2.2
Stoke		PM2.5	200890810	15876	-0.43	1	2.92	2.2	15.93	2.2
Salford Eccles	14-Jan	PM10		13754	0.46	1	2.88	2.2	15.72	2.2
		PM2.5		14616	-0.14	1	2.84	2.2	13.52	2.2
Saltash	14-Jan	PM10	168160208	14084	-0.40	1	2.88	2.2	16.29	2.2
Callington Road		PM2.5	201690811	12339	-0.22	1	2.99	2.2	17.43	2.2
Sandy	03-Feb	PM10	139399707	11332	0.35	1	3.09	2.2	15.02	2.2
Roadside		PM2.5	204841102	16025	-0.34	1	2.95	2.2	16.49	2.2
Scunthorpe Town	13-Jan	PM10	27366	15046	0.30	1	3.06	2.2	16.31	2.2
Sheffield	20-Jan	PM10	25024	12012	-1.94	1	3.01	2.2	16.23	2.2
Devonshire Grn		PM2.5	27253	15538	-0.64	1	2.98	2.2	16.21	2.2
Southampton	26-Feb	PM10	244840303	13946	0.52	1	3.03	2.2	15.85	2.2
Centre		PM2.5	272560809	16555	0.19	1	3.05	2.2	15.89	2.2
Southend-on-Sea	13-Feb	PM2.5	177760401	12385	-0.39	1	2.97	2.2	15.73	2.2
Stanford-le-	12-Feb	PM10	172660303	12773	0.83	1	3.01	2.2	10.67	2.2
Hope Roadside		PM2.5	144209804	13187	1.10	1	3.02	2.2	16.73	2.2
Stockton-on-Tees	28-Jan	PM10	H4554						16.09	2.2
Eaglescliffe		PM2.5	H4558						16.10	2.2
Stoke-on-	23-Jan	PM10	177470401	12459	-0.34	1	2.98	2.2	16.38	2.2
Trent Centre		PM2.5	200570809	13348	-1.14	1	3.04	2.2	16.53	2.2
Storrington	28-Jan	PM10	272360808	15782	0.66	1	3.36	2.2	17.28	2.2
Roadside		PM2.5		12765	0.15	1	3.07	2.2	16.42	2.2
Sunderland Silksworth	28-Jan	PM2.5	272427809	15606	-1.24	1	2.93	2.2	14.46	2.2
Thurrock	12-Feb	PM10	201270810	13910	-0.99	1	2.91	2.2	15.69	2.2
Warrington	08-Jan	PM10	175980309	11923	-0.66	1	2.91	2.2	15.74	2.2
		PM2.5	100060808	16335	-0.14	1	2.92	2.2	15.74	2.2
Wigan Centre	14-Jan	PM2.5	27291	14888	0.16	1	2.85	2.2	15.73	2.2
Wirral Tranmere	06-Jan	PM2.5	153660001	13311	0.13	1	0.00	2.2	11.58	2.2
York Bootham	14-Jan	PM10	21877	14731	-0.04	1	3.11	2.2	16.27	2.2
		PM2.5	27209	16055	-1.39	1	3.05	2.2	16.39	2.2
York	14-Jan	PM10	27232	15861	1.04	1	2.97	2.2	15.89	2.2
Fishergate		PM2.5	27348	18106	-0.75	1	2.93	2.2	15.97	2.2
London Sites										

Camden Kerbside	19-Feb	PM10	211529602	11950	-0.33	1	3.03	2.25	16.68	2.2
		PM2.5	232480009	12943	1.47	1	2.92	2.25	16.24	2.2
Haringey Roadside	18-Feb	PM10	272380810	15315	0.34	1	3.06	2.25	15.95	2.2
		PM2.5	272600809	13649	-1.09	1	3.14	2.25	18.47	2.2
London Bexley	14-Feb	PM2.5	177540401	11732	1.20	1	2.98	2.25	16.51	2.2
London Bloomsbury	12-Feb	PM10	172180302	13701	-0.29	1	2.96	2.25	15.24	2.2
		PM2.5	200610809	14718	-0.29	1	2.98	2.25	12.48	2.2
London Eltham	27-Jan	PM2.5	197840801	14079	1.90	1	3.08	2.25	16.21	2.2
London Harlington	03-Jan	PM10	249020311	12301	0.12	1	3.10	2.25	16.99	2.2
		PM2.5	23950202	12836	0.24	1	3.09	2.2	17.22	2.2
London Harrow Stanmore	19-Feb	PM2.5	272740809	16145	-0.62	1	2.97	2.2	15.53	2.2
London Marylebone Road	29-Jan	PM10	177410401	13105	-0.62	1	3.28	2.2	17.74	2.2
		PM2.5	200450809	13074	2.05	1	3.45	2.2	17.53	2.2
		GR10	209439811						16.85	2.2
		GR2.5	202210001						16.93	2.2
London N. Kensington	31-Jan	PM10	201780811	12775	0.81	1	3.28	2.2	17.41	2.2
		PM2.5	100070808	15848	0.39	1	3.11	2.2	16.51	2.2
		GR10							16.42	2.2
		GR2.5	21019						17.00	2.2
London Teddington Bushy Park	20-Feb	PM2.5	272650809	15296	-0.5	1	2.47	2.2	8.88	2.2
London Westminster	04-Feb	GR2.5	209399811						16.79	2.2
Southwark A2 Old Kent Road	05-Feb	PM10	264800612	15049	-0.49	1	2.97	2.2	16.37	2.2
Northern Irish Sites										
Armagh Roadside	19-Feb	PM10	2000	13786	1.58	1	3.01	2.2	16.35	2.2
Belfast Centre	24-Feb	PM10	172110302	14257	0.45	1	**3.04**	**2.2**	**16.82**	**2.2**
		PM2.5	192980702	15371	-2.28	1	**3.03**	**2.2**	**16.54**	**2.2**
Derry	20-Feb	PM10	2701	16048	1.52	1	3.16	2.2	16.84	2.2
		PM2.5	21313	10954	0.59	1	3.13	2.2	16.72	2.2
Lough Navar	19-Feb	PM10	21196	12966	1.15	1	**3.08**	**2.2**	**16.95**	**2.2**
Scottish Sites										
Aberdeen	11-Feb	PM10	24427	11373	-1.69	1	**2.99**	**2.2**	**16.13**	**2.2**
		PM2.5	27368	12099	-0.99	1	**3.00**	**2.2**	**16.11**	**2.2**
Auchencorth Moss	05-Feb	PM10	187680602	12890	-2.27	1	2.96	2.2	16.78	2.2
		PM2.5	187960603	13612	-2.89	1	2.99	2.2	15.74	2.2
		GR10	15500112						16.96	2.2
		GR2.5	215480112						16.84	2.2
Edinburgh St Leonards	04-Feb	PM10	199970808	13347	-2.51	1	3.23	2.2	16.61	2.2
		PM2.5	200190808	16847	-0.97	1	3.20	2.2	16.45	2.2
Glasgow Kerbside	21-Jan	PM10	220139803	14489	-0.64	1	**3.23**	**2.2**	**17.50**	**2.2**
		PM2.5	273370810	15152	0.21	1	**3.27**	**2.2**	**17.94**	**2.2**
Grangemouth	03-Feb	PM10	201210810	15775	-0.89	1	2.99	2.2	16.54	2.2
		PM2.5	100110808	13517	-1.77	1	3.01	2.2	16.14	2.2

Inverness	12-Feb	GR10	21255						17.06	2.2
		GR2.5	21861						17.10	2.2
Welsh Sites										
Cardiff Centre	23-Jan	PM10	192550701	13588	-2.09	1	2.94	2.2	16.31	2.2
		PM2.5	177700401	10985	-0.09	1	3.02	2.2	16.32	2.2
Chepstow A48	24-Jan	PM10	197340712	14062	-0.86	1	3.11	2.2	17.22	2.2
		PM2.5	200250808	15736	-1.62	1	3.15	2.2	17.22	2.2
Narberth	21-Jan	PM10	192470701	13745	-0.92	1	2.88	2.2	15.31	2.2
Newport	23-Jan	PM10	150509906	13775	-1.52	1	1.41	2.2	14.11	2.2
		PM2.5	100010808	16519	-0.62	1	2.96	2.2	16.07	2.2
Port Talbot Margam	22-Jan	PM10		13931	0.0	1	3.12	2.2	16.92	2.2
		PM2.5		10436	-1.2	1	3.02	2.2	17.09	2.2
		GR10							16.73	2.2
Swansea Roadside	22-Jan	PM10	M9305						10.68	2.2
		PM2.5	M9306						14.79	2.2
Wrexham	07-Jan	GR10	212240001						16.43	2.2
		GR2.5	210119902						16.77	2.2

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

The cal bration 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 Ricardo-AEA at the above address. Hard copies are available on request.

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QA/QC Data Ratification Report for the Automatic Urban and Rural Network, July-September 2013, and Intercalibration Report, Summer 2013

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

Ricardo-AEA/R/3413 Issue 1

Customer:

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Rachel Yardley

Date:

03 April 2014

Signed:

Executive summary

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

Ratified hourly average data capture for the network averaged 87.69% for all pollutants (O_3, NO_2, SO_2, CO, PM_{10} and $PM_{2.5}$) during the 3-month reporting period July-September 2013. Data capture for NO_2, O_3 and CO were above 90%. There were 45 sites with data capture less than 90% for the period.

A total of 135 monitoring sites in the AURN operated during this quarter, of which 74 are Local Authority owned sites affiliated to the national network. Some are co-located and separately named gravimetric particulate analysers at sites with automatic analysers. Many affiliated sites have additional Defra-funded analysers installed on site.

The main reasons for data loss at the sites have been provided and these were predominantly due to instrument faults, response instability or problems associated with the replacement of analysers and infrastructure.

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Appendices

SECTION A Data Ratification Report, July-September 2013

1 Introduction

This quarterly report covers the Quality Assurance and Control (QA/QC) activities undertaken by Ricardo-AEA to ratify automatic monitoring data from Defra and the Devolved Administrations' urban and rural air quality monitoring network (AURN) for the period 1 July-30 September 2013. During this quarter there were a total of 135 operational monitoring sites in the Network of which there were 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 were 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 co-located with FDMS analysers at Auchencorth Moss, Harwell, London North Kensington and Marylebone Road for both PM_{10} and $PM_{2.5}$, plus PM_{10} at Port Talbot Margam.

1.1 Overview of Network Performance

Ratified hourly average (daily average for Partisols) data capture for the network averaged 87.7% for all pollutants (O_3, NO_2, SO_2, CO, PM_{10} and $PM_{2.5}$) during the 3 month reporting period July-September 2013 (see Table 1.1). The data captures for O_3, NO_2 and CO were above 90% average, whilst $PM_{2.5}$, PM_{10} and SO_2 failed to meet this target. Data capture statistics 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; gaps due to service and maintenance are counted as lost data. It is permissible to discount routine service and calibration from achievable data capture targets, but this is not yet calculated. For sites starting or closing during the period, the data capture is based on the actual date starting or closing.

Table 1.1: AURN Ratified Data Capture (%) by Quarter, January-September 2013

	CO	PM_{10}	$PM_{2.5}$	NO_2	O_3	SO_2	Mean
Q1 2013	**95.85**	**91.56**	**93.10**	**91.20**	**94.53**	**92.85**	**92.62**
Q2 2013	**95.23**	**81.43**	**89.29**	**95.77**	**96.51**	**93.61**	**92.89**
Q3 2013	**91.13**	**77.17**	**79.85**	**92.16**	**93.56**	**88.16**	**87.69**

Overall, 270 out of the 379 analysers (71%) achieved data capture levels above the required 90% target during this reporting period. Table 1.2 shows the number of analysers which did not meet the target.

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

Total Number Of Analysers		Q1 Jan-Mar 2013 (No. below 90%)	Q2 Apr-June 2013 (No. below 90%)	Q3 Jul-Sept 2013 (No. below 90%)
CO	7	1	1	1
NO_2	116	15	10	20
O_3	82	10	5	9
PM_{10}[1]	69	15	26	34
$PM_{2.5}$[1]	80	14	14	39
SO_2	29	4	2	6
Total <90%		59	58	109

[1] Includes FDMS, BAM and Partisol analysers.

In total, 45 out of the 135 operational network sites in the quarter (16%) had an average data capture rate below the required 90% level for the July-September 2013 period. Of these, 38 were below 85%.

1.2 Changes to Ratified Data

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

Gases:

Bath Roadside NOx reprocessed from January-June 2013

Camden Kerbside NOx reprocessed from January-June 2013

Charlton Mackrell NOx reprocessed from January-June 2013

Chatham Roadside NOx reprocessed from January-March 2013

Harwell NOx deleted from 15 May to 30 June (and on to 30 September); sampling fault

Narberth NOx NOx reprocessed from January-June 2013

Norwich Lakenfields NOx reprocessed from January-June 2013

Peebles, NOx and O_3 deleted from 4 February to 1 August, sampling faults

Portsmouth O_3, sample leak from 25 April up to 30 June (and on to 8 August)

Yarner Wood NOx reprocessed February 2013

Particulates:

Blackpool Marton $PM_{2.5}$, deleted from 1 January to 30 June, poor quality data

Eastbourne PM_{10}, deleted 14 April- 15 June, regional outlier

Haringey Roadside, PM_{10} deleted from 12 May to 30 June (and on to 26 August) and $PM_{2.5}$, 18-21 June, poor dryer performance.

Leamington Spa Rugby Road PM_{10}, deleted 20 April to 30 June, noisy data

Port Talbot Margam PM_{10}, deleted 29-30 June, PM_{10} volatiles lower than $PM_{2.5}$

Stanford-le-Hope Roadside PM_{10}, deleted 29 to 30 June (and on to 29 August), dryer fault resulting in high volatile concentrations

A list of changes to ratified data is given at http://uk-air.defra.gov.uk/data/changes-to-ratified-data

2 Changes in the Network for Directive Compliance

3 The following sites commenced operation this quarter:

Site	Pollutants	Date commissioned
Leicester University	NOx O_3 $PM_{2.5}$	27 September 2013*
London Teddington Bushy Park	$PM_{2.5}$	29 August 2013

The following sites closed

Site	Date closed
Lerwick	29 August 2013
Sheffield Centre	30 August 2013
Leicester Centre	23 September 2013

3 Generic Data Quality Issues

3.1 FDMS Performance Issues

Ongoing and intensive investigation into the performance of FDMS analysers has highlighted an apparent baseline offset, often related to dryer faults. In order to determine this, zero checks are being carried out by placing a filter over the inlet and leaving for several days. This method does allow the determination of the analyser "zero" but requires a visit by QA/QC staff and the LSO, and therefore it will take time to complete all sites. The findings and implications of these tests are described in Section 5.

3.2 Internal Sampling

There were significant data losses from two sites noted this quarter; both affect data from previous quarters. These were at Harwell (NOx) and Peebles (NOx and O_3).

In the case of Harwell, the ESU installed individual sample lines in May following failure of the manifold fan. The sample inlet is particularly high at this site, and the tubes were installed below the top of the inlet in error, causing the analyser to sample air from inside the monitoring cabin. The NOx was clearly affected, and the SO_2 and O_3 will be reviewed next quarter.

Figure 1 Peebles NOx and O3, 2013

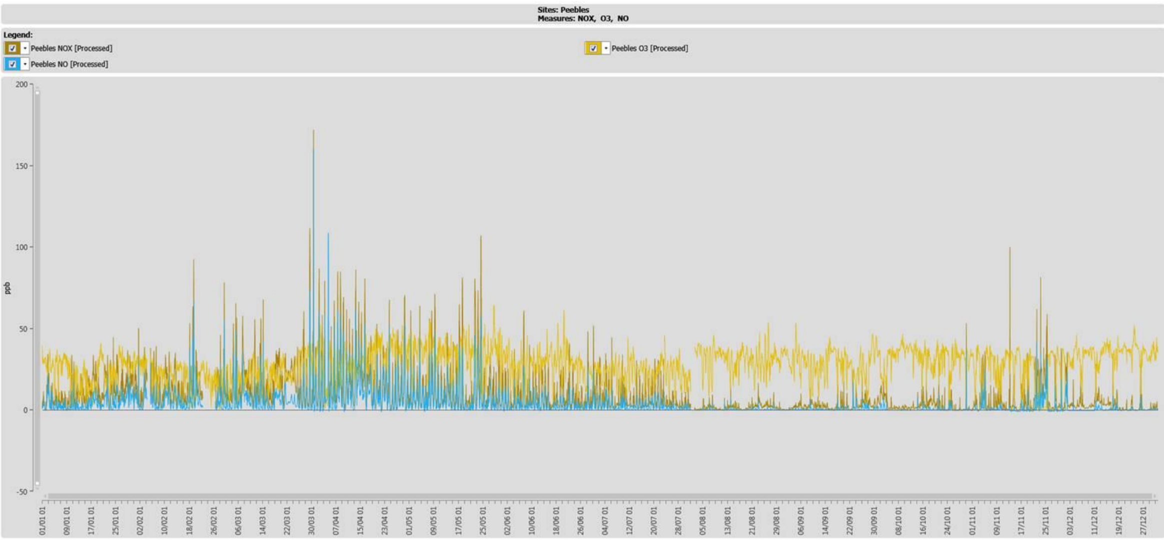

Figure *1* shows a clear step change in both pollutants (NOx and O_3) at the summer service. The engineer noted a leaking ozone sample filter, but it is believed that the NOx (and possibly O_3) sample inlets were disturbed during the service. The NOx profiles then much more closely resemble 2012 patterns. Both the NOx and O_3 datasets have been deleted between the winter and summer services.

4 Site Specific Issues

In this section, we now discuss in turn specific site issues for sites in the following geographic groupings – London, England (excluding London), Scotland, Northern Ireland and Wales. Where analysers were commissioned during the period, the stated data capture for these instruments is calculated from the date of commissioning. Further details on individual analyser performance issues are given in the relevant CMCU reports at http://aurnhub.defra.gov.uk/cmcu-reports.php.

Sites/pollutants that have less than 90% data capture are shaded in yellow and those which have less than 85% data capture are shaded in orange.

4.1 London

4.1.1.Data Capture

The data capture for sites in London (within the M25) for the period July-September 2013 is given in Table 4.1:

Table 4.1 Data Capture for London, July-September 2013

Name	CO	PM_{10}	PM_{25}	NO_2	O_3	SO_2	Average
Camden Kerbside		95.38	96.01	99.82			97.07
Haringey Roadside		28.85	96.42	99.73			75.00
London Bexley			96.51	99.77		99.18	98.49
London Bloomsbury		77.85	88.68	96.29	96.38	57.11	83.26
London Eltham			98.60	99.68	99.82		99.37
London Haringey Priory Park South				99.64	99.91		99.77
London Harlington		96.15	96.69	96.29	97.28		96.60
London Harrow Stanmore			62.59				62.59
London Hillingdon				98.82	98.73		98.78
London Marylebone Road	97.69	96.51	97.15	97.55	99.73	97.64	97.71
London Marylebone Road		97.83	100.00				98.91
London N. Kensington	99.68	29.71	95.52	99.68	98.60	99.68	87.15
London N. Kensington		98.91	100.00				99.46
London Teddington			100.00	97.51	97.46		97.62
London Westminster			93.48	98.51	97.78		98.05

Name	CO	PM_{10}	PM_{25}	NO_2	O_3	SO_2	Average
Southwark A2 Old Kent Road		92.48		97.55			95.02
Tower Hamlets Roadside				99.73			99.73
Number of Sites	**2**	**9**	**13**	**14**	**9**	**4**	**17**
Number of Sites <85%	**0**	**3**	**1**	**0**	**0**	**1**	**3**
Number of Sites <90%	**0**	**3**	**2**	**0**	**0**	**1**	**4**
Mean	**98.69**	**79.30**	**93.97**	**98.61**	**98.41**	**88.41**	**93.21**

4.1.2 Site Specific Issues

Haringey Roadside

Both the $PM_{2.5}$ and PM_{10} volatile concentrations were seen to be low in comparison with other sites. Replacement dryers were requested. PM_{10} data have been deleted from 12 May to 26 August, and $PM_{2.5}$ data from 18 to 21 June.

London Bloomsbury

The SO_2 analyser had a lamp fault resulting in the loss of data from 18-23 July. The gas sample manifold was found to be full of water at the audit on 31 July; the analysers were turned off to prevent further damage. The SO_2 pump was found to be faulty at the service on 20 August; data between these events have been deleted.

The FDMS analysers, particularly the PM_{10}, suffered some data loss in July due to elevated site temperatures. A further problem with the main valve resulted in the loss of PM_{10} data from 28-30 August.

London Harrow Stanmore

Following the FDMS zero check on 7 August, the Hepa filter was not removed until 13 August. However, the sharp cut cyclone was not replaced when the filter was removed, and this was only detected on 10 September so data from 7 August to 10 September have been lost

London North Kensington

Following a dryer replacement in August, the PM_{10} concentrations were unstable and inconsistent with other local sites; all PM_{10} data up to 4 September have been deleted.

4.2 England (excluding London)

4.2.1Data Capture

The data capture for sites in England for the period July-September 2013 is given in Table 4.2:

Table 4.2 Data Capture for England, July-September 2013

Name	CO	PM_{10}	PM_{25}	NO_2	O_3	SO_2	Average
Barnsley Gawber				97.92	97.96	96.38	97.42
Bath Roadside				99.32			99.32
Billingham				98.60			98.60
Birmingham Acocks Green			95.20	98.37	98.64		97.40

Name	CO	PM_{10}	PM_{25}	NO_2	O_3	SO_2	Average
Birmingham Tyburn		96.29	80.53	99.14	99.82	82.43	91.64
Birmingham Tyburn Roadside		58.11	48.82	86.96	90.40		71.07
Blackburn Darwen Roadside				84.74			84.74
Blackpool Marton			0.00	94.52	98.64		64.39
Bottesford					96.20		96.20
Bournemouth			95.65	98.19	88.95		93.61
Brighton Preston Park			97.83	98.46	98.51		98.47
Bristol St Paul's		89.67	90.63	97.24	98.19		93.93
Cambridge Roadside				98.32			98.32
Canterbury				97.19	93.70		95.45
Carlisle Roadside		95.83	85.01	99.73			93.52
Charlton Mackrell				97.33	98.41		97.87
Chatham Centre Roadside		99.59	88.77	99.59			95.98
Chesterfield		84.19	91.89	98.69			91.59
Chesterfield Roadside		96.24	85.73	94.66			92.21
Coventry Memorial Park			77.26	94.20	98.14		89.87
Eastbourne		38.90	96.20	96.11			77.07
Exeter Roadside				97.92	98.78		98.35
Glazebury				98.37	96.24		97.31
Great Dun Fell					70.20		70.20
Harwell		7.88	19.11	0.00	97.60	93.52	43.62
Harwell		97.83	66.30				82.07
High Muffles				98.78	98.82		98.80
Honiton				98.46			98.46
Horley				98.28			98.28
Hull Freetown		84.19	94.61	92.48	95.97	97.06	92.86
Ladybower				98.10	98.41	42.30	79.60
Leamington Spa		88.50	88.32	95.43	99.64		92.97
Leamington Spa Rugby Road		0.00	95.24	98.01			64.42
Leeds Centre	97.06	94.57	78.85	97.01	91.12	96.88	92.58
Leeds Headingley Kerbside		96.74	68.70	98.91			88.12
Leicester Centre		92.96	91.17	93.30	97.27		93.68
Leominster				95.24	98.41		96.83
Lincoln Canwick Road				98.60			98.60
Liverpool Queen's Drive Roadside				59.65			59.65
Liverpool Speke		97.55	97.64	97.46	96.60	93.39	96.53
Lullington Heath				83.65	96.65	93.48	91.26
Manchester Piccadilly			89.86	77.31	97.10	97.01	90.32
Manchester South				67.07	97.74		82.40
Market Harborough				95.65	95.79		95.72
Middlesbrough		97.74	3.62	97.64	98.46	98.28	79.15
Newcastle Centre		94.07	93.89	93.30	97.46		94.68
Newcastle Cradlewell Roadside				95.38			95.38

Name	CO	PM_{10}	PM_{25}	NO_2	O_3	SO_2	Average
Northampton Kingsthorpe			97.83	98.10	97.15		97.63
Norwich Lakenfields		81.25	90.81	89.90	93.66		88.90
Nottingham Centre		97.69	97.55	89.99	89.67	86.19	92.22
Oxford Centre Roadside				99.14			99.14
Oxford St Ebbes		89.72	90.08	98.01			92.60
Plymouth Centre		83.47	80.80	97.51	97.60		89.84
Portsmouth		90.17	81.70	99.55	45.15		79.14
Preston			47.24	80.21	92.71		73.38
Reading New Town		72.10	76.90	98.23	98.51		86.44
Rochester Stoke		99.23	86.68	84.78	97.42	72.96	88.22
Salford Eccles		94.57	94.52	98.14	96.24		95.87
Saltash Callington Road		92.93	90.94				91.94
Sandy Roadside		62.27	87.27	99.50			83.02
Scunthorpe Town		47.24		98.55		98.96	81.58
Sheffield Centre		53.54	89.86	96.18	95.97		83.89
Sheffield Tinsley				64.40			64.40
Sibton					99.32		99.32
Southampton Centre		93.98	94.02	96.60	96.47	93.07	94.83
Southend-on-Sea			98.78	98.51	98.51		98.60
St Osyth				96.56	98.28		97.42
Stanford-le-Hope Roadside		35.05	66.80	89.95			63.93
Stockton-on-Tees Eaglescliffe		92.21	90.90	94.16			92.42
Stoke-on-Trent Centre		98.55	98.55	78.35	99.18		93.66
Storrington Roadside		49.46	76.59	99.14			75.06
Sunderland Silksworth			77.22	89.99	83.74		83.65
Thurrock		96.83		97.69	98.28	92.48	96.32
Walsall Woodlands				98.82	99.82		99.32
Warrington		99.55	92.16	99.28			97.00
Weybourne					99.05		99.05
Wicken Fen				98.23	98.28	0.00	65.50
Wigan Centre			95.15	98.55	98.87		97.52
Wirral Tranmere			87.45	90.13	96.69		91.43
Yarner Wood				87.73	98.60		93.16
York Bootham		95.06	95.24				95.15
York Fishergate		94.88	80.80	99.09			91.59
Number of Sites	**1**	**40**	**50**	**75**	**53**	**16**	**82**
Number of sites < 85 %	0	14	17	10	3	4	22
Number of sites < 90%	0	17	26	16	5	5	28
Network mean	**97.06**	**80.77**	**81.73**	**92.80**	**95.26**	**83.40**	**89.07**

4.2.2.Site Specific Issues

Birmingham Tyburn Roadside

The PM_{10} FDMS had a motor/seal fault resulting in the loss of data from 2 to 31 July; following the repair, the data were unstable up to 8 August and these data have been deleted. The $PM_{2.5}$ FDMS also had a motor failure on 8 August and was removed for workshop repair. Data has been lost from 1 July to 13 August. Both instruments were unstable for short periods later in the quarter resulting in further data loss.

Blackburn Darwen Roadside

A logger fault following the summer service resulted in no data being recorded up to 25 July, when the internal logger was configured and connected to the modem.

Blackpool Marton

The poor quality $PM_{2.5}$ data continued this quarter, following concerns in previous periods. The volatile concentrations are persistently negative, despite considerable ESU efforts to correct it. All $PM_{2.5}$ data have been deleted from 1 January to 30 September.

Coventry Memorial Park

The $PM_{2.5}$ data was of poor quality during the quarter, following problems with seals and the cooler.

Eastbourne

The volatile $PM_{2.5}$ concentrations were observed to be noisy and low in comparison with other sites; data have been deleted from 13 July to 30 August.

Great Dun Fell

An intermittent lamp fault was responsible for the loss of data between 19 July and 12 August.

Harwell

The sample inlet system was replaced by the ESU following failure of the manifold fan on 15 May. However, the NOx sample tube (and possibly the others) was not pushed fully through the conduit, and this resulted in partial sampling of internal cabin air. The sample inlet was replaced by the QA/QC unit on 30 October, where a step change in concentrations was observed. The NOx data have been deleted between these dates, and the SO_2 and ozone will be reviewed in the fourth quarter.

It was noted that both FDMS analysers over-read compared to the collocated Partisol data. Zero checks carried out on the FDMS analysers showed the baselines were above the acceptable limits, and new dryers were requested. The $PM_{2.5}$ data has been deleted up to the dryer change on 11 September, but the PM_{10} analyser remained noisy following the dryer change, and data have been deleted from 1 July to the ESU callout on 23 September.

Ladybower

The SO_2 analyser had a photomultiplier fault resulting in the deletion of data from 25 July to 13 September.

Leamington Spa Rugby Road

The PM_{10} data was noted as unacceptably noisy from 20 April to the end of this quarter.

Leeds Headingley Roadside

The $PM_{2.5}$ FDMS showed an unacceptably high zero during the zero check carried out 16-19 July. Data have been deleted from 2 to 31 July.

Liverpool Queens Drive Roadside

A fault with the air conditioning resulted in the analyser being switched off from 13 July to 5 August. Following this, the data looked anomalously high and have been deleted up to 14 August.

Manchester South

The NOx analyser was found to have a photomultiplier fault at the service on 28 August. This was finally resolved by workshop repair; data collection restarted on 26 September

Middlesbrough

The $PM_{2.5}$ analyser suffered from serious problems resulting in lengthy workshop repairs; all data from 4 July to 30 September have been deleted, and problems continue into the next quarter.

Norwich Lakenfields

Some PM_{10} data have been deleted due to zero checks and a pump fault found at the service on 31 July.

Plymouth

Following the FDMS zero checks on 3 July, the LSO did not reinstall the sharp cut cyclone on the $PM_{2.5}$ FDMS analyser. This was replaced at the scheduled service on 18 July. The PM_{10} FDMS was identified as a regional outlier and data from 6 to 18 July have been deleted.

Portsmouth

The ozone sample line was found to be loose at the back of the analyser at the summer QA/QC audit. On inspection of the data, the concentrations appear unexpectedly low and the data have been deleted from 25 April to 6 August.

The $PM_{2.5}$ FDMS had a number of ESU callouts for pump faults and leaks. Data have been deleted from 6 to 18 September.

Preston

Both the $PM_{2.5}$ FDMS and the NOx analysers suffered serious faults which required workshop repair. NOx data was lost from 22 August to 4 September, and $PM_{2.5}$ data from 4 to 8 July, and from 11 July to 22 August.

Reading New Town

Problems with the air conditioning at the site resulted in poor quality $PM_{2.5}$ And PM_{10} data throughout the quarter.

Rochester Stoke

The NOx analyser was found to be internally sampling from the service resulting in data loss from 9-17 July. A broken pump resulted in some lost $PM_{2.5}$ data during August. An unspecified fault with the SO_2 analyser resulted in data from 27 July to 6 August being deleted.

Sandy Roadside

The problem with unstable measurements of $PM_{2.5}$ and PM_{10} continued this quarter, with substantial data loss due to temperature and dryer faults despite numerous callouts and attention to the air conditioning.

Scunthorpe

The PM_{10} volatile concentrations were seen to be anomalously high (and rising) throughout the quarter, leading ultimately to dryer replacement on 17 October. Data from 20 August to the dryer replacement have been deleted.

Sheffield Centre

The performance of the PM_{10} FDMS was becoming increasingly poor during the quarter, and data from 8 August up to the site closure on 2 September have been deleted.

Sheffield Tinsley

The NOx analyser suffered from a flow sensor, photomultiplier and autozero faults, which resulted in some poor quality data which have been deleted.

Stanford-le-Hope Roadside

The sample manifold fan was switched off from 3 to 10 September; NOx data have been deleted.

A leak was found in the $PM_{2.5}$ FDMS on 25 July; data from 8 to 25 July have been deleted.

The PM_{10} dryer was found to require replacement on 22 August. Data have been deleted from 29 June to 29 August. Data improved noticeably following replacement of the dryer.

Storrington Roadside

Substantial losses of $PM_{2.5}$ and PM_{10} data occurred during the quarter resulting from air conditioning faults.

Sunderland Silkworth

The NOx sample pump failed on 23 July. Further problems with the pump and delays in organising repairs caused further data loss in September. The service on the $PM_{2.5}$ FDMS introduced some instability; data from 17 July to 6 August have been deleted. Ozone data from 17 September have been lost due to various failed components.

Wicken Fen

Ongoing problems with noisy SO_2 data continued throughout this quarter and beyond. All SO_2 data have been deleted for this quarter.

4.3 Scotland

4.3.1Data Capture

The data capture for sites in Scotland for the period July-September 2013 is given in Table 4.3.

Table 4.3 Data Capture for Scotland, July-September 2013

Name	CO	PM_{10}	PM_{25}	NO_2	O_3	SO_2	Average
Aberdeen		57.47	39.76	0.00	53.53		37.69
Aberdeen Union Street Roadside				99.05			99.05
Auchencorth Moss		67.39	98.91		99.77		98.49
Auchencorth Moss (FDMS)		0.00	0.00				0.00
Bush Estate				98.87	98.91		98.89

Name	CO	PM_{10}	PM_{25}	NO_2	O_3	SO_2	Average
Dumbarton Roadside				98.60			98.60
Dumfries				98.41			98.41
Edinburgh St Leonards	58.11	94.88	95.97	99.46	99.64	97.96	91.00
Eskdalemuir				98.55	98.73		98.64
Fort William				95.34	99.00		97.17
Glasgow Kerbside		71.38	80.03	93.70			81.70
Grangemouth		87.45	35.24	97.96		98.46	79.78
Grangemouth Moray				99.46			99.46
Inverness		93.48	98.91	98.91			98.70
Lerwick					64.27		64.27
Peebles				64.67	64.67		64.67
Strath Vaich					99.91		99.91
Number of Sites	**1**	**7**	**7**	**13**	**9**	**2**	**17**
Number of Sites<85%	**1**	**4**	**4**	**2**	**3**	**0**	**6**
Number of Sites<90%	**1**	**5**	**4**	**2**	**3**	**0**	**6**
Mean	**58.11**	**67.44**	**64.12**	**87.92**	**86.49**	**98.21**	**82.73**

4.3,2 Site Specific Issues

Aberdeen

The NOx analyser was reported with autozero faults in July, and this persisted throughout the quarter. All data for Q3 have been deleted. The ozone analyser was suspected to be internal sampling, as the sample line was found to be loose at the summer QA/QC audit. The data have been deleted from 9 July to 20 August. Both FDMS analysers were affected by fluctuating dew points during July and August, resulting in significant data loss. In addition, the sharp cut cyclone was not replaced following zero checks; $PM_{2.5}$ data from 12 to 20 August have been lost.

Auchencorth Moss

The sites had ongoing air conditioning faults during the quarter. In addition, the PM_{10} analyser had a chiller fault in July, and a replacement part could not be sourced due to the age of the instrument. All data from both FDMS instruments have been deleted for this quarter.

Glasgow Kerbside

The concentrations of volatiles of both $PM_{2.5}$ and PM_{10} have been observed to peak every evening between 21:00 and 24:00, possibly due to an air conditioning issue. The data for this period each day have been deleted.

Grangemouth

The $PM_{2.5}$ data were identified as a regional outlier (volatile concentration too high) from 15 July to 5 September; the data have been deleted.

Lerwick

The site ceased operation on 29 August pending redevelopment of the Lewick observatory.

Peebles

There was a fault with the sampling inlet-see Section 3.2.

4.4 Wales

4.4.1Data Capture

The data capture for sites in Wales for July-September 2013 is given in Table 4.4.

Table 4.4 Data Capture for Wales, July-September 2013

Name	CO	PM_{10}	PM_{25}	NO_2	O_3	SO_2	Average
Aston Hill				98.64	95.20		96.92
Cardiff Centre	97.60	81.02	78.58	97.55	97.55	96.33	91.44
Chepstow A48		95.52	89.36	98.69			94.52
Cwmbran				98.87	99.23		99.05
Mold				100.00	93.07		96.54
Narberth		93.84		97.87	98.64	98.37	97.18
Newport		67.26	60.96	66.12			64.78
Port Talbot Margam		93.48					93.48
Port Talbot Margam	98.46	82.43	20.38	98.55	98.46	98.46	82.79
Swansea Roadside		94.61	94.61	98.73			95.98
Wrexham		88.04	96.74	98.10		100.00	98.78
Number of Sites	**2**	**8**	**6**	**10**	**6**	**4**	**11**
Number of Sites<85%	**0**	**3**	**3**	**1**	**0**	**0**	**2**
Number of Sites<90%	**0**	**4**	**4**	**1**	**0**	**0**	**2**
Mean	**98.03**	**87.02**	**73.44**	**95.31**	**97.03**	**98.29**	**91.95**

Shaded boxes are for data capture < 90%

4.4.2 Site Specific Issues

Newport

The logger used for recording NOx and PM_{10} concentrations locked up on 14th August. No data from these instruments was recorded until 11 September, when the NOx analyser was reconfigured to store these data.

In addition, the $PM_{2.5}$ FDMS sharp cut cyclone was not replaced following the zero check on 12 July. This was replaced on 29 July, and data between these dates have been deleted. Further data loss from this instrument occurred between 11 and 25 September due to failed v-seals.

Port Talbot Margam

The volatile $PM_{2.5}$ concentration was observed to be significantly higher than the PM_{10} volatile concentration for much of the quarter. PM_{10} data have been deleted during ratification from 29 June to 15 July, and $PM_{2.5}$ from 11 July to 29 September.

4.5 Northern Ireland (including Mace Head)

4.5.1 Data Capture

The data capture for sites in Northern Ireland (including Mace Head in the Republic of Ireland) for the period July-September 2013 is given in Table 4.5.

Table 4.5 Data Capture for Ireland, July-September 2013

Name	CO	PM_{10}	PM_{25}	NO_2	O_3	SO_2	Average
Armagh Roadside		33.70		99.68			66.69
Ballymena Ballykeel						94.29	94.29
Belfast Centre	90.58	39.67	39.58	97.24	96.97	97.51	76.92
Derry		89.72	95.24	92.07	99.86	94.79	94.34
Lough Navar		49.14			94.70		71.92
Mace Head					98.69		98.69
Number of Sites	**1**	**4**	**2**	**3**	**4**	**3**	**6**
Number of sites < 85 %	**0**	**3**	**1**	**0**	**0**	**0**	**3**
Number of sites < 90%	**0**	**4**	**1**	**0**	**0**	**0**	**3**
Network mean	**90.58**	**53.06**	**67.41**	**96.33**	**97.18**	**95.53**	**80.83**

4.5.2Site Specific Issues

Armagh Roadside

The volatile PM_{10} concentrations became increasingly low then negative during the quarter, and were not in line with other regional sites; data from 1 August to 30 September have been deleted. The ESU replaced the v seals on 7 October.

Belfast Centre

The $PM_{2.5}$ and PM_{10} volatiles were identified as being above other regional sites from the previous quarter; data from 1-20 July have been deleted.

Lough Navar

The site suffered from temperature problems during the summer, which resulted in the loss of some data this quarter. The air conditioning unit was deemed to be inadequate, and was replaced on 2 September.

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 Overall Data Capture, July-September 2013

	CO	PM_{10}	PM_{25}	NO_2	O_3	SO_2	Site Total
Number of Sites	7	69	80	116	82	29	135
Number of sites < 85 %	1	24	27	13	6	5	38
Number of sites < 90%	1	33	37	19	8	6	45
Network mean	91.13	77.17	79.85	92.16	93.56	88.16	87.69

5 FDMS Baseline Checks

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

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

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

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

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

As the zero calibration and baseline correlation is so strong, QA/QC will be setting up a mechanism for calibration of PM analysers, to coincide with the routine 6 month service exercise. It is likely that this will require careful coordination of LSO CMCU and ESU effort to achieve this cost effectively, so it will not be rolled out until the summer 2014.

6 LSO Manual and AURN Hub

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

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Section B – Intercomparison Report, Summer 2013

7 Introduction

During July to September 2013, Ricardo-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. There is some ongoing restructuring of the network since the winter 12/13 intercalibration-see Section 2.

The intercalibration requires the coordination and close cooperation of QA/QC unit, Management Units, ESUs and LSOs in making sure the entire operation runs smoothly and is the result of many months of planning. Leading up to the intercalibration, a draft schedule of visits is prepared and circulated to MUs and ESUs for approval. ESU ozone photometers are calibrated at Ricardo-AEA and all QA/QC equipment and cylinders are tested, calibrated and verified before use.

QA/QC visits are always undertaken before any ESU visits, to allow the performance of the sites to be quantified for the six month period prior to the visit. During the QA/QC visit, the LSO usually attends to demonstrate their competence in performing routine calibrations. The audits are used to transport independent calibration standard gases and test apparatus to all of the sites, to quantify the performance of the entire measurement process at the monitoring stations. The results obtained from these tests are fed into the ratification process, where any correction of datasets can be applied to account for any performance anomalies.

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

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

8 Scope of Intercalibration Exercise

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

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

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

1. Analyser accuracy and precision. These are basic checks to ensure analysers respond to known concentrations of gases in a reliable manner.
2. Instrument linearity. This test refines the response checks on analysers, by assessing whether doubling a concentration of gas to the analyser results in a doubling of the analyser signal response. If an analyser's response characteristics are not linear, data cannot be reliably scaled into concentrations.
3. Instrument signal noise. This test checks that an analyser responds to calibration gases in a stable manner with time. A "noisy" analyser may not provide high quality data which may be difficult to process at lower concentrations.
4. Analyser response time. This test checks that the analyser responds quickly to a change in gas concentrations. If analyser response is too slow, data may not accurately reflect ambient concentrations.
5. Leak and flow checks. These tests ensure that ambient air reaches the analysers, without being compromised in any way. Leaks in the sampling system can affect the ability of the analyser to sample ambient air reliably.
6. NOx analyser converter efficiency. This test evaluates the ability of the analyser to measure NO_2. An inefficient converter severely compromises the data from the analyser.
7. FDMS k_0 evaluation. The analyser uses this factor to calculate mass concentrations, so the value is calculated to determine its accuracy compared to the stated value.
8. Particulate analyser flow rate checks. These tests ensure that the flow rates through critical parts of the analyser are within specified limits. There are specific analyser flow rates that are set to make sure particle size fractions and mass concentration calculations are performed correctly.
9. SO_2 analyser hydrocarbon interference. This test evaluates the analyser's ability to remove interfering hydrocarbon gases from the sample gas. A failed test could have significant implications for analyser data.
10. Evaluation of site cylinder concentrations. These tests use a set of Ricardo-AEA certified cylinders that are taken to all the sites. The concentrations of the site cylinders are used to scale pollution datasets, so it is important to ensure that the concentrations of gases in the cylinders do not change.

11. Competence of Local Site Operators (LSO) in undertaking calibrations. As it is the calibrations by the LSO's that are used to scale pollution datasets, it is important to check that these are undertaken competently.
12. For the first time, a coordinated zero "calibration" of all automatic PM analysers was undertaken during the summer 2013 intercalibration. This test allows the baseline performance of PM analysers to be evaluated, to determine whether any remedial action is required.

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

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

- The analyser responses to audit gas are converted into concentrations, using provisional calibration factors obtained from the Management Units on the day of the intercalibration. These factors are also used for the provisional data supplied to the web/interactive TV services.
- These individual results are tabulated, and statistical analyses undertaken (e.g. network average result, network standard deviation, deviation of individual sites from the network mean etc.).

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

- ±10% of the network average for NOx, CO and SO_2 analysers,
- ±5% of the reference standard photometer for Ozone analysers,
- ±2.5 % of the stated k_0 value for FDMS analysers,
- ±10% for particulate analyser flow rates,
- Particulate analyser average zero response within ±3.0 µg/m^3.
- ±10% for the recalculation of site cylinder concentrations.

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

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

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

very sensitive to small changes in applied flow rates of calibration gas. This is more difficult to identify and correct, and may have consequences for data quality.

- Leaks, sample switching valves, etc. Outliers can be generated if an analyser is not sampling ambient air properly. It is likely that if a leaking analyser is identified, data losses will result.

9 Results

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

9.1 National Network Overview

9.1.1 Summary

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

Table 9.1 - Summary of audited analyser performance – 135 UK stations

Parameter	Number of outliers	Number in network	% outliers in total
NOx analyser	36	117	31%
CO analyser	0	9	0%
SO_2 analyser	8	30	27%
Ozone analyser	14	82	17%
FDMS and BAM analysers	0 k_0, 4 flow, (33 zero)	58 FDMS PM_{10} 2 BAM PM_{10} 69 FDMS $PM_{2.5}$ 2 BAM $PM_{2.5}$	3%
Gravimetric PM analysers	0 flow	9 PM_{10} 9 $PM_{2.5}$	0%
Total	62	387	16.0%

Two of the 135 sites were not in operation at the time of the intercalibration. Replacement locations are currently being sought for the sites at Bury Roadside and Glasgow Centre.

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

The number of analyser outliers identified is worse than the previous exercise. At the Winter 2013 intercalibration 14.0% of the analysers in use were identified as outliers.

The procedures used to determine network performance are documented in Ricardo-AEA Work Instructions. These methods are regularly updated and improved and are evaluated by the United Kingdom Accreditation Service (UKAS). Ricardo-AEA holds ISO17025 accreditation for the on-site calibration of all the analyser types (NOx, CO, SO_2, O_3) and for the determination of the FDMS k_0 factor and particulate analyser flow rates used in the network. An ISO17025 certificate of calibration (Calibration Laboratory number 0401) for the analysers in the AURN is appended to this report.

9.1.2 Network Intercomparisons

The concentration of the audit cylinders was calculated averaged across all monitoring sites using the zero and scaling factors provided by the CMCU on the day of audit. How close the result is to the stated cylinder concentration is a good indication of the accuracy of the provisional results across the entire network. The results are given in Table 9.2. Certified cylinder concentrations are normalised for this purpose as several cylinders are used.

Table 9.2 Audit Cylinder Results

Parameter	Network Mean	Audit reference concentration	Network Accuracy %	%Std Dev
NO	463 ppb	459 ppb	1.6	4.0
NO_2	443 ppb	460 ppb	-3.6	4.8
CO	21.2 ppm	21.0 ppm	0.8	3.5
SO_2	456 ppb	456 ppb	-0.1	4.4

- Oxides of Nitrogen.

  A total of 36 outliers (31%) were identified during this intercalibration. This is significantly worse than the previous exercise - 22% of the analysers were identified as outliers in the summer exercise. Of these outliers, 21 can be attributed to analyser drift, 13 to changes in site cylinder concentration and 2 to issues experienced during the audit which compromised the results.

  There was a single converter which fell outside the ±5% acceptance limits. There were 4 further converters identified where the initial result was outside the ±2% trigger for NO_2 rescaling. Additional analysis showed that a total of three outlier converters required rescaling or data deletion to be undertaken.

- Carbon Monoxide

  There were no outliers identified at this intercalibration. No outliers were identified at the previous exercise.

- Sulphur Dioxide

  A total of 8 outliers (27%) were identified at this intercalibration. This is slightly worse than the winter exercise, when 6 analysers were found to be outside the acceptance limits. All m-xylene interference tests were less than 18ppb, compared to 16ppb in winter 2013.

- Ozone

  A total of 14 outliers (17%) were identified during the summer exercise. This is better the previous intercalibration, where 17 analysers were found to be outside the ±5%

acceptance criterion.

- Particulate Analysers

  There were no calculated k_0 determination outside the required ±2.5% of the stated values. A single outlier was identified at the previous exercise.

  One FDMS main flow was found to be outside the ±10% acceptance limits. Three BAM total flows were found to be outside this limit. This total is identical to the previous exercise; four analyser flow outliers were identified in the winter.

  All Partisol analyser total flows were within the acceptance limits.

- PM analyser zero tests

  For the first time, a coordinated programme to assess zero performance of automatic PM analysers was conducted at the summer intercalibration. Of the 131 PM analysers in the network, 33 (25%) gave average responses to particle-free air that were higher than ±3μg/m^3. These results will be fed into the ratification process to determine appropriate action.

- Site Cylinder Concentrations

  12 of the 273 site cylinders (4.3%) used to scale ambient pollution data were found to be outside the ±10% acceptance limit, a little worse than the 3.3% identified in the winter.

9.2 London Sites

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

Table 9.3 - Summary of audited analyser performance – London Sites

Parameter	Number of outliers	Number in region
NOx analyser	3	13
NOx converter	0	
CO analyser	0	3
SO_2 analyser	1	4
Ozone analyser	3	9
FDMS and BAM analysers	0 k_0, 0 flow (2 zero)	6 FDMS PM_{10} 10 FDMS $PM_{2.5}$
Gravimetric PM analysers	0	2 PM_{10} 3 $PM_{2.5}$
Cylinders	2	37

9.3 Scottish Sites

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

Table 9.4 - Summary of audited analyser performance – Scottish Sites

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

9.4 Welsh Sites

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

Table 9.5 - Summary of audited analyser performance – Welsh Sites

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

9.5 Northern Ireland Sites (incl. Mace Head)

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

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

Parameter	Number of outliers	Number in region
NOx analyser	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, 0 flow (3 zero)	4 FDMS PM_{10} 1 FDMS $PM_{2.5}$
Gravimetric PM analysers	0	0 PM_{10} 0 $PM_{2.5}$
Cylinders	0	9

9.6 English Sites

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

Table 9.7 - Summary of audited analyser performance – English Sites

Parameter	Number of outliers	Number in region
NOx analyser	24	76
NOx converter	3	
CO analyser	0	1
SO_2 analyser	3	16
Ozone analyser	9	53
FDMS and BAM analysers	0 k_0, 3 flow (23 zero)	37 FDMS PM_{10} 1 BAM PM_{10} 46 FDMS $PM_{2.5}$ 1 BAM $PM_{2.5}$
Gravimetric PM analysers	0	1 PM_{10} 4 $PM_{2.5}$
Cylinders	7	191

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

10 Site Cylinder Concentrations

During the intercalibration, the concentrations of the on-site cylinders were evaluated using the audit cylinder standards. The calculated results showed that 12 of the 273 cylinders (4.3%) used to scale analyser data into concentrations (NO, CO and SO_2) were outside the ±10% acceptance criterion. This is worse than the winter exercise, where 3.3% (9) of the scaling cylinders were outside the acceptance limits. There were 12 NO cylinders identified as outliers.

In addition, the concentrations of 25 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 37 of the 273 cylinders (13.5%) were outside the acceptance limits. This is better than the previous intercalibration, when 16.2% of cylinders were found to be outside the 10% acceptance.

One of the 12 NO cylinders, three appear to have been contaminated (Dumbarton Roadside, London Bexley and Wirral Tranmere); significant oxidation of the NO into NO_2 has occurred since the last intercalibration. The cylinders have been replaced and the performance of the new cylinders will be closely monitored at subsequent audits.

Six cylinders showed significant drift and have been replaced.

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

11 Site Information

All site information is now uploaded to CMCU and UK-Air archive for dissemination using Google Earth. Ricardo-AEA makes considerable effort in ensuring that site locations are accurate on the new Google Earth site information and UK-Air archive pages. All future additions to the AURN will include accurate positioning using Google Earth.

12 CEN

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

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

To comply with the Directive, the uncertainty for gaseous analyser measurements must be less than ±15%. For sites that have CEN-compliant gaseous instrumentation, it is possible to calculate the overall uncertainty of measuring air quality. This information is site and analyser specific and presented in the table below:

Table 12.1 – Analyser measurement uncertainties

Date	Site	O_3	CO	SO_2	NO_2 ann	NO_2 hour	PM_{10}	$PM_{2.5}$
08-Jul	Barnsley Gawber	10.7		13.4	10	10		
04-Jul	Bath Roadside				13.5	14		
16-Jul	Billingham				13.5	14		
09-Jul	Birmingham Acocks Green	12.4			13.5	14		16.4
08-Jul	Birmingham Tyburn	8.7		12.3	11.8	11.8	9.57	16.4
08-Jul	Birmingham Tyburn Roadside	12.4			13.5	14	No test	16.4
03-Jul	Blackburn Darwen Roadside				10.5	10.5		
03-Jul	Blackpool Marton	10.7			10	10		16.4
24-Jun	Bottesford	10.7						

Date	Site	O_3	CO	SO_2	NO_2 ann	NO_2 hour	PM_{10}	$PM_{2.5}$
07-Aug	Bournemouth	12.4			13.5	14		11
16-Jul	Brighton Preston Park	12.4			13.5	14		11
01-Jul	Bristol St Paul's	12.4			13.5	14	8.7	16.4
24-Jul	Cambridge Roadside				10.5	10.5		
07-Aug	Camden Kerbside				10.5	10.5	8.7	16.4
31-Jul	Canterbury	12.4			13.5	14		
02-Jul	Carlisle Roadside				10.5	10.5	8.7	16.4
03-Jul	Charlton Mackrell	11.8			13.5	14		
27-Jun	Chatham Centre Roadside				13.5	14	8.7	16.4
09-Jul	Chesterfield				10.5	10.5	8.7	16.4
09-Jul	Chesterfield Roadside				10.5	10.5	8.7	16.4
30-Jul	Coventry Memorial Park	10.7			10	10		16.4
16-Jul	Eastbourne				13.5	14	8.7	16.4
02-Jul	Exeter Roadside	8.7			11.8	11.8		
16-Aug	Glazebury	12.4			13.5	14		
02-Jul	Great Dun Fell	12.4						
06-Aug	Haringey Roadside				10.5	10.5	9.84	16.4
12-Aug	Harwell	12.4		13.4	13.5	14	8.7	16.4
12-Aug	Harwell PARTISOL						8	11
17-Jul	High Muffles	12.4			13.5	14		
02-Jul	Honiton				13.5	14		
15-Jul	Horley				10.5	10.5		
17-Jul	Hull Freetown	10.7		13.4	10	10	8.7	18.56
10-Jul	Ladybower	12.4		13.4	13.5	14		
02-Jul	Leamington Spa	11.8		No test	10.5	10.5	9.31	16.4
01-Jul	Leamington Spa Rugby Road				13.5	14	8.7	16.4
16-Jul	Leeds Centre	10.7	9.5	13.4	10	10	8.7	16.4
16-Jul	Leeds Headingley Kerbside				13.5	14	8.7	16.4
31-Jul	Leicester Centre	10.7			10	10	8.7	16.4
25-Jul	Leominster	12.4			13.5	14		
28-Jun	Lincoln Canwick Road				13.5	14		
20-Jun	Liverpool Queen's Drive Roadside				13.5	14		
20-Jun	Liverpool Speke	10.7		13.4	10	10	10.02	16.4
30-Jul	London Bexley			13.4	13.5	14		16.4

Date	Site	O_3	CO	SO_2	NO_2 ann	NO_2 hour	PM_{10}	$PM_{2.5}$
31-Jul	London Bloomsbury	12.4		13.4	13.5	14	8.7	16.4
18-Jul	London Eltham	11.8			10.5	10.5	8.7	16.4
05-Aug	London Haringey Priory Park South	11.8			13.5	14		
25-Jul	London Harlington	12.4			13.5	14	8.7	16.4
07-Aug	London Harrow Stanmore							16.4
25-Jul	London Hillingdon	10.7			10	10		
15-Jul	London Marylebone Road	12.4	9.5	13.4	13.5	14	8.7	16.4
15-Jul	London Marylebone Road PARTISOL						8	11
16-Jul	London N. Kensington	12.4	9.5	13.4	13.5	14	8.7	16.4
22-Jan	London N. Kensington PARTISOL						8	11
08-Aug	London Teddington	12.4			13.5	14		
08-Aug	London Teddington Bushy Park							11
24-Jul	London Westminster	Not compliant			13.5	14		11
04-Jul	Lullington Heath	12.4		13.4	13.5	14		
15-Aug	Manchester Piccadilly	10.7		13.4	10	10		16.4
15-Aug	Manchester South	12.4			13.5	14		
09-Aug	Market Harborough	10.7			10	10		
16-Jul	Middlesbrough	12.4		13.4	13.5	14	8.7	No test
15-Jul	Newcastle Centre	10.7			10	10	8.7	16.4
15-Jul	Newcastle Cradlewell Roadside				10.5	10.5		
01-Aug	Northampton Kingsthorpe	8.7			11.8	11.8		11
23-Jul	Norwich Lakenfields	10.7			10	10	8.7	16.4
24-Jun	Nottingham Centre	10.7		13.4	10	10	8.7	16.4
14-Aug	Oxford Centre Roadside				10.5	10.5		
14-Aug	Oxford St Ebbes				10.5	10.5	8.7	16.4
03-Jul	Plymouth Centre	10.7			10	10	8.7	16.4
06-Aug	Portsmouth	10.7			11.8	11.8	8.7	16.4
03-Jul	Preston	10.7			10	10		16.4
13-Aug	Reading New Town	10.7			10	10	10.92	16.4
25-Jun	Rochester Stoke	Not compliant		13.4	13.5	14	8.7	16.4

Date	Site	O_3	CO	SO_2	NO_2 ann	NO_2 hour	PM_{10}	$PM_{2.5}$
14-Aug	Salford Eccles	11.8			10.5	10.5	8.7	16.4
03-Jul	Saltash Callington Road						8.7	16.4
25-Jul	Sandy Roadside				13.5	14	15.36	16.4
17-Jul	Scunthorpe Town			11	10.5	10.5	8.8	
08-Jul	Sheffield Centre	10.7			10.43	10.43	8.7	16.4
09-Jul	Sheffield Tinsley				13.5	14		
22-Jul	Sibton	12.4						
05-Aug	Southampton Centre	10.7		13.4	10	10	9.78	16.4
27-Jun	Southend-on-Sea	10.7			10	10		16.4
22-Jul	Southwark A2 Old Kent Road				13.5	14	8.7	
03-Jul	St Osyth	10.7			10	10		
04-Jul	Stanford-le-Hope Roadside				13.5	14	8.7	16.4
16-Jul	Stockton-on-Tees Eaglescliffe				13.5	14	17.68	12.6
21-Jun	Stoke-on-Trent Centre	10.7			10	10	8.75	16.4
17-Jul	Storrington Roadside				10	10	8.7	16.4
17-Jul	Sunderland Silksworth	12.4			10.5	10.5		16.4
27-Jun	Thurrock	12.4			13.5	14	8.7	
01-Aug	Tower Hamlets Roadside				10.5	10.5		
10-Jul	Walsall Woodlands	12.4			13.5	14		
19-Jun	Warrington				10.5	10.5	8.7	16.4
23-Jul	Weybourne	10.7						
23-Jul	Wicken Fen	12.4		13.4	13.5	14		
14-Aug	Wigan Centre	10.7			10	10		16.4
18-Jun	Wirral Tranmere	10.7			10	10		16.4
02-Jul	Yarner Wood	12.4			13.5	14		
18-Jul	York Bootham						13.62	16.4
18-Jul	York Fishergate				10.5	10.5	8.7	16.4
13-Aug	Mace Head	Not approved						
20-Aug	Armagh Roadside				10.5	10.5	8.7	
15-Aug	Ballymena Ballykeel			11				
20-Aug	Belfast Centre	No test	9.5	13.5	10	10	8.7	16.4
16-Aug	Derry	12.4		13.4	13.54	14.02	8.7	16.4
12-Aug	Lough Navar	12.4					11.07	

Date	Site	O_3	CO	SO_2	NO_2 ann	NO_2 hour	PM_{10}	$PM_{2.5}$
05-Aug	Aberdeen	12.4			13.5	14	8.7	16.4
06-Aug	Aberdeen Union Street Roadside				13.5	14		
24-Jul	Auchencorth Moss	12.4					No test	No test
24-Jul	Auchencorth Moss PM_{10} PM_{25} (FDMS)						8.7	16.4
24-Jul	Bush Estate	12.4			13.5	14		
22-Jul	Dumbarton Roadside				10.5	10.5		
01-Jul	Dumfries				13.5	14		
23-Jul	Edinburgh St Leonards	12.4	9.5	13.4	13.5	14	8.7	16.4
01-Jul	Eskdalemuir	12.4			13.6	14		
24-Jul	Fort William	12.4			13.5	14		
22-Jul	Glasgow Kerbside				10	10	8.7	16.4
22-Jul	Grangemouth			11	10.5	10.5	8.7	16.4
22-Jul	Grangemouth Moray				11.0	11.1		
08-Aug	Inverness				13.5	14	8	11
07-Aug	Lerwick	12.4						
23-Jul	Peebles	12.4			13.5	14		
08-Aug	Strath Vaich	12.4						
01-Jul	Aston Hill	12.4			13.5	14		
12-Jul	Cardiff Centre	12.4	9.5	13.4	13.5	14	8.7	No test
11-Jul	Chepstow A48				10.5	10.5	8.7	16.4
12-Jul	Cwmbran	10.7			11.8	11.8		
17-Jun	Mold	12.4			13.5	14		
09-Jul	Narberth	12.4		13.8	13.5	14	8.7	
10-Jul	Newport				10.5	10.5	8.7	16.4
11-Jul	Port Talbot Margam	10.7	9.5	13.4	13.5	14	No test	No test
11-Jul	Port Talbot Margam PM_{10} $PM_{2.5}$ PM_{10} Partisol)						No test	
11-Jul	Swansea Roadside				13.5	14	19.1	**34.3**
18-Jun	Wrexham			13.4	13.5	14	11.7	11

This table is updated and extended after every intercalibration to include upgraded sites and replacement analysers.

