



0401

## CERTIFICATE OF CALIBRATION

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Approved Signatories:

- |                                   |  |
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| <input type="checkbox"/> B Davies | <input type="checkbox"/> S Gray              |

Signed:

Date of issue:

27 May 20

Certificate Number:

4982

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 the air monitoring station(s) at  
Glasgow City Council

Ricardo Energy & Environment ID:

ED11194 / 4982

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.

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Date of issue: 27 May 20  
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Glasgow City Council  
 NOx analysers

Station	Date of Audit	Species	Analyser Serial no	Zero Response <sup>1</sup>	Zero uncertainty ppb	Calibration Factor <sup>2</sup>	Factor uncertainty %	Converter eff. (%) <sup>3</sup>
Glasgow Anderston	11-Dec	NOx	18-0383	0.9	2.5	0.9118	3.50	100.0
		NO		0.2	2.5	0.9035	3.50	
Glasgow Burgher St	16-Dec	NOx	cm11050006	-0.6	2.5	0.9617	3.74	100.0
		NO		-0.2	2.5	0.9685	3.62	
Glasgow Byres Road	12-Dec	NOx	4156	1.3	2.6	1.0459	3.50	98.0
		NO		1.5	2.5	0.9979	3.50	
Glasgow Dumbarton Road	12-Dec	NOx	4154	1.6	2.5	1.0011	3.50	98.9
		NO		2.4	2.5	1.0137	3.50	
Glasgow Nithsdale Road	11-Dec	NOx	1152030001	1.0	2.5	1.0309	3.5	99.3
		NO		0.0	2.5	1.0355	3.5	
Glasgow Waulkmillglen Reservoir	11-Dec	NOx	4155	-2.1	2.5	0.9251	3.50	100.3
		NO		-0.1	2.5	0.9385	3.50	

PM10 analysers

Station	Date of audit	Analyser Serial no	Calculated ko	Uncertainty %	Total flow	Uncertainty %	Main flow	Uncertainty %
Glasgow Broomhill	12-Dec	10106			4.37	2.2		2.2
Glasgow Burgher St	16-Dec	1200c149419903	16332	1.0	15.80	2.2	2.77	2.2
Glasgow Byres Road	12-Dec	8734			4.58	2.2		2.2
Glasgow Dumbarton Road	12-Dec	8736			4.67	2.2		2.2
Glasgow Nithsdale Road	11-Dec	6249			4.59	2.2		2.2
Glasgow Waulkmillglen Reservoir	11-Dec	8735			4.50	2.2		2.2

PM2.5 analysers

Station	Date of audit	Analyser Serial no	Calculated ko	Uncertainty %	Total flow	Uncertainty %	Main flow	Uncertainty %
Glasgow Broomhill	12-Dec	10106			4.37	2.2		2.2
Glasgow Byres Road	12-Dec	8734			4.58	2.2		2.2
Glasgow Dumbarton Road	12-Dec	8736			4.67	2.2		2.2
Glasgow Nithsdale Road	11-Dec	6249			4.59	2.2		2.2
Glasgow Waulkmillglen Reservoir	11-Dec	8735			4.50	2.2		2.2

O3 analysers

Station	Date of Audit	Analyser Serial no	Zero Response <sup>1</sup>	Zero uncertainty ppb	Calibration Factor <sup>2</sup>	Factor uncertainty %
Glasgow Waulkmillglen Reservoir	11-Oct	3787	-1.6	3.0	1.0166	3.0
Glasgow Waulkmillglen Reservoir	11-Dec	3787	-0.4	3.0	0.9998	3.1



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The gaseous ambient analysers listed above have been tested for zero response, calibration factor, linearity and converter efficiency (NO<sub>x</sub> analysers) 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.

<sup>1</sup> 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.

<sup>2</sup> 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<sub>x</sub>, SO<sub>2</sub>, O<sub>3</sub> and ppm for CO. Where 1 ppm = 1000ppb). 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

<sup>3</sup> Converter eff. is the measured efficiency of the NO<sub>2</sub> to NO converter within the oxides of nitrogen analyser under test.

<sup>4</sup> The measured main flow rate (where this is applicable) is the flow rate through the sensor unit 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<sup>-1</sup>, reported at prevailing ambient conditions unless otherwise specified. 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.

<sup>5</sup> The calculated  $k_0$  value (specifically for TEOM analysers) 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 value of  $k_0$ .

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.