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# CERTIFICATE OF CALIBRATION

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Signed:



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Customer Name and Address:

Scottish Government  
Water, Air, Soils and Flooding Division  
Environmental Quality Directorate  
Scottish Government  
Victoria Quay  
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Description:

Calibration factors for Falkirk Council's Falkirk Banknock, Grangemouth MC, Grangemouth Moray, Falkirk Haggs, Falkirk Hope Street, Falkirk West Bridge Street and Grangemouth Zetland Park monitoring station's.

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>
Grangemouth Municipal Chambers 1 <sup>st</sup> August 2016	NO <sub>x</sub>	890617	1.4	2.6	0.9967	3.5	97.3
	NO	0204	0.1	2.6	1.0108	3.5	
	SO <sub>2</sub>	890414 0505	1.5	2.5	0.9712	3.6	
Grangemouth Moray 8 <sup>th</sup> August 2016	NO <sub>x</sub>	1011852	1.0	2.5	1.0245	3.5	98.4
	NO		-1.0	2.5	1.0268	3.5	
	SO <sub>2</sub>	570203014	1.0	2.5	0.8795	4.2	
Falkirk Haggs 1 <sup>st</sup> August 2016	NO <sub>x</sub>	1401925	0.0	2.7	0.9755	3.5	101.2
	NO		0.0	2.7	0.9734	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.	Zero Response <sub>1</sub>	Uncertainties ppb	Calibration Factor <sup>2</sup>	Uncertainties %	Converter eff. (%) <sup>3</sup>
Falkirk Hope Street 2 <sup>nd</sup> August 2016	NO <sub>x</sub>	890704	-0.5	2.5	1.0478	3.5	98.7
	NO	0214	0.8	2.6	1.0709	3.5	
	SO <sub>2</sub>	890617056	1.7	2.5	0.9545	3.00	
Falkirk West Bridge Street 1 <sup>st</sup> August 2016	NO <sub>x</sub>	1228	1.5	2.5	1.0510	3.5	98.6
	NO		0.5	2.5	1.0582	3.5	
Grangemouth Zetland Park 1 <sup>st</sup> August 2016	SO <sub>2</sub>	4080666 00209	6.0	2.5	0.8670	2.9	

Site / Date Test Carried Out	Species	Analyser Serial No.	Parameter	Specified Value	Measured Value	Deviation %	Uncertainty %
Grangemouth Municipal Chambers 1 <sup>st</sup> August 2016	TEOM PM <sub>10</sub>	22697	Main Flow <sup>4</sup>	3.00	3.00	0.0	2.25
			Aux Flow <sup>4</sup>	13.67			
			Total Flow	16.67	16.22	-2.7	2.25
			k <sub>0</sub> <sup>5</sup>	13841	13863	0.2	1.00

Falkirk Haggs 1 <sup>st</sup> August 2016	TEOM PM <sub>10</sub>	23170	Main Flow <sup>4</sup>	3.00	<b>3.16</b>	5.3	2.25
			Aux Flow <sup>4</sup>	13.67	<b>14.10</b>	3.2	2.25
			Total Flow	16.67	<b>17.26</b>	3.5	2.25
			k <sub>0</sub> <sup>5</sup>	13865	14569	5.1	1.00

Falkirk West Bridge Street 1 <sup>st</sup> August 2016	TEOM PM <sub>10</sub>	27493	Main Flow <sup>4</sup>	3.00	3.02	0.6	2.25
			Aux Flow <sup>4</sup>	13.67			
			Total Flow	16.67	15.43	-7.4	2.25
			k <sub>0</sub> <sup>5</sup>	13101	12874	-1.7	1.00

Site / Date Test Carried Out	Species	Analyser Serial No.	Parameter	Specified Value	Measured Value	Deviation %	Uncertainty %
Falkirk Banknock 1 <sup>st</sup> August 2016	FIDAS	6179	Total Flow <sup>4</sup>	4.8	4.7	-4.03	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:

$$\text{Concentration} = F (\text{Output} - \text{Zero Response})$$

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 within our scope of accreditation, all other results on this certificate are not UKAS accredited, but have been included for completeness.