The poor measurement uncertainty reported for the PM analysers at Swansea arose as a result of the very low measured flow rates at the audit. The significance of this will be examined fully during ratification.

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

13 Certification

The Network Certificate of Calibration is presented in Appendix 3. This certificate presents the results of the individual analyser scaling factors on the day of the audit, as calculated by Ricardo-AEA using the audit cylinder standards, in accordance with our ISO17025 accreditation.

14 Summary

The intercalibration exercise demonstrates its ongoing value as an effective tool in determining overall site performance and assessing the reliability and traceability of air quality measurements from a large scale network. The results from this intercalibration have been used to assess data quality during the ratification of the network datasets for the period April to September 2013.

Appendices

Appendix 1: Partisol Data – July-September 2013
Appendix 2: Information for New Sites
Appendix 3: Certificate of Calibration

Appendix 1

Partisol Data: July-September 2013

Table A2: Principal Reasons for Data Loss (below 90%), Partisols

Site	PM_{10}	PM_{25}	Reason
Auchencorth Moss	67%		Failed seal
Harwell		66%	Leak
Wrexham	89%		Flow sensor fault

Appendix 2

Site Details

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

Appendix 3

Certificate of Calibration

CERTIFICATE OF CALIBRATION

Ricardo-AEA, Gemini, Fermi Avenue Harwell, Didcot, Oxfordshire OX11 0QJ

Telephone 01235 753212

Authorised Signatories: S Eaton

B Stacey

Signed:

Date of Issue: 21 May 2014

Customer Name and Address: Daniel Waterman

Atmosphere and Noise
Resource, Atmosphere and Sustainability
Department for Environment, Food and Rural Affairs
Area 2C Nobel House, 17 Smith Square, London, SW1P 3JR

Date of Calibration: July to September 2013

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

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

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

1. Carbon Monoxide

Date Year = 2013	Site	Analyser number	[1]Zero output	Uncertainty (ppm)	[2]Calibration Factor	Uncertainty (%)	*Maximum Residual (%)
English sites							
16-Jul	Leeds Centre	458	-0.4	0.2	0.990	2.2	3.4
London Sites							
15-Jul	London Marylebone Road	651	0.1	0.2	1.032	2.2	2.7
16-Jul	London N. Kensington	2313	0.1	0.2	1.027	2.1	1.0
Northern Irish Sites							
20-Aug	Belfast Centre	462	0	0.2	0.990	3.1	5.6
Scottish Sites							
23-Jul	Edinburgh St Leonards	159	0.7	0.2	0.933	2.1	0.9
Welsh Sites							
12-Jul	Cardiff Centre	12599	0.7	0.2	0.959	2.1	1.0
11-Jul	Port Talbot Margam	605214618	0.1	0.2	1.039	2.1	1.8

2. Sulphur Dioxide

Date Year =2013	Site	Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	*Max Residual (%)	*m-xylene interference (ppb)
English sites								
08-Jul	Barnsley Gawber	08050082	4.4	2.5	1.055	3.2	3	2.1
08-Jul	Birmingham Tyburn	EH937000	1.8	2.5	0.983	3.1	3.9	9.5
12-Aug	Harwell	83	-3.9	2.5	1.048	3.0	1.8	22.7
17-Jul	Hull Freetown	342	2	2.6	1.116	3.1	0.8	
10-Jul	Ladybower	1178	0	2.5	1.031	3.3	2.2	1.0
16-Jul	Leeds Centre	CM050084	3	2.5	0.963	3.1	1.3	4.6
20-Jun	Liverpool Speke	17509	1.9	2.5	1.035	3.2	1.9	5.7
04-Jul	Lullington Heath	12181	-1	2.5	0.981	3.2	1.9	7.5
15-Aug	Manchester Piccadilly	19216	1	2.5	0.950	3.5	5.1	15.7
16-Jul	Middlesbrough	1660	0.6	2.5	0.975	3.3	6.0	15.5
24-Jun	Nottingham Centre	1629	-1.2	2.5	1.022	3.1	2.1	14.0
25-Jun	Rochester Stoke	19446	0	2.5	0.832	3.6	2.0	20.0
17-Jul	Scunthorpe Town	110870	42	2.5	0.694	3.7	3.8	12.5
05-Aug	Southampton Centre	14895	10.2	2.6	1.063	3.1	1.4	14.1
23-Jul	Wicken Fen	14349	3.9	2.5	1.024	3.3	1.4	8.3
London Sites								
30-Jul	London Bexley	318	0.1	2.6	1.158	3.4	2.9	0.0
31-Jul	London Bloomsbury	74	-0.8	2.52	0.995	3.3	2.3	7.6
15-Jul	London Marylebone Road	2644	0.9	2.57	1.131	3.1	1.7	3.1
16-Jul	London N.	2576	7.7	2.51	0.980	3.2	3.6	7.8

Date Year =2013	Site	Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	[*]Max Residual (%)	[*]m-xylene interference (ppb)
	Kensington							
Northern Irish Sites								
15-Aug	Ballymena Ballykeel	4901234	0	2.4	0.710	3.8	2.4	17.8
20-Aug	Belfast Centre	1766	6.9	2.5	1.035	5.3	4.2	4.5
16-Aug	Derry	1697	0.7	2.54	1.055	4.1	2.9	15.4
Scottish Sites								
23-Jul	Edinburgh St Leonards	84	-5.1	2.51	0.972	3.3	1.9	12.2
22-Jul	Grangemouth	1211322	0	2.5	0.951	2.9	1.1	21.9
Welsh Site								
12-Jul	Cardiff Centre	14319	6.6	2.52	1.006	3.0	0.3	11.1
09-Jul	Narberth	14896	1.5	2.48	0.895	5.9	5.6	18.4
11-Jul	Port Talbot Margam	1	0.9	2.53	1.023	3.0	1.9	2.3
18-Jun	Wrexham	1181	3.9	2.5	0.860	3.8	2.8	2.6

3. Ozone

Date Year =2013	Site	Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	[*]Max Residual (%)
English sites							
08-Jul	Barnsley Gawber	cm08060030	0.3	3	0.958	3.1	2.4
09-Jul	Birmingham Acocks Green	19224	-3.2	3	1.028	3.3	1.3
08-Jul	Birmingham Tyburn	WB6AG7TF	1.2	3	0.949	3.1	1.2
08-Jul	Birmingham Tyburn Roadside	19188	0.6	3	1.060	3.3	0.9
03-Jul	Blackpool Marton	cm08060037	0.1	3	0.974	3.1	0.7
24-Jun	Bottesford	CM08060022	0.1	3	0.945	3.2	1.0
07-Aug	Bournemouth	17503	-1.2	3	1.004	3.1	0.0
16-Jul	Brighton Preston Park	12461	-1.8	3	0.959	3.1	1.7
01-Jul	Bristol St Paul's	14358	0.2	3	1.016	3.3	0.2
03-Jul	Charlton Mackrell	1111957	-1	3	1.005	3.4	1.2
30-Jul	Coventry Memorial Park	CM08060044	-0.2	3	1.023	3.1	0.9
02-Jul	Exeter Roadside	F0100E0S	-0.7	3	1.013	3.3	1.2
16-Aug	Glazebury	19751	0.5	3	1.013	3.2	1.9
12-Aug	Harwell	1648	-1.1	3	1.034	3.1	0.5
17-Jul	High Muffles	1641	0.1	3	1.029	3.1	0.9
17-Jul	Hull Freetown	08060045	0	3	0.993	3.1	0.3
10-Jul	Ladybower	1651	0	3	0.993	3.1	2.5
02-Jul	Leamington Spa	411370	4.5	3	0.954	3.3	0.7
16-Jul	Leeds Centre	M)8060036	0.4	3	1.097	3.1	1.4
31-Jul	Leicester Centre	CM08060020	-2.2	3	1.058	3.2	1.3
25-Jul	Leominster	14470	0.3	3	1.009	3.6	0.5

Date Year =2013	Site	Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	*Max Residual (%)
20-Jun	Liverpool Speke	CM08060041	0.7	3	1.033	3.3	0.5
04-Jul	Lullington Heath	17494	-0.5	3	1.012	3.1	0.7
15-Aug	Manchester Piccadilly		-0.5	3	1.083	3.1	2.0
15-Aug	Manchester South	16954	-0.9	3	1.057	3.1	0.8
09-Aug	Market Harborough	CM08060031	-3.9	3	1.061	3.2	2.3
16-Jul	Middlesbrough	944	-0.6	3	1.043	3.1	1.9
15-Jul	Newcastle Centre	cm08060033	-0.9	3	0.955	3.2	1.3
01-Aug	Northampton Kingsthorpe	47R76STR	1.6	3	1.055	3.1	0.9
23-Jul	Norwich Lakenfields	aea10	0.2	3	1.056	3.1	0.7
24-Jun	Nottingham Centre	CM08060032	0.8	3	0.959	3.3	0.8
03-Jul	Plymouth Centre	CM08060027	-0.5	3	1.073	3.3	0.1
06-Aug	Portsmouth	80600203	2.2	3	1.103	3.1	0.3
03-Jul	Preston	cm08060042	0.3	3	0.998	3.1	0.3
13-Aug	Reading New Town	CM08060025	0.1	3	1.016	3.3	0.3
25-Jun	Rochester Stoke	378	2	3	0.978	3.1	1.6
14-Aug	Salford Eccles	411771	3.3	3	0.884	3.3	1.3
08-Jul	Sheffield Centre	cm08060024	0	3	0.982	3.1	1.2
22-Jul	Sibton	146	-0.8	3	1.014	3.1	1.0
05-Aug	Southampton Centre	CM08060021	-0.5	3	1.046	3.2	2.1
27-Jun	Southend-on-Sea	60017	0.4	3	1.033	3.1	0.3
03-Jul	St Osyth	60035	-3.0	3	0.998	3.1	1.6
21-Jun	Stoke-on-Trent Centre	CM08060026	0.5	3	1.085	3.3	2.1
17-Jul	Sunderland Silksworth	436	1.0	3	0.942	3.1	2.4
27-Jun	Thurrock	20094	0.5	3	1.010	3.1	1.6
10-Jul	Walsall Woodlands	19222	2.3	3	0.972	3.4	1.1
23-Jul	Weybourne	80038	-0.7	3	1.021	3.1	0.5
23-Jul	Wicken Fen	14345	-1.2	3	1.057	3.2	0.6
14-Aug	Wigan Centre	cm08060018	-1.8	3	1.020	3.1	0.4
18-Jun	Wirral Tranmere	CM08060040	-0.5	3	1.212	3.4	0.5
02-Jul	Yarner Wood	2437	-1.7	3	1.016	3.1	0.3
London Sites							
31-Jul	London Bloomsbury	435	-0.6	3	1.073	3.4	0.9
18-Jul	London Eltham	1111958	0	3	1.030	3.4	0.4
25-Jul	London Harlington	107	-1.0	3	1.064	3.3	1.3
25-Jul	London Hillingdon	8060034	-0.1	3	1.040	3.5	1.0
15-Jul	London Marylebone Road	2432	6.2	3	1.025	3.3	1.1
16-Jul	London N. Kensington	2372	2.3	3	1.061	3.3	0.5
08-Aug	London Teddington	2447	1.1	3	1.058	3.3	1.2
24-Jul	London Westminster	879	1.5	3	1.415	3.3	1.7
Northern Ireland Sites (plus Mace Head)							
20-Aug	Belfast Centre	1586	Not	tested	photometer	fault at	audit

Date Year =2013	Site	Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	[*]Max Residual (%)
16-Aug	Derry	1586	-1.8	3	1.036	3.1	0.6
12-Aug	Lough Navar	1640	3.2	3	1.059	3.4	2.3
13-Aug	Mace Head	77086-385	0.6	3	1.000	3.2	0.3
Scottish Sites							
05-Aug	Aberdeen	800	-0.2	3	0.991	3.1	1.1
24-Jul	Auchencorth Moss	1646	-0.3	3	1.036	3.1	0.1
24-Jul	Bush Estate	1645	0.0	3	1.006	3.1	1.1
23-Jul	Edinburgh St Leonards	136	2.4	3	1.006	3.1	1.5
01-Jul	Eskdalemuir	158	1.8	3	1.060	3.1	0.9
24-Jul	Fort William	1023	0.9	3	1.014	3.1	1.5
07-Aug	Lerwick	2433	-1	3	0.993	3.1	0.6
23-Jul	Peebles	2449	3.2	3	1.285	3.1	1.9
08-Aug	Strath Vaich	176	-0.2	3	0.999	3.1	0.1
Welsh Sites							
01-Jul	Aston Hill	144	1.0	3	1.005	3.1	1.3
12-Jul	Cardiff Centre	14348	-2.6	3	1.011	3.2	1.6
12-Jul	Cwmbran	60043	0.1	3	0.972	3.1	0.4
17-Jun	Mold	17499	0.4	3	1.004	3.3	0.6
09-Jul	Narberth	10290	0.5	3	1.029	3.1	0.8
11-Jul	Port Talbot Margam	3	0.4	3	0.945	3.1	0.5

4. Oxides of Nitrogen

Date Year =2013	Site		Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	[*]Max residual (%)	[*]Converter efficiency (%)
08-Jul	Barnsley	NO	08050057	1	2.5	0.960	3.9	3.3	99.3
	Gawber	NOx		0.6	2.5	0.956	3.7	2.7	
04-Jul	Bath Roadside	NO	12758	1.1	2.6	1.088	3.5	1.9	99.6
		NOx		0.7	2.6	1.082	3.5	2.0	
16-Jul	Billingham	NO	574	1.4	2.6	1.152	3.5	0.4	99.6
		NOx		2.6	2.6	1.173	3.5	1.6	
09-Jul	Birmingham	NO	19212	0.2	2.6	1.215	3.5	1.6	99.2
	Acocks Green	NOx		3	2.6	1.221	3.5	1.2	
08-Jul	Birmingham	NO	Y78CC7MC	1.1	2.6	1.163	3.5	1.3	99.8
	Tyburn	NOx		3.9	2.5	1.039	3.5	1.2	
08-Jul	Birmingham	NO	14324	-2.5	2.8	1.473	3.5	1.9	99.4
	Tyburn Roadside	NOx		-2.3	3.0	1.487	3.5	1.5	
03-Jul	Blackburn Darwen	NO	1011851	0	2.5	0.998	3.5	3.5	99.6
	Roadside	NOx		3	2.5	1.009	4.5	4.5	
03-Jul	Blackpool	NO	08050075	0.6	2.5	0.967	3.5	0.5	101.5
	Marton	NOx		0.9	2.5	0.926	3.5	0.7	
07-Aug	Bournemouth	NO	17507	0.3	2.6	1.192	3.68	2.5	97.9
		NOx		0.7	2.6	1.163	3.5	1.5	

Date Year =2013	Site		Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	[*]Max residual (%)	[*]Converter efficiency (%)
16-Jul	Brighton Preston	NO	13068	0.3	2.6	1.162	3.5	0.7	98.1
	Park	NOx		0.8	2.6	1.173	3.5	0.5	
01-Jul	Bristol St Paul's	NO	14353	0	2.6	1.099	3.5	1.4	97.9
		NOx		2.5	2.6	1.111	3.5	1.2	
24-Jul	Cambridge	NO	1011843	1	2.7	1.332	3.5	1.4	98.1
	Roadside	NOx		2	2.7	1.338	3.5	1.8	
31-Jul	Canterbury	NO	11666	0	2.6	1.177	3.5	0.6	98.7
		NOx		0	2.6	1.171	3.5	1.1	
02-Jul	Carlisle	NO	1011849	0	2.6	1.219	3.5	0.8	98.7
	Roadside	NOx		1	2.6	1.232	3.5	0.4	
03-Jul	Charlton	NO	2120	1.1	2.5	0.895	3.5	0.5	101.3
	Mackrell	NOx		0.8	2.5	0.874	3.5	0.2	
27-Jun	Chatham Centre	NO	19206	1	2.6	1.072	3.5	1.2	98.5
	Roadside	NOx		3	2.6	1.059	3.5	0.3	
09-Jul	Chesterfield	NO	1011837	-1	2.6	1.110	3.65	1.8	101.6
		NOx		2	2.6	1.113	3.74	1.3	
09-Jul	Chesterfield	NO	1011835	0	2.8	1.521	4.25	2.2	99.6
	Roadside	NOx		1	2.8	1.530	4.27	2.2	
30-Jul	Coventry	NO	08030109	0.5	2.6	1.246	3.5	0.8	99.5
	Memorial Park	NOx		0.5	2.6	1.250	3.5	0.6	
16-Jul	Eastbourne	NO	19209	1.4	2.6	1.152	3.5	0.7	99.6
		NOx		0.4	2.6	1.167	3.5	1.1	
02-Jul	Exeter Roadside	NO	G0000D1S	0	2.7	0.879	3.5	1.0	98.7
		NOx		1.4	2.7	0.876	3.5	1.0	
16-Aug	Glazebury	NO	14354	1.2	2.6	1.129	3.5	0.1	99.1
		NOx		1.5	2.6	1.143	3.5	0.5	
12-Aug	Harwell	NO	79	1.9	2.6	1.161	3.5	1.6	99.7
		NOx		6.5	2.6	1.180	3.5	1.5	
17-Jul	High Muffles	NO	1783	-0.6	2.6	1.211	3.5	1.0	99.6
		NOx		-0.5	2.6	1.234	3.5	1.1	
02-Jul	Honiton	NO	19214	0.1	2.7	1.288	3.5	0.5	99.6
		NOx		0.7	2.6	1.283	3.5	0.8	
15-Jul	Horley	NO	1401954	-1	3.1	1.169	3.5	0.5	100.4
		NOx		2	2.8	1.180	3.5	0.4	
17-Jul	Hull Freetown	NO	08050056	0	2.6	1.104	3.55	0.2	99.5
		NOx		-6	2.6	1.104	3.54	0.3	
10-Jul	Ladybower	NO	72	0	2.6	1.089	3.95	2.4	99.2
		NOx		-1	2.5	1.066	4.25	3.3	
02-Jul	Leamington Spa	NO	1011842	0	2.6	1.230	3.5	1.1	100.5
		NOx		7	2.8	1.269	3.5	1.2	
01-Jul	Leamington Spa	NO	19211	2.6	2.6	1.092	3.51	2.2	100.5
	Rugby Road	NOx		-22.6	2.6	1.078	3.74	1.6	

Date Year =2013	Site		Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	*Max residual (%)	*Converter efficiency (%)
16-Jul	Leeds Centre	NO	CM08050066	0.8	2.6	1.161	3.59	0.5	99.6
		NOx		0.3	2.6	1.155	3.54	0.5	
16-Jul	Leeds Headingley	NO	342	0.3	2.6	1.177	3.58	0.5	98.1
	Kerbside	NOx		2.6	2.6	1.188	3.61	0.9	
31-Jul	Leicester Centre	NO	08050021	0.5	2.6	1.055	3.5	0.5	98.7
		NOx		0.5	2.6	1.093	3.5	0.6	
25-Jul	Leominster	NO	14863	-0.6	2.5	0.963	3.5	0.7	99.6
		NOx		-0.5	2.5	0.979	3.5	0.2	
28-Jun	Lincoln Canwick	NO	19203	3	2.6	1.100	3.5	0.5	98.6
	Road	NOx		1.6	2.6	1.098	3.5	0.8	
20-Jun	Liverpool Queen's	NO	16927	-1.2	2.6	1.231	3.5	2.0	98.1
	Drive Roadside	NOx		1.6	2.6	1.242	3.5	1.6	
20-Jun	Liverpool Speke	NO	08050069	0.2	2.5	0.959	3.7	1.7	100.3
		NOx		0.6	2.5	0.95	3.5	1.6	
04-Jul	Lullington Heath	NO	14313	0.6	2.6	1.072	3.5	0.3	95.9
		NOx		0.9	2.6	1.063	3.5	0.3	
15-Aug	Manchester	NO	08050065	3.9	2.5	0.937	3.5	1.6	99.3
	Piccadilly	NOx		3.5	2.5	0.982	3.5	1.7	
15-Aug	Manchester	NO	17311	4.6	3.2	2.137	3.5	0.4	101.7
	South	NOx		4.8	3.2	2.160	3.5	0.7	
09-Aug	Market	NO	08050068	0	2.4	0.642	3.5	0.5	99.7
	Harborough	NOx		-0.1	2.4	0.689	3.5	0.7	
16-Jul	Middlesbrough	NO	2287	1.7	2.6	1.146	3.5	1.4	100.4
		NOx		1.7	2.6	1.148	3.5	1.6	
15-Jul	Newcastle	NO	08050063	0.7	2.5	0.999	3.5	1.2	99.3
	Centre	NOx		0.8	2.5	1.031	3.5	1.2	
15-Jul	Newcastle Cradlewell	NO	1011853	1	3.5	0.960	3.5	0.8	98.2
	Roadside	NOx		6	2.7	0.975	3.5	1.9	
01-Aug	Northampton	NO	8ATJ6APR	-0.5	2.5	0.937	3.5	0.1	98.8
	Kingsthorpe	NOx		1.1	2.5	0.943	3.5	0.3	
23-Jul	Norwich	NO	aea13	0.3	2.5	1.024	3.5	1.2	98.1
	Lakenfields	NOx		0.8	2.5	1.021	3.5	1.2	
24-Jun	Nottingham	NO	08050072	1.3	2.5	0.832	3.5	4.3	98.6
	Centre	NOx		1.1	2.5	0.820	3.5	3.9	
14-Aug	Oxford Centre	NO	1011844	0.1	2.7	1.321	3.5	0.9	98.3
	Roadside	NOx		0.2	2.7	1.331	3.5	1.4	
14-Aug	Oxford St Ebbes	NO	1011830	0	2.5	1.083	3.5	1.7	101.7
		NOx		2	2.8	1.098	3.5	2.0	
03-Jul	Plymouth Centre	NO	08050062	0.2	2.5	0.947	3.5	0.4	99.3
		NOx		0.7	2.5	0.952	3.5	0.4	
06-Aug	Portsmouth	NO	A24819	-0.9	2.5	0.951	3.5	0.2	99.6

Date Year =2013	Site		Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	*Max residual (%)	*Converter efficiency (%)
		NOx		0.7	2.5	0.951	3.5	0.6	
03-Jul	Preston	NO	08050664	1	2.5	1.044	3.5	0.8	107.1
		NOx		1	2.5	1.050	3.5	0.6	
13-Aug	Reading New Town	NO	08050059	0.5	2.5	0.868	3.5	0.9	98.9
		NOx		-0.4	2.5	0.919	3.5	0.9	
25-Jun	Rochester Stoke	NO	18593	0	2.6	1.105	3.5	0.6	98.2
		NOx		-1	2.6	1.088	3.5	0.9	
14-Aug	Salford Eccles	NO	1011881	0	2.5	1.005	3.5	1.2	97.6
		NOx		4	2.6	1.023	3.5	0.8	
25-Jul	Sandy Roadside	NO	2585	-2.4	2.8	1.553	3.5	2.0	100.6
		NOx		-8.2	2.8	1.593	3.5	1.2	
17-Jul	Scunthorpe Town	NO	1011847	50	3.4	2.472	4.3	1.6	101.1
		NOx		53	3.4	2.494	4.0	1.5	
08-Jul	Sheffield Centre	NO	08050055	0.5	2.5	1.031	5.8	5.3	100.4
		NOx		1.0	2.5	1.039	5.8	5.2	
09-Jul	Sheffield Tinsley	NO	847	7.8	2.5	0.855	3.6	2.2	100.0
		NOx		10.5	2.5	0.900	3.7	2.8	
05-Aug	Southampton Centre	NO	08030106	0	2.7	0.957	3.5	1.8	100.8
		NOx		0.8	2.5	0.965	3.5	1.1	
27-Jun	Southend-on-Sea	NO	50071	0.1	2.5	1.054	3.5	1.2	99.6
		NOx		0.3	2.5	1.059	3.5	0.7	
03-Jul	St Osyth	NO	50073	0	2.5	0.925	3.5	0.9	99.3
		NOx		-3	2.5	0.906	3.5	1.2	
04-Jul	Stanford-le-Hope Roadside	NO	20093	1	2.5	1.069	3.5	0.8	98.7
		NOx		2	2.6	1.082	3.5	0.9	
16-Jul	Stockton-on-Tees Eaglescliffe	NO	332	1.2	2.7	1.353	4.3	3.1	98.8
		NOx		1.5	2.7	1.358	4.2	3.2	
21-Jun	Stoke-on-Trent Centre	NO	08050070	1	2.5	0.971	3.6	0.6	99.3
		NOx		0.5	2.6	1.010	3.5	0.2	
17-Jul	Storrington Roadside	NO	40022	0.3	2.8	1.550	3.5	1.0	100.5
		NOx		-0.3	2.8	1.546	3.5	0.7	
17-Jul	Sunderland Silksworth	NO	1011854	0	2.6	1.181	4.4	5.1	98.0
		NOx		4	2.6	1.194	3.8	3.3	
27-Jun	Thurrock	NO	20092	0.3	2.7	1.358	3.5	0.3	97.4
		NOx		0.4	2.7	1.361	3.5	0.3	
10-Jul	Walsall Woodlands	NO	192123	0.6	2.6	1.121	3.5	0.5	99.9
		NOx		4.2	3.7	1.127	3.5	0.2	
19-Jun	Warrington	NO	1011826	-0.1	2.5	0.965	3.8	2.1	98.3
		NOx		5	2.7	0.993	3.5	1.5	
23-Jul	Wicken Fen	NO	13069	0.9	2.4	0.729	3.5	0.4	98.6
		NOx		1.6	2.4	0.730	3.5	2.3	

Date Year =2013	Site		Analyser number	1Zero output	Uncertainty (ppb)	2Calibration Factor	Uncertainty (%)	*Max residual (%)	*Converter efficiency (%)
14-Aug	Wigan Centre	NO	1011832	0	2.5	1.044	4.9	4.6	100.8
		NOx		2	2.5	1.054	4.8	4.4	
18-Jun	Wirral Tranmere	NO	08050060	0	2.8	1.546	3.5	0.1	98.8
		NOx		0.3	2.8	1.638	3.5	0.4	
02-Jul	Yarner Wood	NO	1784	0.4	2.6	1.084	3.5	1.5	99.9
		NOx		0.3	2.6	1.070	3.5	0.7	
18-Jul	York Fishergate	NO	1011848	-1	2.5	0.931	3.5	0.3	101.2
		NOx		3	2.5	0.937	3.6	0.7	
London Sites									
07-Aug	Camden Kerbside	NO	1011846	0	2.7	1.208	3.5	0.6	98.9
		NOx		2	2.8	1.217	3.5	0.1	
06-Aug	Haringey Roadside	NO	1011827	0	2.8	1.161	3.5	0.6	101.6
		NOx		4	3.3	1.172	3.5	0.4	
30-Jul	London Bexley	NO	327	0.9	2.6	1.131	3.5	0.9	98.4
		NOx		1.1	2.6	1.181	3.5	1.6	
31-Jul	London Bloomsbury	NO	74	1	3.4	1.374	3.6	3.0	100.0
		NOx		0.9	2.8	1.357	3.8	4.3	
18-Jul	London Eltham	NO	1101834	0	2.8	1.034	3.5	0.8	98.6
		NOx		6	2.6	1.043	3.5	1.0	
05-Aug	London Haringey	NO	1084	2.2	2.6	1.244	3.5	0.3	98.4
		NOx		1.6	3.0	1.244	3.5	0.4	
25-Jul	London Harlington	NO	1090	1.2	2.7	1.269	3.5	1.5	100.7
		NOx		1.7	2.8	1.273	3.5	1.1	
25-Jul	London Hillingdon	NO	8050017	0.6	2.5	0.929	3.5	0.4	99.1
		NOx		0.8	2.5	0.926	3.5	0.3	
15-Jul	London Marylebone Road	NO	3366	0.6	2.6	1.202	3.5	1.5	99.6
		NOx		3.2	2.6	1.240	3.5	1.6	
16-Jul	London N. Kensington	NO	3273	1.5	2.6	1.132	3.5	0.6	98.3
		NOx		3	2.6	1.132	3.5	0.3	
08-Aug	London Teddington	NO	3406	2	2.6	1.258	3.5	1.6	99.1
		NOx		-0.3	2.8	1.258	3.5	1.4	
24-Jul	London Westminster	NO	573	0	2.6	1.109	3.5	2.8	98.7
		NOx		1.8	4.4	1.128	3.5	1.4	
22-Jul	Southwark A2 Old Kent Road	NO	1954	-9.8	2.8	1.214	3.6	2.4	98.3
		NOx		-5.9	4.6	1.268	3.9	2.4	
01-Aug	Tower Hamlets Roadside	NO	1011838	0	2.8	1.071	3.5	0.5	98.3
		NOx		7	3	1.105	3.5	0.3	
Northern Irish Sites									
20-Aug	Armagh Roadside	NO	1011845	0	2.7	1.403	3.6	1.3	99.5
		NOx		3	2.7	1.410	4.0	2.9	
20-Aug	Belfast Centre	NO	08050074	-0.2	2.7	1.431	3.6	1.6	99.5
		NOx		-1.1	2.7	1.429	3.6	1.4	

Date Year =2013	Site		Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	[*]Max residual (%)	[*]Converter efficiency (%)
16-Aug	Derry	NO	2130	1.7	2.6	1.1354	4.3	5.23	100
		NOx		5.3	2.6	1.1374	4.7	5.46	
Scottish Sites									
05-Aug	Aberdeen	NO	519	0.9	2.6	1.210	4.9	3.9	94.7
		NOx		1.2	2.6	1.221	4.9	4.0	
06-Aug	Aberdeen Union	NO	299	0.8	2.6	1.125	4.2	2.6	100.4
	Street Roadside	NOx		0.9	2.6	1.138	3.9	1.9	
24-Jul	Bush Estate	NO	2244	1	2.5	0.984	3.5	1.3	101.8
		NOx		3.2	2.5	0.997	3.5	1.5	
22-Jul	Dumbarton	NO	10118	1	2.6	1.192	4.0	3.4	99.1
	Roadside	NOx		2	2.6	1.195	4.1	3.9	
01-Jul	Dumfries	NO	1494	1	2.5	1.023	3.5	1.2	98.5
		NOx		1.4	2.5	1.039	3.5	0.6	
23-Jul	Edinburgh St	NO	73	0.5	2.7	1.295	3.5	0.9	101.0
	Leonards	NOx		0.9	2.7	1.297	3.5	0.8	
01-Jul	Eskdalemuir	NO	347	1.5	2.5	0.945	6.9	6.0	98.1
		NOx		2	2.5	0.957	5.1	3.5	
24-Jul	Fort William	NO	344	0	2.5	0.981	3.9	1.9	100.4
		NOx		0.1	2.5	0.955	3.8	3.1	
22-Jul	Glasgow	NO	06010041	0	2.6	1.214	3.7	3.0	99.6
	Kerbside	NOx		0	2.6	1.217	4.0	3.2	
22-Jul	Grangemouth	NO	1011836	-1	2.6	0.983	3.5	0.1	99.3
		NOx		0	2.6	0.998	3.5	0.8	
22-Jul	Grangemouth	NO	1011852	0	2.7	1.011	5.9	5.3	99.1
	Moray	NOx		2	3.1	1.048	6.0	5.5	
08-Aug	Inverness	NO	1489	0.5	2.6	1.208	3.6	0.8	99.5
		NOx		0.4	2.6	1.218	3.5	0.3	
23-Jul	Peebles	NO	2213	0.7	2.6	1.076	3.5	1.4	101.4
		NOx		2.7	2.6	1.098	3.5	0.8	
Welsh Sites									
01-Jul	Aston Hill	NO	2302	0.2	2.6	1.085	3.5	0.7	98.9
		NOx		1.4	3.2	1.085	3.5	1.5	
12-Jul	Cardiff Centre	NO	14325	0.4	2.7	1.383	3.5	1.3	100.0
		NOx		2.2	2.7	1.414	3.5	1.2	
11-Jul	Chepstow A48	NO	6595058	0	2.7	1.424	3.5	0.9	99.4
		NOx		6	2.7	1.428	3.5	0.9	
12-Jul	Cwmbran	NO	1	0.6	2.5	1.018	3.5	0.7	98.9
		NOx		1.2	2.5	0.998	3.5	0.7	
17-Jun	Mold	NO	345	1.6	2.6	1.039	3.5	0.9	98.1
		NOx		2.2	2.5	1.055	3.5	1.0	
09-Jul	Narberth	NO	14311	0	2.5	0.967	3.5	0.6	98.2
		NOx		0.5	2.5	0.957	3.5	0.3	

Date Year =2013	Site		Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	Max residual (%)	Converter efficiency (%)
10-Jul	Newport	NO	829	0	2.6	1.173	3.5	0.7	101.3
		NOx		6	2.8	1.189	3.5	0.8	
11-Jul	Port Talbot	NO	12811	7.1	2.5	1.002	3.5	0.7	99.1
	Margam	NOx		6.6	2.5	0.998	3.5	2.4	
11-Jul	Swansea	NO	16695	1.3	2.6	1.214	3.6	1.5	98.6
	Roadside	NOx		1.6	2.6	1.204	3.5	0.2	
18-Jun	Wrexham	NO	1490	2.2	2.6	1.079	3.5	1.4	98.1
		NOx		3.8	2.6	1.101	3.5	1.5	

5. Particulate Analysers

Date Year =2013	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 (%)
English sites										
09-Jul	Birmingham Acocks Green	PM2.5	192900702	15926	1	1.15	3.01	2.2	15.70	2.2
08-Jul	Birmingham	PM10	200390809	14921	1	-0.13	2.83	2.2	15.40	2.2
	Tyburn	PM2.5	200860809	14726	1	0.29	2.87	2.2	15.58	2.2
08-Jul	Birmingham	PM10		Analyser	not	present				
	Tyburn Roadside	PM2.5	190220606	14208	1	-1.56	2.95	2.2	15.79	2.2
03-Jul	Blackpool Marton	PM2.5	244240302	13036	1	1.10	2.96	2.2	17.41	2.2
07-Aug	Bournemouth	PM2.5	218630603						15.47	2.2
16-Jul	Brighton Preston Park	PM2.5	218650603						16.47	2.2
01-Jul	Bristol St Paul's	PM10	244260302	13232	1	0.41	2.97	2.2	15.64	2.2
		PM2.5	264950701	13647	1	-1.97	3.00	2.2	15.49	2.2
02-Jul	Carlisle	PM10	272570809	14378	1	-0.77	3.00	2.2	16.37	2.2
	Roadside	PM2.5	273410810	15084	1	-0.57	2.98	2.2	16.12	2.2
27-Jun	Chatham Centre	PM10	27108	14514	1	-0.06	3.07	2.2	15.92	2.2
	Roadside	PM2.5	27343	16007	1	0.04	2.93	2.2	15.45	2.2
09-Jul	Chesterfield	PM10	27316	16126	1	-1.20	2.99	2.2	16.63	2.2
		PM2.5	27341	12334	1	-0.81	3.11	2.2	16.79	2.2
09-Jul	Chesterfield	PM10	22299	11334	1	-0.10	3.07	2.2	16.55	2.2
	Roadside	PM2.5	27339	10914	1	-1.55	3.06	2.2	16.58	2.2
30-Jul	Coventry Memorial Park	PM2.5	192890702	14831	1	-0.92	**3.07**	2.2	**17.07**	2.2
16-Jul	Eastbourne	PM10	272380809	14337	1	-1.15	3.13	2.2	17.07	2.2
		PM2.5	272440809	14839	1	0.04	3.00	2.2	16.22	2.2
12-Aug	Harwell	PM10	201670811	14771	1	-1.13	2.87	2.2	15.90	2.2
		PM2.5	167570401	12434	1	0.34	2.92	2.2	16.12	2.2
12-Aug	Harwell Partisol	PM10	21859						16.13	2.2
		PM2.5	21257						15.98	2.2
17-Jul	Hull Freetown	PM10	220209803	14100	1	-0.07	3.00	2.2	16.40	2.2
		PM2.5	264980701	13912	1	-1.98	3.01	2.2	13.88	2.2

RICARDO-AEA

Date Year =2013	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-Jul	Leamington	PM10	27295	15073	1	0.52	2.94	2.2	15.46	2.2
	Spa	PM2.5	27248	14218	1	0.26	2.93	2.2	15.35	2.2
01-Jul	Leamington Spa	PM10	26566	13826	1	-0.75	2.89	2.2	15.87	2.2
	Rugby Road	PM2.5	27205	15905	1	-0.81	2.90	2.2	15.61	2.2
16-Jul	Leeds Centre	PM10	24451	13279	1	-0.87	2.97	2.2	16.02	2.2
		PM2.5	27254	16821	1	-1.29	2.90	2.2	15.68	2.2
16-Jul	Leeds Headingley	PM10	27287	17550	1	-0.20	2.82	2.2	15.71	2.2
	Kerbside	PM2.5	27249	14542	1	-1.09	2.93	2.2	15.31	2.2
31-Jul	Leicester	PM10	134079605	14214	1	-1.68	2.97	2.2	17.04	2.2
	Centre	PM2.5	192490701	14791	1	-1.16	3.05	2.2	16.24	2.2
20-Jun	Liverpool	PM10	172220302	15839	1	0.17	2.98	2.2	15.31	2.2
	Speke	PM2.5	192860702	14760	1	-0.99	3.10	2.2	15.90	2.2
15-Aug	Manchester Piccadilly	PM2.5	26038	13869	1	-1.12	3.01	2.2	16.75	2.2
16-Jul	Middlesbrough	PM10	167250309	13951	1	-1.29	2.84	2.2	16.61	2.2
		PM2.5		Analyser	fault	not	tested			
15-Jul	Newcastle	PM10	172140302	13885	1	0.45	3.00	2.2	16.65	2.2
	Centre	PM2.5	171990301	14926	1	0.60	2.99	2.2	16.44	2.2
01-Aug	Northampton Kingsthorpe	PM2.5	21013						16.21	2.2
23-Jul	Norwich	PM10	21495	15628	1	-0.51	3.02	2.2	16.23	2.2
	Lakenfields	PM2.5	27328	15732	1	0.83	2.95	2.2	15.55	2.2
24-Jun	Nottingham	PM10	273690811	15378	1	-1.30	3.37	2.2	17.30	2.2
	Centre	PM2.5	250250401	12147	1	-0.30	3.04	2.2	16.43	2.2
14-Aug	Oxford St	PM10	200870809	14818	1	0.01	3.03	2.2	16.18	2.2
	Ebbes	PM2.5	200160808	17123	1	-0.27	2.97	2.2	16.46	2.2
03-Jul	Plymouth	PM10	201750811	12259	1	-0.15	2.97	2.2	15.77	2.2
	Centre	PM2.5	203960911	14300	1	-0.28	2.95	2.2	15.70	2.2
06-Aug	Portsmouth	PM10	1121	16736	1	-1.47	2.93	2.2	15.77	2.2
		PM2.5	22823	18358	1	-0.99	2.95	2.2	14.85	2.2
03-Jul	Preston	PM2.5	228810001	12974	1	0.15	3.06	2.2	16.81	2.2
13-Aug	Reading New	PM10	21314	13231	1	0.24	2.93	2.2	15.13	2.2
	Town	PM2.5	26575	13941	1	-1.38	2.98	2.2	15.73	2.2
25-Jun	Rochester	PM10	27224	14820	1	-0.62	3.05	2.2	16.36	2.2
	Stoke	PM2.5	27258	15942	1	-0.02	3.06	2.2	16.27	2.2
14-Aug	Salford Eccles	PM10	2000	13721	1	0.22	2.91	2.2	15.96	2.2
		PM2.5	27272	14602	1	-0.24	2.91	2.2	15.92	2.2
03-Jul	Saltash	PM10	168160208	14084	1	-0.40	2.91	2.2	15.61	2.2
	Callington Road	PM2.5	201690811	12286	1	-0.65	2.97	2.2	15.96	2.2
25-Jul	Sandy	PM10	27278	11337	1	0.40	2.99	2.2	14.30	2.2
	Roadside	PM2.5	27632	15969	1	-0.69	2.87	2.2	15.36	2.2
17-Jul	Scunthorpe Town	PM10	273200810	14894	1	-0.70	2.88	2.2	15.58	2.2
08-Jul	Sheffield	PM10	25024	11978	1	-2.22	3.04	2.2	16.47	2.2

Date Year =2013	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 (%)
	Centre	PM2.5	27253	15443	1	-1.25	3.03	2.2	16.33	2.2
05-Aug	Southampton	PM10	172560302	13934	1	0.43	2.92	2.2	15.36	2.2
	Centre	PM2.5	200330808	16617	1	0.57	3.09	2.2	16.43	2.2
27-Jun	Southend-on-Sea	PM2.5	22927	12388	1	-0.38	2.57	2.2	15.53	2.2
04-Jul	Stanford-le-	PM10	21800	12715	1	0.38	**3.08**	**2.2**	**16.63**	**2.2**
	Hope Roadside	PM2.5	22048	13205	1	1.24	**2.97**	**2.2**	**16.41**	**2.2**
16-Jul	Stockton-on-Tees	PM10	H4554						13.90	2.2
	Eaglescliffe	PM2.5	H4553						15.82	2.2
21-Jun	Stoke-on-Trent	PM10	177470401	12424	1	-0.62	2.86	2.2	15.58	2.2
	Centre	PM2.5	200570809	13467	1	-0.26	2.84	2.2	15.79	2.2
17-Jul	Storrington	PM10	200280808	15761	1	0.52	2.93	2.2	16.04	2.2
	Roadside	PM2.5	201760811	12875	1	1.01	2.99	2.2	16.25	2.2
17-Jul	Sunderland Si ksworth	PM2.5	200310808	15687	1	-0.72	2.98	2.2	14.47	2.2
27-Jun	Thurrock	PM10	27329	13953	1	-0.68	2.97	2.2	16.08	2.2
19-Jun	Warrington	PM10	175980309	11921	1	-0.68	3.06	2.2	15.63	2.2
		PM2.5	100060808	16269	1	-0.54	3.09	2.2	15.74	2.2
14-Aug	Wigan Centre	PM2.5	27291	14803	1	-0.41	2.90	2.2	15.75	2.2
18-Jun	Wirral Tranmere	PM2.5	15366001	13240	1	-0.40	2.93	2.2	15.74	2.2
18-Jul	York Bootham	PM10	218779212	14522	1	-1.46	2.88	2.2	14.62	2.2
		PM2.5	272090807	16008	1	-1.68	2.96	2.2	15.57	2.2
18-Jul	York Fishergate	PM10	273480810	15572	1	-0.80	2.98	2.2	15.60	2.2
		PM2.5	272320808	17944	1	-1.63	2.97	2.2	15.92	2.2
London Sites										
07-Aug	Camden	PM10	21152	12121	1	1.10	3.00	2.2	16.18	2.2
	Kerbside	PM2.5	23248	13021	1	2.08	3.14	2.2	16.49	2.2
06-Aug	Haringey	PM10	27338	15349	1	0.56	2.98	2.2	15.35	2.2
	Roadside	PM2.5	27260	13747	1	-0.38	3.02	2.2	17.77	2.2
30-Jul	London Bexley	PM2.5	25007	11625	1	0.27	3.04	2.2	15.76	2.2
31-Jul	London	PM10	24446	13820	1	0.58	3.06	2.2	16.40	2.2
	Bloomsbury	PM2.5	27240	14738	1	-0.16	3.09	2.2	15.93	2.2
18-Jul	London Eltham	PM10	27012	14112	1	2.14	2.94	2.2	15.96	2.2
		PM2.5	27012	14084	1	1.93	2.90	2.2	15.64	2.2
25-Jul	London	PM10	24902	12071	1	-1.75	3.06	2.2	16.55	2.2
	Harlington	PM2.5	23959	12637	1	-1.31	3.11	2.2	16.58	2.2
07-Aug	London Harrow Stanmore	PM2.5	27274	16232	1	-0.08	3.06	2.2	16.08	2.2
15-Jul	London	PM10	27230	16695	1	-1.45	3.00	2.2	15.95	2.2
	Marylebone Road	PM2.5	24192	12963	1	1.18	3.07	2.2	16.32	2.2
15-Jul	Marylebone Road	PM10	21221						16.61	2.2
	Partisol	PM2.5	20943						16.47	2.2
16-Jul	London N.	PM10	27391	12717	1	0.35	3.01	2.2	16.35	2.2

Date Year =2013	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 (%)
	Kensington	PM2.5	27189	15902	1	0.74	3.06	2.2	16.08	2.2
16-Jul	N. Kensington	PM10	21019						16.55	2.2
	Partisol	PM2.5	21015						16.33	2.2
08-Aug	London Teddington	PM2.5	27265	15335	1	-0.21	3.14	2.2	15.97	2.2
24-Jul	London Westminster	PM2.5	20939						16.45	2.2
22-Jul	Southwark A2 Old Kent Road	PM10	26480	15048	1	-0.50	3.06	2.2	16.71	2.2
Northern Irish Sites										
20-Aug	Armagh Roadside	PM10	166530201	13677	1	0.77	3.01	2.2	16.97	2.2
20-Aug	Belfast Centre	PM10	172110302	14208	1	0.10	**3.03**	**2.2**	**16.41**	**2.2**
		PM2.5	929880702	15693	1	-0.23	**3.04**	**2.2**	**16.77**	**2.2**
16-Aug	Derry	PM10	202830902	16041	1	1.48	3.12	2.2	16.72	2.2
		PM2.5	134949608	10956	1	0.61	3.05	2.2	16.57	2.2
12-Aug	Lough Navar	PM10	133999604	13044	1	1.76	not	measured	18.24	2.2
Scottish Sites										
05-Aug	Aberdeen	PM10	24427	11499	1	-0.61	2.97	2.2	16.22	2.2
		PM2.5	27368	11995	1	-1.84	3.03	2.2	16.28	2.2
24-Jul	Auchencorth	PM10		dryer	fault	not	Tested			
	Moss	PM2.5		analyser	switched	Off				
24-Jul	Auchencorth	PM10	215500112						analyser	fault
	Moss Partisol	PM2.5	215480112						16.67	2.2
23-Jul	Edinburgh St	PM10	199970808	13696	1	0.03	3.09	2.2	16.27	2.2
	Leonards	PM2.5	201190808	17045	1	0.20	3.11	2.2	16.26	2.2
22-Jul	Glasgow	PM10	27344	14287	1	-2.02	**3.19**	**2.2**	**17.38**	**2.2**
	Kerbside	PM2.5	27337	14855	1	-1.75	**3.19**	**2.2**	**17.44**	**2.2**
22-Jul	Grangemouth	PM10	201210810	16013	1	0.60	3.07	2.2	16.78	2.2
		PM2.5	100110808	13764	1	0.02	3.04	2.2	16.36	2.2
08-Aug	Inverness	PM10	21555						16.91	2.2
		PM2.5	21861						16.79	2.2
Welsh Sites										
12-Jul	Cardiff Centre	PM10	25499	13633	1	-1.77	2.87	2.2	15.88	2.2
		PM2.5		dryer	fault	not	tested	2.2		
11-Jul	Chepstow A48	PM10	27242	14153	1	-0.22	2.97	2.2	16.03	2.2
		PM2.5	27223	15955	1	-0.25	2.94	2.2	16.59	2.2
09-Jul	Narberth	PM10	26563	13799	1	-0.53	2.93	2.2	16.12	2.2
10-Jul	Newport	PM10	21029	13794	1	-1.38	**3.22**	2.2	**18.18**	2.2
		PM2.5	26566	16452	1	-1.02	2.94	2.2	15.88	2.2
11-Jul	Port Talbot	PM10								
	Margam	PM2.5		analysers	not	tested	episode	in	progress	
11-Jul	PT Margam Partisol	PM10		analyser	not	tested	episode	in	progress	

Date Year =2013	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-Jul	Swansea	PM10	20072						13.65	2.2
	Roadside	PM2.5	20071						11.08	2.2
18-Jun	Wrexham	PM10	21224						18.39	2.2
		PM2.5	21011						16.62	2.2

The above factors have been calculated using certified standards. The analysers listed above have been tested for zero response, cal bration 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 cal bration 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.

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QA/QC Data Ratification Report for the Automatic Urban and Rural Network, July-September 2014 and Intercalibration Report, Summer 2014

ED 57002 Q3 2014 | Issue 1 | Date 06/05/2015

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06 May 2015

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Executive summary

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

Ratified hourly average data capture for the network averaged 85.94% for all pollutants (O_3, NO_2, SO_2, CO, PM_{10} and $PM_{2.5}$) during the 3-month reporting period July-September 2014. Average data capture for all pollutants except $PM_{2.5}$ and PM_{10} were above 85%. There were 36 stations with data capture less than 85% for the period.

A total of 139 monitoring stations in the AURN operated during this quarter. Some of these are co-located and separately named gravimetric particulate analysers at stations with automatic analysers. Many affiliated stations have additional Defra-funded analysers installed on site.

The main reasons for data loss at the stations have been provided and these were predominantly due to instrument or air conditioning faults, response instability or problems associated with the replacement of analysers and infrastructure.

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Section A: Data Ratification, July-September 2014

1 Introduction

This quarterly report covers the Quality Assurance and Quality Control (QA/QC) activities undertaken by Ricardo-AEA to ratify automatic monitoring data from Defra and the Devolved Administrations' Automatic Urban and Rural Network (AURN) for the period 1 July- 30 September 2014. Eleven stations also use non-automatic gravimetric particulate samplers (Partisols); there are 17 of these in the network. Eight of them are co-located with FDMS analysers at Auchencorth Moss, Harwell, London North Kensington and Marylebone Road for both PM_{10} and $PM_{2.5}$.

1.1 Overview of Network performance

Ratified hourly average (daily average for Partisols) data capture for the network averaged 85.94% for all pollutants (O_3, NO_2, SO_2, CO, PM_{10} and $PM_{2.5}$) during the 3 month reporting period July-September 2014 (see Table 1.1). Data capture statistics 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 stations starting or closing during the period, the data capture is based on the actual date starting or closing. All except $PM_{2.5}$ and PM_{10} achieved 85% or higher data capture on average. The data capture target for the purposes of monitoring compliance with the EU Air Quality Directive (Directive 2008/50/EC) is 90% excluding planned servicing and maintenance. For practical purposes in the AURN, planned maintenance is assumed to be 5% so a target of 85% data capture is used.

Table 1.1: AURN Ratified Data Capture (%) by Quarter, 2014

	CO	PM_{10}	$PM_{2.5}$	NO_2	O_3	SO_2	Mean
Q1 2014	95.35	85.45	83.51	94.31	95.01	90.02	89.72
Q2 2014	99.75	83.40	89.99	91.98	95.43	91.07	89.41
Q3 2014	86.65	80.07	78.89	87.16	93.33	94.85	85.94

1.2 Changes to Ratified Data

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

- Armagh Roadside PM_{10} 22 May-30 June 2014, low volatile concentrations
- Harwell PM_{10} 18-30 June 2014, step change in volatile concentrations
- Ladybower NOx, 27 May-30 June 2014, analyser faults
- London Teddington Bushy Park $PM_{2.5}$, 18-22 June 2014, leak in mass transducer
- Oxford St Ebbes PM10 28 May-30 June 2014, low volatiles
- Port Talbot Margam $PM_{2.5}$, 27 March-30 June 2014, leak
- Sunderland Silksworth NOx, 1 April-30 June 2014, data reinstated
- Wirral Tranmere NOx, 1 Jan 2013-30 June 2014, sampling fault
- Warrington $PM_{2.5}$, 6-30 June 2014, high zero test result

A list of changes to ratified data is given at http://uk-air.defra.gov.uk/data/changes-to-ratified-data .

1.3 Precision of Measured Data

As part of the requirements of INSPIRE, data is required to be reported to one decimal place (two for CO). As of September 2014, a number of sites are still reporting gaseous data as integers. These are:

Armagh Roadside
Carlisle Roadside
Newcastle Cradlewell Roadside
Newport
Scunthorpe (to 0.5ppb)
Sunderland Silksworth
Warrington
Salford Eccles
York Fishergate

The relevant ESUs have been instructed to reconfigure loggers to record data to one decimal place.

2 Changes in Network for Directive Compliance

The Narberth site was moved to a new location at the service on 11 August to avoid sampling emissions from farming machinery.

3 Station Specific Issues

In this section, we now discuss in turn specific station issues for the following geographic groupings – London, England (excluding London), Scotland, Northern Ireland and Wales. Where analysers were commissioned during the period, the stated data capture for these instruments is calculated from the date of commissioning. Analysers with data capture less than 90% are highlighted in yellow and those with data capture less than 85% are highlighted in orange.

3.1 London

3.1.1 Data Capture

The data capture for the sites in London (within the M25) is given in Table 3.1

Table 3.1 London Data Capture

	CO	PM_{10}	$PM_{2.5}$	NO_2	O_3	SO_2	Mean
Camden Kerbside		58.97	59.24	99.55			72.58
Ealing Horn Lane		91.98					91.98
Haringey Roadside			49.82	0.00			24.91
London Bexley			88.86	94.16		90.13	91.05
London Bloomsbury		95.20	88.27	98.19	98.51	98.14	95.66
London Eltham			95.56	50.68	90.44		78.89
London Haringey Priory Park South				96.69	91.08		93.89
London Harlington		94.20	94.43	95.47	98.73		95.71
London Harrow Stanmore			96.78				96.78
London Hillingdon				94.29	98.60		96.44
London Marylebone Road	98.32	92.98	93.03	99.23	97.19	93.30	95.67

	CO	PM_{10}	$PM_{2.5}$	NO_2	O_3	SO_2	Mean
London Marylebone Road (Partisol)		96.74	98.91				97.83
London N. Kensington	99.46	32.38	23.05	99.64	99.59	88.59	73.78
London N. Kensington (Partisol)		98.91	98.91				98.91
London Teddington				98.23	97.64		97.94
London Teddington Bushy Park			0.00				0.00
London Westminster			98.91	98.32			98.35
Southwark A2 Old Kent Road		0.00		0.00			0.00
Tower Hamlets Roadside				99.32			99.32
Number of Sites	**2**	**9**	**13**	**14**	**8**	**4**	**19**
Number of sites < 85 %	**0**	**3**	**4**	**3**	**0**	**0**	**7**
Number of sites < 90%	**0**	**3**	**6**	**3**	**0**	**1**	**7**
Network mean	**98.89**	**62.49**	**75.83**	**80.27**	**96.47**	**92.54**	**76.33**

3.1.2 Principal Reasons for Data Loss

Camden Kerbside

The air conditioning unit failed during the summer, and the $PM_{2.5}$ analyser was switched off for much of the summer period. Data from the PM_{10} analyser was unstable and have been deleted this quarter up to replacement of the air conditioning unit on 3 August.

