



0401

# CERTIFICATE OF CALIBRATION

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

Telephone 01235 753642

Authorised Signatories:

D Hector ✓  
S Stratton

Signed: 

Date of Issue: 18<sup>th</sup> July 2017

Certificate Number: 3756

Page 1 of 2

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 East Dunbartonshire's Bearsden, Bishopbriggs, Kirkintilloch and Milngavie air monitoring stations.

Site / Date Test Carried Out	Species	Analyser Serial No.	Zero Response <sup>1</sup>	Uncertainties ppb	Calibration Factor <sup>2</sup>	Uncertainties %	Converter eff. (%) <sup>3</sup>
Bearsden 21 <sup>st</sup> February 2017	NO <sub>x</sub>	502004	-5.4	2.7	0.9950	3.5	98.0
	NO		-2.7	2.7	1.0117	3.5	
Bishopbriggs 20 <sup>th</sup> February 2017	NO <sub>x</sub>	8906170202	-0.1	2.5	1.0020	3.5	101.1
	NO		-0.2	2.5	1.0150	3.5	
Kirkintilloch 21 <sup>st</sup> February 2017	NO <sub>x</sub>	7010003	-0.1	2.5	0.9976	3.5	100.8
	NO		-0.1	2.5	0.9976	3.5	
Milngavie 21 <sup>st</sup> February 2017	NO <sub>x</sub>	CM1002 0066	-3.7	2.5	1.0606	3.5	96.1
	NO		-0.9	2.5	0.9894	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 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. Ricardo Energy & Environment is a trading name of Ricardo-AEA Ltd.*

**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.	Parameter	Specified Value	Measured Value	Deviation %	Uncertainty %
Kirkintilloch 21 <sup>st</sup> February 2017	FDMS PM <sub>10</sub>	26488	Main Flow <sup>4</sup>	3.00	3.12	4.1	2.25
			Aux Flow <sup>4</sup>	13.67			
			Total Flow	16.67	16.47	-1.2	2.25
			k <sub>0</sub> <sup>5</sup>	15453	15625	1.1	1.00

Milngavie 21 <sup>st</sup> February 2017	FDMS PM <sub>10</sub>	27585	Main Flow <sup>4</sup>	3.00	3.05	1.6	2.25
			Aux Flow <sup>4</sup>	13.67			
			Total Flow	16.67	16.28	-2.4	2.25
			k <sub>0</sub> <sup>5</sup>	15455	15447	-0.1	1.00

Site / Date Test Carried Out	Species	Analyser Serial No.	Parameter	Specified Value	Measured Value	Deviation %	uncertainty
Bearsden 21 <sup>st</sup> February 2017	Eberline PM10	953	Total Flow <sup>4</sup>	16.67	17.09	2.5	2.25

Bishopbriggs 20 <sup>th</sup> February 2017	Eberline PM10	834	Total Flow <sup>4</sup>	16.67	17.19	3.1	2.25
--	------------------	-----	-------------------------	-------	-------	-----	------

The gaseous ambient analysers listed above have been tested for zero response, calibration factor, linearity and converter efficiency (NO<sub>x</sub> 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<sub>0</sub> (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 = 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

<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 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<sup>-1</sup>. 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<sub>0</sub> value (TEOM analysers only) is the calculated k<sub>0</sub> 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<sub>0</sub> 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.