CERTIFICATE OF CALIBRATION

Ricardo Energy & Environment, 18 Blythswood Square, Glasgow, G2 4BG

Telephone 01235 753642

0401

Authorised Signatories: D Hector
S Stratton✓

Signed: Date of Issue: 28th July 2017

Certificate Number: 3765

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 North Lanarkshire Council's Chapelhall, Croy, Coatbridge Whifflet, Kirkshaws, Moodiesburn, Motherwell and Shawhead Coatbrige air monitoring station's.

Site / Date Test Carried Out	Species	Analyser Serial No.	Zero Response [1]	Uncertainties ppb	Calibration Factor[2]	Uncertainties %	Converter eff. (%)[3]
Chapelhall 8th September 2016	NO_x	AT4DAK5Y	-0.3	2.5	1.0465	3.5	100.8
	NO		-0.4	2.5	1.0603	3.5	
Croy 9th September 2016	NO_x	AYKTCJU8	-1.4	2.5	0.9851	3.5	98.9
	NO		0.7	2.5	1.0140	3.5	
	SO_2	5776290409	1.1	2.6	1.1534	3.2	
	O_3	OO4003	0.4	0.4	1.0231	5.0	
Kirkshaws 8th September 2016	NO_x	HUK1502 0066	0.6	2.7	1.3731	3.5	101.1
	NO		0.7	2.7	1.3925	3.5	
Moodiesburn 8th September 2016	NO_x	7NLHD0L8	-0.2	2.5	1.0697	3.5	99.6
	NO		-0.3	2.6	1.1908	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.

Ricardo Energy & Environment

Head Office
Gemini Building,
Fermi Avenue,
Harwell,
Oxon
OX11 0QR

Tel: +44 (0)1235 753 000

Registered office

Shoreham Technical Centre
Shoreham-by-Sea
West Sussex
BN43 5FG

Registered in England No.
08229264

VAT Registration No.
GB 212 8365 24

Site / Date Test Carried Out	Species	Analyser Serial No.	Zero Response [1]	Uncertainties ppb	Calibration Factor[2]	Uncertainties %	Converter eff. (%)[3]
Shawhead Coatbridge 9th September 2016	NO_x	7NHSKHBC	-2.2	2.5	1.0016	3.7	100.4
	NO		-1.7	2.5	1.0132	3.7	

Site / Date Test Carried Out	Species	Analyser Serial No.	Parameter	Specified Value	Measured Value	Deviation %	Uncertainty %
Chapelhall 8th September 2016	TEOM PM_{10}	140AB215 579705	Main Flow[4]	3.00	2.90	-3.3	2.25
			Aux Flow[4]	13.67			
			Total Flow	16.67	16.20	-2.8	2.25
			k_0[5]	10372	10500	1.2	1.00
Croy 9th September 2016	TEOM PM_{10}	140AB217 699710	Main Flow[4]	3.00	2.88	-3.9	2.25
			Aux Flow[4]	13.67			
			Total Flow	16.67	16.72	0.3	2.25
			k_0[5]	14864	15080	1.5	1.00
Coatbridge Whifflet 9th September 2016	TEOM PM_{10}	25385	Main Flow[4]	3.00	3.10	3.3	2.25
			Aux Flow[4]	13.67			
			Total Flow	16.67	17.20	3.2	2.25
			k_0[5]	12763	13313	4.3	1.00
Motherwell 9th September 2016	TEOM PM_{10}	24903	Main Flow[4]	3.00	3.15	4.9	2.25
			Aux Flow[4]	13.67	15.25	11.6	2.25
			Total Flow	16.67	18.40	10.4	2.25
			k_0[5]	12919	13277	2.8	1.00

Site / Date Test Carried Out	Species	Analyser Serial No.	Parameter	Specified Value	Measured Value	Deviation %	Uncertainty %
Kirkshaws 8th September 2016	BAM PM_{10}	P15543	Total Flow[4]	16.67	16.94	1.6	2.25
Moodiesburn 8th September 2016	BAM PM_{10}	H4552	Total Flow[4]	16.67	15.82	-5.1	2.25
Shawhead Coatbridge 9th September 2016	BAM PM_{10}	J2657	Total Flow[4]	16.67	16.49	-1.1	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.

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.