Haringey Roadside

The NOx analyser suffered a variety of faults during the quarter, and the Equipment Support Unit (ESU) failed to adequately rectify them In addition there were very few reliable calibrations carried out; as a result, all data for this quarter have been deleted. In addition, the $PM_{2.5}$ FDMS analyser was serviced in error on 18 August, which introduced a fault. At the QA/QC audit on 3 September, it was found that the sharp cut cyclone had not been fitted, presumably since the service. Data from 10 August to the scheduled service on 29 September have been deleted.

London Eltham

The ozone generator in the NOx analyser failed on 19 August. The ESU removed the analyser for repair, and finally returned the analyser to site on 17 December. In addition, the $PM_{2.5}$ analyser suffered frequent drier faults; the drier was replaced on 14 November.

London North Kensington

Both FDMS analysers gave high responses during the zero tests in July. The PM_{10} data have been deleted from 22 July to the drier replacement on 22 September; the $PM_{2.5}$ data have been deleted from 22 July to the end of the quarter. Further data loss is likely in Q4.

London Teddington Bushy Park

The poor quality $PM_{2.5}$ data issues remain in this quarter; all data have been deleted. The mass transducer was broken during the QA/QC audit on 14 August; repairs were completed on 30 September.

Southwark A2 Old Kent Road

The site remained closed for the entire quarter due to impending enclosure replacement.

3.2 England (excluding London)

3.2.1 Data Capture

	CO	PM_{10}	$PM_{2.5}$	NO_2	O_3	SO_2	Mean
Barnsley Gawber				98.10	98.05	97.69	97.95
Barnstaple A39		97.64	81.07				89.36
Bath Roadside				98.32			98.32
Billingham				89.86			89.86
Birmingham Acocks Green			96.33	98.14	98.64		97.71
Birmingham Tyburn		91.03	94.07	98.46	98.51	97.74	95.96
Birmingham Tyburn Roadside		94.97	93.93	95.79	97.42		95.53
Blackburn Accrington Road				99.41			99.41
Blackpool Marton			75.63	94.25	98.46		89.45
Bottesford					93.66		93.66
Bournemouth			44.57	46.60	46.56		46.54
Brighton Preston Park			94.57	98.51	98.64		98.49
Bristol St Paul's		87.64	0.00	77.81	97.69		65.78
Cambridge Roadside				74.68			74.68
Canterbury				97.83	98.64		98.23
Carlisle Roadside		53.53	52.22	62.32			56.02
Charlton Mackrell				98.37	99.50		98.94
Chatham Centre Roadside		92.26	92.80	93.84			92.96
Chesterfield Roadside		95.43	90.13	78.89			88.15
Coventry Allesley			92.48	98.46	98.41		96.45
Eastbourne		37.14	37.18	41.49			38.60
Exeter Roadside				89.09	89.40		89.24
Glazebury				81.79	98.82		90.31
Great Dun Fell					99.68		99.68
Harwell		35.37	96.47	99.23	99.82	99.73	86.12
Harwell		92.39	97.83				95.11
High Muffles				80.21	75.77		77.99
Honiton				98.41			98.41
Horley				95.02			95.02
Hull Freetown		61.78	91.35	97.33	97.55	97.42	89.09
Ladybower				52.58	94.88	94.61	80.69
Leamington Spa		93.98	95.02	94.02	98.69		95.43
Leamington Spa Rugby Road		53.67	94.07	97.60			81.78
Leeds Centre	97.15	94.38	93.61	92.66	97.15	92.71	94.61
Leeds Headingley Kerbside		76.63	94.52	98.55			89.90
Leicester University			96.56	86.78	97.96		93.77
Leominster				37.27	97.92		67.60
Lincoln Canwick Road				98.51			98.51
Liverpool Queen's Drive Roadside				98.41			98.41
Liverpool Speke		87.50	91.89	97.24	97.33	97.15	94.22

	CO	PM_{10}	$PM_{2.5}$	NO_2	O_3	SO_2	Mean
Lullington Heath				22.28	98.46	94.43	71.72
Manchester Piccadilly			94.02	94.11	97.28	96.78	95.55
Manchester South				98.37	98.41		98.39
Market Harborough				94.16	98.01		96.08
Middlesbrough		92.57	91.26	44.57	97.51	97.92	84.76
Newcastle Centre		41.12	40.13	37.09	42.84		40.30
Newcastle Cradlewell Roadside				95.43			95.43
Northampton Kingsthorpe			100.00	98.37	95.88		97.18
Norwich Lakenfields		96.24	90.26	98.46	98.64		95.90
Nottingham Centre		87.68	92.26	97.42	97.42	82.74	91.50
Oldbury Birmingham Road				73.05			73.05
Oxford Centre Roadside				99.28			99.28
Oxford St Ebbes		45.06	92.48	99.41			78.99
Plymouth Centre		94.93	75.91	96.42	98.46		91.43
Portsmouth		82.97	85.55	88.54	98.69		88.94
Preston			42.44	50.86	50.86		48.05
Reading New Town		95.79	68.98	98.32	98.51		90.40
Rochester Stoke		94.79	93.52	98.28	98.51	94.25	95.87
Salford Eccles		97.10	96.97	94.25			96.11
Saltash Callington Road		93.61	20.79				57.20
Sandy Roadside		0.00	82.07	88.13			56.73
Scunthorpe Town		88.18		99.05		99.32	95.52
Shaw Crompton Way				79.44			79.44
Sheffield Devonshire Green		61.68	94.43	99.68	99.68		88.87
Sheffield Tinsley				86.37			86.37
Sibton					99.82		99.82
Southampton Centre		94.84	94.97	97.28	96.83	93.30	95.44
Southend-on-Sea			0.59	89.63	91.89		60.70
St Osyth				93.80	97.60		95.70
Stanford-le-Hope Roadside		95.11	88.00	98.69			93.93
Stockton-on-Tees Eaglescliffe		82.84	93.84	98.51			91.73
Stoke-on-Trent Centre		91.76	96.24	96.42	98.78		95.80
Storrington Roadside		84.10	84.51	97.96			88.86
Sunderland Silksworth			48.32	62.05	61.55		57.31
Thurrock		98.05		98.60	98.69	98.37	98.43
Walsall Woodlands				99.77	99.91		99.84
Warrington		91.67	58.92	99.59			83.39
Weybourne					99.91		99.91
Wicken Fen				93.34	93.39	93.12	93.28
Wigan Centre			67.75	95.83	91.85		85.14
Wirral Tranmere			97.01	98.05	98.37		97.81
Yarner Wood				81.20	81.16		81.18
York Bootham		97.33	97.01				97.17
York Fishergate		96.47	96.65	96.33			96.48

	CO	PM_{10}	$PM_{2.5}$	NO_2	O_3	SO_2	Mean
Number of Sites	**1**	**39**	**50**	**76**	**52**	**16**	**84**
Number of sites < 85 %	**0**	**13**	**17**	**18**	**6**	**1**	**22**
Number of sites < 90%	**0**	**17**	**19**	**25**	**7**	**1**	**35**
Network mean	**97.15**	**80.75**	**79.62**	**87.69**	**93.23**	**95.45**	**87.18**

3.2.2 Principal Reasons for Data Loss

Barnstaple A39

The $PM_{2.5}$ cyclone was found to have been removed when the sampling head was replaced following zero checks on 14 July. Some further data were lost in September following a cooler fault.

Billingham

A poorly performing NOx converter was identified in August, following replacement of the converter in June. Data between 11 and 16 August have been deleted.

Bournemouth

The power was turned off from 18 July to 4 September due to an electrical fault with the air conditioning unit.

Bristol St Pauls

The $PM_{2.5}$ analyser was relocated inside the cabin on 27 May to allow better roof access. Following this, the $PM_{2.5}$ data were unstable, and despite several visits, the analyser was removed for workshop repair, returning to service on 17 October.

Cambridge Roadside

The converter was found to be faulty at the QA/QC audit, although it appeared to have rectified itself by the following service. Data between the audit and the service have been deleted.

Carlisle Roadside

The air conditioning unit failed causing a power cut on 24 July, followed by a considerable period of high cabin temperatures causing instrument faults and poor quality data.

High Muffles

All data were lost between 10 and 24 July due to a communication failure with the site.

Leamington Spa Rugby Road

The PM_{10} analyser was reinstalled at site on 27 July following workshop repair. Some further data were lost while the analyser settled down.

Sandy Roadside

The persistent problems with the PM_{10} analyser continued through this period, with the analyser ultimately removed for workshop repair. In addition some $PM_{2.5}$ data were lost due to a power failure, and from a slightly extended zero test.

Ladybower

The NOx analyser developed a fault on 22 July, and was removed from site for workshop repair. A loan analyser was installed on 29 July, but this too developed a fault, resulting in the loss of data up to 13 August.

Middlesbrough

The NOx filter holder was found to be leaking at the service on 20 August, data from 1 July to the service have been deleted.

Newcastle Centre

The station was closed from 4 August to 25 September for installation of a new cabin. Once site operation recommenced, a leak in the NOx sampling system resulted in internal sampling; the NOx data have been deleted up to the end of the quarter.

Oxford St Ebbes

Following deletion of data up to 28 May, the volatile PM_{10} data continue to be a regional outlier into this quarter, and data have been deleted up to 13 August.

Preston

The station was closed from 21 July to 2 September for installation of a new cabin.

Portsmouth

Both FDMS analysers gave very high baselines at the summer QA/QC audit. The PM_{10} data between 12 and 22 September, and the $PM_{2.5}$ data between At the QA/QC audit in October, it was found that the NOx analyser was connected to a redundant sample manifold, resulting in internal sampling. Data have been deleted from a suspected service on 2 September.

Saltash Callington Road

The $PM_{2\ 5}$ data have shown to be of poor quality throughout the quarter. The drier was replaced on 24 July, and following several further visits, data remained poor until a replacement mass transducer was fitted in October.

Sandy Roadside

The PM_{10} FDMS analyser continued to perform poorly for the duration of this quarter, ultimately being removed for workshop repair. All data for this quarter have been deleted. Further data loss in the fourth quarter is inevitable.

Shaw Crompton Way

A NOx converter fault was repaired on 17 July; data from 1 to17 July have been deleted.

Sheffield Devonshire Green

The PM_{10} FDMS suffered a valve failure from 8 July to 12 August.

Sheffield Tinsley

The analyser suffered a converter temperature fault which was repaired on 31 July; data from 24 July have been deleted

Southend on Sea

The drier in the $PM_{2.5}$ FDMS was identified as being faulty at the beginning of July; this drier was of a different type to most in the network, and a delay in obtaining a replacement resulted in the loss of data from 1 July to 17 October.

Sunderland Silksworth

The station was closed from 1 to 30 September for installation of a new cabin.

Warrington

The air conditioning unit failed, resulting in the loss of data from 7 to 25 July. A suspected $PM_{2\ 5}$ valve failure on 27 August was repaired on 1 September, but a further fault required a return visit, finally fixed on 8 September

Wigan Centre

The $PM_{2.5}$ zero check was rather longer than intended, from 20 August to 2 September; following this, incorrect filters were installed, and data up to 9 September were deleted during ratification.

Yarner Wood

The station was closed from 26 August to 12 September for installation of a new cabin.

3.3 Scotland

3.3.1 Data Capture

The data capture for the sites in Scotland is given in Table 3.3

Table 3.3 Data Capture-Scotland

	CO	PM_{10}	$PM_{2.5}$	NO_2	O_3	SO_2	Mean
Aberdeen		64.90	82.16	86.96	99.05		83.27
Aberdeen Union Street Roadside				88.54			88.54
Auchencorth Moss (Partisol)		98.91	96.74		98.46		98.41
Auchencorth Moss		94.20	82.93				88.56
Bush Estate				95.29	98.69		96.99
Dumbarton Roadside				98.55			98.55
Dumfries				98.41			98.41
Edinburgh St Leonards	44.20	72.92	73.01	77.17	77.17	76.99	70.24
Eskdalemuir				98.78	98.82		98.80
Fort William				97.92	98.05		97.98
Glasgow Great Western Road				99.82			99.82
Glasgow Kerbside		82.29	45.29	98.28			75.29
Glasgow Townhead		92.03	85.28	98.32	98.41		93.51
Grangemouth		95.92	96.56	98.37		97.33	97.04
Grangemouth Moray				75.77			75.77
Inverness		93.48	98.91	98.60			98.41
Lerwick					0.00		0.00
Peebles				98.46	98.51		98.48
Strath Vaich					99.64		99.64
Number of Sites	**1**	**8**	**8**	**15**	**10**	**2**	**19**
Number of sites < 85 %	**1**	**3**	**4**	**3**	**2**	**1**	**5**
Number of sites < 90%	**1**	**3**	**5**	**5**	**2**	**1**	**7**
Network mean	**44.20**	**77.18**	**82.61**	**93.27**	**86.68**	**87.16**	**87.25**

3.3.2 Principal Reasons for Data Loss

Aberdeen

Both FDMS analysers showed excessively high sample dewpoints during the quarter, and the PM_{10} analyser also gave a high zero result at the summer audit. The PM_{10} data have been deleted from 13 August to 10 September; a new drier was fitted on 3 September. The $PM_{2.5}$ data were also deleted from 18 August to 3 September; possibly cabin temperatures were too high. Some NOx data was lost due to a pump fault in July.

Aberdeen Union Street Roadside

Data were deleted from 7 to 15 July due to a pump fault

Edinburgh St Leonards

The station was closed from 12 September to 11 December for installation of a new cabin.

Glasgow Kerbside

The poor performance of the FDMS analysers, particularly the $PM_{2.5}$, continued this quarter; leaks in both analysers were found at the summer audit. The driers were replaced on 8 August which resulted in improved data.

Grangemouth Moray

A communications fault resulted in the loss of data from 4 to 13 September. In addition, the run-on of the overnight span check resulted in the loss of one hour's data each night.

Lerwick

Lerwick remained closed due to relocation of the site.

3.4 Wales

3.4.1 Data Capture

The data capture for the sites in Wales is given in Table 3.4

Table 3.4 Data Capture-Wales

	CO	PM_{10}	$PM_{2.5}$	NO_2	O_3	SO_2	Mean
Aston Hill				94.20	98.32		96.26
Cardiff Centre	97.51	84.65	93.16	97.37	97.46	97.10	94.54
Chepstow A48		96.78	78.22	69.25			81.42
Cwmbran				98.41	99.95		99.18
Narberth		67.12		97.37	97.24	97.37	89.78
Newport		92.75	93.39	93.93			93.36
Port Talbot Margam (Partisol)		98.91					98.91
Port Talbot Margam	96.60	89.76	0.00	70.56	96.78	96.65	75.06
Swansea Roadside		91.08	91.89	98.19			93.72
Wrexham		84.78	69.57	82.25		97.51	89.37
Number of Sites	**2**	**8**	**6**	**9**	**5**	**4**	**10**
Number of sites < 85 %	**0**	**3**	**3**	**3**	**0**	**0**	**3**
Number of sites < 90%	**0**	**4**	**3**	**3**	**0**	**0**	**5**
Network mean	**97.06**	**88.23**	**71.04**	**89.06**	**97.95**	**97.16**	**91.16**

3.4.2 Principal Reasons for Data Loss

Chepstow A48

A fault with the memory storage in the NOx analyser resulted in the loss of data from 8 August to 2 September. In addition, the PM2.5 data were poor from the service on 4 August up to a callout on 21 August, when the sensor unit was replaced; data have been deleted between the visits.

Narberth

The PM_{10} volatile concentrations were identified as a regional outlier up to 29 July; data up to this point have been deleted during ratification.

Port Talbot Margam

A leak was discovered in the $PM_{2.5}$ FDMS at the service on 2 September. The data remained low until a further visit to retune the amplifier board on 20 November. Data have been deleted back to 26 January.

Wrexham

The NOx analyser appears to have been sampling internally from 12 to 26 August. The $PM_{2.5}$ Partisol pump failed on 6 July; 23 days data were lost. The PM_{10} Partisol suffered a number of filter exchange faults in July and August, and both sets of filters were returned wet up to 12 August.

3.5 Ireland

3.5.1 Data Capture

Table 3.5 Data Capture-Ireland

	CO	PM_{10}	$PM_{2.5}$	NO_2	O_3	SO_2	Mean
Armagh Roadside		27.67		0.00			13.84
Ballymena Ballykeel						98.19	98.19
Belfast Centre	73.32	94.07	94.20	92.71	97.10	98.28	91.61
Belfast Stockman's Lane		98.60		98.64			98.62
Derry		96.47	84.19	94.88	99.50	93.70	93.75
Lough Navar		95.70			99.73		97.71
Mace Head					100.00		100.00
Number of Sites	**1**	**5**	**2**	**4**	**4**	**3**	**7**
Number of sites < 85 %	**1**	**1**	**1**	**1**	**0**	**0**	**1**
Number of sites < 90%	**1**	**1**	**1**	**1**	**0**	**0**	**1**
Network mean	**73.32**	**82.50**	**89.20**	**71.56**	**99.08**	**96.72**	**84.82**

3.5.2 Principal Reasons for Data Loss

Armagh Roadside

The NOx data have been deleted for the quarter as there were apparently no calibrations carried out for more than 3 months, and there is no evidence that the filter had been changed during this period.

The volatile PM_{10} data look low compared to other local sites, and despite requests to the ESU to attend, no repairs were carried out. Data from 22 May to 3 September have been deleted.

4 Particle Analyser Zero Checks

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

The study initially concentrated on FDMS analysers, examining the baseline profile of the reference channels and the relationship with other neighbouring monitoring stations. It has become clear that, on a daily mean basis, regional reference PM concentrations regularly reach a minimum value that approaches 0 μgm^{-3}. The test is equally valid for BAM instruments, and thus the tests are also carried out on these.

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

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

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

Section B: Summer 2014 Intercalibration

4 Introduction

During July to September 2014, Ricardo-AEA undertook an intercalibration of 134 monitoring stations in operation in the Defra and the Devolved Administrations Automatic Urban and Rural Monitoring Network. The intercalibration exercise is a vital step in the process of data ratification. The audits are used to undertake a number of analyser and infrastructure performance checks that cannot be performed by Local Site Operators, with a view to ensuring confidence in the accuracy, consistency and traceability of air pollution measurements made at all the monitoring stations.

The intercalibration requires the coordination and close cooperation of QA/QC unit, Management Units, ESU's and LSO's in making sure the entire operation runs smoothly and is the result of many months of planning. Leading up to the intercalibration, a draft schedule of visits is prepared and circulated to MU's and ESU's for approval. ESU ozone photometers are calibrated at Ricardo-AEA and all QA/QC equipment and cylinders are tested, calibrated and verified before use.

QA/QC visits are always undertaken before any ESU visits, to allow the performance of the sites to be quantified for the six month period prior to the visit. During the QA/QC visit, the LSO usually attends to demonstrate their competence in performing routine calibrations. The audits are used to transport independent calibration standard gases and test apparatus to all of the sites, to quantify the performance of the entire measurement process at the monitoring stations. The results obtained from these tests are fed into the ratification process, where any correction of datasets can be applied to account for any performance anomalies.

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

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

5 Scope of Intercalibration Exercise

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

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

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

1. Analyser accuracy and precision. These are basic checks to ensure analysers respond to known concentrations of gases in a reliable manner.
2. Instrument linearity. This test refines the response checks on analysers, by assessing whether doubling a concentration of gas to the analyser results in a doubling of the analyser signal response. If an analyser's response characteristics are not linear, data cannot be reliably

scaled into concentrations.

3. Instrument signal noise. This test checks that an analyser responds to calibration gases in a stable manner with time. A "noisy" analyser may not provide high quality data which may be difficult to process at lower concentrations.
4. Analyser response time. This test checks that the analyser responds quickly to a change in gas concentrations. If analyser response is too slow, data may not accurately reflect ambient concentrations.
5. Leak and flow checks. These tests ensure that ambient air reaches the analysers, without being compromised in any way. Leaks in the sampling system can affect the ability of the analyser to sample ambient air reliably.
6. NOx analyser converter efficiency. This test evaluates the ability of the analyser to measure NO_2. An inefficient converter severely compromises the data from the analyser.
7. FDMS k_0 evaluation. The analyser uses this factor to calculate mass concentrations, so the value is calculated to determine its accuracy compared to the stated value.
8. Particulate analyser flow rate checks. These tests ensure that the flow rates through critical parts of the analyser are within specified limits. There are specific analyser flow rates that are set to make sure particle size fractions and mass concentration calculations are performed correctly.
9. SO_2 analyser hydrocarbon interference. This test evaluates the analyser's ability to remove interfering hydrocarbon gases from the sample gas. A failed test could have significant implications for analyser data.
10. Evaluation of site cylinder concentrations. These tests use a set of Ricardo-AEA certified cylinders that are taken to all the sites. The concentrations of the site cylinders are used to scale pollution datasets, so it is important to ensure that the concentrations of gases in the cylinders do not change.
11. Competence of Local Site Operators (LSO) in undertaking calibrations. As it is the calibrations by the LSO's that are used to scale pollution datasets, it is important to check that these are undertaken competently.
12. Zero "calibration" of all automatic PM analysers. This test allows the baseline performance of PM analysers to be evaluated, to determine whether any remedial action is required.

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

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

- The analyser responses to audit gas are converted into concentrations, using provisional calibration factors obtained from the Management Units on the day of the intercalibration. These factors are also used for the provisional data supplied to the web/interactive TV services.
- These individual results are tabulated, and statistical analyses undertaken (e.g. network average result, network standard deviation, deviation of individual sites from the network mean etc.).

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

- ±10% of the network average for NOx, CO and SO_2 analysers,
- ±5% of the reference standard photometer for Ozone analysers,
- ±2.5 % of the stated ko value for FDMS analysers,
- ±10% for particulate analyser flow rates,
- Particulate analyser average zero response within ±3.0 µg/m^3.
- ±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.

6 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.

6.1 National Network Overview

6.1.1 Summary

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

Table 6.1 - Summary of audited analyser performance – 134 UK stations

Parameter	Number of outliers	Number in network	% outliers in total
NOx analyser	23	115	20 (15)%
CO analyser	0	7	0%
SO_2 analyser	6	30	20 (20)%
Ozone analyser	21	81	26 (28)%
FDMS and BAM analysers	1 k_0, 10 flow, (17 zero)	57 FDMS PM_{10} 2 BAM PM_{10} 69 FDMS $PM_{2.5}$ 2 BAM $PM_{2.5}$	8 (7)%
Gravimetric PM analysers	1 flow	9 PM_{10} 9 $PM_{2.5}$	6%
Total	62	381	16.3%

Four sites were not in operation at the time of the intercalibration. Replacement locations are currently being sought for the sites at Bury Roadside, Chesterfield and Glasgow Centre. The station at Southwark A2 Old Kent Road is currently suspended pending repair of the air conditioning unit.

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

The number of analyser outliers identified is worse than the previous exercise. At the Winter 2014 intercalibration 14.5% of the analysers in use were identified as outliers.

The procedures used to determine network performance are documented in Ricardo-AEA Work Instructions. These methods are regularly updated and improved and are evaluated by the United Kingdom Accreditation Service (UKAS). Ricardo-AEA holds ISO17025 accreditation for the on-site calibration of all the analyser types (NO_x, CO, SO_2, O_3) and for the determination of the FDMS k_0 factor and particulate analyser flow rates used in the network. An ISO17025 certificate of calibration (Calibration Laboratory number 0401) for the analysers in the AURN is appended to this report.

6.1.2 Network Intercomparisons

The concentration of the audit cylinders was calculated averaged across all monitoring sites using the zero and scaling factors provided by the CMCU on the day of audit. How close the result is to the stated cylinder concentration is a good indication of the accuracy of the provisional results across the entire network. The results are given in Table 9.2. Certified cylinder concentrations are normalised for this purpose as several cylinders are used.

Table 6.2 Audit Cylinder Results

Parameter	Network Mean	Audit reference concentration	Network Accuracy %	%Std Dev
NO	488 ppb	482 ppb	1.3	4.3
NO_2	494 ppb	497 ppb	-0.6	4.7
CO	21.2 ppm	21.3 ppm	-0.4	4.6
SO_2	463 ppb	449 ppb	3.2	4.9

- Oxides of Nitrogen.

  A total of 23 outliers (20%) were identified during this intercalibration. This is worse than the previous exercise - 15% of the analysers were identified as outliers in the winter exercise. Of these outliers, nine can be attributed to analyser drift, seven to changes in site cylinder concentration and five to issues experienced during the audit which compromised the results. There is a multitude of logger types in use at one site (Scunthorpe) which meant that the audit and previous LSO calibrations were recorded using different systems. All of the above outliers can be corrected with no data loss or impact on data quality.

  There was one converter which fell outside the ±5% acceptance limits. There were four further converters identified where the initial result was outside the ±2% trigger for NO_2 rescaling. Additional analysis showed that a total of two outlier converters required rescaling or data deletion to be undertaken.

- Carbon Monoxide

  There were no outliers identified at this intercalibration. No outliers were identified at the previous exercise.

- Sulphur Dioxide

A total of six outliers (20%) were identified at this intercalibration. This is the same as the winter exercise. All m-xylene interference tests were less than 21ppb, compared to 20ppb in winter 2014.

- Ozone

  A total of 21 outliers (26%) were identified during the winter exercise. This is slightly better than the previous intercalibration, where 23 analysers were found to be outside the ±5% acceptance criterion.

- Particulate Analysers

  There was a single calculated k_0 determination outside the required ±2.5% of the stated values. Three outliers were identified at the previous exercise.

  Eight FDMS main flows were found to be outside the ±10% acceptance limits. two BAM total flows were found to be outside this limit. This total is worse than the previous exercise; a total of six analyser flow outliers were identified in the winter.

  A single Partisol analyser total flows was outside the acceptance limits. There were no outliers identified at the winter exercise

- PM analyser zero tests

  A total of 17 analysers (9%) gave average responses to particle-free air that were higher than ±3μg/m^3. This is worse than the previous exercise, where 12 responses were higher than 3μg/m^3. These results will be fed into the ratification process to determine appropriate action.

- Site Cylinder Concentrations

  14 of the 275 site cylinders (5.1%) used to scale ambient pollution data were found to be outside the ±10% acceptance limit, better than the 6.2% identified in the winter.

6.2 London Sites

The results of the intercomparison for the 15 London sites in operation at the time of the intercalibration are summarised below:

Table 6.3 - Summary of audited analyser performance – London Sites

Parameter	Number of outliers	Number in region
NOx analyser	3	12
NOx converter	1	
CO analyser	0	3
SO_2 analyser	0	4
Ozone analyser	4	9
FDMS and BAM analysers	0 k_0, 0 flow (2 zero)	5 FDMS PM_{10} 10 FDMS $PM_{2.5}$
Gravimetric PM analysers	0	2 PM_{10}

		3 $PM_{2.5}$
Cylinders	1	35

6.3 Scottish Sites

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

Table 6.4 - Summary of audited analyser performance – Scottish Sites

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

6.4 Welsh Sites

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

Table 6.5 - Summary of audited analyser performance – Welsh Sites

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

6.5 Northern Ireland Sites (incl. Mace Head)

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

Table 6.6 - Summary of audited analyser performance – Northern Irish Sites

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

6.6 English Sites

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

Table 6.7 - Summary of audited analyser performance – English Sites

Parameter	Number of outliers	Number in region
NOx analyser	17	76
NOx converter	3	
CO analyser	0	1
SO_2 analyser	4	16
Ozone analyser	14	53
FDMS and BAM analysers	0 k_0, 4 flow (11 zero)	37 FDMS PM_{10} 1 BAM PM_{10} 46 FDMS $PM_{2.5}$ 1 BAM $PM_{2.5}$
Gravimetric PM analysers	0	1 PM_{10} 4 $PM_{2.5}$
Cylinders	9	191

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.

7 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 14 of the 275 cylinders (6.1%) 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 4.3% (12) of the scaling cylinders were outside the acceptance limits. There were 9 NO cylinders identified as outliers.

Of the nine NO cylinders, one appears to have been contaminated (York Fishergate); significant oxidation of the NO into NO_2 has occurred since the last intercalibration. The cylinder has been replaced and the performance of the new cylinder will be closely monitored at subsequent audits.

Two NO cylinders showed significant drift and have been replaced.

Four SO_2 cylinders showed continued drift from the last intercalibration (Derry, Leeds Centre, Nottingham and Wrexham) and have been replaced.

The remaining six NO cylinders and the one SO_2 cylinders will be checked at the next audits and appropriate action taken if necessary.

8 Site Information

All site information is now uploaded to CMCU and UK-Air archive for dissemination using Google Earth. Ricardo-AEA makes considerable effort in ensuring that site locations are accurate on the new Google Earth site information and UK-Air archive pages. All future additions to the AURN will include accurate positioning using Google Earth.

9 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 needed to be replaced before June 2013. Ricardo-AEA has taken steps to ensure the procedures used in the UK comply with the requirements ahead of any imposed deadlines. To this end, the procedures used for the intercomparisons have been fully compliant with the CEN protocols since January 2006.

To comply with the Directive, the uncertainty for gaseous analyser measurements must be less than ±15%. For PM analysers, the required measurement uncertainty is less than ±25%. For sites that have CEN-compliant 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 9.1 – Analyser measurement uncertainties

Date	Site	O_3	CO	SO_2	NO_2	PM_{10}	$PM_{2.5}$
23-Jul	Barnsley Gawber	8.3		11.7	9.8		
10-Jul	Bath Roadside				12.6		
01-Aug	Billingham				11.7		
14-Jul	Birmingham Acocks Green	11.2			12.5		16.4
14-Jul	Birmingham Tyburn	7.4		12.4	13.1	8.8	16.4
15-Jul	Birmingham Tyburn Road	11.2			12.3	8.7	16.4
15-Jul	Blackburn Accrington Rd				11.1		
16-Jul	Blackpool Marton	8.3			9.8		17.5
11-Jul	Bottesford	8.3					
	Bournemouth						
15-Jul	Brighton Preston Park	11.2			11.2		11.0
09-Jul	Bristol St Paul's	11.4			12.5	8.7	16.4
29-Jul	Cambridge Roadside				12.1		
04-Jul	Canterbury	11.2			12.0		
15-Jul	Carlisle Roadside				11.1	8.7	16.4
20-Aug	Charlton Mackrell	10.4			10.9		
03-Jul	Chatham Centre Roadside				13.1	8.7	16.4
	Chesterfield				site	not	online
22-Jul	Chesterfield Roadside				11.1	8.7	16.4
05-Aug	Coventry Allesley	8.3			11.3		16.4
06-Jun	Coventry Memorial Pk	10.7			10.0		
15-Jul	Eastbourne				12.2	8.7	16.4
09-Jul	Exeter Roadside	7.9			13.2		
18-Aug	Glazebury	11.2			12.2		
07-Jul	Great Dun Fell	11.7					
26-Aug	Harwell	11.2		10.0	12.2	8.7	16.4
26-Aug	Harwell Partisol					8.0	11.0
31-Jul	High Muffles	11.2			10.9		
08-Jul	Honiton				12.4		
14-Jul	Horley				18.8		
09-Jul	Hull Freetown	8.3		11.0	11.6		
22-Jul	Ladybower	11.4		8.7	fault		
10-Jul	Leamington Spa	10.4			11.5	10.5	16.4
10-Jul	Leamington Spa Rugby Road				12.2	fault	16.4
09-Jul	Leeds Centre	8.3	8.2	12.8	11.7		
09-Jul	Leeds Headingley Kerbside				12.2		
07-Aug	Leicester University	8.3			9.9		16.4
18-Aug	Leominster	11.2			12.2		
08-Jul	Lincoln Canwick Road				12.5		
03-Jul	Liverpool Queen's Drive Roadside				12.2		
03-Jul	Liverpool Speke	8.3		10.0	11.0	11.1	16.4
21-Aug	Lullington Heath	11.2		8.7	11.0		
19-Aug	Manchester Piccadilly	8.3		10.0	12.2	9.3	16.4
19-Aug	Manchester South			10.1	12.2		
07-Aug	Market Harborough	8.6			9.8		
01-Aug	Middlesbrough	11.2		10.7	11.3	8.7	16.4
30-Jul	Newcastle Centre	8.3			10.4	8.7	16.4
30-Jul	Newcastle Cradlewell Roadside				11.2		
06-Aug	Northampton Kingsthorpe	7.3			13.7		11.0

Date	Site	O_3	CO	SO_2	NO_2	PM_{10}	$PM_{2.5}$
30-Jul	Norwich Lakenfields	8.3			9.9	8.7	16.4
09-Jul	Nottingham Centre	8.3		8.9	9.8	8.7	16.4
26-Aug	Oxford Centre Roadside				13.1		
26-Aug	Oxford St Ebbes	10.4			11.9	8.7	16.4
08-Jul	Plymouth Centre	8.3			9.9	8.7	16.4
28-Aug	Portsmouth	8.3			13.0	19.4	16.4
03-Sep	Preston				9.8		16.4
29-Aug	Reading New Town	8.3			11.1	8.7	16.4
03-Jul	Rochester Stoke			10.1	17.0	8.7	16.4
20-Aug	Salford Eccles	10.4			11.1	9.4	16.4
	Saltash Callington Road						
28-Jul	Sandy Roadside				12.4	12.3	16.4
08-Jul	Scunthorpe Town			4.1	11.4	8.7	
21-Aug	Shaw Crompton Way				12.2	9.3	
21-Jul	Sheffield Devonshire Grn	8.3			11.3		
21-Jul	Sheffield Tinsley				11.0		
11-Sep	Sibton	11.2					
12-Aug	Southampton Centre	8.3		10.3	9.8	8.7	16.4
01-Jul	Southend-on-Sea	8.3			9.8		16.4
01-Jul	St Osyth	8.3			9.8		
30-Jun	Stanford-le-Hope Road				12.4	8.7	16.4
31-Jul	Stockton-on-Tees Eaglescliffe				12.2	9.3	12.6
30-Jun	Stoke-on-Trent Centre				12.2	8.7	16.4
16-Jul	Storrington Roadside				11.5	15.3	16.4
29-Jul	Sunderland Silksworth	11.2			12.1		16.4
30-Jun	Thurrock	11.2		10.0	12.2	8.7	
16-Jul	Walsall Woodlands	12.4			12.4		
02-Jul	Warrington			9.8	11.1	8.7	16.4
31-Jul	Weybourne	8.4					
29-Jul	Wicken Fen	11.2		10.0	11.1		
20-Aug	Wigan Centre	8.3			11.3		16.4
01-Jul	Wirral Tranmere	8.3			10.7		16.4
19-Aug	Yarner Wood	11.2			10.9		
23-Jul	York Bootham					8.7	16.4
08-Jul	York Fishergate				11.8		
13-Aug	Camden Kerbside				16.7	8.7	16.4
22-Jul	Ealing Horn Lane					8.7	
11-Aug	Haringey Roadside				16.1		16.4
05-Aug	London Bexley			10.1	18.4		16.4
06-Aug	London Bloomsbury	11.2		10.0	12.4	11.2	16.4
21-Jul	London Eltham	10.4			12.2		16.4
11-Aug	London Haringey Priory Park South	10.4			15.2		
31-Jul	London Harlington	13.2			12.2	8.7	16.4
13-Aug	London Harrow Stanmore						16.4
31-Jul	London Hillingdon	9.8			14.3		
24-Jul	London Marylebone Rd			10.0	12.2	8.7	16.4
24-Jul	London Marylebone Road Partisol					8.0	11.0
22-Jul	London N. Kensington	11.2	7.5	10.0	12.8	8.7	16.4
22-Jul	London N. Kensington Partisol					8.0	11.0
14-Aug	London Teddington	11.2			13.0		
14-Aug	London Teddington Bushy Park					8.7	
30-Jul	London Westminster				11.3		11.0

Date	Site	O_3	CO	SO_2	NO_2	PM_{10}	$PM_{2.5}$
	Southwark A2 OKR						
07-Aug	Tower Hamlets Roadside				11.5		
28-Aug	Armagh Roadside				11.5	8.7	
25-Aug	Ballymena Ballykeel			9.9			
29-Aug	Belfast Centre	8.3	7.5	10.3	9.8	8.7	16.4
20-Aug	Derry	11.2		10.6	12.6	9.8	16.4
18-Aug	Lough Navar	11.2				8.7	
18-Aug	Mace Head	N/A					
13-Aug	Aberdeen	11.2			10.9	8.7	16.4
14-Aug	Aberdeen Union Street Roadside				12.2		
06-Aug	Auchencorth Moss	11.2				10.1	16.4
06-Aug	Auchencorth Moss Partisol					12.0	11.0
06-Aug	Bush Estate	11.2			13.0		
24-Jul	Dumbarton Roadside				12.6		
14-Jul	Dumfries				10.9		
07-Jul	Edinburgh St Leonards	11.5	8.8	10.1	17.0	8.7	16.4
14-Jul	Eskdalemuir	11.2			12.2		
23-Jul	Fort William				12.4		
21-Jul	Glasgow Kerbside				10.5	8.7	16.4
21-Jul	Glasgow Townhead	8.3			11.0	11.4	16.4
04-Aug	Grangemouth			10.7	11.7	8.7	16.4
04-Aug	Grangemouth Moray				11.3		
14-Aug	Inverness				10.9	8.0	11.0
05-Aug	Peebles	11.2			12.2		
14-Aug	Strath Vaich	11.2					
18-Aug	Aston Hill	11.2			12.3		
24-Jul	Cardiff Centre	11.2		10.2	13.3	8.7	16.4
21-Jul	Chepstow A48				14.7	8.7	16.4
24-Jul	Cwmbran				13.0		
22-Jul	Narberth			10.0	11.2	8.7	
23-Jul	Newport				11.7	8.7	16.4
23-Jul	Port Talbot Margam	8.3	11.5	11.6	11.3	8.7	16.4
23-Jul	Port Talbot Margam Partisol					8.0	11.0
22-Jul	Swansea Roadside				12.5	41.7	41.1
01-Jul	Wrexham			9.7	10.9	8.0	11.0

This table is updated and extended after every intercalibration to include upgraded sites and replacement analysers.

The poor measurement uncertainty reported for the NOx analysers at Camden Kerbside, Haringey Roadside, Horley, London Bexley, London Haringey Priory Park South and Edinburgh St Leonards were all due to significant instrument noise recorded during the audit

The PM analysers at Swansea Roadside again arose as a result of the very low measured instrument flow rates at the audit. The significance of this will be examined fully during ratification.

The ozone analyser at Mace Head is not a CEN compliant model and therefore no generic performance data have been calculated.

10 Certification

The Network Certificate of Calibration is presented in Appendix 1. This certificate presents the results of the individual analyser scaling factors on the day of the audit, as calculated by Ricardo-AEA using the audit cylinder standards, in accordance with our ISO17025 accreditation

Appendices

Appendix 1: Certificate of Calibration

Appendix 1 – Certificate of Calibration

CERTIFICATE OF CALIBRATION

RICARDO-AEA

Ricardo-AEA, Gemini, Fermi Avenue Harwell, Didcot,
Oxfordshire OX11 0QJ
Telephone 01235 753212

0401

Certificate Number: 03064
Ricardo-AEA Calibration ID Number: ED57002030

Authorised Signatories: S Eaton
B Stacey

Signed:

Date of Issue: 26 February 2015

Customer Name and Address: John Newington
Atmosphere and Noise
Resource, Atmosphere and Sustainability
Department for Environment, Food and Rural Affairs
Area 2C Nobel House, 17 Smith Square, London, SW1P 3JR

Date of Calibration: July to September 2014

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

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

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

Certificate Number: 03064
Ricardo-AEA Calibration ID Number: ED57002030

1. Carbon Monoxide

Site	Date Year = 2014	Analyser number	[1]Zero output	Uncertainty (ppm)	[2]Calibration Factor	Uncertainty (%)	[3]Maximum Residual (%)
English Sites							
Leeds Centre	09-Jul	458	0.8	0.2	1.030	3.3	3.3
London Sites							
London Marylebone Road	24-Jul	10073	0.9	0.2	1.000	2.2	1.5
London N. Kensington	22-Jul	2313	0.3	0.2	1.056	2.2	1.1
Northern Irish Sites							
Belfast Centre	29-Aug	462	0.20	0.20	1.1152	2.3	0.8
Scottish Sites							
Edinburgh St Leonards	07-Jul	159	0.10	0.20	1.0503	2.4	4.2
Welsh Sites							
Cardiff Centre	24-Jul	12599	0.9	0.2	1.040	2.1	1.8
Port Talbot Margam	23-Jul	605214618	2.1	0.2	0.968	2.2	1.2

2. Sulphur Dioxide

Site	Date Year =2014	Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	[3]Max Residual (%)	[4]m-xylene interference (ppb)
English Sites								
Barnsley Gawber	23-Jul	08050082	5.1	2.5	0.906	3.5	2.4	-1.0
Birmingham Tyburn	14-Jul	EH937000	3.8	2.5	0.941	3.1	0.5	0.6
Harwell	26-Aug	83	4.3	2.5	0.931	3.1	0.3	9.7
Hull Freetown	09-Jul	342	2.8	2.5	0.886	3.6	4.1	3.7
Ladybower	22-Jul	1178	3.5	2.5	0.997	3.3	0.6	4.0
Leamington Spa	10-Jul	Analyser	not	present				
Leeds Centre	09-Jul	08050084	0.3	2.5	0.908	4.1	5.0	6.1
Liverpool Speke	03-Jul	17509	1.8	2.5	0.951	3.1	0.5	10.2
Lullington Heath	21-Aug	1179	5.1	2.5	0.914	3.2	0.4	10.7
Manchester Piccadilly	19-Aug	19216	-0.2	2.5	1.050	3.1	0.4	6.0
Middlesbrough	01-Aug	345	-1.6	2.7	1.335	3.7	3.6	6.4
Nottingham Centre	09-Jul	1629	-1.8	2.4	0.810	3.2	2.1	10.4
Rochester Stoke	03-Jul	2800	16.0	2.7	0.808	3.2	1.8	9.7
Scunthorpe Town	08-Jul	635b-258	-1.0	2.7	1.329	3.4	0.9	10.6
Southampton Centre	12-Aug	343	22.2	2.5	0.924	3.2	2.6	3.0
Thurrock	30-Jun	189	7.2	2.5	0.956	3.3	1.7	2.1
Wicken Fen	29-Jul	73	1.1	2.5	0.960	3.1	1.0	6.3
London Sites								
London Bexley	05-Aug	318	35.4	3.1	0.926	3.4	1.3	16.1
London Bloomsbury	06-Aug	74	1.2	2.5	0.936	3.1	0.1	9.6
London Marylebone Road	24-Jul	19220	1.3	2.5	1.036	3.2	0.1	11.3
London N. Kensington	22-Jul	2576	15.2	2.5	0.947	3.1	1.1	11.3
Northern Irish Sites								
Ballymena Ballykeel	25-Aug	4901234	3.0	2.7	0.931	3.4	1.1	14.0
Belfast Centre	29-Aug	1766	4.7	2.5	1.010	3.5	2.5	8.6
Derry	20-Aug	1697	-5.7	2.4	0.680	4.2	3.3	3.8
Scottish Sites								
Edinburgh St Leonards	07-Jul	84	5.4	2.5	0.922	3.3	2.1	11.8
Grangemouth	04-Aug	1211322	1.0	2.5	0.855	4.0	3.9	21.4

Certificate Number: 03064
Ricardo-AEA Calibration ID Number: ED57002030

Site	Date Year =2014	Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	[1]Max Residual (%)	[1]m-xylene interference (ppb)
Welsh Sites								
Cardiff Centre	24-Jul	14319	30.6	2.5	0.968	3.2	2.3	3.1
Narberth	22-Jul	14896	5.7	2.6	1.131	3.1	0.6	8.1
Port Talbot Margam	23-Jul	605214617	2.6	2.5	1.014	3.3	1.5	0.8
Wrexham	01-Jul	1181	23.3	2.4	0.736	3.6	3.9	16.1

3. Ozone

Site	Date Year =2014	Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	[1]Max Residual (%)
English Sites							
Barnsley Gawber	23-Jul	cm08060030	0.5	3	0.986	3.1	0.4
Birmingham Acocks Green	14-Jul	2435	-2.4	3	1.025	3.1	0.4
Birmingham Tyburn	14-Jul	WB6AG7TM	0.5	3	0.810	3.1	1.3
Birmingham Tyburn Roadside	15-Jul	2434	0.3	3	1.040	3.1	0.3
Blackpool Marton	16-Jul	CM08060037	0.2	3	1.030	3.1	0.0
Bottesford	11-Jul	CM08060022	-0.2	3	0.962	3.1	1.3
Bournemouth		Not Audited					
Brighton Preston Park	15-Jul	12461	5.3	3	0.925	3.2	1.0
Bristol St Paul's	09-Jul	155	-0.7	3	1.019	3.1	2.4
Canterbury	04-Jul	2448	7.6	3	0.891	3.1	0.5
Charlton Mackrell	20-Aug	1111957	0.5	3	0.993	3.1	0.2
Coventry Memorial Park	06-Jun	CM08060044	0.2	3	1.016	3.2	1.7
Exeter Roadside	09-Jul	F0100E0S	-3.2	3	0.768	3.5	2.8
Glazebury	18-Aug	19751	1.2	3	0.998	3.1	0.6
Great Dun Fell	07-Jul	1647	1.5	3	1.005	3.1	3.5
Harwell	26-Aug	1648	-1.1	3	1.008	3.1	0.7
High Muffles	31-Jul	1641	0.5	3	0.9676	3.1	1.6
Hull Freetown	09-Jul	cm68060045	0.3	3	0.988	3.0	0.5
Ladybower	22-Jul	1651	-1.0	3	0.957	3.1	2.5
Leamington Spa	10-Jul	411770	0.5	3	0.981	3.1	0.8
Leeds Centre	09-Jul	080060036	-1.2	3	0.925	3.0	0.2
Leicester University	07-Aug	CM08060020	-0.1	3	1.133	3.6	0.3
Leominster	18-Aug	170	2.4	3	1.007	3.1	0.4
Liverpool Speke	03-Jul	cm08060041	0.2	3	1.016	3.1	0.1
Lullington Heath	21-Aug	1644	-0.7	3	1.005	3.1	0.2
Manchester Piccadilly	19-Aug	0	-0.1	3	1.065	3.1	0.3
Manchester South	19-Aug	16954	-0.8	3	1.037	3.1	0.5
Market Harborough	07-Aug	CM08060031	1.5	3	1.083	3.7	2.5
Middlesbrough	01-Aug	2436	0.2	3	1.008	3.1	1.4
Newcastle Centre	30-Jul	8060033	0.4	3	0.985	3.1	0.5
Northampton Kingsthorpe	06-Aug	47R76STR	0.1	3	0.840	3.6	0.8
Norwich Lakenfields	30-Jul	CM08060028	0.5	3	1.083	3.6	0.4
Nottingham Centre	09-Jul	CM08060032	0.1	3	0.980	3.1	1.1
Plymouth Centre	08-Jul	CM08060027	0.5	3	0.985	3.2	0.9
Portsmouth	28-Aug	CM08060023	-1.1	3	0.963	3.1	0.6
Preston	03-Sep	CM08060042	-0.6	3	1.007	3.1	0.8
Reading New Town	29-Aug	CM08060025	-0.2	3	0.997	3.2	1.5
Rochester Stoke	03-Jul	378	-1.0	3	1.013	3.1	0.8
Salford Eccles	20-Aug	1111596	0.0	3	1.020	3.4	1.5
Sheffield Devonshire Green	21-Jul	cm08060024	0.7	3	0.968	3.1	0.8
Sibton	11-Sep	146	0.4	3	1.035	3.1	0.6
Southampton Centre	12-Aug	cm08060021	-0.1	3	1.021	3.1	0.4
Southend-on-Sea	01-Jul	CM08060017	0.1	3	1.030	3.1	0.1

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Site	Date Year =2014	Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	[3]Max Residual (%)
St Osyth	01-Jul	CM08060035	0.2	3	0.992	3.1	1.0
Stoke-on-Trent Centre	30-Jun	CM08060026	-0.5	3	1.187	3.2	1.6
Sunderland Si ksworth	29-Jul	436	0.7	3	0.990	3.1	0.4
Thurrock	30-Jun	221	0.2	3	1.135	3.1	0.8
Walsall Woodlands	16-Jul	2431	7.4	3	1.032	3.2	4.8
Weybourne	31-Jul	CM10180038	-0.6	3	1.048	3.7	1.5
Wicken Fen	29-Jul	165	-1.3	3	1.063	3.6	0.7
Wigan Centre	20-Aug	CM08060018	-1.8	3	0.939	3.1	0.4
Wirral Tranmere	01-Jul	CM08060040	-0.2	3	1.016	3.1	0.8
Yarner Wood	19-Aug	2437	-1.3	3	1.007	3.1	0.8
London Sites							
London Bloomsbury	06-Aug	435	-0.5	3	1.024	3.2	0.6
London Eltham	21-Jul	1111958	analyser	fault			
London Haringey Priory Park South	11-Aug	1111953	0.3	3	0.874	3.1	0.4
London Harlington	31-Jul	14309	1.5	3	1.313	7.3	3.2
London Hillingdon	31-Jul	8060034	1.0	3	1.213	3.8	4.9
London Marylebone Road	24-Jul	19223	7.3	3	1.053	3.2	0.2
London N. Kensington	22-Jul	2372	0.1	3	0.979	3.1	0.3
London Teddington	14-Aug	2447	0.4	3	1.068	3.1	0.4
London Westminster							
Northern Ireland Sites (plus Mace Head)							
Belfast Centre	29-Aug	cm08060038	0.4	3	1.020	3.1	0.5
Derry	20-Aug	1586	-3.3	3	1.040	3.1	0.8
Lough Navar	18-Aug	1640	1.1	3	1.032	3.1	0.6
Mace Head	18-Aug	77086-385	0.3	3	1.005	3.1	2.4
Scottish Sites							
Aberdeen	13-Aug	800	0.6	3	1.000	3.1	1.3
Auchencorth Moss	06-Aug	1646	0.0	3	1.017	3.0	0.6
Bush Estate	06-Aug	1645	0.2	3	0.998	3.1	1.2
Edinburgh St Leonards	07-Jul	136	-2.0	3	1.049	3.1	2.8
Eskdalemuir	14-Jul	158	1.0	3	1.044	3.1	0.4
Fort William	23-Jul	1023	-0.4	3	1.002	3.1	0.5
Glasgow Townhead	21-Jul	8060029	0.0	3	0.968	3.1	1.1
Lerwick			site	not	operational		
Peebles	05-Aug	2449	audit	photometer	fault		
Strath Vaich	14-Aug	176	-0.5	3	1.072	3.0	0.9
Welsh Sites							
Aston Hill	18-Aug	144	-0.2	3	1.086	3.1	1.0
Cardiff Centre	24-Jul	14348	-2.3	3	1.047	3.6	0.3
Cwmbran	24-Jul		1.8	3	0.995	3.7	2.3
Narberth	22-Jul	10280	0.1	3	1.558	3.7	1.6
Port Talbot Margam	23-Jul	CM10140049	-0.1	3	0.953	3.1	1.4

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4. Oxides of Nitrogen

Site	Date Year =2014	Analyser number		[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	[3]Max residual (%)	[4]Converter efficiency (%)
English Sites									
Barnsley Gawber	23-Jul	08050057	NOx	-2.5	2.5	0.961	3.5	0.6	100.7
			NO	0.2	2.5	0.952	3.5	0.6	
Bath Roadside	10-Jul	1957	NOx	-21.6	3.3	1.281	3.5	2.8	99.7
			NO	-20.7	2.7	1.299	3.5	3.2	
Billingham	01-Aug	574	NOx	-0.1	2.4	0.790	3.5	3.6	99.7
			NO	-0.4	2.5	0.902	3.6	3.0	
Birmingham Acocks Green	14-Jul	3364	NOx	2.8	2.9	1.308	3.5	0.7	99.2
			NO	0.2	2.7	1.312	3.5	0.8	
Birmingham Tyburn	14-Jul	Y7ACC7MC	NOx	1.4	2.5	0.981	3.5	0.9	98.3
			NO	-0.9	2.6	0.994	3.5	0.9	
Birmingham Tyburn Roadside	15-Jul	68	NOx	1.3	3.0	1.678	3.5	0.2	98.3
			NO	0.1	2.9	1.692	3.5	0.2	
Blackburn Darwen Roadside					Site	not	operational		
Blackpool Marton	16-Jul	08050075	NOx	1.2	2.5	0.937	3.5	0.6	100.5
			NO	1.1	2.5	0.984	3.5	0.6	
Bournemouth					Site	not	audited		
Brighton Preston Park	15-Jul	13068	NOx	3.8	2.6	1.106	3.5	2.2	98.9
			NO	3.0	2.6	1.109	3.5	1.7	
Bristol St Paul's	09-Jul	77	NOx	1.4	2.8	1.340	3.5	1.9	98.5
			NO	0.7	2.7	1.347	3.5	1.4	
Cambridge Roadside	29-Jul	1011843	NOx	2.0	2.9	1.345	3.5	0.9	107.1
			NO	0.0	2.7	1.331	3.5	1.7	
Canterbury	04-Jul	1147	NOx	1.9	2.9	1.162	3.5	2.7	99.9
			NO	1.8	2.7	1.172	3.5	2.6	
Carlisle Roadside	15-Jul	1011849	NOx	2.0	2.5	1.036	3.5	0.7	98.3
			NO	-1.0	2.5	1.028	3.5	0.9	
Charlton Mackrell	20-Aug	2120	NOx	-2.2	2.6	1.119	3.5	0.5	97.9
			NO	0.2	2.6	1.140	3.5	0.7	
Chatham Centre Roadside	03-Jul	3393	NOx	1.2	2.9	1.201	3.5	2.4	99.0
			NO	0.7	2.6	1.199	3.5	1.5	
Chesterfield					Site	not	operational		
Chesterfield Roadside	22-Jul	1011835	NOx	2.0	2.6	1.159	3.5	0.6	99.1
			NO	-2.0	2.8	1.128	3.5	0.2	
Coventry Memorial Park	06-Jun	08030109	NOx	-0.3	2.4	0.766	3.5	0.4	98.4
			NO	0.0	2.4	0.755	3.5	0.3	
Eastbourne	15-Jul	19209	NOx	0.1	2.6	1.174	3.5	0.7	99.0
			NO	0.5	2.6	1.160	3.5	0.5	
Exeter Roadside	09-Jul	G0000D1S	NOx	-0.2	2.5	0.997	3.5	1.9	98.6
			NO	0.2	2.6	1.026	3.5	2.2	
Glazebury	18-Aug	14354	NOx	-0.9	2.9	1.694	3.5	0.6	98.4
			NO	-1.7	2.9	1.728	3.5	1.3	
Harwell	26-Aug	79	NOx	1.9	2.6	1.253	3.5	1.0	99.0
			NO	1.7	2.6	1.259	3.5	0.9	
High Muffles	31-Jul	1783	NOx	0.7	2.6	1.258	3.5	0.5	98.5
			NO	0.8	2.6	1.233	3.5	0.3	
Honiton	08-Jul	3392	NOx	2.2	2.7	1.347	3.5	1.9	99.6
			NO	2.3	3.2	1.332	3.5	2.2	
Horley	14-Jul	1401954	NOx	9.0	3.6	1.087	3.5	0.5	99.6

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Site	Date Year =2014	Analyser number		[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	[3]Max residual (%)	[4]Converter efficiency (%)
			NO	0.0	2.7	1.050	3.5	1.1	
Hull Freetown	09-Jul	1882	NOx	-0.1	2.6	1.175	4.1	3.3	100.8
			NO	-0.1	2.6	1.170	4.1	3.2	
Ladybower	22-Jul		NOx		Analyser	not	operational		
			NO						
Leamington Spa	10-Jul	1011842	NOx	4.0	2.7	1.121	3.5	0.6	98.0
			NO	-1.0	2.8	1.124	3.5	1.0	
Leamington Spa Rugby Road	10-Jul	3365	NOx	-0.2	2.6	1.069	3.5	0.4	98.7
			NO	0.7	2.5	1.032	3.5	1.3	
Leeds Centre	09-Jul	08050066	NOx	-1.0	2.4	0.755	3.5	3.0	101.6
			NO	0.8	2.4	0.754	3.5	3.4	
Leeds Headingley Kerbside	09-Jul	342	NOx	-0.3	2.6	1.233	3.5	1.2	98.6
			NO	-2.3	2.6	1.209	3.5	1.2	
Leicester University	07-Aug	08050021	NOx	8.4	2.6	1.151	3.5	1.8	98.1
			NO	9.2	2.6	1.085	3.5	1.7	
Leominster	18-Aug	346	NOx	-4.9		1.152	Analyser	leak	failed
			NO	-1.3		1.143			
Lincoln Canwick Road	08-Jul	3394	NOx	1.0	2.6	1.111	3.5	2.4	98.2
			NO	0.8	2.6	1.112	3.5	1.0	
Liverpool Queen's Drive Roadside	03-Jul	16927	NOx	1.0	2.6	1.227	3.5	0.2	99.5
			NO	-0.4	2.6	1.226	3.5	0.6	
Liverpool Speke	03-Jul	08050069	NOx	0.6	2.5	1.006	3.7	4.5	98.7
			NO	0.1	2.5	1.023	3.6	4.1	
Lullington Heath	21-Aug	2579	NOx	-0.2	2.7	1.341	3.5	1.1	98.1
			NO	1.0	2.7	1.332	3.5	0.5	
Manchester Piccadilly	19-Aug	21278	NOx	1.7	2.5	0.953	3.5	0.5	98.6
			NO	0.0	2.5	0.932	3.5	0.6	
Manchester South	19-Aug	17311	NOx	1.5	2.5	1.015	3.5	0.8	99.8
			NO	0.9	2.5	1.021	3.5	0.6	
Market Harborough	07-Aug	08050068	NOx	1.2	2.4	0.549	3.5	1.1	100.0
			NO	0.9	2.4	0.497	3.5	1.2	
Middlesbrough	01-Aug	2287	NOx	-3.2	2.6	1.178	3.6	2.6	99.1
			NO	-3.4	2.6	1.169	3.8	2.9	
Newcastle Centre	30-Jul	8050063	NOx	-0.4	2.5	1.042	3.7	3.4	100.4
			NO	-0.2	2.5	1.030	3.6	3.0	
Newcastle Cradlewell Roadside	30-Jul	1011853	NOx	-1.0	2.5	0.888	3.5	1.3	98.4
			NO	0.0	2.5	0.875	3.5	1.4	
Northampton Kingsthorpe	06-Aug	8ATJ6APR	NOx	1.2	2.8	0.996	3.5	0.6	99.8
			NO	-0.4	2.6	1.004	3.5	0.5	
Norwich Lakenfields	30-Jul	08050067	NOx	0.5	2.5	1.066	3.5	0.5	99.6
			NO	0.3	2.5	1.071	3.5	0.7	
Nottingham Centre	09-Jul	08050072	NOx	0.7	2.5	0.945	3.5	1.5	99.2
			NO	-0.3	2.5	0.943	3.5	1.4	
Oxford Centre Roadside	26-Aug	1011844	NOx	3.0	2.8	1.345	3.5	1.1	99.4
			NO	-1.0	2.9	1.331	3.5	1.6	
Oxford St Ebbes	26-Aug	1011830	NOx	1.0	2.6	1.164	3.5	1.2	99.0
			NO	-1.0	2.6	1.155	3.5	0.6	
Plymouth Centre	08-Jul	08050062	NOx	-0.2	2.5	0.903	3.5	1.8	99.3
			NO	1.0	2.5	0.891	3.5	1.7	
Portsmouth	28-Aug	P0T7CYA5	NOx	-0.3	2.5	0.985	3.5	0.4	99.6
			NO	-1.0	2.7	1.006	3.5	0.3	

