





## CERTIFICATE OF CALIBRATION

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Signed: Date of Issue: 19th July 2017

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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 Fife Council's four air monitoring stations.

Site / Date Test Carried Out	Species	Analyser Serial No.	Zero Response	Uncertainties ppb	Calibration Factor <sup>2</sup>	Uncertainties %	Converter eff. (%) <sup>3</sup>
Fife Cupar	NO <sub>x</sub>	531113337	-1.3	2.7	1.3014	3.5	94.6
4 <sup>th</sup> July 2016	NO		-1.4	2.6	1.2956	3.5	
Fife Dunfermline	NO <sub>x</sub>	1151310002	-0.9	2.5	1.0194	3.5	99.6
4 <sup>th</sup> July 2016	NO		-1.2	2.5	1.0059	3.5	
Fife Kirkcaldy	NO <sub>x</sub>	1007841312	-0.4	2.5	1.0055	3.5	99.2
4 <sup>th</sup> July 2016	NO		0.1	2.5	0.9939	3.5	
Fife Rosyth	NO <sub>x</sub>	CMO75600	0.6	2.5	0.9185	3.5	99.0
4 <sup>th</sup> July 2016	NO	74	0.6	2.5	0.9094	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.	Parameter	Specified Value	Measured Value	Deviation %	Uncertainty
Fife Cupar 4 <sup>th</sup> July 2016	FDMS PM <sub>10</sub>	225809	Main Flow⁴	3.00	3.06	1.9	2.25
			Aux Flow <sup>4</sup>	13.67			
			Total Flow	16.67	15.65	-6.1	2.25
			$k_0^5$	14073	14199	0.9	1.00
	FDMS PM <sub>10</sub>	27637	Main Flow⁴	3.00	3.05	1.5	2.25
Fife Dunfermline			Aux Flow <sup>4</sup>	13.67			
4 <sup>th</sup> July 2016			Total Flow	16.67	16.51	-1.0	2.25
			$k_0^5$	16280	16074	-1.3	1.00
Fife Kirkcaldy 4 <sup>th</sup> July 2016	FIDAS	6655	Total Flow <sup>4</sup>	4.78	4.8	0.5	2.25
Fife Rosyth 4 <sup>th</sup> July 2016	FIDAS	6652	Total Flow <sup>4</sup>	4.8	3.62	-24.5	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  $k_0$  (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.

## **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

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.

<sup>&</sup>lt;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>&</sup>lt;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:

<sup>&</sup>lt;sup>3</sup>Converter eff. is the measured efficiency of the NO₂ to NO converter within the oxides of nitrogen analyser under test.

<sup>&</sup>lt;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-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.

<sup>&</sup>lt;sup>5</sup>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.