



# CERTIFICATE OF CALIBRATION

Ricardo Energy and Environment, Gemini Building, Fermi Avenue Harwell,  
Didcot, Oxfordshire OX11 0QR. Telephone 01235 753692



Approved Signatories:

- |                                   |                                            |
|-----------------------------------|--------------------------------------------|
| <input type="checkbox"/> S. Eaton | <input type="checkbox"/> B Stacey          |
| <input type="checkbox"/> D Hector | <input type="checkbox"/> S Stratton        |
| <input type="checkbox"/> N Rand   | <input type="checkbox"/> S Telfer          |
| <input type="checkbox"/> B Davies | <input checked="" type="checkbox"/> S Gray |

Signed:

Date of issue:

09 May 19

Certificate Number:

4505

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  
Falkirk Council

Ricardo Energy & Environment ID:

ED61598/4505

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

**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



# CERTIFICATE OF CALIBRATION



Date of issue: 09 May 19  
 Certificate Number: 4505  
 Ricardo Energy & Environment ID: ED61598/4505

Falkirk Council  
 NOx analysers

Station	Date of Audit	Species	Analyser Serial no	Zero Response <sup>1</sup>	Zero uncertainty DOB	Calibration Factor <sup>2</sup>	Factor uncertainty %	Converter eff. (%) <sup>3</sup>
Falkirk Bainsford	06-Jul-18	NOx	809007	-0.4	2.5	0.9750	3.50	95.5
		NO		-1.8	2.5	0.9783	3.50	
Falkirk Grangemouth MC	03-Jul-18	NOx	8906170204	-1.6	2.5	1.0095	3.50	97.0
		NO		-0.6	2.5	1.0378	3.50	
Falkirk Hags	02-Jul-18	NOx	1401925	1.0	2.5	1.0160	3.50	97.5
		NO		1.0	2.5	1.0114	3.50	
Falkirk Hope Street	02-Jul-18	NOx	890704214	-0.2	2.5	0.9655	3.50	97.6
		NO		-0.1	2.5	0.9862	3.50	
Falkirk West Bridge Street	06-Jul-18	NOx	1228	2.6	2.5	1.0052	3.50	97.9
		NO		0.5	2.5	0.9840	3.50	
		NOx						
		NO						
		NOx						
		NO						

PM10 analysers

Station	Date of audit	Analyser Serial no	Calculated ko	Uncertainty %	Total flow	Uncertainty %	Main flow	Uncertainty %
Falkirk Bainsford	06-Jul-18	1200C167500401	15187	1.0	17.38	2.2	3.06	2.2
Falkirk Banknock	06-Jul-18	6179			4.76	2.2		2.2
Falkirk Graham's Road	02-Jul-18	1200C177970401	12679	1.0	16.45	2.2	2.97	2.2
Falkirk Grangemouth MC	03-Jul-18	1200C176400311	13943	1.0	16.42	2.2	3.12	2.2
Falkirk Hags	02-Jul-18	1200C164790109	14078	1.0	16.55	2.2	3.15	2.2
Falkirk Hope Street	02-Jul-18	0						
Falkirk West Bridge Street	06-Jul-18	7661			4.73	2.2		2.2

PM2.5 analysers

Station	Date of audit	Analyser Serial no	Calculated ko	Uncertainty %	Total flow	Uncertainty %	Main flow	Uncertainty %
Falkirk Banknock	06-Jul-18	6179			4.76	2.2		2.2
Falkirk West Bridge Street	06-Jul-18	7661			4.73	2.2		2.2



# CERTIFICATE OF CALIBRATION



### SO2 analysers

Station	Date of Audit	Analyser Serial no	Zero Response <sup>1</sup>	Zero uncertainty ppb	Calibration Factor <sup>2</sup>	Factor uncertainty %	Response to m xylene (ppb)
Falkirk Bo'ness	03-Jul-18	616X6GNF	5.6	2.4	0.6778	3.2	0.7
Falkirk Grangemouth MC	03-Jul-18	le to see back of an	1.7	2.4	0.6721	3.0	1.1
Falkirk Hope St	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
Falkirk Zetland Park	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
Grangemouth Moray Scot Gov	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A

### CO analysers

Station	Date of Audit	Analyser Serial no	Zero Response <sup>1</sup>	Zero uncertainty ppb	Calibration Factor <sup>2</sup>	Factor uncertainty %

### O3 analysers

Station	Date of Audit	Analyser Serial no	Zero Response <sup>1</sup>	Zero uncertainty ppb	Calibration Factor <sup>2</sup>	Factor uncertainty %





# CERTIFICATE OF CALIBRATION



Date of issue: 09 May 19  
Certificate Number: 4505  
Ricardo Energy & Environment ID: ED61598/4505

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 1ppm = 1000ppb). 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 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  $\text{l}\cdot\text{min}^{-1}$ , 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 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.