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Site	Date Year =2014	Analyser number		[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	*Max residual (%)	*Converter efficiency (%)
Preston	03-Sep	08050664	NOx	0.2	2.5	0.964	3.5	0.3	98.9
			NO	0.4	2.5	0.964	3.5	0.5	
Reading New Town	29-Aug	08050059	NOx	0.0	2.5	0.895	3.5	0.8	99.0
			NO	0.3	2.5	0.887	3.5	0.9	
Rochester Stoke	03-Jul	3095	NOx	1.0	2.6	1.265	3.6	2.3	99.5
			NO	1.0	2.9	1.257	3.5	2.1	
Salford Eccles	20-Aug	1011831	NOx	4.0	2.5	0.987	3.5	0.4	99.1
			NO	-1.0	2.5	0.980	3.5	0.2	
Sandy Roadside	28-Jul	2585	NOx	6.1	2.6	0.979	3.5	0.9	99.4
			NO	0.7	2.5	1.000	3.5	0.8	
Scunthorpe Town	08-Jul	1011847	NOx	12.0	2.6	1.073	3.5	0.9	100.0
			NO	0.0	2.6	1.049	3.5	0.5	
Shaw Crompton Way	21-Aug	20861	NOx	-4.2	2.5	1.054	3.5	0.4	99.2
			NO	-0.4	2.5	1.058	3.5	1.2	
Sheffield Devonshire Green	21-Jul	08050055	NOx	1.4	2.5	0.993	4.9	1.5	100.4
			NO	1.2	2.5	1.042	4.0	5.3	
Sheffield Tinsley	21-Jul	571	NOx	5.7	2.6	1.098	3.5	0.5	96.4
			NO	5.7	2.6	1.089	3.5	0.9	
Southampton Centre	12-Aug	08030106	NOx	1.3	2.5	0.911	3.5	1.6	98.1
			NO	1.0	2.5	0.908	3.5	1.6	
Southend-on-Sea	01-Jul	08050071	NOx	0.5	2.5	1.015	3.5	0.7	99.2
			NO	0.4	2.5	1.015	3.5	0.8	
St Osyth	01-Jul	08050073	NOx	-2.8	2.5	0.902	3.5	0.1	100.7
			NO	-2.3	2.5	0.907	3.5	0.3	
Stanford-le-Hope Roadside	30-Jun	191	NOx	2.9	2.6	1.165	3.5	1.2	99.1
			NO	1.0	2.6	1.172	3.5	0.9	
Stockton-on-Tees Eaglescliffe	31-Jul		NOx	0.4	2.7	1.355	3.5	0.8	100.5
			NO	0.9	2.7	1.353	3.5	0.4	
Stoke-on-Trent Centre	30-Jun	08050070	NOx	-2.1	2.5	1.013	3.5	0.5	100.0
			NO	-2.3	2.5	1.004	3.5	0.4	
Storrington Roadside	16-Jul	12190	NOx	-8.6	2.7	1.205	3.5	2.8	98.4
			NO	-2.2	2.6	1.229	3.5	1.9	
Sunderland Silksworth	29-Jul	1011854	NOx	2.0	2.8	1.150	3.5	3.2	100.7
			NO	-1.0	2.6	1.139	3.5	3.6	
Thurrock	30-Jun	192	NOx	1.2	2.6	1.087	3.5	0.8	99.6
			NO	0.7	2.6	1.096	3.5	0.9	
Walsall Woodlands	16-Jul	3391	NOx	2.5	2.7	1.306	3.5	2.0	98.9
			NO	0.7	2.7	1.316	3.5	1.2	
Warrington	02-Jul	1011826	NOx	9.0	2.5	1.056	3.5	0.2	98.1
			NO	0.0	2.5	1.032	3.5	0.5	
Wicken Fen	29-Jul	2223	NOx	2.5	2.6	1.179	3.5	1.9	96.3
			NO	2.5	2.6	1.190	3.5	2.0	
Wigan Centre	20-Aug	1011832	NOx	2.0	2.6	1.038	3.5	0.6	100.5
			NO	-1.0	2.5	1.035	3.5	0.7	
Wirral Tranmere	01-Jul	08050060	NOx	1.1	2.5	1.044	3.5	1.4	99.2
			NO	0.8	2.5	1.050	3.5	1.3	
Yarner Wood	19-Aug	1784	NOx	0.9	2.5	1.037	3.5	0.7	98.1
			NO	-0.1	2.5	1.041	3.5	0.6	
York Fishergate	08-Jul	1011848	NOx	1.0	2.9	1.205	3.5	1.2	98.6
			NO	-1.0	2.6	1.193	3.5	1.2	

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Site	Date Year =2014	Analyser number		[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	[3]Max residual (%)	[3]Converter efficiency (%)
London Sites									
Camden Kerbside	13-Aug	1011846	NOx	3.0	4.3	1.025	3.5	0.6	101.2
			NO	0.0	2.6	1.023	3.5	0.5	
Haringey Roadside	11-Aug	1011827	NOx	6.0	3.5	1.004	3.5	0.3	100.0
			NO	0.0	2.6	0.987	3.5	0.7	
London Bexley	05-Aug	327	NOx	4.1	2.7	1.136	3.6	1.5	100.6
			NO	0.2	2.5	1.019	3.5	0.4	
London Bloomsbury	06-Aug	74	NOx	-10.6	2.6	0.965	3.5	1.1	98.3
			NO	0.2	2.5	1.006	3.5	0.2	
London Eltham	21-Jul	1011834	NOx	4.0	3.0	1.086	3.5	0.8	100.8
			NO	0.0	2.6	1.066	3.5	0.6	
London Haringey Priory Park South	11-Aug	1084	NOx	0.2	3.3	1.022	3.5	1.8	98.2
			NO	0.1	2.6	1.026	3.5	2.2	
London Harlington	31-Jul	21123	NOx	3.1	2.5	1.042	3.5	0.6	97.0
			NO	0.4	2.5	1.049	3.5	1.6	
London Hillingdon	31-Jul	8050017	NOx	6.8	2.5	0.949	3.5	0.2	99.2
			NO	7.1	2.5	0.948	3.5	0.4	
London Marylebone Road	24-Jul	19210	NOx	3.5	2.6	1.194	3.5	0.2	100.0
			NO	1.2	2.6	1.196	3.5	0.7	
London N. Kensington	22-Jul	3273	NOx	4.1	2.8	1.096	3.5	1.3	99.7
			NO	3.8	2.5	1.051	3.5	2.7	
London Teddington	14-Aug	3406	NOx	2.0	3.4	1.538	3.5	1.0	98.2
			NO	0.6	2.8	1.517	3.5	1.0	
London Westminster	30-Jul	573	NOx	4.0	2.8	1.634	3.5	2.5	99.3
			NO	2.4	2.7	1.450	3.5	0.5	
Southwark A2 Old Kent Road					Site	not	operational		
Tower Hamlets Roadside	07-Aug	1011838	NOx	1.0	2.7	1.110	3.5	0.2	99.1
			NO	-1.0	2.7	1.102	3.5	1.0	
Northern Irish Sites									
Armagh Roadside	28-Aug	1011845	NOx	4.0	2.6	1.108	3.5	1.0	98.5
			NO	0.0	2.8	1.100	3.5	1.7	
Belfast Centre	29-Aug	08050074	NOx	-0.1	2.6	1.118	3.5	0.5	98.7
			NO	-0.2	2.6	1.109	3.5	0.5	
Derry	20-Aug	2130	NOx	3.7	2.8	1.074	3.5	0.4	98.8
			NO	-0.2	2.6	1.053	3.5	0.6	
Scottish Sites									
Aberdeen	13-Aug	519	NOx	0.0	2.8	1.500	3.5	0.6	100.6
			NO	0.0	2.8	1.480	3.5	0.5	
Aberdeen Union Street Roadside	14-Aug	299	NOx	2.3	2.7	1.446	3.5	0.2	99.0
			NO	1.0	2.7	1.426	3.5	0.4	
Bush Estate	06-Aug	2244	NOx	4.2	2.8	0.949	3.5	0.9	100.7
			NO	1.4	2.5	0.987	3.5	1.0	
Dumbarton Roadside	24-Jul	1411835	NOx	1.0	2.8	1.172	3.5	2.7	101.0
			NO	0.0	2.6	1.170	3.5	2.5	
Dumfries	14-Jul	1494	NOx	0.5	2.6	1.172	3.5	0.8	95.2
			NO	0.6	2.6	1.156	3.5	0.9	
Edinburgh St Leonards	07-Jul	73	NOx	-0.5	3.0	1.877	3.5	0.8	99.3
			NO	-1.4	3.0	1.855	3.7	2.0	
Eskdalemuir	14-Jul	347	NOx	2.3	2.5	0.929	3.5	0.7	98.3
			NO	2.0	2.5	0.921	3.5	0.6	

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Site	Date Year =2014	Analyser number		[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	Max residual (%)	Converter efficiency (%)
Fort William	23-Jul	344	NOx	-0.3	2.5	1.014	3.5	2.1	100.4
			NO	-0.6	2.5	1.018	3.5	1.9	
Glasgow Kerbside	21-Jul	8050061	NOx	-2.0	2.5	0.964	4.1	3.4	99.7
			NO	-2.4	2.5	0.959	3.5	2.2	
Glasgow Townhead	21-Jul	1713	NOx	0.3	2.6	1.205	3.5	1.4	99.7
			NO	-0.1	2.6	1.210	3.5	1.5	
Grangemouth	04-Aug	1011836	NOx	1.0	2.5	1.015	3.5	0.7	99.6
			NO	-1.0	2.5	1.000	3.5	2.8	
Grangemouth Moray	04-Aug	1011852	NOx	1.0	2.6	1.120	3.5	1.1	100.9
			NO	0.0	2.8	1.121	3.5	0.7	
Inverness	14-Aug	1489	NOx	0.1	2.5	1.034	3.5	0.5	98.0
			NO	-0.1	2.5	1.020	3.5	0.3	
Peebles	05-Aug	2213	NOx	-2.1	2.6	1.065	3.5	0.6	100.4
			NO	0.3	2.5	1.080	3.5	0.8	
Welsh Sites									
Aston Hill	18-Aug	2302	NOx	0.8	2.5	0.849	3.5	1.6	99.1
			NO	0.5	2.5	0.848	3.5	1.6	
Cardiff Centre	24-Jul	14325	NOx	1.0	2.7	1.260	3.8	2.0	98.8
			NO	0.8	2.7	1.259	3.7	1.8	
Chepstow A48	21-Jul	1011828	NOx	2.0	3.2	1.186	3.5	0.8	100.9
			NO	-1.0	2.8	1.183	3.5	0.8	
Cwmbran	24-Jul		NOx	0.4	2.5	1.009	3.5	0.5	98.9
			NO	-0.1	2.5	1.041	3.5	0.5	
Narberth	22-Jul	14311	NOx	1.6	2.4	0.583	3.5	1.4	98.7
			NO	-0.2	2.4	0.589	3.5	0.9	
Newport	23-Jul	1011829	NOx	6.0	2.7	1.066	3.5	1.5	98.8
			NO	1.0	2.7	1.060	3.5	1.4	
Port Ta bot Margam	23-Jul	12811	NOx	1.1	2.6	1.111	3.5	2.6	100.0
			NO	0.1	2.5	0.983	3.5	0.1	
Swansea Roadside	22-Jul	16695	NOx	2.9	2.7	1.070	3.5	1.6	98.0
			NO	0.3	2.6	1.112	3.5	1.2	
Wrexham	01-Jul	1490	NOx	4.6	2.5	1.038	3.5	0.3	99.9
			NO	-0.1	2.5	1.036	3.5	0.2	

5. Particulate Analysers

Site	Date Year =2014		Analyser number	Calculated Spring Constant k_0	[4]k_0 accuracy (%)	Uncertainty (%)	[3]Measured Main Flow (l/min)	Uncertainty (%)	[3]Measured Total Flow (l/min)	Uncertainty (%)
English Sites										
Barnstaple A39	07-Jul	PM10	660811	17296	0.1	1	3.05	2.2	16.23	2.2
		PM2.5	811002	14200	0.3	1	2.96	2.2	16.01	2.2
Birmingham Acocks Green	14-Jul	PM2.5	900702	15829	0.5	1	3.04	2.2	15.39	2.2
Birmingham Tyburn	14-Jul	PM10	90809	14869	-0.5	1	3.02	2.2	15.57	2.2
		PM2.5	60809	14725	0.3	1	3.06	2.2	15.43	2.2
Birmingham Tyburn Roadside	15-Jul	PM10	20603	12091	-2.3	1	2.92	2.2	15.72	2.2
		PM2.5	20606	14263	-1.2	1	3.12	2.2	14.97	2.2
Blackpool Marton	16-Jul	PM2.5		12503	-0.3	1	2.86	2.2	14.08	2.2
Bournemouth		GR2.5	21863						Not	tested
Brighton Preston Park	15-Jul	GR2.5	21865						16.38	2.2

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Bristol St Paul's	09-Jul	PM10	60302	13315	1.0	1	3.03	2.2	16.61	2.2
		PM2.5	95071	13707	-1.5	1	3.01	2.2	16.25	2.2
Carlisle Roadside	15-Jul	PM10	600809	14400	-0.6	1	2.93	2.2	15.79	2.2
		PM2.5	030810	15078	-0.6	1	2.60	2.2	15.12	2.2
Chatham Centre Roadside	03-Jul	PM10	710809	14517	0.0	1	3.07	2.2	16.62	2.2
		PM2.5	430810	15987	-0.1	1	3.00	2.2	16.20	2.2
Chesterfield		PM10		Site	not	operating				
		PM2.5								
Chesterfield Roadside	22-Jul	PM10	999810	11471	1.1	1	3.00	2.2	16.34	2.2
		PM2.5	390810	11022	-0.6	1	2.99	2.2	16.43	2.2
Coventry Memorial Park	06-Jun	PM2.5	890702	14865	-0.7	1	**2.93**	**2.2**	**16.49**	**2.2**
Eastbourne	15-Jul	PM10	380809	14423	-0.6	1	3.13	2.2	17.44	2.2
		PM2.5	440809	14854	0.1	1	3.07	2.2	16.72	2.2
Harwell	26-Aug	PM10		14785	-1.0	1	3.02	2.2	15.60	2.2
		PM2.5	250302	12396	0.0	1	3.04	2.2	15.66	2.2
		GR10	439802						15.83	2.2
		GR2.5	590603						16.86	2.2
Hull Freetown	09-Jul	PM10	960301	14182	0.5	1	3.29	2.2	16.36	2.2
		PM2.5	510701	13993	-1.4	1	2.75	2.2	17.17	2.2
Leamington Spa	10-Jul	PM10	510809	14985	-0.1	1	2.97	2.2	15.22	2.2
		PM2.5	110810	14169	-0.1	1	2.90	2.2	14.92	2.2
Leamington Spa Rugby Road	10-Jul	PM10				instrument	fault			
		PM2.5	440809	16000	-0.2	1	2.93	2.2	15.68	2.2
Leeds Centre	09-Jul	PM10	221002	13153	-1.8	1	3.18	2.2	17.71	2.2
		PM2.5	170808	16896	-0.8	1	2.41	2.2	17.63	2.2
Leeds Headingley Kerbside	09-Jul	PM10	921103	17418	-1.0	1	2.88	2.2	16.23	2.2
		PM2.5	980808	14583	-0.8	1	2.66	2.2	16.18	2.2
Leicester Uni	07-Aug	PM2.5	490701	14700	-1.8	1	3.04	2.2	16.67	2.2
Liverpool Speke	03-Jul	PM10	500302	15812	0.0	1	2.78	2.2	15.09	2.2
		PM2.5	640702	14818	-0.6	1	2.84	2.2	15.16	2.2
Manchester Piccadilly	19-Aug	PM2.5	089810	13975	-0.4	1	2.87	2.2	15.83	2.2
Middlesbrough	01-Aug	PM10	24325	13973	-1.1	1	3.00	2.2	16.25	2.2
		PM2.5	2000	15837	-1.1	1	3.06	2.2	16.38	2.2
Newcastle Centre	30-Jul	PM10	24448	13979	1.1	1	3.05	2.2	15.92	2.2
		PM2.5	24447	15042	1.4	1	3.01	2.2	15.62	2.2
Northampton Kingsthorpe	06-Aug	PM2.5	139902						16.34	2.2
Norwich Lakenfields	30-Jul	PM10	981105	15620	-0.6	1	3.20	2.2	16.70	2.2
		PM2.5	180810	15675	0.5	1	3.04	2.2	16.56	2.2
Nottingham Centre	09-Jul	PM10	690811	15567	-0.1	1	2.88	2.2	15.66	2.2
		PM2.5	250401	12105	-0.6	1	3.03	2.2	15.95	2.2
Oxford St Ebbes	26-Aug	PM10	960809	14774	-0.3	1	3.00	2.2	16.47	2.2
		PM2.5	350808	17199	0.2	1	3.03	2.2	16.62	2.2
Plymouth Centre	08-Jul	PM10		12190	-0.7	1	2.87	2.2	15.80	2.2
		PM2.5	280302	14252	-0.6	1	3.06	2.2	16.37	2.2
Portsmouth	28-Aug	PM10	281101	16799	-1.1	1	3.03	2.2	13.59	2.2
		PM2.5	500809	18392	-0.8	1	3.01	2.2	16.31	2.2
Preston	03-Sep	PM2.5	510108	12875	-0.6	1	2.85	2.2	14.68	2.2
Reading New Town	29-Aug	PM10	149610	13141	-0.4	1	2.90	2.2	16.41	2.2
		PM2.5	750702	13888	-1.8	1	3.01	2.2	16.84	2.2
Rochester Stoke	03-Jul	PM10	410809	14704	-1.4	1	3.02	2.2	16.55	2.2
		PM2.5	580809	15922	-0.1	1	3.02	2.2	16.57	2.2
Salford Eccles	20-Aug	PM10	979604	13869	1.3	1	2.87	2.2	15.43	2.2
		PM2.5	050807	14395	-1.7	1	2.85	2.2	15.72	2.2
Saltash Callington Road	07-Jul	PM10	280210	14118	-0.2	1	2.98	2.2	16.33	2.2
		PM2.5	860811	12295	-0.6	1	2.96	2.2	16.36	2.2

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Sandy Roadside	28-Jul	PM10	399707	11316	0.2	1	3.07	2.2	14.87	2.2
	28-Jul	PM2.5	841102	15985	-0.6	1	3.02	2.2	16.40	2.2
Scunthorpe Town	08-Jul	PM10	100810	14912	-0.6	1	3.17	2.2	16.69	2.2
Sheffield Devonshire Grn	21-Jul	PM10		analyser	fault					
	21-Jul	PM2.5		analyser	fault					
Southampton Centre	12-Aug	PM10	560307	13995	0.9	1	2.95	2.2	16.02	2.2
	12-Aug	PM2.5	330808	16519	0.0	1	2.91	2.2	15.77	2.2
Southend-on-Sea	01-Jul	PM2.5	230401	12383	-0.4	1	3.03	2.2	15.95	2.2
Stanford-le-Hope Roadside	30-Jun	PM10	180008	12598	-0.5	1	3.03	2.2	10.75	2.2
	30-Jun	PM2.5	489804	13153	0.8	1	2.98	2.2	16.81	2.2
Stockton-on-Tees Eaglescliffe	31-Jul	PM10	h4554						15.70	2.2
	31-Jul	PM2.5	h4553						15.60	2.2
Stoke-on-Trent Centre	30-Jun	PM10	280401	12399	-0.8	1	3.03	2.2	16.19	2.2
	30-Jun	PM2.5	630809	13447	-0.4	1	3.06	2.2	16.37	2.2
Storrington Roadside	16-Jul	PM10	360808	15680	0.0	1	5.26	2.2	19.04	2.2
	16-Jul	PM2.5		12864	0.9	1	2.99	2.2	16.21	2.2
Sunderland Silksworth	29-Jul	PM2.5	27247	15662	-0.9	1	3.01	2.2	16.76	2.2
Thurrock	30-Jun	PM10	290810	13996	-0.4	1	2.94	2.2	15.88	2.2
Warrington	02-Jul	PM10	830806	11995	-0.1	1	3.02	2.2	15.90	2.2
	02-Jul	PM2.5	690809	16331	-0.2	1	3.01	2.2	15.95	2.2
Wigan Centre	20-Aug	PM2.5	910809	14773	-0.6	1	2.88	2.2	15.44	2.2
Wirral Tranmere	01-Jul	PM2.5	300001	13340	0.4	1	2.85	2.2	15.81	2.2
York Bootham	23-Jul	PM10	779712	14543	-1.3	1	2.99	2.2	16.20	2.2
	23-Jul	PM2.5	090807	16036	-1.5	1	2.96	2.2	15.83	2.2
York Fishergate	08-Jul	PM10	060810	15800	0.6	1	2.98	2.2	16.12	2.2
	08-Jul	PM2.5	220808	18052	-1.0	1	3.09	2.2	16.70	2.2
London Sites										
Camden Kerbside	13-Aug	PM10	529602	12012	0.2	1	3.22	2.2	16.26	2.2
	13-Aug	PM2.5	800009	12966	1.6	1	3.08	2.2	16.11	2.2
Ealing Horn Lane	22-Jul	PM10	380810	15390	0.8	1	3.04	2.2	15.79	2.2
Haringey Roadside	11-Aug	PM10		Analyser	not	present				
	11-Aug	PM2.5	600809	13774	-0.2	1	2.94	2.2	16.00	2.2
London Bexley	05-Aug	PM2.5	070401	11648	0.5	1	3.00	2.2	15.28	2.2
London Bloomsbury	06-Aug	PM10	460302	13791	0.4	1	2.92	2.2	15.08	2.2
	06-Aug	PM2.5	400809	14712	-0.3	1	2.95	2.2	14.95	2.2
London Eltham	21-Jul	PM2.5	120801	14019	1.5	1	3.02	2.2	15.19	2.2
London Harlington	31-Jul	PM10	440311	12306	0.2	1	2.96	2.2	15.60	2.2
	31-Jul	PM2.5	920202	12865	0.5	1	2.96	2.2	15.08	2.2
London Harrow Stanmore	13-Aug	PM2.5	740809	16061	-1.1	1	2.97	2.2	15.37	2.2
London Marylebone Road	24-Jul	PM10	410401	13042	-1.1	1	2.93	2.2	16.25	2.2
	24-Jul	PM2.5	450809	13003	1.5	1	2.97	2.2	16.24	2.2
	24-Jul	GR10	430811						16.21	2.2
	24-Jul	GR2.5	210001						16.43	2.2
London N. Kensington	22-Jul	PM10	910811	12726	0.4	1	3.25	2.2	16.80	2.2
	22-Jul	PM2.5	890806	15771	-0.1	1	3.21	2.2	15.94	2.2
	22-Jul	GR10	159902						16.80	2.2
	22-Jul	GR2.5	199902						16.74	2.2
London Teddington Bushy Park	14-Aug	PM2.5	650809	Analyser	failed	during	audit			
London Westminster	30-Jul	GR2.5	399811						16.19	2.2

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Southwark A2 Old Kent Road		PM10		site	not	operating				
Northern Irish Sites										
Armagh Roadside	28-Aug	PM10	450202	13563	-0.1	1	2.95	2.2	15.93	2.2
Belfast Centre	29-Aug	PM10	230303	14184	-0.1	1	3.09	2.2	16.57	2.2
	29-Aug	PM2.5	650702	15564	-1.1	1	3.10	2.2	16.58	2.2
Derry	20-Aug	PM10	830902	16099	1.8	1	2.86	2.2	15.35	2.2
	20-Aug	PM2.5	949608	10940	0.5	1	2.72	2.2	14.78	2.2
Lough Navar	18-Aug	PM10	999604	12995	1.4	1			15.64	2.2
Scottish Sites										
Aberdeen	13-Aug	PM10	270302	11683	1.0	1	3.03	2.2	16.13	2.2
	13-Aug	PM2.5	680811	12152	-0.6	1	2.79	2.2	16.36	2.2
Auchencorth Moss	06-Aug	PM10	390602	12931	-2.0	1	2.88	2.2	15.30	2.2
	06-Aug	PM2.5	033602	13617	-2.9	1	2.86	2.2	15.28	2.2
	06-Aug	GR10	500112						18.45	2.2
	06-Aug	GR2.5	480112						17.96	2.2
Edinburgh St Leonards	07-Jul	PM10	270808	13503	-1.4	1	3.02	2.2	16.37	2.2
	07-Jul	PM2.5	330808	16850	-0.9	1	3.04	2.2	16.12	2.2
Glasgow Kerbside	21-Jul	PM10	27344	14415	-1.1	1	2.52	2.2	15.67	2.2
	21-Jul	PM2.5	27337	15026	-0.6	1	2.88	2.2	14.35	2.2
Glasgow Townhead	21-Jul	PM10	27331	14584	-0.3	1	2.92	2.2	15.03	2.2
	21-Jul	PM2.5	22980	13091	-0.4	1	3.02	2.2	15.78	2.2
Grangemouth	04-Aug	PM10	280809	15769	-0.9	1	3.01	2.2	16.32	2.2
	04-Aug	PM2.5	590809	13517	-1.8	1	3.05	2.2	15.98	2.2
Inverness	14-Aug	GR10	550003						15.76	2.2
	14-Aug	GR2.5	610603						15.74	2.2
Welsh Sites										
Cardiff Centre	24-Jul	PM10	990701	13718	-1.2	1	2.89	2.2	16.02	2.2
	24-Jul	PM2.5	190401	11031	0.3	1	2.93	2.2	16.29	2.2
Chepstow A48	21-Jul	PM10	420809	14121	-0.4	1	2.97	2.2	16.18	2.2
	21-Jul	PM2.5	230808	15951	-0.3	1	3.00	2.2	16.36	2.2
Narberth	22-Jul	PM10	630702	13855	-0.1	1	2.89	2.2	16.03	2.2
Newport	23-Jul	PM10	029805	13835	-1.1	1	3.41	2.2	16.77	2.2
	23-Jul	PM2.5	660702	16445	-1.1	1	2.97	2.2	16.13	2.2
Port Talbot Margam	23-Jul	PM10	170807	13935	0.0	1	3.02	2.2	16.38	2.2
	23-Jul	PM2.5	900402	10550	-0.1	1	2.98	2.2	16.19	2.2
	23-Jul	GR10	389903						17.11	2.2
Swansea Roadside	22-Jul	PM10	M9305						9.79	2.2
	22-Jul	PM2.5	M9306						9.92	2.2
Wrexham	01-Jul	GR10	240001						16.27	2.2
	01-Jul	GR2.5	119902						16.51	2.2

Certificate Number: 03064
Ricardo-AEA Calibration ID Number: ED57002030

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

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

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

Concentration = (output – zero response) x Calibration factor

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

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

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

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

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CERTIFICATE OF CALIBRATION

0401

Ricardo Energy & Environment, The Gemini Building, Fermi Avenue,
Harwell, Didcot, Oxfordshire OX11 0QR
Telephone 01235 753212

Certificate Number: 03233

Authorised Signatories:	S Eaton B Stacey	
Signed:	Date of issue:	7th January 2015

Customer Name and Address:	John Newington Atmosphere and Noise Resource, Atmosphere and Sustainability Department for Environment, Food and Rural Affairs Area 2C Nobel House, 17 Smith Square, London, SW1P 3JR
Date of Calibration:	July to September 2015
Description:	Calibration factors for monitoring stations in the UK Automatic Urban and Rural Monitoring Network

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

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

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CERTIFICATE OF CALIBRATION

1. Carbon Monoxide

Site	Date Year = 2015	Analyser number	[1]Zero output	Uncertainty (ppm)	[2]Calibration Factor	Uncertainty (%)	[*]Maximum Residual (%)
Belfast Centre	25-Aug	462	0.20	0.2	1.0366	2.3	2.8
Cardiff Centre	22-Jul	12599	0.50	0.2	1.0049	2.4	4.6
Edinburgh St Leonards	30-Jul	159	0.20	0.2	0.8991	3.4	1.4
Leeds Centre	01-Jul	458	0.80	0.2	0.9951	2.1	0.6
London Marylebone Road	23-Jul	651	1.50	0.2	0.9587	2.2	3.0
London N. Kensington	23-Jul	19097	0.10	0.2	0.9812	2.2	3.1
Port Talbot Margam	21-Jul	505214618	1.95	0.2	0.9338	2.1	0.8

2. Sulphur Dioxide

Site	Date Year =2015	Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	[*]Max Residual (%)	[*]m-xylene interference (ppb)
Ballymena Ballykeel	21-Aug	4901234	0.0	2.6	0.8357	3.2	1.2	5.8
Barnsley Gawber	22-Jul	08050082	0.7	2.5	0.9064	3.5	2.3	1.2
Belfast Centre	25-Aug	1766	5.8	2.5	0.9832	3.1	1.1	22.2
Cardiff Centre	22-Jul	14319	3.5	2.6	1.0645	3.6	1.5	15.4
Derry	18-Aug	1697	4.3	2.5	1.0733	3.7	2.3	-0.3
Edinburgh St Leonards	30-Jul	84	0.7	2.4	0.7618	3.2	3.1	7.8
Grangemouth	31-Jul	1211322	0.0	2.5	0.9231	3.1	1.8	2.2
Harwell	20-Jul	14350	10.2	2.5	0.9049	3.0	1.3	6.7
Hull Freetown	29-Jun	342	3.5	2.5	1.0054	4.8	3.4	-2.3
Ladybower	20-Jul	1178	0.9	2.5	0.9545	3.3	1.7	2.0
Leeds Centre	01-Jul	08050084	1.1	2.5	0.9691	3.8	5.0	10.1
Liverpool Speke	07-Jul	17509	2.7	2.5	1.0245	4.6	9.9	19.7
London Bloomsbury	27-Jul	74	10.0	2.5	0.9262	3.1	0.4	17.9
London Marylebone Road	23-Jul	2644	1.5	2.5	1.0713	3.2	5.6	25.2
London N. Kensington	23-Jul	19095	4.6	2.5	1.0651	3.1	1.1	26.7
Lullington Heath	02-Jul	82	1.1	2.5	1.0029	2.5	0.7	24.5
Manchester Piccadilly	14-Jul	19216	0.5	2.5	1.0102	3.7	4.9	20.6
Middlesbrough	04-Jul	345	0.5	2.5	1.0118	3.3	1.5	5.4
Narberth	20-Jul	344	5.6	2.5	1.0354	3.2	0.3	18.0
Nottingham Centre	10-Aug	1629	0.5	2.6	1.0229	3.2	0.5	24.0
Port Talbot Margam	21-Jul	605214617	0.6	2.5	1.0173	3.2	0.3	11.7
Rochester Stoke	03-Aug	2800	4.0	2.6	0.8596	3.2	0.4	22.4
Scunthorpe Town	06-Jul	1576	-4.0	2.5	0.9697	3.7	5.1	24.5
Southampton Centre	20-Aug	343	9.3	2.5	0.8938	4.0	2.6	19.2
Thurrock	04-Aug	192	-0.1	2.5	0.9669	3.2	0.3	21.5
Wicken Fen	06-Jul	14322	10.1	2.5	1.0104	3.5	1.7	21.5
Wrexham	06-Jul	1181	6.2	2.5	0.9887	3.8	5.3	11.2

CERTIFICATE OF CALIBRATION

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3. Ozone

Site	Date Year =2015	Analyser number	1Zero output	Uncertainty (ppb)	2Calibration Factor	Uncertainty (%)	*Max Residual (%)
Aston Hill	29-Jun	144	-0.7	3.0	1.0077	3.2	1.1
Auchencorth Moss	29-Jul	1646	0.4	3.0	1.0575	3.1	0.7
Barnsley Gawber	22-Jul	cm08060030	0.2	3.0	1.0058	3.0	1.6
Belfast Centre	25-Aug	CM08060038	-0.1	3.0	1.0170	3.0	0.9
Birmingham Acocks Green	27-Jul	2435	-2.4	3.0	0.9954	3.1	0.6
Birmingham Tyburn	28-Jul	wb6ag7tm	0.8	3.0	0.9777	3.2	0.3
Birmingham Tyburn Road	28-Jul	2434	0.6	3.0	1.0222	3.3	0.8
Blackpool Marton	09-Jul	CM08060037	0.4	3.0	1.0490	3.1	0.5
Bottesford	11-Aug	CM08060022	-0.4	3.0	0.9379	3.1	0.5
Bournemouth	19-Aug	1650	-0.8	3.0	1.0094	3.1	0.6
Bristol St Paul's	17-Aug	155	-0.3	3.0	1.0200	3.1	0.2
Bush Estate	29-Jul	1645	-0.1	3.0	1.0238	3.1	0.3
Canterbury	06-Aug	1647	-0.4	3.0	0.9427	3.1	0.4
Cardiff Centre	22-Jul	14348	-2.3	3.0	1.0533	3.4	5.3
Charlton Mackrell	30-Jun	1111957	0.3	3.0	0.9589	3.2	1.6
Coventry Allesley	12-Aug	CM08060044	0.1	3.0	1.0431	3.1	1.0
Cwmbran	23-Jul	cm08060043	0.4	3.0	0.9832	3.1	1.1
Derry	18-Aug	1586	-0.2	3.0	1.0085	3.0	1.0
Edinburgh St Leonards	30-Jul	136	-2.7	3.0	1.0037	3.1	1.4
Eskdalemuir	07-Jul	158	1.0	3.0	1.0505	3.1	0.3
Exeter Roadside	20-Aug	F0100E0S	-7.6	3.0	0.9921	3.1	0.2
Fort William	08-Jul	1023	0.1	3.0	0.9533	3.1	0.4
Glasgow Townhead	15-Jul	CM08060029	0.1	3.0	1.0489	3.1	0.1
Glazebury	15-Jul	19751	1.4	3.0	1.0053	3.1	0.6
Great Dun Fell	08-Jul	1647	-0.3	3.0	0.7604	3.1	1.6
Harwell	20-Jul	17497	-0.7	3.0	1.0028	3.1	0.3
High Muffles	22-Jul	1641	-0.5	3.0	0.9744	3.0	0.3
Hull Freetown	29-Jun	cm08060045	-0.2	3.0	1.0064	3.1	0.5
Ladybower	20-Jul	1651	-0.4	3.0	0.9597	3.0	0.5
Leamington Spa	12-Aug	411770	1.5	3.0	0.9991	3.2	0.6
Leeds Centre	01-Jul	080060036	0.4	3.0	0.9825	3.1	0.5
Leicester University	13-Aug	CM08060020	0.0	3.0	1.1090	3.1	0.3
Leominster	29-Jun	170	4.5	3.0	1.0077	3.2	0.6
Lerwick	15-Jul	2433	-2.6	3.0	0.9915	3.0	0.4
Liverpool Speke	07-Jul	cm08060041	0.1	3.0	1.0168	3.1	0.5
London Bloomsbury	27-Jul	435	-0.6	3.0	1.0389	3.2	0.3
London Eltham	21-Jul	1111958	0.0	3.0	0.9993	3.2	0.9
London Haringey Priory Park South	06-Aug	1111953	0.3	3.0	0.9355	3.2	1.4
London Harlington	22-Jul	1109	0.6	3.0	0.9639	3.1	1.6
London Hillingdon	22-Jul	8060034	-0.3	3.0	1.1669	3.5	4.1
London Marylebone Road	23-Jul	2432	7.0	3.0	1.0250	3.1	0.6
London N. Kensington	23-Jul	19098	0.9	3.0	0.9660	3.2	1.3
London Teddington	05-Aug	2447	36.2	3.0	1.1018	3.2	3.6
Lough Navar	19-Aug	1640	0.8	3.0	1.0190	3.1	1.1
Lullington Heath	02-Jul	1644	-0.3	3.0	0.9934	3.2	1.7
Mace Head	20-Aug	77086-385	0.6	3.0	0.9914	3.1	3.4
Manchester Piccadilly	14-Jul	cm08060039	-0.2	3.0	1.0587	3.1	0.3
Manchester South	14-Jul	16954	-1.0	3.0	1.0545	3.3	1.6
Market Harborough	14-Aug	CM08060031	0.5	3.0	1.0364	3.1	0.9
Middlesbrough	04-Jul	2436	-1.1	3.0	1.0474	3.2	1.1
Narberth	20-Jul	824	0.2	3.0	0.9896	3.1	0.3

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Site	Date Year =2015	Analyser number	1Zero output	Uncertainty (ppb)	2Calibration Factor	Uncertainty (%)	*Max Residual (%)
Newcastle Centre	06-Aug	cm08060033	-0.4	3.0	0.9935	3.1	2.2
Northampton Kingsthorpe	11-Aug	47R76STR	-0.5	3.0	0.9588	3.1	0.3
Norwich Lakenfields	09-Jul	CM08060028	0.1	3.0	1.0419	3.1	0.4
Nottingham Centre	10-Aug	cm08060032	-1.1	3.0	1.1546	3.3	0.8
Peebles	30-Jul	2449	-1.2	3.0	1.0399	3.1	2.0
Plymouth Centre	19-Aug	CM08060027	0.1	3.0	1.0420	3.1	0.5
Port Talbot Margam	21-Jul	cm10140049	0.1	3.0	0.9748	3.2	1.9
Portsmouth	02-Jul	cm08060023	-0.8	3.0	1.0630	3.1	1.0
Preston	09-Jul	CM08060042	-0.3	3.0	0.9578	3.1	0.5
Reading New Town	17-Aug	CM08060025	-0.2	3.0	1.0218	3.1	0.4
Rochester Stoke	03-Aug	378	2.0	3.0	0.9570	3.2	0.9
Sheffield Devonshire Grn	21-Jul	cm08060024	0.6	3.0	0.9678	3.0	0.1
Sibton	09-Jul	146	-0.5	3.0	1.0185	3.1	0.1
Southampton Centre	20-Aug	CM08060021	-0.2	3.0	1.0556	3.2	2.8
Southend-on-Sea	05-Aug	cm08060017	0.0	3.0	1.0266	3.1	0.1
St Osyth	05-Aug	CM08050073	1.6	3.0	1.0501	3.1	0.1
Stoke-on-Trent Centre	29-Jul	cm08060026	0.3	3.0	1.2802	3.5	3.0
Strath Vaich	16-Jul	176	-1.0	3.0	0.9503	3.0	1.0
Sunderland Si ksworth	05-Jul	436	1.0	3.0	0.9122	3.1	3.0
Thurrock	04-Aug	221	0.0	3.0	1.0055	3.2	1.0
Walsall Woodlands	30-Jul	2431	12.0	3.0	1.0043	3.1	1.6
Weybourne	10-Jul	CM10180038	-1.0	3.0	1.0087	3.1	0.2
Wicken Fen	06-Jul	14345	0.7	3.0	0.9696	3.1	0.4
Wigan Centre	13-Jul	cm08060018	-2.0	3.0	1.0006	3.1	1.3
Wirral Tranmere	06-Jul	8060040	-0.5	3.0	1.0183	3.1	0.6
Yarner Wood	01-Jul	2437	-2.4	3.0	0.9982	3.1	0.6

4. Oxides of Nitrogen

Site	Date Year =2015	Analyser number		1Zero output	Uncertainty (ppb)	2Calibration Factor	Uncertainty (%)	*Max residual (%)	*Converter efficiency (%)
Aberdeen	13-Jul	519	NOx	0.7	2.5	1.0424	3.5	0.8	99.1
			NO	0	2.5	0.9829	3.5	0.2	
Aberdeen Union Street Roadside	14-Jul	299	NOx	1.6	2.6	1.2112	3.5	0.8	99.5
			NO	0.1	2.6	1.2008	3.5	0.9	
Armagh Roadside	25-Aug	1011845	NOx	4	2.7	1.4784	3.5	0.4	98.0
			NO	1	2.7	1.4533	3.5	1.2	
Aston Hill	29-Jun	2302	NOx	1.2	3.8	1.2154	3.5	0.9	100.2
			NO	0.2	2.6	1.2254	3.5	0.4	
Barnsley Gawber	22-Jul	08050057	NOx	0	2.5	0.9119	3.5	0.9	99.3
			NO	0	2.5	0.9083	3.5	0.8	
Bath Roadside	18-Aug	1953	NOx	-0.9	2.6	1.2510	3.5	1.8	98.1
			NO	-1.7	2.6	1.2586	3.5	1.2	
Belfast Centre	25-Aug	08050074	NOx	0.5	2.5	1.0659	3.5	0.1	100.4
			NO	0.3	2.5	1.0565	3.5	0.6	
Belfast Stockman's Lane	24-Aug	2159	NOx	2.2	2.6	1.1797	3.5	0.9	99.2
			NO	1	2.6	1.1714	3.5	0.9	
Billingham	04-Jul	574	NOx	-0.1	2.6	1.1769	3.5	1.0	100.4
			NO	-0.1	2.6	1.1441	3.5	0.9	
Birmingham Acocks Green	27-Jul	3364	NOx	1.7	2.6	1.1808	3.5	3.0	100.6
			NO	0.1	2.6	1.1770	3.5	2.8	

Site	Date Year =2015	Analyser number		[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	*Max residual (%)	*Converter efficiency (%)
Birmingham Tyburn	28-Jul	y7acc7mc	NOx	1.6	2.6	1.0110	3.5	1.7	98.5
			NO	-0.7	2.6	1.0080	3.5	1.7	
Birmingham Tyburn Roadside	28-Jul	68	NOx	1.6	2.8	1.6067	3.5	0.5	99.4
			NO	-0.1	2.8	1.5875	3.5	0.5	
Blackburn Accrington Road	09-Jul		NOx	1	2.8	1.2247	3.5	0.9	94.4
			NO	-2	2.6	1.2169	3.5	0.4	
Blackpool Marton	09-Jul	08050075	NOx	0.5	2.5	0.9509	3.5	0.1	99.6
			NO	0.1	2.5	0.9979	3.5	0.2	
Bournemouth	19-Aug	2214	NOx	0.5	2.6	1.1137	3.5	0.9	99.0
			NO	0.3	2.6	1.1480	3.5	0.7	
Bradford Mayo Avenue	29-Jun	1011823	NOx	3	2.5	1.0207	3.5	0.5	98.8
			NO	-1	2.5	1.0166	3.5	0.6	
Brighton Preston Park	01-Jul	2222	NOx	0.2	2.5	0.9741	3.5	3.5	98.0
			NO	1.4	2.5	0.9844	3.5	4.2	
Bristol St Paul's	17-Aug	77	NOx	2.1	2.6	1.0749	3.5	1.7	98.5
			NO	1.6	2.5	1.0720	3.5	1.4	
Bury Whitefield Roadside	10-Jul	1011850	NOx	6	2.6	1.1231	3.5	4.5	98.4
			NO	0	2.6	1.1137	3.5	4.9	
Bush Estate	29-Jul	2244	NOx	-0.7	2.5	1.0547	3.5	0.6	98.8
			NO	1.3	2.6	1.0749	3.5	0.4	
Cambridge Roadside	07-Jul	1011843	NOx	4	2.6	1.2392	3.5	0.8	98.0
			NO	-1	2.7	1.2292	3.5	0.5	
Camden Kerbside	04-Aug	1011846	NOx	7	4.3	1.1346	3.5	0.2	99.1
			NO	0	2.8	1.1172	3.5	0.8	
Canterbury	06-Aug	1147	NOx	-0.1	2.7	1.2256	3.5	0.6	95.9
			NO	-0.8	2.6	1.2209	3.5	1.4	
Cardiff Centre	22-Jul	14325	NOx	-2	2.9	1.5682	3.5	0.4	100.1
			NO	0	2.8	1.5992	3.5	1.6	
Carlisle Roadside	08-Jul	1011849	NOx	3	2.6	1.2824	3.5	0.9	98.4
			NO	0	2.6	1.2706	3.5	0.4	
Charlton Mackrell	30-Jun	2120	NOx	-1.4	2.5	0.8827	3.5	0.5	98.4
			NO	-0.9	2.5	0.8858	3.5	1.3	
Chatham Centre Roadside	06-Aug	3393	NOx	3.4	2.7	1.2461	3.5	1.2	99.1
			NO	0.3	2.6	1.2367	3.5	0.4	
Chepstow A48	24-Jul	1011828	NOx	2	2.9	1.2101	3.5	0.8	100.5
			NO	0	2.8	1.1861	3.5	1.1	
Chesterfield Loundsley Green	21-Jul	1011837	NOx	0	2.8	1.1125	3.5	0.6	98.1
			NO	1	2.7	1.0660	3.5	0.7	
Chesterfield Roadside	20-Jul	1011835	NOx	-5	2.9	1.3166	3.5	0.6	101.2
			NO	-6	2.9	1.3015	3.5	0.6	
Coventry Allesley	12-Aug	08030109	NOx	-0.4	2.5	0.9340	3.5	0.8	99.6
			NO	-0.3	2.5	0.9402	3.5	1.1	
Cwmbran	23-Jul	loon2xg8	NOx	1.6	2.5	1.0349	3.5	0.9	98.5
			NO	0.9	2.6	1.0503	3.5	0.7	
Derry	18-Aug	2130	NOx	3.6	2.5	0.9687	3.5	1.8	98.6
			NO	0.8	2.5	0.9685	3.5	1.9	
Doncaster A630 Cleveland Street	22-Jul	1565	NOx	0.9	2.5	1.0669	3.5	0.6	99.6
			NO	1.1	2.6	1.0795	3.5	0.4	
Dumbarton Roadside	14-Jul	1011883	NOx	0	2.5	1.0660	3.5	0.5	100.0
			NO	0	2.5	1.0460	3.5	0.3	

Site	Date Year =2015	Analyser number		[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	[*]Max residual (%)	[*]Converter efficiency (%)
Dumfries	07-Jul	1494	NOx	1.2	2.5	1.0118	3.5	0.9	97.1
			NO	0.8	2.5	0.9988	3.5	1.2	
Eastbourne	01-Jul	3363	NOx	-1.4	2.6	1.1054	3.5	1.6	99.5
			NO	1.3	2.6	1.1026	3.5	2.0	
Edinburgh St Leonards	30-Jul	73	NOx	-7.5	2.8	1.5401	3.6	3.9	96.1
			NO	-0.1	2.8	1.5590	3.5	1.8	
Eskdalemuir	07-Jul	347	NOx	2.6	2.7	1.1077	3.5	0.5	98.3
			NO	0.6	2.6	1.0912	3.5	0.2	
Exeter Roadside	20-Aug	G0000D1S	NOx	1.7	2.6	1.0328	3.5	2.9	98.6
			NO	0.7	2.6	1.0391	3.5	2.5	
Fort William	08-Jul	344	NOx	0	2.6	1.1635	3.5	1.0	100.0
			NO	0	2.6	1.1727	3.5	0.5	
Glasgow Kerbside	15-Jul	08050061	NOx	-0.3	2.6	1.0811	3.5	0.4	99.2
			NO	0.8	2.6	1.0768	3.5	0.5	
Glasgow Townhead	15-Jul	1713	NOx	1	2.6	1.1423	3.5	0.2	99.1
			NO	1.9	2.6	1.1395	3.5	1.4	
Glasgow Great Western Road	14-Jul	1193	NOx	1	2.5	1.0416	3.5	0.6	99.7
			NO	0.4	2.5	1.0392	3.5	0.2	
Glasgow High Street	14-Jul	1567	NOx	1.1	2.6	1.1072	3.5	0.3	100.4
			NO	0.2	2.6	1.1034	3.5	1.3	
Glazebury	15-Jul	14354	NOx	1.6	2.5	0.9569	3.5	4.5	99.1
			NO	0.6	2.5	0.9859	3.5	4.8	
Grangemouth	31-Jul	1011836	NOx	1	2.5	1.0634	3.6	1.7	Not tested
			NO	0	2.5	1.0485	3.5	1.4	
Grangemouth Moray	31-Jul	1011852	NOx	1	2.6	1.1978	3.5	0.4	98.1
			NO	-1	2.8	1.1901	3.5	0.8	
Hafod-yr-ynys Roadside	24-Jul	2362	NOx	4	2.7	1.1974	3.5	1.2	100.1
			NO	3.5	2.7	1.1944	3.5	1.3	
Haringey Roadside	06-Aug	1011827	NOx	8	3.2	1.1257	3.5	0.7	99.5
			NO	0	2.6	1.1028	3.5	1.4	
Harwell	20-Jul	14355	NOx	2.1	2.7	1.4133	3.5	1.1	95.6
			NO	0.6	2.7	1.4251	3.5	1.3	
High Muffles	22-Jul	1783	NOx	-0.8	2.7	1.3292	3.5	2.3	95.6
			NO	-0.6	2.7	1.3148	3.7	2.0	
Honiton	20-Aug	3392	NOx	1.9	2.7	1.3318	3.5	2.6	97.9
			NO	0.5	2.7	1.3226	3.5	2.4	
Horley	30-Jun	1401954	NOx	9	2.9	1.0484	3.5	2.3	100.0
			NO	0	2.7	0.9943	3.5	1.2	
Hull Freetown	29-Jun	08050056	NOx	-0.4	2.5	0.9852	3.5	0.4	98.8
			NO	0.2	2.5	0.9785	3.5	0.4	
Hull Holderness Road	30-Jun	1564	NOx	4.6	2.6	1.1089	3.5	0.8	98.2
			NO	3	2.6	1.1039	3.5	0.3	
Inverness	16-Jul	1489	NOx	-2.1	2.5	1.0528	3.5	2.8	98.7
			NO	-1.6	2.5	1.0396	4.0	2.8	
Ladybower	20-Jul	72	NOx	1.1	2.6	1.2296	3.5	0.4	100.5
			NO	0.2	2.6	1.2084	3.5	0.6	
Leamington Spa	12-Aug	1011842	NOx	2	2.7	1.4845	3.5	0.4	98.8
			NO	0	2.7	1.4891	3.5	0.2	
Leamington Spa Rugby Road	12-Aug	3365	NOx	2.2	2.6	1.2566	3.5	2.0	99.0
			NO	0.6	2.6	1.2543	3.5	1.1	

CERTIFICATE OF CALIBRATION

Certificate Number: 03233

Site	Date Year =2015	Analyser number		[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	[*]Max residual (%)	[*]Converter efficiency (%)
Leeds Centre	01-Jul	08050066	NOx	8.1	2.6	1.0887	3.5	0.2	101.7
			NO	8.9	2.6	1.0909	3.5	0.6	
Leeds Headingley Kerbside	01-Jul	342	NOx	4.3	2.6	1.2853	3.5	1.5	98.9
			NO	-1.1	2.6	1.2481	3.5	1.6	
Leicester University	13-Aug	08050021	NOx	1.4	2.5	0.9099	3.5	1.4	98.8
			NO	1	2.5	0.9032	3.5	1.1	
Leominster	29-Jun	346	NOx	1.2	2.9	1.1538	3.5	0.5	98.8
			NO	1	2.6	1.1579	3.5	0.2	
Lincoln Canwick Road	11-Aug	3394	NOx	3	2.6	1.1977	3.5	1.2	98.1
			NO	1.4	2.6	1.2040	3.5	1.5	
Liverpool Queen's Drive Roadside	07-Jul	16927	NOx	-24.9	2.5	0.9992	3.5	2.9	98.3
			NO	-12.8	2.5	1.0349	3.5	5.4	
Liverpool Speke	07-Jul	19356	NOx	0.9	2.5	1.0160	4.0	8.1	99.6
			NO	0.8	2.5	1.0200	4.0	8.3	
London Bexley	29-Jul	327	NOx	5.2	3.0	1.1562	3.5	0.7	99.2
			NO	1.7	2.6	1.1529	3.5	0.6	
London Bloomsbury	27-Jul	74	NOx	0.8	2.8	1.2580	3.5	0.2	101.8
			NO	0.8	2.7	1.2647	3.5	0.3	
London Eltham	21-Jul	1011834	NOx	3	2.6	1.2536	3.5	2.3	100.6
			NO	-1	2.6	1.2471	3.5	1.1	
London Haringey Priory Park South	06-Aug	1084	NOx	2.1	3.0	1.1040	3.5	0.5	98.1
			NO	0.1	2.6	1.1008	3.5	0.4	
London Harlington	22-Jul	1090	NOx	-2.2	2.7	0.9224	3.5	3.2	99.4
			NO	-0.7	2.5	0.9161	3.5	2.7	
London Hillingdon	22-Jul	8050017	NOx	0.8	2.5	0.9530	3.9	5.5	98.3
			NO	0.5	2.5	0.9608	3.9	5.6	
London Marylebone Road	23-Jul	3366	NOx	0.3	2.6	1.2099	3.5	0.7	100.8
			NO	2.2	2.6	1.2293	3.5	1.0	
London N. Kensington	23-Jul	19096	NOx	-0.4	2.6	1.1331	3.5	1.2	98.6
			NO	0.5	2.6	1.1378	3.5	1.0	
London Teddington	05-Aug	3406	NOx	2.3	3.5	1.3078	3.7	1.5	98.3
			NO	0.4	2.7	1.3135	3.5	1.3	
London Westminster	20-Jul	573	NOx	1.5	not evaluated	1.3642	not evaluated	not tested	Not tested
			NO	1.1		1.3099			
Lullington Heath	02-Jul	2579	NOx	-0.6	2.6	1.0425	3.5	0.6	101.0
			NO	0.3	2.5	1.0412	3.5	0.7	
Luton A505 Roadside	10-Jul	1563	NOx	2.8	2.6	1.2209	3.5	0.2	98.7
			NO	0.1	2.6	1.2125	3.5	0.5	
Manchester Piccadilly	14-Jul	08050065	NOx	-0.9	2.7	1.4570	3.5	3.2	100.0
			NO	-0.2	2.7	1.4449	3.5	3.3	
Manchester South	14-Jul	17311	NOx	0.8	analyser fault	2.4276	analyser fault	not tested	96.9
			NO	1.1		2.4264			
Market Harborough	14-Aug	08050068	NOx	-0.3	2.5	1.0280	3.5	1.4	100.0
			NO	-0.4	2.5	1.0205	3.5	1.4	
Middlesbrough	04-Jul	2287	NOx	-5.5	2.6	1.1914	3.5	1.5	98.7
			NO	-5.4	2.6	1.1771	3.5	1.3	
Narberth	20-Jul	2577	NOx	3.1	2.6	1.1049	3.5	3.3	98.3
			NO	1	2.6	1.1090	3.5	0.4	
Newcastle Centre	06-Aug	08050063	NOx	-1.6	2.6	1.1164	3.5	1.1	101.3
			NO	-1.7	2.6	1.1423	3.5	1.0	

CERTIFICATE OF CALIBRATION

Site	Date Year =2015	Analyser number		[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	[*]Max residual (%)	[*]Converter efficiency (%)
Newcastle Cradlewell	05-Jul	1011853	NOx	6	2.6	0.8865	3.5	0.8	100.4
Roadside			NO	-2	2.5	0.8617	3.5	0.9	
Newport	23-Jul	1011829	NOx	1.4	2.7	1.0025	3.5	1.3	99.8
			NO	-2.2	2.6	1.0023	3.5	0.5	
Northampton	11-Aug	8ATJ6APR	NOx	2.3	2.6	1.0113	3.5	0.9	99.1
Kingsthorpe			NO	-0.7	2.6	1.0116	3.5	0.5	
Norwich Lakenfields	09-Jul	08050067	NOx	-1.3	2.5	1.0182	3.5	0.7	98.0
			NO	0.7	2.5	1.0231	3.5	0.8	
Nottingham Centre	10-Aug	08050072	NOx	0.8	2.5	0.9614	3.5	0.5	100.7
			NO	0.9	2.5	0.9596	3.5	1.3	
Oldbury Birmingham	30-Jul	D00064EU	NOx	0.7	2.5	0.9408	3.5	0.9	100.8
Road			NO	0.1	2.5	0.9507	3.5	1.3	
Oxford Centre	23-Jul	1011844	NOx	6	2.5	1.0697	3.5	3.3	98.1
Roadside			NO	0	2.7	1.0541	3.5	3.3	
Oxford St Ebbes	23-Jul	1011830	NOx	1	2.7	1.2428	4.7	10.7	100.0
			NO	-1	2.7	1.2119	4.5	9.6	
Peebles	30-Jul	2213	NOx	-2	2.6	1.1038	3.5	1.1	98.3
			NO	0.3	2.6	1.1268	3.5	0.7	
Plymouth Centre	19-Aug	08050062	NOx	-0.3	2.5	0.9554	3.5	2.3	100.0
			NO	0	2.5	0.9541	3.5	2.1	
Port Ta bot Margam	21-Jul	1426962887	NOx	0.2	2.7	1.3944	3.5	0.7	99.5
			NO	0.1	2.7	1.4022	3.5	0.6	
Portsmouth	02-Jul	A24819	NOx	-0.3	2.6	1.1421	3.6	4.6	98.0
		POT7CYA5	NO	-0.2	2.6	1.2036	3.7	4.8	
Preston	09-Jul	08050664	NOx	0.6	2.5	0.9229	3.5	2.0	99.2
			NO	1.6	2.5	0.9223	3.5	2.4	
Reading New Town	17-Aug	08050059	NOx	-9.2	2.5	0.9488	3.5	0.6	101.1
			NO	-1.6	2.5	0.9671	3.5	0.4	
Rochester Stoke	03-Aug	3095	NOx	3	3.2	1.1744	3.5	0.7	98.5
			NO	7	2.7	1.1891	3.5	1.1	
Salford Eccles	09-Jul	1011831	NOx	4	2.7	1.0297	3.5	5.1	99.1
			NO	0	2.7	1.0058	3.5	4.5	
Sandy Roadside	06-Jul	18006	NOx	3.4	2.7	1.4052	3.5	0.6	100.0
			NO	0.7	2.7	1.4386	3.5	0.6	
Scunthorpe Town	06-Jul	1011847	NOx	4	3.5	1.2081	3.5	0.5	99.0
			NO	-1	2.9	1.1970	3.5	0.2	
Shaw Crompton Way	10-Jul	20861	NOx	2.7	2.6	1.2045	3.5	5.3	98.8
			NO	0.4	2.6	1.2132	3.5	5.5	
Sheffield Devonshire	21-Jul	08050055	NOx	-1.2	2.5	0.9819	3.5	0.7	99.6
Green			NO	-0.4	2.5	0.9680	3.5	0.8	
Sheffield Tinsley	21-Jul	1882	NOx	0.5	2.5	0.9769	3.9	2.6	98.8
			NO	0.9	2.5	0.9730	3.5	2.7	
Southampton Centre	20-Aug	08030106	NOx	-0.1	analyser	1.0021	analyser	not	98.9
			NO	0.3	fault	0.9018	fault	tested	
Southend-on-Sea	05-Aug	08050071	NOx	0.7	2.5	0.9729	3.5	1.1	98.4
			NO	0.2	2.5	0.9779	3.5	1.5	
Southwark A2 Old	21-Jul	1495	NOx	3.5	2.7	1.2349	3.5	3.1	99.8
Kent Road			NO	1.8	2.6	1.2313	3.6	3.8	
St Osyth	05-Aug	08060035	NOx	0.4	2.5	1.0800	3.5	0.8	99.0
			NO	0.5	2.6	1.0778	3.5	1.0	

CERTIFICATE OF CALIBRATION

Site	Date Year =2015	Analyser number		[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	[*]Max residual (%)	[*]Converter efficiency (%)
Stanford-le-Hope Roadside	04-Aug	191	NOx	-1.4	2.6	1.1381	3.5	0.6	98.5
			NO	0.2	2.6	1.0971	3.5	0.4	
Stockton-on-Tees Eaglescliffe	03-Jul	355	NOx	1.7	2.6	1.2317	3.5	1.7	99.1
			NO	0.9	2.6	1.1975	3.6	1.7	
Stockton-on-Tees A1305	03-Jul	1210	NOx	6.9	2.6	1.1677	3.5	1.0	100.5
			NO	6.7	2.6	1.1617	3.5	0.7	
Stoke-on-Trent Centre	29-Jul	08050070	NOx	-1.9	2.5	0.9411	3.5	1.4	99.3
			NO	-0.6	2.5	0.9417	3.5	1.1	
Stoke-on-Trent A50 Roadside	29-Jul	1588	NOx	2.6	2.6	1.1608	3.5	1.4	100.2
			NO	1.3	2.6	1.1625	3.5	0.8	
Storrington Roadside	30-Jun	09040022	NOx	-0.8	2.5	0.8065	3.5	1.4	100.0
			NO	-0.8	2.5	0.8024	3.5	0.9	
Sunderland Wessington Way	05-Jul	1195	NOx	2.1	2.6	1.1384	3.5	1.2	98.3
			NO	2.2	2.6	1.1157	3.5	0.9	
Sunderland Silksworth	05-Jul	1011854	NOx	4	2.7	1.0349	3.5	0.8	100.8
			NO	1	2.8	1.0406	3.5	0.9	
Swansea Roadside	21-Jul	1229	NOx	3.2	2.6	1.1577	3.5	0.8	99.8
			NO	1.3	2.6	1.1873	3.5	0.8	
Thurrock	04-Aug	189	NOx	3	2.6	1.1205	3.5	0.3	99.7
			NO	0.9	2.6	1.1449	3.5	0.2	
Tower Hamlets Roadside	28-Jul	1011838	NOx	7	3.1	1.4098	3.5	0.2	101.2
			NO	1	3.1	1.3750	3.5	0.4	
Walsall Woodlands	30-Jul	3391	NOx	3	2.6	1.2104	3.5	0.8	99.7
			NO	1.1	2.6	1.2750	3.5	1.1	
Warrington	08-Jul	1011826	NOx	5	2.7	1.1379	3.6	5.0	99.5
			NO	-1	3.4	0.9830	3.6	5.6	
Wicken Fen	06-Jul	13069	NOx	0.3	2.5	0.9064	3.5	1.2	99.3
			NO	-0.1	2.5	0.9053	3.5	0.4	
Widnes Milton Road	09-Jul	21351	NOx	1.4	2.5	0.9531	3.5	5.5	98.2
			NO	0.7	2.5	0.9021	4.5	5.4	
Wigan Centre	13-Jul	1011832	NOx	1	2.6	1.0811	3.5	5.4	101.2
			NO	-1	2.7	1.0723	3.5	5.2	
Wrexham	06-Jul	1490	NOx	-0.7	2.6	1.1946	3.5	4.4	98.5
			NO	1.5	2.6	1.2106	3.5	4.4	
Yarner Wood	01-Jul	1784	NOx	-0.5	2.8	1.0249	3.5	1.7	101.3
			NO	-0.6	2.5	1.0303	3.5	1.8	
York Fishergate	30-Jun		NOx	9	2.8	1.1469	3.5	0.3	99.2
			NO	0	2.6	1.1084	3.5	2.0	

5. Particulates

Site	Date Year =2015		Analyser number	Calculated Spring Constant k_0	[4]k_0 accuracy (%)	Uncertainty (%)	[3]Measured Main Flow (l/min)	Uncertainty (%)	[3]Measured Total Flow (l/min)	Uncertainty (%)
Aberdeen	13-Jul	PM10	270302	11604	0.30	1.0	3.15	2.2	16.49	2.2
		PM2.5	680811	12169	-0.42	1.0	3.03	2.2	16.74	2.2
Armagh Roadside	25-Aug	PM10	530201	13607	0.26	1.0	**3.15**	**2.2**	**17.32**	**2.2**
Auchencorth Moss	29-Jul	PM10	680602	13068	-0.92	1.0	2.65	2.2	14.97	2.2
		PM2.5	960603	13730	-2.05	1.0	2.67	2.2	15.08	2.2
		GR10							15.73	2.2

		GR2.5							15.65	2.2
Barnstaple A39	21-Aug	PM10	300810	17512	1.39	1.0	2.95	2.2	15.72	2.2
	21-Aug	PM2.5	821002	14247	0.60	1.0	2.96	2.2	15.85	2.2
Belfast Centre	25-Aug	PM10	110302	14283	0.63	1.0	**3.21**	**2.2**	**18.00**	**2.2**
	25-Aug	PM2.5	880702	15650	-0.50	1.0	**3.21**	**2.2**	**17.87**	**2.2**
Belfast Stockman's Lane	24-Aug	PM10	K1042						13.28	2.2
Birmingham Acocks Green	27-Jul	PM2.5	900702	15924	1.15	1.0	3.04	2.2	16.44	2.2
Birmingham Tyburn	28-Jul	PM10	900809	14881	-0.40	1.0	3.02	2.2	15.96	2.2
	28-Jul	PM2.5	540701	13749	-0.43	1.0	3.01	2.2	15.92	2.2
Birmingham Tyburn Road	28-Jul	PM10	020603	12127	-2.01	1.0	2.95	2.2	16.05	2.2
	28-Jul	PM2.5	220606	14235	-1.37	1.0	2.75	2.2	15.51	2.2
Blackpool Marton	09-Jul	PM2.5	240505	12692	1.25	1.0	2.81	2.2	14.79	2.2
Bournemouth	19-Aug	GR2.5	630603						17.08	2.2
Brighton Preston Park	01-Jul	GR2.5	650603						13.08	2.2
Bristol St Paul's	17-Aug	PM10	260302	13314	1.03	1.0	2.98	2.2	16.56	2.2
	17-Aug	PM2.5	50701	14806	-0.83	1.0	3.07	2.2	16.32	2.2
Bury Whitefield Rd	10-Jul	PM10	350810	15132	0.45	1.0	3.09	2.2	16.82	2.2
	10-Jul	PM2.5	340810	16429	1.44	1.0	3.07	2.2	16.75	2.2
Camden Kerbside	04-Aug	PM10	619902	12026	0.31	1.0	3.65	2.2	17.28	2.2
	04-Aug	PM2.5	100009	12977	1.74	1.0	3.04	2.2	16.63	2.2
Cardiff Centre	22-Jul	PM10	550701	13820	-0.43	1.0	3.02	2.2	16.26	2.2
	22-Jul	PM2.5	700401	11139	1.31	1.0	3.00	2.2	16.41	2.2
Carlisle Roadside	08-Jul	PM10	600809	14634	1.00	1.0	2.99	2.2	15.95	2.2
	08-Jul	PM2.5	130310	15303	0.88	1.0	3.02	2.2	15.89	2.2
Chatham Centre Road	06-Aug	PM10	840809	14680	1.08	1.0	3.04	2.2	16.81	2.2
	06-Aug	PM2.5	090810	16238	1.49	1.0	3.08	2.2	16.59	2.2
Chepstow A48	24-Jul	PM10	220705	15556	1.09	1.0	3.07	2.2	16.39	2.2
	24-Jul	PM2.5	881103	16779	1.78	1.0	3.09	2.2	16.07	2.2
Chesterfield Loundsley	21-Jul	PM10	27316	16277	-0.28	1.0	2.98	2.2	16.08	2.2
	21-Jul	PM2.5	27341	15566	0.66	1.0	2.99	2.2	16.17	2.2
Chesterfield Roadside	20-Jul	PM10	22299	11177	-1.48	1.0	2.99	2.2	16.41	2.2
	20-Jul	PM2.5	27339	10938	-1.33	1.0	3.04	2.2	16.61	2.2
Coventry Allesley	12-Aug	PM2.5	450702	15032	0.43	1.0	2.93	2.2	16.68	2.2
Derry	18-Aug	PM10	2701	15648	-1.01	1.0	3.05	2.2	16.08	2.2
	18-Aug	PM2.5	21313	10727	-1.50	1.0	2.98	2.2	15.98	2.2
Ealing Horn Lane	03-Aug	PM10	160810	15343	0.53	1.0	3.05	2.2	16.32	2.2
Eastbourne	01-Jul	PM10	380809	14482	-0.15	1.0	3.19	2.2	17.73	2.2
	01-Jul	PM2.5	430809	14885	0.35	1.0	3.43	2.2	17.39	2.2
Edinburgh St Leonards	30-Jul	PM10	970808	13591	-0.73	1.0	2.89	2.2	15.68	2.2
	30-Jul	PM2.5	190808	16965	-0.27	1.0	2.94	2.2	15.60	2.2
Glasgow Townhead	15-Jul	PM10	510207	13191	-1.03	1.0	2.93	2.2	15.09	2.2
	15-Jul	PM2.5	060002	13159	0.12	1.0	2.98	2.2	15.49	2.2
Glasgow High Street	14-Jul	PM10	388903	14622	0.27	1.0	3.07	2.2	15.72	2.2
	14-Jul	PM2.5	070810	15246	0.83	1.0	3.00	2.2	16.67	2.2
Grangemouth	31-Jul	PM10	210810	15967	0.31	1.0	3.02	2.2	16.38	2.2
	31-Jul	PM2.5	110808	13677	-0.61	1.0	3.00	2.2	15.43	2.2
Haringey Roadside	06-Aug	PM2.5	970810	13731	-0.49	1.0	3.01	2.2	16.70	2.2
Harwell	20-Jul	PM10	670811	15031	0.61	1.0	3.02	2.2	16.50	2.2
	20-Jul	PM2.5	570401	12442	0.40	1.0	2.97	2.2	16.42	2.2
	20-Jul	GR10	438902						16.76	2.2

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CERTIFICATE OF CALIBRATION

	20-Jul	GR2.5	590603						17.06	2.2
Hull Freetown	29-Jun	PM2.5	510701	14007	-1.31	1.0	3.22	2.2	16.54	2.2
Hull Holderness Rd	30-Jun	PM10	960301	14202	0.66	1.0	3.02	2.2	16.58	2.2
Inverness	16-Jul	GR10	21255						16.23	2.2
	16-Jul	GR2.5	21861						15.61	2.2
Leamington Spa	12-Aug	PM10	510809	15101	0.70	1.0	2.94	2.2	16.09	2.2
	12-Aug	PM2.5	110810	14233	0.37	1.0	3.00	2.2	16.38	2.2
Leamington Rugby Road	12-Aug	PM10	150705	13975	-0.51	1.0	2.93	2.2	16.22	2.2
	12-Aug	PM2.5	440809	15900	-0.84	1.0	3.11	2.2	16.91	2.2
Leeds Centre	01-Jul	PM10	210302	13436	0.30	1.0	3.01	2.2	16.35	2.2
	01-Jul	PM2.5	170808	16917	-0.72	1.0	2.92	2.2	16.63	2.2
Leeds Headingley K	01-Jul	PM10	921103	17517	-0.39	1.0	2.90	2.2	15.71	2.2
	01-Jul	PM2.5	980808	14524	-1.21	1.0	3.00	2.2	16.26	2.2
Leicester University	13-Aug	PM2.5	000701	14994	0.20	1.0	3.03	2.2	16.54	2.2
Liverpool Speke	07-Jul	PM10	860702	14977	0.47	1.0	2.97	2.2	15.89	2.2
	07-Jul	PM2.5	220302	15827	0.10	1.0	2.96	2.2	15.95	2.2
London Bexley	29-Jul	PM2.5	430401	11658	0.56	1.0	3.02	2.2	16.02	2.2
London Bloomsbury	27-Jul	PM10								
	27-Jul	PM2.5	610809	14787	0.18	1.0	2.95	2.2	15.68	2.2
London Eltham	21-Jul	PM2.5	840801	14060	1.76	1.0	3.41	2.2	16.26	2.2
London Harlington	22-Jul	PM10	440311	12316	0.24	1.0	3.04	2.2	16.38	2.2
	22-Jul	PM2.5	920202	12875	0.55	1.0	3.01	2.2	16.27	2.2
London Harrow Stanmore	04-Aug	PM2.5	660809	16167	-0.48	1.0	2.99	2.2	16.05	2.2
London Marylebone Road	23-Jul	PM10	410401	13080	-0.81	1.0	3.08	2.2	16.67	2.2
	23-Jul	PM2.5	450809	13022	1.64	1.0	3.04	2.2	16.53	2.2
	23-Jul	GR10	439811						16.71	2.2
	23-Jul	GR2.5	210001						16.66	2.2
London N. Kensington	23-Jul	PM10	780811	12680	0.07	1.0	3.04	2.2	16.50	2.2
	23-Jul	PM2.5	070808	15918	0.84	1.0	3.11	2.2	16.53	2.2
	23-Jul	GR10	159902						16.34	2.2
	23-Jul	GR2.5	199902						16.26	2.2
London Teddington Bushy Park	05-Aug	PM2.5	N11133	0	0.00	1.0	2.87	2.2	15.89	2.2
London Westminster	20-Jul	GR2.5							16.69	2.2
Lough Navar	19-Aug	PM10	21196	12720	-0.77	1.0	3.01	2.2	16.46	2.2
Manchester Piccadilly	14-Jul	PM2.5	380602	13902	-0.87	1.0	2.85	2.2	15.91	2.2
Middlesbrough	04-Jul	PM10	24325	14197	0.45	1.0	2.96	2.2	16.24	2.2
	04-Jul	PM2.5	2000	16150	0.88	1.0	3.01	2.2	16.43	2.2
Narberth	20-Jul	PM10	630702	13936	0.46	1.0	2.95	2.2	15.89	2.2
Newcastle Centre	06-Aug	PM10	24448	13790	-0.24	1.0	2.98	2.2	16.87	2.2
	06-Aug	PM2.5	24447	14935	0.67	1.0	3.08	2.2	17.45	2.2
Newport	23-Jul	PM10		13908	-0.56	1.0	3.07	2.2	16.50	2.2
	23-Jul	PM2.5	010808	16662	0.24	1.0	2.99	2.2	15.75	2.2
Northampton Kingsthorpe	11-Aug	GR2.5	139902						16.81	2.2
Norwich Lakenfields	09-Jul	PM10	981105	15554	-0.99	1.0	3.22	2.2	16.53	2.2
	09-Jul	PM2.5	180810	15671	0.44	1.0	3.09	2.2	16.83	2.2
Nottingham Centre	10-Aug	PM10	580811	15568	-0.08	1.0	2.85	2.2	16.04	2.2
	10-Aug	PM2.5	400401	12171	-0.09	1.0	2.79	2.2	15.60	2.2
Oxford St	23-Jul	PM10	870809	14807	-0.06	1.0	3.02	2.2	16.39	2.2

Ebbes	23-Jul	PM2.5	160808	17222	0.31	1.0	not	tested	**12.79**	**2.2**
Plymouth Centre	19-Aug	PM10	280302	12311	0.27	1.0	3.05	2.2	16.18	2.2
	19-Aug	PM2.5								
Port Talbot Margam	21-Jul	PM10	830807	13813	-0.88	1.0	3.08	2.2	15.94	2.2
	21-Jul	PM2.5	510103	11563	-0.85	1.0	3.11	2.2	16.25	2.2
	21-Jul	GR10	389903						17.04	2.2
Portsmouth	02-Jul	PM10	281101	16873	-0.36	1.0	3.25	2.2	17.01	2.2
	02-Jul	PM2.5	500809	18432	-0.60	1.0	3.09	2.2	16.47	2.2
Preston	09-Jul	PM2.5	240505	13015	0.47	1.0	**3.05**	**2.2**	**19.56**	**2.2**
Reading New Town	17-Aug	PM10	940003	13255	0.41	1.0	2.95	2.2	16.68	2.2
	17-Aug	PM2.5	140702	13966	-1.20	1.0	2.99	2.2	18.23	2.2
Rochester Stoke	03-Aug	PM10	750809	14964	0.34	1.0	3.04	2.2	16.17	2.2
	03-Aug	PM2.5	890810	16165	1.38	1.0	2.48	2.2	15.48	2.2
Salford Eccles	09-Jul	PM10	250809	13727	0.26	1.0	2.94	2.2	16.83	2.2
	09-Jul	PM2.5	840808	14539	-0.67	1.0	3.15	2.2	16.89	2.2
Saltash Callington Rd	19-Aug	PM10	280210	14135	-0.04	1.0	3.04	2.2	16.60	2.2
	19-Aug	PM2.5	860811	12513	-0.50	1.0	2.95	2.2	16.45	2.2
Sandy Roadside	06-Jul	PM10	399707	11206	-0.77	1.0	3.32	2.2	17.69	2.2
	06-Jul	PM2.5	841102	15887	-1.20	1.0	3.08	2.2	16.51	2.2
Scunthorpe Town	06-Jul	PM10	710602	12484	-2.39	1.0	3.05	2.2	16.84	2.2
Sheffield Devonshire G	21-Jul	PM10	25024	12172	-0.63	1.0	2.93	2.2	15.88	2.2
	21-Jul	PM2.5	27253	15759	0.78	1.0	2.96	2.2	16.34	2.2
Southampton Centre	20-Aug	PM10	560302	13828	-0.33	1.0	2.97	2.2	16.32	2.2
	20-Aug	PM2.5	330808	16554	0.19	1.0	2.92	2.2	15.86	2.2
Southend-on-Sea	05-Aug	PM2.5	760401	12459	0.21	1.0	3.03	2.2	20.68	2.2
Southwark A2 Old Kent Road	21-Jul	PM10	370612	14966	-1.04	1.0	2.98	2.2	15.78	2.2
Stanford-le-Hope Road	04-Aug	PM10	880303	12807	1.10	1.0	3.04	2.2	16.58	2.2
	04-Aug	PM2.5	209804	13371	2.52	1.0	2.98	2.2	16.22	2.2
Stockton-on-Tees Eagles	03-Jul	PM10	h4554						16.25	2.2
	03-Jul	PM2.5	h4553						16.23	2.2
Stoke-on-Trent Centre	29-Jul	PM2.5	570809	13343	-1.18	1.0	2.92	2.2	15.95	2.2
Stoke-on-Trent A50 Roadside	29-Jul	PM10	470401	12544	0.34	1.0	3.05	2.2	16.91	2.2
Storrington Roadside	30-Jun	PM10	360808	15719	0.25	1.0	3.85	2.2	16.21	2.2
	30-Jun	PM2.5	760811	12861	0.90	1.0	3.36	2.2	16.67	2.2
Sunderland Silksworth	05-Jul	PM2.5	27247	14305	0.24	1.0	3.05	2.2	16.49	2.2
Swansea Roadside	21-Jul	PM10	m9305						16.85	2.2
	21-Jul	PM2.5	m9306						15.49	2.2
Thurrock	04-Aug	PM10	270810	14089	0.28	1.0	2.96	2.2	16.15	2.2
Warrington	08-Jul	PM10	980309	12055	0.44	1.0	3.17	2.2	16.28	2.2
	08-Jul	PM2.5	060808	16265	-0.57	1.0	3.01	2.2	16.10	2.2
Wigan Centre	13-Jul	PM2.5	290809	14780	-0.57	1.0	3.04	2.2	15.57	2.2
Wirral Tranmere	06-Jul	PM2.5	660001	13310	0.13	1.0	3.08	2.2	16.51	2.2
Wrexham	06-Jul	GR10							16.67	2.2
	06-Jul	GR2.5	119902						16.91	2.2
York Bootham	30-Jun	PM10	259712	14691	-0.31	1.0	3.06	2.2	15.38	2.2
	30-Jun	PM2.5	961105	16049	-1.43	1.0	2.98	2.2	15.33	2.2
York Fishergate	30-Jun	PM10	060810	15743	0.29	1.0	2.85	2.2	16.23	2.2
	30-Jun	PM2.5	220808	18137	-0.58	1.0	2.91	2.2	16.01	2.2

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

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

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

Concentration = (output – zero response) x Calibration factor

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

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

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

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

CERTIFICATE OF CALIBRATION

0401

Ricardo Energy & Environment, The Gemini Building, Fermi Avenue,
Harwell, Didcot, Oxfordshire OX11 0QR
Telephone 01235 753212

Certificate Number: 03632

Authorised Signatories: S Eaton
B Stacey

Signed:

Date of issue: 31st March 2017

Customer Name and Address: Jo Scully, Environment Agency, Lutra House, Dodd Way, Off Seedlee Road, Walton Summit, Bamber Bridge, Preston, Lancs, PR5 8BX

Date of Calibration: July to September 2016

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

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

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

1. Carbon Monoxide

Site	Date Year = 2016	Analyser number	[1]Zero output	Uncertainty (ppm)	[2]Calibration Factor	Uncertainty (%)	[*]Maximum Residual (%)
Belfast Centre	23-Aug	462	0.30	0.20	0.9970	2.2	1.0
Cardiff Centre	13-Jul	1502	0.20	0.20	0.9885	2.2	4.8
Edinburgh St Leonards	09-Aug	159	0.80	0.20	0.9406	2.2	0.8
Leeds Centre	11-Jul	458	0.50	0.20	0.9970	2.2	2.6
London Marylebone Road	27-Jul	651	-1.40	0.20	1.0286	2.2	1.7
London N. Kensington	26-Jul	2313	0.10	0.20	0.9889	2.1	1.2
Port Talbot Margam	12-Jul	605214618	1.30	0.20	0.9885	2.2	0.7

2. Sulphur Dioxide

Site	Date Year =2016	Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	[*]Max Residual (%)	[*]m-xylene interference (ppb)
Ballymena Ballykeel	18-Aug	4901234	0.0	2.5	0.8811	3.1	0.2	22.9
Barnsley Gawber	28-Jul	8050082	2.1	2.6	1.0991	3.2	2.5	2.1
Belfast Centre	23-Aug	1766	26.3	2.6	1.1106	5.8	16.8	18.7
Birmingham Tyburn	21-Jul		3.6	2.4	0.7961	3.0	0.6	0.3
Cardiff Centre	13-Jul	70	8.9	2.6	1.2587	3.1	2.1	22.5
Chilbolton	28-Jul	83	3.8	2.5	0.9924	2.9	0.1	16.2
Derry Rosemount	18-Aug	1697	18.5	2.5	0.8778	3.2	2.7	3.2
Edinburgh St Leonards	09-Aug	84	26.5	2.4	0.7564	3.2	2.6	0.5
Grangemouth	08-Aug	1211322	1.0	2.5	1.0086	3.1	1.1	22.2
Hull Freetown	13-Jul	342	5.3	2.5	0.9739	3.9	3.8	6.7
Ladybower	26-Jul	1178	-2.8	2.6	1.0765	3.4	3.3	8.3
Leeds Centre	11-Jul		0.3	2.5	1.0385	3.5	5.1	6.3
Liverpool Speke	21-Jul	17509	5.2	2.6	1.1183	3.0	1.6	13.6
London Bloomsbury	08-Aug	74	-0.7	2.5	0.9299	3.0	2.4	23.0
London Marylebone Road	27-Jul	2644	1.6	2.5	1.0360	3.1	0.8	6.8
London N. Kensington	26-Jul	2576	7.2	2.5	1.0331	3.0	2.0	18.9
Lullington Heath	28-Jul	82	1.7	2.6	1.0806	3.1	1.0	26.2
Manchester Piccadilly	14-Jul		0.9	2.5	0.9544	3.2	4.8	10.2
Middlesbrough	02-Aug	345	13.8	2.5	0.9974	3.2	2.5	-2.8
Narberth	11-Jul	344	7.9	2.9	1.8066	3.3	3.3	19.7
Nottingham Centre	18-Aug	1629	5.6	2.6	1.1067	3.3	1.4	27.0
Port Talbot Margam	12-Jul	605214617	0.7	2.6	1.0278	3.1	0.5	8.2
Rochester Stoke	10-Aug	2800	14.0	2.5	0.8114	3.1	1.0	23.5
Scunthorpe Town	12-Jul	1576	0.0	2.6	1.1146	4.5	5.4	19.7
Southampton Centre								
Thurrock	09-Aug	189	-0.6	2.5	0.9799	3.5	4.1	23.8
Wicken Fen	02-Aug	14322	6.6	2.6	1.1378	3.9	2.2	19.8
Wrexham	20-Jul	1181	11.9	2.6	1.0998	3.2	5.5	16.3

3. Ozone

Site	Date Year =2016	Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	[*]Max Residual (%)
Aberdeen	18-Jul	800	1.1	3.0	1.0175	3.1	0.4
Aston Hill	08-Aug	1643	-0.6	3.0	1.0054	3.1	1.4
Auchencorth Moss	10-Aug	1646	-0.2	3.0	1.0605	3.1	0.2
Barnsley Gawber	28-Jul	8060030	0.1	3.0	1.0059	3.1	1.1
Belfast Centre	23-Aug		-0.1	3.0	0.9878	3.1	0.2
Birmingham Acocks Green	22-Jul	2435	-0.4	3.0	1.0420	3.1	0.4
Birmingham Tyburn	21-Jul		1.4	3.0	0.9652	3.1	0.5
Birmingham A4540 Roadside	21-Jul	2434	0.3	3.0	1.0724	3.2	1.6
Blackpool Marton	14-Jul		0.1	3.0	1.0420	3.1	0.9
Bottesford	23-Aug		0.0	3.0	0.9725	3.1	0.6
Bournemouth	24-Aug	1650	0.7	3.0	1.0390	3.1	0.4
Brighton Preston Park	26-Jul	542	11.1	3.0	1.0508	3.1	0.4
Bristol St Paul's	04-Jul	155	-0.4	3.0	1.0351	3.2	0.4
Bush Estate	10-Aug	1645	0.2	3.0	1.0564	3.1	0.7
Canterbury	11-Aug	1642	0.2	3.0	1.1288	3.1	0.4
Cardiff Centre	13-Jul	168	-1.5	3.0	1.1482	3.1	0.4
Charlton Mackrell	10-Aug	1111957	0.5	3.0	1.0574	3.2	0.9
Chilbolton	28-Jul	1648	-0.3	3.0	1.0548	3.1	0.3
Coventry Allesley	20-Jul		-0.7	3.0	1.0099	3.1	1.9
Cwmbran	14-Jul		0.5	3.0	0.9619	3.3	4.5
Derry Rosemount	18-Aug	1586	1.3	3.0	1.0235	3.1	0.8
Edinburgh St Leonards	09-Aug	136	-1.7	3.0	0.8730	3.1	1.8
Eskdalemuir	12-Jul	158	0.3	3.0	1.0557	3.1	1.0
Exeter Roadside	07-Jul		1.1	3.0	0.9916	3.1	0.4
Fort William	20-Jul	437	0.4	3.0	1.0522	3.2	0.6
Glasgow Townhead	27-Jul		0.0	3.0	1.0284	3.2	0.9
Glazebury	13-Jul	1274	2.5	3.0	1.0927	3.1	0.6
Great Dun Fell	13-Jul	1647	0.2	3.0	0.9147	3.1	2.7
High Muffles	29-Jul	1641	0.2	3.0	1.0845	3.1	2.0
Hull Freetown	13-Jul		-0.2	3.0	0.9881	3.1	0.5
Ladybower	26-Jul	1651	0.3	3.0	1.1400	3.2	4.8
Leamington Spa	24-Aug	411770	1.5	3.0	1.0147	3.2	2.0
Leeds Centre	11-Jul		0.1	3.0	1.0055	6.2	13.1
Leicester University	16-Aug		-0.3	3.0	1.0934	3.2	0.9
Leominster	18-Aug	170	4.5	3.0	1.0430	3.1	0.1
Lerwick	20-Jul	2257	-0.6	3.0	0.9915	3.1	0.1
Liverpool Speke	21-Jul		-0.2	3.0	1.0240	3.1	0.8
London Bloomsbury	08-Aug	435	-0.2	3.0	1.0667	3.3	0.8
London Eltham	29-Jul	1111958	0.3	3.0	0.9139	3.1	0.6
London Haringey Priory Park South	17-Aug	1111953	0.0	3.0	1.0242	3.1	1.2
London Harlington	03-Aug	1109	1.1	3.0	0.9750	3.1	0.3
London Hillingdon	11-Aug		0.1	3.0	1.0430	3.1	0.4
London Marylebone Road	27-Jul	2432	1.6	3.0	1.1119	3.2	0.9
London N. Kensington	26-Jul	2372	-1.6	3.0	0.9970	3.2	0.8
Lough Navar	16-Aug	1640	2.2	3.0	1.0570	3.2	0.8
Lullington Heath	28-Jul	1644	5.2	3.0	1.0013	3.1	1.9
Mace Head	17-Aug		0.5	3.0	0.9917	3.1	1.2
Manchester Piccadilly	14-Jul		-0.1	3.0	1.0501	3.1	0.9
Manchester Sharston	14-Jul	16954	-0.8	3.0	1.0263	3.1	1.0
Market Harborough	17-Aug	60031	2.3	3.0	1.0079	3.1	0.2
Middlesbrough	02-Aug	236	0.1	3.0	1.0475	3.1	3.1

Site	Date Year =2016	Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	[*]Max Residual (%)
Narberth	11-Jul	824	0.6	3.0	0.9861	3.1	0.4
Newcastle Centre	04-Aug	8060033	0.4	3.0	0.9954	3.1	0.6
Northampton Kingsthorpe	15-Aug		-1.4	3.0	0.9068	3.1	0.5
Norwich Lakenfields	03-Aug		0.0	3.0	1.0390	3.2	0.8
Nottingham Centre	18-Aug		0.2	3.0	1.0164	3.2	1.9
Peebles	09-Aug	2449	-2.1	3.0	1.1143	3.1	1.1
Plymouth Centre	05-Jul		0.5	3.0	0.9825	3.2	0.6
Port Talbot Margam	12-Jul		0.1	3.0	0.9885	3.1	0.2
Portsmouth	01-Sep		-0.6	3.0	0.9459	3.2	0.7
Preston	14-Jul		-0.6	3.0	1.0391	3.1	1.2
Reading New Town	06-Jul		0.0	3.0	1.0063	3.1	0.3
Rochester Stoke	10-Aug	378	3.3	3.0	1.0089	3.2	1.6
Salford Eccles	12-Jul	0					
Sheffield Devonshire Green	27-Jul	8060024	0.2	3.0	1.0237	3.1	2.2
Sibton	03-Aug	14339	-0.2	3.0	1.0619	3.1	0.4
Southampton Centre							
Southend-on-Sea	08-Aug		-3.4	3.0	1.0556	3.4	4.3
St Osyth	08-Aug		0.3	3.0	1.0501	3.1	0.7
Stoke-on-Trent Centre	19-Jul		0.4	3.0	1.0578	3.5	2.0
Strath Vaich	21-Jul	176	-0.5	3.0	1.0438	3.1	1.6
Sunderland Si ksworth	03-Aug	436	-4.0	3.0	1.0338	3.1	1.9
Thurrock	09-Aug	221	0.2	3.0	1.0361	3.2	2.1
Walsall Woodlands	18-Jul	2431	9.9	3.0	1.0526	3.1	1.3
Weybourne	04-Aug	366	-0.4	3.0	0.9534	3.1	0.5
Wicken Fen	02-Aug	14345	0.9	3.0	0.9987	3.2	4.8
Wigan Centre	12-Jul		0.1	3.0	1.0272	3.1	0.7
Wirral Tranmere	19-Jul		-0.5	3.0	1.0187	3.1	0.4
Yarner Wood	09-Aug	2437	1.6	3.0	1.0409	3.1	1.1

4. Oxides of Nitrogen

Site	Date Year =2016	Analyser number		[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	[*]Max residual (%)	[*]Converter efficiency (%)
Aberdeen	18-Jul	2586	NOx	1.1	2.5	1.0631	3.5	2.6	101.8
			NO	0.2	2.5	1.0752	3.5	1.7	
Aberdeen Union Street Roadside	19-Jul	299	NOx	6.6	2.6	1.1549	3.5	2.5	99.0
			NO	4.4	2.6	1.1579	3.5	2.3	
Aberdeen Wellington Road	19-Jul	2248	NOx	5.1	2.6	1.1258	3.6	4.6	98.7
			NO	1.6	2.6	1.0908	3.6	4.8	
Armagh Roadside	19-Aug	1011845	NOx	4	2.8	1.5700	3.5	1.4	98.8
			NO	0	2.8	1.5612	3.5	1.5	
Aston Hill	08-Aug	2302	NOx	-0.3	2.5	0.9956	3.5	1.0	104.5
			NO	0.7	2.5	1.0065	3.5	1.3	
Ballymena Ballykeel	18-Aug	1965	NOx	4.3	2.6	1.0829	3.5	0.5	99.6
			NO	0.8	2.6	1.1015	3.5	0.9	
Barnsley Gawber	28-Jul	8050057	NOx	0.1	2.5	1.0363	3.5	1.0	100.4
			NO	0.2	2.5	1.0437	3.5	0.8	
Bath Roadside	04-Jul	1953	NOx	2	2.6	1.1567	3.5	0.4	98.1
			NO	0.4	2.6	1.1527	3.5	0.3	
Belfast Centre	23-Aug		NOx	0.1	2.6	1.0877	3.7	5.1	100.0
			NO	-0.1	2.6	1.0952	3.7	4.8	

Site	Date Year =2016	Analyser number		[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	*Max residual (%)	*Converter efficiency (%)
Belfast Stockman's Lane	23-Aug	2159	NOx	1.3	2.6	1.1865	3.5	2.0	96.8
			NO	0.4	2.6	1.1842	3.5	1.8	
Billingham	01-Aug	574	NOx	-4.8	2.6	1.2017	3.5	1.5	101.0
			NO	-1.8	2.6	1.1806	3.5	1.7	
Birmingham Acocks Green	22-Jul	3364	NOx	5.2	2.7	1.2655	3.5	0.7	98.7
			NO	2.3	2.6	1.2240	3.5	0.6	
Birmingham Tyburn	21-Jul		NOx	1.5	2.6	1.0216	3.5	0.2	100.3
			NO	-0.4	2.5	1.0166	3.5	0.2	
Birmingham A4540 Roadside	21-Jul	68	NOx	7.3	2.5	1.0778	3.5	1.6	99.8
			NO	3.4	2.6	1.0928	3.5	2.3	
Blackburn Accrington Road	14-Jul	1011851	NOx	-1	2.8	1.0989	3.5	0.6	100.9
			NO	0	2.8	1.1044	3.5	0.8	
Blackpool Marton	14-Jul		NOx	-0.1	2.5	0.9635	3.5	0.6	99.6
			NO	-0.2	2.5	0.9892	3.5	0.6	
Bournemouth	24-Aug	2214	NOx	3.2	2.6	1.0917	3.5	0.9	99.2
			NO	3	2.6	1.1195	3.5	0.7	
Bradford Mayo Avenue	11-Jul	1011823	NOx	0	2.5	1.0773	3.5	4.7	99.5
			NO	0	2.5	1.0775	3.5	4.6	
Brighton Preston Park	26-Jul	2222	NOx	1.1	2.5	0.9951	3.5	1.4	98.3
			NO	1.2	2.5	0.9981	3.5	1.0	
Bristol St Paul's	04-Jul	77	NOx	1	2.6	1.1395	3.5	0.8	96.3
			NO	0.9	2.6	1.1516	3.5	0.4	
Bury Whitefield Roadside	15-Jul	2625	NOx	4.6	2.5	0.8574	4.0	12.9	101.0
			NO	2.9	2.5	0.8534	4.1	12.1	
Bush Estate	10-Aug	2244	NOx		Analyser	failed	during	test	
			NO						
Cambridge Roadside	02-Aug	1011843	NOx	2.4	3.0	1.3124	3.5	1.2	93.6
			NO	0	2.6	1.2845	3.5	1.3	
Camden Kerbside	16-Aug	1011846	NOx	3	2.9	1.2533	3.5	1.3	98.5
			NO	-1	3.5	1.2326	3.5	1.8	
Canterbury	11-Aug	1147	NOx	1.3	2.6	1.1924	3.5	0.8	93.2
			NO	2.1	2.6	1.1844	3.5	1.1	
Cardiff Centre	13-Jul	71	NOx	0	2.7	1.3165	3.5	1.5	98.3
			NO	0.9	2.7	1.3455	3.5	1.9	
Carlisle Roadside	15-Jul	1011849	NOx	2	2.7	1.0505	3.5	0.8	100.0
			NO	0	2.5	1.0439	3.5	0.8	
Charlton Mackrell	10-Aug	2120	NOx	-1.3	2.6	1.0995	3.5	0.7	95.8
			NO	0.5	2.6	1.1054	3.5	1.5	
Chatham Centre Roadside	11-Aug	3393	NOx	3.8	2.7	1.3613	3.5	0.7	98.0
			NO	1.8	2.7	1.3463	3.5	0.3	
Chepstow A48	15-Jul	1011828	NOx	4	2.7	1.0400	3.5	0.9	100.9
			NO	0	3.1	1.0153	3.5	0.9	
Chesterfield Loundsley Green	27-Jul	1011837	NOx	0	2.9	1.1765	3.5	1.8	100.5
			NO	-1	2.8	1.1591	3.5	1.8	
Chesterfield Roadside	26-Jul	1011835	NOx	0	2.6	1.1735	3.5	0.5	99.5
			NO	0	2.6	1.1650	3.5	0.8	
Chilbolton	28-Jul	79	NOx	4.4	3.1	1.3158	3.5	0.4	98.4
			NO	1	2.7	1.2939	3.5	0.3	
Coventry Allesley	20-Jul		NOx	0.2	2.5	0.9126	3.5	0.1	100.0
			NO	-0.1	2.5	0.9045	3.5	0.0	

CERTIFICATE OF CALIBRATION

0401

Certificate Number: 03632

Site	Date Year =2016	Analyser number		[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	[*]Max residual (%)	[*]Converter efficiency (%)
Cwmbran	14-Jul		NOx	-2	4.6	0.9813	3.5	0.2	100.0
			NO	-5	5.6	0.9759	3.5	0.1	
Derry Rosemount	18-Aug	2130	NOx	17.1	2.6	1.1047	3.5	1.5	98.8
			NO	0.2	2.5	1.0044	3.5	1.0	
Doncaster A630 Cleveland Street	28-Jul	1565	NOx	-0.5	2.6	1.1071	3.5	0.6	100.0
			NO	-0.3	2.6	1.1381	3.5	0.6	
Dumbarton Roadside	25-Jul	1011833	NOx	0	3.0	1.1116	3.5	0.3	100.4
			NO	0	2.7	1.1121	3.5	0.9	
Dumfries	12-Jul	1494	NOx	1.1	2.5	1.0087	3.5	0.9	98.8
			NO	0.9	2.5	1.0104	3.5	0.7	
Eastbourne	26-Jul	3363	NOx	1.1	2.6	1.0600	3.5	0.9	98.2
			NO	0.2	2.5	1.0468	3.5	0.1	
Edinburgh St Leonards	09-Aug	73	NOx	0.9	2.5	0.8634	3.5	0.5	100.7
			NO	0.3	2.5	0.8625	3.5	0.8	
Eskdalemuir	12-Jul	347	NOx	0	2.5	1.0694	3.5	0.6	99.2
			NO	0.3	2.5	1.0704	3.5	0.6	
Exeter Roadside	07-Jul		NOx	0	2.6	1.0402	3.5	0.9	99.8
			NO	-0.4	2.6	1.0655	3.5	1.2	
Fort William	20-Jul	344	NOx	-0.1	2.6	1.0810	3.5	0.2	98.0
			NO	0.4	2.6	1.0808	3.5	0.5	
Glasgow Kerbside	27-Jul		NOx	0	2.5	0.9917	3.5	0.2	99.6
			NO	0	2.5	1.0021	3.5	0.2	
Glasgow Townhead	27-Jul	1713	NOx	0.3	2.6	1.1205	3.5	0.3	96.6
			NO	0.2	2.6	1.1142	3.5	1.0	
Glasgow Great Western Road	27-Jul	1193	NOx	2.8	2.6	1.0271	3.5	1.3	99.4
			NO	2.5	2.5	1.0299	3.5	1.2	
Glasgow High Street	28-Jul	1567	NOx	-0.3	2.5	1.0065	3.5	0.3	100.0
			NO	0	2.5	1.0087	3.5	0.6	
Glazebury	13-Jul	78	NOx	-1.2	2.5	0.9975	3.5	0.9	98.5
			NO	0	2.5	0.9917	3.5	0.6	
Grangemouth	08-Aug	1011836	NOx	1	2.5	1.0384	3.5	1.7	99.6
			NO	-1	2.5	1.0361	3.5	2.7	
Grangemouth Moray	08-Aug	1011852	NOx	1	2.5	1.0245	3.5	3.9	98.4
			NO	-1	2.5	1.0268	3.5	3.9	
Greenock A8 Roadside	07-Jul	1007841313	NOx	-0.2	2.6	1.0908	3.5	0.3	99.2
			NO	-0.2	2.5	1.0457	3.5	0.8	
Hafod-yr-ynys Roadside	14-Jul	2362	NOx	0.7	2.6	1.2271	3.5	0.3	99.3
			NO	-0.2	2.6	1.2230	3.5	0.7	
Haringey Roadside	17-Aug	1011827	NOx	6	3.2	1.3533	3.5	1.3	100.0
			NO	0	3.2	1.3209	3.5	1.2	
High Muffles	29-Jul	1783	NOx	1.2	2.6	1.1892	3.5	0.7	99.5
			NO	0.8	2.6	1.1644	3.5	0.7	
Honiton	06-Jul	3392	NOx	4.5	2.9	1.7378	3.5	0.9	98.8
			NO	4.4	2.9	1.6915	3.5	1.0	
Horley	25-Jul	1401954	NOx	3	2.9	1.0734	3.5	2.9	98.7
			NO	-1	2.7	1.0153	3.5	3.2	
Hull Freetown	13-Jul		NOx	0.6	2.5	0.9821	3.5	0.4	98.3
			NO	0.2	2.5	0.9812	3.5	0.8	
Hull Holderness Road	13-Jul	1564	NOx	1.5	2.7	1.2994	3.5	2.4	99.0
			NO	0.6	2.6	1.2854	3.5	1.8	

Site	Date Year =2016	Analyser number		[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	*Max residual (%)	*Converter efficiency (%)
Inverness	21-Jul	1489	NOx	-5.7	2.5	1.0254	3.5	1.7	101.5
			NO	1.4	2.5	1.0146	3.5	2.0	
Ladybower	26-Jul	72	NOx	0.8	2.7	1.4411	3.9	2.7	100.6
			NO	0.9	2.7	1.4475	3.8	2.4	
Leamington Spa	24-Aug	1011842	NOx	2	2.8	1.5000	3.5	0.8	99.5
			NO	1	3.1	1.4715	3.5	1.3	
Leamington Spa Rugby Road	19-Aug	3365	NOx	5.4	2.5	0.9724	3.5	1.0	100.5
			NO	0.4	2.5	1.0391	3.5	1.1	
Leeds Centre	11-Jul		NOx	-4.3	2.6	1.1378	3.5	0.4	99.2
			NO	-2.5	2.6	1.1154	3.5	3.8	
Leeds Headingley Kerbside	12-Jul	342	NOx	2.8	2.6	1.2683	3.5	2.6	101.5
			NO	1.5	2.6	1.2627	3.5	1.7	
Leicester University	16-Aug		NOx	0.1	2.6	1.1014	3.5	1.6	100.4
			NO	0.4	2.6	1.1108	3.5	1.3	
Leicester A594 Roadside	16-Aug	1570	NOx	-0.1	2.6	1.1020	3.5	0.3	100.7
			NO	-1.1	2.6	1.1448	3.5	0.3	
Leominster	18-Aug	346	NOx	2.6	2.6	1.0742	3.5	0.6	98.3
			NO	0.7	2.5	1.0649	3.5	1.0	
Lincoln Canwick Road	25-Aug	3394	NOx	-1.2	2.7	1.3491	3.5	0.6	98.5
			NO	0.9	2.7	1.3502	3.5	0.8	
Liverpool Queen's Drive Roadside	21-Jul	16927	NOx	12.2	2.5	1.0141	3.5	2.1	99.5
			NO	-0.1	2.5	1.0219	3.5	2.1	
Liverpool Speke	21-Jul		NOx	1.4	2.5	0.8902	3.5	1.3	101.7
			NO	0.8	2.5	0.8761	3.5	1.1	
London Bexley	09-Aug	326	NOx	1.8	3.0	1.4363	3.5	0.6	96.7
			NO	-0.1	2.7	1.3940	3.5	0.2	
London Bloomsbury	08-Aug	74	NOx	2.7	2.7	1.3844	3.5	0.6	99.5
			NO	0.2	2.7	1.3374	3.5	0.5	
London Eltham	29-Jul	1011834	NOx	4	2.9	1.1671	3.5	1.0	99.1
			NO	0	2.8	1.1468	3.5	0.3	
London Haringey Priory Park South	17-Aug	1084	NOx	3	2.8	1.1893	3.5	0.2	95.6
			NO	1.9	2.6	1.1781	3.5	0.3	
London Harlington	03-Aug	1090	NOx	5	3.2	1.1267	3.7	1.4	99.3
			NO	1.5	2.6	1.1258	3.5	1.8	
London Hillingdon	11-Aug		NOx	0	2.5	0.9577	3.5	0.4	99.6
			NO	0	2.5	0.9525	3.5	0.5	
London Marylebone Road	27-Jul	3366	NOx	2.6	3.7	1.1435	3.5	0.6	99.8
			NO	1.1	2.6	1.1695	3.5	0.7	
London N. Kensington	26-Jul	3273	NOx	4	3.6	1.1962	3.5	0.2	98.1
			NO	1.4	2.6	1.1811	3.5	0.4	
London Westminster	01-Aug	573	NOx	-14.9	2.8	1.5084	3.5	1.7	93.4
			NO	-3.8	2.8	1.5356	3.5	1.1	
Lullington Heath	28-Jul	2579	NOx	0.8	2.7	1.2290	3.5	1.4	98.3
			NO	0.7	2.6	1.2176	3.5	1.1	
Luton A505 Roadside	01-Aug	21345	NOx	3.3	2.6	1.0816	3.5	0.5	98.8
			NO	0.1	2.6	1.0801	3.5	0.7	
Manchester Piccadilly	14-Jul		NOx	0.7	2.5	1.0572	3.5	5.6	100.5
			NO	0.2	2.5	1.0295	3.5	5.8	
Manchester Sharston	14-Jul	17311	NOx	0.9	2.5	1.0160	4.1	12.2	101.6
			NO	0.9	2.5	0.9993	4.1	11.3	

Site	Date Year =2016	Analyser number		[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	*Max residual (%)	*Converter efficiency (%)
Market Harborough	17-Aug	50068	NOx	0.2	2.5	0.9898	3.5	1.6	100.4
			NO	0.2	2.5	0.9814	3.5	1.4	
Middlesbrough	02-Aug	2287	NOx	2.6	2.6	1.1431	3.5	1.8	99.5
			NO	2.3	2.6	1.1600	3.5	1.4	
Narberth	11-Jul	2577	NOx	1.1	2.6	1.2348	3.5	1.0	98.3
			NO	0.9	2.6	1.2269	3.5	0.9	
Newcastle Centre	04-Aug	8050063	NOx	-0.1	2.6	1.0796	3.5	0.6	101.3
			NO	-0.1	2.6	1.1303	3.5	0.7	
Newcastle Cradlewell Roadside	04-Aug	1011853	NOx	2	2.5	1.0455	3.5	1.3	100.4
			NO	0	2.5	1.0625	3.5	1.4	
Newport	13-Jul	1011829	NOx	4	3.3	1.1527	3.5	0.6	100.0
			NO	0	3.0	1.1369	3.5	0.9	
Northampton Kingsthorpe	15-Aug		NOx	1.8	2.5	1.0245	3.5	1.1	100.5
			NO	-0.6	2.5	1.0197	3.5	1.0	
Norwich Lakenfields	03-Aug		NOx	-0.5	2.6	1.0771	3.5	0.7	100.4
			NO	-0.5	2.6	1.0928	3.5	1.2	
Nottingham Centre	18-Aug		NOx	-2.7	2.6	0.9636	3.5	0.3	98.5
			NO	-3.4	2.5	0.9600	3.5	1.0	
Nottingham Western Boulevard	18-Aug	1958	NOx	3.7	2.6	1.0853	3.5	0.9	98.3
			NO	-0.1	2.6	1.0655	3.5	0.4	
Oldbury Birmingham Road	20-Jul		NOx	-0.1	2.5	0.9824	3.5	0.2	98.0
			NO	-1.1	2.5	0.9854	3.5	0.0	
Oxford Centre Roadside	25-Jul	1011844	NOx	5	4.4	1.5819	3.5	0.5	98.6
			NO	-2	3.5	1.5392	3.5	0.6	
Oxford St Ebbes	25-Jul	1011830	NOx	0.4	2.5	1.0518	3.5	1.4	99.1
			NO	0	2.5	1.0430	3.5	0.9	
Peebles	09-Aug	2213	NOx	0.7	2.5	1.0750	3.5	3.4	88.3
			NO	0.8	2.5	1.0378	3.5	1.6	
Plymouth Centre	05-Jul		NOx	0.7	2.6	1.1082	3.5	0.8	99.1
			NO	0.1	2.6	1.1074	3.5	0.7	
Port Ta bot Margam	12-Jul	1426962867	NOx	-0.3	2.5	1.0347	3.5	0.4	100.4
			NO	0	2.5	1.0333	3.5	0.1	
Portsmouth	01-Sep		NOx	-1.1	2.6	1.0000	3.5	1.0	98.0
			NO	-0.7	2.5	0.9898	3.5	0.6	
Preston	14-Jul		NOx	-0.4	2.5	0.9514	3.5	0.3	100.0
			NO	-0.1	2.5	0.9537	3.5	0.3	
Reading London Road	07-Jul		NOx	-1	2.6	0.9582	3.5	1.0	99.2
			NO	-1	2.7	0.9578	3.5	1.1	
Reading New Town	06-Jul		NOx	-0.7	3.0	1.9682	3.5	0.8	98.3
			NO	-0.2	3.0	1.9637	3.5	0.8	
Rochester Stoke	10-Aug	3095	NOx	2	2.6	1.0446	3.5	1.0	98.7
			NO	1	2.5	1.0333	3.5	1.1	
Salford Eccles	12-Jul	1011831	NOx	6	2.5	1.0722	3.5	0.6	98.6
			NO	0	2.5	1.0360	3.5	0.8	
Sandy Roadside	01-Aug	18006	NOx	1.6	2.9	1.5136	3.5	0.6	99.9
			NO	0.3	2.8	1.5005	3.5	1.4	
Scunthorpe Town	12-Jul	1011847	NOx	4	2.5	0.9705	3.5	3.6	100.6
			NO	-1	2.5	0.9684	3.5	3.4	
Shaw Crompton Way	15-Jul	733	NOx	1.2	2.6	1.1884	3.5	5.6	100.0
			NO	0.4	2.6	1.1878	3.5	5.8	

CERTIFICATE OF CALIBRATION

Site	Date Year =2016	Analyser number		[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	*Max residual (%)	*Converter efficiency (%)
Sheffield Barnsley Road	03-Aug	1962	NOx	-0.1	2.5	1.0493	3.5	0.9	99.6
			NO	-0.3	2.5	1.0359	3.5	1.1	
Sheffield Devonshire Green	27-Jul		NOx	0	2.6	1.1886	3.5	1.7	100.9
			NO	0	2.6	1.2473	3.5	1.9	
Sheffield Tinsley	27-Jul	1011841	NOx	0	2.6	1.0926	3.5	2.3	100.0
			NO	-1	2.6	1.0877	3.5	2.3	
Southampton Centre			NOx						
			NO						
Southampton A33 Roadside	24-Aug	1566	NOx	-1.6	2.6	1.1034	3.5	1.1	99.8
			NO	-0.4	2.6	1.1255	3.5	0.3	
Southend-on-Sea	08-Aug		NOx	-0.3	2.5	1.0393	3.5	0.3	100.4
			NO	-0.5	2.6	1.0414	3.5	0.4	
Southwark A2 Old Kent Road	04-Aug	1495	NOx	-0.3	2.7	1.1198	3.5	0.7	90.3
			NO	0.3	2.6	1.0511	3.5	1.2	
St Osyth	08-Aug		NOx	-1.3	2.5	1.0101	3.5	0.7	99.1
			NO	-1.2	2.5	1.0171	3.5	0.5	
Stanford-le-Hope Roadside	12-Aug	191	NOx	1.9	2.6	1.1103	3.5	0.3	98.5
			NO	1.6	2.6	1.1071	3.5	0.6	
Stockton-on-Tees Eaglescliffe	02-Aug	355	NOx	0.2	2.6	1.0880	3.5	0.9	100.9
			NO	0.3	2.6	1.0963	3.5	1.2	
Stockton on Tees A1035 Roadside	01-Aug	1210	NOx	-0.2	2.5	1.0332	3.5	0.7	100.5
			NO	0.1	2.5	1.0387	3.5	0.7	
Stoke-on-Trent Centre	19-Jul		NOx	1.3	2.5	0.9880	3.5	3.8	98.6
			NO	0.6	2.5	0.9843	3.5	3.6	
Stoke on Trent A50 Roadside	19-Jul	1568	NOx	-0.3	2.7	1.0741	3.5	0.2	101.4
			NO	-1.9	2.5	0.9994	3.5	0.2	
Storrington Roadside	28-Jul		NOx	-0.7	2.5	0.9636	3.5	0.5	99.2
			NO	-0.6	2.5	0.9596	3.5	0.7	
Sunderland Wessington Way	04-Aug	1195	NOx	0.9	2.5	1.0452	3.5	1.1	100.4
			NO	0.3	2.5	1.0632	3.5	0.8	
Sunderland Silksworth	03-Aug	1011854	NOx	2	2.7	0.9350	3.5	1.2	100.8
			NO	-1	2.5	0.9180	3.5	1.5	
Swansea Roadside	12-Jul	1229	NOx	3	2.7	1.0744	3.5	0.9	97.7
			NO	0.1	2.6	1.1009	3.5	0.8	
Thurrock	09-Aug	192	NOx	2.2	2.9	1.1381	3.5	0.4	99.3
			NO	1.4	2.6	1.1397	3.5	0.3	
Tower Hamlets Roadside	11-Aug	2613	NOx	3.4	2.7	1.1529	3.5	3.5	98.5
			NO	4.5	2.6	1.1508	3.5	2.9	
Walsall Woodlands	18-Jul	3391	NOx	6.1	2.6	1.0734	3.5	0.4	98.3
			NO	1.7	2.5	1.0518	3.5	1.2	
Warrington	18-Jul	1011826	NOx	0	2.5	1.0281	3.5	0.6	101.0
			NO	-2	2.7	1.0110	3.5	0.9	
Wicken Fen	02-Aug	13069	NOx	-1.3	2.6	1.0545	3.5	1.1	99.7
			NO	1.9	2.5	1.0561	3.5	1.2	
Widnes Milton Road	19-Jul	1569	NOx	8.2	2.5	0.9354	3.5	1.9	100.4
			NO	-0.1	2.5	0.8992	3.5	2.9	
Wigan Centre	12-Jul	1011832	NOx	2	2.8	1.1256	3.5	1.9	99.0
			NO	0	2.8	1.1162	3.5	2.8	
Wirral Tranmere	19-Jul		NOx	5.5	2.5	0.9664	3.5	0.9	99.2
			NO	1.4	2.5	1.0141	3.5	0.2	

CERTIFICATE OF CALIBRATION

Site	Date Year =2016	Analyser number		[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	'Max residual (%)	'Converter efficiency (%)
Wrexham	20-Jul	1490	NOx	4	2.6	1.1418	3.7	7.6	101.0
			NO	0	2.6	1.1496	3.9	8.2	
Yarner Wood	09-Aug	1784	NOx	0.9	2.5	1.0461	3.5	0.7	100.2
			NO	0.9	2.5	1.0748	3.5	0.9	
York Fishergate	14-Jul	1011848	NOx	3	2.8	1.1414	3.5	0.6	96.7
			NO	0	2.6	1.1361	3.5	0.9	

5. Particulates

Site	Date Year =2016		Analyser number	Calculated Spring Constant k_0	[4]k_0 accuracy (%)	Uncertainty (%)	[3]Measured Main Flow (l/min)	Uncertainty (%)	[3]Measured Total Flow (l/min)	Uncertainty (%)
Aberdeen	18-Jul	PM10		11699	1.13	1.0	3.00	2.2	16.20	2.2
		PM2.5		13496	0.31	1.0	3.04	2.2	16.48	2.2
Armagh Roadside	19-Aug	PM10		13696	0.91	1.0	2.97	2.2	16.04	2.2
Auchencorth Moss	10-Aug	PM10		Analyser	not	tested				2.2
		PM2.5		14046	0.21	1.0	3.08	2.2	16.38	2.2
		GR10	21550						17.00	2.2
		GR2.5	21548						16.87	2.2
Barnstaple A39	06-Jul	PM10		17496	1.29	1.0	3.18	2.2	16.33	2.2
	06-Jul	PM2.5		14304	0.99	1.0	3.10	2.2	16.09	2.2
Belfast Centre	23-Aug	PM10		14592	2.81	1.0	3.29	2.2	18.17	2.2
	23-Aug	PM2.5		15941	1.35	1.0	3.07	2.2	16.53	2.2
Belfast Stockman's Lane	23-Aug	PM10							16.90	2.2
Birmingham Acocks Green	22-Jul	PM2.5		16013	1.71	1.0	3.06	2.2	16.32	2.2
Birmingham Tyburn	21-Jul	PM10		14801	-0.94	1.0	2.94	2.2	16.40	2.2
	21-Jul	PM2.5		13753	-0.40	1.0	3.03	2.2	16.32	2.2
Birmingham A4540 Roadside	21-Jul	PM10		13424	1.93	1.0	3.07	2.2	16.20	2.2
	21-Jul	PM2.5		14389	-0.30	1.0	2.94	2.2	15.80	2.2
Blackpool Marton	14-Jul	PM2.5	21317	12414	-0.97	1.0	3.00	2.2	16.38	2.2
Bournemouth	24-Aug	GR2.5							16.96	2.2
Brighton Preston Park	26-Jul	GR2.5							16.69	2.2
Bristol St Paul's	04-Jul	PM10		13373	1.48	1.0	3.04	2.2	15.90	2.2
	04-Jul	PM2.5		14953	0.15	1.0	3.07	2.2	15.75	2.2
Bury Whitefield Roadside	15-Jul	PM10		15073	0.06	1.0	3.20	2.2	17.79	2.2
Camden Kerbside	16-Aug	PM10		12202	1.78	1.0	3.13	2.2	16.75	2.2
	16-Aug	PM2.5		13045	2.27	1.0	3.09	2.2	16.40	2.2
Cardiff Centre	13-Jul	PM10		13759	-0.86	1.0	3.09	2.2	16.39	2.2
	13-Jul	PM2.5		10971	-0.22	1.0	3.06	2.2	16.01	2.2
Carlisle Roadside	15-Jul	PM10	27257	14542	0.36	1.0	3.04	2.2	15.79	2.2
	15-Jul	PM2.5	27320	15012	-1.04	1.0	2.99	2.2	15.86	2.2
Chatham Centre Roadside	11-Aug	PM10		15753	2.44	1.0	3.10	2.2	16.81	2.2
	11-Aug	PM2.5		12529	2.56	1.0	3.02	2.2	16.57	2.2
Chepstow A48	15-Jul	PM10		15345	-0.29	1.0	2.91	2.2	16.01	2.2
	15-Jul	PM2.5		16737	1.52	1.0	3.01	2.2	16.06	2.2
Chesterfield Loundsley Grn	27-Jul	PM10	27316	16381	0.36	1.0	2.98	2.2	15.89	2.2
	27-Jul	PM2.5	27341	15557	0.61	1.0	3.01	2.2	16.25	2.2
Chesterfield Roadside	26-Jul	PM10	22299	11256	-0.78	1.0	3.00	2.2	16.40	2.2
	26-Jul	PM2.5	27339	10929	-1.42	1.0	3.04	2.2	16.75	2.2

Chi bolton	28-Jul	PM10		17231	-0.13	1.0	2.97	2.2	16.11	2.2
	28-Jul	PM2.5		12632	1.93	1.0	3.02	2.2	16.04	2.2
	28-Jul	GR10							22.82	2.2
	28-Jul	GR2.5							19.15	2.2
Coventry Allesley	20-Jul	PM2.5		14777	-1.28	1.0	3.11	2.2	16.63	2.2
Derry Rosemount	18-Aug	PM10		15979	1.09	1.0	2.89	2.2	16.01	2.2
	18-Aug	PM2.5		11052	1.49	1.0	2.74	2.2	16.42	2.2
Ealing Horn Lane	01-Aug	PM10		15555	1.91	1.0	2.96	2.2	16.24	2.2
Eastbourne	26-Jul	PM10		14382	-0.84	1.0	3.05	2.2	16.36	2.2
	26-Jul	PM2.5		15000	1.13	1.0	3.06	2.2	16.27	2.2
Edinburgh St Leonards	09-Aug	PM10		13776	0.62	1.0	3.04	2.2	16.19	2.2
	09-Aug	PM2.5		17112	0.60	1.0	3.03	2.2	16.28	2.2
Glasgow Townhead	27-Jul	PM10		13243	-0.64	1.0	3.07	2.2	15.68	2.2
	27-Jul	PM2.5		13257	0.86	1.0	3.09	2.2	15.81	2.2
Glasgow High Street	28-Jul	PM10	27344	14482	-0.69	1.0	2.96	2.2	15.52	2.2
	28-Jul	PM2.5		15246	0.83	1.0	3.04	2.2	15.85	2.2
Grangemouth	08-Aug	PM10		15847	-0.44	1.0	3.04	2.2	16.40	2.2
	08-Aug	PM2.5		13679	-0.59	1.0	3.06	2.2	16.16	2.2
Greenock A8 Roadside	07-Jul	PM10	6822						4.19	2.2
Hull Freetown	13-Jul	PM2.5	26498	14007	-1.31	1.0	3.10	2.2	16.81	2.2
Hull Holderness Road	13-Jul	PM10		17699	-0.71	1.0	3.10	2.2	16.87	2.2
Inverness	21-Jul	GR10	21255						13.83	2.2
	21-Jul	GR2.5	21861						16.18	2.2
Leamington Spa	24-Aug	PM10		15036	0.27	1.0	3.05	2.2	16.10	2.2
	24-Aug	PM2.5		14271	0.63	1.0	2.93	2.2	15.67	2.2
Leamington Spa Rugby Road	19-Aug	PM10		13973	-0.52	1.0	3.02	2.2	16.26	2.2
	19-Aug	PM2.5		16155	0.75	1.0	3.04	2.2	16.57	2.2
Leeds Centre	11-Jul	PM10		13472	0.57	1.0	2.97	2.2	16.64	2.2
	11-Jul	PM2.5		17197	0.92	1.0	2.97	2.2	16.76	2.2
Leeds Headingley Kerbside	12-Jul	PM10		17703	0.67	1.0	3.07	2.2	16.39	2.2
	12-Jul	PM2.5		14222	-3.27	1.0	3.14	2.2	16.78	2.2
Leicester University	16-Aug	PM2.5		15000	0.23	1.0	3.09	2.2	16.23	2.2
Leicester A594 Roadside	16-Aug	PM10		12643	0.73	1.0	3.00	2.2	16.47	2.2
Liverpool Speke	21-Jul	PM10		15941	0.81	1.0	3.05	2.2	15.34	2.2
	21-Jul	PM2.5		14947	0.27	1.0	3.08	2.2	15.52	2.2
London Bexley	09-Aug	PM2.5		11717	1.07	1.0	3.01	2.2	16.36	2.2
London Bloomsbury	08-Aug	PM10		14768	-0.20	1.0	3.01	2.2	14.54	2.2
	08-Aug	PM2.5		14733	-0.19	1.0	3.02	2.2	15.64	2.2
London Eltham	29-Jul	PM2.5		14132	2.28	1.0	3.15	2.2	16.63	2.2
London Harlington	03-Aug	PM10		12251	-0.28	1.0	2.99	2.2	16.02	2.2
	03-Aug	PM2.5		12895	0.71	1.0	3.07	2.2	15.99	2.2
London Harrow Stanmore	16-Aug	PM2.5		16397	0.93	1.0	3.01	2.2	16.08	2.2
London Marylebone Road	27-Jul	PM10		13152	-0.27	1.0	2.98	2.2	16.42	2.2
	27-Jul	PM2.5		13184	2.90	1.0	3.01	2.2	16.50	2.2
	27-Jul	GR10							16.57	2.2
	27-Jul	GR2.5							16.36	2.2
London N. Kensington	26-Jul	PM10		12747	0.59	1.0	2.90	2.2	16.30	2.2
	26-Jul	PM2.5		15873	0.55	1.0	3.03	2.2	16.09	2.2
	26-Jul	GR10							16.56	2.2
	26-Jul	GR2.5							16.13	2.2
London Teddington Bushy Park	15-Aug	PM2.5	90705	13342	-0.14	1.0	3.07	2.2	15.97	2.2
London Westminster	01-Aug	GR2.5							16.23	2.2
Lough Navar	16-Aug	PM10		12911	0.73	1.0	Not	tested	16.36	2.2

CERTIFICATE OF CALIBRATION

Manchester Piccadilly	14-Jul	PM2.5		13930	-0.68	1.0	2.92	2.2	15.51	2.2
Middlesbrough	02-Aug 02-Aug	PM10 PM2.5	24325 2000	14058 15939	-0.53 -0.44	1.0 1.0	3.07 2.94	2.2 2.2	16.63 15.96	2.2 2.2
Narberth	11-Jul	PM10		13769	-0.74	1.0	3.05	2.2	16.14	2.2
Newcastle Centre	04-Aug 04-Aug	PM10 PM2.5	24448 24447	13738 14881	-0.61 0.30	1.0 1.0	2.89 2.93	2.2 2.2	15.55 15.74	2.2 2.2
Newport	13-Jul 13-Jul	PM10 PM2.5		13848 16570	-0.99 -0.31	1.0 1.0	3.03 3.00	2.2 2.2	16.55 15.93	2.2 2.2
Northampton Kingsthorpe	15-Aug	GR10							16.93	2.2
Norwich Lakenfields	03-Aug 03-Aug	PM10 PM2.5		15645 15690	-0.41 0.56	1.0 1.0	2.94 3.00	2.2 2.2	16.55 16.50	2.2 2.2
Nottingham Centre	18-Aug 18-Aug	PM10 PM2.5		15733 12328	0.98 1.19	1.0 1.0	2.96 2.91	2.2 2.2	15.78 15.76	2.2 2.2
Nottingham Western Boulevard	18-Aug	PM10		14952	0.80	1.0	2.96	2.2	16.14	2.2
Oxford St Ebbes	25-Jul 25-Jul	PM10 PM2.5		14925 17392	0.73 1.30	1.0 1.0	2.99 3.00	2.2 2.2	16.28 16.39	2.2 2.2
Plymouth Centre	05-Jul 05-Jul	PM10 PM2.5		12368 12991	0.73 0.42	1.0 1.0	3.07 3.08	2.2 2.2	15.96 15.89	2.2 2.2
Port Talbot Margam	12-Jul 12-Jul 12-Jul	PM10 PM2.5 GR10		13979 11693	0.31 0.26	1.0 1.0	3.12 3.15	2.2 2.2	10.17 16.86 16.91	2.2 2.2 2.2
Portsmouth	01-Sep 01-Sep	PM10 PM2.5		16999 15868	0.38 0.41	1.0 1.0	2.86 3.19	2.2 2.2	16.51 17.55	2.2 2.2
Preston	14-Jul	PM2.5	22881	12946	-0.06	1.0	2.97	2.2	15.00	2.2
Reading London Road	07-Jul	PM10							16.87	2.2
Reading New Town	06-Jul 06-Jul	PM10 PM2.5		13329 14017	0.98 -0.84	1.0 1.0	3.01 3.08	2.2 2.2	16.58 16.54	2.2 2.2
Rochester Stoke	10-Aug 10-Aug	PM10 PM2.5		14781 16059	-0.88 0.71	1.0 1.0	3.00 3.07	2.2 2.2	16.14 16.33	2.2 2.2
Salford Eccles	12-Jul 12-Jul	PM10 PM2.5		13762 14747	0.52 0.75	1.0 1.0	3.11 3.27	2.2 2.2	16.84 16.45	2.2 2.2
Saltash Callington Road	05-Jul 05-Jul	PM10 PM2.5		12732 12608	-0.37 0.33	1.0 1.0	3.08 3.13	2.2 2.2	16.19 16.31	2.2 2.2
Sandy Roadside	01-Aug 01-Aug	PM10 PM2.5		13688 15959	-0.83 -0.75	1.0 1.0	3.02 3.02	2.2 2.2	16.45 16.49	2.2 2.2
Scunthorpe Town	12-Jul	PM10		12610	-1.40	1.0	3.09	2.2	16.76	2.2
Sheffield Devonshire Green	27-Jul 27-Jul	PM10 PM2.5	25024 27253	12115 15772	-1.10 0.86	1.0 1.0	3.02 3.03	2.2 2.2	16.45 16.17	2.2 2.2
Southampton Centre		PM10 PM2.5		Analyser Analyser	not not	tested tested				
Southampton A33 Roadside	24-Aug	PM10		8470	-1.47	1.0	2.92	2.2	16.04	2.2
Southend-on-Sea	08-Aug	PM2.5		12531	0.79	1.0	3.06	2.2	16.06	2.2
Southwark A2 Old Kent Road	04-Aug	PM10		14989	-0.89	1.0	3.09	2.2	16.44	2.2
Stanford-le-Hope Roadside	12-Aug 12-Aug	PM10 PM2.5		12702 13353	0.27 2.38	1.0 1.0	3.11 3.08	2.2 2.2	16.69 16.59	2.2 2.2
Stockton-on-Tees Eaglescliffe	02-Aug 02-Aug	PM10 PM2.5							16.23 16.68	2.2 2.2
Stockton on Tees A1035 Roadside	01-Aug	PM2.5	27278	13729	-0.51	1.0	3.00	2.2	16.35	2.2
Stoke-on-Trent Centre	19-Jul	PM2.5		13393	-0.81	1.0	2.94	2.2	15.90	2.2
Stoke on Trent A50 Roadside	19-Jul	PM10		12593	0.73	1.0	3.09	2.2	16.61	2.2

Storrington Roadside	28-Jul 28-Jul	PM10 PM2.5		15820 12945	0.90 1.56	1.0 1.0	2.96 3.14	2.2 2.2	16.65 16.60	2.2 2.2
Sunderland Silksworth	03-Aug	PM2.5	27247	14265	-0.03	1.0	2.95	2.2	15.97	2.2
Swansea Roadside	12-Jul 12-Jul	PM10 PM2.5							16.56 16.04	2.2 2.2
Thurrock	09-Aug	PM10		14068	0.14	1.0	2.96	2.2	15.77	2.2
Warrington	18-Jul 18-Jul	PM10 PM2.5		12008 16324	0.05 -0.21	1.0 1.0	3.16 3.11	2.2 2.2	15.73 15.47	2.2 2.2
Wigan Centre	12-Jul	PM2.5		14836	-0.19	1.0	2.98	2.2	16.74	2.2
Wirral Tranmere	19-Jul	PM2.5		13363	0.53	1.0	3.10	2.2	16.34	2.2
Wrexham	20-Jul 20-Jul	GR10 GR2.5							Not Not	tested tested
York Bootham	14-Jul 14-Jul	PM10 PM2.5		14685 16376	-0.35 0.59	1.0 1.0	3.10 2.99	2.2 2.2	16.14 16.06	2.2 2.2
York Fishergate	14-Jul 14-Jul	PM10 PM2.5		15757 18429	0.37 1.03	1.0 1.0	3.22 3.23	2.2 2.2	17.03 17.06	2.2 2.2

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

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

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

Concentration = (output – zero response) x Calibration factor

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

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

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

CERTIFICATE OF CALIBRATION

RICARDO-AEA

0401

Ricardo-AEA, Gemini, Fermi Avenue Harwell, Didcot,
Oxfordshire OX11 0QR
Telephone 01235 753212

Certificate Number: 03174
Ricardo-AEA Calibration ID Number: ED60071704

Authorised Signatories: S Eaton
B Stacey

Signed:

Date of Issue: 10 August 2015

Customer Name and Address:	John Newington Atmosphere and Noise Resource, Atmosphere and Sustainability Department for Environment, Food and Rural Affairs Area 2C Nobel House, 17 Smith Square, London, SW1P 3JR
Date of Calibration:	January to March 2015
Description:	Calibration factors for monitoring stations in the UK Automatic Urban and Rural Monitoring Network

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

Certificate Number: 03174
Ricardo-AEA Calibration ID Number: ED60071704

1. Carbon Monoxide

Site	Date Year = 2015	Analyser number	[1]Zero output	Uncertainty (ppm)	[2]Calibration Factor	Uncertainty (%)	*Maximum Residual (%)
English Sites							
Leeds Centre	12-Jan	458	1.2	0.2	1.015	2.2	0.8
London Sites							
London Marylebone Road	26-Jan	828	1.4	0.2	1.010	4.1	1.1
London N. Kensington	27-Jan	2313	-0.1	0.2	1.030	2.1	1.0
Northern Irish Sites							
Belfast Centre	24-Feb	462	0.0	0.2	1.056	2.1	0.8
Scottish Sites							
Edinburgh St Leonards	22-Dec	159	-0.2	0.2	1.010	2.1	0.6
Welsh Sites							
Cardiff Centre	06-Mar	1502	0.5	0.2	1.025	2.2	2.7
Port Talbot Margam	20-Jan	605214618	0.3	0.2	1.005	5.8	1.1

2. Sulphur Dioxide

Site	Date Year =2015	Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	*Max Residual (%)	*m-xylene interference (ppb)
English Sites								
Barnsley Gawber	12-Feb	8050082	0.2	2.5	0.911	3.4	2.6	1.6
Birmingham Tyburn	20-Jan	eh937000	6.7	2.5	0.856	3.7	5.5	0.3
Harwell	29-Jan	83	4.5	2.5	0.898	3.1	0.3	19.5
Hull Freetown	14-Jan	342	2.1	2.5	0.967	5.3	5.8	3.9
Ladybower	10-Feb	1176	-0.1	2.5	1.004	3.5	2.2	3.1
Leeds Centre	12-Jan	08050084	1.4	2.5	0.999	3.6	2.6	12.2
Liverpool Speke	06-Jan	1765	2.8	2.5	1.063	5.4	5.2	6.9
Lullington Heath	27-Jan	1179	-1.0	2.5	0.944	3.4	5.3	2.9
Manchester Piccadilly	13-Jan	2648	-11.0	2.5	0.942	3.3	0.4	2.8
Middlesbrough	21-Jan	345	0.5	2.6	1.171	3.2	2.8	2.9
Nottingham Centre	25-Feb	1629	1.3	2.5	0.823	3.6	5.2	20.2
Rochester Stoke	19-Feb	2800	50.6	2.5	0.820	3.7	4.5	2.5
Scunthorpe Town	14-Jan	635b-258	0.0	2.8	1.523	3.1	1.1	9.1
Southampton Centre	23-Feb	343	5.4	2.5	0.963	3.4	2.0	18.4
Thurrock	11-Feb	189	0.5	2.6	0.940	3.2	2.3	10.9
Wicken Fen	22-Dec	73	-0.6	2.5	0.958	3.2	3.0	18.3
London Sites								
London Bexley	10-Feb	318	3.8	2.6	1.093	3.3	1.4	16.8
London Bloomsbury	05-Feb	74	3.3	2.5	0.984	3.4	4.9	13.1
London Marylebone Road	26-Jan	2644	0.4	2.6	1.072	3.6	2.8	17.7
London N. Kensington	27-Jan	2576	1.2	2.5	1.055	3.7	5.9	23.5
Northern Irish Sites								
Ballymena Ballykeel	17-Feb	4901234	0.0	2.5	0.960	4.2	3.3	1.9
Belfast Centre	24-Feb	1766	16.1	2.5	0.992	3.2	2.4	5.6
Derry	18-Feb	1637	-0.8	2.5	0.948	3.0	1.2	2.8
Scottish Sites								
Edinburgh St Leonards	22-Dec	84	-1.4	2.5	0.917	3.6	5.7	8.6
Grangemouth	26-Jan	1211322	-1.0	2.5	1.020	3.7	2.9	22.4
Welsh Sites								
Cardiff Centre	06-Mar	70	-0.9	2.5	1.037	3.2	0.4	12.2

Certificate Number: 03174
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Site	Date Year =2015	Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	*Max Residual (%)	*m-xylene interference (ppb)
Narberth	19-Jan	344	1.9	2.5	0.911	3.3	3.7	11.9
Port Talbot Margam	20-Jan	605214617	0.4	2.6	1.018	3.1	0.5	7.1
Wrexham	05-Jan	1181	14.2	2.5	0.927	5.0	1.0	0.7

3. Ozone

Site	Date Year =2015	Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	*Max Residual (%)
English Sites							
Barnsley Gawber	12-Feb	8060030	0.1	3.0	1.007	3.1	1.0
Birmingham Acocks Green	19-Jan	2435	-3.0	3.0	1.017	3.1	0.7
Birmingham Tyburn	20-Jan	wb6ag7tm	0.5	3.0	0.960	3.1	0.9
Birmingham Tyburn Roadside	20-Jan	2434	0.3	3.0	1.039	3.2	1.1
Blackpool Marton	15-Jan	CM08060037	0.1	3.0	1.018	4.6	4.1
Bottesford	25-Feb	CM08060022	0.1	3.0	0.952	3.1	0.2
Bournemouth	25-Feb	1650	-0.3	3.0	1.091	3.2	1.4
Brighton Preston Park	28-Jan	542	6.9	3.0	0.949	3.1	1.3
Bristol St Paul's	13-Jan	155	0.3	3.0	1.048	3.1	0.1
Canterbury	12-Feb	19194	2.1	3.0	0.989	3.2	0.8
Charlton Mackrell	17-Feb	1111957	-0.3	3.0	0.977	3.2	1.1
Coventry Allesley	17-Feb	cm0806644	0.8	3.0	1.075	3.1	0.9
Exeter Roadside	15-Jan	F0100E0S	1.3	3.0	0.955	3.1	1.0
Glazebury	15-Jan	1274	1.0	3.0	0.990	3.1	0.5
Great Dun Fell	14-Jan	1647	1.2	3.0	1.005	3.1	0.3
Harwell	29-Jan	1648	-0.8	3.0	1.002	3.1	0.6
High Muffles	12-Feb	1641	12.1	3.0	0.973	3.1	1.2
Hull Freetown	14-Jan	cm08069945	-0.2	3.0	1.025	3.2	5.1
Ladybower	10-Feb	1651	0.1	3.0	0.975	3.1	0.8
Leamington Spa	26-Feb	411770	0.5	3.0	0.972	3.2	2.0
Leeds Centre	12-Jan	cm08060036	0.6	3.0	0.983	3.1	1.9
Leicester University	18-Feb	cm08060020	-0.1	3.0	1.111	3.2	0.8
Leominster	09-Feb	14470	3.4	3.0	1.010	3.1	1.0
Liverpool Speke	06-Jan	CM08060041	0.1	3.0	1.024	3.1	0.7
Lullington Heath	27-Jan	1644	-0.3	3.0	1.009	3.2	0.5
Manchester Piccadilly	13-Jan	CM08060039	0.1	3.0	1.079	3.1	0.7
Manchester South	13-Jan	1317	-1.1	3.0	1.031	3.3	2.2
Market Harborough	19-Feb	CM08060031	0.4	3.0	1.109	3.2	1.1
Middlesbrough	21-Jan	2438	0.1	3.0	1.024	3.1	0.7
Newcastle Centre	19-Jan	cm08060033	0.3	3.0	0.995	3.2	1.0
Northampton Kingsthorpe	16-Feb	47r76str	0.0	3.0	1.007	3.1	0.5
Norwich Lakenfields	03-Feb	cm08060028	4.7	3.0	1.284	3.2	1.6
Nottingham Centre	25-Feb	cm08060032	-1.3	3.0	1.017	3.3	1.0
Plymouth Centre	14-Jan	CM08060027	0.1	3.0	0.998	3.4	1.9
Portsmouth	24-Feb	CM08060023	0.5	3.0	1.017	3.1	0.8
Preston	16-Jan	CM08060042	-0.2	3.0	0.975	3.1	0.7
Reading New Town	16-Feb	CM08060025	-0.2	3.0	1.022	3.1	0.4
Rochester Stoke	19-Feb	378	3.0	3.0	1.029	3.1	0.9
Salford Eccles	12-Jan	1111956	-2.0	3.0	0.955	3.1	2.3
Sheffield Devonshire Green	11-Feb	8060024	0.1	3.0	1.006	3.1	0.5
Sibton	04-Feb	146	0.5	3.0	1.019	3.2	0.2
Southampton Centre	23-Feb	CM08060021	-0.1	3.0	1.021	3.2	0.7
Southend-on-Sea	10-Feb	cm08060017	0.0	3.0	1.031	3.1	1.0
St Osyth	09-Feb	CM08060035	-0.1	3.0	0.984	3.3	1.1
Stoke-on-Trent Centre	22-Jan	CM08060026	1.1	3.0	1.163	3.4	0.8
Sunderland Si ksworth	20-Jan	436	0.3	3.0	0.982	3.1	0.6
Thurrock	11-Feb	221	-0.3	3.0	1.167	3.2	1.1

0401

CERTIFICATE OF CALIBRATION

RICARDO-AEA

Certificate Number: 03174
Ricardo-AEA Calibration ID Number: ED60071704

Site	Date Year =2015	Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	[*]Max Residual (%)
Walsall Woodlands	21-Jan	2431	8.4	3.0	1.019	3.1	0.9
Weybourne	03-Feb	CM10180038	-0.7	3.0	1.030	3.1	0.3
Wicken Fen	22-Dec	165	-4.8	3.0	0.949	3.1	0.9
Wigan Centre	08-Jan	CM08060018	-2.0	3.0	1.003	3.1	0.6
Wirral Tranmere	06-Jan	CM08060040	0.2	3.0	1.020	3.1	0.2
Yarner Wood	18-Feb	2437	-1.3	3.0	1.026	3.2	1.6
London Sites							
London Bloomsbury	05-Feb	435	-0.2	3.0	1.045	3.1	0.5
London Eltham	13-Feb	1111958	-0.5	3.0	0.995	3.1	0.7
London Haringey Priory Park South	17-Feb	1111953	-0.3	3.0	0.899	3.3	5.3
London Harlington	30-Jan	1109	0.2	3.0	0.984	3.5	1.8
London Hillingdon	30-Jan	CM08060034	-0.2	3.0	1.034	3.2	0.3
London Marylebone Road	26-Jan	2432	5.8	3.0	1.024	3.1	0.2
London N. Kensington	27-Jan	2372	-0.8	3.0	0.937	3.2	2.3
London Teddington	19-Feb	2447	3.8	3.0	1.060	3.2	1.2
Northern Ireland Sites (plus Mace Head)							
Belfast Centre	24-Feb	cm08060038	-0.1	3.0	1.073	3.1	0.4
Derry	18-Feb	1586	-1.8	3.0	1.131	3.2	3.1
Lough Navar	19-Feb	1640	1.2	3.0	1.050	3.3	4.8
Mace Head	26-Feb	77086-385	0.0	3.0	0.995	3.1	0.7
Scottish Sites							
Aberdeen	21-Jan	892	-1.4	3.0	0.969	3.4	2.5
Auchencorth Moss	28-Jan	1646	0.6	3.0	1.024	3.0	0.5
Bush Estate	28-Jan	1645	-0.3	3.0	0.992	3.0	1.1
Edinburgh St Leonards	22-Dec	136	-2.5	3.0	1.048	3.1	2.0
Eskdalemuir	13-Jan	158	1.1	3.0	1.008	3.1	1.9
Fort William	04-Feb	1023	0.2	3.0	0.989	3.4	2.4
Glasgow Townhead	05-Feb	CM08060029	0.2	3.0	0.950	3.1	0.4
Lerwick	04-Mar	2433	1.1	3.0	1.006	3.1	0.9
Peebles	29-Jan	2449	-3.4	3.0	0.993	3.0	0.9
Strath Vaich	05-Mar	176	0.3	3.0	0.993	3.1	0.5
Welsh Sites							
Aston Hill	09-Feb	14337	-0.9	3.0	0.998	3.1	0.6
Cardiff Centre	06-Mar	168	-2.5	3.0	1.012	3.2	0.2
Cwmbran	22-Jan	CM08060043	-0.2	3.0	0.960	3.3	1.9
Narberth	19-Jan	Analyser	not	operational	at	audit	
Port Talbot Margam	20-Jan	CM10140049	0.1	3.0	0.984	3.1	0.4

CERTIFICATE OF CALIBRATION

RICARDO-AEA

0401

Certificate Number: 03174
Ricardo-AEA Calibration ID Number: ED60071704

4. Oxides of Nitrogen

Site	Date Year =2015	Analyser number		[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	[*]Max residual (%)	[*]Converter efficiency (%)
English Sites									
Barnsley Gawber	12-Feb	8050057	NOx	-0.3	2.5	0.880	3.5	0.9	100.3
			NO	-0.4	2.5	0.876	3.5	0.8	
Bath Roadside	12-Jan	1953	NOx	-1.6	3.5	1.194	3.5	1.9	100.3
			NO	-0.5	2.6	1.196	3.5	2.5	
Billingham	20-Jan	574	NOx	-0.1	2.7	1.460	3.5	0.8	99.4
			NO	-0.2	2.7	1.454	3.5	0.9	
Birmingham Acocks Green	19-Jan	3346	NOx	1.1	2.7	1.248	3.5	0.8	98.8
			NO	0.2	2.7	1.246	3.5	1.1	
Birmingham Tyburn	20-Jan	Y7ACC7MC	NOx	1.5	2.6	1.022	3.5	0.2	99.6
			NO	0.1	2.6	1.023	3.5	0.3	
Birmingham Tyburn Roadside	20-Jan	68	NOx	0.7	2.9	1.601	3.5	2.8	98.0
			NO	0.2	2.8	1.572	3.5	2.7	
Blackburn Accrington Road	15-Jan	1011851	NOx	0	2.6	1.054	3.5	0.5	101.1
			NO	-1	2.6	1.040	3.5	1.0	
Blackpool Marton	15-Jan	08050075	NOx	1.5	2.5	0.917	3.5	0.4	100.9
			NO	1.4	2.5	0.958	3.5	0.6	
Bournemouth	25-Feb	2214	NOx	1.2	2.7	1.154	3.5	0.2	100.6
			NO	0.5	2.6	1.179	3.5	0.9	
Brighton Preston Park	28-Jan	2222	NOx	-6.8	2.6	1.114	3.5	2.3	95.1
			NO	-0.3	2.6	1.134	3.5	2.6	
Bristol St Paul's	13-Jan	77	NOx	0.4	3.7	2.501	3.5	1.5	98.7
			NO	1.1	3.4	2.470	3.5	1.2	
Bury Whitefield Roadside	25-Feb	1011850	NOx	5	2.9	1.077	3.5	1.0	98.7
			NO	-1	3.1	1.047	3.5	0.9	
Cambridge Roadside	04-Feb	1011843	NOx	1.4	2.7	1.192	3.5	0.8	98.8
			NO	0.2	2.6	1.172	3.5	1.1	
Cannock Watling Street	03-Dec-2014	1194	NOx	1.5	2.6	1.121	3.5	1.6	98.1
			NO	0.4	2.6	1.122	3.5	1.3	
Canterbury	12-Feb	11666	NOx	0	2.6	1.272	3.5	1.3	99.7
			NO	-1.4	2.6	1.256	3.5	1.2	
Carlisle Roadside	27-Feb	1011849	NOx	4	2.9	1.209	3.5	1.7	100.5
			NO	1	2.9	1.185	3.5	2.3	
Charlton Mackrell	17-Feb	2120	NOx	-17.5	2.6	1.137	3.5	1.1	98.3
			NO	-6.3	2.6	1.184	3.5	0.9	
Chatham Centre Roadside	12-Feb	3393	NOx	0.8	3.3	1.850	3.5	2.0	99.4
			NO	0	3.0	1.847	3.5	0.9	
Chesterfield Roadside	11-Feb	1011835	NOx	-0.8	2.5	1.039	3.5	0.3	100.4
			NO	-0.9	2.5	1.025	3.5	0.4	
Coventry Allesley	17-Feb	21369	NOx	0.7	2.5	0.792	3.5	1.0	100.0
			NO	0.5	2.4	0.791	3.5	0.7	
Eastbourne	27-Jan	3363	NOx	0.1	2.6	1.060	3.7	3.1	99.7
			NO	1.4	2.6	1.078	3.8	3.3	
Exeter Roadside	15-Jan	G0000DS1	NOx	-1.4	2.6	0.945	3.5	1.4	101.9
			NO	-0.5	2.6	0.979	3.5	1.4	
Glazebury	15-Jan	78	NOx	0.6	2.6	1.110	3.5	0.1	98.0
			NO	0.4	2.6	1.134	3.5	0.3	
Harwell	29-Jan	1956	NOx	5.2	2.4	0.672	3.5	0.2	99.4
			NO	7.8	2.4	0.671	3.5	0.5	
High Muffles	12-Feb	1783	NOx	0.1	2.6	1.207	3.5	0.6	100.5
			NO	0.2	2.6	1.217	3.5	0.8	

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Site	Date Year =2015	Analyser number		[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	*Max residual (%)	*Converter efficiency (%)
Honiton	15-Jan	3392	NOx	0.8	3.1	1.265	3.5	1.7	98.5
			NO	0.3	2.8	1.253	3.5	0.7	
Horley	26-Jan	1401954	NOx	3	2.6	1.049	3.5	5.0	100.2
			NO	-1	2.6	1.016	3.5	3.6	
Hull Freetown	14-Jan	1882	NOx	-11.7	2.6	1.277	3.5	3.7	99.5
			NO	-3.1	2.7	1.366	3.5	2.6	
Hull Holderness Road	15-Jan	1564	NOx	2.3	2.5	0.965	3.5	0.6	101.1
			NO	3.1	2.5	0.973	3.5	0.5	
Ladybower	10-Feb	280	NOx	-0.1	2.6	1.096	3.5	1.7	100.8
			NO	0	2.6	1.089	3.5	2.0	
Leamington Spa	26-Feb	1011842	NOx	2	2.8	1.094	3.5	1.1	101.8
			NO	0	2.8	1.075	3.5	0.8	
Leamington Spa Rugby Road	26-Feb	3365	NOx	4.8	2.7	1.303	3.5	1.1	100.5
			NO	0.9	2.6	1.190	3.5	2.2	
Leeds Centre	12-Jan	08050066	NOx	-0.4	2.5	1.062	3.5	1.5	99.2
			NO	0.3	2.5	1.057	3.5	1.6	
Leeds Headingley Kerbside	12-Jan	341	NOx	-0.7	2.6	1.237	3.5	1.2	97.9
			NO	0.1	2.6	1.241	3.5	0.3	
Leicester University	18-Feb	08050021	NOx	3.1	2.4	0.756	3.5	0.0	99.7
			NO	3.5	2.4	0.728	3.5	0.0	
Leominster	09-Feb	14863	NOx	2	2.7	1.364	3.5	0.7	99.4
			NO	2.3	2.7	1.364	3.5	0.3	
Lincoln Canwick Road	24-Feb	3391	NOx	1.8	2.5	1.041	3.5	1.9	100.4
			NO	1.5	2.5	1.037	3.5	0.8	
Liverpool Queen's Drive Roadside	07-Jan	1734	NOx	0.3	2.7	1.293	3.5	0.5	100.2
			NO	0	2.6	1.287	3.5	0.5	
Liverpool Speke	06-Jan	08050069	NOx	0	2.5	0.963	3.5	0.2	100.3
			NO	0.7	2.5	0.961	3.5	0.1	
Lullington Heath	27-Jan	1881	NOx	1.3	2.6	1.093	3.5	2.6	96.0
			NO	0.9	2.6	1.097	3.5	2.9	
Manchester Piccadilly	13-Jan	345	NOx	0.7	2.6	1.074	3.5	1.2	100.3
			NO	0.6	2.5	1.045	3.5	0.5	
Manchester South	13-Jan	2115	NOx	2.8	2.5	0.996	3.5	1.2	99.3
			NO	2.5	2.5	0.996	3.5	0.6	
Market Harborough	19-Feb	08050068	NOx	-0.5	3.1	2.026	3.5	1.5	100.8
			NO	-0.5	3.0	1.935	3.5	1.5	
Middlesbrough	21-Jan	2287	NOx	0.8	2.6	1.071	3.5	0.3	99.5
			NO	0.7	2.5	1.061	3.5	0.5	
Newcastle Centre	19-Jan	08050063	NOx	0.3	2.5	0.853	3.5	2.8	100.4
			NO	0.6	2.5	0.867	3.5	2.8	
Newcastle Cradlewell Roadside	19-Jan	1011853	NOx	-1	3.3	1.661	3.5	2.1	98.6
			NO	0	3.3	1.662	3.6	1.7	
Northampton Kingsthorpe	16-Feb	8atj6apr	NOx	1.6	2.6	0.995	3.5	0.8	100.6
			NO	-0.7	2.5	1.031	3.5	0.9	
Norwich Lakenfields	03-Feb	1859	NOx	1	2.6	1.067	3.5	1.7	99.2
			NO	0.5	2.5	1.076	3.5	1.5	
Nottingham Centre	25-Feb	08050072	NOx	0.2	2.6	1.013	3.5	0.2	101.7
			NO	-0.6	2.5	1.009	3.5	0.2	
Oldbury Birmingham Road	21-Jan	D00064EU	NOx	0.2	2.7	0.970	3.5	1.4	99.3
			NO	-0.2	2.6	0.976	3.5	1.5	
Oxford Centre Roadside	23-Feb	1011844	NOx	2	2.6	1.084	3.5	0.3	98.5
			NO	0	2.7	1.067	3.5	1.9	

Certificate Number: 03174
Ricardo-AEA Calibration ID Number: ED60071704

Site	Date Year =2015	Analyser number		[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	*Max residual (%)	*Converter efficiency (%)
Oxford St Ebbes	23-Feb	1011830	NOx	-1	3.2	1.155	3.5	3.9	101.0
			NO	-2	3.0	1.136	3.5	1.9	
Plymouth Centre	14-Jan	08050062	NOx	-0.9	2.5	0.929	3.5	0.2	101.2
			NO	-0.3	2.5	0.928	3.5	0.1	
Portsmouth	24-Feb	P0T7CYA5	NOx	0.3	2.6	1.011	3.5	0.4	98.5
			NO	-0.6	2.5	1.029	3.5	0.6	
Preston	16-Jan	08050664	NOx	3.5	2.5	0.923	3.5	4.0	99.6
			NO	3.8	2.5	0.921	3.5	4.0	
Reading New Town	16-Feb	08050059	NOx	-1	2.5	0.820	3.5	0.5	98.2
			NO	-0.6	2.5	0.810	3.5	0.2	
Rochester Stoke	19-Feb	3095	NOx	0.4	2.7	1.305	3.5	1.0	98.6
			NO	0.4	2.7	1.311	3.5	0.7	
Salford Eccles	12-Jan	1011831	NOx	2	2.7	1.019	3.5	0.5	100.4
			NO	-1	2.8	1.013	3.5	0.6	
Sandy Roadside	02-Feb	2585	NOx	0.5	2.7	1.293	3.5	4.7	99.2
			NO	-0.6	2.7	1.313	3.5	4.5	
Scunthorpe Town	14-Jan	1011847	NOx	2	2.6	1.272	3.5	0.8	99.5
			NO	1	2.6	1.277	3.5	0.6	
Shaw Crompton Way	14-Jan	733	NOx	-2.9	2.6	1.195	3.5	1.0	98.6
			NO	-0.2	2.6	1.205	3.5	0.5	
Sheffield Devonshire Green	11-Feb	8050055	NOx	0.1	2.5	0.986	3.5	1.1	99.3
			NO	0.2	2.5	1.037	3.5	1.4	
Sheffield Tinsley	11-Feb	571	NOx	-0.3	2.5	0.953	3.5	0.4	99.6
			NO	-0.7	2.5	0.963	3.5	0.4	
Southampton Centre	23-Feb	08030106	NOx	0.6	2.5	0.925	3.5	0.2	100.0
			NO	1.1	2.5	0.911	3.5	0.2	
Southend-on-Sea	10-Feb	08050071	NOx	-0.5	2.6	1.129	3.5	0.3	98.6
			NO	-0.3	2.6	1.128	3.5	0.5	
St Osyth	09-Feb	08050073	NOx	-2.1	2.5	0.861	3.5	1.0	98.9
			NO	-1	2.5	0.861	3.5	1.0	
Stanford-le-Hope Roadside	11-Feb	191	NOx	1.2	2.6	1.204	3.5	1.6	100.1
			NO	0.5	2.6	1.195	3.5	2.6	
Stockton-on-Tees Eaglescliffe	20-Jan	355	NOx	0.5	2.7	1.303	3.5	0.8	100.6
			NO	0.7	2.6	1.283	3.5	0.6	
Stockton-on-Tees A1305	21-Jan	1210	NOx	5.5	2.5	1.054	3.5	0.7	99.1
			NO	5.8	2.5	1.057	3.5	0.6	
Stoke-on-Trent Centre	22-Jan	08050070	NOx	0.1	2.5	0.951	3.5	0.5	99.2
			NO	0.4	2.5	0.920	3.5	0.4	
Storrington Roadside	28-Jan	1495	NOx	2.2	2.6	0.991	3.5	1.8	98.2
			NO	1	2.5	1.031	3.5	1.8	
Sunderland Wessington Way	19-Jan	1195	NOx	0.7	2.5	1.047	3.5	0.2	99.8
			NO	0.8	2.5	1.045	3.5	0.5	
Sunderland Silksworth	20-Jan	1011854	NOx	-1	2.7	1.049	3.5	0.7	98.6
			NO	0	2.8	1.047	3.5	0.9	
Thurrock	11-Feb	192	NOx	1.2	2.6	1.206	3.5	0.7	98.1
			NO	0.7	2.6	1.203	3.5	0.8	
Walsall Woodlands	21-Jan	3391	NOx	1.1	3.0	1.218	3.5	1.1	99.8
			NO	-0.5	2.6	1.233	3.5	0.1	
Warrington	07-Jan	1011826	NOx	4	2.7	1.098	3.5	0.7	99.2
			NO	-1	2.8	1.049	3.5	0.4	
Wicken Fen	22-Dec	2223	NOx	-3.3	2.6	0.989	3.5	1.6	98.9

0401

CERTIFICATE OF CALIBRATION

Certificate Number: 03174
Ricardo-AEA Calibration ID Number: ED60071704

Site	Date Year =2015	Analyser number		[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	'Max residual (%)	'Converter efficiency (%)
			NO	0.2	2.5	1.009	3.5	1.8	
Wigan Centre	08-Jan	1011832	NOx	1.3	2.8	1.098	3.5	0.8	99.7
			NO	-0.5	3.3	1.079	3.5	0.4	
Wirral Tranmere	06-Jan	08050060	NOx	0.2	2.5	0.948	3.5	0.6	100.0
			NO	0.2	2.5	0.958	3.5	0.7	
Yarner Wood	18-Feb	1784	NOx	0.5	2.6	1.084	3.5	1.3	100.4
			NO	0.8	2.6	1.097	3.5	1.4	
York Fishergate	13-Jan	1011848	NOx	1	2.8	1.178	3.5	0.5	98.5
			NO	-1	2.6	1.164	3.5	1.5	
London Sites									
Camden Kerbside	18-Feb	1011846	NOx	6	2.8	1.116	3.5	0.8	98.7
			NO	0	2.6	1.093	3.5	1.1	
Haringey Roadside	17-Feb	1011827	NOx	5	2.9	1.043	3.5	0.9	97.9
			NO	-1	2.5	1.039	3.5	1.5	
London Bexley	10-Feb	327	NOx	2.6	2.5	1.016	3.5	0.3	98.2
			NO	-0.1	2.5	0.976	3.5	0.5	
London Bloomsbury	05-Feb	74	NOx	0.6	2.8	1.526	3.5	0.6	96.1
			NO	2	2.8	1.532	3.5	0.4	
London Eltham	13-Feb	1011834	NOx	6	3.3	1.140	3.5	0.2	98.5
			NO	0	2.7	1.119	3.5	0.9	
London Haringey Priory Park South	17-Feb	1084	NOx	2.3	4.2	1.430	3.5	1.9	98.5
			NO	-0.2	2.7	1.422	3.5	2.4	
London Harlington	30-Jan	1090	NOx	-6.8	3.6	1.044	3.5	0.2	100.7
			NO	1.5	2.5	1.058	3.5	0.1	
London Hillingdon	30-Jan	08050017	NOx	-0.9	2.5	0.905	3.5	1.6	100.0
			NO	-0.7	2.5	0.905	3.5	1.5	
London Marylebone Road	26-Jan	3366	NOx	1.9	3.7	1.204	3.5	4.0	99.9
			NO	0	2.6	1.206	3.5	4.1	
London N. Kensington	27-Jan	3273	NOx	-3.9	2.9	1.098	3.5	3.2	99.5
			NO	0.1	2.6	1.088	3.5	2.1	
London Teddington	19-Feb	3406	NOx	4.8	2.7	1.234	3.5	1.2	100.7
			NO	1.6	2.7	1.202	3.5	0.4	
London Westminster	03-Feb	573	NOx	-5.4	2.8	1.343	3.5	0.3	95.7
			NO	-1.7	2.7	1.353	3.5	1.2	
Southwark A2 Old Kent Road	#N/A	#N/A	NOx	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
			NO	#N/A	#N/A	#N/A	#N/A	#N/A	
Tower Hamlets Roadside	09-Feb	1011838	NOx	2	5.2	1.184	3.5	0.7	99.5
			NO	-1	3.3	1.157	3.5	1.2	
Northern Irish Sites									
Armagh Roadside	20-Feb	1011845	NOx	1	2.7	1.320	3.5	1.2	99.5
			NO	0	2.7	1.304	3.5	0.9	
Belfast Centre	24-Feb	08050074	NOx	-0.7	2.5	0.989	3.5	0.6	98.6
			NO	-0.1	2.5	0.988	3.5	0.4	
Belfast Stockman's Lane	23-Feb	2159	NOx	0.4	2.6	1.078	3.5	2.0	98.6
			NO	0	2.6	1.084	3.5	1.9	
Derry	18-Feb	2130	NOx	0.6	2.5	1.002	3.5	1.8	101.1
			NO	-0.1	2.5	0.992	3.5	1.9	
Scottish Sites									
Aberdeen	21-Jan	519	NOx	-3.5	2.5	0.912	3.6	2.5	99.1
			NO	-3.2	2.5	0.879	3.5	1.7	
Aberdeen Union Street Roadside	22-Jan	299	NOx	1.6	2.7	1.221	3.5	0.8	98.3
			NO	1.3	2.8	1.252	3.5	0.6	

CERTIFICATE OF CALIBRATION

RICARDO-AEA

0401

Certificate Number: 03174
Ricardo-AEA Calibration ID Number: ED60071704

Site	Date Year =2015	Analyser number		[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	'Max residual (%)	'Converter efficiency (%)
Bush Estate	28-Jan	2244	NOx	-1.6	2.5	1.000	3.5	0.1	99.1
			NO	0.6	2.5	1.012	3.5	0.3	
Dumbarton Roadside	03-Feb	1011883	NOx	1	2.5	1.049	3.5	0.7	98.8
			NO	0	2.7	1.032	3.5	0.4	
Dumfries	27-Feb	1494	NOx	0.7	2.5	0.973	3.5	0.9	100.3
			NO	0.9	2.5	0.977	3.5	2.4	
Edinburgh St Leonards	22-Dec	73	NOx	1	2.5	1.024	3.5	2.1	100.5
			NO	0.1	2.5	1.023	3.5	2.0	
Eskdalemuir	13-Jan	347	NOx	0.4	2.6	1.291	3.5	2.9	99.5
			NO	0.5	2.6	1.296	3.5	2.5	
Fort William	04-Feb	344	NOx	0	2.6	1.157	3.5	0.7	99.5
			NO	0.5	2.6	1.159	3.5	0.4	
Glasgow Kerbside	05-Feb	08050061	NOx	-4.4	2.5	1.003	3.5	0.9	98.0
			NO	0.4	2.5	1.001	3.5	0.4	
Glasgow Townhead	05-Feb	1713	NOx	1.2	2.6	1.288	3.5	1.4	98.9
			NO	1.4	2.6	1.286	3.5	1.9	
Glasgow Great Western Road	03-Feb	1193	NOx	-1.4	2.6	1.132	3.5	0.3	98.9
			NO	0	2.6	1.141	3.5	0.2	
Glasgow High Street	20-Jan	1567	NOx	0.4	2.5	1.025	3.5	0.8	98.5
			NO	0	2.5	1.026	3.5	0.6	
Grangemouth	26-Jan	1011836	NOx	1	2.5	0.992	3.5	1.7	99.3
			NO	1	2.5	0.990	3.5	2.0	
Grangemouth Moray	26-Jan	1011852	NOx	0	2.6	1.101	3.5	0.6	99.2
			NO	-1	2.6	1.101	3.5	0.6	
Inverness	23-Jan	489	NOx	2.8	2.6	1.141	3.5	0.8	98.3
			NO	1.7	2.6	1.136	3.5	0.7	
Peebles	29-Jan	2213	NOx	0.6	2.5	1.048	3.5	0.4	98.8
			NO	2.3	2.5	1.060	3.5	0.7	
Welsh Sites									
Aston Hill	09-Feb	17677	NOx	3	2.6	1.086	3.5	0.8	100.4
			NO	1.1	2.6	1.095	3.5	0.4	
Cardiff Centre	06-Mar	71	NOx	-2.1	2.8	1.526	3.5	0.5	100.2
			NO	0.3	2.8	1.556	3.5	0.1	
Chepstow A48	23-Jan	1011828	NOx		analyser	malfunction	during	audit	
			NO						
Cwmbran	22-Jan	L00N2XG8	NOx	0.4	2.5	0.973	3.5	0.3	98.9
			NO	1.2	2.6	0.983	3.5	0.4	
Hafod-yr-Ynys Roadside	21-Jan	2362	NOx	-0.2	2.6	1.166	3.5	0.7	99.0
			NO	0	2.6	1.159	3.5	0.6	
Narberth	19-Jan	2577	NOx	0	2.6	1.102	3.5	1.0	99.1
			NO	0.9	2.6	1.133	3.5	1.7	
Newport	22-Jan	1011829	NOx	2	3.0	0.992	3.6	0.9	101.1
			NO	0	2.6	0.983	3.5	0.7	
Port Ta bot Margam	20-Jan	1428982887	NOx	5.9	2.5	1.039	3.5	0.6	98.7
			NO	0.9	2.5	1.041	3.5	0.6	
Swansea Roadside	20-Jan	1229	NOx	0.8	5.0	1.149	3.5	1.1	99.2
			NO	0	2.6	1.182	3.5	0.9	
Wrexham	05-Jan	1490	NOx	0.1	2.6	1.211	3.5	1.2	98.8
			NO	0.5	2.6	1.223	3.5	1.2	

Certificate Number: 03174
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5. Particulates

Site	Date Year =2015		Analyser number	Calculated Spring Constant k_0	[4]k_0 accuracy (%)	Uncertainty (%)	[3]Measured Main Flow (l/min)	Uncertainty (%)	[3]Measured Total Flow (l/min)	Uncertainty (%)
English Sites										
Barnstaple A39	16-Jan	PM10	660811	17431	0.92	1	2.97	2.2	16.22	2.2
		PM2.5	811002	13989	-1.23	1	2.97	2.2	16.17	2.2
Birmingham Acocks Green	19-Jan	PM2.5	40809	15700	-0.28	1	2.91	2.2	16.35	2.2
Birmingham Tyburn	20-Jan	PM10	390809	14668	-1.83	1	2.91	2.2	15.96	2.2
		PM2.5	860809	14608	-0.52	1	2.88	2.2	15.76	2.2
Birmingham Tyburn Roadside	20-Jan	PM10	20603	12145	-1.87	1	2.98	2.2	16.58	2.2
		PM2.5	220606	14210	-1.54	1	3.06	2.2	16.43	2.2
Blackpool Marton	15-Jan	PM2.5	179610	12573	0.31	1	2.78	2.2	15.85	2.2
Bournemouth	25-Feb	GR2.5	630603						16.58	2.2
Brighton Preston Park	28-Jan	GR2.5	650603						15.84	2.2
Bristol St Paul's	13-Jan	PM10	260302	13276	0.74	1	2.97	2.2	16.32	2.2
		PM2.5	950701	14785	-0.97	1	3.03	2.2	14.81	2.2
Bury Whitefield Roadside	25-Feb	PM10	115080	14984	-0.53	1	3.08	2.2	17.01	2.2
		PM2.5	220810	16081	-0.71	1	3.14	2.2	16.68	2.2
Carlisle Roadside	27-Feb	PM10	725700	0	0.00	1	2.99	2.2	16.40	2.2
		PM2.5	732000	15222	0.34	1	2.98	2.2	16.12	2.2
Chatham Centre Roadside	12-Feb	PM10	840809	14523	0.00	1	2.95	2.2	15.93	2.2
		PM2.5	090810	15976	-0.15	1	3.00	2.2	15.72	2.2
Chesterfield Roadside	11-Feb	PM10	229900	11419	0.65	1	2.98	2.2	16.03	2.2
		PM2.5	733900	11000	-0.77	1	2.97	2.2	15.85	2.2
Coventry Allesley	17-Feb	PM2.5	890702	14741	-1.51	1	3.06	2.2	16.15	2.2
Eastbourne	27-Jan	PM10	931105	14278	-1.55	1	3.06	2.2	17.24	2.2
		PM2.5		analyser	not	operating	at	audit		
Harwell	29-Jan	PM10	670811	14758	-1.22	1	2.98	2.2	16.61	2.2
		PM2.5	570401	12428	0.29	1	2.98	2.2	16.46	2.2
		GR10	439802						17.11	2.2
		GR2.5	2025A						14.51	2.2
Hull Freetown	14-Jan	PM2.5	980701	13976	-1.53	1	2.96	2.2	18.24	2.2
Hull Holderness Road	15-Jan	PM10	209803	14157	0.34	1	3.05	2.2	16.93	2.2
Leamington Spa	26-Feb	PM10	510809	14946	-0.34	1	3.00	2.2	16.25	2.2
		PM2.5	110810	14198	0.12	1	2.93	2.2	16.10	2.2
Leamington Spa Rugby Road	26-Feb	PM10	150705	14001	-0.32	1	3.11	2.2	16.97	2.2
		PM2.5	440809	15914	-0.76	1	2.98	2.2	16.85	2.2
Leeds Centre	12-Jan	PM10	510302	13312	-0.63	1	3.00	2.2	16.89	2.2
		PM2.5	540809	16908	-0.78	1	3.00	2.2	16.64	2.2
Leeds Headingley Kerbside	12-Jan	PM10	710809	17431	-0.87	1	3.07	2.2	16.15	2.2
		PM2.5	490809	14550	-1.03	1	3.02	2.2	16.37	2.2
Leicester University	18-Feb	PM2.5	490701	14771	-1.30	1	2.99	2.2	16.55	2.2
Liverpool Speke	06-Jan	PM10	220302	15615	-1.24	1	3.05	2.2	16.31	2.2
		PM2.5	860702	14717	-1.27	1	2.95	2.2	16.42	2.2
Manchester Piccadilly	13-Jan	PM2.5	719909	13992	-0.24	1	2.82	2.2	16.20	2.2
Middlesbrough	21-Jan	PM10	24325	14250	0.83	1	3.01	2.2	15.86	2.2
		PM2.5	2000	15902	-0.67	1	3.07	2.2	16.01	2.2
Newcastle Centre	19-Jan	PM10	24448	13882	0.42	1	2.99	2.2	16.54	2.2
		PM2.5	24447	14703	-0.90	1	3.00	2.2	16.60	2.2
Northampton Kingsthorpe	16-Feb	PM2.5	39902						16.87	2.2

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Norwich Lakenfields	03-Feb	PM10	981105	15595	-0.72	1	3.16	2.2	16.87	2.2
		PM2.5	180810	15684	0.52	1	3.11	2.2	16.93	2.2
Nottingham Centre	25-Feb	PM10	580811	15491	-0.58	1	3.16	2.2	16.92	2.2
		PM2.5	400401	12177	-0.05	1	2.92	2.2	15.87	2.2
Oxford St Ebbes	23-Feb	PM10	870809	14794	-0.15	1	3.05	2.2	16.93	2.2
		PM2.5	160808	17157	-0.07	1	3.05	2.2	16.96	2.2
Plymouth Centre	14-Jan	PM10	280302	12116	-1.32	1	2.90	2.2	15.08	2.2
		PM2.5	210807	14050	-2.02	1	2.89	2.2	15.24	2.2
Portsmouth	24-Feb	PM10	281101	16764	-1.30	1	2.91	2.2	17.07	2.2
		PM2.5	500809	18262	-1.51	1	2.89	2.2	15.82	2.2
Preston	16-Jan	PM2.5	510108	12907	-0.36	1	2.89	2.2	15.91	2.2
Reading New Town	16-Feb	PM10	940003	13317	0.89	1	2.96	2.2	16.54	2.2
		PM2.5	140702	14130	-0.04	1	3.04	2.2	16.50	2.2
Rochester Stoke	19-Feb	PM10	410809	14711	-1.35	1	2.95	2.2	16.14	2.2
		PM2.5	580809	15950	0.03	1	2.85	2.2	16.05	2.2
Salford Eccles	12-Jan	PM10	140810	13681	-0.07	1	2.98	2.2	16.36	2.2
		PM2.5	330808	14559	-0.54	1	2.95	2.2	15.99	2.2
Saltash Callington Rd	14-Jan	PM10	280210	13904	-1.7	1	2.92	2.2	16.08	2.2
		PM2.5	860811	12409	-1.3	1	2.98	2.2	15.96	2.2
Sandy Roadside	02-Feb	PM10	399707	11074	-1.93	1	3.14	2.2	16.96	2.2
		PM2.5	841102	15847	-1.44	1	3.04	2.2	16.62	2.2
Scunthorpe Town	14-Jan	PM10	320602	12558	-1.81	1	3.17	2.2	15.86	2.2
Sheffield Devonshire Grn	11-Feb	PM10	25024	12242	-0.06	1	2.96	2.2	16.01	2.2
		PM2.5	27253	15784	0.94	1	2.95	2.2	15.52	2.2
Southampton Centre	23-Feb	PM10	560302	13789	-0.61	1	2.96	2.2	16.35	2.2
		PM2.5	330808	16493	-0.18	1	2.87	2.2	16.08	2.2
Southend-on-Sea	10-Feb	PM2.5	760401	12373	-0.48	1	2.44	2.2	16.39	2.2
Stanford-le-Hope Roadside	11-Feb	PM10	880303	12594	-0.58	1	3.06	2.2	16.41	2.2
		PM2.5	209804	13185	1.09	1	2.97	2.2	16.05	2.2
Stockton-on-Tees Eaglescliff	20-Jan	PM10	h4554						16.07	2.2
		PM2.5	h4553						16.02	2.2
Stoke-on-Trent Centre	22-Jan	PM10	470401	12230	-2.17	1	2.90	2.2	16.30	2.2
		PM2.5	570809	13316	-1.37	1	2.94	2.2	16.46	2.2
Storrington Roadside	28-Jan	PM10	280808	15639	-0.26	1	3.86	2.2	15.86	2.2
		PM2.5	760811	12787	0.32	1	2.77	2.2	15.71	2.2
Sunderland Silksworth	20-Jan	PM2.5	27247	13434	-0.70	1	3.07	2.2	15.84	2.2
Thurrock	11-Feb	PM10	270810	13981	-0.49	1	2.95	2.2	10.34	2.2
Warrington	07-Jan	PM10	980309	11952	-0.42	1	2.98	2.2	15.93	2.2
		PM2.5	060808	16259	-0.61	1	2.87	2.2	15.20	2.2
Wigan Centre	08-Jan	PM2.5	971105	14827	-0.25	1	2.99	2.2	15.81	2.2
Wirral Tranmere	06-Jan	PM2.5	660001	13263	-0.23	1	3.02	2.2	16.78	2.2
York Bootham	13-Jan	PM10	779712	14635	-0.69	1	3.03	2.2	15.26	2.2
		PM2.5	090807	16109	-1.05	1	2.93	2.2	15.58	2.2
York Fishergate	13-Jan	PM10	480810	15656	-0.27	1	3.05	2.2	16.72	2.2
		PM2.5	320808	18670	2.34	1	3.04	2.2	16.77	2.2
London Sites										
Camden Kerbside	18-Feb	PM10	619902	12182	1.61	1	3.01	2.2	16.07	2.2
		PM2.5	100009	12928	1.35	1	2.97	2.2	16.18	2.2
Ealing Horn Lane	09-Feb	PM10	380810	15258	-0.04	1	3.04	2.2	17.04	2.2
Haringey Roadside	17-Feb	PM2.5	970810	13841	0.30	1	3.00	2.2	16.24	2.2
London Bexley	10-Feb	PM2.5	70401	11552	-0.35	1	3.01	2.2	15.96	2.2
London Bloomsbury	05-Feb	PM10	180302	13741	0.00	1	2.95	2.2	15.68	2.2
		PM2.5	610809	14627	-0.91	1	2.97	2.2	15.93	2.2
London Eltham	13-Feb	PM2.5		analyser	not	present	at	audit		
London	30-Jan	PM10	020311	12158	-1.04	1	2.98	2.2	16.28	2.2

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Harlington		PM2.5	590202	12756	-0.39	1	2.91	2.2	16.23	2.2
London Harrow Stanmore	26-Feb	PM2.5	660809	16106	-0.86	1	3.04	2.2	16.39	2.2
London Marylebone Road	26-Jan	PM10	410401	13149	-0.29	1	3.09	2.2	16.83	2.2
		PM2.5	450809	13157	2.70	1	3.05	2.2	16.74	2.2
		GR10	439811						16.39	2.2
		GR2.5	210001						16.22	2.2
London N. Kensington	27-Jan	PM10	910811	12778	0.83	1	3.28	2.2	17.24	2.2
		PM2.5	890806	15897	0.70	1	3.17	2.2	16.72	2.2
		GR10	159902						16.47	2.2
		GR2.5	199902						16.29	2.2
London Teddington Bushy Park	19-Feb	PM2.5	190705	13242	-0.88	1	2.92	2.2	16.11	2.2
London Westminster	03-Feb	GR2.5	399811						16.62	2.2
Northern Irish Sites										
Armagh Roadside	20-Feb	PM10	2000	not	tested	C status	2.90	2.2	15.77	2.2
Belfast Centre	24-Feb	PM10	24423	14132	-0.43	1	3.03	2.2	16.14	2.2
		PM2.5	26565	15572	-1.00	1	3.09	2.2	16.51	2.2
Belfast Stockman's Lane	23-Feb	PM10	K1042						16.07	2.2
Derry	18-Feb	PM10	2701	16001	1.22	1	2.86	2.2	15.07	2.2
		PM2.5	21313	10870	-0.19	1	2.85	2.2	15.14	2.2
Lough Navar	19-Feb	PM10	21196	12735	-0.64	1	2.93	2.2	15.91	2.2
Scottish Sites										
Aberdeen	21-Jan	PM10	520209	11556	-0.11	1	3.03	2.2	16.39	2.2
		PM2.5	540811	12168	-0.42	1	3.05	2.2	16.19	2.2
Auchencorth Moss	28-Jan	PM10	331602	13735	-2.01	1	2.62	2.2	14.50	2.2
		PM2.5	390602	12992	-1.50	1	2.70	2.2	14.85	2.2
		GR10							16.19	2.2
		GR2.5							16.47	2.2
Edinburgh St Leonards	22-Dec	PM10	109808	13571	-0.88	1	3.01	2.2	15.49	2.2
		PM2.5	970808	16899	-0.66	1	2.84	2.2	15.08	2.2
Glasgow Townhead	05-Feb	PM10	420302	14566	-0.40	1	3.00	2.2	16.05	2.2
		PM2.5	350002	13083	-0.47	1	3.04	2.2	16.37	2.2
Glasgow High Street	20-Jan	PM10	440810	14376	-1.41	1	3.02	2.2	15.89	2.2
		PM2.5	370810	15072	-0.32	1	2.42	2.2	15.83	2.2
Grangemouth	26-Jan	PM10	280809	15764	-0.96	1	2.99	2.2	16.33	2.2
		PM2.5	590809	13593	-1.22	1	3.01	2.2	15.58	2.2
Inverness	23-Jan	GR10	550003						15.92	2.2
		GR2.5	610603						16.12	2.2
Welsh Sites										
Cardiff Centre	06-Mar	PM10	550701	13556	-2.3	1	3.04	2.2	16.83	2.2
		PM2.5	700401	10906	-0.8	1	3.01	2.2	16.63	2.2
Chepstow A48	23-Jan	PM10	340712	analyser	fault	during test	2.98	2.2	16.17	2.2
		PM2.5	881103	16577	0.6	1	3.01	2.2	16.63	2.2
Narberth	19-Jan	PM10	470701	13687	-1.34	1	3.00	2.2	16.79	2.2
Newport	22-Jan	PM10	029805	13731	-1.83	1	2.92	2.2	16.21	2.2
		PM2.5	660702	16359	-1.58	1	2.93	2.2	15.78	2.2
Port Talbot Margam	20-Jan	PM10	830807	13940	0.03	1	2.99	2.2	16.00	2.2
		PM2.5	510103	11694	0.28	1	3.00	2.2	16.54	2.2
		GR10	389903						16.76	2.2
Swansea Roadside	20-Jan	PM10	M9305						15.93	2.2
		PM2.5	M9306						15.48	2.2
Wrexham	05-Jan	GR10	119902						16.55	2.2
		GR2.5	240001						16.88	2.2

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

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

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

Concentration = (output – zero response) x Calibration factor

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

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

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

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

CERTIFICATE OF CALIBRATION

0401

Ricardo Energy & Environment, The Gemini Building, Fermi Avenue, Harwell, Didcot, Oxfordshire OX11 0QR
Telephone 01235 753212

Certificate Number: 03476

Authorised Signatories: S Eaton
B Stacey

Signed:

Date of issue: 28th September 2016

Customer Name and Address: John Newington
Atmosphere and Noise
Resource, Atmosphere and Sustainability
Department for Environment, Food and Rural Affairs
Area 2C Nobel House, 17 Smith Square, London,
SW1P 3JR

Date of Calibration: January to March 2016

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

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

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

CERTIFICATE OF CALIBRATION

1. Carbon Monoxide

Site	Date Year = 2016	Analyser number	[1]Zero output	Uncertainty (ppm)	[2]Calibration Factor	Uncertainty (%)	*Maximum Residual (%)
Belfast Centre	26-Feb	462	0.10	0.20	1.0556	2.3	4.7
Cardiff Centre	13-Jan	1502	0.40	0.20	0.9855	2.2	2.2
Edinburgh St Leonards	09-Feb	analyser	not	present	at	audit	
Leeds Centre	11-Jan	458	1.30	0.22	1.0245	2.6	1.5
London Marylebone Road	27-Jan	651	-0.10	0.20	1.0250	2.3	0.8
London N. Kensington	26-Jan	2313	0.20	0.20	1.0354	2.2	1.6
Port Talbot Margam	12-Jan	605214618	2.10	0.20	0.9623	2.2	1.8

2. Sulphur Dioxide

Site	Date Year =2016	Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	*Max Residual (%)	*m-xylene interference (ppb)
Ballymena Ballykeel	17-Feb	4901234	0.0	2.5	0.8733	3.2	1.2	10.5
Barnsley Gawber	28-Jan	8050082	-0.9	2.5	0.8735	3.0	0.8	5.5
Belfast Centre	26-Feb	1766	6.7	2.5	1.0306	3.0	1.3	11.0
Birmingham Tyburn	19-Jan	EH937000	1.9	2.5	1.0350	3.0	0.7	-0.2
Cardiff Centre	13-Jan	70	6.6	2.5	1.0194	3.6	2.5	22.1
Chilbolton	28-Jan	83	-0.5	2.5	1.0239	3.4	2.9	22.7
Derry	17-Feb	1697	7.3	2.6	1.1379	3.2	2.4	1.3
Edinburgh St Leonards	09-Feb	84	15.0	2.5	0.9670	3.0	1.6	2.2
Grangemouth	08-Feb	1211322	0.0	2.5	0.9614	3.0	0.4	22.1
Hull Freetown	13-Jan	342	2.7	2.5	0.9465	3.6	2.1	1.4
Ladybower	26-Jan	1178	-0.8	2.5	0.9676	3.1	1.9	3.5
Leeds Centre	11-Jan	08050084	-1.0	2.5	1.0467	3.2	2.9	2.1
Liverpool Speke	21-Jan	17509	3.1	2.5	1.0691	3.0	0.7	17.6
London Bloomsbury	08-Feb	74	13.7	2.6	0.9622	3.0	0.8	20.3
London Marylebone Road	27-Jan	2644	1.1	2.5	1.0326	3.0	0.9	20.5
London N. Kensington	26-Jan	2576	6.2	2.6	1.0576	3.1	0.8	22.4
Lullington Heath	27-Jan	82	-2.2	2.5	0.9397	3.5	5.7	20.0
Manchester Piccadilly	13-Jan	19218	0.8	2.6	1.0815	3.0	1.1	22.3
Middlesbrough	02-Feb	345	-2.9	2.6	1.1144	3.1	1.1	7.5
Narberth	11-Jan	344	2.9	2.5	0.9428	3.3	4.5	14.8
Nottingham Centre	22-Feb	1629	0.7	2.6	1.0786	3.0	0.3	21.1
Port Talbot Margam	12-Jan	605214617	0.9	2.5	0.9889	3.1	1.6	5.0
Rochester Stoke	09-Feb	2800	7.0	2.4	0.7537	2.9	0.5	9.0
Scunthorpe Town	13-Jan	1576	0.7	2.5	1.0559	3.0	3.0	3.7
Southampton Centre	22-Feb	343	10.0	2.5	0.8872	3.0	1.1	17.2
Thurrock	10-Feb	189	1.1	2.5	0.9620	2.9	0.3	20.8
Wicken Fen	02-Feb	73	11.0	2.4	0.8028	2.9	0.6	18.5
Wrexham	21-Jan	1181	10.0	2.5	1.0766	3.0	0.2	8.1

CERTIFICATE OF CALIBRATION

3. Ozone

Site	Date Year =2016	Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	*Max Residual (%)
Aberdeen	19-Jan	800	0.9	3.0	1.0440	3.2	4.2
Aston Hill	09-Feb	2448	3.4	3.0	0.9636	3.1	0.8
Auchencorth Moss	10-Feb	1646	0.1	3.0	1.0536	3.1	0.3
Barnsley Gawber	28-Jan	8060030	0.4	3.0	1.0100	3.1	0.6
Belfast Centre	26-Feb	CM08060038	-0.1	3.0	0.9713	3.2	1.9
Birmingham Acocks Green	18-Jan	2435	-2.6	3.0	1.0838	3.1	0.2
Birmingham Tyburn	19-Jan	WB6AG7TM	0.9	3.0	1.0323	3.2	3.2
Blackpool Marton	13-Jan	cm080037	0.0	3.0	1.0079	3.0	0.9
Bottesford	22-Feb	CM08060022	-1.0	3.0	1.0339	3.1	0.5
Bournemouth	24-Feb	1650	0.8	3.0	1.0687	3.1	0.4
Brighton Preston Park		Site not	audited	safety	restrictions	in place	
Bristol St Paul's	08-Jan	155	0.0	3.0	1.0477	3.1	0.8
Bush Estate	19-Feb	1645	-0.3	3.0	1.0274	3.0	0.4
Canterbury	08-Feb	1647	0.0	3.0	0.9556	3.1	1.1
Cardiff Centre	13-Jan	168	-2.1	3.0	1.1279	5.0	19.0
Charlton Mackrell	11-Feb	1111957	0.5	3.0	0.9602	3.2	0.3
Chilbolton	28-Jan	1648	-0.5	3.0	1.0605	3.1	0.8
Coventry Allesley	16-Feb	cm08060044	-0.2	3.0	1.0654	3.2	2.6
Cwmbran	14-Jan	CM08060043	0.6	3.0	0.9896	3.3	3.7
Derry	17-Feb	1586	1.1	3.0	1.0037	3.1	1.4
Edinburgh St Leonards	09-Feb	136	-2.3	3.0	1.0822	3.1	0.3
Eskdalemuir	25-Jan	158	0.6	3.0	1.0648	3.0	0.5
Exeter Roadside	07-Jan	F0100E0S	-1.5	3.0	0.8981	3.1	0.8
Fort William	20-Jan	1023	0.6	3.0	1.0087	3.1	1.1
Glasgow Townhead	27-Jan	CM08060029	-1.4	3.0	1.0037	3.1	1.1
Glazebury	12-Jan	1274	2.3	3.0	1.0277	3.0	0.8
Great Dun Fell	26-Jan	1647	1.1	3.0	0.9111	3.1	2.6
High Muffles	29-Jan	1641	1.1	3.0	0.9729	3.1	0.6
Hull Freetown	13-Jan	CM08060045	0.0	3.0	1.0178	3.1	0.8
Ladybower	26-Jan	1651	-1.1	3.0	1.0062	3.1	1.1
Leeds Centre	11-Jan	CM08060036	-0.1	3.0	1.1559	4.2	14.6
Leicester University	17-Feb	CM08060020	-0.4	3.0	1.1362	3.1	1.1
Leominster	08-Feb	170	5.3	3.0	1.0333	3.1	0.8
Liverpool Speke	21-Jan	cm08060041	0.1	3.0	1.0204	3.1	0.4
London Bloomsbury	08-Feb	435	-0.5	3.0	1.1048	3.1	0.4
London Eltham	25-Jan	1111958	0.0	3.0	0.9593	3.1	1.2
London Haringey Priory Park South	19-Feb	1111953	0.0	3.0	1.0460	3.1	0.4
London Harlington	04-Feb	1109	0.8	3.0	1.0236	3.2	2.5
London Hillingdon	03-Feb	CM08060034	0.1	3.0	1.0343	3.1	0.3
London Marylebone Road	27-Jan	2432	-0.2	3.0	1.0528	3.2	3.3
London N. Kensington	26-Jan	2372	-0.6	3.0	1.0555	3.2	2.4
London Teddington	17-Feb	2447	-0.2	3.0	0.9724	3.1	0.7
Lough Navar	16-Feb	1640	2.1	3.0	0.9936	3.1	1.3
Lullington Heath	27-Jan	1644	-0.5	3.0	1.0635	3.1	0.4
Mace Head	23-Feb	77086 - 385	-0.1	3.0	0.9903	3.1	0.8
Manchester Piccadilly	13-Jan	cm08060039	0.1	3.0	1.0693	3.1	0.7
Manchester Sharston	18-Feb	1317	-1.0	3.0	1.0812	3.1	0.3
Manchester South	13-Jan	16954	-1.0	3.0	1.0961	3.1	1.6
Market Harborough	18-Feb	Cm08060031	0.0	3.0	1.0733	3.2	1.8
Middlesbrough	02-Feb	2436	-1.4	3.0	0.9944	3.1	0.5
Narberth	11-Jan	824	0.4	3.0	1.0123	3.1	1.0

Site	Date Year =2016	Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	*Max Residual (%)
Newcastle Centre	03-Feb	8060033	-0.3	3.0	0.9956	3.1	0.5
Northampton Kingsthorpe	15-Feb	47R76STR	0.8	3.0	1.0028	3.1	0.5
Norwich Lakenfields	03-Feb	CM08060028	0.3	3.0	1.0711	3.1	0.7
Nottingham Centre	22-Feb	CM08060032	0.2	3.0	1.0398	3.3	1.7
Peebles	09-Feb	2449	-3.6	3.0	1.0477	3.1	0.3
Plymouth Centre	06-Jan	CM08060027	0.7	3.0	1.0199	3.1	0.2
Port Talbot Margam	12-Jan	CM10140049	0.0	3.0	1.0215	3.3	0.9
Portsmouth	23-Feb	CM08060023	0.1	3.0	1.1015	3.1	1.0
Preston	12-Jan	cm08060042	0.3	3.0	0.9186	3.0	0.4
Reading New Town	25-Feb	CM08060025	-0.4	3.0	1.0205	3.1	0.4
Rochester Stoke	09-Feb	378	3.3	3.0	1.0317	3.2	0.4
Salford Eccles	12-Jan	analyser	not	tested			
Sheffield Devonshire Grn	27-Jan	8060024	0.3	3.0	1.0148	3.2	2.5
Sibton	03-Feb	146	0.0	3.0	1.0813	3.1	0.1
Southampton Centre	22-Feb	CM08060021	0.2	3.0	1.0392	3.1	0.2
Southend-on-Sea	11-Feb	cm08060017	0.1	3.0	1.0934	3.1	0.5
St Osyth	11-Feb	cm08060035	0.0	3.0	1.0339	3.1	0.7
Stoke-on-Trent Centre	20-Jan	cm08060026	-0.3	3.0	1.1152	3.2	0.7
Strath Vaich	17-Feb	176	0.0	3.0	1.0161	3.1	0.6
Sunderland Si ksworth	04-Feb	436	-0.1	3.0	1.0198	3.2	4.1
Thurrock	10-Feb	221	0.4	3.0	1.0177	3.1	0.5
Walsall Woodlands	21-Jan	2431	9.5	3.0	1.0983	3.1	1.1
Weybourne	04-Feb	CM10180038	-0.6	3.0	1.0451	3.1	0.2
Wicken Fen	02-Feb	165	-0.3	3.0	1.1115	3.2	1.0
Wigan Centre	14-Jan	CM08060018	-1.6	3.0	0.9121	3.1	0.9
Wirral Tranmere	19-Jan	cm08060040	0.3	3.0	1.0385	3.1	0.5
Yarner Wood	10-Feb	2437	2.7	3.0	1.0575	3.1	0.1

4. Oxides of Nitrogen

Site	Date Year =2016	Analyser number		[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	*Max residual (%)	*Converter efficiency (%)
Aberdeen	19-Jan	519	NOx	-12.9	2.5	1.0010	3.5	0.7	98.1
			NO	-14.4	2.5	0.9772	3.5	0.5	
Aberdeen Union Street	19-Jan	299	NOx	3.8	2.5	1.0737	3.5	1.0	98.1
Roadside			NO	1.9	2.5	1.0721	3.5	1.2	
Armagh Roadside	15-Feb	1011845	NOx	3	2.6	1.0809	3.5	5.4	101.1
			NO	1	2.5	1.0690	3.5	5.2	
Aston Hill	09-Feb	2302	NOx	0.1	2.6	1.0516	3.5	0.6	99.3
			NO	0.6	2.5	1.0593	3.5	0.3	
Barnsley Gawber	28-Jan	8050057	NOx	0.1	2.5	0.9234	3.5	1.1	100.4
			NO	0.1	2.5	0.9250	3.5	1.3	
Bath Roadside	05-Jan	1953	NOx	0.5	2.8	1.1930	3.5	0.4	99.0
			NO	-0.1	2.6	1.1920	3.5	0.7	
Belfast Centre	26-Feb	08050074	NOx	0.3	2.5	0.9568	3.5	1.1	101.6
			NO	0.1	2.5	0.9488	3.5	1.0	
Belfast Stockman's	25-Feb	2159	NOx	1.9	2.6	1.1336	3.5	0.9	98.6
Lane			NO	1	2.6	1.1442	3.5	1.4	
Billingham	02-Feb	574	NOx	-13.2	2.7	1.3607	3.5	0.7	100.0
			NO	-5.6	2.7	1.4076	3.5	0.5	
Birmingham Acocks	18-Jan	3364	NOx	1.4	2.6	1.2108	3.5	2.4	99.3
Green			NO	0	2.6	1.1966	3.5	2.6	

CERTIFICATE OF CALIBRATION

Site	Date Year =2016	Analyser number		[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	[*]Max residual (%)	[*]Converter efficiency (%)
Birmingham Tyburn	19-Jan	Y7ACC7MC	NOx	0.2	2.5	1.0098	3.5	1.2	99.0
			NO	0	2.6	1.0156	3.5	1.2	
Blackburn Accrington Road	11-Jan	1011851	NOx	1	2.6	1.2950	3.5	1.6	100.6
			NO	0	2.6	1.2794	3.5	1.1	
Blackpool Marton	13-Jan	08050075	NOx	0.2	2.5	1.0457	3.5	1.4	97.9
			NO	0.1	2.6	1.0988	3.5	1.7	
Bournemouth	24-Feb	2214	NOx	0.6	2.6	1.1304	3.5	0.6	98.5
			NO	0.7	2.6	1.1531	3.5	0.5	
Bradford Mayo Avenue	12-Jan	1011823	NOx	0	2.5	0.9639	3.5	2.1	99.3
			NO	2	2.7	0.9697	3.5	2.0	
Brighton Preston Park			NOx		analyser	not	audited	safety	restrictions
			NO						
Bristol St Paul's	08-Jan	77	NOx	2	3.3	1.0798	3.5	0.9	99.0
			NO	0.8	2.5	1.0682	3.5	0.7	
Bury Whitefield Roadside	25-Jan	1859	NOx	-0.1	2.5	1.0189	3.5	1.0	99.6
			NO	-0.2	2.5	1.0230	3.5	0.8	
Bush Estate	19-Feb	2244	NOx	0.3	2.5	1.0086	3.5	0.6	0.3
			NO	2	2.5	0.9938	3.5	0.5	
Cambridge Roadside	02-Feb	1011843	NOx	2.5	2.9	1.1736	4.7	3.9	101.8
			NO	0	3.1	1.1550	4.5	3.4	
Camden Kerbside	16-Feb	1011846	NOx	2	3.0	1.3079	4.0	3.0	98.5
			NO	0	2.9	1.2939	4.1	3.1	
Canterbury	08-Feb	1147	NOx	0.2	2.6	1.0985	3.5	2.1	91.6
			NO	-0.1	2.6	1.1000	3.5	2.5	
Cardiff Centre	13-Jan	71	NOx	2.4	2.7	1.3550	3.5	1.9	98.6
			NO	-0.1	2.7	1.3624	3.5	1.6	
Carlisle Roadside			NOx		analyser	not	audited	safety	restrictions
			NO						
Charlton Mackrell	11-Feb	2120	NOx	-1.6	2.8	1.1158	3.5	3.2	97.1
			NO	-0.6	2.6	1.1083	3.6	3.9	
Chatham Centre Roadside	09-Feb	3393	NOx	1	2.6	1.2265	3.5	1.4	98.1
			NO	1.1	2.6	1.2294	3.5	1.5	
Chepstow A48	15-Jan	1011828	NOx	1	2.8	1.1964	3.5	1.1	98.0
			NO	-1	2.6	1.1816	3.5	1.3	
Chesterfield Loundsley Green	26-Jan	1011837	NOx	0	2.6	1.1134	3.5	0.8	100.0
			NO	0	2.8	1.1009	3.5	0.5	
Chesterfield Roadside	27-Jan	1011835	NOx	-1	2.6	1.1398	3.5	1.4	99.6
			NO	-1	2.6	1.1321	3.5	1.5	
Chilbolton	28-Jan	79	NOx	4.8	2.5	0.9654	3.5	2.8	98.4
			NO	1.3	2.5	0.9602	3.5	2.6	
Coventry Allesley	16-Feb	08030109	NOx	1.2	2.5	0.9511	3.5	0.1	99.6
			NO	1.5	2.5	0.9516	3.5	0.2	
Cwmbran	14-Jan	L00N2XG8	NOx	1	2.5	0.9966	3.5	1.3	99.8
			NO	0.2	2.5	0.9910	3.5	1.3	
Derry	17-Feb	2130	NOx	2.5	2.6	1.0937	3.5	2.5	98.5
			NO	0	2.6	1.0897	3.5	1.9	
Doncaster A630 Cleveland Street	28-Jan	1565	NOx	-0.6	2.6	1.1093	3.5	1.4	99.6
			NO	0	2.6	1.1111	3.5	1.1	
Dumbarton Roadside	28-Jan	1011883	NOx	0	2.6	1.0975	3.5	0.1	100.0
			NO	0	2.5	1.0794	3.5	0.8	

CERTIFICATE OF CALIBRATION

Site	Date Year =2016	Analyser number		[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	*Max residual (%)	*Converter efficiency (%)
Dumfries	14-Jan	1494	NOx	-1.7	2.6	1.0872	3.5	2.9	99.6
			NO	0.2	2.6	1.1103	3.6	3.6	
Eastbourne	26-Jan	3363	NOx	2	2.6	1.1449	3.5	0.1	98.1
			NO	1.4	2.6	1.1454	3.5	0.6	
Edinburgh St Leonards	09-Feb	73	NOx	-0.3	2.6	1.0989	3.5	0.6	96.6
			NO	1.2	2.6	1.0979	3.5	1.7	
Eskdalemuir	25-Jan	347	NOx	2.3	2.6	1.1100	3.5	0.3	98.5
			NO	0.7	2.6	1.0919	3.5	0.6	
Exeter Roadside	07-Jan	G0000D1S	NOx	-5.5	3.4	1.6489	3.5	0.1	101.5
			NO	-0.1	2.9	1.5592	3.5	0.1	
Fort William	20-Jan	344	NOx	-0.2	2.8	1.0959	3.5	0.3	100.0
			NO	1.6	2.6	1.0930	3.5	0.6	
Glasgow Kerbside	27-Jan	08050061	NOx	0.1	2.9	1.7780	3.5	0.8	100.4
			NO	0	2.9	1.7540	3.5	0.6	
Glasgow Townhead	27-Jan	1713	NOx	0.3	2.6	1.1352	3.5	1.4	98.4
			NO	1.1	2.6	1.1305	3.5	1.8	
Glasgow Great Western Road	27-Jan	1193	NOx	0.9	2.5	1.0800	3.5	0.1	98.9
			NO	1.5	2.6	1.0834	3.5	0.4	
Glasgow High Street	05-Feb	1567	NOx	2.5	2.5	1.0124	3.5	3.1	98.9
			NO	0.5	2.5	1.0029	3.5	2.4	
Glazebury	12-Jan	78	NOx	0.6	2.5	1.0334	3.8	4.9	100.4
			NO	1.1	2.5	1.0625	3.8	5.0	
Grangemouth	08-Feb	1011836	NOx	1	2.7	1.0809	3.5	0.2	98.3
			NO	-1	2.8	1.0690	3.5	0.6	
Grangemouth Moray	08-Feb		NOx	0	2.4	0.7964	3.5	1.6	99.7
			NO	-1	2.4	0.8040	3.5	0.8	
Hafod-yr-ynys Roadside	14-Jan	2362	NOx	-0.2	2.6	1.1312	3.5	1.0	98.9
			NO	0.1	2.6	1.1349	3.5	1.5	
Haringey Roadside	19-Feb	1011827	NOx	5	3.0	1.0118	3.9	4.0	98.7
			NO	0	2.7	0.9930	3.8	3.5	
High Muffles	29-Jan	1783	NOx	0.8	2.7	1.3854	3.5	0.5	100.0
			NO	0.7	2.7	1.3781	3.5	0.8	
Honiton	06-Jan	3392	NOx	0.7	2.7	1.3165	3.5	1.2	98.3
			NO	0	2.7	1.2883	3.5	1.0	
Horley	25-Jan	1401954	NOx	1	2.8	1.1000	3.8	2.9	99.5
			NO	-2	2.7	1.0491	3.7	2.1	
Hull Freetown	13-Jan	08050056	NOx	0.5	2.5	0.9727	3.9	2.1	100.7
			NO	0.6	2.5	0.9768	3.5	2.6	
Hull Holderness Road	14-Jan	1564	NOx	1.8	2.7	1.2923	5.7	2.9	100.0
			NO	2.3	2.6	1.2948	3.8	2.8	
Inverness	18-Jan	1489	NOx	1.4	2.5	1.0482	3.5	1.6	101.4
			NO	1.6	2.5	1.0329	3.5	1.1	
Ladybower	26-Jan	72	NOx	-0.5	3.2	2.2166	3.8	3.2	99.0
			NO	0	3.2	2.2130	3.5	2.4	
Leamington Spa	25-Feb	1011842	NOx	2	2.7	1.4290	3.5	0.7	98.3
			NO	0	2.7	1.4043	3.5	1.2	
Leamington Spa Rugby Road	25-Feb	1	NOx	4.1	2.6	1.1841	3.5	0.3	98.1
			NO	3.1	2.6	1.2277	3.5	0.5	
Leeds Centre	11-Jan	08050066	NOx	-7.6	2.6	1.0819	3.5	2.0	100.0
			NO	-7.5	2.6	1.0774	3.5	1.8	

Site	Date Year =2016	Analyser number		[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	*Max residual (%)	*Converter efficiency (%)
Leeds Headingley Kerbside	12-Jan	342	NOx	2.1	2.6	1.1347	3.5	1.5	99.2
			NO	0.9	2.6	1.1426	3.5	1.2	
Leicester University	17-Feb	08050021	NOx	1.2	2.5	0.9670	3.5	0.4	98.2
			NO	1	2.5	0.9809	3.5	0.5	
Leicester A594 Roadside	17-Feb	1570	NOx	2.1	2.6	1.2143	3.5	0.1	99.7
			NO	0.5	2.6	1.2053	3.5	0.9	
Leominster	08-Feb	346	NOx	-2.9	2.6	1.1731	3.5	2.5	99.0
			NO	0.1	2.6	1.1857	3.5	1.9	
Lincoln Canwick Road	23-Feb	3394	NOx	3.5	2.6	1.0959	3.5	0.2	98.4
			NO	2.5	2.6	1.1168	3.5	0.8	
Liverpool Queen's Drive Roadside	20-Jan	16927	NOx	2.5	2.6	1.2744	3.5	1.6	99.5
			NO	-1.1	2.6	1.2663	3.5	0.3	
Liverpool Speke	21-Jan	08050069	NOx	1	2.5	0.9138	3.5	1.3	100.4
			NO	1.5	2.5	0.9108	3.5	1.0	
London Bexley	10-Feb	326	NOx	0.1	2.8	1.2576	3.5	0.9	99.2
			NO	0.1	2.7	1.3021	3.5	1.1	
London Bloomsbury	08-Feb	74	NOx	4.6	3.2	1.2185	3.5	0.5	97.8
			NO	3.3	2.6	1.2133	3.5	0.4	
London Eltham	25-Jan	1011834	NOx	4	2.9	1.1606	3.5	0.6	101.0
			NO	0	2.8	1.1529	3.5	0.3	
London Haringey Priory Park South	19-Feb	1084	NOx	2.8	2.7	1.1471	4.0	4.8	98.2
			NO	2.2	2.6	1.1466	4.0	4.7	
London Harlington	04-Feb	1090	NOx	-4.6	2.6	1.0158	3.5	0.5	98.5
			NO	-0.6	2.5	1.0000	3.5	1.3	
London Hillingdon	03-Feb	08050017	NOx	0.6	2.6	0.9476	3.5	0.5	100.8
			NO	0.8	2.6	0.9534	3.5	0.5	
London Marylebone Road	27-Jan	3366	NOx	-0.1	2.6	1.2520	3.5	1.9	100.3
			NO	-3.1	2.6	1.2293	3.5	0.6	
London N. Kensington	26-Jan	3273	NOx	0.6	3.5	1.1450	3.5	0.6	98.6
			NO	1.6	2.6	1.1369	3.5	0.4	
London Teddington	17-Feb	3406	NOx	2.6	2.6	1.1795	3.5	1.3	99.5
			NO	0.9	2.6	1.1591	3.8	2.7	
London Westminster	01-Feb	573	NOx	0.8	3.0	0.9017	3.5	0.3	100.7
			NO	-0.2	2.5	0.9086	3.5	0.3	
Lullington Heath	27-Jan	2579	NOx	0.6	2.6	1.1693	3.5	2.5	98.2
			NO	0.5	2.6	1.1629	3.5	2.8	
Luton A505 Roadside	04-Feb	1563	NOx	-0.2	2.7	1.2073	3.5	0.5	98.9
			NO	-1.3	2.6	1.1957	3.5	0.8	
Manchester Piccadilly	13-Jan	08050065	NOx	-1.5	2.6	1.2374	3.7	2.3	99.5
			NO	-1.2	2.7	1.2019	3.7	2.3	
Manchester Sharston	18-Feb	2115	NOx	1	2.5	0.9979	3.8	3.5	99.0
			NO	1.1	2.5	0.9921	3.6	2.7	
Market Harborough	18-Feb	08050068	NOx	0.6	2.7	1.3846	3.5	0.5	98.9
			NO	0.7	2.7	1.3779	3.5	0.5	
Middlesbrough	02-Feb	2287	NOx	-7.1	2.5	1.0082	3.5	2.1	99.2
			NO	-2.8	2.5	1.0217	3.5	2.0	
Narberth	11-Jan	2577	NOx	0.1	2.5	1.0198	3.5	2.4	98.0
			NO	0.5	2.5	1.0474	3.5	2.2	
Newcastle Centre	03-Feb	8050063	NOx	1.1	2.5	0.8515	3.5	0.7	98.7
			NO	1	2.5	0.8791	3.5	0.6	

Site	Date Year =2016	Analyser number		[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	[*]Max residual (%)	[*]Converter efficiency (%)
Newcastle Cradlewell Roadside	03-Feb	1011853	NOx	2	2.8	1.1398	3.5	0.7	100.8
			NO	0	2.6	1.1321	3.5	0.4	
Newport	15-Jan	1011829	NOx	2	2.6	1.1265	3.5	0.6	99.0
			NO	0	2.9	1.1241	3.5	1.1	
Northampton Kingsthorpe	15-Feb	8ATJ6APR	NOx	4.1	2.7	1.3308	3.5	0.1	100.3
			NO	0.4	2.7	1.3766	3.5	0.3	
Norwich Lakenfields	03-Feb	08050067	NOx	-0.1	2.5	1.0151	3.5	0.2	98.7
			NO	0.3	2.5	1.0296	3.5	0.1	
Nottingham Centre	22-Feb	08050072	NOx	1.9	2.7	1.0765	3.5	1.1	98.4
			NO	1.7	2.6	1.0762	3.5	0.9	
Nottingham Western Boulevard	24-Feb	1958	NOx	2.8	2.5	0.9540	3.5	0.5	99.1
			NO	2	2.5	0.9559	3.5	0.3	
Oldbury Birmingham Road	21-Jan	D00064EU	NOx	0.8	2.6	1.0651	3.5	1.1	100.1
			NO	-0.3	2.6	1.0657	3.5	1.0	
Oxford Centre Roadside	23-Jul	1011844	NOx	6	2.5	1.0697	3.5	3.3	98.1
			NO	0	2.7	1.0541	3.5	3.3	
Oxford St Ebbes	05-Feb	1011830	NOx	1	3.0	1.1522	3.5	2.1	100.0
			NO	-1	2.8	1.1446	3.5	1.9	
Peebles	09-Feb	2213	NOx	2.9	2.5	1.0639	3.5	3.1	99.3
			NO	1.6	2.6	1.0816	3.5	3.2	
Plymouth Centre	06-Jan	08050062	NOx	-0.5	2.6	1.1766	3.5	0.1	100.0
			NO	-0.2	2.6	1.1661	3.5	0.1	
Port Ta bot Margam	12-Jan	1426962867	NOx	2.6	2.5	0.8914	3.5	0.5	99.3
			NO	0	2.5	0.8851	3.5	0.5	
Portsmouth	23-Feb	P0T7CYA5	NOx	-0.9	2.5	0.9871	3.5	0.9	98.3
			NO	-0.5	2.5	0.9944	3.5	0.6	
Preston	12-Jan	08050064	NOx	-0.4	2.6	1.0856	3.5	2.3	100.0
			NO	-0.6	2.6	1.0832	3.5	2.6	
Reading London Road	19-Feb	1072M2767	NOx	4	2.7	0.9168	3.5	0.6	99.3
			NO	2	2.5	0.9094	3.5	0.6	
Reading New Town	25-Feb	08050059	NOx	0	2.5	1.0463	3.6	1.1	100.0
			NO	0.3	2.5	1.0551	3.8	1.2	
Rochester Stoke	09-Feb	3095	NOx	-7	2.6	1.0869	3.5	0.4	99.2
			NO	2	2.6	1.1026	3.5	0.3	
Salford Eccles	12-Jan	1011831	NOx	2	2.6	1.0438	3.5	0.9	101.0
			NO	0	2.6	1.0259	3.5	0.5	
Sandy Roadside	01-Feb	2585	NOx	1.4	2.6	1.0966	3.5	0.5	98.1
			NO	0.1	2.6	1.0963	3.5	0.3	
Scunthorpe Town	13-Jan	1011847	NOx	2	2.6	0.8139	3.5	2.4	100.9
			NO	0	2.6	0.8108	3.5	2.9	
Shaw Crompton Way	18-Jan	20861	NOx	1.6	2.6	1.1277	3.5	0.3	101.4
			NO	0.3	2.6	1.1353	3.5	1.6	
Sheffield Devonshire Green	27-Jan	8050055	NOx	-1.5	2.5	1.0400	3.5	1.2	99.6
			NO	-0.6	2.5	1.0700	3.5	1.1	
Sheffield Tinsley	27-Jan	1882	NOx	-0.3	3.1	2.1283	3.5	2.2	99.2
			NO	0.2	3.2	2.1419	3.5	1.3	
Southampton Centre	22-Feb	08030106	NOx	6.9	2.5	0.9244	3.5	0.7	100.4
			NO	6.7	2.5	0.9216	3.5	0.4	
Southend-on-Sea	11-Feb	08050071	NOx	0.3	2.5	0.9013	3.5	0.2	99.0
			NO	0.4	2.5	0.9048	3.5	0.4	

Site	Date Year =2016	Analyser number		[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	[*]Max residual (%)	[*]Converter efficiency (%)
Southwark A2 Old Kent Road	02-Feb	1495	NOx	-18.4	2.6	1.1226	3.5	0.3	98.7
			NO	-5.4	2.6	1.1515	3.5	0.5	
St Osyth	11-Feb	08050073	NOx	-0.5	2.5	0.9758	3.5	0.3	99.6
			NO	-0.4	2.5	0.9821	3.5	0.3	
Stanford-le-Hope Roadside	10-Feb	191	NOx	2.4	2.6	1.1584	3.5	0.1	98.2
			NO	2	2.5	1.0734	3.5	0.5	
Stockton-on-Tees Eaglescliffe	01-Feb	355	NOx	-0.4	2.6	1.2384	3.5	0.7	99.0
			NO	0	2.6	1.2500	3.5	0.5	
Stockton-on-Tees A1305	01-Feb	1210	NOx	-0.6	2.5	1.0243	3.5	0.6	99.6
			NO	-0.3	2.5	1.0228	3.5	1.0	
Stoke-on-Trent Centre	20-Jan	08050070	NOx	0.1	2.5	0.9490	3.5	0.5	99.7
			NO	0.4	2.5	0.9494	3.5	0.5	
Stoke-on-Trent A50 Roadside	22-Jan	1568	NOx	2.9	2.6	1.1393	3.5	1.6	98.7
			NO	1.7	2.6	1.1082	3.5	1.5	
Storrington Roadside	26-Jan	09040022	NOx	2.4	2.5	0.8452	3.5	0.6	100.0
			NO	1.8	2.5	0.8764	3.5	0.6	
Sunderland Wessington Way	03-Feb	1195	NOx	-5.6	2.6	1.0962	3.5	0.5	100.0
			NO	-0.3	2.6	1.0929	3.5	0.8	
Sunderland Silksworth	04-Feb	1011854	NOx	-1	2.8	1.0411	3.5	1.3	100.8
			NO	0	2.5	1.0390	3.5	1.1	
Swansea Roadside	12-Jan	1229	NOx	2.7	2.6	1.0820	3.5	0.8	98.1
			NO	0.1	2.6	1.1135	3.5	1.1	
Thurrock	10-Feb	192	NOx	0.9	2.6	1.1695	3.5	0.4	98.1
			NO	0.6	2.6	1.1816	3.5	0.2	
Tower Hamlets Roadside	09-Feb	2014	NOx	-4.4	2.5	0.9108	3.5	0.9	96.0
			NO	1.7	2.5	0.9327	3.5	0.6	
Walsall Woodlands	21-Jan	3391	NOx	-0.8	2.6	1.2430	3.5	0.6	99.0
			NO	0.6	2.6	1.2456	3.5	1.5	
Warrington	18-Jan	204002c	NOx	1	2.8	1.1522	3.5	1.2	100.0
			NO	0	2.6	1.1557	3.5	1.9	
Wicken Fen	02-Feb	2223	NOx	0.9	2.7	1.2630	3.5	0.5	98.2
			NO	2.2	2.7	1.2713	3.5	0.2	
Widnes Milton Road	19-Jan	21351	NOx	2.4	2.6	1.0910	3.5	3.9	99.1
			NO	0.2	2.6	1.0935	3.5	2.0	
Wigan Centre	14-Jan	1011832	NOx	1	2.5	1.0236	3.5	1.2	101.8
			NO	-1	2.5	1.0281	3.5	2.8	
Wirral Tranmere	19-Jan	08050060	NOx	1.9	2.5	0.9171	3.5	2.4	100.4
			NO	2.4	2.5	0.9159	3.5	2.3	
Wrexham	21-Jan	1	NOx	5.4	2.6	1.1848	3.5	1.5	101.0
			NO	1.9	2.6	1.1857	3.5	1.2	
Yarner Wood	10-Feb	1784	NOx	-0.7	2.6	1.0876	3.5	1.6	98.8
			NO	-0.1	2.6	1.1075	3.5	1.1	
York Fishergate	15-Jan	1011848	NOx	2	2.5	1.0502	3.5	0.4	100.4
			NO	-1	2.5	1.0390	3.5	1.7	

5. Particulates

Site	Date Year =2016		Analyser number	Calculated Spring Constant k_0	[4]k_0 accuracy (%)	Uncertainty (%)	[3]Measured Main Flow (l/min)	Uncertainty (%)	[3]Measured Total Flow (l/min)	Uncertainty (%)
Aberdeen	19-Jan	PM10	168520209	11591	0.2	1.0	3.01	2.2	16.49	2.2
		PM2.5	201540811	12104	-0.9	1.0	3.05	2.2	16.66	2.2
Armagh Roadside	15-Feb	PM10	166530201	13589	0.13	1.0	2.93	2.2	15.83	2.2
Auchencorth Moss	10-Feb	PM10	187680602	13146	-0.33	1.0	2.77	2.2	15.18	2.2
		PM2.5	187960603	13793	-1.60	1.0	2.90	2.2	15.24	2.2
		GR10	215500112						Leak fail	2.2
		GR2.5	215480112						16.33	2.2
Barnstaple A39	07-Jan	PM10	100000808	17352	0.46	1.0	3.11	2.2	17.28	2.2
		PM2.5	204291001	14049	-0.81	1.0	3.02	2.2	16.53	2.2
Belfast Centre	26-Feb	PM10	172110302	14424	1.63	1.0	3.05	2.2	16.27	2.2
		PM2.5	192880702	15706	-0.14	1.0	3.03	2.2	16.29	2.2
Belfast Stockman's Lane	25-Feb	PM10	K1042						15.29	2.2
Birmingham Acocks Green	18-Jan	PM2.5	192900702	15761	0.11	1.0	2.98	2.2	15.91	2.2
Birmingham Tyburn	19-Jan	PM10	200390809	14879	-0.42	1.0	3.04	2.2	16.28	2.2
		PM2.5	192540701	13781	-0.20	1.0	3.05	2.2	16.32	2.2
Blackpool Marton	13-Jan	PM2.5	213179610	12478	-0.45	1.0	3.00	2.2	16.34	2.2
Bournemouth	24-Feb	GR2.5	218630603						16.16	2.2
Brighton Preston Park		GR2.5		analyser	not	tested	safety	restriction		
Bristol St Paul's	08-Jan	PM10	168420209	13220	0.32	1.0	3.11	2.2	16.56	2.2
		PM2.5	191880611	14737	-1.30	1.0	3.06	2.2	16.25	2.2
Bury Whitefield Road	25-Jan	PM10	27335	14845	-1.45	1.0	3.03	2.2	16.23	2.2
Camden Kerbside	16-Feb	PM10	148619902	12216	1.89	1.0	3.19	2.2	17.34	2.2
		PM2.5	158100009	12986	1.81	1.0	3.17	2.2	17.08	2.2
Cardiff Centre	13-Jan	PM10	192550701	13798	-0.59	1.0	3.05	2.2	16.38	2.2
		PM2.5	177700401	11082	0.79	1.0	3.04	2.2	16.65	2.2
Carlisle Roadside		PM10		analysers	not	tested	safety	restriction		
		PM2.5								
Chatham Centre Roadside	09-Feb	PM10	200840809	14389	-0.92	1.0	2.95	2.2	15.95	2.2
		PM2.5	201090810	15972	-0.17	1.0	3.14	2.2	16.34	2.2
Chepstow A48	15-Jan	PM10	194220705	15474	0.55	1.0	2.90	2.2	15.87	2.2
		PM2.5	204881103	16629	0.87	1.0	2.97	2.2	16.00	2.2
Chesterfield Loundsley Grn	26-Jan	PM10	27316	16206	-0.71	1.0	2.80	2.2	15.10	2.2
		PM2.5	27341	15321	-0.92	1.0	2.81	2.2	15.35	2.2
Chesterfield Roadside	27-Jan	PM10	22299	11147	-1.74	1.0	3.00	2.2	16.08	2.2
		PM2.5	27339	11131	0.40	1.0	2.97	2.2	16.00	2.2
Chi bolton	28-Jan	PM10	201670811	14892	-0.32	1.0	3.07	2.2	16.45	2.2
		PM2.5	167570401	12628	1.90	1.0	3.19	2.2	16.58	2.2
		GR10	201439802						16.34	2.2
		GR2.5	218590603						16.62	2.2
Coventry Allesley	16-Feb	PM2.5	192890702	14899	-0.46	1.0	3.04	2.2	16.64	2.2
Derry	17-Feb	PM10	202830902	16323	3.27	1.0	2.87	2.2	15.40	2.2
		PM2.5	134949608	10965	0.68	1.0	2.88	2.2	15.24	2.2
Ealing Horn Lane	03-Feb	PM10	201160810	15268	0.03	1.0	3.08	2.2	16.68	2.2
Eastbourne	26-Jan	PM10	204931105	14395	-0.75	1.0	2.93	2.2	16.25	2.2
		PM2.5	200430809	14752	-0.54	1.0	2.88	2.2	16.40	2.2

Edinburgh St Leonards	09-Feb	PM10	199970808	13443	-1.81	1.0	3.08	2.2	15.74	2.2
		PM2.5	200190808	17117	0.62	1.0	3.07	2.2	15.53	2.2
Glasgow Townhead	27-Jan	PM10	167510207	13241	-0.66	1.0	2.92	2.2	16.03	2.2
		PM2.5	154060002	13134	-0.07	1.0	2.94	2.2	15.97	2.2
Glasgow High Street	05-Feb	PM10	143889804	14512	-0.48	1.0	2.98	2.2	15.51	2.2
		PM2.5	201070810	15606	3.22	1.0	2.91	2.2	15.75	2.2
Grangemouth	08-Feb	PM10	201210810	15941	0.15	1.0	3.03	2.2	16.23	2.2
		PM2.5	100110808	13675	-0.62	1.0	3.04	2.2	15.35	2.2
Hull Freetown	13-Jan	PM2.5	26498	13926	-1.88	1.0	2.90	2.2	16.46	2.2
Hull Holderness Rd	14-Jan	PM10	24445	14159	0.36	1.0	2.96	2.2	16.14	2.2
Inverness	18-Jan	GR10	212550003						16.04	2.2
		GR2.5	218610603						16.62	2.2
Leamington Spa	25-Feb	PM10	201110310	15006	0.06	1.0	3.02	2.2	16.63	2.2
		PM2.5	200510809	14199	0.13	1.0	2.94	2.2	15.76	2.2
Leamington Spa Rugby Road	25-Feb	PM10	194150705	14158	0.80	1.0	2.57	2.2	15.39	2.2
		PM2.5	200440809	16107	0.45	1.0	3.07	2.2	16.67	2.2
Leeds Centre	11-Jan	PM10	24451	13390	-0.04	1.0	3.10	2.2	16.33	2.2
		PM2.5	27254	16708	-1.95	1.0	2.94	2.2	16.58	2.2
Leeds Headingley Kerbside	12-Jan	PM10	27287	17405	-1.02	1.0	3.04	2.2	16.15	2.2
		PM2.5	27249	14621	-0.55	1.0	2.96	2.2	16.22	2.2
Leicester Univ	17-Feb	PM2.5	192490701	14908	-0.38	1.0	3.02	2.2	16.55	2.2
Leicester A594 Roadside	17-Feb	PM10	169070205	12621	0.55	1.0	2.93	2.2	16.18	2.2
Liverpool Speke	21-Jan	PM10	244500302	15831	0.12	1.0	**3.09**	**2.2**	**16.98**	**2.2**
		PM2.5	265640702	14813	-0.63	1.0	**2.99**	**2.2**	**17.11**	**2.2**
London Bexley	10-Feb	PM2.5	177450401	11602	0.08	1.0	3.02	2.2	16.32	2.2
London Bloomsbury	08-Feb	PM10	200860809	14838	0.27	1.0	3.02	2.2	15.58	2.2
		PM2.5	200610809	14704	-0.38	1.0	2.97	2.2	15.72	2.2
London Eltham	25-Jan	PM2.5	197840801	14102	2.06	1.0	3.43	2.2	17.16	2.2
London Harlington	04-Feb	PM10	176440311	12330	0.35	1.0	3.02	2.2	16.64	2.2
		PM2.5	166920202	12774	-0.24	1.0	2.93	2.2	15.92	2.2
London Harrow Stanmore	16-Feb	PM2.5	200660809	16234	-0.07	1.0	3.04	2.2	16.39	2.2
London Marylebone Road	27-Jan	PM10	177410401	13004	-1.39	1.0	3.14	2.2	16.88	2.2
		PM2.5	200450809	13087	2.14	1.0	3.17	2.2	16.85	2.2
		GR10	209439811						16.64	2.2
		GR2.5	21221						16.40	2.2
London N. Kensington	26-Jan	PM10	201780811	12762	0.71	1.0	2.89	2.2	16.33	2.2
		PM2.5	100070808	15926	0.88	1.0	3.18	2.2	16.75	2.2
		GR10	210159902						16.58	2.2
		GR2.5	210199902						16.66	2.2
London Teddington Bushy Park	17-Feb	PM2.5	194190705	13464	0.78	1.0	2.98	2.2	16.59	2.2
London Westminster	01-Feb	GR2.5	209399811						16.55	2.2
Lough Navar	16-Feb	PM10	133999604	13192	2.92	1.0	not	measured	16.31	2.2
Manchester Piccadilly	13-Jan	PM2.5	223089810	13976	-0.35	1.0	3.03	2.2	17.15	2.2
Middlesbrough	02-Feb	PM10	24325	14039	-0.66	1.0	2.90	2.2	16.08	2.2
		PM2.5	2000	15930	-0.50	1.0	2.88	2.2	15.81	2.2
Narberth	11-Jan	PM10	192470701	13896	0.18	1.0	2.90	2.2	16.01	2.2
Newcastle Centre	03-Feb	PM10	24448	13921	0.71	1.0	2.88	2.2	10.27	2.2
		PM2.5	24447	15068	1.56	1.0	2.91	2.2	14.96	2.2
Newport	15-Jan	PM10	150509906	13644	-2.45	1.0	2.99	2.2	16.48	2.2
		PM2.5	100010808	16426	-1.18	1.0	2.93	2.2	15.05	2.2

Northampton Kingsthorpe	15-Feb	GR10	210139902						16.56	2.2
Norwich Lakenfields	03-Feb	PM10	214959704	15586	-0.79	1.0	2.98	2.2	16.38	2.2
		PM2.5	273280810	15663	0.38	1.0	3.22	2.2	16.78	2.2
Nottingham Centre	22-Feb	PM10	201580811	15616	0.23	1.0	2.92	2.2	16.26	2.2
		PM2.5	177400401	12274	0.75	1.0	2.89	2.2	16.26	2.2
Oxford St Ebbes	05-Feb	PM10	200870809	14982	1.12	1.0	3.10	2.2	16.83	2.2
		PM2.5	200160808	17428	1.51	1.0	3.01	2.2	16.60	2.2
Plymouth Centre	06-Jan	PM10	201750811	12232	-0.37	1.0	3.02	2.2	16.34	2.2
		PM2.5	203960911	14255	-0.59	1.0	3.11	2.2	16.99	2.2
Port Talbot Margam	12-Jan	PM10	199830807	14039	0.74	1.0	3.01	2.2	15.98	2.2
		PM2.5	162510103	11766	0.89	1.0	2.90	2.2	16.35	2.2
		GR10	210389903						16.55	2.2
Portsmouth	23-Feb	PM10	204811102	16791	-0.85	1.0	3.18	2.2	17.11	2.2
		PM2.5	200270808	15607	-1.24	1.0	2.97	2.2	15.92	2.2
Preston	12-Jan	PM2.5	22881	12828	-0.97	1.0	2.91	2.2	15.26	2.2
Reading New Town	25-Feb	PM10		Instrument	turned	off	on	arrival		
		PM2.5		Instrument	turned	off	on	arrival		
Reading London Road	19-Feb	PM10	D1425						16.39	2.2
Rochester Stoke	09-Feb	PM10	200750809	14971	0.39	1.0	2.95	2.2	16.12	2.2
		PM2.5	200890810	16035	0.56	1.0	3.02	2.2	17.05	2.2
Salford Eccles	12-Jan	PM10	211979604	13800	0.80	1.0	2.93	2.2	16.32	2.2
		PM2.5	272050807	14658	0.14	1.0	2.92	2.2	15.83	2.2
Saltash Callington Rd	06-Jan	PM10	168160208	14086	-0.39	1.0	3.14	2.2	16.90	2.2
		PM2.5	201520811	12549	-0.21	1.0	3.05	2.2	16.89	2.2
Sandy Roadside	01-Feb	PM10		analyser	away	for	repair			
		PM2.5	276321101	15996	-0.52	1.0	3.20	2.2	16.72	2.2
Scunthorpe Town	13-Jan	PM10	27366	12469	-2.50	1.0	3.08	2.2	16.87	2.2
Sheffield Devonshire Grn	27-Jan	PM10	25024	12190	-0.48	1.0	2.87	2.2	15.40	2.2
		PM2.5	27253	15825	1.20	1.0	2.84	2.2	15.25	2.2
Southampton Centre	22-Feb	PM10	172560302	14009	0.97	1.0	3.02	2.2	16.08	2.2
		PM2.5	200330808	16586	0.38	1.0	3.10	2.2	16.07	2.2
Southampton A33 Roadside	23-Dec	PM10	201220810	16317	0.8	1.0	3.05	2.2	15.41	2.2
Southend-on-Sea	11-Feb	PM2.5	177760401	12516	0.67	1.0	2.91	2.2	15.39	2.2
Southwark A2 Old Kent Road	02-Feb	PM10	192370612	14887	-1.57	1.0	3.05	2.2	16.87	2.2
Stanford-le-Hope Roadside	10-Feb	PM10	172880303	12890	1.76	1.0	3.19	2.2	16.54	2.2
		PM2.5	144209804	13356	2.40	1.0	3.01	2.2	16.40	2.2
Stockton onTees Eaglescliffe	01-Feb	PM10	h4554						16.30	2.2
		PM2.5	h4553						15.57	2.2
Stoke-on-Trent Centre	20-Jan	PM2.5	200570809	13528	0.19	1.0	2.90	2.2	15.86	2.2
Stoke-on-Trent A50 Roadside	22-Jan	PM10	177470401	12418	-0.67	1.0	3.02	2.2	17.16	2.2
Storrington Roadside	26-Jan	PM10	200280808	15680	0.01	1.0	3.13	2.2	16.52	2.2
		PM2.5	201760811	12944	1.55	1.0	3.21	2.2	16.63	2.2
Sunderland Silksworth	04-Feb	PM2.5	27247	14179	-0.64	1.0	2.98	2.2	15.73	2.2
Swansea Roadside	12-Jan	PM10	M9306						16.11	2.2
		PM2.5	M9305						16.40	2.2
Thurrock	10-Feb	PM10	201270810	14102	0.38	1.0	2.96	2.2	15.91	2.2
Warrington	18-Jan	PM10	213040808	11985	-0.14	1.0	2.96	2.2	15.86	2.2
		PM2.5	272690809	16275	-0.51	1.0	2.96	2.2	15.85	2.2
Wigan Centre	14-Jan	PM2.5	272910809	14811	-0.35	1.0	3.05	2.2	16.07	2.2

Wirral Tranmere	19-Jan	PM2.5	228830001	13297	0.03	1.0	3.02	2.2	16.46	2.2
Wrexham	21-Jan	GR10	212240001						16.51	2.2
		GR2.5	210119902						17.04	2.2
York Bootham	14-Jan	PM10	21877	14583	-1.04	1.0	2.97	2.2	15.63	2.2
		PM2.5	27209	16148	-0.82	1.0	2.14	2.2	14.59	2.2
York Fishergate	15-Jan	PM10	27232	15925	1.45	1.0	2.86	2.2	16.31	2.2
		PM2.5	27348	17995	-1.35	1.0	2.89	2.2	16.03	2.2

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

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

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

Concentration = (output – zero response) x Calibration factor

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

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

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

CERTIFICATE OF CALIBRATION

0401

Ricardo Energy & Environment, The Gemini Building, Fermi Avenue, Harwell, Didcot, Oxfordshire OX11 0QR
Telephone 01235 753212

Certificate Number: 03705

Authorised Signatories: S Eaton
B Stacey

Signed:

Date of issue: 02 June 2017

Customer Name and Address: Jo Scully, Environment Agency, Lutra House, Dodd Way, Off Seedlee Road, Walton Summit, Bamber Bridge, Preston, Lancs, PR5 8BX

Date of Calibration: January to March 2017

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

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

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

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CERTIFICATE OF CALIBRATION

1. Carbon Monoxide

Site	Date Year = 2017	Analyser number	[1]Zero output	Uncertainty (ppm)	[2]Calibration Factor	Uncertainty (%)	*Maximum Residual (%)
Belfast Centre	23-Aug	462	0.30	0.20	0.9970	2.2	1.0
Cardiff Centre	13-Jul	1502	0.20	0.20	0.9885	2.2	4.8
Edinburgh St Leonards	09-Aug	159	0.80	0.20	0.9406	2.2	0.8
Leeds Centre	11-Jul	458	0.50	0.20	0.9970	2.2	2.6
London Marylebone Road	27-Jul	651	-1.40	0.20	1.0286	2.2	1.7
London N. Kensington	26-Jul	2313	0.10	0.20	0.9889	2.1	1.2
Port Talbot Margam	12-Jul	605214618	1.30	0.20	0.9885	2.2	0.7

2. Sulphur Dioxide

Site	Date Year =2017	Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	*Max Residual (%)	*m-xylene interference (ppb)
Ballymena Ballykeel	06-Feb	4901234	-1.0	2.8	0.9786	3.2	0.7	3.5
Barnsley Gawber	18-Jan		0.8	2.5	1.0183	2.9	0.5	-1.5
Belfast Centre	14-Feb	1766	0.7	2.6	1.1811	3.4	3.2	8.1
Birmingham Tyburn	17-Jan		4.3	2.4	0.7716	3.1	2.4	-0.2
Cardiff Centre	11-Jan	70	32.5	2.6	1.0788	3.0	0.7	16.3
Chilbolton	24-Jan	83	5.4	2.8	1.5011	5.1	4.2	28.1
Derry Rosemount	07-Feb	1697	30.6	2.7	1.4162	3.3	1.8	19.0
Edinburgh St Leonards	07-Feb	84	3.1	2.5	0.9947	3.0	0.5	8.4
Grangemouth	31-Jan	1211322	0.0	2.5	0.9978	4.1	3.1	2.3
Hull Freetown	13-Jan	342	1.3	2.6	1.0926	3.5	3.8	4.2
Ladybower	17-Jan	1178	0.5	2.5	1.0391	3.1	1.8	15.1
Leeds Centre	10-Jan		0.6	2.7	1.2718	3.4	2.1	8.8
Liverpool Speke	17-Jan	1765	4.6	2.5	0.9866	3.1	0.6	13.3
London Bloomsbury	06-Feb	74	2.4	2.5	0.9464	4.7	10.3	19.9
London Marylebone Road	02-Feb	2644	0.0	2.6	1.1069	3.0	0.6	18.9
London N. Kensington	30-Jan	2576	4.4	2.6	1.0885	3.5	1.5	24.2
Lullington Heath	26-Jan	82	3.0	2.6	1.0553	3.2	1.4	18.6
Manchester Piccadilly	11-Jan		8.7	2.6	1.0167	3.1	0.7	4.9
Middlesbrough	01-Feb	345	-0.4	2.6	1.0833	3.2	2.7	4.8
Narberth	09-Jan	344	-0.4	2.5	1.0095	3.3	5.1	12.7
Nottingham Centre	20-Feb	1629	6.4	2.6	0.9715	3.4	1.6	9.4
Port Talbot Margam	10-Jan	605214617	-1.3	2.6	1.0251	3.1	2.3	7.3
Rochester Stoke	16-Feb	2800	-16.6	2.5	0.8262	3.1	0.7	not tested
Southampton Centre	26-Jan	343	-0.3	2.5	0.7507	4.6	4.9	19.4
Thurrock	08-Feb	189	0.4	2.5	1.0098	3.4	1.6	13.2
Wicken Fen	02-Feb	2624	2.3	2.5	0.8565	3.1	1.9	10.8
Wrexham	19-Jan		10.1	2.6	1.0454	3.0	0.2	10.3

CERTIFICATE OF CALIBRATION

3. Ozone

Site	Date Year =2017	Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	*Max Residual (%)
Aberdeen	27-Jan	800	0.4	3.0	0.9267	3.1	1.1
Aston Hill	14-Feb	144	-0.9	3.0	1.0150	3.1	1.0
Auchencorth Moss	08-Feb	1646	-0.1	3.0	1.0584	3.2	3.5
Barnsley Gawber	18-Jan		0.1	3.0	1.0282	3.1	0.5
Belfast Centre	14-Feb	8050074	0.1	3.0	0.9763	3.1	1.3
Birmingham Acocks Green	16-Jan	2435	-1.0	3.0	1.0391	3.1	0.7
Birmingham A4540 Roadside	17-Jan	2434	1.2	3.0	1.0267	3.5	0.8
Birmingham Tyburn	17-Jan		0.9	3.0	0.9624	3.1	0.5
Blackpool Marton	12-Jan	8060037	0.3	3.0	1.0288	3.1	0.8
Bournemouth	21-Feb	1650	0.8	3.0	1.0254	3.2	0.5
Brighton Preston Park	23-Jan	542	-2.3	3.0	1.0603	3.1	0.9
Bristol St Paul's	04-Jan	155	-0.8	3.0	1.0457	3.1	0.2
Bush Estate	08-Feb	1645	-0.1	3.0	1.0544	3.1	1.0
Canterbury	09-Feb	1642	0.1	3.0	0.9979	3.1	0.5
Cardiff Centre	11-Jan	168	-1.9	3.0	1.0426	3.1	0.3
Charlton Mackrell	16-Feb	1111957	0.0	3.0	1.0829	3.1	1.0
Chilbolton	24-Jan	1648	-1.2	3.0	1.0459	3.1	0.8
Coventry Allesley	13-Feb		0.1	3.0	1.0139	3.3	0.7
Cwmbran	12-Jan		-0.1	3.0	0.9618	3.2	0.7
Derry Rosemount	07-Feb	1586	2.5	3.0	1.0330	3.0	2.1
Edinburgh St Leonards	07-Feb	136	-2.1	3.0	1.1198	3.1	1.7
Eskdalemuir	10-Jan	158	-0.5	3.0	1.0548	3.1	0.9
Exeter Roadside	03-Jan		0.3	3.0	0.9496	3.3	0.9
Fort William	04-Jan	437	2.3	3.0	1.0181	3.1	4.3
Glasgow Townhead	16-Jan		0.7	3.0	1.0067	3.1	2.0
Glazebury	11-Jan	1274	2.3	3.0	1.0463	3.1	0.4
High Muffles	19-Jan	1641	-0.1	3.0	1.0167	3.1	0.2
Hull Freetown	13-Jan		-0.3	3.0	0.9792	3.0	0.5
Ladybower	17-Jan	1651	-7.4	3.0	1.0052	3.1	2.3
Leamington Spa	21-Feb	411770	1.0	3.0	1.0360	3.2	0.5
Leeds Centre	10-Jan		-0.1	3.0	1.0013	3.1	0.7
Leicester University	14-Feb		0.0	3.0	1.0661	3.3	0.6
Leominster	13-Feb	170	0.2	3.0	1.0661	3.1	0.4
Lerwick	25-Jan	2433	-0.5	3.0	0.9825	3.0	0.0
Liverpool Speke	17-Jan		-0.1	3.0	1.0216	3.3	0.2
London Bloomsbury	06-Feb	435	-0.6	3.0	1.0473	3.1	0.4
London Eltham	26-Jan		0.0	3.0	1.0674	3.1	2.3
London Haringey Priory Park South	16-Feb	1111953	1.0	3.0	0.9640	3.1	0.9
London Harlington	31-Jan	1109	1.3	3.0	0.9742	3.2	1.0
London Hillingdon	27-Jan		-0.1	3.0	1.0783	3.1	1.2
London Marylebone Road	02-Feb	2432	0.3	3.0	0.9847	3.2	1.4
London N. Kensington	30-Jan	2372	0.5	3.0	0.9977	3.1	0.6
Lough Navar	09-Feb	1640	0.2	3.0	1.0268	3.1	0.8
Lullington Heath	26-Jan	1644	-0.5	3.0	1.0521	3.1	0.8
Mace Head	08-Feb		0.3	3.0	0.9974	3.1	0.4
Manchester Piccadilly	11-Jan		0.0	3.0	1.0329	3.5	1.7
Manchester Sharston	11-Jan	1317	-0.9	3.0	1.0266	3.3	1.4
Market Harborough	15-Feb		-0.1	3.0	1.0110	3.2	0.9
Middlesbrough	01-Feb	2436	-1.8	3.0	1.1287	4.7	4.3
Narberth	09-Jan	824	-0.4	3.0	0.9874	3.2	0.7
Newcastle Centre	02-Feb	8060033	-0.5	3.0	1.0166	3.2	3.4

Site	Date Year =2017	Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	*Max Residual (%)
Northampton Kingsthorpe	13-Feb		-0.4	3.0	0.7932	3.1	1.1
Norwich Lakenfields	30-Jan		0.0	3.0	1.0306	3.1	0.3
Nottingham Centre	20-Feb		-0.1	3.0	1.0454	3.1	0.4
Peebles	07-Feb	2449	-1.4	3.0	1.0267	3.9	2.9
Plymouth Centre	04-Jan		-0.1	3.0	0.9819	3.1	0.9
Port Talbot Margam	10-Jan		0.0	3.0	0.9902	3.1	0.8
Portsmouth	22-Feb		0.0	3.0	1.0804	3.2	1.2
Preston	12-Jan	8060042	-0.4	3.0	1.0257	3.1	1.5
Reading New Town	06-Jan		-0.1	3.0	1.0303	3.5	1.3
Rochester Stoke	16-Feb	378	2.8	3.0	0.9741	3.3	0.7
Sheffield Devonshire Green	17-Jan		0.1	3.0	1.0554	3.1	1.0
Sibton	06-Feb	146	-0.7	3.0	1.0531	3.1	0.2
Southend-on-Sea	06-Feb	60017	0.2	3.0	1.0342	3.1	0.5
St Osyth	06-Feb	60035	-0.1	3.0	1.0093	3.1	0.3
Stoke-on-Trent Centre	18-Jan		-0.3	3.0	1.0757	3.3	1.4
Strath Vaich	24-Jan	176	0.1	3.0	1.0216	3.0	0.6
Sunderland Si ksworth	02-Feb		-0.7	3.0	1.0184	3.1	2.2
Thurrock	08-Feb	221	-0.5	3.0	0.9802	3.1	0.9
Walsall Woodlands	19-Jan	2431	3.8	3.0	1.0969	3.2	0.9
Weybourne	31-Jan		0.4	3.0	1.0533	3.1	0.4
Wicken Fen	02-Feb	165	-1.4	3.0	1.0196	3.1	0.7
Wigan Centre	12-Jan		-0.2	3.0	1.0494	3.4	0.5
Wirral Tranmere	18-Jan		0.1	3.0	1.0206	3.3	0.4
Yarner Wood	15-Feb	2473	0.7	3.0	1.0156	3.1	0.4

4. Oxides of Nitrogen

Site	Date Year =2017	Analyser number		[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	*Max residual (%)	*Converter efficiency (%)
Aberdeen	27-Jan	1011840	NOx	1	2.6	1.1138	3.5	0.4	101.9
			NO	-1	2.8	1.1168	3.5	1.4	
Aberdeen Union Street Roadside	27-Jan	299	NOx	1.9	2.6	1.1572	3.5	0.3	98.2
			NO	0.5	2.6	1.1670	3.5	0.4	
Aberdeen Wellington Road	27-Jan	2248	NOx	2.7	2.5	1.0261	3.5	4.4	100.0
			NO	-0.4	2.5	1.0305	3.5	4.0	
Armagh Roadside	09-Feb	1011845	NOx	4	2.8	1.1917	3.5	2.0	101.0
			NO	3	2.6	1.1769	3.5	2.6	
Aston Hill	14-Feb	2302	NOx	1.3	2.6	1.0560	3.5	1.4	99.3
			NO	0.4	2.6	1.0700	3.5	0.6	
Ballymena Ballykeel	06-Feb	1965	NOx	2	2.6	1.0200	3.5	1.7	99.6
			NO	-0.3	2.5	1.0472	3.5	3.5	
Barnsley Gawber	18-Jan		NOx	-0.1	2.5	0.9160	3.5	0.7	100.3
			NO	-0.2	2.5	0.9229	3.5	0.4	
Bath Roadside	04-Jan	1953	NOx	2.6	2.6	1.0792	3.5	0.2	98.3
			NO	0	2.6	1.0793	3.5	0.4	
Belfast Centre	14-Feb	8060038	NOx	0.1	2.5	1.0179	3.5	2.0	100.4
			NO	0.1	2.5	1.0225	3.5	2.1	
Belfast Stockman's Lane	14-Feb	2159	NOx	0.7	2.6	1.2128	3.5	1.6	100.9
			NO	0	2.6	1.2079	3.5	1.5	
Billingham	01-Feb	574	NOx	2.8	2.6	1.2732	3.5	0.8	101.0
			NO	1.7	2.6	1.2712	3.5	0.8	

CERTIFICATE OF CALIBRATION

0401

Certificate Number: 03705

Site	Date Year =2017	Analyser number		[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	*Max residual (%)	*Converter efficiency (%)
Birmingham Acocks Green	16-Jan	3364	NOx	1.8	2.7	1.1283	3.5	2.7	99.2
			NO	0.7	2.6	1.1492	3.5	3.8	
Birmingham A4540 Roadside	17-Jan	68	NOx	1.1	2.6	1.0918	3.5	0.6	99.3
			NO	0.6	2.6	1.0605	3.5	0.5	
Birmingham Tyburn	17-Jan		NOx	-0.6	2.6	0.9458	3.5	0.8	99.7
			NO	-0.9	2.6	0.9864	3.5	1.0	
Birkenhead Borough Road	18-Jan	1950	NOx	2.4	2.6	1.1513	3.5	0.2	100.5
			NO	2	2.6	1.1406	3.5	0.2	
Blackburn Accrington Road	12-Jan	10118951	NOx	1	2.6	1.1650	4.1	2.1	100.4
			NO	0	2.6	1.1628	4.1	2.1	
Blackpool Marton	12-Jan	8050075	NOx	-0.5	2.6	1.2422	3.5	0.9	99.1
			NO	-0.6	2.6	1.2744	3.5	0.9	
Bournemouth	21-Feb	2214	NOx	1.7	Not	1.1149	Not		Not tested
			NO	0.3	Tested	1.1306	Tested		
Bradford Mayo Avenue	11-Jan	1011823	NOx	1	2.6	0.9218	3.5	0.1	97.4
			NO	-1	2.7	0.9143	3.5	0.4	
Brighton Preston Park	23-Jan	2222	NOx	-4.1	2.6	1.2796	3.5	2.5	96.3
			NO	-4.4	2.6	1.2769	3.5	2.7	
Bristol St Paul's	04-Jan	77	NOx	1.9	2.7	1.3721	3.5	0.3	98.2
			NO	0.8	2.7	1.3623	3.5	0.4	
Bury Whitefield Roadside	09-Jan	2625	NOx	2.6	2.6	1.1229	3.5	0.3	98.2
			NO	0.5	2.6	1.1144	3.5	0.9	
Bush Estate	08-Feb	2244	NOx	0.5	2.5	0.8913	3.5	0.7	99.0
			NO	0.3	2.5	0.9166	3.5	0.7	
Cambridge Roadside	06-Feb	1011843	NOx	4	2.9	1.1832	3.5	1.1	101.5
			NO	1	2.6	1.1602	3.5	0.2	
Camden Kerbside	14-Feb	1011846	NOx	5	3.6	1.1832	3.5	0.4	100.5
			NO	2	3.0	1.1693	3.5	1.0	
Cannock A5190 Roadside	20-Jan	1194	NOx	2.3	2.6	1.2955	3.5	1.0	99.9
			NO	1.7	2.7	1.2947	3.5	0.9	
Canterbury	09-Feb	2715	NOx	0.8	2.6	1.0466	3.5	0.3	98.9
			NO	0.4	2.5	1.0530	3.5	1.2	
Cardiff Centre	11-Jan	71	NOx	-2.1	3.3	1.9593	3.7	4.8	98.4
			NO	-0.1	3.0	1.9702	4.8	4.4	
Carlisle Roadside	11-Jan	1011849	NOx	2	2.5	1.0775	3.5	1.3	100.0
			NO	0	2.5	1.0703	3.5	1.2	
Charlton Mackrell	16-Feb	2120	NOx	-2.6	2.5	1.0680	3.5	0.3	96.3
			NO	0.3	2.6	1.0925	3.5	1.0	
Chatham Centre Roadside	09-Feb	3393	NOx	1	2.6	1.1437	3.5	0.7	99.0
			NO	0.2	2.6	1.1431	3.5	1.1	
Chepstow A48	13-Jan	1011828	NOx	2	2.8	1.0536	3.5	0.9	100.0
			NO	0	2.8	1.0394	3.5	1.0	
Chesterfield Loundsley Green	16-Jan	1011837	NOx	3	2.6	1.1141	3.5	0.8	99.0
			NO	-1	2.6	1.0933	3.9	1.9	
Chesterfield Roadside	16-Jan	1011835	NOx	1	2.5	1.0749	4.7	2.8	99.5
			NO	-1	2.5	1.0482	5.2	3.4	
Chilbolton	24-Jan	79	NOx	2.9	2.7	1.3796	3.5	0.6	96.7
			NO	0.7	2.7	1.3933	3.5	0.4	
Christchurch Barrack Road	21-Feb	1956	NOx	2.8	2.6	1.1404	3.5	0.8	100.2
			NO	1.1	2.6	1.1311	3.5	1.0	

Site	Date Year =2017	Analyser number		[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	*Max residual (%)	*Converter efficiency (%)
Coventry Allesley	13-Feb		NOx	2	2.6	1.1207	3.5	0.8	100.4
			NO	1.8	2.6	1.1019	3.5	0.8	
Cwmbran	12-Jan		NOx	0.1	2.6	0.9998	3.5	0.2	101.4
			NO	0	2.6	0.9903	3.5	0.6	
Derby St Alkmunds Way	22-Feb	2641	NOx	0.9	2.5	0.9996	3.5	1.1	99.6
			NO	0	2.5	0.9945	3.5	0.8	
Derry Rosemount	07-Feb	2130	NOx	2.2	2.6	1.1010	3.5	1.9	96.1
			NO	-0.1	2.6	1.0952	3.5	1.9	
Doncaster A630 Cleveland Street	19-Jan	1565	NOx	0.4	2.6	1.1815	3.5	0.9	99.1
			NO	0.6	2.6	1.1797	3.5	0.9	
Dumbarton Roadside	19-Jan	1011883	NOx	-1	2.5	1.0000	3.5	1.3	98.7
			NO	0	2.5	1.0022	3.5	1.7	
Dumfries	10-Jan	1160820015	NOx	-1.5	2.6	1.1074	3.5	0.7	100.7
			NO	-1.4	2.6	1.1108	3.5	1.3	
Eastbourne	24-Jan	3363	NOx	2.5	2.5	1.0534	3.5	1.0	98.0
			NO	0	2.5	1.0215	3.5	0.2	
Edinburgh St Leonards	07-Feb	73	NOx	0.2	2.5	0.9905	3.5	1.5	98.3
			NO	-0.1	2.5	0.9902	3.5	1.8	
Eskdalemuir	10-Jan	347	NOx	0.9	2.5	1.0266	3.5	0.9	100.0
			NO	0.8	2.5	1.0335	3.5	0.7	
Exeter Roadside	03-Jan		NOx	3.4	2.8	1.1409	3.5	0.6	99.1
			NO	4.1	3.1	1.1817	3.5	0.4	
Fort William	04-Jan	344	NOx	1.3	2.6	1.1350	3.5	0.2	98.5
			NO	1.4	2.6	1.1387	3.5	0.3	
Glasgow Kerbside	16-Jan		NOx	1.2	2.5	1.0070	3.5	0.5	100.7
			NO	0.7	2.5	1.0239	3.5	0.7	
Glasgow Townhead	16-Jan	1713	NOx	4	2.6	1.1068	3.5	1.7	98.2
			NO	3.9	2.6	1.1143	3.5	1.6	
Glasgow Great Western Road	17-Jan	1193	NOx	2.2	2.6	1.0880	3.5	1.3	100.4
			NO	1.6	2.6	1.1212	3.5	1.5	
Glasgow High Street	16-Jan	1567	NOx	2.1	2.6	1.1034	3.5	1.2	98.5
			NO	0.2	2.6	1.1039	3.5	1.3	
Glazebury	11-Jan	78	NOx	0.4	2.6	1.1757	3.5	0.3	99.2
			NO	0.3	2.6	1.1766	3.5	0.3	
Grangemouth	31-Jan	1011836	NOx	0.1	2.5	1.0410	3.5	3.1	98.0
			NO	-0.1	2.5	1.0574	3.5	3.7	
Grangemouth Moray	31-Jan	1011852	NOx	0.3	2.5	1.0680	3.5	0.4	99.2
			NO	0	2.6	1.0699	3.5	0.8	
Hafod-yr-ynys Roadside	12-Jan	2362	NOx	0.1	2.6	1.1695	3.5	0.4	98.7
			NO	-0.4	2.6	1.1587	3.5	1.9	
Haringey Roadside	16-Feb	1011827	NOx	5	2.8	1.1024	3.5	0.3	99.6
			NO	-2	3.4	1.0742	3.5	0.4	
High Muffles	19-Jan	1783	NOx	1.5	2.5	1.0380	3.5	1.1	100.0
			NO	1.1	2.5	1.0377	3.5	1.3	
Honiton	03-Jan	3392	NOx	3.9	2.7	1.4188	3.5	0.9	100.1
			NO	3.6	2.7	1.4037	3.5	0.5	
Horley	23-Jan	1401954	NOx	2.4	3.5	1.0859	3.8	4.7	100.5
			NO	-2.4	2.7	1.0284	3.8	5.2	
Hull Freetown	13-Jan		NOx	-0.2	2.5	0.9701	3.5	0.8	101.1
			NO	-0.1	2.5	0.9702	3.5	0.6	

CERTIFICATE OF CALIBRATION

Certificate Number: 03705

Site	Date Year =2017	Analyser number		[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	[*]Max residual (%)	[*]Converter efficiency (%)
Hull Holderness Road	12-Jan	1564	NOx	2.5	2.5	0.9756	3.5	0.6	98.8
			NO	0.3	2.5	0.9772	3.5	1.1	
Inverness	23-Jan	1489	NOx	1.4	2.6	1.0994	3.5	1.5	98.3
			NO	1.5	2.6	1.1084	3.5	0.8	
Ladybower	17-Jan	72	NOx	1.1	2.5	0.9523	3.5	0.3	99.1
			NO	0.9	2.5	0.9505	3.5	1.2	
Leamington Spa	21-Feb	1011842	NOx	2	2.8	1.5804	3.5	1.4	98.1
			NO	0	2.8	1.5377	3.5	1.3	
Leamington Spa Rugby Road	21-Feb	3365	NOx	0.8	2.8	1.1713	3.5	0.4	100.3
			NO	0.7	2.6	1.2538	3.5	0.6	
Leeds Centre	10-Jan		NOx	-0.7	2.8	1.5716	3.5	1.3	99.4
			NO	0.2	2.8	1.5839	3.5	1.7	
Leeds Headingley Kerbside	11-Jan	342	NOx	2.1	2.7	1.2045	3.5	0.5	97.0
			NO	1.1	2.6	1.2243	3.5	0.8	
Leicester University	14-Feb		NOx	0.2	2.5	1.0586	3.5	0.2	100.0
			NO	0.1	2.5	1.0514	3.5	0.3	
Leicester A594 Roadside	14-Feb	1570	NOx	2	2.8	1.2024	3.5	0.3	99.4
			NO	-0.3	2.6	1.2193	3.5	1.6	
Leominster	13-Feb	346	NOx	0.9	2.5	1.0675	3.5	1.1	99.2
			NO	-0.4	2.6	1.0658	3.5	1.7	
Lincoln Canwick Road	23-Feb	3394	NOx	4.4	2.7	1.1792	3.5	0.6	95.5
			NO	3.9	2.6	1.1668	3.5	0.5	
Liverpool Speke	17-Jan		NOx	0.3	2.6	1.2341	3.5	1.1	100.5
			NO	0.5	2.6	1.2200	3.5	1.4	
London Bexley	08-Feb	327	NOx	2	2.6	1.0313	3.5	0.5	89.3
			NO	1.4	2.6	1.0298	3.5	0.2	
London Bloomsbury	06-Feb	74	NOx	1.7	2.9	0.9760	3.5	2.0	99.1
			NO	0.8	2.5	0.9673	3.5	1.9	
London Eltham	26-Jan		NOx	3	2.8	1.1375	3.5	0.6	98.3
			NO	0	2.8	1.1160	3.5	0.9	
London Haringey Priory Park South	16-Feb	1084	NOx	4.5	2.8	1.2111	3.5	1.2	95.0
			NO	0.9	2.6	1.1859	3.5	0.9	
London Harlington	31-Jan	1249	NOx	5.1	2.5	0.9511	3.5	0.3	99.6
			NO	2.4	2.5	0.9385	3.5	0.9	
London Hillingdon	27-Jan		NOx	-0.3	2.5	0.9205	3.5	0.5	99.0
			NO	-0.2	2.5	0.9202	3.5	0.4	
London Marylebone Road	02-Feb	3366	NOx	2.6	2.8	1.0450	3.5	0.6	98.7
			NO	-0.3	2.5	1.0470	3.5	0.1	
London N. Kensington	30-Jan	3273	NOx	8.7	4.0	1.1369	3.5	0.0	98.9
			NO	5.7	2.6	1.1311	3.5	0.6	
London Westminster	01-Feb	2643	NOx	2.1	2.5	0.9120	3.5	0.1	99.6
			NO	0.8	2.5	0.8514	3.5	0.3	
Lullington Heath	26-Jan	2579	NOx	-0.2	2.6	1.1517	3.5	1.1	98.0
			NO	0	2.6	1.1428	3.5	1.8	
Luton A505 Roadside	01-Feb	1563	NOx	2.5	2.7	1.2018	3.5	3.1	98.8
			NO	0.2	2.6	1.1897	3.8	2.4	
Manchester Piccadilly	11-Jan		NOx	-0.7	2.5	1.0540	3.5	1.1	99.1
			NO	-0.5	2.5	1.0623	3.5	0.9	
Manchester Sharston	11-Jan	2115	NOx	0.4	2.5	1.0082	3.5	0.2	99.6
			NO	0.2	2.5	0.9938	3.5	0.4	

CERTIFICATE OF CALIBRATION

Certificate Number: 03705

Site	Date Year =2017	Analyser number		[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	[*]Max residual (%)	[*]Converter efficiency (%)
Market Harborough	15-Feb		NOx	0.2	3.3	2.3381	3.5	0.2	100.5
			NO	0.2	3.3	2.3239	3.5	0.6	
Middlesbrough	01-Feb	2287	NOx	-6.4	2.5	1.0329	3.5	2.0	100.4
			NO	-0.5	2.5	1.0494	3.5	1.6	
Narberth	09-Jan	2577	NOx	-1.1	2.6	1.0770	3.5	3.4	97.3
			NO	0.1	2.6	1.0778	3.5	3.7	
Newcastle Centre	02-Feb	8050063	NOx	0.5	2.5	1.0189	3.6	2.3	100.0
			NO	0.4	2.5	1.0165	3.6	2.2	
Newcastle Cradlewell Roadside	02-Feb	1011853	NOx	1	2.5	1.0650	3.5	1.9	100.8
			NO	0	2.5	1.0554	3.5	1.7	
Newport	11-Jan	1011829	NOx	4	2.8	1.1590	3.5	2.2	99.1
			NO	-1	2.8	1.1425	3.5	2.3	
Northampton Kingsthorpe	13-Feb		NOx	5.9	3.0	1.6783	3.5	1.1	101.8
			NO	1.6	3.0	1.7472	3.5	0.8	
Norwich Lakenfields	30-Jan		NOx	1	2.5	0.9262	3.5	0.9	101.8
			NO	0.8	2.5	0.9254	3.5	1.0	
Nottingham Centre	20-Feb		NOx	-0.3	2.5	1.0578	3.5	1.5	100.0
			NO	-0.3	2.5	1.0508	3.5	2.1	
Nottingham Western Boulevard	22-Feb	1958	NOx	1.7	2.5	1.0180	3.5	0.3	100.0
			NO	0.6	2.5	1.0459	3.5	0.3	
Oldbury Birmingham Road	19-Jan		NOx	0.4	2.6	0.9850	3.5	0.8	94.3
			NO	0	2.6	0.9888	3.5	0.6	
Oxford Centre Roadside	09-Feb	1011844	NOx	4	3.1	1.5909	3.5	1.9	98.8
			NO	0	3.1	1.5640	3.5	2.0	
Oxford St Ebbes	09-Feb	1011830	NOx	1	2.8	1.1152	3.5	0.9	100.8
			NO	-2	2.8	1.0971	3.6	1.4	
Peebles	07-Feb	2213	NOx	0.4	2.5	1.0630	3.5	0.7	100.4
			NO	0.9	2.6	1.0930	3.5	0.6	
Plymouth Centre	04-Jan		NOx	-2.7	2.9	1.7725	3.5	0.6	100.0
			NO	-0.6	2.9	1.7823	3.5	0.5	
Plymouth Tavistock Road	06-Jan	1743	NOx	-3.6	2.6	1.0062	3.5	0.6	96.6
			NO	-3.1	2.5	1.0018	3.5	0.7	
Port Ta bot Margam	10-Jan	1426962867	NOx	-0.2	2.5	0.9996	3.5	0.4	101.3
			NO	0	2.5	0.9956	3.5	0.4	
Portsmouth	22-Feb		NOx	-0.8	2.5	0.9781	3.5	0.2	97.5
			NO	0.2	2.6	1.0058	3.5	0.2	
Preston	12-Jan	8050664	NOx	0.1	2.5	0.9747	3.5	0.3	99.3
			NO	0.1	2.5	0.9746	3.5	0.6	
Reading London Road	06-Jan		NOx	0	2.8	1.0343	3.9	0.2	100.4
			NO	0	2.6	1.0228	3.7	0.7	
Reading New Town	06-Jan		NOx	-2.4	2.5	0.8804	3.5	0.3	100.0
			NO	-0.7	2.5	0.9040	3.5	0.5	
Rochester Stoke	16-Feb	3095	NOx	-0.9	2.6	1.2163	3.5	1.2	97.1
			NO	1	2.6	1.2079	3.5	0.2	
Salford Eccles	10-Jan	1011831	NOx	3.1	2.7	1.1138	3.5	0.9	99.2
			NO	-0.7	2.6	1.0716	3.5	0.7	
Sandy Roadside	09-Feb	2585	NOx	1.1	2.6	1.1993	3.5	0.9	96.7
			NO	0.1	2.6	1.1948	3.5	0.4	
Scunthorpe Town	12-Jan	1011847	NOx	4	2.7	1.0088	3.5	0.9	95.4
			NO	1	2.6	1.0177	3.5	0.4	

CERTIFICATE OF CALIBRATION

Site	Date Year =2017	Analyser number		[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	*Max residual (%)	*Converter efficiency (%)
Shaw Crompton Way	10-Jan	733	NOx	-3.2	2.7	1.2842	3.5	0.6	98.4
			NO	1.2	2.7	1.3098	3.5	0.5	
Sheffield Barnsley Road	18-Jan	1962	NOx	2.4	2.6	1.0939	3.5	0.4	98.1
			NO	1.7	2.6	1.0840	3.5	0.7	
Sheffield Devonshire Green	17-Jan		NOx	-0.1	2.6	1.1501	3.5	0.9	101.2
			NO	-0.3	2.6	1.2080	3.5	0.8	
Sheffield Tinsley	17-Jan	1011841	NOx	1	2.5	1.0223	3.5	0.4	100.0
			NO	0	2.5	1.0111	5.1	3.4	
Southampton Centre	26-Jan		NOx	-2.1	2.5	0.8775	3.5	1.8	98.1
			NO	-1	2.5	0.8635	3.5	1.0	
Southampton A33 Roadside	20-Feb	1566	NOx	2.5	2.6	1.0917	3.5	1.0	98.4
			NO	1.2	2.6	1.1073	3.5	1.5	
Southend-on-Sea	06-Feb	50071	NOx	0.6	2.5	0.9419	3.5	0.5	98.5
			NO	0.9	2.5	0.9382	3.5	0.3	
Southwark A2 Old Kent Road	25-Jan	1495	NOx	1.9	2.9	1.2611	3.5	0.6	98.1
			NO	0.7	2.6	1.2563	3.5	0.6	
St Helens Linkway	12-Jan	1966	NOx	3.4	2.6	1.1355	3.5	0.3	99.5
			NO	3.2	2.6	1.1300	3.5	0.5	
St Osyth	06-Feb	50073	NOx	1	2.5	1.0088	3.5	0.8	99.2
			NO	0.3	2.5	1.0051	3.5	1.1	
Stanford-le-Hope Roadside	08-Feb	191	NOx	-1	2.8	1.2853	3.5	0.6	98.8
			NO	0.4	2.7	1.2888	3.5	0.7	
Stockton-on-Tees Eaglescliffe	31-Jan	1	NOx	0.2	2.6	1.2722	3.8	2.5	100.0
			NO	0.3	2.6	1.2600	3.7	2.5	
Stockton on Tees A1035 Roadside	31-Jan	1210	NOx	0.8	2.6	1.0770	3.5	1.4	100.9
			NO	0.3	2.6	1.1348	3.5	1.1	
Stoke-on-Trent Centre	18-Jan		NOx	0.2	2.5	1.0162	3.5	1.4	100.0
			NO	0.2	2.5	1.0140	3.5	1.8	
Stoke on Trent A50 Roadside	18-Jan	1588	NOx	0.8	2.6	1.2538	3.5	0.8	100.6
			NO	0.1	2.6	1.2507	3.5	0.3	
Storrington Roadside	24-Jan		NOx	-1	2.5	0.9808	3.5	0.5	98.5
			NO	-0.8	2.5	0.9748	3.5	0.9	
Sunderland Wessington Way	01-Feb	2642	NOx	0.4	2.6	1.1261	3.5	2.5	100.9
			NO	0.3	2.6	1.1155	3.5	2.4	
Sunderland Silksworth	02-Feb	1011854	NOx	0	2.8	1.1034	3.5	0.9	100.4
			NO	0	2.5	1.0804	3.5	1.1	
Swansea Roadside	10-Jan	1229	NOx	2.9	2.6	1.0876	3.5	0.2	98.7
			NO	0	2.6	1.1217	3.5	0.5	
Thurrock	08-Feb	192	NOx	1.1	2.6	1.1503	3.5	1.9	99.8
			NO	0.6	2.6	1.1584	3.5	1.6	
Tower Hamlets Roadside	08-Feb	2613	NOx	-2.2	3.3	1.1502	3.5	0.3	99.2
			NO	-0.1	2.6	1.1417	3.5	1.4	
Walsall Woodlands	19-Jan	3391	NOx	-2	2.6	1.1783	3.5	0.5	99.4
			NO	-0.1	2.6	1.1989	3.5	0.4	
Warrington	16-Jan	1011826	NOx	0	3.1	1.0938	3.5	0.2	98.7
			NO	0	3.2	1.0892	3.5	0.1	
Wicken Fen	02-Feb	2223	NOx	-4.4	2.6	1.1623	3.5	0.8	98.0
			NO	-0.3	2.6	1.1684	3.5	1.0	
Widnes Milton Road	17-Jan	1569	NOx	2.5	2.5	1.0082	3.5	0.6	100.8
			NO	0.8	2.5	0.9923	3.5	1.1	

Site	Date Year =2017	Analyser number		[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	*Max residual (%)	*Converter efficiency (%)
Wigan Centre	12-Jan	1011832	NOx	3	2.8	1.0885	3.5	0.9	98.1
			NO	-1	2.7	1.0686	3.5	0.1	
Wirral Tranmere	18-Jan		NOx	-1	2.5	1.0000	3.5	0.3	100.0
			NO	0.1	2.5	0.9958	3.5	0.3	
Worthing A27 Roadside	27-Jan	1954	NOx	4.4	2.5	0.9014	3.5	0.4	99.3
			NO	4.6	2.5	0.8984	3.5	0.7	
Wrexham	19-Jan		NOx	2.8	2.6	1.0412	3.5	0.4	99.1
			NO	0.8	2.6	1.0420	3.5	0.4	
Yarner Wood	15-Feb	1784	NOx	0.3	2.8	1.4734	3.5	1.3	98.7
			NO	1.4	2.8	1.5315	3.7	2.2	
York Fishergate	06-Jan	1011848	NOx	3	2.6	1.1475	3.5	1.6	98.5
			NO	0	2.6	1.1312	5.2	3.4	

5. Particulates

Site	Date Year =2017		Analyser number	Calculated Spring Constant k_0	[4]k_0 accuracy (%)	Uncertainty (%)	[3]Measured Main Flow (l/min)	Uncertainty (%)	[3]Measured Total Flow (l/min)	Uncertainty (%)
Aberdeen	27-Jan	PM10		11684	0.99	1.0	3.01	2.2	16.19	2.2
		PM2.5		13523	0.50	1.0	3.02	2.2	16.02	2.2
Armagh Roadside	09-Feb	PM10		13922	2.58	1.0	2.95	2.2	16.26	2.2
Auchencorth Moss	08-Feb	PM10		13233	0.32	1.0	3.31	2.2	16.50	2.2
		PM2.5		14057	0.28	1.0	3.26	2.2	16.70	2.2
		GR10								2.2
		GR2.5								2.2
Barnstaple A39	06-Jan	PM10		17382	0.64	1.0	3.13	2.2	16.57	2.2
		PM2.5		14232	0.49	1.0	3.05	2.2	16.16	2.2
Belfast Centre	14-Feb	PM10	24423	14476	2.00	1.0	3.03	2.2	15.80	2.2
		PM2.5	26565	14053	-0.92	1.0	3.03	2.2	16.08	2.2
Belfast Stockman's Lane	14-Feb	PM10							15.44	2.2
Birmingham Acocks Green	16-Jan	PM2.5		15769	0.16	1.0	3.08	2.2	16.80	2.2
Birmingham A4540 Roadside	17-Jan	PM10		12142	-0.64	1.0	3.06	2.2	16.32	2.2
		PM2.5		12504	-2.28	1.0	3.07	2.2	16.53	2.2
Birmingham Tyburn	17-Jan	PM10		14803	-0.92	1.0	3.05	2.2	16.19	2.2
		PM2.5		13779	-0.22	1.0	3.01	2.2	16.64	2.2
Blackpool Marton	12-Jan	PM2.5		12684	1.19	1.0	2.99	2.2	16.73	2.2
Bournemouth	21-Feb	GR2.5							16.70	2.2
Brighton Preston Park	23-Jan	GR2.5							17.02	2.2
Bristol St Paul's	04-Jan	PM10		13358	1.36	1.0	3.08	2.2	16.43	2.2
		PM2.5		14894	-0.24	1.0	3.07	2.2	16.08	2.2
Bury Whitefield Roadside	09-Jan	PM10		15057	-0.05	1.0	3.09	2.2	16.74	2.2
Camden Kerbside	14-Feb	PM10		12026	0.31	1.0	3.08	2.2	16.76	2.2
		PM2.5		12944	1.48	1.0	3.05	2.2	16.36	2.2
Cardiff Centre	11-Jan	PM10		13872	-0.05	1.0	3.13	2.2	16.07	2.2
		PM2.5		10883	-1.02	1.0	3.09	2.2	16.56	2.2

Carlisle Roadside	11-Jan	PM10		14343	-1.01	1.0	3.07	2.2	16.52	2.2
		PM2.5		15323	1.01	1.0	3.03	2.2	16.05	2.2
Chatham Centre	09-Feb	PM10							16.68	2.2
Roadside		PM2.5							16.52	2.2
Chepstow A48	13-Jan	PM10		15592	1.32	1.0	2.98	2.2	16.21	2.2
		PM2.5		16831	2.09	1.0	2.95	2.2	16.96	2.2
Chesterfield	16-Jan	PM10		16765	2.71	1.0	2.93	2.2	16.30	2.2
Loundsley Green		PM2.5		15896	2.80	1.0	2.94	2.2	16.52	2.2
Chesterfield	16-Jan	PM10		11753	3.59	1.0	3.15	2.2	16.90	2.2
Roadside		PM2.5		11244	1.42	1.0	3.01	2.2	16.86	2.2
Chilbolton	24-Jan	PM10		11681	-1.77	1.0	2.96	2.2	15.90	2.2
		PM2.5		12504	0.90	1.0	3.10	2.2	16.41	2.2
Coventry Allesley	13-Feb	PM2.5		14786	-1.21	1.0	3.07	2.2	17.08	2.2
Derry Rosemount	07-Feb	PM10		16508	4.43	1.0	2.84	2.2	15.41	2.2
		PM2.5		11140	2.30	1.0	2.89	2.2	15.01	2.2
Ealing Horn Lane	01-Feb	PM10		15418	1.01	1.0	3.09	2.2	16.04	2.2
Eastbourne	24-Jan	PM10		Analyser	not	tested				
		PM2.5		11395	-1.81	1.0	3.06	2.2	16.71	2.2
Edinburgh St	07-Feb	PM10		13902	1.54	1.0	2.96	2.2	15.73	2.2
Leonards		PM2.5		17385	2.20	1.0	2.85	2.2	15.98	2.2
Glasgow	16-Jan	PM10		13544	1.62	1.0	3.06	2.2	15.71	2.2
Townhead		PM2.5		13455	2.37	1.0	3.08	2.2	16.02	2.2
Glasgow High	16-Jan	PM10		14862	1.92	1.0	3.06	2.2	15.88	2.2
Street		PM2.5		15473	2.34	1.0	3.03	2.2	15.95	2.2
Grangemouth	31-Jan	PM10		16272	2.23	1.0	3.02	2.2	16.28	2.2
		PM2.5		14024	1.91	1.0	3.00	2.2	15.21	2.2
Hull Freetown	13-Jan	PM2.5		14415	1.57	1.0	2.95	2.2	14.76	2.2
Hull Holderness Road	12-Jan	PM10		18214	2.18	1.0	3.00	2.2	16.36	2.2
Inverness	23-Jan	GR10	21255						16.23	2.2
		GR2.5	21861						16.42	2.2
Leamington Spa	21-Feb	PM10		15023	0.18	1.0	2.87	2.2	15.45	2.2
		PM2.5		14267	0.61	1.0	3.11	2.2	16.37	2.2
Leamington Spa	21-Feb	PM10		14122	0.54	1.0	3.04	2.2	16.49	2.2
Rugby Road		PM2.5		15974	-0.38	1.0	3.05	2.2	16.32	2.2
Leeds Centre	10-Jan	PM10		13761	2.73	1.0	2.95	2.2	15.94	2.2
		PM2.5		17374	1.96	1.0	2.97	2.2	15.27	2.2
Leeds Headingley	11-Jan	PM10		17959	2.13	1.0	2.95	2.2	15.47	2.2
Kerbside		PM2.5		14957	1.73	1.0	3.01	2.2	15.93	2.2
Leicester University	14-Feb	PM2.5		14888	-0.51	1.0	3.00	2.2	15.25	2.2
Leicester A594 Roadside	14-Feb	PM10		12524	-0.22	1.0	3.04	2.2	16.35	2.2
Liverpool Speke	17-Jan	PM10		15833	0.14	1.0	3.02	2.2	15.92	2.2
		PM2.5		14820	-0.59	1.0	2.97	2.2	16.09	2.2
London Bexley	08-Feb	PM2.5		11785	1.65	1.0	3.02	2.2	16.72	2.2
London	06-Feb	PM10		14706	-0.62	1.0	2.90	2.2	15.77	2.2
Bloomsbury		PM2.5		14846	0.57	1.0	3.05	2.2	16.19	2.2
London Eltham	26-Jan	PM2.5		14020	1.47	1.0	3.12	2.2	16.64	2.2
London Harlington	31-Jan	PM10	5989						4.42	2.2
		PM2.5								2.2
London Harrow Stanmore	13-Feb	PM2.5		16082	-1.00	1.0	3.01	2.2	16.29	2.2

London Marylebone Road	02-Feb	PM10 PM2.5 GR10 GR2.5		12959 13061	-1.73 1.94	1.0 1.0	2.97 2.98	2.2 2.2	16.24 16.26 16.72 16.30	2.2 2.2 2.2 2.2
London N. Kensington	30-Jan	PM10 PM2.5		12647 15847	-0.20 0.38	1.0 1.0	2.90 2.98	2.2 2.2	15.61 16.32	2.2 2.2
London Teddington Bushy Park	13-Feb	PM2.5		12420	1.67	1.0	3.01	2.2	16.33	2.2
London Westminster	01-Feb	GR2.5							16.68	2.2
Lough Navar	09-Feb	PM10		13398	4.53	1.0	3.04	2.2	16.50	2.2
Manchester Piccadilly	11-Jan	PM2.5							16.41	2.2
Middlesbrough	01-Feb	PM10 PM2.5	24325 2000	14177 16121	0.31 0.70	1.0 1.0	3.07 3.15	2.2 2.2	17.48 16.79	2.2 2.2
Narberth	09-Jan	PM10		13703	-1.22	1.0	2.97	2.2	16.09	2.2
Newcastle Centre	02-Feb	PM10 PM2.5	24448 24447	14013 15140	1.37 2.05	1.0 1.0	2.87 2.86	2.2 2.2	15.49 15.76	2.2 2.2
Newport	11-Jan	PM10 PM2.5		13761 16592	-1.61 -0.18	1.0 1.0	3.02 3.01	2.2 2.2	16.71 16.24	2.2 2.2
Northampton Kingsthorpe	13-Feb	GR10	39902						16.98	2.2
Norwich Lakenfields	30-Jan	PM10 PM2.5		15653 15717	-0.36 0.73	1.0 1.0	3.08 3.10	2.2 2.2	17.24 16.05	2.2 2.2
Nottingham Centre	20-Feb	PM10 PM2.5		15583 12181	0.01 -0.02	1.0 1.0	2.96 3.02	2.2 2.2	15.95 15.96	2.2 2.2
Nottingham Western Boulevard	22-Feb	PM10		14811	-0.15	1.0	2.99	2.2	16.70	2.2
Oxford St Ebbes	09-Feb	PM10 PM2.5		14911 17329	0.64 0.93	1.0 1.0	2.91 3.00	2.2 2.2	16.11 16.81	2.2 2.2
Plymouth Centre	04-Jan	PM10 PM2.5		12172 12812	-0.86 -0.96	1.0 1.0	3.09 3.02	2.2 2.2	16.31 15.94	2.2 2.2
Port Talbot Margam	10-Jan	PM10 PM2.5 GR10		14002 11691	0.47 0.25	1.0 1.0	3.04 3.00	2.2 2.2	16.56 17.62 16.69	2.2 2.2 2.2
Portsmouth	22-Feb	PM10 PM2.5		16895 15691	-0.24 -0.71	1.0 1.0	2.84 3.09	2.2 2.2	16.69 16.49	2.2 2.2
Preston	12-Jan	PM2.5		13014	0.46	1.0	2.94	2.2	16.37	2.2
Reading London Rd	06-Jan	PM10							9.70	2.2
Reading New Town	06-Jan	PM10 PM2.5		13417 14142	1.65 0.04	1.0 1.0	3.09 2.98	2.2 2.2	16.70 15.71	2.2 2.2
Rochester Stoke	16-Feb	PM10 PM2.5		14834 15959	-0.53 0.09	1.0 1.0	3.08 3.08	2.2 2.2	16.75 16.56	2.2 2.2
Salford Eccles	10-Jan	PM10 PM2.5		13680 14609	-0.08 -0.19	1.0 1.0	3.13 2.96	2.2 2.2	16.76 16.17	2.2 2.2
Saltash Callington Road	05-Jan	PM10 PM2.5		14360 12608	-2.30 0.33	1.0 1.0	3.03 3.02	2.2 2.2	16.35 16.49	2.2 2.2
Sandy Roadside	09-Feb	PM10 PM2.5		13672 15985	-0.94 -0.58	1.0 1.0	3.06 2.97	2.2 2.2	16.58 16.23	2.2 2.2
Scunthorpe Town	12-Jan	PM10		12823	0.27	1.0	3.10	2.2	16.28	2.2
Sheffield Devonshire Green	17-Jan	PM10 PM2.5		12588 16235	2.77 3.82	1.0 1.0	2.99 3.02	2.2 2.2	16.30 17.00	2.2 2.2
Southampton Centre	26-Jan	PM10 PM2.5		13945 analyser	0.52 not	1.0 tested	3.00	2.2	16.80	2.2

Southampton A33 Roadside	20-Feb	PM10		8421	-2.05	1.0	3.05	2.2	14.59	2.2
Southend-on-Sea	06-Feb	PM2.5		12662	1.84	1.0	2.98	2.2	15.71	2.2
Southwark A2 Old Kent Road	25-Jan	PM10		14996	-0.85	1.0	2.89	2.2	16.53	2.2
St Helens Linkway	02-Mar	PM10	27238	14826	2.22	1.0	3.03	2.2	15.37	2.2
Stanford-le-Hope Roadside	08-Feb	PM10		12989	2.54	1.0	3.07	2.2	16.82	2.2
		PM2.5		13569	4.04	1.0	2.99	2.2	16.45	2.2
Stockton-on-Tees Eaglescliffe	31-Jan	PM10							15.64	2.2
		PM2.5							16.82	2.2
Stockton on Tees A1035 Roadside	31-Jan	PM2.5	27278	13969	1.23	1.0	3.04	2.2	16.48	2.2
Stoke-on-Trent Centre	18-Jan	PM2.5		13449	-0.39	1.0	2.98	2.2	16.23	2.2
Stoke on Trent A50 Roadside	18-Jan	PM10		12455	-0.38	1.0	3.06	2.2	16.78	2.2
Storrington Roadside	24-Jan	PM10		15908	1.46	1.0	2.97	2.2	16.24	2.2
		PM2.5		12951	1.61	1.0	3.05	2.2	16.37	2.2
Sunderland Silksworth	02-Feb	PM2.5	27247	14534	1.85	1.0	2.99	2.2	16.13	2.2
Swansea Roadside	10-Jan	PM10							15.49	2.2
		PM2.5							16.71	2.2
Thurrock	08-Feb	PM10		14289	1.71	1.0	2.93	2.2	15.88	2.2
Warrington	16-Jan	PM10		12024	0.18	1.0	3.08	2.2	16.43	2.2
		PM2.5		16330	-0.17	1.0	3.09	2.2	16.34	2.2
Wigan Centre	12-Jan	PM2.5		14775	-0.60	1.0	3.07	2.2	16.54	2.2
Wirral Tranmere	18-Jan	PM2.5		13331	0.28	1.0	3.02	2.2	16.62	2.2
Wrexham	19-Jan	GR10							16.65	2.2
		GR2.5							16.65	2.2
York Bootham	06-Jan	PM10		15097	2.44	1.0	3.07	2.2	16.06	2.2
		PM2.5		16518	1.45	1.0	3.09	2.2	16.03	2.2
York Fishergate	06-Jan	PM10		16109	2.62	1.0	3.14	2.2	16.48	2.2
		PM2.5		18567	1.78	1.0	3.11	2.2	16.66	2.2

CERTIFICATE OF CALIBRATION

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.

Cert No	Site	Date of audit	Parameter	Measurement	Result	Third Party Auditor Comments
3753	Union St	27/1/17	PM_{10}	Total flow	-10.4%	Borderline Fail (+/- 10%). Data checked during ratification process and no effect on data identified. No action carried out in terms of data.
3744	King St	18/7/16	PM_{10}	Total flow	21.5%	Data checked during the ratification process and found not to be effected. No action carried out on data for this period.
2765	Wellington Rd	4/2/13	NOx	No data	No data	The NOx analyser became very unstable when auditor introduced higher concentration gas. Engineer call out was advised. No audit results obtained due to fault. Data was removed from 4/2 to 5/2 due to multiple faults. No data from 15/2 to 1/3 due to analyser repair
3306	Anderson Dr	20/1/16	NOx	Conversion	88% efficiency	NOx convertor failed at 88%- engineer investigate. Data nulled between 19/1 – 31/1 (engineers service) due to multiple faults. Data prior to 19th was viewed to be accurate after technical review.
3306	Market St	14/10/15 & 19/1/16	PM_{10}	Total flow	>10%	FIDAS- Stated flow 4.8, measured 4. Flow out by 15% ESU to investigate at service. Data checked during ratification period. No evidence to suggest flow fault found was affecting data. Data left in.
3089	Anderson Dr	14/8/14	PM_{10}	Main flow	-49.3%	PM10 Main flow found to be out by over 50% when taken from inlet. PM10 main flow check taken inside Main found to be 2.957lpm. Repeated main flow test from inlet and found flow to be 2.56lpm suggesting possible leak or internal sampling. Engineer to check connections. No evidence of data being affected by flow fault found at audit. Data left in.